

ACADEMIC CURRICULA 2021 - 2025

BACHELOR'S DEGREE PROGRAMME

B. Tech in Electronics & Computer Science Engineering

Curricula & Syllabi



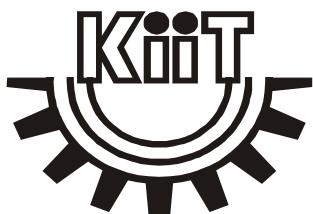
Kalinga Institute of Industrial Technology (KIIT)
Deemed to be University U/S 3 of UGC Act, 1956
Bhubaneswar, Odisha, India

ACADEMIC CURRICULA

2021 - 2025

BACHELOR'S DEGREE PROGRAMME
B. Tech in
Electronics & Computer Science Engineering

**Course Structure and Detailed Syllabi
for students admitted in
2021 - 25
Academic Session**



Kalinga Institute of Industrial Technology (KIIT)
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B. TECH IN ELECTRONICS AND COMPUTER SCIENCE ENGINEERING

Programme Educational Objectives (PEOs)

The B. Tech programme in Electronics and Computer Science Engineering aims to prepare the graduates with the following objectives:

1. Graduates will be able to lead a successful career in industry, pursue higher study or entrepreneurial endeavour through application of domain specific knowledge in areas of microelectronics, embedded system design, network security, cloud computing, big data analysis, web-technology, computer architecture, software engineering and allied fields of Electronics and Computer Science Engineering.
2. Graduates shall perceive the sound knowledge in core areas of computational science and Information Technology to comprehend engineering trade-offs and technical skill inclined towards product development, higher study, and research.
3. Graduates shall be inculcated with high professionalism, ethical standards, and effective communication skills to work as an individual or part of a team in diverse professional environments related to social, economical, and emerging technologies.

Programme Outcomes (POs):

The programme outcomes are:

- a) Engineering knowledge: Ability to apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- b) Problem analysis: Ability to identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- c) Design/Development of solutions: Ability to design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- d) Conduct investigations on complex problems: Ability to use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- e) Modern tool usage: Ability to create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- f) The engineer and society: Ability to apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- g) Environment and sustainability: Ability to understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- h) Ethics: Ability to apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- i) Individual and team: Ability to function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- j) Communication: Ability to communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

- k) Project management and finance: Ability to demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- l) Life-long learning: Ability to recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes (PSOs):

The programme specific outcomes are:

- m) Impart knowledge of data management system like data acquisition, big data so as to enable students in solving problems using the techniques of data analytics, pattern recognition and knowledge discovery.
- n) Acquire basic knowledge in hardware/software methods and tools for solving real-life and R&D problems with an orientation to lifelong learning.
- o) Acquire sound knowledge base to develop and expand professional careers in the fields related to human-computer interaction and management of industrial processes for the design and implementation of intelligent systems.

Abbreviations used in describing the category in all the courses are as follows:

BSC:	Basic Science Course
BSLC:	Basic Science Laboratory Course
ESC:	Engineering Science Course
ESLC:	Engineering Science Laboratory Course
HSMC:	Humanities, Social Science & Management Course
PCC:	Professional Core Course
PCLC:	Professional Core Laboratory Course
PEC:	Professional Elective Course
OEC:	Open Elective Course
PROJ:	Project
IEC:	Industry Elective Course

**COURSE STRUCTURE FOR B. TECH IN ELECTRONICS AND COMPUTER SCIENCE
ENGINEERING**

**SCHEME-I
SEMESTER – I**

Theory							
Sl. No	Course Code	Course Title	L	T	P	Total	Credit
1.	MA 1003	Mathematics – I	3	1	0	4	4
2.	PH 1007	Physics	3	1	0	4	4
3.	EE 1003	Basic Electrical Engineering	3	0	0	3	3
4.	ME 1003	Engineering Mechanics	3	0	0	3	3
Total of Theory							14
Practical							
1.	PH 1097	Physics Lab	0	0	3	3	1.5
2.	EE 1093	Basic Electrical Engineering Lab	0	0	2	2	1
Sessional							
1.	ME 1083	Basic Manufacturing Systems	0	1	2	3	2
2.	CH 1081	Environmental Science	0	0	2	2	1
Total of Practical & Sessional							10
Semester Total							19.5

SCHEME-I
SEMESTER - II

Theory							
Sl. No	Course Code	Course Title	L	T	P	Total	Credit
1.	MA 1004	Mathematics – II	3	1	0	4	4
2.	CH 1007	Chemistry	3	0	0	3	3
3.	HS 1005	Professional Communication	2	0	0	2	2
4.	LS 1001	Biology	2	0	0	2	2
Total of Theory						11	11
Practical							
1.	CS 1093	Computer Programming	0	2	4	6	4
2.	CH 1097	Chemistry Lab	0	0	3	3	1.5
Sessional							
1.	HS 1085	Language Lab	0	0	2	2	1
2.	CE 1083	Engg. Graphics	0	1	2	3	2
Total of Practical & Sessional						14	8.5
Semester Total						25	19.5
	EAA- 1	Extra Academic Activity					P/NP

SEMESTER III

Sl. No	Course Code	Course Title	L	T	P	Total	Credit
Theory							
1	MA 2009	Mathematics-III (Electronics)	3	1	0	4	4
2	EC 2027	Analog Electronics	3	1	0	4	4
3	EI 2010	Principle of Measurements and Instrumentation	3	0	0	3	3
4	CS 2001	Data Structures and Algorithms	3	1	0	4	4
5	EC 2021	Signals and Networks	3	0	0	3	3
6	EC 2011	Digital Electronics	3	0	0	3	3
Total of Theory						21	21
Practical							
1	EC 2091	Electronic Circuits & Network Lab	0	0	3	3	1.5
2	CS 2091	Data Structures Lab	0	0	2	2	1
3	EC 2096	Digital & Linear IC Lab	0	0	2	2	1
Sessional							
1	HS 2081	Business Communication	0	0	2	2	1
Total of Practical & Sessional						9	4.5
Semester Total						30	25.5

SEMESTER IV

Sl. No	Course Code	Course Title	L	T	P	Total	Credit
Theory							
1	MA 2013	Discrete Mathematics	3	0	0	3	3
2	IT 2005	Object Oriented Programming	3	0	0	3	3
3	CS 2004	Database Management Systems	3	1	0	4	4
4	EC 2020	Microprocessors, Microcontrollers & Interfacing	3	1	0	4	4
5	CS 2006	Computer Architecture	3	1	0	4	4
6		HS Elective-I	3	0	0	3	3
Total of Theory						21	21
Practical							
1	IT 2095	Object Oriented Programming Lab	0	0	2	2	1
2	CS 2094	DBMS Lab	0	0	2	2	1
3	EC 2090	Microprocessor and Microcontroller Lab	0	0	2	2	1
Total of Practical						6	3
Semester Total						27	24

SEMESTER V

Sl. No	Course Code	Course Title	L	T	P	Total	Credit
Theory							
1	CS 2012	Design & Analysis of Algorithms	3	0	0	3	3
2	EC 3011	VLSI Design	3	0	0	3	3
3	EC 2004	Principle of Digital Communication	3	1	0	4	4
4	CS 2002	Operating Systems	3	0	0	3	3
5		Department Elective-I	3	0	0	3	3
6		Department Elective-II	3	0	0	3	3
Total of Theory						19	19
Practical							
1	EC 2094	Communication Engineering Lab	0	0	3	3	1.5
2	CS 2098	Algorithms Lab	0	0	2	2	1
3	EC 3095	VLSI Lab	0	0	2	2	1
Total of Practical						7	3.5
Semester Total						26	22.5

SEMESTER VI

Sl. No	Course Code	Course Title	L	T	P	Total	Credit
Theory							
1	IT 3003	Software Engineering	3	1	0	4	4
2	IT 3005	Computer Networks	3	0	0	3	3
3		Department Elective-III	3	0	0	3	3
4		Department Elective-IV	3	0	0	3	3
5		Department Elective-V	3	0	0	3	3
6		Open Elective -I / (MI-1)	3	0	0	3	3
Total of Theory						19	19
Practical							
1	IT 3095	Networks Lab	0	0	2	2	1
2	CS 3096	Tools & Techniques Lab	0	1	2	3	2
Sessional							
1	EM 3082	Minor Project	0	0	4	4	2
Total of Practical & Sessional						9	5
Semester Total						28	24

SEMESTER VII

Sl. No	Course Code	Course Title	L	T	P	Total	Credit
Theory							
1		HS Elective-II	3	0	0	3	3
2	HS 4001	Professional Practice, Law & Ethics	2	0	0	2	2
3		Open Elective-II / (MI-2)	3	0	0	3	3
(4)		(MI-3)	(3)	(0)	(0)	(3)	(3)
(5)		(MI-4)	(3)	(0)	(0)	(3)	(3)
(6)		(HO-1)	(3)	(0)	(0)	(3)	(3)
Total of Theory						8	8
Sessional							
1	EM 4081	Project-I / Internship					3
2	EM 4083	Practical Training	-	-	-	-	2
(3)		(Project – Minor / Lab)	(0)	(0)	(4)	(4)	(2)
Semester Total							13

SEMESTER VIII

Sl. No	Course Code	Course Title	L	T	P	Total	Credit
Theory							
(1)		(MI-5)	(3)	(0)	(0)	(3)	(3)
(2)		(MI-6)	(3)	(0)	(0)	(3)	(3)
(3)		(HO-2)	(3)	(0)	(0)	(3)	(3)
(4)		(HO-3)	(3)	(0)	(0)	(3)	(3)
Sessional							
1	EM 4082	Project - II / Internship					10
Semester Total							10

MI – Minor

HO - Honors

LIST OF HS ELECTIVES

HS Elective – I

Sl. No	Course Code	Course Title	Credit
1.	HS 2002	Engineering Economics	3
2.	HS 2008	Economic Environment of India	3
3.	HS 2010	Financial Institutions, Markets and Regulations	3
4.	HS 2012	Development Economics	3

HS Elective – II

1.	HS 3006	Entrepreneurship	3
2.	HS 3008	Management Concepts & Practices	3
3.	HS 3002	Organizational Behaviour	3
4.	HS 3004	Human Resource Management	3

LIST OF DEPARTMENT ELECTIVES

Dept. Elective – I

1	IT 2004	Web Technology	3
2	CS 3037	Principles of Automata	3
3	CS 3029	Advanced Database Management System	3
4	EC 3035	High Speed Digital System Design	3

Dept. Elective – II

1	EC 3031	ARM and Advanced Processors	3
2	EC 3033	Embedded System Design and Applications	3
3	CS 3031	Computational Intelligence	3
4	IT 3006	Data Analytics	3

Dept. Elective – III

1	EC 6128	Wireless Sensor Network	3
2	EC 3060	Mobile Communication Engineering	3
3	EC 3064	Information Theory and Coding	3
4	EC 6112	Communication and Network Security	3

Dept. Elective - IV

1	IT 3007	Internet of Things	3
2	CS 3012	Parallel and distributed Computing	3
3	IT 3022	Cloud Computing	3
4	CS 3032	Big Data	3

Dept. Elective – V

1	EC 6224	Low Power VLSI Design	3
2	EC 3058	Nanoelectronics	3
3	EC 3029	Optical Communication and Networking	3
4	EC 3068	Real Time Systems and Application	3

LIST OF OPEN ELECTIVES OFFERED BY SCHOOL OF ELECTRONICS ENGINEERING

Sl. No	Course Code	Course Title	Prerequisite/s
1	EC 2011	Digital Electronics	NIL
2	EC 2021	Signals & Networks	Math-II (MA 1004)
3	EC 3044	Introduction to Communication Engineering	NIL
4	EC 3066	Principles of Microprocessors and Microcontrollers	Digital Electronics (EC 2011)
5	EI 3027	Industrial Instrumentation	Basic Electrical Engineering (EE 1003)
6	EC 3013	Principle of Digital Signal Processing	Math-II (MA 1004)
7	EL 2002	Principle of Control System	Signals & Networks (EC 2021)
8	EC 3011	VLSI Design	Digital Electronics (EC 2011)
9	EC 3033	Embedded system Design and Applications	Microprocessors and Microcontrollers (EC 2020) /Principles of Microprocessors and Microcontrollers (EC 3066)
10	EL 3024	Industrial Automation & Control	Principle of Control Systems (EL 2002) /Linear Control System (EL 2028)
11	EC 6108	Digital Image Processing	Principle of Digital Signal Processing (EC 3013) / Digital Signal Processing (EC 3007)
12	EC 3060	Mobile Communication Engineering	Communication Engineering (EC 2016) /Introduction to Communication Engineering (EC 3044) / Principle of Digital Communication (EC 2004)
13	EC 3050	Internet of Things and its applications	Microprocessors and Microcontrollers (EC 2020) / Principles of Microprocessors and Microcontrollers (EC 3066)

MINOR IN ELECTRONICS & TELECOMMUNICATION ENGINEERING

Sl. No	Course Code	Course Title	Prerequisite/s
1	EC 2025	Principles of Electronics Engineering	Nil
2	EC 2011	Digital Electronics	Nil
3	EC 3066	Principle of Microprocessors and Microcontrollers	Digital Electronics (EC2011)
4	EC 2021	Signals and Networks	Mathematics-II (MA1004)
5	EC 2014	Electromagnetic Theory	Mathematics-II (MA1004)
6	EC 3011	VLSI Design	Analog Electronic Circuits
7	EC 3031	ARM and Advanced Processors	Principle of Microprocessors and Microcontrollers (EC3066)
8	EC 3035	High speed Digital system Design	Digital Electronics (EC2011)
9	EC 3044	Introduction to Communication Engineering	Nil
10	EC 3015	Microwave Engineering	Nil
11	EC 3028	Data Communication and Networking	Introduction to Communication Engineering (EC3044)
12	EC 3060	Mobile communication Engineering	Introduction to Communication Engineering (EC3044)/Principle of Digital Communication (EC2004)/Communication Engineering (EC2016)
13	EC 3050	Internet of Things and its Applications	Principle of Microprocessors and Microcontrollers (EC3066)
14	EC 6122	Satellite Communication Systems	Introduction to Communication Engineering (EC3044)/Principle of Digital Communication (EC2004)/Communication Engineering (EC2016)
15	EC 3029	Optical Communication and Networking	Introduction to Communication Engineering (EC3044)/Principle of Digital Communication (EC2004)/Communication

			Engineering (EC2016)
16	EC 3021	Neural Networks and Machine Learning	Mathematics-I &II (MA1003 and MA1004)
17	EC 1094	Analog Electronic Circuits Lab	
18	EC 2093	Digital Electronics Lab	
19	EC 3095	VLSI Lab	

MINOR IN ELECTRONICS & INSTRUMENTATION ENGINEERING

Sl. No	Course Code	Course Title	Prerequisite/s
1	EC 2025	Principles of Electronics Engineering	Nil
2	EI 2003	Electrical & Electronic Measurement Techniques	Basic Electrical Engineering (EE 1003)
3	EC 2021	Signals and Networks	Mathematics-II (MA 1004)
4	EL 2002	Principle of Control System	Signals and Networks (EC 2021)
5	EI 2012	Sensors and Signal Conditioning	Electrical and Electronic Measurement Techniques (EI 2003)
6	EI 3009	Instrumentation Measurement Techniques	Electrical & Electronic Measurement Techniques (EI 2003)
7	EI 3029	Process Dynamics and Control	Principle of Control System (EL 2002)
8	EI 3025	Principle of Analytical Instrumentation	Chemistry (CH 1007)
9	EI 3030	Power Plant Instrumentation	Instrumentation Measurement Techniques (EI 3009)
10	EI 3032	Principle of Sensors and Data Acquisition	Electrical and Electronic Measurement Techniques (EI 2003)
11	EI 3023	Neural Network & Fuzzy Logic Control	Mathematics-I (MA 1003), Mathematics-II (MA 1004) and Principle of Control System (EL 2002)
12	EI 2095	Electrical & Electronic Measurements Lab	
13	EI 3091	Instrumentation Lab	
14	EI 3092	Process Control Lab	

MINOR IN VLSI AND EMBEDDED SYSTEM

Sl. No	Course Code	Course Title	Prerequisite/s
1	EC 2025	Principles of Electronics Engineering	Nil
2	EC 2011	Digital Electronics	Principles of Electronics Engineering (EC 2025)
3	EC 2005	Semiconductor Devices	Principles of Electronics Engineering (EC 2025)
4	EC 3066	Principle of Microprocessors and Microcontrollers	Digital Electronics (EC 2011)
5	EC 3011	VLSI Design	Digital Electronics (EC2011)
6	EC 3035	High Speed Digital System Design	Digital Electronics (EC2011)
7	EC3033	Embedded System Design and Applications	Digital Electronics (EC2011)
8	EC 3031	ARM and Advanced Processors	Microprocessors, Microcontrollers& Interfacing (EC 2020) / Principle of Microprocessors and Microcontrollers (EC 3066)
9	EC 3068	Real Time Systems and Application	Digital Electronics (EC 2011)
10	EC 6224	Low Power VLSI Design	VLSI design (EC 3011)
11	EC 3058	Nanoelectronics	Principles of Electronics Engineering (EC 2025)
12	EC 2093	Digital Electronics Lab	
13	EC 2090	Microprocessor and Microcontroller Lab	
14	EC 3095	VLSI Lab	

MINOR IN SENSORS & SIGNALS

Sl. No	Course Code	Course Title	Prerequisite/s
1	EC 2025	Principles of Electronics Engineering	Nil
2	EC 2011	Digital Electronics	Nil
3	EC 2021	Signals and Networks	Mathematics-II (MA1004)
4	EC 3066	Principle of Microprocessors and Microcontrollers	Digital Electronics (EC 2011)
5	EI 2003	Electrical & Electronic Measurement Techniques	Basic Electrical Engineering (EE 1003)
6	EI 2012	Sensors & Signal Conditioning	Electrical and Electronic Measurement Techniques (EI 2003)
7	EC 3013	Principle of Digital Signal Processing	Signals and Network (EC 2021)
8	EI 3032	Principle of Sensors & Data Acquisition	Electrical & Electronic Measurement Techniques (EI 2003)
9	EC 3021	Neural Networks &Machine Learning	Mathematics-I and Mathematics-II (MA1003 and MA1004)
10	EC 3050	Internet of Things and its applications	Principle of Microprocessors and Microcontrollers (EC3066)
11	EC 6108	Digital Image Processing	Principle of Digital Signal Processing (EC 3013)
12	EI 3024	Virtual Instrumentation	Sensors and Signal Conditioning (EI 2012),Digital Electronics (EC 2011)
13	EC 3056	Speech and Audio Signal Processing	Principle of Digital Signal Processing (EC 3013)
14	EC 2093	Digital Electronics Lab	-
15	EI 2095	Measurements and Instrumentation Lab	-
16	EC 3099	DSP Lab	-

MINOR IN “COMMUNICATION NETWORKS, INTELLIGENT IOT & CYBER PHYSICAL SYSTEMS”

Sl No	Course Code	Course Title	Prerequisite/s
1	EC 2025	Principles of Electronics Engineering	Nil
2	EC 2011	Digital Electronics	Nil
3	EC 3044	Introduction to Communication Engineering	Nil
4	EC 3066	Principle of Microprocessors and Microcontrollers	Digital Electronics (EC 2011)
5	EC 3033	Embedded System Design and Applications	Principles of Microprocessors and Microcontrollers (EC 3066)
6	EC 3028	Data Communication and Networking	Introduction to Communication Engineering (EC 3044)
7	EC3050	Internet of Things and its applications	Principles of Microprocessors and Microcontrollers (EC 3066)
8	EC 3070	MANET AND WSN	Data Communication and Networking (EC 3028)
9	EC 6112	Communication & Network Security	Data Communication and Networking (EC 3028)
10	EC 3072	Introduction to machine learning	Mathematics-I & II (MA1003 and MA1004)
11	EC 3074	Internet Technologies for cloud & Edge computing	Computer Programming (CS 1093)
12	EC 3076	IoT & Cyber-Physical System Design	Internet of Things and its applications (EC3050)
13	EC 4061	AI and Machine Learning for IoT	Mathematics-I & II (MA1003 and MA1004) & Internet of Things and its applications (EC3050)
14	EC 2093	Digital Electronics lab	

15	EC 2090	Microprocessor and Microcontroller Lab	
14	EC 4099	Internet of Things & connected intelligent systems Lab	
15	EC XXXX	Project	

MINOR IN “APPLIED MACHINE LEARNING”

Sl No	Course Code	Course Title	Prerequisite/s
1	EC 2025	Principles of Electronics Engineering	Nil
2	EC 2011	Digital Electronics	Nil
3	EC 3044	Introduction to Communication Engineering	Nil
4	EC 3066	Principle of Microprocessors and Microcontrollers	Digital Electronics (EC 2011)
5	EC 3033	Embedded System Design and Applications	Principles of Microprocessors and Microcontrollers (EC 3066)
6	EC 3028	Data Communication and Networking	Introduction to Communication Engineering (EC 3044)
7	EC3007	Digital Signal Processing	
8	EC 6108	Digital Image Processing	Digital Signal Processing
9	EC 3072	Introduction to Machine learning	Computer Programming (CS 1093)
10	EC 3078	Signal Understanding Using Machine Learning	Signal and Network
	EC 3080	Deep Learning	
11	EC 4059	Computer Vision and Pattern Recognition	Digital Image Processing
12	EC 2093	Digital Electronics lab	
13	EC 2090	Microprocessor and Microcontroller Lab	
12	EC 4097	Machine learning Lab	
13	EC XXXX	Project	

COURSES OF FIRST YEAR

MA 1003 Mathematics-I

Credit: 4

Category: BSC

Prerequisite(s): Nil

Course Description:

The laws of nature are expressed as differential equations. The construction of mathematical models to address real-world problems has been one of the most important aspects of each of the branches of science. This course is designed to familiarize the prospective engineers with techniques in ordinary differential equations, multivariate calculus and solution for ODEs numerically. This course also focuses on Linear algebra that covers system of linear equations and properties of matrices. The objective of the course is to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced levels of mathematics and applications that they would find useful in their disciplines.

Course Outcomes: At the end of the course, the students will be able to:

CO1: model and formulate differential equation of Physical problems

CO2: apply different methods to solve 1st and 2nd order ODEs

CO3: apply numerical methods to solve ODEs

CO4: study differential calculus in engineering problems

CO5: use the essential tool of matrices and linear algebra

CO6: analyze Eigenvalue problems

Topics:

- Ordinary Differential Equations.
- Linear differential equations of 2nd order.
- Differential calculus and Numerical methods to solve ODEs
- Vector space and system linear of equations
- Matrix-eigenvalue Problems

Textbook(s):

1. Advanced Engineering Mathematics by Erwin Kreyszig, Wiley, INC, (online) 10th Edition.
2. Differential Calculus, Shanti Narayan and P. K. Mittal, S. Chand, reprint 2009.

Reference Book(s):

1. Higher Engineering Mathematics, Grewal B.S., Khanna Publishers, 36th edition.
2. Introduction to engineering Mathematics, Dass H.K., S.Chand & Co Ltd, 11th edition.
3. Higher Engineering Mathematics, Ramana B.V., TMH, 2007.
4. A course on ordinary & Partial Differential Equation, Sinha Roy and S Padhy, Kalyani Publication, 3rd edition.

PH 1007 **Physics**

Credit: 4
Category: BSC
Prerequisite(s): Nil

Course Description:

This course includes the fundamentals of different types of oscillations and its applications; mathematical expression of waves and its physical interpretation; the concept of interference, diffraction and their applications; the principle, construction and working of different Lasers. The course also gives a flavour of Quantum mechanics, which is the founding stone to the state of the art in modern techniques and paves the way towards the world of nano devices. It covers the formulation of Maxwell's electromagnetic equations, and verification of different properties of electromagnetic waves. Mechanical and magnetic properties of different materials and their applications are also covered in this course.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: utilize the concept of waves and intensity modulation in day to day life through various applications
- CO2: apply the mechanism of LASER technology in different fields
- CO3: formulate and solve engineering problems of electricity and magnetism using Maxwell's electromagnetic equations
- CO4: apply the principles of quantum mechanics to related problems
- CO5: apply the knowledge of magnetic materials in related applications
- CO6: analyze the macroscopic behavior of solids and utilize them in future applications

Topics:

- Oscillation and wave
- Interference and diffraction
- LASER
- Quantum mechanics
- Electromagnetism
- Properties of matter (mechanical)
- Magnetism

Textbook (s):

1. Engineering Physics, B. K. Pandey and S. Chaturvedi, Cengage Publication, New Delhi

Reference Book(s):

1. Introduction to Electrodynamics, D J Griffiths, Pearson Education
2. Quantum Mechanics, L. I. Schiff, Tata McGraw-Hill Publications
3. Optics, A K Ghatak, Tata McGraw-Hill Publications
4. Concepts of Modern Physics, A. Beiser, Tata McGraw-Hill Publications
5. Engineering Physics, R K Gaur and S. L. Gupta, Dhanpat Rai Publications, New Delhi.

ME 1003 Engineering Mechanics

Credit: 2
Category: ESC
Prerequisite(s): Nil

Course Description:

The course on Engineering Mechanics is a specialized need-based extension of applied physics which is aimed at developing an understanding of the principle of statics and dynamics. The course focuses on learning methodical and logical idealization and subsequent implementation of corresponding procedures for analysis of rigid body, frame and machine under the action of force system which is highly essential for effective design. The course intends to develop the ability of drawing and analyzing the free body diagram of a system when at rest or motion using scalar/vector techniques. Further, the course serves as a prerequisite to fundamental machine design courses such as mechanics of solids and design of machine elements.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: draw complete and correct free-body diagrams and write the appropriate equilibrium equations from the free-body diagram
- CO2: use scalar analytical techniques for analyzing forces and moments in mechanical systems
- CO3: analyzing forces in statically determinate structures such as trusses, frames and problems related to friction
- CO4: determine the centroid and second moment of area
- CO5: apply fundamental concepts of kinematics and kinetics of particles to the analysis of simple and practical problems
- CO6: solve real-life problems by using mathematics, physical laws and theorems

Topics:

- Concurrent Forces in a Plane
- Friction
- Parallel Forces in a Plane
- Moment of Inertia
- Force analysis of Plane Trusses
- Principle of Virtual Work
- Kinematics of Rectilinear Motion
- Kinematics of Curvilinear Motion
- Rotation of a rigid body

Textbook(s):

1. Engineering Mechanics (Revised 5th edition), TMH by S. Timoshenko, D.H. Young, J.V Rao and S. Pati.

Reference Book (s):

1. Engineering Mechanics (Statics and Dynamics) - Bear and Johnson, TMH
2. Engineering Mechanics (Statics and Dynamics) by I.H. Shames, Prentice Hall
3. Engineering Mechanics –S.S. Bhavikatti, New Age International
4. Engineering Mechanics (Statics and Dynamics)-S. Rajasekaran & G Sankarasubramanian, Vikas Publishing House.

PH 1097 Physics Laboratory

Credit: 1.5
Category: BSLC
Prerequisite(s): Nil

Course Description:

This lab course covers different measurement techniques of various parameters using the instruments i.e. interferometer, spectrometer, spherometer, Screw gauge, vernier calliper, microspope, and telescope. It includes the application of photoelectric effect and photovoltaic effect in photo cell and solar cell respectively. Evaluation of the mechanical strength of materials by calculating elastic constants such as Young's modulus, rigidity modulus and Poisson's ratio are also included. This course provides hands on training for the usage of electrical, optical and mechanical systems for various measurements with precision and analysis of the experimental data by graphical interpretation and error calculation.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: calculate appropriate structural members using the fundamental concepts of the elastic behavior of materials
- CO2: use the principles of interference and diffraction to find out the wavelength of an unknown monochromatic source of light
- CO3: apply the concept of photoelectric emission to calculate the Planck's constant and analyze some aspects of electron-photon interaction through characteristic curves
- CO4: explore the efficiency in terms of power output of a green energy source i.e. solar cell
- CO5: calculate the acceleration due to gravity 'g' by using the concept of a compound pendulum

Topics:

- Estimation of elastic constants such as Young's modulus, rigidity modulus and Poisson's ratio
- Determination of wavelength of unknown source using Newton's rings and Michelson's interferometer
- Precision length measurement up to the order of 6 A° (distance between sodium D-lines) using Michelson interferometer
- Determination of grating element using a diffraction grating
- Study of photo cell and solar cell by analyzing their characteristic curves
- Determination of acceleration due to gravity using a bar pendulum

EE 1093 Basic Electrical Engineering Laboratory

Credit: 1
Category: ESLC
Prerequisite(s): Nil

Course Description:

Basic Electrical Engineering lab comprises of various equipments and loads i.e voltmeters, ammeters, wattmeters, single phase and three phase transformer, induction motors etc. It is a specialized practical oriented course which intends to develop and understand various principles like Ohm's law and Kirchoff's law. The course focused on learning methodical and logical idealization of various theorems which is highly essential for solving a network. The course intends to make the students familiar with various parts of DC machines and AC machines. The course intends to develop the ability of problem solving by analyzing RL and RLC series circuits. This lab helps the students to understand the principle of operation of a single phase transformer with its no load calculation.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: recall the safety practices in the laboratory and the associated work areas
- CO2: comprehend the skills for working in a team with common objective
- CO3: apply different theorems to find the parameters in DC and AC circuit
- CO4: analyse the different parts of DC and AC machines to describe operational features thereof
- CO5: apprise the experimental results in systematic manner
- CO6: discuss about determination of resistance in incandescent lamp and power factor in fluorescent lamp

Topics:

- measurement of resistance of tungsten filament lamp
- measurement of inductance of a choke coil
- study and use of megger
- study of different parts of dc machine and three phase induction motor
- layout of power system analysis
- determination of voltage ratio of a single phase transformer
- measurement of no load current and core loss of a single phase transformer
- verification of KCL and KVL
- verification of voltage and current ratio of star and delta connection
- study & determine the power factor of the RLC series circuit
- study, connection & determine the power factor of fluorescent tube
- verification of the superposition theorem
- transient analysis of series RL and RC circuit using matlab-simulink with dc excitation

Textbook(s):

1. Basic Electrical Engineering by D.C. Kulshreshtha, Tata Mcgraw publication, 1st Edition 2011.
2. Basic Electrical Engineering, T.K. Nagasarkar and M.S. Sukhija, Oxford University press, 2nd Edition 2011.

Reference Book(s):

1. Basics Electrical Engineering Sanjeev Sharma, I.K. International, New Delhi.(Third Reprint 2010).

ME 1083 Basic Manufacturing Systems

Credit: 2
Category: ESLC
Prerequisite(s): Nil

Course Description:

This laboratory practice is designed to impart students the basic knowledge on manufacturing or developing a given object irrespective of their branch of engineering. While furnishing the given object, students will familiar with various mechanical operations and the respective tools or machines. This course involves four different sections namely Fitting, Welding, Turning and Sheet metal which covers both conventional and advanced tools to provide students the updated manufacturing experience. Students are also advised with various safety precautions to be followed during a specific manufacturing practice. At the end, students will also gain knowledge on different advanced machines such as CNC and 3D printing.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: practice different operations related to fitting shop
- CO2: use different welding tools to prepare a given type of joint
- CO3: demonstrate various turning operations including taper turning and knurling using a conventional lathe machine
- CO4: design a tray and prepare it using sheet metal equipment involving soldering
- CO5: appraise different operations using a CNC machine
- CO6: interpret different advanced machines such as 3D printing/additive manufacturing

Topics:

- Turning operations
- Sheet metal operations
- Fitting
- Welding

CH 1081 Environmental Science

Credit: 1
Category: BSLC
Prerequisite(s): Nil

Course Description:

The course is designed to make the students aware of different environmental components and their composition. It will make the students understand different pollutants, their sources and management. It will also help students to apply the principles of Green Chemistry and implement them in synthesis of advanced materials required for engineering applications. It also outlines the basic steps for developing the EIA statements

Course Outcomes: At the end of the course, the students will be able to:

- CO1: understand the different components and composition of the environment
- CO2: rationalize the different pollutants, their sources, effects and controlling measures
- CO3: quantify water quality parameters
- CO4: apply the systematic environmental impact assessment (EIA) requirements before setup of any project
- CO5: understand and implement the principles of solid waste management
- CO6: conceptualize the principles of green chemistry and implement them in synthesis of advanced material, so as to reduce the pollution

Topics:

- Overview on environment
- Environmental pollution: air pollution, water pollution
- Pollution management

Textbook(s):

1. Environmental Chemistry, A. K. De, New Age International Publishers.

Reference Book(s):

1. Environmental Chemistry- S. Chakroborty, D. Dave, S.S. Katewa, Cengage Publishers
2. Environment Science and Engineering, Aloka Debi. Second Edition ;Universities Press
3. Text Book of Environment studies for under graduate courses, Erach Bharucha : 2nd Edition, Universities Press
4. Fundamentals of Environment and Ecology, D. De, D. De; 2013, S. Chand Group
5. Engineering Chemistry, Jain and Jain, Dhanpat Rai Publishing Company

MA 1004 Mathematics-II

Credit: 4
Category: BSC
Prerequisite(s): Nil

Course Description:

The course is to familiarize the students with series solutions of ODEs, Laplace Transforms, Fourier series, vector calculus, and numerical integration. For the ODEs with variable coefficients, the situation is more complicated to get their solutions in elementary functions. Legendre and Bessel's equations are important ODEs of this kind and their solutions, the Legendre polynomials and Bessel functions play an important role in engineering applications. Laplace transforms can be used as a mathematical toolbox for engineers to solve linear ODEs and related initial value problems. The Fourier series and vector calculus play a very important role in many engineering areas such as solid mechanics, aerodynamics, fluid flow, heat flow, quantum physics. The applied mathematician, engineer, physicist, or scientist must become familiar with the essentials of numerics and its ideas, such as interpolation and numerical integration.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: understand application of Power series and solution of ODEs
- CO2: use Power series solutions to Legendre and Bessel's equations
- CO3: comprehend Laplace transform and IVPs
- CO4: study periodic and non-periodic functions and their Fourier series expansion
- CO5: develop vector differential and integral calculus and the applications of Green's theorem, Gauss Divergence Theorem & Stokes Theorem
- CO6: apply numerical techniques in interpolation and evaluation of the definite integral

Topics:

- Series Solution of Differential Equations
- Laplace Transforms
- Fourier Series
- Vector Differential and Integral Calculus
- Interpolation and Numerical Integration

Textbook(s):

1. Advanced Engineering Mathematics by Erwin Kreyszig, Wiley, INC, 10th Edition.

Reference Book(s):

1. Higher Engineering Mathematics, Grewal B.S., Khanna Publishers, 36th edition.
2. Introduction to engineering Mathematics, Dass H.K., S.Chand& Co Ltd, 11th edition.
3. Higher Engineering Mathematics, Ramana B.V., TMH, 2007.
4. A course on ordinary & partial differential Equation, Sinha Roy and S Padhy, Kalyani Publication, 3rd edition.

CH 1007 Chemistry

Credit: 3
Category: BSC
Prerequisite(s): Nil

Course Description:

The course is designed to enrich the students with basic concepts in Chemistry to strengthen their fundamentals which will support them for pursuing education and research in engineering. It will help them to develop the idea on feasibility and mechanism of different chemical processes, conceptualize alternative sources of energy, give an exposure for handling instrumental techniques to explore structure of organic molecules and an idea of different methods for synthesis of advanced materials.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: rationalize bulk properties and processes using thermodynamic consideration and apply the knowledge to decide the feasibility of a given process
- CO2: analyze the kinetics of simple and multistep reactions as well as theories of reaction rates
- CO3: evaluate some properties such as pH, solubility product etc. by using electrochemical cell and understand the working of modern batteries
- CO4: able to understand the mechanism of corrosion and its different controlling measures
- CO5: distinguish the different electromagnetic radiations used for exciting different molecular energy levels in various spectroscopic techniques to evaluate the structure of molecules
- CO6: get an exposure to different methods used for synthesis of nanostructured materials

Topics:

- Chemical Equilibrium and Thermodynamics
- Chemical Kinetics
- Electrochemistry
- Spectroscopy
- Chemistry of Nano Materials

Textbook(s):

1. Engineering Chemistry: Fundamentals and Applications- Shikha Agarwal, Cambridge University Press, 2016

Reference Book(s):

1. Textbook of Engineering Chemistry: Sashi Chawala, Dhanpat Rai and Co, 2016
2. Principles of Physical Chemistry- B.R. Puri, L.R Sharma, M.S. Pathania; 42nd Edition, Vishal Publishing Co.
3. Spectrometric Identification of Organic compounds, 7th Edition -Robert M. Silverstein, Fransis , Webster, Dravid j. Kiemle; Jhon Wiley& Sons, INC.
4. Nanostructures & Nanomaterials: Synthesis, Properties and Applications- G. Cao and Y. Wang, World Scientific Pvt. Ltd.; 2nd Edition

HS 1005 Professional Communication

Credit: 2

Category: HSMC

Prerequisite(s): Nil

Course Description:

Professional Communication is more emphasized on enhancing the four LSRW skills like Listening, Speaking, Reading and Writing in order to improve students' professional communication. It is basically designed to enhance speaking skills through pronunciation, stress and tone. This course is prepared to improve reading skills through reading, comprehending and retaining information. This course is basically expected to provide the learner an approach to communicate using all the four skills

Course Outcomes: At the end of the course, the students will be able to:

CO1: understand the communication process and practical implementations in the workplace

CO2: apply verbal and non-verbal modes of communication effectively in practical situations

CO3: apply effective conflict management strategies

CO4: use English grammar correctly and unambiguously in technical writing

CO5: bridge the gap between native language and target language i.e. English

CO6: retain a logical flow while drafting reports and other technical pieces of writing

Topics:

- Communication: Process and Methods of Communication
- Basics of Grammar: Time & Tense, Subject-Verb Agreement, Analogy, Active & Passive Voice, Error Detection in Sentences
- Writing Skills: Paragraph Writing-Techniques & Skills, Use of Punctuation, Business Letter-Enquiry, Claim/ Complaint, Order
- Basic Sounds of English: Hearing & Listening, Introduction to Basic Sounds of IPA, Problem Sounds & MTI

Textbook(s):

1. Technical Communication Principles & Practices. Meenakshi Raman and Sangeeta Sharma OUP. Second Edition-2011

Reference Book(s):

1. A Communicative English Grammar. Geoffrey Leech and Jan Svartvik. Third Edition. Routledge Publication. New York. 2013.
2. Effective Technical Communication. M Ashraf Rizvi TMH 2005
3. The Oxford Grammar (English) Sidney Greenbaum, Oxford University Press India. 1st Edition. 2005
4. Verbal Ability and Reading Comprehension for the CAT. Arun Sharma and Meenakshi Upadhyay, TMH, New Delhi, 2007
5. Better English Pronunciation, Cambridge University Press, J D O'Connor, 2nd Edition (Paper Back) 2013

LS 1001 Biology

Credit: 2
Category: BSC
Prerequisite(s): Nil

Course Description:

Biology is important to everyday life because it allows humans to better understand their bodies, their resources and the potential threats existing in the environment. The engineering undergraduates need to be suitably exposed to the biological mechanisms of living organisms from the perspective of engineers. In addition, the course is expected to encourage engineering students to think about solving biological problems with engineering tools.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: comprehend the typical characteristics which distinguish life forms and analyze life process at cellular level
- CO2: apply concepts on structure and function of simple biomolecules in life processes
- CO3: comprehend different biological process involved in life and to analyze their effect
- CO4: understand different biological phenomenon and then relate it with engineering application domains
- CO5: comprehend different physiological functions and then relate it to computer based techniques
- CO6: understand biology and its relevance to engineering and technology

Topics:

- The Cellular organization of a living Organism
- The molecular and biochemical basis of an organism
- Enzymes, photosynthesis, metabolism and bioenergetics
- Molecular machines, biosensor and bioremediation
- Nervous system, immune system and cell signaling

Textbook(s):

1. Biology for Engineers. S. Thyagarajan, N. Selvamurugan, M.P Rajesh, R.A Nazeer, Richard W. Thilagarajan, S. Bharathi, M.K. Jaganathan. McGraw Hill Education (India) Ed., 2012

Reference Book(s):

1. Biology (Indian Edition), P.H. Raven and G.B. Johnson. McGraw Hill Education (India) Private Limited.
2. Concepts of Biology, Eldon D. Enger, Feederick C, Ross and David B. Bailey. TMH Publications.
3. Biology. Neil A. Campbell and Jane B. Recee, Pearson Education.
4. Biology Concepts and Application, Cecie Starr, Thomson Books.

CS 1093 Computer Programming Laboratory

Credit: 4
Category: ESLC
Prerequisite(s): Nil

Course Description:

The course aims to provide exposure to problem-solving through programming. It aims to train the student to the basic concepts of the C-programming language. This course involves lab component which is designed to give the student hands-on experience with the concepts.

Course Outcomes: At the end of the course, the students will be able to:

CO1: have fundamental knowledge on basics of computers hardware and number systems
with concept on basics commands in Linux

CO2: write, compile and debug programs in C language

CO3: design programs involving decision structures, loops, and functions

CO4: understand the dynamics of memory by the use of pointers

CO5: use different data structures and create/update basic data files

Topics:

- Basic linux commands
- Operators and Expressions
- Branching statements (if-else, switch).
- Control statements (looping - for, while, do-while).
- Arrays
- Character Arrays (strings).
- Functions.
- Pointers and Dynamic Memory Allocation.
- Structures and Unions
- File Handling

CH 1097 Chemistry Laboratory

Credit: 1.5
Category: BSLC
Prerequisite(s): Nil

Course Description:

The Chemistry laboratory course is designed to develop basic concepts of quantitative analysis by using volumetric as well as instrumental methods. It includes classical titrations to estimate hardness, alkalinity, dissolved oxygen, ferrous ion content, chloride content in water/solution samples. It also gives hands on training to use advanced titration techniques such as potentiometric, pH metric and conductometric titrations which can be used with turbid and colored solutions in incredibly low concentrations. The course also gives an exposure to extensive use of UV-Vis spectroscopy for estimation of different ions in solution phase.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: understand the significance of quantitative chemical analysis
- CO2: prepare solutions of different concentrations and do their standardization
- CO3: get an exposure to different instrumental techniques such as Conductometry, pH-metry, Potentiometry and Colorimetry
- CO4: evaluate the rate constant of pseudo first order reactions
- CO5: analyse basic water quality parameters like hardness, dissolved oxygen, alkalinity, ferrous iron contents
- CO6: rationalize chemical handling and chemical safety in an advanced modern laboratory

Topics:

- Hardness of water sample
- Alkalinity of water
- Estimation of Fe^{2+} iron
- Dissolved Oxygen
- Potentiometric Titration
- Kinetics of Ester Hydrolysis
- Chloride Estimation
- pH metric Titration
- Conductometric Titration
- Concentration of KMnO_4 by Visible spectroscopy

HS 1085 Language Laboratory

Credit: 1
Category: HSMC
Prerequisite(s): Nil

Course Description:

Language Lab is more practical oriented which is designed with an objective to make the learner practice the skills which he/she has learnt in the theory I.e Listening, Speaking, Reading and Writing in order to improve their communication skills. It is basically designed to engage the students to learn to perform group activity or an individual activity. This course is prepared to improve the listening reading, speaking and writing skills . It is expected to orient the students with vocabulary, analogy, sentence completion and sentence correction.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: use English grammar correctly and unambiguously in technical writing
- CO2: apply verbal and non-verbal modes of communication effectively in practical situations
- CO3: have a basic understanding of the communication process and to know the practical implementations in the workplace
- CO4: retain a logical flow while drafting reports and other technical pieces of writing
- CO5: develop competence in reading and comprehension
- CO6: be familiar with English pronunciation and use neutral accent successfully

Topics:

- Reading & Comprehension
- Skit/ Role-Play Practice
- Listening Comprehension
- Time & Tense
- Business Letter
- Business Report
- Subject-Verb Agreement
- Visual Elements in Writing:
- Gadget-Supported Textual Formatting
- Attendance + Lab Record Checking
- Viva Voce

CE 1083 Engineering Graphics

Credit: 2
Category: ESLC
Prerequisite(s): Nil

Course Description:

The course of Engineering Graphics comprises of basics of drafting, projection of points & lines, line inclined to both the planes, projection of planes, Computer Aided Drafting, projection of solids and development of surfaces.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: use common drafting tools properly
- CO2: select, construct and interpret appropriate drawing scale as per the situation
- CO3: draw orthographic projections of points, lines and planes
- CO4: draw orthographic projection of solids like cylinders, cones, prisms and pyramids including sections
- CO5: develop the sections of solids for practical situations
- CO6: communicate ideas effectively using Computer Aided Drafting

Topics:

- Introduction to Engineering graphics
- Lettering
- Projection of points & lines
- Line inclined to both the planes
- Projection of planes
- Introduction to Computer Aided Drafting
- Projection of solids
- Section of solids
- Development of surface

Textbook(s):

1. Engineering Drawing + AutoCAD by K. Venugopal, New Age Publishers, 1st edition, 2011

Reference Book(s):

2. Engineering Drawing with an Introduction to AutoCAD by S. N. Lal, Cengage India Private Limited, 1st edition, 2017

COURSES OF THE PROGRAMME

CS 2001 Data Structures and Algorithms

Credit: 4

Category: PCC

Pre-requisite(s): Computer Programming (CS 1093)

Course Description:

This course explores several fundamental algorithms and data structures of computer science. Some of the data structures include arrays, linked lists, stacks, queues, trees, heaps, hash tables, and graphs. Students also study and analyze algorithms for searching, traversing trees, hashing, sorting, finding shortest searching, and much more.

Course Outcomes: At the end of the course, the students will be able to:

CO1: understand the concepts of data structure, data type, abstract data type (ADT) and compute the complexity of different algorithms

CO2: understand, distinguish and implement array and linked data structure on different types of problems

CO3: apply different linear data structures such as stack and queue to solve various problems

CO4: apply and evaluate different non-linear data structures such as tree and graph on various computing problems

CO5: apply and evaluate standard algorithms for searching, sorting and hashing

CO6: create the data structure that efficiently models the information in a problem

Topics:

- Introduction
- Arrays
- Linked List
- Stacks and Queues
- Trees
- Graphs
- Sorting
- Searching

Textbook(s) :

1. Fundamentals of Data Structures in C, 2nd edition, Horowitz, Sahani, Anderson-Freed, Universities Press.

Reference Book(s):

1. Data Structures, Schaum's OutLines, Seymour Lipschutz, TATA McGRAW HILL
2. Data Structures using C by Aaron M. Tenenbaum, Yedidyah Langsam, Moshe J. Augenstein, Pearson, 1st Edition
3. Data Structures A Pseudocode Approach with C, 2nd Edition, Richard F. Gilberg, Behrouz A. Forouzan, CENGAGE Learning, India Edition
4. Data Structures Using C, Second Edition, Reema Thereja, Oxford University Press
5. Data Structures and Algorithm Analysis in C, Mark Allen Weiss, Pearson Education, 2nd Edition.

CS 2002 Operating Systems

Credit: 3

Category: PCC /OEC

Prerequisite(s): Data Structures and Algorithms (CS 2001)

Course Description:

Operating System (OS) describes the tradeoff between performances, functionalities and division of responsibilities between hardware and software by combining languages, hardware, data structures, algorithms and other necessities. The Course covers the classical internal algorithms and structures of operating systems, including CPU scheduling, memory management, and device management. This course also provides a deeper insight into different functionalities of operating system used in modern computers with respect to their performance.

Course Outcomes: At the end of the course, the students should be able to:

- CO1: understand the difference between different types of modern operating systems, virtual machines, their structure with implementation and applications
- CO2: understand the difference between process & thread, issues in scheduling of user-level processes/threads
- CO3: analyze the use of locks, semaphores, monitors for synchronization in multiprogramming/multithreaded systems and design solutions for multithreaded programs
- CO4: analyze the concepts of deadlock in operating systems and how they can be managed/avoided
- CO5: evaluate the design and management concepts along with issues and challenges of main memory, virtual memory and file system
- CO6: evaluate and analyze I/O management, disk scheduling in operating systems the protection and security problems faced by operating systems for designing methods to minimize these problems

Topics:

- Introduction
- Process and threads
- Concurrent Processes
- Deadlock
- Memory Management
- File System
- Input / Output Management
- Operating System Protection & Security

Textbook(s):

1. Operating System Concepts by A. Silberschatz, P. B. Galvin and G. Gagne, John Wiley & Sons, 9th Edition, Inc., ISBN 978-1-118-06333-0

Reference Book(s):

1. Operating Systems by M. Deitel, P.J. Deitel and D.R. Choffnes, Pearson, ISBN: 9780131453159.
2. Operating Systems Concepts and Design by Milan Milenkovic, Tata McGraw-Hill Education India, ISBN: 9780074632727.
3. Operating Systems Design and Implementation by Andrew S. Tanenbaum, Albert S. Woodhull, Prentice-Hall, ISBN: 9780131429383.

CS 2004 Database Management System

Credit: 4

Category: PCC

Prerequisite(s): Data Structures and Algorithms (CS 2001)

Course Description:

This course focuses on concepts and structures required to design and implement a database management system. Various data models, integrity constraints and concurrency are discussed. It also covers the steps of normalization process. File organizations and indexing methods are also been covered. Students will learn to design and implement small projects using SQL.

Course Outcomes: At the end of the course, the students will be able to:

CO1: understand the fundamental elements of relational database management systems and its applications

CO2: conceptualize and depict a database system using ER diagram

CO3: apply query database using relational algebra, relational calculus and SQL

CO4: analyze functional dependencies and design the database using normalization

CO5: evaluate Transaction processing system and concurrency control mechanisms

CO6: evaluate basic database storage structures and access techniques: file organizations, indexing methods including B-tree, and hashing

Topics:

- Introduction
- E/R Model
- Relational Data Model
- Relational Database Design
- Transaction Processing
- Data Storage & Indexing

Textbook(s) :

1. Fundamentals of Database System By R. Elmasari & S.B. Navathe, 7th Edition, 2018, Pearson Education

Reference Book(s) :

1. Database System Concepts by A. Silberschatz, H.F. Korth & S. Sudarshan, 6th Edition, 2019, McGraw-Hill Education
2. Database Management Systems by R. RamaKrishna & J. Gehrke, 3rd Edition, 2018, McGraw-Hill Education
3. Database System Concepts by P. Rob & C. M. Coronel, Indian Edition, 2011, Cengage Learning
4. Fundamentals of Relational Database management Systems by S. Sumathi & S. Esakkirajan, 2007, Springer.

CS 2006 Computer Architecture

Credit: 4

Category: PCC

Prerequisite(s): Digital Electronics (EC 2011)

Course Description:

This course enables students with a understanding of fundamentals of computer architecture. This also explains the architectural techniques used to build high performance processors. Course topic includes control unit design, memory design and I/O processor. Some emphasis is made on hardware/software interaction to achieve performance. Issues affecting the nexus of architecture, compilers and operating systems touched upon.

Course Outcomes: At the end of the course, the students will be able to:

CO1: remember the functions of each components of computer, and how each components of computer hardware has evolved to meet the requirements of the execution of instructions

CO2: understand Instruction Set Architecture (ISA): Instruction format, types, various addressing modes

CO3: apply the basic components to design the CPU: the ALU and control unit

CO4: analyze the different levels of memory organization: SRAM, DRAM, Cache memory, Virtual Memory

CO5: design the ALU and it's operations: Addition, Subtraction, Multiplication, and Division

CO6: understand the I/O Organization and types of I/O Transfer

Topics:

- Basic Structure of Computers
- Basic Processing Unit
- Memory System
- Arithmetic
- Input/ Output Organization
- Case Study

Textbook(s) :

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Computer Organization, TMH, 5th Edition, 2002.

Reference Book(s) :

1. M. Morris Mano, Computer System Architecture, Pearson Education India, 3rd Edition
2. Computer Organization & Architecture, William Stallings, 7th Edition, PHI, 2006.

CS 2012 Design and Analysis of Algorithms

Credit: 3

Category: PCC / OEC

Prerequisite(s): Data Structures and Algorithms (CS 2001)

Course Description:

The course covers main approaches to design and analysis of algorithms including important algorithms and data structures, and results in complexity and computability. Different algorithms for a given computational task are presented and their relative merits evaluated based on performance measures.

Course Outcomes: At the end of the course, the students will be able to:

CO1: analyze the asymptotic performance of algorithms

CO2: understand different algorithm design techniques

CO3: apply important algorithmic design paradigms and methods of analysis

CO4: demonstrate familiarity with major algorithms and data structures

CO5: evaluate different classes of problems: P, NP , NP Complete and NP Hard

CO6: create algorithms to apply in common engineering design situations

Topics:

- Introduction
- Divide-and-Conquer Method
- Dynamic Programming
- Graph Algorithms
- Complexity Classes

Textbook(s) :

1. T. H. Cormen, C. E. Leiserson, R. L. Rivest, and C. Stein, “Introduction to Algorithms”, Printice Hall of India,3rd Edition.
2. E. Horowitz & S Sahni, “Fundamentals of Computer Algorithms”, Galgotial publication; Second edition.

Reference Book(s):

1. J.Kleinberg and E. Tardos, Algorithm Design, Pearson International Edition, 1st Edition.
2. Michael T Goodrich and Roberto Tamassia, “Algorithm Design: Foundations, Analysis, and Internet Examples”, Wiley, Students Edition.

CS 2091 Data Structures Laboratory

Credit: 1

Category: PCLC

Prerequisite(s): Computer Programming (CS 1093)

Course Description:

The data structure lab is to develop skills for the design, analysis and implementation of operations like search, insertion, deletion, traversal, and other specified problem definition on various linear and nonlinear data structures. It improves the ability to define, apply the appropriate data structure for the real world problem and various techniques for representation of the data in the real world. In addition, it helps them to gain knowledge of data structure applications related to industry.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: understand the importance of structure, unions and abstract data type, and their basic usability in different applications through C programming language
- CO2: analyze, differentiate and implement different algorithms based on their time and space complexity
- CO3: understand and implement the linked implementation, and its uses both in linear and non-linear data structure
- CO4: understand and implement various data structures such as stacks, queues, trees, graphs, etc. to solve various computing problems
- CO5: understand and implement various kinds of searching and sorting techniques, and know when to choose which technique
- CO6: decide and implement the suitable data structure and algorithm to solve a real world problem

Topics:

- Array, pointer with Dynamic Memory Allocation
- Structure, Single Linked List
- Doubly Linked List, Circular Linked List
- Polynomial Representation, Addition & Multiplication, Sparse Matrix Représentation, Addition & Multiplication
- Stack
- More on Stack & Applications of Stack
- Queue
- Tree
- Graph
- Searching & Sorting

CS 2094 Database Management System Laboratory

Credit: 1
Category: PCLC
Prerequisite(s): Nil

Course Description:

This course provides the adequate knowledge to the students related to database concepts, technology and practice to create, modify, and extracting the data from the database based on the application requirement. This course also enables the student to understand different ways of interaction between programming language and different types of databases.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: create database with different types of integrity constraints and use the SQL commands such as DDL, DML, DCL, TCL to access data from database objects
- CO2: use database security & authorization in order to access database for the different kinds of the user
- CO3: access and manipulate data using PL/SQL blocks
- CO4: connect database to front end using JDBC and ODBC driver

Topics:

- Fundamentals of SQL
- Data Definition Language and Data Manipulation Language Commands in SQL
- Operators used in where clause
- Built in functions used in SQL
- Constraints in SQL
- Grouping, and Ordering of data
- Join and Set Theory operations
- Subqueries
- Data Control Language, and Transaction Control Commands
- Use of Programming Language blocks in SQL i.e. PL/SQL

CS 2098 Algorithm Laboratory

Credit: 1

Category: PCLC

Prerequisite(s): Data Structures Laboratory (CS 2091)

Course Description:

This course aims at providing different algorithm techniques for designing efficient algorithms and classify different algorithms based on asymptotic notation.

Course Outcomes: At the end of the course, the students will be able to:

CO1: understand the basic graph algorithms for the fundamental knowledge of graph problem solving

CO2: understand and analyze the different technique of program writing and their comparisons

CO3: to study about various designing paradigms of algorithms for solving real world problems

CO4: have the knowledge of different graph programming

CO5: understand the geometric algorithms

CO6: understand the string programming

Topics:

- Review of Fundamentals of Data Structures
- Fundamentals of Algorithmic Problem Solving-I
Analysis of time complexity of small algorithms through step/frequency count method
- Fundamentals of Algorithmic Problem Solving-II
Analysis of time complexity of algorithms through asymptotic notations
- Divide and Conquer Method
Binary Search, Merge Sort, Quick Sort, Randomized Quick Sort
- Heap & Priority Queues
Building a heap, Heap sort algorithm, Min-Priority queue, Max-Priority queue
- Greedy Technique
Fractional knapsack problem, Activity selection problem, Huffman's code
- Dynamic Programming
Matrix Chain Multiplication, Longest Common Subsequence

CS 3012 Parallel And Distributed Computing

Credit: 3
Category: PEC

Pre-requisite(s):Data Structures and Algorithms (CS 2001), Design and Analysis of Algorithms (CS 2012)

Course Description:

This course focuses on various parallel programming platforms, principle of parallel algorithm design, cost analysis, and implementation of parallel algorithms. The design of parallel algorithms uses a class of basic communication operations as building blocks. The scope of this course covers metrics for quantifying the performance of parallel algorithms including basic concepts of the message-passing programming paradigm. The design of different sorting & searching & graph algorithms on parallel platforms and its challenges are part of this course.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: analyze different models of parallel and distributed computing and understand the basic techniques for designing algorithms in these models
- CO2: learn and apply knowledge of parallel and distributed computing techniques and methodologies
- CO3: design, develop, and analyzing performance of parallel and distributed applications
- CO4: implement fundamental Computer Science methods and algorithms in the development of parallel applications
- CO5: explain the design, testing, and performance analysis of a software system, and to be able to communicate that design to others
- CO6: evaluate design, development, and performance analysis of parallel and distributed applications

Topics:

- Introduction to Parallel Computing
- Parallel Programming Platforms
- Principles of Parallel Algorithm Design
- Basic Communication Operations
- Analytical Modeling of Parallel Programs
- Programming Using the Message Passing Paradigm
- Sorting & Searching Algorithms
- Graph Algorithms

Textbook(s):

1. Introduction to Parallel Computing, Second Edition, Ananth Gram, Anshul Gupta, George Karypis, Vipin Kumar, Person Education.
2. Parallel programming in c with MPI and Open MP, M.J. Quinn, TMH.

Reference Book(s):

1. Parallel Computer Architecture and Programming, D.E.Culler,J.P Singh & A Gupta, Morgan Kaufman
2. Designing and Building Parallel Programs, I.Foster. Addison-Wesley.

CS 3029 Advanced Database Management System

Credit: 3

Category: PEC

Prerequisite(s): Database Management System (CS 2004)

Course Description:

This course provides a systematic approach of advanced database areas as well as the basics of database systems. It covers the query processing and optimization techniques. The concepts of parallel and distributed database, distributed query processing, distributed concurrency control have been covered. It also covers different data warehousing technologies, multidimensional modeling, data mining techniques.

Course Outcomes: At the end of the course, the students will be able to:

CO1: analyze Database Management Systems and construct simple and moderately advanced database queries using Structured Query Language (SQL)

CO2: apply the detail query processing and techniques involved in query optimization

CO3: evaluate the database storage structures and access techniques such as file organizations, indexing methods

CO4: analyze the details of distributed database design process, concept of a distributed database transaction and related facilities, including concurrency control, backup and recovery

CO5: evaluate the concept of parallel database design process

CO6: study contemporary issues and emerging technologies such as On-Line Analytical Processing (OLAP), Data Warehouse and Data mining

Topics:

- DBMS & SQL
- Query Evaluation
- Physical Database Design & Tuning
- Parallel & Distributed Databases
- Data Warehousing & Data Mining

Textbook(s):

1. Database Management Systems by RamaKrishna & Gehrke, 3rd Edition, 2018, McGraw-Hill Education

Reference Book(s):

1. Fundamentals of Database System By Elmasari & Navathe, 7th Edition, 2018, Pearson Education
2. Database System Concepts by Silberschatz, Korth & Sudarshan, 6th Edition, 2019, McGraw-Hill Education

CS 3031 Computational Intelligence

Credit: 3
Category: PEC
Prerequisite(s): Nil

Course Description:

Computational Intelligence provides a fundamental coverage of the concepts of machine intelligence. This course covers methodologies that can handle imprecision, uncertainty, and partial truth. There are three basic units, i.e. fuzzy logic, neural networks and genetic algorithms. Their application to solve problems of fuzziness, prediction and optimization are discussed. The course also covers combinatorial and hybrid models like fuzzy inference systems, ANFIS (Adaptive Neuro-Fuzzy Inference Systems), multi Layer perceptrons, etc.

Course Outcomes: At the end of the course, the students will be able to :

- CO1: understand the basic concepts and characteristics of soft computing and also its associated methodologies
- CO2: apply various set theoretic operations in fuzzy sets
- CO3: analyze fuzzy rules, fuzzy reasoning and various fuzzy inference systems
- CO4: understand derivative free optimization and apply genetic algorithms to optimization problems
- CO5: analyze concepts of artificial neural networks and apply neural networks to various classification problems
- CO6: analyze some hybrid models such as adaptive Neuro-fuzzy inference systems

Topics:

- Introduction
- Artificial Neural Networks
- Fuzzy Set Theory
- Fuzzy Rules, Fuzzy Reasoning and Fuzzy Inference System
- Neuro-Fuzzy Models
- Optimization

Textbook(s):

1. Neuro-Fuzzy and Soft Computing, Jang, Sun, Mizutani, PHI/Pearson Education

Reference Book(s):

1. Introduction to Soft Computing, Roy and Chakraborty, Pearson Education
2. Fuzzy Logic with Engineering Applications, Timothy J. Ross, McGraw-Hill, 1997.
3. Genetic Algorithms: Search, Optimization and Machine Learning, Davis E. Goldberg, Addison Wesley, N.Y., 1989.
4. Neural Networks: A Comprehensive Foundation, Simon Haykin, Prentice Hall
5. Neural Network Design, M. T. Hagan, H. B. Demuth, Mark Beale, Thomson Learning, Vikash Publishing House
6. Neural Networks, Fuzzy Logic and Genetic Algorithms, S. Rajasekaran and G.A.V. Pai, PHI, 2003

CS 3032 Big Data

Credit: 3
Category: PEC

Prerequisite(s): Database Management System (CS 2004)

Course Description:

The course provides an introduction to big data with a special focus on the big data tools. Besides the theoretical foundations, students acquire practical experience by programming in R. This course provides exposure to theory as well as practical and software used in data analytics such as R.

Course outcomes: At the end of the course, the students will be able to:

- CO1: understand the concept of data management and evolution of Big Data
- CO2: understand and implement various big data technology foundations
- CO3: apply the fundamentals of Hadoop ecosystem and its components for data analysis
- CO4: analyze the optimization techniques in data bases
- CO5: analyze the storage techniques in data bases
- CO6: explore the understanding of text, sentiment analytics

Topics:

- overview of big data
- big data technology foundations
- Hadoop ecosystem
- storing data in databases and data warehouses
- text analytics, sentiment analysis, opinion mining

Textbook(s):

1. Big Data, Black Book, DT Editorial Services, Dreamtech Press, 2015
2. Big Data and Analytics, Seema Acharya, Subhashini Chellappan, Infosys Limited, Publication: Wiley India Private Limited, 1st Edition 2015

Reference Book(s):

1. Bill Franks, Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with advanced analytics, John Wiley & sons, 2012.
2. Glenn J. Myatt, Making Sense of Data, John Wiley & Sons, 2007 Pete Warden, Big Data Glossary, O'Reilly, 2011.
3. Big Data For Dummies, Judith Hurwitz, Alan Nugent, Fern Halper, Marcia Kaufman, Wiley 2013

CS 3037 Principles Of Automata

Credit: 3

Category: PEC

Prerequisite(s): Discrete Mathematics (MA 2013)

Course Description:

The course discusses the concept of automata as acceptors and their associated behaviour. This course focuses on design of different mathematical models such as Finite automata, Push-down automata and Turing machines. Further, the limitation of these automata and their corresponding language is discussed. Along with above, the course also highlights the design of grammar for each language class and discusses the properties of each language class as well. Finally, the course provides an overview of Chomsky hierarchy of language classes in-order to co-relate the language classes.

Course Outcomes: At the end of the course, the students will be able to:

CO1: understand the concepts formal languages and finite automata

CO2: develop an understanding of equivalence in finite automata and its minimization

CO3: analyze the knowledge of regular languages and their properties

CO4: implement the concepts of context-free grammars and their properties

CO5: analyze context-free languages and pushdown automata

CO6: evaluate Turing machines and Chomsky hierarchy of formal languages

Topics:

- Formal Languages and Finite Automata
- Regular Languages and their Properties
- Context-Free Grammars and their Properties
- Context-free Languages and Pushdown Automata
- Turing Machines and Relevant Topics

Textbook(s):

1. Introduction to Automata Theory, Languages, and Computation, 3e, John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, Pearson Education India, 2008.

Reference Book(s):

1. An Introduction to Formal Languages and Automata, 6e. Peter Linz. Jones & Bartlett, 2016.
2. Introduction to Languages and the Theory of Computation, 3e, John C. Martin. McGraw-Hill Education, 2009.
3. Languages and Machines, 3e, Thomas A Sudkamp, Pearson Education India, 2007.

CS 3096 Tools and Techniques Laboratory

Credit: 2

Category: PCLC

Prerequisite(s): Data Structures and Algorithms (CS 2001), Object Oriented Programming (IT 2005), and Probability & Statistics (MA 2011)

Course Description:

The course aims to provide exposure to problem-solving through python programming. It aims to train the student to implement different machine learning techniques using python library.

Course Outcomes: At the end of the course, the students will be able to:

CO1: acquire a fundamental understanding of the basics of Python Programming

CO2: understand and implement the Data Structures in Python: List, Tuple, Set and Dictionary

CO3: explore the understanding of Object Oriented Programming using Python

CO4: comprehend and apply the concept of Regular Expressions using large data-set(csv files)

CO5: implement various Python tools and Libraries like Panda,Numpy, SciKit, matplotlib etc

CO6: develop a Mini project in Python in any of the domain like Machine Learning,Natural Language Processing,Sentiment Analysis,Data Analytics,Web Scrapping and Web development, chatbots etc.

Topics:

- Python Installation, Data types,User Input/Output,Code commenting
- Control Flow and Looping
- Data Structure like Lists, Tuples, Dictionaries and Sets
- Functions, Lambda, Filter, Map, Reduce
- Generators , Iterators, Decorators
- File Handling, Exception Handling
- Basics of Object Oriented Programming in Python
- Regular Expression(Regex)
- JSON and Database Handling in Python
- Data Analytics using Libraries:Pandas,Numpy,Matplotlib
- Web Scrapping using Beautiful soup and Selenium
- Overview of Machine Learning(Supervised & Unsupervised ML)
- Mini Project on Web Development,Data Analytics,Natural Language Processing
- Mini Project on Android Development

EC 2004 Principle of Digital Communication

Credit: 4
Category: PCC

Prerequisite(s): Mathematics-I (MA 1003), Mathematics-II (MA 1004), Digital Electronics (EC 2011)

Course Description:

This course covers signal classification and representation, different types of analog and digital modulation techniques, fundamental concept of information theory, various aspects of information transmission, Shannon's Information Theory concepts and coding techniques.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: comprehend and interpret signals in time and frequency domain
- CO2: comprehend different types of analog modulation techniques and explain their properties and applications
- CO3: classify and apply different types of pulse modulations, multiplexing techniques and their applications
- CO4: analyze the process of analog to digital conversion, different types of digital modulation techniques and interpret their properties
- CO5: analyze the data communication models and data transmission methods
- CO6: identify fundamental problems in information theory and apply different coding techniques for data transmission

Topics:

- Signal (Classification of signals, time and frequency domain representation)
- Analog Modulation (Need of modulation, AM, FM, Types of modulator and de -modulator and receiver)
- Pulse Modulation (Concept of Sampling, Basics of Pulse modulations - PAM, PPM, PWM and Multiplexing)
- PCM & Delta Modulation (Concept of quantization, digitization process of analog signals)
- Digital Modulation (Digital Modulation techniques - ASK, PSK, FSK, DPSK & QPSK, their generation and detection methods)
- Data Communication (Methods of data transmission, Modem, Basics of network)
- Information Theory (Amount of information, entropy, Shannon's theorems, Source Coding techniques)

Textbook(s):

1. Communication Systems – Simon Haykin, 4th Edition, John Wiley

Reference Book(s):

1. Principle of Communication System – H. Taub & D. Schlling, TMH, 3rd edition.
2. Data & Computer Communication – W. Stallings, Pearson, 9th edition.

EC 2005 Semiconductor Devices

Credit: 3

Category: PCC

Prerequisite(s): Analog Electronics Circuit (EC 1004)

Course Description:

This course will give the fundamental concepts of electronics devices that are backbone of all electronics circuits. In this course students will be able to understand the basic semiconductor device physics and how the concepts are used in PN junction, metal semiconductor contacts, BJT, MOSFET, Optoelectronics devices. The course will give in-depth knowledge about the operating principle of the devices with characteristics and how these are related to modern technologies. This course will also help the students to explore various other domains of electronics like VLSI design, Digital electronics etc.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: understand and explain the fundamental semiconductor physics concepts like Fermi level, carrier concentration etc. and analyze them to solve different problems
- CO2: analyze and explain different conduction techniques in semiconductor materials and solve relevant problems
- CO3: comprehend and analyze the operation of different diodes, metal semiconductor contacts and solve different diode problems
- CO4: explain the operation and solve problems associated with of BJT
- CO5: analyze and explain the operation of MOS Transistors and solve relevant problems
- CO6: comprehend and analyze operating principle of different optoelectronic devices and their applications

Topics:

- Energy bands & Current Carriers in Semiconductors
- P-N Junction
- BJT (Bipolar Junction Transistor)
- Metal-Oxide Field Effect Transistor (MOSFET)
- Optoelectronics devices

Textbook(s):

1. Solid State Electronic Devices: Streetman & Banerjee, 7th Edition, Pearson.

Reference Book(s):

1. Semiconductor Devices: Basic Principles, Jasprit Singh John Wiley & Sons,2000
2. Integrated Electronics: Analog And Digital Circuit Systems, Jacob Millman, Christos Halkias, Chetan D Parikh, 2nd Edition, TMH 2010.
3. Semiconductor Physics And Devices: Donald Neaman and Drubesh Biswas,2012, 4thEdition, TMH 2012.

EC 2011 Digital Electronics

Credit: 3
Category: PCC
Prerequisite(s): Nil

Course Description:

This course covers all basic concepts in digital systems. The course starts with fundamentals of Boolean Algebra-different number systems and inter-conversions, binary codes and K-maps. This will be followed by designing of various combinational circuits such as adders, subtractors, decoders, encoders, magnitude comparators, multiplexer and de-multiplexers. Detail concept about memory elements (flip-flops) will be provided that will help the students to learn about various design techniques of sequential circuits like shift registers, counters and FSMs. Fundamentals of digital logic families, ADC and DAC will also be covered that will help the students to learn digital electronics principles comprehensively in today's perspective.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: comprehend, simplify and realize Boolean expression
- CO2: comprehend and analyze combinational circuits using logic gates
- CO3: design various asynchronous & synchronous sequential circuits using Flip-Flops
- CO4: design & implement Mealy and Moore model FSMs for different synchronous sequential circuits
- CO5: analyze and differentiate between different logic families such as TTL & CMOS chips
- CO6: comprehend and analyze the concept of different types of Analog-to-Digital converters and Digital-to-Analog converters

Topics:

- Introduction to Boolean Algebra
- Combinational Circuits
- Sequential Logic
- Finite State Machine (FSM)
- Logic Families
- A/D and D/A

Textbook(s):

1. Fundamentals of Digital Logic – Anand Kumar - PHI, 2nd Edition, 2011
2. Digital Logic and Computer Design – M. Morris Mano – PHI, 2011

Reference Book(s):

1. Digital Principles and Applications – Malvino & Leach – TMH, 7th edition, 2011
2. Digital Fundamentals – T. L. Floyd & Jain – Pearson Education, 10th edition, 2011

EC 2014 Electromagnetic Theory

Credit: 3
Category: PCC
Prerequisite(s): Mathematics-II (MA 1004)

Course Description:

The course provides a basic understanding of electrostatics and magnetostatics using the already known knowledge of vector calculus. This course will also cover different aspects of time varying fields and provide insight to Maxwell's equations. Concepts on the propagation of the EM waves in different media and under boundary conditions will lead to the understanding of transmission line behaviour and impedance matching circuits.

Course Outcomes: At the end of the course, the students will be able to :

- CO1: apply the appropriate coordinate system for a particular vector based problem, and the laws of vector calculus
- CO2: analyze and solve numerical problems involving static charges
- CO3: analyze and solve numerical problems involving constant currents
- CO4: analyze and apply Maxwell's equations for electromagnetism
- CO5: analyze and apply wave behavior during its propagation through multiple media in presence of different boundary conditions
- CO6: design transmission line sections (Length propagation constant and characteristic impedance) along with feeding mechanism for realizing impedance matched conditions

Topics:

- Orthogonal coordinate systems
- Static electric and Static magnetic fields
- Time varying fields and Maxwell's equations
- Plane Electromagnetic waves
- Transmission Lines

Textbook(s):

1. Elements of Electromagnetics (Fourth Edition) by Matthew N.O Sadiku, Oxford University Press, 2009.
2. Field and Wave Electromagnetics (Second Edition) By David K. Cheng, Pearson Education, 1989.

Reference Book(s):

1. Engineering Electromagnetics (Seventh Edition) by William H. Hayt, Jr and John A. Buck, Tata McGraw- Hill Publishing Company Limited, New Delhi, 2007.
2. Electromagnetic Waves and Radiating Systems by Edward C. Jordan and Keith G. Balmain, Prentice Hall of India, New Delhi, 2nd Edition.

EC 2016 Communication Engineering

Credit: 4

Category: PCC

Prerequisite(s): Principles of Signals and Systems (EC 2023)

Course Description:

The course deals with analog and digital communication techniques that includes AM, FM, sampling, pulse modulation techniques, and multiplexing techniques. It also covers fundamentals of modern communication systems such as optical communication, satellite communication and mobile communication.

Course Outcomes: At the end of the course, students will be able to:

- CO1: understand the basic of signal and systems, Fourier transform and their properties, random process, random variable, PSD & ESD of a signal
- CO2: explain the need of communication, its definition & understand the block diagram of different types of communication system
- CO3: classify amplitude modulation, angle modulation, Pulse modulation, Types of digital modulation
- CO4: applying Fourier transform for analysis of radio spectrum, sketch the waveform and interpret the information present
- CO5: design simple systems for generating and demodulating amplitude modulated signals, frequency modulated signal, pulse modulated signal and digital modulation
- CO6: design a communication system and select an appropriate modulation technique for a particular application

Topics:

- Introduction
- Signals
- Amplitude Modulation
- AM Radio Receiver
- Angle Modulation
- FM Radio Receiver
- Pulse Modulation and Demodulation
- Digital Modulation
- Modern Communication Systems

Textbook(s):

1. Introduction to Analog & Digital Communication System, Simon Haykins, 2011, John Wiley.
2. Modern Digital and Analog Communications Systems, B. P. Lathi, Oxford University Press, 4th edition.

Reference Book(s):

1. Principles of Communication System, H. Taub & D. L. Schilling, TMH, 3rd edition

EC 2020 Microprocessors, Microcontrollers & Interfacing

Credit: 4

Category: PCC

Prerequisite(s): Digital Electronics (EC 2011)

Course Description:

The objective of this course is to teach the fundamentals of Microprocessor (like 8085, 8086) and Microcontroller (like 8051) systems to the students. In this course, the students learn about assembly language to program the Microprocessors, Microcontrollers and develop programs to solve simple applications.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: comprehend the basic concept of Bus structure, a basic 8-bit Microprocessor (like 8085) system, its architecture, concept of stack, Addressing modes etc.
- CO2: explain the architecture of a 16-bit Microprocessor like 8086 including the concept of instruction queue, segmented memory structure and address generation
- CO3: explain and analyze the Addressing modes, Assembly language instructions of 8086 and implement them to solve 8086 related design problems
- CO4: design Memory Interfacing using memory chips with proper decoder circuits with a 16-bit processor and analyze the interrupt structure of 8086 Microprocessor
- CO5: explain the features of the peripherals such as PPI, Programmable interrupt control, USART and their interfacing with a 16-bit processor
- CO6: explain and analyze memory organization of a 8-bit Microcontroller (like 8051), its addressing modes, instructions, timers & counters and its serial communication

Topics:

- 8085 (8-bit Microprocessor)
- 8086 (16-bit Microprocessor)
- Interfacing Chips
- 8051 Family of Microcontrollers

Textbook(s):

1. Microprocessors and Interfacing, Programming & Hardware - Douglas V. Hall, McGraw Hill Education Pvt Ltd., 3rd edition.

Reference Book(s):

1. Microprocessor Architecture, Programming and Applications with the 8085 - Ramesh S. Goankar, Penram International Publishing (India).
2. Microprocessors & Microcomputer based System Design - Md. Rafiquzzaman, 2nd edition.
3. Microcontroller Theory & Applications - Deshmukh, McGraw Hill Education Pvt Ltd.

Credit: 3
Category: PCC
Prerequisite(s): Mathematics-II (MA 1004)

Course Description:

This course is designed to establish a strong foundation for communication and signal processing. It will enable students to classify various analog and discrete time signals and visualize the signals after various operations. The course will enable the students to represent various signals in terms of singularity functions and find relationships between signals. It will provide the knowledge of various classifications of systems as well as time and frequency domain analysis of signals and systems using in-depth knowledge of Fourier and Laplace transforms. It will provide the knowledge of linear circuit analysis using Laplace transform to find dynamic and steady state responses. It is designed to provide the concepts of fundamental network theorems and network parameters to analyze linear electrical circuits.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: understand and classify various continuous and discrete signals, understand sampling process and visualize signals after various operations
- CO2: classify and analyze system characteristics and determine output of LTI system in time domain
- CO3: analyze continuous time signals and systems in frequency domain using continuous time Fourier series and continuous time Fourier transform
- CO4: determine the Laplace Transform of various signals and analyze analog systems characteristics using Laplace transform and its properties
- CO5: analyze RLC circuits for AC/DC excitation using Laplace transform
- CO6: analyze and apply network theorems and network parameters to various electrical circuits

Topics:

- Introduction to signal classification and operation and sampling process
- Introduction to system classification and time domain analysis of systems
- Analysis of signals and systems in frequency domain using Fourier analysis
- Analysis of signals and system using Laplace transform
- Linear circuit analysis using Laplace transforms
- Network theorems and network parameters and their applications for analyzing linear circuits

Textbook(s):

1. Signals and Systems by Alan V. Oppenheim, Alan S. Willsky, PHI , edition
2. Circuit Theory, Analysis and Synthesis A, Chakrabarti, Dhanpat Rai Publishing Company (P) Limited 5th edition, 2008.

Reference Book(s):

1. Signals & Systems – P. Ramesh Babu –Scitec,4th edition
2. Network Analysis 3rd edition, by M. E. Van Valkenburg, Pearson Education, 2006

EC 2023 Principle of Signals and Systems

Credit: 2

Category: PCC

Prerequisite(s): Mathematics-II (MA 1004)

Course Description:

The course presents basic concepts for both continuous-time and discrete-time signals and systems. This course also covers Fourier transform, Laplace transform basics of signal and systems.

Course Outcomes: At the end of the course, the students will be able to:

CO1: comprehend and plot continuous and discrete signals and determine respective characteristics.

CO2: analyze the concept of vector space and orthogonality

CO3: classify various types of systems and analyze system characteristics in time domain

CO4: determine the frequency domain representations of periodic and aperiodic signals using Fourier analysis and its properties

CO5: analyze LTI systems in frequency domain using Fourier analysis for periodic as well as aperiodic signals

CO6: determine the Laplace Transform of various signals and analyze analog systems characteristics using Laplace transform and its properties

Topics:

- Introduction to signals and Classification of signals
- Introduction to continuous and discrete time signals and sampling theorem
- Decomposition of signals, Representation of signals in terms of impulses
- Introduction&classification to systems with examples
- Characteristics of LTI systems and derivation of system response
- Causality and stability criteria of discrete and analog LTI IIR, FIR
- Introduction to Fourier Analysis and their need in LTI
- Properties of CTFS with examples &Approximation of Fourier Series to Transform for aperiodic signals
- Properties of Fourier transform with examples
- Analysis of LTI Systems using FT, Establishment of Laplace transform as modification of FT
- Laplace transform. Convergence of Laplace Transform, Properties of Laplace Transform
- Transfer function, Pole-Zero plot and ROC properties

Textbook(s):

1. Signals & Systems, Alan V Oppenheim and Alan S Willsky, PHI publication, 2nd edition.

Reference Book(s):

1. Signals and systems, Ramesh Babu, Scitech Publication, 4th edition.

EC 2025 Principle of Electronics Engineering

Credit: 3
Category: PCC
Prerequisite(s): Nil

Course Description:

The course objective is to make students of Engineering to understand the efficacy of Electronic principles which are pervasive in engineering applications. Students will be able to understand the essence and applications of electronic components used in different electronic circuit. They will understand the working of diode and transistor and their characteristics, benefits of feedback in amplifier, oscillators, design of simple circuits like amplifiers (inverting and non-inverting), adders, integrator and differentiator using OPAMPS, a digital logic and apply it to solve real life problems.

Course Outcomes: At the end of course the students will be able to:

- CO1: understand the properties of semiconductors and current conduction mechanisms
- CO2: comprehend the working of P-N junction diodes; identify different diode circuits and analyze them
- CO3: understand the working of BJT, different modes and configuration, identify and analyze their biasing circuits, understanding the working of CE amplifier and its properties
- CO4: analyze the working of op-amp using either inverting or non -inverting configurations, timing circuit, regulated power supply ICs and their applications
- CO5: comprehend the concept of feedback in electronic circuits, types of feedback, their applications
- CO6: comprehend the working of different logic gates, combinational and sequential circuits, develop a brief idea about microprocessor and microcontrollers

Topics:

- Semiconductors
- Junction Diodes
- Bipolar Junction Transistor (BJT)
- Feedback Concept
- Operational Amplifiers (OPAMP) and 555 timer
- Digital Electronics

Textbook(s):

1. Electronics- Fundamentals & Applications- D. Chattopadhyay and P.C Rakshit- 11th Edition (New Age International)
2. Electronic Devices and Circuits- D. A. Bell- 5th Edition (Oxford)

Reference Book (s):

1. Electronic Devices & Circuits- R. L. Boylestad- 10th Edition(Pearson)
2. Digital Principles and Applications- A. Malvino and Leach-7th Edition(TMH)

EC 2027 Analog Electronics

Credit: 4

Category: PCC

Prerequisite(s): Basic Electrical Engineering (EE 1003)

Course Description:

This course deal with basic circuit components and semiconductor components viz., diode, BJT, FET based circuits and op-amp based practical circuits. Design and analysis of circuits such as rectifier, amplifier, oscillator are covered under this course.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: comprehend the significance of terminology associated with semiconductor devices and solve the different diode circuits
- CO2: explain and analyze different biasing circuits using BJTs and FETs
- CO3: analyze and design different amplifier circuits using BJTs and FETs with the help of their small signal model
- CO4: analyze and design electronic circuits using BJTs or FETs for different feedback topologies depending on applications as amplifier and oscillators
- CO5: explain and analyze different power amplifier circuits, differential amplifier and current mirror circuits
- CO6: explain and design different analog circuits using Operational amplifiers and 555 timer

Topics:

- Semiconductor
- P-N junction
- Transistors
- Transistor biasing circuits
- Small signal analysis of transistor amplifiers
- Feedback and oscillator circuits
- Power amplifiers
- Differential amplifiers
- Operational amplifiers

Textbook(s):

1. Integrated Electronics, Analog and Digital Circuits and Systems, J. Millman & Halkias, C.D. Parikh, Mc-Graw Hill India, 2nd edition, 2013, 10th Reprint.
2. Op-Amps and LIC, Ramakant A. Gayakward, Pearson, 4th edition.

Reference Book(s):

1. Microelectronics circuits, A. S. Sedra and K. C. Smith, Oxford University Press, 5th edition, 2011.
2. Linear Integrated Circuits, D. Roy Choudhury and Shail B. Jain, 4th edition, New Age International Publishers.

EC 2090 Microprocessor and Microcontroller Laboratory

Credit: 1

Category: PCLC

Prerequisite(s): Digital Electronics (EC 2011)

Course Description:

This lab is utilized by 4th semester Electronics and Telecommunication Engineering, Electronics and Computer Science Engineering students, 5th semester Electronics and Electrical Engineering and Electronics and Instrumentation Engineering students. Students develop Assembly language programming skills on 8085, 8086 and 8051 kits. Students do their experiments in both hardware and software platforms. They use TALK software and design some Interfacing circuits on bread board like seven segment display to glow decimal digits 0-9 and four-way traffic control circuits and design of LEDs to glow in proper sequence. They also Interface with CRO to display square wave and interface with Digital to Analog Converter to display Triangular and Saw tooth wave forms.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: develop Assembly language programming skills on 8085, 8086 Microprocessor and 8051 Microcontroller trainer kit
- CO2: utilize PCLink communication software for Intel 8085 & 8086 Assembly language programming to execute programs and design practical circuits
- CO3: design practical circuits like 4 way traffic light system, generation of square wave using CRO, interfacing of seven segment display using PPI
- CO4: utilize 86DRV communication software for Intel 8086 Assembly language programming to execute programs and design practical circuits
- CO5: utilize B30DRVVM communication software for 8051 Microcontroller & Assembly language programming to execute programs and design practical circuits
- CO6: formulate, design and solve real life engineering problems for executing projects

Topics:

- Familiarization with 8085 and 8086 Microprocessor Kit and verification of instruction sets
- Execution of sample Assembly language programs on 8085 MP Kit
- Introduction to TALK communication software and execution of Assembly language programs using Cross Assembler
- Design a circuit and write a suitable program to display decimal digits 0 to 9 using 8085 and seven segment display
- Design a four lane Traffic control system using PC, 8085 MP Kit and additional hardware
- Familiarization with 8051 Microcontroller Kit and execution of basic programs using TALK communication software & Cross Assembler
- Generation of a 2 KHz square wave on Port 1.3 (Pin-4) with Timer 0 interrupt, using TALK software and 8051 MC Kit
- Open Ended Experiments

EC 2091 Electronic Circuits & Network Laboratory

Credit: 1.5

Category: PCLC

Prerequisite(s): Basic Electrical Engineering (EE 1003), Basic Electrical Engineering Lab (EE 1093)

Course Description:

This laboratory course is basically designed to impart essential practical knowledge of electronic devices and its associated circuits for 3rd semester undergraduate Electronics Engineering students. Hardware and Simulation experiments here are designed specifically for augmented learning . This will help students to understand and design various electronic circuits such as rectifiers, amplifiers and oscillators using discrete components like BJT/FET which are essential building blocks for any electronic system. Major equipment include function generator, CRO, multi-meter, Variac, voltmeter, ammeter, breadboard trainer kit and software's like Tina-TI, Lab VIEW and NI My DAQ v. 2016.A well-organized systematic procedure is included in each experiment to facilitate the hardware testing and simulation. This course imbibes the students with necessary practical knowledge which will help them in making their minor and major undergraduate projects.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: identify different discrete components, understand the function of Cathode Ray Oscilloscope ,Function Generator & multi-meter and use these equipment for circuit related learning
- CO2: explain and verify basic linear network theorems
- CO3: plot and demonstrate the V-I characteristics of a P-N junction diode and the Zener diode
- CO4: explain and analyze the input and output characteristics of BJT and JFET
- CO5: design and simulate amplifier, oscillator circuits using BJT and JFET
- CO6: formulate, design and implement different types of low frequency amplifiers and oscillator circuits using BJT/JFET to solve the real life engineering problems by executing mini projects

Topics:

- Basic linear network theorems
- P-N junction diode and Zener diode
- Transistors (BJT and JFET)
- CE amplifier and RC-coupled amplifier
- CS amplifier and CD amplifier
- LC and RC oscillators
- Open ended experiments

EC 2093 Digital Electronics Laboratory

Credit: 1
Category: PCLC
Prerequisite(s): Nil

Course Description:

This lab is utilized by 3rd semester Electronics and Telecommunication Engineering, Electronics & Computer Science Engineering, Computer Science and System Engineering, Computer Science and Communication Engineering students. In this laboratory Analog to Digital converters, Digital to Analog converters, Lab designer Kits, Cathode Ray Oscilloscopes, Function generators and NI-MyRIO Kits are available . The DEC Lab is containing some Verilog simulation experiments along with the hardware implementation of simple digital circuits. Students do their experiments and open ended experiments in both hardware and software platforms. They use discrete components and Xilinx, PSpice, LabVIEW software to design and simulate the combinational and sequential logic circuits. This lab is also used by B. Tech and M. Tech students for executing projects.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: comprehend the significance of terminology associated with Verilog HDL and the procedure to Simulate and Verify combinational logic circuits in EDA Playground and TinkerCAD
- CO2: simulate and design combinational logic circuits like adder using Logic Gates in association with EDA Playground and TinkerCAD
- CO3: simulate and design combinational logic circuits like decoder using Logic Gates in association with EDA Playground and TinkerCAD.
- CO4: simulate and design combinational logic circuits like Multiplexer using Logic Gates in association with EDA Playground and TinkerCAD
- CO5: simulate and design sequential logic circuits of different Flip-Flops and Flip-Flop conversion in association with EDA Playground and TinkerCAD
- CO6: simulate and design sequential logic circuits like Synchronous type counter , Asynchronous type counters and shift registers using flip-flops in association with EDA Playground and TinkerCAD

Topics:

- Logic Gates
- 2-Line-to-4 line Decoder
- 2X1 Multiplexer
- J-K Flip-Flop and D Flip-flop
- 2-bit Synchronous Up Counter
- 2-bit Asynchronous Up Counter
- Serial In-Parallel Out(SIPO) Shift Register
- Open ended experiments

EC 2094 Communication Engineering Laboratory

Credit: 1.5
Category: PCLC
Prerequisite(s): Nil

Course Description:

This lab is utilized by 5th semester Electronics and Telecommunication Engineering students. In this laboratory students are performing experiments based on hardware, software as well as using Trainer Kit. In hardware some design problems are performed by the students using discrete components on breadboard. MATLAB is used for software simulation where the students after conducting the experiment on trainer kit verifying the same using the said software. In this laboratory adequate no of trainer kits, spectrum analyzer and DSO are available for both analog communications and digital communication based Experiments. Moreover this laboratory is also utilized for M. TECH and Ph. D scholars for their research work.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: understand the principle of different types of Amplitude Modulation(AM) and demodulation.
Also gain knowledge on the principle of Superheterodyne receivers
- CO2: generate Frequency Modulated (FM) signals using IC XR2206 with its principle of operation and apply the FM signal to PLL IC 565 circuit for demodulation process
- CO3: analyze the process of sampling and quantization with different Pulse modulation techniques and Waveform Coding techniques. Also acquire some knowledge on multiplexing scheme
- CO4: explain the operating principles of different digital modulation techniques with respective waveforms representations using Trainer Kit and software platform
- CO5: design and implement the Modulator and Demodulator circuits using discrete components
- CO6: simulate the modulated signals using Matlab programs. Formulate design and real life engineering problems for executing minor projects

Topics:

- Generation and detection of various amplitude Modulation and demodulation schemes
- Generation and detection of frequency modulation and demodulation
- Generation and detection of Pulse Modulation and demodulation
- Time division multiplexing, modulation and demodulation of PCM system
- Delta modulation technique
- Data formating, different Digital Modulation and Demodulation Techniques such as BASK, BPSK, BFSK, QPSK
- Open ended experiments

EC 2096 Digital and Linear Integrated Circuit Laboratory

Credit: 1

Category: PCLC

Prerequisite(s): Analog Electronics (EC 2027), Electronic Circuits & Network Laboratory (EC 2091)

Course Description:

This laboratory includes analog to digital converters, digital to analog converters, lab designer kits, Cathode Ray Oscilloscopes, Function generators and NI-MyRIO Kits for different experiments. Verilog, Xilinx, LabVIEW, TinkerCAD and PSpice simulation experiments along with the hardware implementation of simple digital and analog circuits are performed in this laboratory.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: comprehend the significance of terminology associated with Verilog HDL and the procedure to Simulate and Verify combinational logic circuits in EDA Playground and TinkerCAD
- CO2: analyze and simulate combinational logic circuits like adder. using Logic Gates in association with EDA Playground and TinkerCAD
- CO3: analyze and simulate combinational logic circuits like decoder using Logic Gates in association with EDA Playground and TinkerCAD
- CO4: analyze and simulate sequential logic circuits like synchronous type counters and shift registers using flip-flops in association with EDA Playground and TinkerCAD
- CO5: design and simulate the analog circuits like R-C differentiator circuit in association with TinkerCAD
- CO6: design and simulate the analog circuits like practical Integrator and Comparator using operational amplifier IC LM 741 in association with TinkerCAD

Topics:

- Logic Gates
- Half Adder
- 2 Line- to- 4-Line Decoder
- 2 bit Synchronous Up Counter
- Serial In-Parallel Out(SIPO) Shift Register
- R-C Differentiator circuit
- Integrator circuit using Operational Amplifier IC LM 741
- Comparator circuit using Operational Amplifier IC LM 741
- Open ended experiments

EC 3007 Digital Signal Processing

Credit: 4

Category: PCC

Prerequisite(s): Principle of Signals and Systems (EC2023), Signals and Networks (EC2021)

Course Description:

This course begins with the mathematical concepts behind digital processing. It includes implementation of signal processing techniques used in hardware and software systems. The course covers Discrete time signals and systems, Z transform, DFT, FFT and properties. The concepts of digital filter design, realization of systems, multi-rate signal processing and introduction to adaptive filters with their applications will be discussed.

Course Outcomes: At the end of the course, the students will be able to:

CO1: determine and understand appropriate transformation technique for signal analysis

CO2: analyze the signal and its properties in its frequency domain

CO3: apply Fourier transform techniques in real time applications

CO4: apply the knowledge of analog filters to digital filters, design and realization of digital filter

CO5: design and implement multi-rate systems and filter banks

CO6: explain and apply the adaptive filtering concepts for system identification, channel equalization, noise cancellation and line enhancer

Topics:

- Fundamental of Signals and System & Z-Transform
- Fourier Transforms:
- DFT, IDFT and FFT
- Digital filters
- Multi-rate DSP
- Adaptive filters

Textbook(s):

1. Digital Signal Processing – J. G. Proakis & D. G. Manolakes, 4th edition – PHI
2. Digital Signal Processing – T. K. Rawat, Oxford University Press, 1st edition

Reference Book(s):

1. Digital Signal Processing – Oppenheim & Schafer, PHI, 1st edition.
2. Digital Signal Processing – P. Ramesh Babu, Scitech Publication, 4th edition.

EC 3011 VLSI Design

Credit: 3
Category: PCC

Prerequisite(s): Digital Electronics Circuits (EC 2011)

Course Description:

The VLSI design course introduces students to basic theories and techniques of digital VLSI design in CMOS technology, fabrication and layout techniques pertaining to digital integrated circuits domain. The course enables students to analyze and design different VLSI architectures using the fundamental concepts of digital VLSI systems. The domain specific skill sets include deep understanding of CMOS devices and circuits, CMOS design rules, static and dynamic logic structures, interconnect analysis and low power techniques in ultra-deep sub-micron regime.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: understand and explain VLSI design flow, design strategy, role of different methods for chip design and basic fabrication process flow
- CO2: analyze different components of threshold voltage, drain current and scaling strategy
- CO3: evaluate different performance metrics of MOS inverter architecture
- CO4: illustrate the logic design process used for complex combinational circuit and its layout using static CMOS
- CO5: analyze different switch based logic involving pass transistor, complementary pass transistor and transmission gate
- CO6: create different high performance dynamic CMOS logic

Topics:

- VLSI Methodologies
- Unit process in VLSI IC fabrication
- MOSFET Analysis
- CMOS Inverter and its analysis
- Transient characteristics
- CMOS logic design
- CMOS switch-based logic
- Dynamic Logic Circuit

Textbook(s):

1. CMOS digital integrated circuits by Sung –Mo KANG Y. Lebeleci, 4th edition, Mc-Graw Hill publications

Reference Book(s):

1. CMOS Circuit Design, Layout, Simulation R. Jacob baker, Harry W. Li, David E Boyce,4th edition, Wiley publications.

EC 3013 Principles of Digital Signal Processing

Credit: 3
Category: PEC
Prerequisite(s): Mathematics-II (MA 1004)

Course Description:

This course begins with the mathematical concepts behind digital processing. It includes implementation of signal processing techniques used in hardware and software systems. The course covers Discrete time signals and systems, Z transform, DFT, FFT and properties. Techniques to design FIR and IIR filters are discussed.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: comprehend the significance of terminology associated with various components of a digital system
- CO2: analyze the different types of digital systems and linear convolution
- CO3: analyze and apply the discrete Fourier transform (DFT)
- CO4: solve Z-transform and apply it for discrete signals
- CO5: analyze and apply the sectional convolutional methods
- CO6: design digital filters using different techniques

Topics:

- Difference between analog and digital signals
- Types of digital systems
- Linear time invariant system
- Linear convolution
- Discrete Fourier transform (DFT) and its calculation
- Properties of DFT
- Circulation convolution and its significance
- Sectional convolution using overlap-add and overlap save methods
- Fast Fourier transform (FFT) algorithm for fast computation of DFT
- z-transform of digital signals and its applications
- Design of digital filters

Textbook(s):

1. Digital Signal Processing by T. K. Rawat, Oxford Publication 1 st Edition
2. Principle of Signal Processing and Linear System: B.P.Lathi, First Edition, Oxford University Press

Reference Book(s):

1. Digital Signal Processing – J.G.Proakis and D.G.Manolakis , 4th Edition-PHI
2. Signals & Systems: Alan V. Oppenheim & Schafer-2nd Edition 2011 Pearson
3. Digital Signal Processing: P. Ramesh Babu: Scitech,2nd Edition

EC 3015 Microwave Engineering

Credit: 3

Category: PCC

Prerequisite(s): Electromagnetic Waves and Antennas (EC 2022)

Course Description:

The course is intended to describe the principles of operations and design aspects of microwave sources, devices and components. Course includes the propagation characteristics and design parameters of rectangular waveguide, circular waveguide and cavity resonator. Microwave amplifiers and sources like, Klystron amplifier, travelling wave tubes, Reflex Klystron, Magnetron oscillator, backward wave oscillator are part of this course. The operations of microwave solid state devices, like, Gunn diode, Gunn oscillator, PIN diode, READ diode, IMPATT diode and microwave components are described in the course. Different types of microwave measurement techniques are included in the course.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: explain propagation characteristics and design parameters of rectangular waveguide, circular waveguide and cavity resonator
- CO2: comprehend the limitations of conventional vacuum tubes at microwave frequencies
- CO3: analyze the design aspects of Klystron amplifier and Reflex Klystron oscillators, and slow wave structures
- CO4: explain and Analyze the operations of microwave solid state devices, like, Gunn diode, Gunn oscillator, PIN diode, READ diode, IMPATT diode
- CO5: explain the principles of operation and design aspects of various types of microwave components
- CO6: perform power measurements, frequency and impedance measurements, gain and radiation pattern measurement of antennas

Topics:

- Waveguide and Cavity Resonator
- Microwave Vacuum Type Amplifiers and Sources
- Microwave Solid State Devices & Sources
- Microwave Components
- Microwave Measurements

Textbook(s):

1. Microwave Devices & Circuits. S. Y. Liao, PEA Publication, 2009

Reference book(s):

1. Electromagnetic Waves and Radiating Systems by E. C. Jordan and K. G. Balmain, Prentice Hall of India, New Delhi.
2. Microwaves: Introduction to Circuits, Devices & Antennas. M. L. Sisodia and V. L. Gupta, New Age Publication, 2012.

EC 3021 Neural Networks and Machine Learning

Credit: 3

Category: PEC

Prerequisite(s): Mathematics-I (MA 1003) and Mathematics-II (MA 1004)

Course Description:

This course will cover the history of neural networks, study the fundamental structures and state-of-the-art approaches to machine learning. The course will focus on theory and practice of these models, how they are trained and validated, and how they can be deployed in practice. Students will learn to design neural network architectures and training procedures via hands-on assignments. Students will learn how to use neural networks and machine learning algorithms for identifying, classifying and solving different problems related to pattern recognition, function approximation, data visualization etc.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: understand the context of neural networks and develop broad overview of learning strategies
- CO2: explain the fundamental neural network models, their learning strategies and apply them for modeling problems
- CO3: analyze multi-layer feed forward neural networks, recurrent neural networks, radial basis functions and employ them for different applications
- CO4: comprehend the concepts, architecture, training and testing algorithms of associative memory networks and Hopfield networks and apply them to evaluate practical problems
- CO5: develop a comprehensive idea on unsupervised learning networks and advanced neural networks
- CO6: explain the motivation for architectures and models and select the appropriate architecture for a given problem

Topics:

- Artificial neural network architecture
- Applications of neural networks
- Associative memory networks
- Unsupervised learning networks and advanced networks

Textbook(s):

1. Principles of Soft Computing by S. N. Sivanandam and S. N. Deepa - Wiley

Reference Book(s):

1. Neuro-fuzzy and soft computing by J. S. R. Jang, C. T. Sun and E. Mizutani - PHI Publications
2. Neural networks and learning machines by Simon Haykin - Parson, Prentice Hall

EC 3028 Data Communication & Networking

Credit: 3
Category: PCC

Prerequisite(s): Analog Communication Techniques (EC 2012), Digital Communication Technique (EC 3005), Communication Engineering (EC 2016), Introduction to communication Engineering (EC 3044)

Course Description:

Data Communication & Networking course deals with down-to-top approach to TCP/IP protocol stack, OSI layered architecture for packet switched data networks and the TCP/IP stack implements by focusing in details from Physical, Data-Link, Network, Transport, and Quality of Service (QoS) parameters. This course covers different key concepts of networking like physical media dependant layer, MAC, Flow Control, Error Control, IP addressing, Sub-netting, IPv4/ IPv6, Routing, DHCP, ARP, ICMP, NAT, TCP/UDP and QoS.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: analyze, compare and contrast OSI layered Architecture and TCP/IP protocol stack
- CO2: analyze different techniques and algorithms implemented in Logical Link Control (LLC) Media Access Control (MAC) sub-layers associated with data-link layer
- CO3: explain design scenario-specific datagram networks based on IPv4 and IPv6
- CO4: investigate various protocols associated with TCP/IP stack
- CO5: investigate connection-oriented (TCP) and connection-less (UDP) protocols in transport layers to comprehend design features and functionalities
- CO6: analyze data communication networks to differentiate various Quality of Service (QoS) approach

Topics:

- Packet switched network
- OSI Layered Architecture, TCP/IP protocol stack implementation
- Services of Physical Layer, Data-Link Layer
- Error detection and correction techniques, Framing, High level Data-Link Control (HDLC)
- Multiple Access Control (MAC) protocols, Link-Layer Addressing, ARP
- Ethernet IEEE 802.3 Standards Frame format, GIGABIT Ethernet, wireless LAN IEEE 802.11 Architecture, Network Layer
- IPv4 & IPv6 protocol, IPv4 Addressing, Sub-netting, Super-netting, IPv6 Addressing
- Routing Algorithms and protocols, DHCP, ICMP, NAT
- Transport Layer Services, TCP, UDP, QoS

Textbook(s):

1. Data Communications and Networking, B A Forouzan, McGraw-Hill, 4th Edition, 2011.
2. Computer Networking – A top-down approach featuring the Internet, James F. Kurose and Keith W. Ross, 2nd Edition, Pearson Education, Asia, 2004.

Reference Book(s):

1. Internetworking with TCP-IP: Principles, Protocols and Architecture, D. E. Comer, Vol I, 2nd Edition, Prentice Hall, 1991.
2. Data and Computer Communications, William Stalling, 10th edition, Prentice Hall, 2013.
3. Communication Networking – An analytical Approach, Anurag Kumar, D Manjunath and JoyKuri, Morgan Kaufmann, 2004

EC 3029 Optical Communication and Networking

Credit: 3
Category: PEC

Prerequisite(s): Communication Engineering (EC 2016), Introduction to communication Engineering (EC 3044), Analog Communication Technique (EC 2012), Digital communication techniques (EC 3005)

Course Description:

The course intend to introduce the students to light signal propagation through optical fiber, various optical fiber modes, configurations and various signal degradation factors associated with optical fiber and to study about various optical sources and optical detectors and their use in the optical communication system. This course provides a basic understanding of various measurement techniques used for optical communication system. The optical networking system is also explained with the concept of fiber optic network components, variety of networking aspects, topologies, FDDI, SONET/SDH and operational principles WDM.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: comprehend the significance of terminology associated with optical communication, analyze the principle of light propagation through optical fiber with concept of modes and solve problems on this concept
- CO2: analyze various types of losses and dispersions in optical fiber and solve related problems associated with the concept
- CO3: explain and analyze the structure, principle of operation and the characteristics of optical sources and detectors
- CO4: comprehend and analyze the optical communication system link elements and prepare link budget
- CO5: comprehend various measurement techniques for optical communication system
- CO6: comprehend and analyze the fiber optical network components, variety of networking aspects, FDDI, SONET/SDH and operational principles WDM

Topics:

- Transmission characteristics of optical fibers
- Optical sources and detectors
- Optical Communication System and Measurements
- Optical measurements
- Optical networks

Textbook(s):

1. Fiber Optic Communications, Joseph C. Palais, Pearson Education,5th Edition 2013
2. Optical Fiber Communication, Gerd Keiser, McGraw Hill, Third Edition, 2000.

Reference Book(s):

1. Optical Fiber Communication, John M. Senior, Pearson Education, Second Edition, 2007.
2. Optical Communication System, J. Gower, Prentice Hall of India, 2001.
3. Optical Networks, Rajiv Rama swami, Elsevier ,Second Edition, , 2004.
4. Optical Communication Network, Viswanath Mukherjee, McGraw Hill Publication,2000.

EC 3031 ARM and Advanced Processors

Credit: 3

Category: PEC

Prerequisite(s): Microprocessors, Microcontrollers & Interfacing (EC 2020)

Course Description:

The objective of this course is to teach the higher level concepts of Advanced Microprocessors (like 80286, 80386, 80486 and Pentium) and Microcontroller (like ARM) to the students. In this course, the students learn about Multitasking, Virtual memory, Memory management, Paging, TLB, RISC features, Pipelining and Branch Prediction like concepts. They develop skills for writing programs on ARM to solve simple problems as well as some real time applications.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: analyze the concepts implemented in higher level Processors like Multitasking, Virtual Memory, Memory Management etc.
- CO2: analyze the mode of Operation of 80286 like Real Address Mode and Protected Virtual Address Mode, Concept of program in visible registers, Segment Descriptors etc.
- CO3: explain the Mode of Operation of 80386, Segment Descriptors, Privilege level and Protection, Virtual'86 Mode, Paging
- CO4: analyze the RISC features implemented in the design of Pentium Processors, Parallel processing through U&V Pipelines/Superscalar Execution and Branch Prediction Techniques
- CO5: analyze the concept of a 32-bit ARM Processor, its RISC features, Registers, Pipelining and Interrupts
- CO6: analyze the 32-bit ARM instruction set vis-a-vis 16-bit Thumb instructions and its applications

Topics:

- Intel higher level Processors, Concept of Multitasking, Virtual memory & Memory management
- Intel 80286 Microprocessor, Real mode, Protected virtual Address mode, Program Invisible Registers, Segment descriptor, Limitation of 80286
- Intel 80386 & 80486 , 80386 Segment descriptor, Privilege level & protection, Task switching, Virtual 86 mode, Paging, TLB, Enhanced features of 80486
- Pentium Processor: Features of RISC processors & Implementation of RISC features in Pentium, Pipelining, Super scalar execution & Branch prediction
- ARM Microcontroller: Introduction to RISC design philosophy and ARM design, Arm Processor Registers, CPSR, Memory map, Pipelines, Exceptions, Interrupt Vector Table
- ARM Instruction set and Thumb instructions

Textbook(s) :

1. The 8088 and 8086 Microprocessors : Programming, Interfacing, Software, Hardware and Applications by Triebel and Singh-Pearson Education, 4th Edition.

Reference Book(s):

1. Microprocessors & Interfacing, Programming&Hardware by D.V.Hall-TMH-3rd Edition, 2012.
2. The Intel Microprocessors 8086/8088, 80186/80188, 80386, 80486, Pentium and Processor by B.B.Brey-PHI-8th Edition.
3. Microprocessors&Microcomputer based System Design by Md.Rafiquzzaman-UBS-2nd Edition.
4. An Introduction to the Intel Family of Microprocessors by James L. Antonakos-Pearson Education-3rd Edition.

5. ARM Assembly Language Programming &Architecture- M A Mazidi &others - www.MicroDigitalEd.Com.
6. ARM System Developers Guide Design &Optimizing System Software – Andrew N. Sloss &others-Elsevier

EC 3033 Embedded System Design and Application

Credit: 3

Category: PEC

Prerequisite(s): Microprocessor, Microcontrollers and Interfacing (EC2020)

Course Description:

This course covers fundamentals of embedded system hardware and firmware design. Topics such as embedded processor selection, hardware/firmware partitioning, circuit design, circuit layout, circuit debugging, development tools, firmware architecture, firmware design, and firmware debugging will be discussed. The Intel 8051 and PIC18F series microcontroller with instructions will be studied. The course briefly covers ARM processor architecture, instruction set and programming. The course will culminate with a significant design examples using ARM processor.

Course Outcomes: At the end of the course, the students will be able to:

CO1: understand the architecture, programming, and interface requirements of Embedded System Design

CO2: learn to apply assemblers, compilers, simulators and emulators to help with design and verification for ARM processors

CO3: create Interface of Microcontroller to displays, memories, different I/O ports

CO4: analyse and apply ALP / Embedded C code to solve real-time problems like timers, counters, A2D, Motors, etc. using ARM

CO5: understand and explain RTOS and its functionality, different scheduling for real time application

CO6: design closed and open embedded systems with firmware

Topics:

- Embedded system description and design aspects
- Processor and memory selection for embedded system
- Interrupt service and its uses in the embedded system design
- Embedded system design flow
- Embedded system programming concepts
- Brief introduction to 8051 and PIC18F series architecture and its instruction sets
- ARM architecture and its assembly language programming
- Designing hardware interface with ARM using embedded C programming
- Real Time Operating system and its scheduling

Textbook(s):

1. Embedded Systems: Architecture, Programming & Design, Raj Kamal, TMH, 2011
2. ARM Assembly Language: Fundamentals and Techniques by William Hohl, Christopher Hinds, CRC Press, 2nd Edition, 2015.

Reference Book(s):

1. Embedded System Design : A unified Hardware/Software Introduction by Rank Vahid, Wiley Student Edition, Wiley, 2002
2. Arm Assembly Language Programming & Architecture: Volume 1 by Muhammad Ali Mazidi, Sarmad Naimi, SepehrNaimi, Microdigitaled.com, 2nd Edition, 2016

EC 3035 High Speed Digital System Design

Credit: 3

Category: PEC

Prerequisite(s): Digital Electronics (EC 2011)

Course Description:

This course describes the ASIC design flow and FPGA design flow. It also introduces different design methodology such as top-down and bottom-up methodologies. Here, students will learn different coding styles that can be used in Verilog HDL to design and synthesize digital circuits. Also, it is necessary to verify the correctness of the design by applying different input patterns. Therefore, students will also learn testbench writing strategies to verify the correctness of the design. Several examples that include important arithmetic units of digital systems are covered in this course which demonstrate how to design and test the digital circuits using Verilog HDL. In addition, the course discusses the mapping of Verilog HDL to logic gates. It depicts with examples how Verilog HDL constructs are transformed into logic gates and their interconnections. Finally, a brief introduction on how logic-level circuits are converted into transistor-level circuits is illustrated in this course.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: comprehend and analyze the ASIC-based and FPGA-based design flow and VLSI design methodology
- CO2: design digital systems using Hardware Description Language (HDL)
- CO3: develop test cases to simulate and verify the correctness of the design
- CO4: convert Hardware Description Language to a gate-level netlist
- CO5: implement optimized digital circuits using different HDL-based mechanisms
- CO6: design circuits by using knowledge of translating logic circuits to transistor-level circuits

Topics:

- Digital design methodology
- Coding styles of Verilog HDL
- Synthesis of logic circuits
- Mapping of logic circuits to transistor-level circuits
- Case studies for Verilog HDL

Textbook(s):

1. Verilog HDL: A Guide to Digital Design and Synthesis; Samir Palnitkar; 2nd edition, Pearson Education, 2011.

Reference Books (s) :

1. A System Verilog Primer by J. Bhaskar, BS Publication 2013.
2. Advanced Digital Design with the Verilog HDL; Michael D. Ciletti; 2009,1st edition, PHI,2010.
3. Design Through Verilog HDL by T. R. Padmanabhan (Author), B. Bala Tripura Sundari, Wiley Student Edition, Wiley, 2012.

EC 3044 Introduction to Communication Engineering

Credit: 3
Category: OEC
Prerequisite(s): Nil

Course Description:

The course covers different types of signals and their analysis in time domain and frequency domain, different analog modulation techniques such as Amplitude Modulation (AM), Frequency Modulation (FM) and Phase Modulation (PM). Sampling technique and its application in Pulse Code Modulation (PCM) is discussed. The course further discusses different digital modulation techniques such as Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK) and Phase Shift Keying (PSK), Binary PSK and Quadrature PSK. Data transmission techniques such as frequency division multiplexing, time-division multiplexing and multiple access techniques are covered. Finally fundamentals of several modern communication system viz. satellite communication system, cellular system are explained.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: analyze signals in time domain and frequency domain
- CO2: interpret analog modulation techniques, investigate their limitations, advantages and applications
- CO3: explain sampling theorem and investigate pulse code modulation
- CO4: comprehend digital modulation techniques and multiplexing techniques
- CO5: interpret different types of noise, their sources and investigate their effect on communication systems
- CO6: analyze several modern communication systems

Topics:

- Representation of signals in time and frequency domains
- Understanding of Fourier series and Fourier Transform, Need of modulation and their types
- Amplitude modulation techniques such as AM, DSB-SC, SSB-SC, VSB
- AM modulators and demodulators, Super-heterodyne radio receiver
- Qualitative concepts of different angle modulation techniques such as FM (Narrowband FM and Wideband FM) and PM
- FM modulators and demodulators
- Sampling theorem and Nyquist rate, sampling types, quantization, Pulse code modulation
- Concept of digital modulation (ASK, FSK, PSK, QPSK) probability of error
- Frequency division multiplexing and Time division multiplexing
- Random processes, concept of noise, different types of noises and their sources
- Representation of white noise in frequency domain, concept of signal to noise ratio
- Introduction to satellite communication, wireless and mobile communication

Textbook(s):

1. Principles of Communication System- H. Taub and D.L. Schilling-TMH, 3rd Edition.

Reference Book(s):

1. Introduction to Analog and Digital Communication System-Simon Haykins, Wiley Student Edition 2011-John Wiley.
2. Electronics Communication System by Kennedy and Davis, Tata McGraw-Hill Publishing Company Limited, 4th Edition.

EC 3050 Internet of Things & Applications

Credit: 3

Category: PEC

Prerequisite(s): Microprocessors, Microcontrollers & Interfacing (EC 2020), Principles of Microprocessors and Microcontrollers (EC 3066)

Course Description:

This course is designed to provide essence and applications of Internet of Things and connected devices. This course establishes solution for real-world applications including appropriate modules and instruments. It also describes the IoT industry, the technologies used to create these types of devices, working principles, information storage and the types of distributed networks required to sustain them.

Course Outcomes: At the end of the course, the students will be able to:

CO1: explain different characteristics of IoT and demonstrate the need of appropriate sensors, microprocessor and microcontroller units and communication networks to develop IoT systems

CO2: identify application specific need of suitable sensors and actuators by analyzing the working of various sensors

CO3: design and evaluate application specific IoT prototypes based on Arduino platform by means of hardware interfaces like Digital IO, Analog In, PWM, UART, SPI, I2C and applications using Arduino IDE

CO4: design and evaluate application specific IoT prototypes based on Raspberry Pi Family development boards and develop small scale applications using python in Linux environment

CO5: apply suitable TCP/IP protocols and networking standards for development of IoT projects

CO6: design IoT application based on Client Server Model, HTTP, ThingSpeak, AWS, Cloud MQTT and evaluate the design specifications and requirements from case studies in the context of various IoT applications

Topics:

- Introduction & Overview of IoT.
- Sensors, Actuators & Signal Conditioning.
- Embedded Platforms & Prototyping (Arduino family and relevant topics)
- Advanced Embedded Development Platforms (PI family and relevant topics)
- Data Communication & Networking
- Cloud, Analytics, User interfaces
- IoT Applications and relevant case studies

Textbook(s):

1. "Internet of Things" by Jeeva Jose, 1st Edition-2018, Khanna Publications
2. "Internet of Things: A Hands-On Approach" by Arshdeep Bahga, Vijay Madisetti

Reference Book(s):

1. "Designing the Internet of Things" by Adrian McEwen, Hakim Cassimally, 1st Edition, Wiley Publishers
2. "Getting Started with the Internet of Things" by Cuno Pfister 1st Edition, O'Reilly Media.
3. "IoT: Building Arduino-Based Projects" by Peter Waher, Pradeeka Seneviratne, Brian Russell, Drew Van Duren, 2016 Edition, Packt Publishing Ltd.
4. "Raspberry Pi IoT Projects: Prototyping Experiments for Makers" by John C. Shovic, 2016 Edition,

EC 3056 Speech & Audio Signal Processing

Credit: 3

Category: PEC

Prerequisite(s): Digital Signal Processing (EC 3007), Principle of Digital Signal Processing (EC 3013)

Course Description:

The aim of this subject is to cover fundamental application research areas such as audio and speech signal processing for separation, recognition, transcription, enhancement, coding, synthesis as well as applications to advanced fixed and wireless communication systems. This course begins with preliminaries to digital signal processing and different transformations. Then the course continues to Speech production, Time domain analysis, Frequency domain analysis, LPC analysis, Speech coding, Speech recognition, Speech enhancement. Signal Processing Models of Audio Perception, Psycho-acoustic analysis, Spatial Audio Perception and rendering, Transform coding of digital audio, audio quality analysis are covered. Applications like speaker verification, identification and enhancement of speech quality are discussed.

Course Outcomes: At the end of the course, the students will be able to:

CO1: determine the digital model of speech production

CO2: analyze the spectral characteristics of the speech signal

CO3: distinguish and analyze between different speech coding techniques

CO4: apply various types of algorithms for speech analysis and synthesis

CO5: design different models for speech recognition

CO6: develop to perform speaker verification, identification and enhance the quality of speech signal

Topics:

- Preliminaries of digital Signals processing and different transform techniques
- Digital modelling of speech signal
- Spectral analysis of speech signal
- Speech coding
- Speech transformation
- Speaker verification, identification and enhancement of speech signal

Textbook(s):

1. Lawrence R. Rabiner and Ronald W. Schafer, Theory and Applications of Digital Speech Processing Pearson, 2010.

Reference Book(s):

1. Thomas F. Quatieri , Discrete-time Speech Signal Processing: Principles and Practice, Prentice Hall, Signal Processing Series, 2002.
2. Philipos C. Loizou, Speech Enhancement – Theory and Practice, CRC Press, 2013.

EC 3058 Nanoelectronics

Credit: 3

Category: PEC

Prerequisite(s): Electronics Devices and Circuits (EC 2019), Analog Electronic Circuits (EC 1004)

Course Description:

Nanoelectronics has emerged as a new advanced discipline due to rapid growth in Integrated Circuit (IC) Industry. This course imparts knowledge and understanding of physical background and application of nanoelectronics. To describe electrons at the nanoscale, the course starts with an introduction to the principles of quantum mechanics, including quantization, the wave-particle duality, wave functions and Schrödinger's equation. The course will further discuss different properties of materials and nanostructures, fabrication of nanostructures, nanoelectronic devices including resonant-tunneling devices, transistors, and single-electron transfer devices. The course will also focus on MEMS and NEMS and its applications in Sensors.

Course Outcomes: At the end of the course, the students will be able to:

CO1: understand the basic and advanced concepts of nanoelectronics

CO2: understand and evaluate the use of fundamental science of quantum mechanics in nanoelectronics

CO3: get an idea on nanoelectronics materials and will be able to distinguish from other materials

CO4: analyze the different fabrication and characterization techniques of nanostructure materials

CO5: learn the concepts of few nano electronics devices

CO6: analyze and evaluate the idea of single electron transistors and its further applications

Topics:

- Introduction to Particles and waves
- Nanoelectronics Materials
- Tunnel junction and applications of tunnelling
- Growth, fabrication, and measurement techniques for nanostructures
- Nano structure devices: MEMS AND NEMS
- The Single-Electron Transistor

Textbook(s):

1. Stephen D. Senturia, Microsystem Design, Kluwer Academic Press, 2005
2. Marc Madou, Fundamentals of microfabrication & Nanofabrication, CRC Press, 2011.
3. T. Fukada & W.Mens, Micro Mechanical system Principle & Technology, Elsevier, 1998

Reference Book(s):

1. WR Fahrner, Nano Technology and Nano Electronics – Materials, devices and measurement Techniques, Springer, 2004.

EC 3060 Mobile Communication Engineering

Credit: 3
Category: PEC

Prerequisite(s): Communication Engineering (EC 2016), Introduction to communication Engg.(EC 3044)

Course Description:

The course covers the evolution of mobile communication from first generation to third generation digital communication. The concept of Frequency reuse, handoff, trunking and the interference between mobiles and base stations which are the core of mobile communication for providing service to the subscribers are explained in this course. This course also explains different type of propagation path loss, fading and modulation techniques used in mobile communication, Inter Symbol Interference (ISI) by multipath propagation within time dispersive channel and its mitigation technique by Equalizer. Implementation of different diversity techniques for the compensation of fading is elaborated here. This course also explains various type of multiple access techniques and impacts on capacity for a cellular architecture.

Course Outcomes: At the end of the course, students will be able to:

- CO1: define and explain basic Cellular Architecture, Different propagation models, various modulation schemes, multiple access schemes and GSM technology
- CO2: classify different generation of mobile communications and improvements, different types of Handoff Strategies, different types of System capacity Improvement Techniques , various fading in multipath propagation, Different modulation techniques, various diversity techniques and different type of multiplexing
- CO3: identify different parameters required to improve channel capacity, requirement of Handoff in mobile communication, reasons of Fading, development of transmitter and receiver using different modulation schemes and the requirement of multiplexing
- CO4: analyze improvements in different generation of mobile communications, the reason of considering cellular architecture, generation of ISI (Inter symbol Interference) due to multipath propagation, different modulations e.g. QPSK, Offset QPSK, $\pi/4$ QPSK, MSK, GMSK, QAM and spread spectrum modulation and its properties
- CO5: compare various technologies implemented among different generation of mobile communications
- CO6: solve problems related to different aspects of mobile communication

Topics:

- Mobile Communication Principle
- RF Propagation & Multi-path Model
- Modulation Techniques
- Equalization and Diversity Techniques
- Spread Spectrum modulation
- Multiple Access Techniques

Textbook(s):

1. Wireless Communication – T.S. Rappaport , Pearson Education, 2nd edition, 2012
2. Wireless Communication – Andrea Goldsmith, Cambridge Press, 1st edition, 2005

Reference Book(s):

1. Wireless and Cellular Communication – C. Y. Lee, McGraw Hill, 3rd edition, 2006
2. Mobile Communication – Schillar, Pearson Education, 2nd edition, 2010
3. Wireless Communication-Tse and Viswanath, Cambridge Press, 2010

EC 3064 Information Theory and Coding

Credit: 3

Category: PEC

Prerequisite(s): Digital Communication Techniques (EC 2005)

Course Description:

The course will help in forming a strong foundation for the broad areas of information theory, coding and cryptography. It emphasizes on the basic concepts, lays stress on the fundamental principles and motivates their application to practical problems. This course starts with the basics of information theory and source coding. The theory of linear block codes (including cyclic codes, BCH codes, RS codes), convolutional codes are explained. Basics of secure communications including cryptography and physical layer security are covered.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: explain the mathematical definitions of information, using conditional and unconditional probability theorem
- CO2: demonstrate and differentiate different sources of information and coding techniques
- CO3: explain and analyze channel coding schemes and Shannon's information theory
- CO4: distinguish between various error decoding schemes
- CO5: design and simplify different codes such as cyclic codes, CRC codes (cyclic Redundancy Codes) and BCH codes
- CO6: generate Convolution codes

Topics:

- Source Coding
- Channel Capacity & Coding
- Speech Coding
- Error control coding
- Cyclic codes
- BCH Codes and convolutional Codes

Textbook(s):

1. Information Theory, Coding and Cryptography- Ranjan Bose, Tata Mcgraw Hill, 2nd edition, 2011
2. Principle of Digital Communication- J. Das, P. K. Chatterjee & S. K. Mullick, New age Internationals, 2008

Reference Book(s):

1. Elements of Information Theory- T. M. Cover & J. A. Thomas, Wiley-Interscience-2nd edition 2010.
2. Digital Communication- J. G. Proakis, McGraw Hill Education, 4th edition

EC 3066 Principle of Microprocessors and Microcontrollers

Credit: 3

Category: PEC

Prerequisite(s): Digital Electronics (EC 2011)

Course Description:

This subject deals with Microprocessors 8085, 8086, 8255 PPI, 8259 PIC and 8251 USART and basics of 8051 Microcontroller. In this course, the students learn about assembly language programming on Microprocessors, Microcontrollers and develop programs for simple applications.

Course Outcomes: At the end of the course, the students will be able to :

- CO1: understand and explain the concept of Bus structure, a basic 8 bit Microprocessor system
- CO2: explain the architecture of a 16 bit Microprocessor like 8086 including the concept of instruction queue, segmented memory structure and address generation technique
- CO3: explain and analyze the Addressing modes, Assembly language instructions of 8086 and implement them to solve 8086 related design problems
- CO4: design Memory Interfacing using memory chips with proper decoder circuits with a 16-bit processor and analyze the interrupt structure of 8086 Microprocessor
- CO5: explain the peripherals such as PPI, Programmable interrupt control, USART and their interfacing with a 16 bit processor
- CO6: analyze memory organization of a 8 bit Microcontroller (like 8051), its addressing modes, instructions

Topics:

- Semiconductor Memory Chips, Tristate Concept & Bus Structure, A Basic Microprocessor based system
- 8 bit Processor, Bus Structure, 8085 Microprocessor Architecture, Concept of stack, Instructions & Addressing Modes
- 8086 (16 bit Microprocessor) Architecture, Pins & Signals, Minimum & Maximum Mode Configuration, Timing Diagrams; 8086 Addressing Modes and Instructions, Memory Interfacing, Interrupts
- Interfacing chips : 8255 (PPI), 8259 (PIC), 8251 (USART)
- 8051 Family of Microcontrollers, Overview of MCS-51 Family of Microcontrollers Memory Organization Pins & Signals, Addressing Modes, 8051 Instruction set, Interrupts

Textbook(s):

1. Microprocessors and Interfacing, Programming & Hardware - Douglas V. Hall, McGraw Hill Education Pvt Ltd., 3rd Edition

Reference Book(s):

1. Microprocessors & Microcomputer based System Design - Md. Rafiquzzaman, 2nd Edition
2. Advanced Microprocessor and Peripherals - Architecture, Programming and Interfacing by A. K. Ray and K. M. Bhurchandi - McGraw Hill Education Pvt Ltd - 3rd Edition.
3. 8051 Microcontroller - Hardware, Software & Applications - V Udayshankara & M. Mallikarjunswamy - TMH - 1st edition.

EC 3068 Real Time Systems and Application

Credit: 3
Category: PEC
Prerequisite(s): Nil

Course Description:

This course covers the principles of real-time systems, modeling of a real-time system, task assignment and scheduling, resource management, real-time operating systems, RTOS services. Programming language with real-time support, system design techniques, inter task communication, fault tolerant techniques, reliability evaluation methods, performance analysis, and case studies of real-time systems applications are also covered.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: differentiate between a real time system and other systems
- CO2: identify the different parts of hardware needed for real time system
- CO3: analyse and design to interface a microprocessor to displays, memories, different I/O ports
- CO4: analyse and use RTOS for Real Time System design
- CO5: design and Evaluate the function of a real time System
- CO6: apply the knowledge to different real time System for solving engineering and social problems

Topics:

- Basic overview of Operating System
- Real Time concepts and hardware considerations.
- Real Time Operating Systems
- Software requirements and Design process
- Application of Real time systems
- Case study

Textbook(s):

1. Real-Time Systems Design and Analysis by Phillip A. Laplante John Wiley & Sons, Inc.
Publication,3rd edition, 2011.

Reference Book(s):

1. Embedded and Real-Time Operating Systems by K.C. Wang, Springer, 2017
2. Real-Time Systems: Theory and Practice by Rajiv Mall, Pearson Publisher, 1st edition,2017

EC 3070 MANET and WSN

Credit: 3

Category: PEC

Prerequisite(s): Communication Engineering (EC 2016)

Course Description:

The objective of the course is to provide the basic knowledge of MANET and WSN, identify and analyze the goals, challenges, protocols and the issues involved in designing and implementing MANET and WSN for providing a good quality of service.

Course Outcomes: At the end of the course, the students will be able to:

CO1: comprehend the working and features of MANET

CO2: comprehend and explain the goals, challenges, protocols and issues involved in designing MANET and the quality of service required

CO3: comprehend the fundamentals of WSN

CO4: explain the working principles of physical layer of WSN

CO5: explain and analyze the different protocols, transport layer features and routing of WSN

CO6: identify the challenges in WSN and cross layer solutions

Topics:

- MANET
- MAC, routing and QoS in MANET
- Introduction to WSN
- Physical, MAC & Routing for WSN
- Challenges in WSN and cross layer solutions

Textbook(s):

1. C.Sivaraman Murthy and B.S.Manoj, “Ad Hoc Wireless Networks” , Person Education, Second Edition, India,2001
2. Ian F. Akyildiz and MehmetCan Varun, “Wireless Sensor Networks”, John Wiley and Sons Ltd, Publication 2010

Reference Book(s):

1. K Toh, “Adhoc mobile wireless networks, protocols and Systems”, 2nd Edition, Pearson Education,2009
2. Stefano Basangi, “ Mobile Adhoc Networking”, Wiley Inter science, IEEE Press, 2004
3. George Aggelou, “Mobile Adhoc Networks”, McGrawHill, 2004
4. Jun Zhny and Abbas Jama, “ Wireless Sensor Network - a networking perspective” 2009
5. C. Raghavendram, K.Sivalingam and T.Znati, “Wireless Sensor Network”,Springer,ISBN:1-4020-7883-8,August,2005

EC 3072 Introduction to Machine learning

Credit: 3
Category: PCC
Prerequisite(s): Nil

Course Description:

The course objective is to make students of Engineering to understand the basics of machine learning algorithms which are pervasive in engineering applications. Students will be able to understand the essence and applications of various clustering and classification techniques. Further, they will understand how it can be applied in real world problems. Then, the course covers the detailed analysis on artificial neural network along with few ensemble methods.

Course Outcomes: At the end of course, the students will be able to:

- CO1: develop appreciation for various concepts involved in learning models
- CO2: comprehend a wide variety of learning algorithms
- CO3: analyze and evaluate ML models
- CO4: apply ML algorithms to real-world problems
- CO5: optimize the models and report on the expected accuracy
- CO6: comprehend the concepts of bagging and boosting

Topics:

- Foundations for ML
- Clustering
- Classification
- Artificial Neural Networks
- Ensembles methods

Textbook(s) :

1. Shai Shalev-Shwartz and Shai Ben-David “Understanding Machine Learning” Cambridge University Press. 2017.
2. Christopher Bishop “Pattern Recognition and Machine Learning” Springer. 2006.

Reference Book (s):

1. Neural Networks, C.M. Bishop, Oxford Press, 1995.
2. Machine Learning for Audio, Image and Video Analysis, F. Camastra, Vinciarelli, Springer, 2007.

EC 3074 Internet Technologies for Cloud & Edge Computing

Credit: 3

Category: PEC

Prerequisite(s): Computer Programming (CS 1093)

Course Description:

The course objective is to introduce various aspects of internet, cloud computing and edge computing. Through this course student can learn about TCP/IP stack implementation for internet. The objective deals with analyses of could and edge applications and its requirement in the real world. Several tools for application specific cloud and edge computing models are discussed in this subject.

Course Outcomes: At the end of course the students will be able to:

CO1: comprehend the idea of TCP/IP stack implementation for application specific requirements of Internet

CO2: comprehend the cloud computing concepts and differentiate between different cloud based services

CO3: comprehend the design aspects of edge computing and analyze the application specific resource requirements

CO4: analyze various cloud & edge application design aspects and software technologies

CO5: evaluate the select tools for application specific cloud and edge computing models

CO6: design cloud and edge computing frameworks for scenario specific IoT applications

Topics:

- Cloud computing
- Edge Computing
- Feedback Concept
- Cloud & Edge application design aspects
- Application specific design aspects for IoT

Textbook(s):

1. Janakiram, “Grid and Cloud Computing”, TMH, 2016

2. Shailendra Singh, “Cloud Computing”, Oxford University Press, 2018

Reference Book(s):

1. Perry Lea, “IoT and Edge Computing for Architects: Implementing edge and IoT systems from sensors to clouds with communication systems, analytics, and security”, 2nd Edition. Packt.
2. R. Buyya, C. Vecchiola and S. T. Selvi, Mastering Cloud Computing Foundations and Applications Programming, Morgan Kaufmann, Elsevier, 2013.
3. R. Buyya, S.N Srirama “Fog & Edge computing Principles & Paradigms”: Wiley , 2019.
4. R. Buyya, High Performance Cluster Computing: Architectures and Systems, Volume 1, Pearson education, 2008.

EC 3076 IoT & Cyber-Physical System Design

Credit: 3

Category: PEC

Prerequisite(s): Internet of Things and its applications (EC 3050)

Course Description:

The course objective is to introduce the fundamentals of Internet of Things (IoT) and Cyber Physical System (CPS). This course covers identification and evaluation of different entities pertaining to IoT and CPS. This course enables student to model IoT and CPS in general. The course envisages discussing IoT and CPS components from the various perspectives including design, networking, communication protocols and standards. The course objective is to evaluate the highly complex infrastructure of CPS using several parameters such as security, privacy, integrity, reliability and resiliency. Different data analytics and platform have also been introduced in the course.

Course Outcomes: After completion of course, the students will be able to:

CO1: comprehend IoT and Cyber-Physical Systems components and design blocks

CO2: analyze IoT and Cyber-Physical Systems design issues and challenges

CO3: analyze Sensors, Actuators & Embedded System, Network & protocol design aspects and select appropriate components for designing IoT & Cyber-Physical Systems

CO4: evaluate the performance of various scenario specific requirements of IoT & Cyber-Physical Systems

CO5: evaluate and select appropriate computing & analytics platforms for IoT & Cyber-Physical Systems

CO6: design application specific IoT & Cyber-Physical Systems

Topics:

- IoT and CPS Design issues and challenges
- Sensors, Actuators & Embedded System design aspects
- Network & Protocol design aspects
- Computing platforms and Analytics
- Scenario specific applications of CPS

Textbook(s):

1. Complexity Challenges in Cyber Physical Systems, Saurabh Mittal, Andreas Tolk, Wiley.
2. Cyber-Physical Systems: A Computational Perspective, Gaddadevara Matt Siddesh, et. Al, CRC Press.
3. Scalable Computing and Communications: Theory and Practice, Samee U. Khan, et. al., Wiley-IEEE Press

Reference Book(s):

1. Principles of Cyber-Physical Systems, Rajeev Alur, the MIT Press.
2. Security and Privacy in Cyber-Physical Systems: Foundations, Principles, and Applications.
3. Data Analytics for IT Networks: Developing Innovative Use Cases, First Edition, John Garrett, CISCO press
4. Cyber-Physical Systems, Fei Hu, CRC Press

EC 3078 Signal Understanding Using Machine Learning

Credit: 3

Category: PCC

Prerequisite(s): Signals and Networks (EC 2021)

Course Description:

This course gives students a broad knowledge on, and techniques used in contemporary research on computer vision and pattern recognition. It provides an introduction to computer vision including fundamentals of image formation, feature detection and matching, motion estimation and tracking, and classification. Foundations of pattern recognition algorithms and machines learning methods for feature selection, and classification based on supervised and unsupervised learning methods.

Course Outcomes: At the end of course, the students will be able to :

CO1: comprehend signal processing basics

CO2: apprehend supervised and unsupervised learning mechanisms

CO3: design machine learning models by using various mathematical tools

CO4: use machine learning models for audio & music processing applications

CO5: use machine learning models for image processing applications

CO6: apply machine learning methods in signal processing and communication

Topics:

- Basic of Machine learning Techniques
- Artificial Neural Networks
- Applications of ML for Audio, Music and Image Processing
- Deep Learning Models and its application for image and signal processing

Textbook(s) :

1. Pattern Recognition and Machine Learning, C.M. Bishop, 2nd Edition, Springer, 2011.
2. Deep Learning, I. Goodfellow, Y, Bengio, A. Courville MIT Press, 2016.
3. Automatic Speech Recognition: A Deep Learning Approach, D. Yu and L. Deng Springer, 2016.

EC 3095 VLSI Laboratory

Credit: 1
Category: PCLC
Prerequisite(s): Digital Electronics (EC 2011)

Course Description:

The prime objective of this laboratory is to provide a compact idea about recent trends in digital system design, ASIC design and FPGA based hardware design and implementations. The hardware description language (HDL) such as Verilog is used in this lab for FPGA programming. This lab provides exposure to CAD tools used in analog system design.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: understand the basics of XILINX VIVADO tools and HDL for implementation of digital logic
- CO2: implement different combinational circuits using different modeling style
- CO3: implement sequential logic circuit such using Verilog HDL
- CO4: analyze and implement of memory using Verilog
- CO5: model finite state machines (FSM) using HDL and real time applications using HDL and FPGA
- CO6: model of CMOS logic circuits using SPICE

Topics:

- Introduction to XILINX VIVADO tools and Verilog HDL, design flow
- Gate level and data flow modelling
- Behavioral modelling of sequential logic circuits
- Modelling of Finite state machines
- Modelling of memory
- Real time application: Traffic light controller design
- Design and SPICE simulation of MOSFET, CMOS inverter, NAND and NOR gates

EC 3099 Digital signal processing laboratory

Credit: 1

Category: PCLC

Prerequisite(s): Digital signal processing (EC-3007)

Course Description:

This course is designed to teach implementation methods of various aspects related to digital signal processing on OCTAVE. It imparts the knowledge of discrete time LTI signals and systems and theoretical concepts are analyzed on software platforms. Design concepts on various kinds of filters based on the requirements and specifications are also covered. The implementation of basic concepts of multirate signal processing is also explained.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: apply the fundamentals of OCTAVE programming to simulate discrete time signals and systems and compute Circular convolution, linear convolution and correlation of discrete time signals
- CO2: find solution to the causal difference equations and compute step response and impulse response, compute transfer function, poles and zeros and determine stability of the system
- CO3: analyze the signal and its properties in its frequency domain using MATLAB Simulation environment. Use the Discrete time Fourier transform (DTFT) and Discrete Fourier Transform (DFT) in a variety of applications including: signal analysis, circular convolution and long data filtering
- CO4: design digital FIR low pass, high pass and band pass filters using OCTAVE after determining the required specifications for a given scenario
- CO5: design digital FIR low pass, high pass and band pass filters using OCTAVE after determining the required specifications for a given scenario
- CO6: design sampling rate converters, and analyze the effects of the change of sampling rate in the frequency spectrum of the signals

Topics:

- Analysis of an LTI system in time domain using OCTAVE
- Analysis of discrete time signals and system in frequency domain using DFT and DTFT in OCTAVE
- Design of FIR and IIR filters in OCTAVE
- Analysis of multirate signal processing using OCTAVE

EC 4059 Computer Vision & Pattern Recognition

Credit: 3

Category: PEC

Prerequisite(s): Digital Image Processing (EC 6108)

Course Description:

This course gives students a broad knowledge on, and techniques used in contemporary research on computer vision and pattern recognition. It provides an introduction to computer vision including fundamentals of image formation, feature detection and matching, motion estimation and tracking, and classification. Foundations of pattern recognition algorithms and machines learning methods for feature selection, and classification based on supervised and unsupervised learning methods. We focus less on the machine learning aspect of CV and image classification as that is really classify the theory best learned in an ML course.

Course Outcomes: At the end of course, the students will be able to:

CO1: understand basic concepts, terminology, and theories in the field of computer vision

CO2: become familiar with the major technical approaches involved in computer vision

CO3: identify various approaches of computer vision and pattern recognition, and design the components for it

CO4: understand a wide variety of learning algorithm for pattern recognition

CO5: apply machine learning techniques to solve problems of image classification

CO6: exposure to advanced concepts leading to object categorization and segmentation in images

Topics:

- Introduction
- Motion Estimation
- Computer Vision
- Pattern Recognition
- Image Processing
- Segmentation
- Machine Learning Techniques
- Applications: Surveillance, Object detection, classification etc.

Textbook(s):

1. Computer Vision: Algorithms and Applications by Richard Szeliski.
2. Pattern Recognition and Machine Learning, B. Christopher Bishop, Springer, 2008

Reference Book(s):

1. Computer Vision: A modern Approach, David Forsyth and Jean Ponce, Prentice Hall India, 2004
2. Pattern Classification, Richard O. Duda, Peter E. Hart, and David G. Stork, 2nd edition, Wiley Asia, 2002.

EC 4061 AI and Machine Learning for IoT

Credit: 3
Category: PEC

Prerequisite(s): Mathematics-I (MA 1003), Mathematics-II (MA 1004), Internet of Things and its applications (EC 3050)

Course Description:

The course objective is to explain the data sciences including different types of data acquisition methods using IoT and to their statistical analysis. The course describes the fundamentals of machine learning, artificial intelligence, artificial neural network and deep learning. Understanding the rising importance of IoT it intends to design various IoT based applications using artificial intelligence and machine learning.

Course Outcomes: After completion of course, the students would be able to:

- CO1: comprehend data acquisition using IoT and its analysis using mathematical and statistical tool using Machine learning approach
- CO2: analyze & apply different techniques and algorithms used in machine learning like regression, clustering, classification & decision trees
- CO3: analyze fundamentals of artificial neural network (ANN) techniques and apply it
- CO4: analyze fundamentals of AI & deep learning techniques and apply it
- CO5: analyze fundamentals of convolutional neural network (CNN) techniques and apply it
- CO6: design application specific ML & AI modeling on data acquired through IoT & CPS for intelligent system design

Topics:

- Data science, AI and ML
- ML fundamentals
- Artificial Neural Networks
- Deep Learning
- Application of AI and ML for IoT

Textbook(s):

1. Understanding Machine Learning, Shai Shalev-Shwartz and Shai Ben-David, Cambridge University Press, 2017.
2. Deep learning, Bengio, Yoshua, Ian J. Goodfellow, and Aaron Courville, MIT Press, 2015.

Reference Book(s):

1. Pattern Recognition and Machine Learning, Christopher Bishop, Springer, 2006.
2. Machine Learning, Tom Mitchell, McGraw Hill, 1997.

EC 4097 Machine Learning Laboratory

Credit: 1
Category: PCC

Prerequisite(s): Introduction to Machine learning (EC 3072), Deep Learning (EC 3080)

Course Description:

Machine Learning is concerned with computer programs that automatically improve their performance through experience. This course covers the theory and practical algorithms for machine learning from a variety of perspectives. This laboratory introduces the Python software which is very helpful for implementation of machine learning and deep learning techniques. Familiarization of various important machine learning libraries such as NumPy, Pandas, Matplotlib and Keras will be done followed by implementation of clustering and classification problems using traditional machine learning techniques. Further, the lab covers the implementation of solving real life problems using deep learning techniques.

Course Outcomes: At the end of course, the students will be able to:

- CO1: gain knowledge about basic functions of Python
- CO2: identify various useful machine learning libraries
- CO3: understand the implementation procedures for the machine learning algorithms
- CO4: identify and apply machine learning algorithms to solve real world problems
- CO5: analyze basic operation on data such as accessing, plotting etc.
- CO6: design application using deep learning techniques for real-world problems

Topics:

- Python fundamentals
- Machine learning libraries: NumPy, Pandas, Matplotlib, Keras
- Basic operation such as data accessing, data manipulation, plotting etc.
- Implementation of classification using traditional machine learning techniques
- Clustering using different clustering techniques
- Implementation of classification using deep learning techniques

EC 4099 IoT & Connected Intelligent Systems Laboratory

Credit: 2

Category: PCLC

Prerequisite(s): Internet of Things & its Applications (EC3050), Internet technologies for cloud and Edge Computing (EC 3074), Introduction to Machine Learning (EC 3072), AI & Machine Learning for IoT (EC 4061), IoT & Cyber-Physical System Design (EC 3076)

Course Description:

This laboratory is to provide hands-on exposure in IoT and AI-ML based connected-intelligent systems for industry readiness by bolstering the hands-on aspects of technical-Know-how and practical-skill in IoT & ML based a connected intelligent system that is highly demanded in industry. This lab deals with experiments on IoT-based intelligent systems design. Experiments on IoT-based system design using Embedded systems like NodeMCU, Raspberry Pi etc. along with the complete data communication framework based on TCP/IP protocol stack implementation for various application-specific intelligent connected sensors & actuators are covered. It also provides hands-on exposure to IoT and connected intelligent framework with protocols like MQTT/CoAP with sensor and application based device control technique with machine perception techniques (AI & ML) for scenario-specific application requirements of real-world engineering problems on Smart healthcare, smart city, smart home and smart sustainable IoT-based systems.

Course Outcomes: At the end of the course, students will be able to:

- CO1: design different application-specific sensor data acquisition for IoT-cloud using TCP/IP stack
- CO2: implement sensor-data acquisition system and intelligent actuator control application using cloud and MQTT protocol for intelligent IoT-based systems
- CO3: implement computing on Raspberry Pi and equivalent embedded development platform for intelligent IoT-based systems
- CO4: simulate appropriate Machine learning (ML) techniques on acquired sensor data for intelligent application-specific IoT-based systems
- CO5: design intelligent Machine perception technique on cloud data for intelligent IoT-based systems
- CO6: analyze of AI & ML based techniques on acquired IoT-based Sensor data

Topics:

- Data acquisition for IoT-cloud using TCP/IP stack using NodeMCU and Arduino IDE
- Application- sensor data for IoT-cloud using TCP/IP stack, and Raspberry Pi
- Intelligent actuator control application using cloud and MQTT
- Apply Machine learning (ML) techniques on acquired sensor data
- Analyze and implement of AI & ML based techniques on acquired IoT-based Sensor data and intelligent inference management and actuator control for application-specific requirements of real-world Smart healthcare application
- Implement of AI & ML based techniques on Sensor data and intelligent inference management and actuator control for application-specific requirements of real-world smart city, smart home and smart sustainable IoT-based systems
- Open Ended Design problems

EC 6108 Digital Image Processing

Credit: 3

Category: PEC

Prerequisite(s): Digital Signal Processing (EC 3007), Introduction to Digital Signal Processing (EC 3013)

Course Description:

This course introduces the concept of Digital image formation, representation and processing of digital image using digital devices such as computers. The processing or manipulation of digital image is achieved via both spatial and frequency domain with an aim to improve pictorial information for better human interpretation, storage, transmission and representation. Towards this goal the course provides both basic and in-depth coverage of image processing techniques such as image enhancement, restoration, color image processing, compression, segmentation, morphological processing and different mathematical transforms.

Course Outcomes: At the end of the course, the students will be able to:

CO1: analyze different image processing applications and learn different techniques to create and apply on digital image for better interpretations of an image

CO2: implement various enhancement and restoration techniques

CO3: explain and analyze the concept of color image processing

CO4: evaluate different image compression techniques for various applications

CO5: explain the concept of morphological operations and image segmentation

CO6: interpret the effect of applying different image transforms

Topics:

- Fundamentals of image processing
- Spatial domain methods of image enhancement
- Frequency domain methods of image enhancement
- Image degradation model and restoration via Inverse filter, Weiner filter and constrained least square approach
- Color image processing via different color models and inter conversion between them
- Different image transforms such as DFT, DCT, Hadamard, KL and SVD and its importance in processing of a digital image so that different types of redundancy can be overcome ,hence an adequate of image compression can be occurred
- Morphological processing through dialation, erosion, opening and closing and discussion on few applications
- Region and edge based method of image segmentation and discussion on few applications
- Review of matrix algebra, 2-D convolution

Textbook(s) :

1. Digital Image Processing, R. C. Gonzalez and R. E. Woods, Prentice Hall, 3rd edition, 2008

Reference Book(s):

1. Fundamentals of Digital Image Processing, A.K. Jain, Prentice Hall
2. Digital Image Processing, S.Jayaraman, S. Esakkirajan, T. Veerakumar, TMH, 2009.
3. Digital image processing and Analysis, B. Chanda, D. Dutta Majumder, PHI, 2004.

EC 6112 Communication and Network Security

Credit: 3

Category: PEC

Prerequisite(s): Data Communication and Networking (EC 3028)

Course Description:

This course is intended to explain various communication security attacks and counter mechanisms. Design and implementation of the security services and mechanisms are also covered.

Course Outcomes: At the end of the course, the students will be able to:

CO1: analyze different security threats and attacks with reference to ISO/OSI model security

CO2: differentiate between various cryptography, watermarking, steganography methods

CO3: analyze different symmetric and asymmetric cryptographic algorithms

CO4: differentiate various key distribution and digital signature

CO5: analyze the working of various communication security protocols with respect to OSI layer

CO6: analyze different network security systems implementation in wireless systems

Topics:

- Ciphers &Algorithm
- Cryptographic Key distribution system
- Communication Security layer classification
- Network security

Textbook(s):

1. Cryptography & Network Security, B A Forouzan and D Mukhopadhyay, Mc-Graw Hill, India, 2nd edition, 2010.
2. Security of Information and Communication Network, S V. Kartalopoulos, Wiley-IEEE Press, 2009.

Reference Book(s):

1. Handbook of Information and Communication Security, Stavroulakis Peter, Springer, 2010.
2. Secure Broadcast communication in Wired and Wireless Communication, Adrian Perrig & Doug Tygar, Kluwer Publication, 2002.
3. Modern Cryptography: Theory and Practice, W Mao, Pearson Education, India, 1st edition, 2003.

EC 6122 Satellite Communication Systems

Credit: 3

Category: PEC

Prerequisite(s): Electromagnetic Waves and Antennas (EC 2022)

Course Description:

The course offers basic concepts of satellite communication. The satellite subsystems, orbital parameters, orbital placement of satellites, LEO, MEO, GEO, and HEO satellite systems are also covered under this course. The satellite link budget preparation and various satellite communication applications are also explained.

Course Outcomes: At the end of the course, the students will be able to:

CO1: comprehend basic parameters for satellite communication

CO2: explain satellite launching methods and orbital control mechanisms

CO3: comprehend different types of losses in satellite link and satellite link design

CO4: differentiate between different types of noises and interferences associated with satellite link

CO5: evaluate the stability of a satellite in orbit and different satellite sub-systems

CO6: investigate different types of multiple access techniques for digital satellite communication

Topics:

- Frequency spectrum for satellite communication, Types of orbits, Kepler's Laws of planetary motion, Orbital perturbations, Geostationary orbit, Satellite launching, General satellite communication, Block diagram uplink, Downlink frequencies, Types of modulation techniques used orbits, and altitude control Satellite launch vehicles - Arian, SLV space shuttle
- Signal loss on transmission through earth's atmosphere, Atmospheric losses, Ionospheric effects, Rain attenuation, Satellite link budget: Transmission losses, Interference, System noise temperature, Link power budget
- Antenna sub-systems, Altitude and orbit control sub-system, Power sub-system, Communication sub-system, TTC&M sub-systems
- Satellite application in TV, Internet, Mobile telephony, Receive only home TV, Master Antenna, TV, Low earth orbit satellite systems and uses. Multiple access techniques - FDMA, TDMA, SS-TDMA, Interference in FDMA systems

Textbook(s):

1. Satellite Communications, T. Pratt & C.W. Bostia, Wiley, 2003

2. Satellite Communication, D. Roddy, McGraw Hill, 2006

Reference Book(s) :

1. Digital Satellite Communications, T.T. Ha, McGraw Hill, 1990

EC 6128 Wireless Sensor Network

Credit: 3

Category: PEC

Prerequisite(s): Data Communication and Networking (EC 3028)

Course Description:

The course gives an overview of wireless sensor network and its applications in military, environment, health care and industrial automation. It describes various physical layer and MAC layer protocols with emphasis on basic requirements of WSN. It further deals with network and transport layer protocols also with emphasis on basic requirements of WSN. Various cross layer effects and optimization techniques are also discussed. Further, localization techniques viz. Range based Localization Protocols and Range free Localization Protocols. Finally, the challenges associated with time synchronization and some protocols are discussed.

Course Outcomes: At the end of the course, the students will be able to:

CO1: find the architecture of WSN and network design factors

CO2: interpret the physical and MAC layer issues in WSN

CO3: choose routing mechanisms in applicable in specific WSN

CO4: analyze logical communication between application processes running on different hosts and interlayer and cross layer effects and solutions for WSN

CO5: estimate localization, ranging techniques and ranging based protocols for WSN

CO6: adapt the concepts of Time Synchronization and challenges involved therein

Topics:

- Basic Concepts, Platforms, Standardization, Architecture, Protocols, Applications, PHY layer standard (IEEE 802.15.4), MAC challenges, MAC protocols, S-MAC, B-MAC, CC-MAC, TRAMA, Zebra MAC, Routing challenges, SPIN, LEACH, MECN, SAR, Challenges of Transport layer, PSFQ, CODA, Interlayer Effects, MAC-Network, MAC-Application, Network - PHY, Transport -PHY, Challenges in localization, Ranging Techniques, Range based Localization Protocols, Range free Localization Protocol, Challenges for Time synchronization, TPSN, TDP, RDP

Textbook(s):

1. Wireless Sensor Networks – Ian F. Akyildiz and Mehmet Can Vuran, John Wiley and Sons Ltd, Publication, 2010.

Reference Book(s):

1. Wireless Sensor Network - a Networking Perspective, Jun Zheng and Abbas Jamalipour, Wiley, 2009.
2. Wireless Sensor Network, C. Raghavendram, K Sivalingam and T. Znati, Kluwer Academic Publishers, 2004.

EC 6224 Low power VLSI Design

Credit: 3

Category: PEC

Prerequisite(s): VLSI Design

Course Description:

This course describes the factors that are responsible for power dissipation in MOSFET devices and circuits. It also teaches how to estimate the average and maximum power dissipations in a circuit. In addition, different design techniques to reduce the power dissipations in VLSI circuits are outlined in this course.

Course Outcomes: At the end of the course, the students will be able to:

CO1: comprehend and analyze different MOS Logic circuits and power dissipation concept

CO2: differentiate and apply scaling techniques in different topology

CO3: optimize the power dissipation in CMOS circuits through switched capacitance minimization approach

CO4: optimize the power dissipation in CMOS circuits through different lower power minimization techniques in architecture level

CO5: optimize the power dissipation in CMOS circuits through different lower power minimization techniques in gate level

CO6: design different low power memory logic

Topics:

- Power dissipation and its types
- Scaling methods
- Switched capacitances
- Leakage power optimization in architecture design
- Leakage power optimization in design
- Circuit level implementation for optimum performance

Textbook(s):

1. Low-Power CMOS VLSI Design, Kaushik Roy and Sharat C. Prasad, Wiley-India, 2011.
2. CMOS Digital Integrated Circuits, Sung-Mo Kang and Yusuf Leblebici, 3rd edition, TMH, 2011.

Reference Book(s):

1. CMOS VLSI Design: A circuits and Systems Perspective, West, Harris and Banerjee, 3rd edition, Pearson Education.
2. Low Power VLSI CMOS Circuit Design, A. Bellamour, and M. I. Elmasri, Kluwer Academic Press.
3. Low Power Digital CMOS Design, Anantha P. Chandrakasan and Robert W. Brodersen, Kluwer Academic Publishers, 2002.
4. Essentials of VLSI Circuits and Systems, Eshraghian, Puckness and Eshraghian, 2nd edition, Pearson Education.
5. Digital Integrated Circuits: A Design Perspective, J. M. Rabaey, Anantha Chandrakasan and Borivoje Nikolic, 2nd edition, PHI, 2001.

EM 3082 Minor Project

Credit: 2
Category: PROJ

Course Description:

Students are required to undertake a minor project either as an individual or in a group in consultation with the project guide which may be completed in one semester. The project work is aligned with the discipline of the student and its allied areas. It is preferably related to certain research objective or advanced technical domain. Students will demonstrate higher level learning outcomes and cognitive skills in the implementation of the project.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: perform a background study on certain technical aspect and formulate a project objective
- CO2: outline a pathway for the implementation of the project within the time line
- CO3: apply fundamental engineering concepts, advanced technical know-how, use modern engineering tools, perform experiments and critically analyze the data
- CO4: provide engineering solutions, design system components or processes with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
- CO5: function effectively as an individual, and as a member or leader in a team under multidisciplinary settings following ethical practices
- CO6: communicate effectively with a range of audiences and prepare technical reports

EM 4081 Project-I

Credit: 3
Category: PROJ

Course Description:

Students are required to undertake a final year major project either as an individual or in a group in consultation with the project guide which may be completed in one year. The project should be related to certain research objective or advanced technical domain. The work encompasses two semesters and to be carried out in two phases (Project-I and Project-II). In Project-I, students are expected to complete detailed literature review, identify their objective and start working on the same; perform experiments, carry out analyses and report their findings to their supervisors and the panel.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: conduct a detailed research survey or background study and summarize the theory and findings
- CO2: formulate a research question or a general objective of the project
- CO3: propose and outline the solution to the research question or a pathway for the implementation of the project with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
- CO4: conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
- CO5: function effectively as an individual, and as a member or leader in a team under multidisciplinary settings following ethical practices
- CO6: communicate effectively with a range of audiences and prepare technical reports

EM 4082 Project-II

Credit: 10
Category: PROJ

Course Description:

Project-II is a continuation of Project-I, the second phase of final year major project. Students should complete all related experiments, develop a final solution, product or system and validate the applicability of the same under real time scenario with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors. They produce a detailed technical report on their work as well as individual contribution reports. Throughout the implementation of the major final year project, students should demonstrate all cognitive skills and attainment of all program outcomes and student outcomes.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: readily apply fundamental concepts in their area of study for executing the projects
- CO2: demonstrate skill in using modern technical tools, apply advanced technical knowledge, integrate information from different sources, perform complex experiments and critically analyze the findings to draw conclusions
- CO3: provide engineering solutions to predefined research question or project objective; design system components or processes with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
- CO4: function effectively as an individual, and as a member or leader in a team under multidisciplinary settings following ethical practices
- CO5: communicate effectively with a range of audiences and prepare detailed technical reports
- CO6: demonstrate knowledge and understanding of the management principles in executing their project as a member or leader of the team, and willingness to engage in life-long learning

COURSES OF OTHER PROGRAMMES

EI 2003 Electrical & Electronic Measurement Techniques

Credit: 3

Category: PCC

Prerequisite(s): Basic Electrical Engineering (EE 1003)

Course Description:

The objective of the course is to provide the basic knowledge of Instruments and Measurement techniques providing an in-depth understanding of errors in measurement techniques, Bridge measurements, Function Generator and Spectrum Analyzer, Display devices, watt meters, energy meters and analytical instruments.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: comprehend and explain different measurement techniques and universal instruments
- CO2: explain different measurement techniques for measuring the parameters of various electrical components
- CO3: explain and analyze construction of instruments used for measuring current, voltage, frequency and spectrum
- CO4: measure the power, energy and power factor using watt-meters and energy-meters
- CO5: apply the CRO for various electronic measurements
- CO6: analyze spectral analysis of the signals on spectrum analyzers

Topics:

- Introduction to instrumentation and measurements
- Classification and characteristics of Instruments.
- Overview of electrical and electronic measuring instruments
- DC and AC bridges
- Measurement of Power, Energy
- Function generator and Spectrum analyzer

Textbook(s):

1. A Course in Electrical and Electronic Measurements and Instrumentation, A K Sawhney, Dhanpat Rai & Co, Reprint, 2013.
2. Modern Electronic Instrumentation and Measurement Techniques, Helfrick & Cooper, 2nd Edition, PHI.

Reference Book(s):

1. Electrical Measurements and Measuring Instruments, Golding & Widdis , 5th edition, Reem Publication.
2. Electronic Instrumentation, H S Kalsi, 3rd Edition, TMH.
3. Electronic Instrumentation & Measurements, David A. Bell, 3rd Edition, Oxford University press.
4. Elements of electronic instrumentation and measurement, Joseph J. Carr, 3rd Edition

EI 2010 Principles of Measurement and Instrumentation

Credit: 3
Category: PCC
Prerequisite(s): Nil

Course Description:

The objective of the course is to provide the basic knowledge of Instrumentation and Measurement, identify and correct errors in measurement techniques, Bridge measurements, Function Generator and Analyzer, Display devices, sensors/transducers and Analytical instruments.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: estimate different types of errors in measurements and interpret the instrument data sheet
- CO2: measure the unknown electrical quantities by selecting the appropriate bridge circuit
- CO3: explain and analyze the working principle of various sensors and transducers
- CO4: comprehend the basic principles of operation for various electrical and electronic measuring instruments
- CO5: describe the operation of wave shaping circuits and spectrum analyzer
- CO6: apply appropriate analytical instruments for measuring and analyzing materials

Topics:

- Introduction to instrumentation and measurements, basic requirements & methods of measurement
- Classification and characteristics of Instruments
- Overview of electrical and electronic measuring instruments
- DC and AC bridges
- Introduction to various types of sensors & transducers
- Function generator and Spectrum analyzer
- Analytical instrumentation: Chromatography, Spectrophotometer, pH meter

Textbook (s):

1. Electrical and Electronic Measurements & Instrumentation By A.K. Sawhney – Dhanpat Rai, 2013.
2. Electronic Measurement & Instrumentation By H. Cooper – PHI, 2nd edition.

Reference Book (s):

1. Electronics Instruments & Measurement by David A. Bell –Oxford, 3rd edition

EI 2012 Sensors & Signal Conditioning

Credit: 3

Category: PCC

Prerequisite(s): Electrical & Electronic Measurement Techniques (EI 2003)

Course Description:

The main aim of introducing this course is to provide the basic concept of instrumentation and its characteristics. It covers the details on identification, classification, construction, working and domestic as well as industrial applications of various transducers. The course also includes sensing principle for the measurement of motion, force, torque using analog, digital transducers and methods for signal conditioning and analysis.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: comprehend the concept of various transducers , sensors and their brief performance specifications
- CO2: analyze different types of errors in measurement and instrumentation
- CO3: explain the principle of operation for various transducers used to measure temperature and pressure
- CO4: explain the principle of operation for various transducers used to measure force, acceleration, displacement etc.
- CO5: analyze various signal conditioning techniques
- CO6: apply various transducers for domestic and industrial uses

Topics:

- Introduction to Sensor and Transducer
- Resistive Transducer
- Displacement transducer
- Proximity sensor
- Digital transducer
- Voltage generating transducer
- Magnetic type transducer
- Signal conditioning circuit
- Transducers for Miscellaneous measurement

Textbook(s):

- 1.Transducer & Instrumentation, MurthyDVS,2001,Prentice Hall of India.
2. Principle of Measurement Systems- J.P. Bentley 4th edition, Pearson education.

Reference Book(s):

1. Sensors & Transducers, Patranabis. D, 2003,PHI.
2. Introduction to Measurement and Instrumentation- AK.Ghosh, 2012, PHI.

EI 2095 Electrical & Electronic Measurements Laboratory

Credit: 1
Category: PCLC
Prerequisite(s): Nil

Course Description:

In this E&EM laboratory, experiments will be conducted to measure different parameters such as strain, distance, temperature, level, resistance, inductance, capacitance etc.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: calibrate the ammeters and voltmeters using DC potentiometer
- CO2: measure and analyze unknown electrical parameters such as medium and low resistances using DC bridges
- CO3: measure and analyze unknown electrical parameters such as capacitance and inductance using AC bridges
- CO4: measure the frequency of an unknown periodic signal
- CO5: determine the accurate quality factor of an unknown coil
- CO6: analyze and measure of 3-Phase power using 2-wattmeter method

Topics:

- Measurement of resistance using Wheatstone and Kelvin's double bridge
- Measurement of inductance using Maxwell's bridge, Hay's bridge
- Measurement of Capacitance using Schering's bridge
- Measurement of frequency using Wien's bridge
- Calibration of ammeter and voltmeter by using DC potentiometer
- Measurement of 3-Phase power using 2-wattmeter method

EI 3009 Instrumentation Measurement Techniques

Credit: 3

Category: PCC

Prerequisite(s): Electrical & Electronic Measurement Techniques (EI 2003)

Course Description:

This course deals with the construction and operating principles and applications to Industrial Instruments used for measurement of parameters like temperature, pressure, level, flow, viscosity & humidity and its safety precautions during process measurement.

Course Outcomes: At the end of the course, students will be able to:

CO1: explain and analyze the construction and working principle of Industrial Instruments for Temperature, Level, Pressure, Flow, Viscosity & Humidity

CO2: identify and explain sensor, transducer and their performance specifications for measurement of different process variables

CO3: apply different measurement techniques of instruments in industry

CO4: apply specific instruments for the measurement of different process variables

CO5: analyze the industrial application and calibration of Industrial Instruments

CO6: analyze the use of Industrial Instruments in hazardous locations

Topics:

- Temperature measurement
- Pressure Measurement (Gauge and vacuum)
- Level measurement, Flow measurement
- Viscosity, density, conductivity and humidity measurements
- Instrumentation in hazardous locations

Textbook(s):

1. Industrial Instrumentation & Control, S. K. Singh, 3rd Edition, TMH.
2. Industrial Instrumentation, K.Krishnaswamy, S.Vijayachitra, 2nd Edition, New age international.

Reference Book(s):

1. Instrument Engineers Handbook, Vol1, B.G Liptak, CRC Press
2. Measurement System Application and Design E.O Doeblin, 5th Edition, TMH

EI 3023 Neural Network and Fuzzy Logic Control

Credit: 3

Category: PEC

Prerequisite(s): Mathematics-I (MA 1003), Mathematics-II (MA 1004), Control Systems (EL 3001)

Course Description:

This course is about Artificial Neural Network & Fuzzy Logic models to handle uncertainty and solve engineering problems. Objective of this course is to impart adequate background knowledge so that in future students will be able to design and implement various machine learning algorithms in a range of real-world applications. The course covers learning based solutions for regression and classification, by using error minimization, concept of association, competitive learning, and fuzzy rule based methods. The course also covers applications of ANN and fuzzy logic for solving pattern recognition and control system.

Course Outcomes: At the end of the course, students will be able to:

CO1: analyze supervised and unsupervised learning for regression, classification and clustering

CO2: comprehend the concepts of feed forward neural networks

CO3: identify and describe appropriate Artificial Neural Network techniques in building intelligent machines

CO4: demonstrate the concept of fuzziness involved in various real world phenomena and need of fuzzy set theory

CO5: comprehend fuzzy rule based or expert system

CO6: analyze applications of Neural Network and Fuzzy logic in image processing

Topics:

- Introduction to Machine Learning
- Feed Forward Neural Network and Back-Propagation
- Pattern Association and Adaptive Resonance models
- Learning of ANN models based on Competition
- Fuzzy Set Theory and Fuzzy Membership
- Fuzzy-Inference-Systems
- Applications of Neural Network and Fuzzy Logic

Textbook(s):

1. Fundamentals of Neural Networks, Laurene Fausett, Pearson Education, 2004
2. Fuzzy Logic with Engineering Applications, Timothy Ross, McGraw-Hill, 1998

Reference Book(s):

1. Introduction to Neural Networks Using Matlab, Sivanandam , S. N , Sumathi, S. and Deepa, S. N, 2005, TMH.
2. Fundamentals of Artificial Neural Networks, Mohammad H. Hassoun, 1st edition, 2019, PHI
3. Neural Networks and Fuzzy Systems, Bark Kosko, 1st edition, PHI

EI 3024 Virtual Instrumentation

Credit: 3

Category: PEC

Prerequisite(s): Digital Electronics (EC 2011)

Course Description:

This course provides the basic knowledge of PC based instrumentation systems and to develop concepts of designing virtual instruments along with its applications in various fields ranging from signal processing, image processing to motion control.

Course Outcomes: At the end of the course, the students will be able to :

CO1: identify and explain the components of Virtual instrumentations and use them for PC Based Measurement

CO2: develop programming skills on application development software

CO3: simulate with LabVIEW software for instrument control, measurement, data acquisition and data handling

CO4: differentiate between different data acquisition techniques on virtual instrumentation

CO5: implement different controllers and conduct testing using industry standard software

CO6: differentiate between various Industrial network components and protocols

Topics:

- Sensors and Transducers
- PC Based Measurement
- Introduction to LabVIEW
- Organization of the LabVIEW system and software
- Program elements of LabVIEW
- Data Acquisition & Signal Conditioning
- Remote laboratory for Electrical experiments
- Examples of real time control and measurement applications
- Communication networked modules

Textbook(s):

1. Virtual Instrumentation Using LabView, Jerome, 1st Edition, PHI
2. LabView Graphical Programming, Gary W. Johnson, Richard Jennings, 4th Edition, TMH

Reference Book(s):

1. Practical Data Acquisition for Instrumentation and Control Systems, John Park and Steve Mackay, 2003, Newnes
2. LabVIEW based advanced instrumentation system, Psumathi, 1st edition, 2007, Springer science Elsevier.

EI 3025 Principle of Analytical Instrumentation

Credit: 3

Category: PEC

Prerequisite(s): Chemistry (CH 1007)

Course Description:

This course covers different types of Spectrophotometers such as Infrared Spectrophotometers, Flame Photometers with their instrumentation, Gas Chromatograph and Liquid Chromatography. It also deals with Spectrometers, Radiochemical Instruments and Pollution Monitoring Instruments.

Course Outcomes: At the end of the course, the students will be able to:

CO1: differentiate between various techniques involved to determine the concentration of each component from a mixture

CO2: analyze methods to measure the pH level of a liquid using pH meters

CO3: comprehend different gas analyzers are used in industry

CO4: analyze the different spectrums using spectrometers

CO5: comprehend the operating principle of instruments used for radiation detection

CO6: analyze the operating principle of instruments used for pollution monitoring

Topics:

- Spectrophotometry
- Chromatography
- pH Meters and Ion Analyzers
- Analyzers
- Spectrometers
- Radiochemical Instruments
- Pollution Monitoring Instruments

Textbook(s):

1. Handbook of Analytical Instruments – by R.S. Khandpur, 2nd edition, TMH

Reference Book(s):

1. Instrumental Methods of Analysis, Hobart H. Willard, 2012, 7th edition, CBS publisher
2. Principles of Industrial Instrumentation, D. Patranabis, 3rd edition, TMH.

EI 3027 Industrial Instrumentation

Credit: 3
Category: PEC
Prerequisite(s): Nil

Course Description:

This course is designed to improve knowledge and skills by providing a better understanding of process variables, control systems, sensors, transmitters, and more. It also provides the basic overview of power plant instrumentation and control techniques.

Course Outcomes: At the end of the course, the students will be able to :

- CO1: explain sensor, transducer and their performance specifications for measurement of different process variable
- CO2: analyze the construction and working principle of instruments used in various industries for measurement of different process variables like Temperature, Level and Pressure
- CO3: analyze various instrumentation and control used in power plant
- CO4: identify appropriate analytical instrument for measuring, analyzing and establishing the composition of materials
- CO5: solve design problems of the power plant and its various control mechanisms
- CO6: perform measurements and control of turbine systems and its safety

Topics:

- Principles of various temperature, pressure, and level sensors used in industrial instrumentation.
- Analytical measurements.
- Basics of power plant instrumentation – water circuit, air-fuel circuit.
- Turbine monitoring and control

Textbook(s):

1. Power plant Instrumentation-K. Krishnaswamy, M. Ponnibala, 2ndedition,PHI publication
2. Industrial instrumentation & control, S. K. Singh, 3rd Edition, TMH publication.

Reference Book(s):

1. Instrument Engineers Handbook, Vol-1, B.G Liptak, CRC press.
2. Handbook of Analytical Instruments- by R. S. Khandpur, 2nd edition, TMH

EI 3029 Process Dynamics and Control

Credit: 3

Category: PEC

Prerequisite(s): Principle of Control System (EL 2002)

Course Description:

This course covers the fundamental aspects of process dynamics and control, which includes developing dynamic models of processes, control strategies for linear time-invariant systems and instrumentation aspects. The course deals with the development of models for control system design.

Course Outcomes: At the end of the course, students will be able to:

CO1: develop mathematical model and process

CO2: analyze dynamic behavior of different processes

CO3: design basic control schemes using hydraulic, electronic and pneumatic methods

CO4: tune PID controller to improve the performance

CO5: design various complex control schemes for SISO systems

CO6: design controller for multivariable processes

Topics:

- Process dynamics and modelling
- Dynamic response of processes
- Basic control schemes
- Controller tuning
- Complex control schemes
- Controller design for multivariable process

Textbook(s):

1. Process control: Principles and applications, Surekha Bhanot, Oxford,2008.

Reference Book(s):

1. Modern control engineering, K.Ogata, 5th edition, PHI
2. Process control, Dynamic concepts and applications, S.K.Singh, PHI,2007

EI 3030 Power Plant Instrumentation

Credit: 3
Category: PEC
Prerequisite(s): Nil

Course Description:

This course provides a knowledge of the instruments that are used to measure and control the processes of electric power generation, processes of the generation of electricity from tradition fuel sources. The course covers an overview of power generation covering the various conventional and non-conventional energy sources , instrumentation and control of boilers and turbine monitor.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: comprehend various components of thermal power plants and their operations
- CO2: measure the water flow, steam flow and pressure in the water circuit
- CO3: design control schemes for the water circuit
- CO4: measure flow, pressure, temperature and level in air fuel circuit.
- CO5: measure electrical, mechanical and process turbine parameters
- CO6: design the control schemes for turbines

Topics:

- Overview of Power Generation
- Instrumentation and Control in Water Circuit
- Instrumentation and Control in Air-Fuel Circuit
- Turbine–Monitoring and Control

Textbook(s):

1. Power Plant Instrumentation – K.Krishnaswamy, M.Ponnibala, 2nd edition, PHI publications.
2. Power Plant Engineering - P.K Nag, 3rd edition, Tata McGraw-Hill.

Reference Book(s):

1. Standard Boiler Operations - S.M. Elonka and A.L Kohal, Tata McGraw-Hill.
2. Mechanical and Industrial Measurements - R.K Jain, 2008, Khanna Publishers.
3. Power Plant Engineering – EL. Wakil, Tata McGraw-Hill.

EI 3032 Principle of Sensors & Data Acquisition

Credit: 3

Category: PEC

Prerequisite(s): Electrical & Electronic Measurement Techniques (EI 2003), Principle of Measurement & Instrumentation (EI 2010)

Course Description:

The main aim of introducing the course is to demonstrate a critical understanding of elements of signal conditioning necessary for a number of sensors and transducers. This course includes operation of analog to digital and digital to analog converters. This course includes appropriate techniques and devices for realizing a data acquisition system and function of output drivers and devices also.

Course Outcomes: At the end of the course, the students will be able to:

CO1: comprehend working principle of sensors & transducers

CO2: characterize and calibrate the sensors & transducers

CO3: comprehend the design of motion transducers used for measuring rotational displacement and velocity

CO4: understand the working of industrial automation systems such as PLC, SCADA

CO5: design amplifiers used for signal conditioning

CO6: understand the application of different data acquisition and conversion systems

Topics:

- Introduction to sensors and transducers
- Rotational displacements
- Rotational velocity
- PLC and SCADA
- Signal Conditioning
- Data acquisition systems
- Instrument calibration concepts

Textbook(s):

1. Electronics measurements and Instrumentation, R.K.Rajput, S.Chand, 2nd revised edition, 2011

Reference Book(s):

1. Digital control and state variable methods: Conventional and Intelligent control systems, M.Gopal, 4th edition, 2012.

EI 3091 Instrumentation Laboratory

Credit: 1

Category: PCLC

Prerequisite(s): Basic Electrical Engineering (EE 1003), Analog Electronics (EC 2027)

Course Description:

This lab will deal with various sensors, their operations, different interfacing techniques with microcontrollers and use of LCDs for output.

Course Outcomes: At the end of the course, the students will be able to:

CO1: analyze characterization of strain and force sensors

CO2: measure the level of fluid by capacitive transducers

CO3: design flow sensors for flow measurement

CO4: analyze characterization of temperature sensors

CO5: analyze characterization of the displacement, pressure sensors

CO6: interface sensors with micro-controller for precise measurement

Topics:

- Strain and force sensor
- Capacitive transducers
- Flow sensor
- Temperature sensors
- Displacement, pressure sensors
- Interfacing sensors with microcontroller for precise measurement

EI 3092 Process Control Laboratory

Credit: 1

Category: PCLC

Prerequisite(s): Process Control (EI 3010)

Course Description:

Process control lab deals with automation(PLC/DCS) and different controllers(P, PI, PID) for understanding the characteristics and performance of the level, temperature and flow. PLC platform with HMI is also available through which different on-board applications like conveyor belt control, temperature control, dc motor speed control using ladder logic can be performed. Experiments on pc based level, pressure, flow, temperature loop stations with air compressor using digital PID controller are also conducted.

Course Outcomes : At the end of the course, the students will be able to:

CO1: determine the characteristics of open and close loop systems using PID controller

CO2: apply the concepts of interacting and non-interacting liquid level system

CO3: apply the concepts of PLC, DCS & SCADA and its interfacing with real time system

CO4: control traffic light, water level in tank, speed of DC motor and control conveyor belt with PLC using ladder logic programming

CO5: obtain the response using P, PI & PID controller for a typical flow, level, pressure & temperature process station with air compressor

CO6: analyze the characteristics of control valve, I/p & P/I converter

Topics:

- Introduction to Basic Ladder Logic Programming
- Development of Ladder Logic Using Universal PLC Platform With HMI
- Hardware Verification of Open and Closed Loop Performances of Tank Filling Process Using E-906 PID Controller
- Hardware Verification of Open and Closed Loop Performances of Flow Rate Regulatory Process Using E-906 PID Controller
- Hardware Verification of Open and Closed Loop Performances of Heat Furnace Process Using E-906 PID Controller
- Hardware Verification of Level Control Loop Performance Using Digital PID with Air Compressor
- Hardware Verification of Flow Control Loop Performance Using Digital PID with Air Compressor
- Hardware Verification of Pressure Control Loop Performance Using Digital PID with Air Compressor
- Hardware Verification of Temperature Control Loop Performance Using Digital PID with Air Compressor

EL 2002 Principle of Control Systems

Credit: 3

Category: PCC

Prerequisite(s): Principle of Signals and Systems (EC 2023), Signals and Networks (EC 2021)

Course Description:

This course covers concepts of open- and closed-loop systems, mathematical modeling of physical system, transfer functions, signal flow graphs, feedback theory, time domain analysis, design specifications & performance indices. This course also deals with time response of 2nd order systems, stability analysis using Routh-Hurwitz criteria and root-locus methods, Nyquist plots, frequency responses, Proportional, PI, PID controllers and Lead-lag compensators.

Course Outcomes: At the end of the course, the students will be able to:

CO1: comprehend open and closed loop control systems

CO2: compare various time domain specifications and describe their significance

CO3: explain the concept of P, PI and PID Controller

CO4: analyze stability using root locus and Routh stability criterion

CO5: determine the stability of the given control system by constructing Nyquist Plot

CO6: plot Bode plots for stability analysis and design lag, lead, lag-lead compensators based on its specifications

Topics:

- Mathematical modeling of physical system
- Feedback Theory
- Time domain analysis, design specification & performance indices
- Time response of Second order system
- Stability Criteria
- Frequency domain Analysis
- Cascade Compensation in Frequency Domain

Textbook(s):

1. Control System Engg, I. J. Nagrath & M. Gopal, New Age International (P) Ltd, 2nd edition, 1996.

Reference book(s):

1. Modern Control Engg, K. Ogata, PHI, 3rd edition, 1997.
2. Control Systems Engineering, Norman Nise, Wiley, 3rd Edition.
3. Automatic Control Systems, Benjamin C. Kuo, Prentice Hall.

EL 3024 Industrial Automation and Control

Credit: 3

Category: PEC

Prerequisite(s): Principle of Control System (EL 2002), Linear Control System (EE 2028)

Course Description:

The course discusses a wide range of topics for different types of sensors, actuator, and signal conditioning circuits. This course also discusses about the different types of controllers and its tuning technologies used in the industry. Different automation techniques like PLC including ladder programming, SCADA, DCS are also covered. Different advanced control techniques have also been discussed.

Course Outcomes: At the end of the course, the students will be able to:

CO1: comprehend the working of sensors in signal conditioning circuits and actuators

CO2: determine the effect of gain constant on system performance

CO3: understand different components of PLC and design of the ladder logic

CO4: analyze DCS hardware, its merits/demerits in an industrial automation in comparison with PLC

CO5: analyze SCADA hardware-software and its merits/demerits in industrial automation in comparison with PLC and DCS

CO6: comprehend advanced control techniques

Topics:

- Sensors, Actuators and Signal conditioning
- Controller
- Automation
- PLC
- SCADA
- DCS
- Advanced control techniques

Textbook(s):

1. Computer-Based Industrial Control, Krishna Kant, 2nd edition Prentice Hall of India Ltd.
2. Chemical Process Control – Theory and Practice, Stephanopoulos, Prentice Hall of India Ltd, 1984.
3. Fundamentals of Industrial Instrumentation and Process Control, William C. Dunn, Tata McGraw Hill, 2009.

Reference Book(s):

1. Modern Automation Systems, Muhammad Abdelati, University Science Press, 2009.
2. Modern Control Engineering, 4th edition, Ogata, Prentice Hall of India

HS 2002 Engineering Economics

Credit: 3
Category: HSMC
Prerequisite(s): Nil

Course Description:

The course on Engineering Economics is a specialized need-based extension of applied Economics which is aimed at developing an understanding of the principles governing Economy's vital parameters like market, finance, Production, consumption and distribution.. The course focuses on learning methodical and rational conceptualization and developing the knowledge for effectively implementing these market principles in actual organizational activities and forums. The course intends to develop the ability of taking decisions related to project selection and implementation, optimization of market vitals like sales, revenue, profit, cost etc. It serves as the base of learning all Economics related elective papers offered in higher semesters as well as preparation for any competitive exams like civil services, MAT etc.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: apply economic theory for optimisation of the economic variables of demand, supply, sales, profit, cost and revenue
- CO2: apply the budgeting principles in making economic decisions during project appraisals
- CO3: develop awareness towards all the economic issues related to the financial market, Budget, Money, Credit and Fiscal Policies etc.
- CO4: relate and apply theoretical concepts in Economics with contemporary/modern business practices
- CO5: understand the vitals of the financial market, know the source and methods of raising capital for an organization
- CO6: understand the depreciation of asset principles and efficient inventory/resource management

Topics:

- An Introduction to Economics and Engineering Economics
- Basic Concepts of Economics: Market equilibrium and Consumers and Producer's equilibrium
- Elasticity and Demand Forecasting
- Optimization of Profit and cost
- Break Even Analysis
- Evaluation of Projects: Economic Appraisal Techniques
- Depreciation calculation and Inventory management
- Vitals of Money and capital market

Textbook(s):

1. Managerial Economics: Principles and Worldwide Applications. Dominick Salvatore, Siddartha K. Rastogi, 8th Edition, Pub. Oxford University Press. ISBN: 9780199467068.
2. Engineering Economics – James L. Riggs, David D. Bedworth and Sabah U. Randhawa, 4th Edition, McGraw Hill Education (India) Private Limited, New Delhi, 2016.

Reference Book(s):

1. Principles of Economics, Deviga Vengedasalam and Karunagaran Madhavan, Oxford University Press, New York, 3rd Edition, 2013.
2. Managerial Economics-Principles and Worldwide Applications-Dominick Salvatore, Adapted by Ravikesh Srivastava, 7th Edition, Oxford University Press, 2012.

3. Micro ECON-A South-Asian Perspective-by William A. McEachern and Simrit Kaur, Cengage Learning, 2013.
4. Engineering Economy-Zahid A. Khan, Arshad Noor Siddiquee, BrajeshKumar, Pearson Publication, 2012.
5. Engineering Economics – R.PanneerSelvam, Pub: PHI Learning Private Limited, New Delhi, 9thEdition, 2008.

HS 2008 Economic Environment of India

Credit: 3
Category: HSMC
Prerequisite(s): Nil

Course Description:

The Course on Economic Environment of India is designed to cater encompassing discernment of Indian Economy to the students. The course precisely highlights the role of different sectors in Indian economy and also touches upon the normative aspect of striking balance among different sectors. It covers the status of public economics in Indian context. Besides, it ensures the students to have knowledge on the role of foreign sector.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: develop the analytical understanding of the economic situation of the country
- CO2: develop the skill to interpret the economic indicators during steady growth path and economic crisis
- CO3: acknowledge the role of different policy making bodies in India related to economic affairs
- CO4: develop the ability to analyze the occupational structure of the country and sectoral contribution to growth
- CO5: examine the extent and role played by foreign sector in the form of exchange rate, FDI etc in the domestic economy
- CO6: develop a critical understanding of the fiscal position of the country

Topics:

- Economic Crises and Way out: Economic Crisis of early 1990s-Macro Economic Reforms since 1991
- Primary Sector and Secondary Sector: Agriculture during the Reform Period; New Industrial Policy
- Tertiary Sector and Foreign Sector: Service sector as the engine of growth in India; Trade reforms
- Public Finance: Fiscal reforms in India post 1991; Centre-State Fiscal relationship

Textbook(s):

1. Dutt and Sundaram.Indian Economy. latest edition.

Reference Book(s):

1. Uma Kapila (2019), Indian Economy since Independence, New Delhi, Academic Foundation.
2. Balakrishnan, P. (2010): ‘Economic Growth in India: History and Prospect’. Oxford University Press, New Delhi.
4. Bhagwati Jagdish and Arvind Panagariya(2012): ‘ India’s Tryst with Destiny’. Collins Business, Noida, India.
5. Jean Dereze and Amartya Sen (1996): ‘Indian Development: Selected Regional Perspectives’. Oxford University Press, New Delhi.
7. Ajijava Raychaudhuri and Prabir De (2012), International Trade in Services in India, New Delhi, Oxford University Press.

HS 2010 Financial Institutions, Markets and Regulations

Credit: 3
Category: HSMC
Prerequisite(s): Nil

Course Description:

The course on Financial Institutions, Markets and Regulations is a specialized need-based extension of Financial Economics. This course is designed to present the fundamental concepts and theories in financial market and promote the application to the workplace and professional practice. It introduces current financial concepts and tools towards money management in organizations participating in the local and global economies. The course covers the current best practices in financial analysis and planning through the application of financial concepts in a nutshell. These include financial vitals relate to money and capital markets, time value of money, cost of capital, risks and return, long-term financial budgeting. Inaddition, the course also introduces topics on lease financing, hybrid securities and derivatives, trust funds, mergers and acquisitions and related issues in current financial sector.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: have comprehensive understanding of the nature and functions of the several types of financial institutions operating in the market
- CO2: develop critical skills in applying the principles of finance and financial inter-mediation to the real world situations
- CO3: effectively interact with the financial markets they need to approach for their future economic endeavors and/or in their place of employment
- CO4: make economic decisions and analysis of issues related to security market transactions and policies
- CO5: develop the understanding of the structure and functions of Indian financial institutions, instruments and policies
- CO6: take decisions regarding saving, investments, portfolio contents and diversification to maximize their return and reduce associated risks

Topics:

- Financial systems: Significance of banks and all other Financial institutions
- Financial Innovations
- Overview of Structure of Financial Debts and Equity markets
- Functions of Financial Intermediaries
- Monetary authority: Reserve Bank of India: Its role, structure and functioning
- Subprime crisis
- Derivative markets
- Capital market authority: structure and functions
- Regulation of Capital market, Role of SEBI

Textbook(s):

1. Madura, Jeff (2008), Financial Markets and Institutions, 8th edition, Thomson Publications.

Reference Book(s):

1. Fabozzi, Frank, Modigliani, Franco, Jones, Frank (Feb 2009), Foundations of Financial Markets.
2. Eakins, Stanley G. (2005), Financial Markets and Institutions (5th Edition), Addison Wesley.
3. Howells, Peter, Bain, Keith (2007), Financial Markets and Institutions, 5th Edition.

4. Barth, James R., Caprio, Gerard, and Levine, Ross (2008), Bank Regulations are Changing: For Better or Worse?, Association for Comparative Economic Studies.
5. Goldstein, Morris (2006), Financial Regulation after the Subprime and Credit Crisis, Washington: Peterson institute.

HS 2012 Development Economics

Credit: 3
Category: HSMC
Prerequisite(s): Nil

Course Description:

The course on Development Economics is a specialized need-based extension of Economics dealing with issues related to economic growth and development. It provides an in depth discussion of the different economic description of development and underdevelopment. It will put a deep insight into the most challenging economic issues of poverty, inequality and underdevelopment faced by the humanity. It will deal with the various existing, modern and developing strategies and policies to tackle these issues and foster the economy onto the path of development. The students will be able to assess the pros and cons of a proposed development intervention and its likely impact on the target population.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: develop the understanding of issues related to economic growth and economic development
- CO2: relate and apply the major growth theories in their related academic projects
- CO3: develop the familiarity with major economic issues faced by the country like poverty, inequality, underdevelopment etc.
- CO4: analyse and compare the development paths adopted across countries of the globe
- CO5: analyse the empirical evidence on the pattern of growth and development
- CO6: develop critical understanding of the existing, adopted and needed policies and strategies for sustainable growth and development

Topics:

- Concepts and difference between growth and development.
- Measures of growth and development
- Models of growth and development
- Poverty and Inequality : Perceptions, estimation and measures of improvement
- Impact of poverty and inequality on growth and development
- Cross country perspectives of development

Textbook(s):

1. Todaro, M. P. & Smith, S. C. (2015), Economic Development, Pearson (12th Edition).
2. Thirlwall A. P. Growth and Development (6 th and 7 th edition)

Reference Book(s):

1. Debraj Ray : Development Economics
2. Meier and Rauch,: Leading Issues in Economic Development, OUP, Latest Edition
3. Kaushik Basu :Analytical Development Economics , OUP
4. Human Development Reports, various years
5. Bagchi A. K. The Political Economy of Underdevelopment, Cambridge University Press 1982.

HS 2081 Business Communication

Credit: 1
Category: HSMC
Prerequisite(s): Nil

Course Description:

This course is designed to give students a comprehensive view of communication, its scope and importance in business. This is an interactive course with a view to enhance language and soft skills with the aid of live demonstration within the framework of the syllabus. It is a foundation building measure to enable the students to excel in the corporate world and in day to day life.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: develop competence in reading and comprehension, develop skimming skills for extracting the main idea(s) from the text, and scanning for keywords
- CO2: enrich the fluency of the students with Collocations and Phrasal Verbs
- CO3: use Email effectively and efficiently as per the organization hierarchy. To retain a logical flow while drafting emails, make aware students about the importance of succinct written expression in modern Business Communication
- CO4: write standard and effective Cover Letters and Resume
- CO5: bridge the gap between native language and target language i.e. English, make students communicative competent and develop their fluency in public speaking
- CO6: prepare effective Power Point Slides. Maintain and arrange proper data structure in presentations. To learn skills of making effective presentation (verbal and non-verbal aspects)

Topics:

- Reading Comprehension – Activity based on BEC Training – Matching, Multiple Choice Questions, Open Close, Giving Appropriate Headings
- Collocation – Activity based on Word-Stock, Phrasal Verbs & Vocabulary Building
- E-mail – Activities based on Writing Appropriate Salutation, Paragraphs & Conclusion
- Resume Writing
- Thematic Discussions
- Speaking in Pairs – Everyday Activities & Detailed Introduction
- Activity based on PowerPoint Presentation

HS 3006 Entrepreneurship

Credit: 3
Category: HSMC
Prerequisite(s): Nil

Course Description:

The course has been designed for the students in order to provide basic knowledge of an entrepreneur and opportunities for new entrepreneurship. To provide idea about various financial sources available for small and medium enterprise by different financial institutions. To provide knowledge how to manage working capital of an organization in an efficient manner. To have an idea about motivational tools for increasing the productivity of employees in an enterprise.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: know the contribution of an entrepreneur in growth and development of socioeconomic condition of our country
- CO2: understand the role of SSI units in growth and development of socioeconomic condition of our country
- CO3: learn market survey, sales promotions and management of working capital through costing and book keeping
- CO4: know different decision making technique and benefit of personal management system.
- CO5: learn motivational methods of an enterprise
- CO6: learn how to prepare a project report and knowledge about different tax system of an enterprise

Topics:

- Introduction to entrepreneurship
- SSI Units
- Market survey and research
- Marketing mix
- Financial management
- Working capital management
- Personnel management
- Motivation

Textbook(s):

1. Entrepreneurial Development, S.S.Khanka, S.Chand

Reference Book(s):

1. Industrial Organisation and Engg. Economics, Sharma & Banga, Khanna Publication
2. Entrepreneurship New Venture Creation, David H. Holt, Prentice Hall, PHI

HS 3008 Management Concepts And Practices

Credit: 3
Category: HSMC
Prerequisite(s): Nil

Course Description:

The course curriculum is designed for student in order to provide fundamental knowledge in management area. The students will be able to know about general management concepts and various specialization in management area like marketing, finance, production and strategy management. The marketing management portion of the course will benefit the students to develop their career in marketing line, as most of the organisations give priority for marketing skills. Finance and production management will help the students in their respective domain and serve as a guide in their corporate career. The strategy management portion of this course will serve as a guide for the students to contribute in strategy formulation of the organization and how to achieve that strategy within a stipulated time period.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: perform the critical management functions effectively and develop ideas about implementing principles and theories of management in organizations efficiently
- CO2: develop various marketing skills in order to be successful in corporate world
- CO3: utilize different financial techniques for better management and control of organisational financial resources
- CO4: take strategic decision for day to day operation through proper working capital management.
- CO5: have competency in production planning as well as control measures will become easy in their professional career
- CO6: do strategy formulation of the organization and how to achieve that strategy within a stipulated time period

Topics:

- Introduction to management
- Marketing mix
- Market research
- Financial management
- Working capital management
- Production planning and control
- Inventory management
- Strategy management

Textbook(s)

1. Modern Business Organisation and Management. Sherlekar & Sherlekar, Himalaya Publishing House.
2. Business Organisation and Management. M. C. Shukla, S. Chand

Reference Book(s)

1. Principles & Practices of Management. L. M Prasad
2. A framework for marketing management, Philip Kotler
3. Financial Management. I. M Panday
4. Production and Operation Management, Everett E. Adam Jr. Ronald J. Ebert

HS 3002 Organisational Behaviour

Credit: 3
Category: HSMC
Prerequisite(s): Nil

Course Description:

The course has been designed for the students to provide an understanding about the behaviour of individuals, groups and the system in the organization. The course will help the students how to develop personality and leadership style for achievement of individual and organizational objective. To know about the benefit of motivation for increasing individual and organizational productivity. To Provide knowledge to work in groups and develop techniques for group decision making for organizational development.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: know about organization, organizational behaviour its nature, scope and significance
- CO2: develop their personality as per industry requirement
- CO3: apply motivational techniques to make the employees work with confidence and satisfaction
- CO4: develop different leadership style to adjust themselves in different organizational situations
- CO5: improve the knowledge of group behaviour and techniques of group decision making
- CO6: apply the concepts for managing changes in organization as well as the development of an organization's human resources

Topics:

- Introduction to Organisation and organisational behaviour
- Personality
- Motivation
- Leadership
- Group dynamics
- Organisational change
- Organisational development

Textbook(s) :

1. Organisational behaviour. Stephen P. Robbins, Timothy A. Judge, S. Sanghi, Pearson
2. Organizational Behaviour and Work, F. M. Wilson, Oxford University Press.

Reference Book(s):

1. Organizational Behaviour, Dipak Kumar Bhattacharya, Oxford University Press
2. ORGB, Organizational Behaviour, Nelson, Quick, Khandelwal, Cengage
3. Organisational Behaviour. Dr. S. S. Khanka, S. Chand
4. Managing Organisational Behaviour, Moorhead & Griffin, Cengage Learning.

HS 3004 Human Resource Management

Credit: 3
Category: HSMC
Prerequisite(s): Nil

Course Description:

The course has been designed in order to provide knowledge and idea about human resource management and how to become a professional human resource manager. It will help the students to follow different HR processes like recruitment, training, performance appraisal effectively in organizational level. The students will be able to learn how to manage industrial dispute and develop industrial relation in corporate sector. The course will enable the students to understand the workers participation in management concept through employee discipline and the process of effective bargaining system in the organisation.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: develop personal and professional qualities of a manager in order to manage human resource of an organization effectively
- CO2: meet the human resource requirement of the organization for achieving its objective effectively
- CO3: follow different HR processes like recruitment, selection, training, performance appraisal effectively in organizational level
- CO4: inculcate the sense of inter personal relation required in professional front in handling employer-employee relation effectively for achievement of organizational objectives
- CO5: achieve strategic objectives of the organizations, by optimizing the potentiality of the human resource through workers participation in management
- CO6: know the technique of managing and being managed by the organisation

Topics:

- Human resource management
- Human resource planning
- Recruitment
- Selection
- Training
- Performance appraisal
- Industrial relation
- Industrial dispute
- Collective bargaining
- Workers participation in management

Textbook(s):

1. Human Resource Management, P. Jyoti & D. N. Venkatesh, Oxford Publication, 2016
2. Human Resource Management, B. Varkkey & G. Dessler, Pearson, 2017

Reference Book(s):

1. Human Resource Management. K. Aswathappa, Mc Graw Hill Education, 2013.
2. Human Resource Management. S. S. Khanka, S. Chand, 2019
3. Human Resource Management. P. Subba Rao, Himalaya Publishing House, 2018.

HS 4001 Professional Practice, Law and Ethics

Credit: 2
Category: HSMC
Prerequisite(s): Nil

Course Description:

The course on Professional Practice, Law and Ethics is designed to cater comprehensive insight of law and ethics to the students for practicing in their professional life. The course incisively highlights the role of morals and ethics in leading a sustainable profession. Besides, by containing different relevant laws like laws of contracts, intellectual property law and information technology law, the course provides foundation in law to the students which will help them a lot to face the real life situations with ease.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: select appropriate engineering decisions in consideration of professional ethics in realization of more critical impact of engineering compared to general experiments
- CO2: evaluate and prescribe risk reducing measures
- CO3: comprehend the dynamics in engineers' roles and responsibilities with emerging issues in global scene
- CO4: know the various compliance requirements and the regulatory bodies to protect environment
- CO5: have a fair idea to protect their engineering inventions from unauthorized exploitation under intellectual property rights system and laws relating to information communication technologies
- CO6: understand, analyze and prevent misuse of IT related transactions

Topics:

- Morals and ethics in engineering
- Engineering as social experimentation
- Engineer's responsibility for safety
- Global issues
- Law of contracts and law of torts
- Environmental laws
- Intellectual property law
- Information technology law

Textbook(s):

1. R. Subramaniam, Professional Ethics, Oxford University Press, 2013
2. Indian Contracts Act 1872
3. Patents Act 1970 (Unit-3)
4. Designs Act 2000 (Unit-3)
5. Information Technology Act 2000 (Unit-4)

Reference Book(s):

1. Mike Martin and Ronald Schinzingher, "Ethics in Engineering", McGraw Hill New York, 2005.
2. Charles E Harris, Michael S Pritchard and Michael J Rabins, "Engineering Ethics Concepts and Cases", Thomson Learning, 2000

HS 4003 Legal Issues and Requirements in Engineering

Credit: 1
Category: HSMC
Prerequisite(s): Nil

Course description:

It depicts on law of contracts and law of torts, Consumer Protection Act 1986, Environmental Protection Act 1986, Environmental Impact Assessment 2006, standards for emission, discharge of environmental pollutants from various industries, Intellectual Property Law, Protecting engineering invention, the U.S Utility model approach and need for Utility model in India, Protecting Software and other engineering technologies in cyberspace, maintaining data security and technological privacy in Cyberspace, e-contracts, electronic and digital signatures.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: understand the various legal requirements in terms of contracts
- CO2: interpret the product liability which an engineer is required to take care while processing his engineering innovations
- CO3: illustrate the various compliance requirements and the regulatory bodies to protect the environment
- CO4: demonstrate to protect their engineering inventions from unauthorised exploitation under intellectual property rights system and laws relating to information communication technologies
- CO5: identify Legal Issues in a given case
- CO6: analyse and prevent misuse of IT related transactions

Topics:

- Law of contracts and law of torts
- Environmental Laws
- Intellectual Property Law
- Information Technology Law

Textbook(s):

1. Gurdeep Singh "Environmental Laws" Eastern Book Company, 2nd Edition 2016.
2. V K Ahuja "Law Relating To Intellectual Property Rights" Lexis Nexis, 3rd Edition. July 2017.
3. Pavan Duggal "Cyber Law"-Indian Perspective". 2nd Edition 2016.
4. Avtar Singh "Law of Contracts" Eastern Book Company, 12th Edition, Reprinted 2020.
5. Dr. R K Bangia "Law of Torts". Allahabad Law Agency; 24th 2019 edition (2019).

Reference Book(s):

1. Rosencranz "Environmental Law and policy in india". Oxford University Press, 2001.
2. Howard b rockman "Intellectual Property Law for engineers and scientists". ISBN: 978-0-471-69740-4, Wiley-IEEE Press, June 2004.
3. Mireille Hidebrant " smart technologies and the end of law". ISBN: 978 1 78643 022 9.

IT 2004 Web Technology

Credit: 3

Category: PCC / OEC

Prerequisite(s): Object Oriented Programming (IT 2005)

Course Description:

This course provides a basic overview and understanding of many key web technologies internet fundamentals, such as HTML & Cascading Style Sheets (CSS). This course of study also builds on the skills gained by students in Java Fundamentals or Java Foundations to help advance Java programming skills. Students will design object-oriented applications with Java and will create Java programs using hands-on, engaging activities

Course Outcomes: At the end of the course, the students will be able to:

CO1: understand and design interactive web page(s) using HTM & CSS

CO2: identify classes, objects, members of a class and relationships among them needed for a specific problem

CO3: design Java application programs using basic concepts of OOP principles and proper program structuring

CO4: demonstrate the concepts of polymorphism, inheritance, packages & interfaces

CO5: analyze Java programs to implement error handling techniques using exception handling

CO6: apply I/O streams and design of an applet

Topics:

- Web Development
- Introduction to Java
- Classes, Inheritance
- Interface, Package
- Exception Handling
- String Handling
- Java I/O Stream
- Applet

Textbook(s):

1. Java Programming for Core and Advanced Learners, Sagayaraj, Denis, Karthik and Gajalakshmi, 1st Edition, Universities Press 2018

Reference Book(s) :

1. Java-The Complete Reference,Herbert Schildt, 9th Edition, McGraw Hill Education 2014
 2. HTML- Complete Reference,Powell, 3rd Edition, TMH 2007
- Introduction to JAVA Programming, Y.Daniel Liang, 6th Edition, Pearson Education 2007

IT 2005 Object Oriented Programming

Credit: 3

Category: PCC / OEC

Prerequisite(s): Computer Programming (CS 1093)

Course description:

This course is a comprehensive hands-on introduction to object oriented programming in C++ for C programmers. Emphasis is placed on the features of C++ that support effective modeling of the problem domain and reuse of code. Topics include Introduction to Object Oriented Programming, Class and Object, Constructor and Destructors, Static members, Friend functions, Inheritance, Polymorphism: Operator Overloading, Virtual Functions, Exception Handling, Templates, Files and Streams. Besides the theoretical foundations, students acquire Hands -on experience by implementing all the OOPs concepts.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: understand the difference between structure-oriented programming and object-oriented programming
- CO2: apply object-oriented programming language like C++ and associated libraries to develop object- oriented programs
- CO3: apply various object-oriented features like class, object, inheritance, data abstraction, encapsulation polymorphism to solve various computing problems using C++ language
- CO4: apply and Analyzing concepts of operator-overloading, constructor and destructor
- CO5: apply and evaluate exception handling and use built-in classes from STL
- CO6: implement, test and debug solutions in C++

Topics:

- Introduction to Object Oriented Programming
- Class and Object
- Inheritance
- Polymorphism
- Exception Handling, Templates, Files and Streams

Textbooks(s) :

1. Object Oriented Programming with C++, Reema Thareja, OXFORD University Press, Revised First Edition, 2018.
2. Object Oriented Programming with C++, E.Balaguruswamy, McGraw Hill Education; Seventh edition 2017.

Reference Books(s):

1. C++ completes reference, Herbert Schildt, TMG Hill, 4th Edition, 2002.
2. C++ How to Program, Deitel and Deitel, Pearson Education Asia, 8th Edition, 2011.
Object Oriented Programming with Ansi and Turbo C++, Ashok N Kamthane, Pearson Education, 1st Edition,2003

IT 2095 Object Oriented Programming Laboratory

Credit: 1
Category: PCLC
Prerequisite(s): Nil

Course Description:

Object oriented programming lab uses C++ language for program implementation. This course is helpful for the students as they get to learn the basics of object-oriented programming and to use them along with the traditional programming concepts of C.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: apply an object oriented approach to programming and identify potential benefits of object-oriented programming over other approaches
- CO2: reuse the code and write the classes which work like built-in types
- CO3: design applications which are easier to debug, maintain and extend
- CO4: apply object-oriented concepts in real world applications

Topics:

- Execution of basic Input / Output statements in C++
- Execution of programs using Class & Objects
- Execution of programs using Constructors
- Execution of programs using Friend Function & Friend Class
- Execution of programs using concepts of Inheritance
- Execution of programs using concepts of Polymorphism (Function overloading, Operator overloading, Virtual Functions)
- Execution of programs using Pointers
- Execution of programs using Templates
- Execution of programs using File Handling in C++

IT 3003 Software Engineering

Credit: 4
Category: PCC
Prerequisite(s): Nil

Course Description:

This course will explore several concepts and principles in parallel with software development. The course will begin with an introduction to software engineering as well as discussion of the main methodologies of software engineering. It covers all the phases of SDLC. The quality and reliability attributes of the software also discussed. Recent trends like Client-Server Software engineering, Service Oriented Architecture (SOA), Software as a Service (SaaS) are also discussed.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: differentiate different software process models and understand their applicability in real life projects
- CO2: gather and specify requirements of the software projects
- CO3: apply the basic project management practices in real life projects
- CO4: translate the baseline requirement specifications into design & development process
- CO5: distinguish and apply different testing methodologies
- CO6: evaluate different software matrix

Topics:

- Software Process Models
- Software Requirement Engineering
- Software Project Management
- Structural Analysis & Design
- Testing Strategies
- Software Reliability Software Maintenance
- Emerging Topics

Textbook (s):

1. Fundamentals of Software Engineering, Rajib Mall, PHI, Fifth edition.

Reference Books(s):

1. Software Engineering, A Practitioner's Approach, Roger S. Pressman, TMG Hill, Eighth edition.
2. Software Engineering, I. Sommerville, Pearson Education, Asia, Tenth Edition.

IT 3005 Computer Networks

Credit: 3
Category: PCC
Prerequisite(s): Nil

Course Description:

This course provides an introduction to computer networks, with a special focus on the Internet architecture and protocols. Topics include layered network architectures, addressing, naming, forwarding, routing, communication reliability, the client-server model, web and email protocols. Besides the theoretical foundations, students acquire practical experience by implementing the basic features of real Internet protocols.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: understand different models used for communication in a computer network
- CO2: analyze how information transforms while moving through various layers of a computer network
- CO3: apply the working of various application layer protocols to design a new protocol
- CO4: evaluate the performance and reliability of data transmission
- CO5: evaluate how to check and preserve the integrity of data during communication in a network
- CO6: analyze the techniques of interconnection of nodes

Topics:

- Introduction
- Application Layer
- Transport Layer
- Network Layer
- Link-layer

Textbook(s):

1. Computer Networks: A top-down approach by Forouzan, McGrawHill .

Reference Book(s):

1. Computer Networking: A top-down approach”, by Kurose and Ross, 5th Edition, Pearson
2. Computer Networks”, by A.S. Tannenbaum, 5th Edition, Pearson
3. Computer Networks: A systems approach”, by Peterson and Davie, 5th Edition, Morgan Kaufmann

IT 3006 Data Analytics

Credit: 3
Category: PCC
Prerequisite(s): Nil

Course Description:

This course provides an introduction to the concepts of big data, with focus on data analytics techniques and models. Topics include data analysis techniques such as regression modeling, support vector machines, time series analysis, rule Induction, sequential cover algorithm, data stream management systems, filtering streams for mining data streams. It further covers key topics such as hadoop, mapreduce, pig, hive, NoSQL and visualization concepts for handling the complexity of semi-structured and unstructured data. Besides the theoretical foundations, students formulate the concepts, principles, and techniques focusing on the applications to industry and real world experience.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: understand and classify the characteristics, concepts and principles of big data
- CO2: apply the data analytics techniques and models
- CO3: implement and analyze the data analysis techniques for mining data streams
- CO4: examine the techniques of clustering and frequent item sets
- CO5: analyze and evaluate the framework and vizualization for big data analytics
- CO6: formulate the concepts, principles and techniques focusing on the applications to industry and real world experience

Topics:

- Introduction to Big Data
- Data Analysis
- Mining Data Streams
- Frequent item sets and Clustering
- Frameworks and Visualization

Textbook(s):

1. Data Analytics, Radha Shankarmani,M. Vijayalaxmi, Wiley India Private Limited, ISBN: 9788126560639.

Reference Book(s):

1. Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data by EMC Education Services (Editor), Wiley, 2014
2. Bill Franks, Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with advanced analystics, John Wiley & sons, 2012.
3. Glenn J. Myatt, Making Sense of Data, John Wiley & Sons, 2007 Pete Warden, Big Data Glossary,O'Reilly, 2011.
4. Jiawei Han, MichelineKamber "Data Mining Concepts and Techniques", Second Edition, Elsevier, Reprinted 2008.
5. Stephan Kudyba, Thomas H. Davenport, Big Data, Mining, and Analytics, Components of Strategic Decision Making, CRC Press, Taylor & Francis Group, 2014
6. Big Data, Black Book, DT Editorial Services, Dreamtech Press, 2015

IT 3007 Internet Of Things

Credit: 3
Category: PCC
Prerequisite(s): Computer Networks (IT 3005)

Course Description:

The Internet of Things (IoT) is everywhere. It provides advanced data collection, connectivity, and analysis of information collected by computers everywhere—taking the concepts of Machine-to-Machine communication farther than ever before. This course gives a foundation in the Internet of Things, including the components, tools, and analysis by teaching the concepts behind the IoT and a look at real-world solutions.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: understand basics of IoT
- CO2: apply knowledge of IoT in the application areas of IoT
- CO3: design IoT systems using IoT design methodology
- CO4: analyze the working of different IoT physical devices
- CO5: judge the applications of IoT in BigData and cloud
- CO6: develop different IoT based application related to different domain area of IoT

Topics:

- Introduction to Internet of Things
- Application of Domain Specific IoTs: Home Automation, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health& Lifestyle
- IoT and M2M
- IoT Platform Design Methodology
- IoT Physical Devices & Endpoint
- IoT Physical Server and Cloud Offering
- Case Studies Illustrating IoT Design
- Advanced Topics

Textbook(s):

1. Arshadeep Bahga,Vijay Madisetti, "Internet of Things -A Hands-on Approach", Universities Press, 1st Edition, ISBN:9788173719547.

Reference Book(s):

1. Adrian McEwen, Hakim Cassimally, "Designing the Internet of Things", Wiley Publication, 1st Edition, November 2013,ISBN:9781118430620.
2. Harry Fairhead , "Raspberry Pi IOT in C", IO Press Publication, 1st Edition, ISBN:9781871962468.

IT 3022 Cloud Computing

Credit: 3
Category: PCC
Prerequisite(s): Nil

Course Description:

The course presents a top-down view of cloud computing, from applications and administration to programming and infrastructure. Its main focus is on parallel programming techniques for cloud computing and large scale distributed systems which form the cloud infrastructure. The topics include: overview of cloud computing, cloud systems, parallel processing in the cloud, distributed storage systems, virtualization and security in the cloud.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: understand the basic concepts of Distributed System and Cloud Computing
- CO2: analyze the different cloud models
- CO3: compare the various cloud services and cloud platforms
- CO4: analyze various scheduling techniques applied in cloud platform
- CO5: appraise VM provisioning and migration techniques used in cloud environment
- CO6: examine various cloud applications and issues

Topics:

- Introduction to various computing environment
- Cloud Models
- Cloud Services
- Virtualization
- Cloud Application and challenges

Textbook(s):

1. Cloud Computing by Shailendra Singh, Oxford University Press, 2018

Reference Book(s):

1. Cloud Computing Principles and Paradigms, edited by Rajkumar Buyya, James Broberg and Andrzej Goscinski, Wiley Publication, 2013
2. Cloud Computing for Dummies, Judith Hurwitz, Robin Bloor, Marcia Kaufman and Fern Halper, Wiley Publication, 2009

IT 3095 Networks Laboratory

Credit: 1

Category: PCLC

Prerequisite(s): Computer Programming (CS 1093)

Course Description:

This course enables students to develop skills required to design, develop and troubleshoot network based applications.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: understand how network protocols will work
- CO2: design network protocols for communication
- CO3: implement network protocols
- CO4: troubleshoot implementation of Network protocols
- CO5: understand the working of network routing

Topics:

- The concept of networking and its significance in computer network, its components (i.e. h/w and s/w) required for data communication in a Computer Network. (Showing the h/w components like Network Interface Card (NIC), Network Cable, RG-45 Connector, Hub, Switch, Router etc.)
- Highlight the importance of socket programming as a s/w for data communication and the basic fundamentals required for doing socket programming using C
- Review of function, pointer, structure, structure with in a structure, pointer to structure, and command line argument concept using C programming Language
- The concept of little endian and big endian & its significance of endianness in computer network
- Basics of Socket Programming. Details of Connection less Socket programming APIs for TCP/IP stack using C Programming
- Details of Connection Oriented Socket programming APIs for TCP/IP stack using C Programming
- Demonstration of the packet Analyzer tool (wireshark) to analyze the details of a packet which is captured during packet transmission in the network
- Overview of file transfer over a computer network. Discussion of how to design a stop-and-wait protocol on top of connectionless sockets. Discussion of how to fragment and reassemble packets at the source and destination host respectively

Credit: 4
Category: BSC
Prerequisite(s): Nil

Course Description:

Students are taught Partial differential equations based on the propagation of heat, wave etc to use in solving engineering problems. The concept of Complex analysis, Residual integration are included to get the knowledge on complex plane. Numerical analysis is included to get approximate solutions to difficult problems for which analytical solution is hard to obtain. Students are given common Probability and Statistical knowledge to use statistical analysis of data.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: solve the PDE problems by separable method, Laplace transform
- CO2: know Complex plane , Complex functions, their differentiation and integration
- CO3: find series expansion of complex functions and evaluate real integrals by residue method
- CO4: determine roots of algebraic/transcendental equations through Newton and Lagrange method and obtain interpolating Polynomials
- CO5: solve ODE numerically by single step and multi step method
- CO6: work out problems related to probability distribution and statistical regression and co- relation

Topics:

- Partial Differential Equation
- Complex Analysis
- Numerical Methods
- Probability

Textbook(s):

1. Advanced Engineering Mathematics(10th edition) by E. Kreyszig , Wiley .

Reference Book(s):

1. Engineering Mathematics by S. Pal and S.C. Bhunia, Oxford University Press.

Credit: 4
Category: BSC
Prerequisite(s): Nil

Course Description:

Discrete mathematics includes different mathematical logics, idea of set, relation and function. Emphasis is given on the recurrence relation and their Algebraic structure

Course Outcomes: At the end of the course, the students will be able to:

- CO1: convert sentences in natural language into mathematical statements and understand predicate and quantifiers, rules of inference and prove results by principle of mathematical induction
- CO2: use the principles of inclusion and exclusion of sets, relations and functions and solve related problems
- CO3: use the idea of partition of sets, partial ordering relation, Hasse diagram and Lattice
- CO4: work out problems on recurrence relations by substitution and method of generating functions
- CO5: analyse algebraic structures, groups, semi group, subgroups and proof of Lagrange's theorem
- CO6: identify homomorphism and isomorphism of groups, ring, integral domain and field

Topics:

- Propositional logic, predicate logic, mathematical induction
- Set, Relation & Function
- Recurrence Relation and their solutions Algebraic structure

Textbook(s):

1. Discrete Mathematics and its Applications by Kenneth H Rosen (Mc Graw Hill 7th Edition)

Reference Book(s):

1. Elements of Discrete Mathematics. A Computer oriented approach by C.L Liu, D.P. Mohapatra (Tata Mc Graw Hill 4th Edition-2013)



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ACADEMIC CURRICULA 2021 - 2025

BACHELOR'S DEGREE PROGRAMME
B. Tech in
Electronics & Electrical Engineering
Curricula & Syllabi



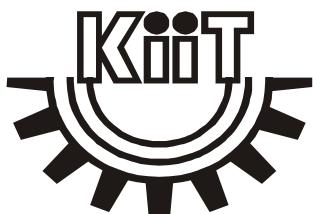
Kalinga Institute of Industrial Technology (KIIT)
Deemed to be University U/S 3 of UGC Act, 1956
Bhubaneswar, Odisha, India

ACADEMIC CURRICULA

2021 - 2025

BACHELOR'S DEGREE PROGRAMME
B. Tech in
Electronics & Electrical Engineering

**Course Structure and Detailed Syllabi
for students admitted in
2021 - 25
Academic Session**



Kalinga Institute of Industrial Technology (KIIT)
Deemed to be University U/S 3 of UGC Act, 1956
Bhubaneswar, Odisha, India

B. TECH IN ELECTRONICS AND ELECTRICAL ENGINEERING

Programme Educational Objectives (PEOs):

The B. Tech Programme in Electronics and Electrical Engineering aims to prepare the graduates with the following objectives:

1. Graduates will be able to lead a successful career in industry, pursue higher study or entrepreneurial endeavor through application of domain specific knowledge in the areas of embedded system design, signal processing, instrumentation and control, electrical machines, power engineering and allied fields of Electronics and Electrical Engineering.
2. Graduates will be able to perceive feasibility and impact of engineering solutions in social, legal, environmental, economic and multi-disciplinary context.
3. Graduates will be able to demonstrate professional and ethical responsibility and engage in life-long learning.

Programme Outcomes (POs):

The programme outcomes are:

- a) Engineering knowledge: Ability to apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- b) Problem analysis: Ability to identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- c) Design/Development of solutions: Ability to design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- d) Conduct investigations on complex problems: Ability to use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- e) Modern tool usage: Ability to create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- f) The engineer and society: Ability to apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- g) Environment and sustainability: Ability to understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- h) Ethics: Ability to apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- i) Individual and team: Ability to function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- j) Communication: Ability to communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

- k) Project management and finance: Ability to demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- l) Life-long learning: Ability to recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes (PSOs)

The programme specific outcomes are:

- m) Ability to design and implement electronic circuits, electrical machine, drives and different power systems in industry.
- n) Ability to carry out research in the fields of embedded systems, renewable energy, machine design and smart grids.
- o) Ability to utilize the knowledge in solving practical problems for electronics and electrical systems.

Abbreviations used in describing the category in all the courses are as follows:

BSC:	Basic Science Course
BSLC:	Basic Science Laboratory Course
ESC:	Engineering Science Course
ESLC:	Engineering Science Laboratory Course
HSMC:	Humanities, Social Science & Management Course
PCC:	Professional Core Course
PCLC:	Professional Core Laboratory Course
PEC:	Professional Elective Course
OEC:	Open Elective Course
PROJ:	Project
IEC:	Industry Elective Course

**COURSE STRUCTURE FOR B. TECH IN ELECTRONICS AND ELECTRICAL
ENGINEERING**

**SCHEME-I
SEMESTER – I**

Theory							
Sl. No	Course Code	Course Title	L	T	P	Total	Credit
1.	MA 1003	Mathematics – I	3	1	0	4	4
2.	PH 1007	Physics	3	1	0	4	4
3.	EE 1003	Basic Electrical Engineering	3	0	0	3	3
4.	ME 1003	Engineering Mechanics	3	0	0	3	3
Total of Theory						14	14
Practical							
1.	PH 1097	Physics Lab	0	0	3	3	1.5
2.	EE 1093	Basic Electrical Engineering Lab	0	0	2	2	1
Sessional							
1.	ME 1083	Basic Manufacturing Systems	0	1	2	3	2
2.	CH 1081	Environmental Science	0	0	2	2	1
Total of Practical & Sessional						10	5.5
Semester Total						24	19.5

SCHEME-I
SEMESTER – II

Theory							
Sl. No	Course Code	Course Title	L	T	P	Total	Credit
1.	MA 1004	Mathematics – II	3	1	0	4	4
2.	CH 1007	Chemistry	3	0	0	3	3
3.	HS 1005	Professional Communication	2	0	0	2	2
4.	LS 1001	Biology	2	0	0	2	2
Total of Theory						11	11
Practical							
1.	CS 1093	Computer Programming	0	2	4	6	4
2.	CH 1097	Chemistry Lab	0	0	3	3	1.5
Sessional							
1.	HS 1085	Language Lab	0	0	2	2	1
2.	CE 1083	Engg. Graphics	0	1	2	3	2
Total of Practical & Sessional						14	8.5
Semester Total						25	19.5
	EAA- 1	Extra Academic Activity					P/NP

SEMESTER – III

Sl. No	Course Code	Course Title	L	T	P	Total	Credit
Theory							
1	MA 2007	Mathematics-III (Electrical)	3	1	0	4	4
2	EC 2027	Analog Electronics	3	1	0	4	4
3	EE 2015	Electrical Circuits Analysis	3	0	0	3	3
4	EC 2023	Principle of Signals and Systems	2	0	0	2	2
5	EE 2017	Transformers and Induction Motors	3	0	0	3	3
6	EI 2003	Electrical & Electronic Measurement Techniques	3	0	0	3	3
Total of Theory						19	19
Practical							
1	EC 2091	Electronic Circuits & Network Lab	0	0	3	3	1.5
2	EI 2095	Electrical & Electronic Measurements Lab	0	0	2	2	1
Sessional							
1	HS 2081	Business Communication	0	0	2	2	1
Total of Practical & Sessional						7	3.5
Semester Total						26	22.5

SEMESTER – IV

Sl. No	Course Code	Course Title	L	T	P	Total	Credit
Theory							
1	EC 2011	Digital Electronics	3	0	0	3	3
2	CS 2001	Data Structure and Algorithms	3	1	0	4	4
3	EE 2020	DC Machines & Synchronous Machines	3	0	0	3	3
4	EC 2014	Electromagnetic Theory	3	0	0	3	3
5	EE 2028	Linear Control System	3	0	0	3	3
6		HS Elective-I	3	0	0	3	3
Total of Theory							19
Practical							
1	EC 2096	Digital & Linear IC Lab	0	0	2	2	1
2	EE 2096	Electrical Machines Lab	0	0	3	3	1.5
3	CS 2091	Data Structures Lab	0	0	2	2	1
4	EC 2098	Simulation Lab	0	0	2	2	1
Total of Practical							9
Semester Total							28
							23.5

SEMESTER – V

Sl. No	Course Code	Course Title	L	T	P	Total	Credit
Theory							
1	EC 2016	Communication Engineering	3	1	0	4	4
2	EE 2024	Generation, Transmission & Distribution of Electric Power	3	1	0	4	4
3	EE 3028	Power Electronics Circuits	3	0	0	3	3
4	EC 2020	Microprocessors, Microcontrollers & Interfacing	3	1	0	4	4
5		Department Elective-I	3	0	0	3	3
6		Department Elective-II	3	0	0	3	3
Total of Theory							21
Practical							
1	EC 2090	Microprocessor and Microcontroller Lab	0	0	2	2	1
2	EE 3098	Control Lab	0	0	2	2	1
3	EE 2098	Power Electronics Lab	0	0	3	3	1.5
Total of Practical							7
Semester Total							28
							24.5

SEMESTER –VI

Sl. No	Course Code	Course Title	L	T	P	Total	Credit
1	EC 3007	Digital Signal Processing	3	1	0	4	4
2	EE 3002	Power System Operation and Control	3	1	0	4	4
3		Department Elective-III	3	0	0	3	3
4		Department Elective-IV	3	0	0	3	3
5		Department Elective-V	3	0	0	3	3
6		Open Elective-I / (MI-1)	3	0	0	3	3
Total of Theory						20	20
Practical							
1	EE 3092	Power System Lab	0	0	3	3	1.5
2	EC 3096	DSP Lab	0	0	2	2	1
Sessional							
1	EL 3082	Minor Project	0	0	4	4	2
Total of Practical & Sessional						9	4.5
Semester Total						29	24.5

SEMESTER – VII

Sl. No	Course Code	Course Title	L	T	P	Total	Credit
Theory							
1		HS Elective-II	3	0	0	3	3
2	HS 4001	Professional Practice, Law & Ethics	2	0	0	2	2
3		Open Elective-II / (MI-2)	3	0	0	3	3
(4)		(MI-3)	(3)	(0)	(0)	(3)	(3)
(5)		(MI-4)	(3)	(0)	(0)	(3)	(3)
(6)		(HO-1)	(3)	(0)	(0)	(3)	(3)
Total of Theory						8	8
Sessional							
1	EL 4081	Project-I / Internship					3
2	EL 4083	Practical Training	-	-	-	-	2
(3)		(Project – Minor / Lab)	(0)	(0)	(4)	(4)	(2)
Semester Total							13

SEMESTER-VIII

Sl. No	Course Code	Course Title	L	T	P	Total	Credit
Theory							
(1)		(MI-5)	(3)	(0)	(0)	(3)	(3)
(2)		(MI-6)	(3)	(0)	(0)	(3)	(3)
(3)		(HO-2)	(3)	(0)	(0)	(3)	(3)
(4)		(HO-3)	(3)	(0)	(0)	(3)	(3)
Sessional							
1	EL 4082	Project - II / Internship					10
Semester Total							10

MI – Minor

HO - Honors

LIST OF HS ELECTIVES

HS Elective – I

Sl. No	Course Code	Course Title	Credit
1.	HS 2002	Engineering Economics	3
2.	HS 2008	Economic Environment of India	3
3.	HS 2010	Financial Institutions, Markets and Regulations	3
4.	HS 2012	Development Economics	3

HS Elective – II

1.	HS 3006	Entrepreneurship	3
2.	HS 3008	Management Concepts & Practices	3
3.	HS 3002	Organizational Behaviour	3
4.	HS 3004	Human Resource Management	3

LIST OF DEPARTMENT ELECTIVES

Dept. Elective – I

1.	EE 3038	Utilization of Electric Power	3
2.	EE 3017	Renewable Energy Sources	3
3.	EI 3027	Industrial Instrumentation	3
4.	EL 3024	Industrial Automation & Control	3

Dept. Elective - II

1.	EL 3022	Advanced Control System	3
2.	EC 3021	Neural Network & Machine Learning	3
3.	EE 3035	Energy Storage Technology	3
4.	EC 3011	VLSI Design	3

Dept. Elective - III

1.	EE 3006	Electric Drives & Control	3
2.	EE 3068	Power Converter Analysis & Design	3
3.	EC 3023	Optimization Techniques in Engineering	3
4.	EC 3060	Mobile Communication Engineering	3

Dept. Elective – IV

1.	EE 3008	Power System Protection	3
2.	EE 3048	HVDC & FACTS	3
3.	EC 3028	Data Communication & Networking	3
4.	EI 3032	Principle of Sensors & Data Acquisition	3

Dept. Elective – V

1.	EE 3058	Energy Audit and Accounting	3
2.	EE 3072	Computer Aided Power Systems	3
3.	EC 3033	Embedded System Design and Applications	3
4.	EI 3022	Biomedical Instrumentation	3

LIST OF OPEN ELECTIVES OFFERED BY SCHOOL OF ELECTRONICS ENGINEERING

Sl. No	Course Code	Course Title	Prerequisite/s
1	EC 2011	Digital Electronics	NIL
2	EC 2021	Signals & Networks	Math-II (MA 1004)
3	EC 3044	Introduction to Communication Engineering	NIL
4	EC 3066	Principles of Microprocessors and Microcontrollers	Digital Electronics (EC 2011)
5	EI 3027	Industrial Instrumentation	Basic Electrical Engineering (EE 1003)
6	EC 3013	Principle of Digital Signal Processing	Math-II (MA 1004)
7	EL 2002	Principle of Control System	Signals & Networks (EC 2021)
8	EC 3011	VLSI Design	Digital Electronics (EC 2011)
9	EC 3033	Embedded system Design and Applications	Microprocessors and Microcontrollers (EC 2020) /Principles of Microprocessors and Microcontrollers (EC 3066)
10	EL 3024	Industrial Automation & Control	Principle of Control Systems (EL 2002) /Linear Control System (EL 2028)
11	EC 6108	Digital Image Processing	Principle of Digital Signal Processing (EC 3013) / Digital Signal Processing (EC 3007)
12	EC 3060	Mobile Communication Engineering	Communication Engineering (EC 2016) /Introduction to Communication Engineering (EC 3044) / Principle of Digital Communication (EC 2004)
13	EC 3050	Internet of Things and its applications	Microprocessors and Microcontrollers (EC 2020) / Principles of Microprocessors and Microcontrollers (EC 3066)

MINOR IN ELECTRONICS & TELECOMMUNICATION ENGINEERING

Sl. No	Course Code	Course Title	Prerequisite/s
1	EC 2025	Principles of Electronics Engineering	Nil
2	EC 2011	Digital Electronics	Nil
3	EC 3066	Principle of Microprocessors and Microcontrollers	Digital Electronics (EC2011)
4	EC 2021	Signals and Networks	Mathematics-II (MA1004)
5	EC 2014	Electromagnetic Theory	Mathematics-II (MA1004)
6	EC 3011	VLSI Design	Analog Electronic Circuits
7	EC 3031	ARM and Advanced Processors	Principle of Microprocessors and Microcontrollers (EC3066)
8	EC 3035	High speed Digital system Design	Digital Electronics (EC2011)
9	EC 3044	Introduction to Communication Engineering	Nil
10	EC 3015	Microwave Engineering	Nil
11	EC 3028	Data Communication and Networking	Introduction to Communication Engineering (EC3044)
12	EC 3060	Mobile communication Engineering	Introduction to Communication Engineering (EC3044)/Principle of Digital Communication (EC2004)/Communication Engineering (EC2016)
13	EC 3050	Internet of Things and its Applications	Principle of Microprocessors and Microcontrollers (EC3066)
14	EC 6122	Satellite Communication Systems	Introduction to Communication Engineering (EC3044)/Principle of Digital Communication (EC2004)/Communication Engineering (EC2016)
15	EC 3029	Optical Communication and Networking	Introduction to Communication Engineering (EC3044)/Principle of Digital Communication (EC2004)/Communication

			Engineering (EC2016)
16	EC 3021	Neural Networks and Machine Learning	Mathematics-I &II (MA1003 and MA1004)
17	EC 1094	Analog Electronic Circuits Lab	
18	EC 2093	Digital Electronics Lab	
19	EC 3095	VLSI Lab	

MINOR IN ELECTRONICS & INSTRUMENTATION ENGINEERING

Sl. No	Course Code	Course Title	Prerequisite/s
1	EC 2025	Principles of Electronics Engineering	Nil
2	EI 2003	Electrical & Electronic Measurement Techniques	Basic Electrical Engineering (EE 1003)
3	EC 2021	Signals and Networks	Mathematics-II (MA 1004)
4	EL 2002	Principle of Control System	Signals and Networks (EC 2021)
5	EI 2012	Sensors and Signal Conditioning	Electrical and Electronic Measurement Techniques (EI 2003)
6	EI 3009	Instrumentation Measurement Techniques	Electrical & Electronic Measurement Techniques (EI 2003)
7	EI 3029	Process Dynamics and Control	Principle of Control System (EL 2002)
8	EI 3025	Principle of Analytical Instrumentation	Chemistry (CH 1007)
9	EI 3030	Power Plant Instrumentation	Instrumentation Measurement Techniques (EI 3009)
10	EI 3032	Principle of Sensors and Data Acquisition	Electrical and Electronic Measurement Techniques (EI 2003)
11	EI 3023	Neural Network & Fuzzy Logic Control	Mathematics-I (MA 1003), Mathematics-II (MA 1004) and Principle of Control System (EL 2002)
12	EI 2095	Electrical & Electronic Measurements Lab	
13	EI 3091	Instrumentation Lab	
14	EI 3092	Process Control Lab	

MINOR IN VLSI AND EMBEDDED SYSTEM

Sl. No	Course Code	Course Title	Prerequisite/s
1	EC 2025	Principles of Electronics Engineering	Nil
2	EC 2011	Digital Electronics	Principles of Electronics Engineering (EC 2025)
3	EC 2005	Semiconductor Devices	Principles of Electronics Engineering (EC 2025)
4	EC 3066	Principle of Microprocessors and Microcontrollers	Digital Electronics (EC 2011)
5	EC 3011	VLSI Design	Digital Electronics (EC2011)
6	EC 3035	High Speed Digital System Design	Digital Electronics (EC2011)
7	EC3033	Embedded System Design and Applications	Digital Electronics (EC2011)
8	EC 3031	ARM and Advanced Processors	Microprocessors, Microcontrollers& Interfacing (EC 2020) / Principle of Microprocessors and Microcontrollers (EC 3066)
9	EC 3068	Real Time Systems and Application	Digital Electronics (EC 2011)
10	EC 6224	Low Power VLSI Design	VLSI design (EC 3011)
11	EC 3058	Nanoelectronics	Principles of Electronics Engineering (EC 2025)
12	EC 2093	Digital Electronics Lab	
13	EC 2090	Microprocessor and Microcontroller Lab	
14	EC 3095	VLSI Lab	

MINOR IN SENSORS & SIGNALS

Sl. No	Course Code	Course Title	Prerequisite/s
1	EC 2025	Principles of Electronics Engineering	Nil
2	EC 2011	Digital Electronics	Nil
3	EC 2021	Signals and Networks	Mathematics-II (MA1004)
4	EC 3066	Principle of Microprocessors and Microcontrollers	Digital Electronics (EC 2011)
5	EI 2003	Electrical & Electronic Measurement Techniques	Basic Electrical Engineering (EE 1003)
6	EI 2012	Sensors & Signal Conditioning	Electrical and Electronic Measurement Techniques (EI 2003)
7	EC 3013	Principle of Digital Signal Processing	Signals and Network (EC 2021)
8	EI 3032	Principle of Sensors & Data Acquisition	Electrical & Electronic Measurement Techniques (EI 2003)
9	EC 3021	Neural Networks &Machine Learning	Mathematics-I and Mathematics-II (MA1003 and MA1004)
10	EC 3050	Internet of Things and its applications	Principle of Microprocessors and Microcontrollers (EC3066)
11	EC 6108	Digital Image Processing	Principle of Digital Signal Processing (EC 3013)
12	EI 3024	Virtual Instrumentation	Sensors and Signal Conditioning (EI 2012),Digital Electronics (EC 2011)
13	EC 3056	Speech and Audio Signal Processing	Principle of Digital Signal Processing (EC 3013)
14	EC 2093	Digital Electronics Lab	-
15	EI 2095	Measurements and Instrumentation Lab	-
16	EC 3099	DSP Lab	-

MINOR IN “COMMUNICATION NETWORKS, INTELLIGENT IOT & CYBER PHYSICAL SYSTEMS”

S1 No	Course Code	Course Title	Prerequisite/s
1	EC 2025	Principles of Electronics Engineering	Nil
2	EC 2011	Digital Electronics	Nil
3	EC 3044	Introduction to Communication Engineering	Nil
4	EC 3066	Principle of Microprocessors and Microcontrollers	Digital Electronics (EC 2011)
5	EC 3033	Embedded System Design and Applications	Principles of Microprocessors and Microcontrollers (EC 3066)
6	EC 3028	Data Communication and Networking	Introduction to Communication Engineering (EC 3044)
7	EC3050	Internet of Things and its applications	Principles of Microprocessors and Microcontrollers (EC 3066)
8	EC 3070	MANET AND WSN	Data Communication and Networking (EC 3028)
9	EC 6112	Communication & Network Security	Data Communication and Networking (EC 3028)
10	EC 3072	Introduction to machine learning	Mathematics-I & II (MA1003 and MA1004)
11	EC 3074	Internet Technologies for cloud & Edge computing	Computer Programming (CS 1093)
12	EC 3076	IoT & Cyber-Physical System Design	Internet of Things and its applications (EC3050)
13	EC 4061	AI and Machine Learning for IoT	Mathematics-I & II (MA1003 and MA1004) & Internet of Things and its applications (EC3050)
14	EC 2093	Digital Electronics lab	

15	EC 2090	Microprocessor and Microcontroller Lab	
14	EC 4099	Internet of Things & connected intelligent systems Lab	
15	EC XXXX	Project	

MINOR IN “APPLIED MACHINE LEARNING”

Sl No	Course Code	Course Title	Prerequisite/s
1	EC 2025	Principles of Electronics Engineering	Nil
2	EC 2011	Digital Electronics	Nil
3	EC 3044	Introduction to Communication Engineering	Nil
4	EC 3066	Principle of Microprocessors and Microcontrollers	Digital Electronics (EC 2011)
5	EC 3033	Embedded System Design and Applications	Principles of Microprocessors and Microcontrollers (EC 3066)
6	EC 3028	Data Communication and Networking	Introduction to Communication Engineering (EC 3044)
7	EC3007	Digital Signal Processing	
8	EC 6108	Digital Image Processing	Digital Signal Processing
9	EC 3072	Introduction to Machine learning	Computer Programming (CS 1093)
10	EC 3078	Signal Understanding Using Machine Learning	Signal and Network
	EC 3080	Deep Learning	
11	EC 4059	Computer Vision and Pattern Recognition	Digital Image Processing
12	EC 2093	Digital Electronics lab	
13	EC 2090	Microprocessor and Microcontroller Lab	
12	EC 4097	Machine learning Lab	
13	EC XXXX	Project	

COURSES OF FIRST YEAR

MA 1003 Mathematics-I

Credit: 4

Category: BSC

Prerequisite(s): Nil

Course Description:

The laws of nature are expressed as differential equations. The construction of mathematical models to address real-world problems has been one of the most important aspects of each of the branches of science. This course is designed to familiarize the prospective engineers with techniques in ordinary differential equations, multivariate calculus and solution for ODEs numerically. This course also focuses on Linear algebra that covers system of linear equations and properties of matrices. The objective of the course is to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced levels of mathematics and applications that they would find useful in their disciplines.

Course Outcomes: At the end of the course, the students will be able to:

CO1: model and formulate differential equation of Physical problems

CO2: apply different methods to solve 1st and 2nd order ODEs

CO3: apply numerical methods to solve ODEs

CO4: study differential calculus in engineering problems

CO5: use the essential tool of matrices and linear algebra

CO6: analyze Eigenvalue problems

Topics:

- Ordinary Differential Equations.
- Linear differential equations of 2nd order.
- Differential calculus and Numerical methods to solve ODEs
- Vector space and system linear of equations
- Matrix-eigenvalue Problems

Textbook(s):

1. Advanced Engineering Mathematics by Erwin Kreyszig, Wiley, INC, (online) 10th Edition.
2. Differential Calculus, Shanti Narayan and P. K. Mittal, S. Chand, reprint 2009.

Reference Book(s):

1. Higher Engineering Mathematics, Grewal B.S., Khanna Publishers, 36th edition.
2. Introduction to engineering Mathematics, Dass H.K., S.Chand & Co Ltd, 11th edition.
3. Higher Engineering Mathematics, Ramana B.V., TMH, 2007.
4. A course on ordinary & Partial Differential Equation, Sinha Roy and S Padhy, Kalyani Publication, 3rd edition.

PH 1007 **Physics**

Credit: 4
Category: BSC
Prerequisite(s): Nil

Course Description:

This course includes the fundamentals of different types of oscillations and its applications; mathematical expression of waves and its physical interpretation; the concept of interference, diffraction and their applications; the principle, construction and working of different Lasers. The course also gives a flavour of Quantum mechanics, which is the founding stone to the state of the art in modern techniques and paves the way towards the world of nano devices. It covers the formulation of Maxwell's electromagnetic equations, and verification of different properties of electromagnetic waves. Mechanical and magnetic properties of different materials and their applications are also covered in this course.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: utilize the concept of waves and intensity modulation in day to day life through various applications
- CO2: apply the mechanism of LASER technology in different fields
- CO3: formulate and solve engineering problems of electricity and magnetism using Maxwell's electromagnetic equations
- CO4: apply the principles of quantum mechanics to related problems
- CO5: apply the knowledge of magnetic materials in related applications
- CO6: analyze the macroscopic behavior of solids and utilize them in future applications

Topics:

- Oscillation and wave
- Interference and diffraction
- LASER
- Quantum mechanics
- Electromagnetism
- Properties of matter (mechanical)
- Magnetism

Textbook (s):

1. Engineering Physics, B. K. Pandey and S. Chaturvedi, Cengage Publication, New Delhi

Reference Book(s):

1. Introduction to Electrodynamics, D J Griffiths, Pearson Education
2. Quantum Mechanics, L. I. Schiff, Tata McGraw-Hill Publications
3. Optics, A K Ghatak, Tata McGraw-Hill Publications
4. Concepts of Modern Physics, A. Beiser, Tata McGraw-Hill Publications
5. Engineering Physics, R K Gaur and S. L. Gupta, Dhanpat Rai Publications, New Delhi.

ME 1003 Engineering Mechanics

Credit: 2
Category: ESC
Prerequisite(s): Nil

Course Description:

The course on Engineering Mechanics is a specialized need-based extension of applied physics which is aimed at developing an understanding of the principle of statics and dynamics. The course focuses on learning methodical and logical idealization and subsequent implementation of corresponding procedures for analysis of rigid body, frame and machine under the action of force system which is highly essential for effective design. The course intends to develop the ability of drawing and analyzing the free body diagram of a system when at rest or motion using scalar/vector techniques. Further, the course serves as a prerequisite to fundamental machine design courses such as mechanics of solids and design of machine elements.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: draw complete and correct free-body diagrams and write the appropriate equilibrium equations from the free-body diagram
- CO2: use scalar analytical techniques for analyzing forces and moments in mechanical systems
- CO3: analyzing forces in statically determinate structures such as trusses, frames and problems related to friction
- CO4: determine the centroid and second moment of area
- CO5: apply fundamental concepts of kinematics and kinetics of particles to the analysis of simple and practical problems
- CO6: solve real-life problems by using mathematics, physical laws and theorems

Topics:

- Concurrent Forces in a Plane
- Friction
- Parallel Forces in a Plane
- Moment of Inertia
- Force analysis of Plane Trusses
- Principle of Virtual Work
- Kinematics of Rectilinear Motion
- Kinematics of Curvilinear Motion
- Rotation of a rigid body

Textbook(s):

1. Engineering Mechanics (Revised 5th edition), TMH by S. Timoshenko, D.H. Young, J.V Rao and S. Pati.

Reference Book (s):

1. Engineering Mechanics (Statics and Dynamics) - Bear and Johnson, TMH
2. Engineering Mechanics (Statics and Dynamics) by I.H. Shames, Prentice Hall
3. Engineering Mechanics –S.S. Bhavikatti, New Age International
4. Engineering Mechanics (Statics and Dynamics)-S. Rajasekaran & G Sankarasubramanian, Vikas Publishing House.

PH 1097 Physics Laboratory

Credit: 1.5
Category: BSLC
Prerequisite(s): Nil

Course Description:

This lab course covers different measurement techniques of various parameters using the instruments i.e. interferometer, spectrometer, spherometer, Screw gauge, vernier calliper, microspope, and telescope. It includes the application of photoelectric effect and photovoltaic effect in photo cell and solar cell respectively. Evaluation of the mechanical strength of materials by calculating elastic constants such as Young's modulus, rigidity modulus and Poisson's ratio are also included. This course provides hands on training for the usage of electrical, optical and mechanical systems for various measurements with precision and analysis of the experimental data by graphical interpretation and error calculation.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: calculate appropriate structural members using the fundamental concepts of the elastic behavior of materials
- CO2: use the principles of interference and diffraction to find out the wavelength of an unknown monochromatic source of light
- CO3: apply the concept of photoelectric emission to calculate the Planck's constant and analyze some aspects of electron-photon interaction through characteristic curves
- CO4: explore the efficiency in terms of power output of a green energy source i.e. solar cell
- CO5: calculate the acceleration due to gravity 'g' by using the concept of a compound pendulum

Topics:

- Estimation of elastic constants such as Young's modulus, rigidity modulus and Poisson's ratio
- Determination of wavelength of unknown source using Newton's rings and Michelson's interferometer
- Precision length measurement up to the order of 6 A° (distance between sodium D-lines) using Michelson interferometer
- Determination of grating element using a diffraction grating
- Study of photo cell and solar cell by analyzing their characteristic curves
- Determination of acceleration due to gravity using a bar pendulum

EE 1093 Basic Electrical Engineering Laboratory

Credit: 1
Category: ESLC
Prerequisite(s): Nil

Course Description:

Basic Electrical Engineering lab comprises of various equipments and loads i.e voltmeters, ammeters, wattmeters, single phase and three phase transformer, induction motors etc. It is a specialized practical oriented course which intends to develop and understand various principles like Ohm's law and Kirchoff's law. The course focused on learning methodical and logical idealization of various theorems which is highly essential for solving a network. The course intends to make the students familiar with various parts of DC machines and AC machines. The course intends to develop the ability of problem solving by analyzing RL and RLC series circuits. This lab helps the students to understand the principle of operation of a single phase transformer with its no load calculation.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: recall the safety practices in the laboratory and the associated work areas
- CO2: comprehend the skills for working in a team with common objective
- CO3: apply different theorems to find the parameters in DC and AC circuit
- CO4: analyse the different parts of DC and AC machines to describe operational features thereof
- CO5: apprise the experimental results in systematic manner
- CO6: discuss about determination of resistance in incandescent lamp and power factor in fluorescent lamp

Topics:

- measurement of resistance of tungsten filament lamp
- measurement of inductance of a choke coil
- study and use of megger
- study of different parts of dc machine and three phase induction motor
- layout of power system analysis
- determination of voltage ratio of a single phase transformer
- measurement of no load current and core loss of a single phase transformer
- verification of KCL and KVL
- verification of voltage and current ratio of star and delta connection
- study & determine the power factor of the RLC series circuit
- study, connection & determine the power factor of fluorescent tube
- verification of the superposition theorem
- transient analysis of series RL and RC circuit using matlab-simulink with dc excitation

Textbook(s):

1. Basic Electrical Engineering by D.C. Kulshreshtha, Tata Mcgraw publication, 1st Edition 2011.
2. Basic Electrical Engineering, T.K. Nagarkar and M.S. Sukhija, Oxford University press, 2nd Edition 2011.

Reference Book(s):

1. Basics Electrical Engineering Sanjeev Sharma, I.K. International, New Delhi.(Third Reprint 2010).

ME 1083 Basic Manufacturing Systems

Credit: 2
Category: ESLC
Prerequisite(s): Nil

Course Description:

This laboratory practice is designed to impart students the basic knowledge on manufacturing or developing a given object irrespective of their branch of engineering. While furnishing the given object, students will familiar with various mechanical operations and the respective tools or machines. This course involves four different sections namely Fitting, Welding, Turning and Sheet metal which covers both conventional and advanced tools to provide students the updated manufacturing experience. Students are also advised with various safety precautions to be followed during a specific manufacturing practice. At the end, students will also gain knowledge on different advanced machines such as CNC and 3D printing.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: practice different operations related to fitting shop
- CO2: use different welding tools to prepare a given type of joint
- CO3: demonstrate various turning operations including taper turning and knurling using a conventional lathe machine
- CO4: design a tray and prepare it using sheet metal equipment involving soldering
- CO5: appraise different operations using a CNC machine
- CO6: interpret different advanced machines such as 3D printing/additive manufacturing

Topics:

- Turning operations
- Sheet metal operations
- Fitting
- Welding

CH 1081 Environmental Science

Credit: 1
Category: BSLC
Prerequisite(s): Nil

Course Description:

The course is designed to make the students aware of different environmental components and their composition. It will make the students understand different pollutants, their sources and management. It will also help students to apply the principles of Green Chemistry and implement them in synthesis of advanced materials required for engineering applications. It also outlines the basic steps for developing the EIA statements

Course Outcomes: At the end of the course, the students will be able to:

- CO1: understand the different components and composition of the environment
- CO2: rationalize the different pollutants, their sources, effects and controlling measures
- CO3: quantify water quality parameters
- CO4: apply the systematic environmental impact assessment (EIA) requirements before setup of any project
- CO5: understand and implement the principles of solid waste management
- CO6: conceptualize the principles of green chemistry and implement them in synthesis of advanced material, so as to reduce the pollution

Topics:

- Overview on environment
- Environmental pollution: air pollution, water pollution
- Pollution management

Textbook(s):

1. Environmental Chemistry, A. K. De, New Age International Publishers.

Reference Book(s):

1. Environmental Chemistry- S. Chakroborty, D. Dave, S.S. Katewa, Cengage Publishers
2. Environment Science and Engineering, Aloka Debi. Second Edition ;Universities Press
3. Text Book of Environment studies for under graduate courses, Erach Bharucha : 2nd Edition, Universities Press
4. Fundamentals of Environment and Ecology, D. De, D. De; 2013, S. Chand Group
5. Engineering Chemistry, Jain and Jain, Dhanpat Rai Publishing Company

MA 1004 Mathematics-II

Credit: 4
Category: BSC
Prerequisite(s): Nil

Course Description:

The course is to familiarize the students with series solutions of ODEs, Laplace Transforms, Fourier series, vector calculus, and numerical integration. For the ODEs with variable coefficients, the situation is more complicated to get their solutions in elementary functions. Legendre and Bessel's equations are important ODEs of this kind and their solutions, the Legendre polynomials and Bessel functions play an important role in engineering applications. Laplace transforms can be used as a mathematical toolbox for engineers to solve linear ODEs and related initial value problems. The Fourier series and vector calculus play a very important role in many engineering areas such as solid mechanics, aerodynamics, fluid flow, heat flow, quantum physics. The applied mathematician, engineer, physicist, or scientist must become familiar with the essentials of numerics and its ideas, such as interpolation and numerical integration.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: understand application of Power series and solution of ODEs
- CO2: use Power series solutions to Legendre and Bessel's equations
- CO3: comprehend Laplace transform and IVPs
- CO4: study periodic and non-periodic functions and their Fourier series expansion
- CO5: develop vector differential and integral calculus and the applications of Green's theorem, Gauss Divergence Theorem & Stokes Theorem
- CO6: apply numerical techniques in interpolation and evaluation of the definite integral

Topics:

- Series Solution of Differential Equations
- Laplace Transforms
- Fourier Series
- Vector Differential and Integral Calculus
- Interpolation and Numerical Integration

Textbook(s):

1. Advanced Engineering Mathematics by Erwin Kreyszig, Wiley, INC, 10th Edition.

Reference Book(s):

1. Higher Engineering Mathematics, Grewal B.S., Khanna Publishers, 36th edition.
2. Introduction to engineering Mathematics, Dass H.K., S.Chand& Co Ltd, 11th edition.
3. Higher Engineering Mathematics, Ramana B.V., TMH, 2007.
4. A course on ordinary & partial differential Equation, Sinha Roy and S Padhy, Kalyani Publication, 3rd edition.

CH 1007 Chemistry

Credit: 3
Category: BSC
Prerequisite(s): Nil

Course Description:

The course is designed to enrich the students with basic concepts in Chemistry to strengthen their fundamentals which will support them for pursuing education and research in engineering. It will help them to develop the idea on feasibility and mechanism of different chemical processes, conceptualize alternative sources of energy, give an exposure for handling instrumental techniques to explore structure of organic molecules and an idea of different methods for synthesis of advanced materials.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: rationalize bulk properties and processes using thermodynamic consideration and apply the knowledge to decide the feasibility of a given process
- CO2: analyze the kinetics of simple and multistep reactions as well as theories of reaction rates
- CO3: evaluate some properties such as pH, solubility product etc. by using electrochemical cell and understand the working of modern batteries
- CO4: able to understand the mechanism of corrosion and its different controlling measures
- CO5: distinguish the different electromagnetic radiations used for exciting different molecular energy levels in various spectroscopic techniques to evaluate the structure of molecules
- CO6: get an exposure to different methods used for synthesis of nanostructured materials

Topics:

- Chemical Equilibrium and Thermodynamics
- Chemical Kinetics
- Electrochemistry
- Spectroscopy
- Chemistry of Nano Materials

Textbook(s):

1. Engineering Chemistry: Fundamentals and Applications- Shikha Agarwal, Cambridge University Press, 2016

Reference Book(s):

1. Textbook of Engineering Chemistry: Sashi Chawala, Dhanpat Rai and Co, 2016
2. Principles of Physical Chemistry- B.R. Puri, L.R Sharma, M.S. Pathania; 42nd Edition, Vishal Publishing Co.
3. Spectrometric Identification of Organic compounds,7th Edition -Robert M. Silverstein, Fransis , Webster, Dravid j. Kiemle; Jhon Wiley& Sons, INC.
4. Nanostructures &Nanomaterials: Synthesis, Properties and Applications- G. Cao and Y. Wang, World Scientific Pvt. Ltd.; 2nd Edition

HS 1005 Professional Communication

Credit: 2

Category: HSMC

Prerequisite(s): Nil

Course Description:

Professional Communication is more emphasized on enhancing the four LSRW skills like Listening, Speaking, Reading and Writing in order to improve students' professional communication. It is basically designed to enhance speaking skills through pronunciation, stress and tone. This course is prepared to improve reading skills through reading, comprehending and retaining information. This course is basically expected to provide the learner an approach to communicate using all the four skills

Course Outcomes: At the end of the course, the students will be able to:

CO1: understand the communication process and practical implementations in the workplace

CO2: apply verbal and non-verbal modes of communication effectively in practical situations

CO3: apply effective conflict management strategies

CO4: use English grammar correctly and unambiguously in technical writing

CO5: bridge the gap between native language and target language i.e. English

CO6: retain a logical flow while drafting reports and other technical pieces of writing

Topics:

- Communication: Process and Methods of Communication
- Basics of Grammar: Time & Tense, Subject-Verb Agreement, Analogy, Active & Passive Voice, Error Detection in Sentences
- Writing Skills: Paragraph Writing-Techniques & Skills, Use of Punctuation, Business Letter-Enquiry, Claim/ Complaint, Order
- Basic Sounds of English: Hearing & Listening, Introduction to Basic Sounds of IPA, Problem Sounds & MTI

Textbook(s):

1. Technical Communication Principles & Practices. Meenakshi Raman and Sangeeta Sharma OUP. Second Edition-2011

Reference Book(s):

1. A Communicative English Grammar. Geoffrey Leech and Jan Svartvik. Third Edition. Routledge Publication. New York. 2013.
2. Effective Technical Communication. M Ashraf Rizvi TMH 2005
3. The Oxford Grammar (English) Sidney Greenbaum, Oxford University Press India. 1st Edition. 2005
4. Verbal Ability and Reading Comprehension for the CAT. Arun Sharma and Meenakshi Upadhyay, TMH, New Delhi, 2007
5. Better English Pronunciation, Cambridge University Press, J D O'Connor, 2nd Edition (Paper Back) 2013

LS 1001 Biology

Credit: 2
Category: BSC
Prerequisite(s): Nil

Course Description:

Biology is important to everyday life because it allows humans to better understand their bodies, their resources and the potential threats existing in the environment. The engineering undergraduates need to be suitably exposed to the biological mechanisms of living organisms from the perspective of engineers. In addition, the course is expected to encourage engineering students to think about solving biological problems with engineering tools.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: comprehend the typical characteristics which distinguish life forms and analyze life process at cellular level
- CO2: apply concepts on structure and function of simple biomolecules in life processes
- CO3: comprehend different biological process involved in life and to analyze their effect
- CO4: understand different biological phenomenon and then relate it with engineering application domains
- CO5: comprehend different physiological functions and then relate it to computer based techniques
- CO6: understand biology and its relevance to engineering and technology

Topics:

- The Cellular organization of a living Organism
- The molecular and biochemical basis of an organism
- Enzymes, photosynthesis, metabolism and bioenergetics
- Molecular machines, biosensor and bioremediation
- Nervous system, immune system and cell signaling

Textbook(s):

1. Biology for Engineers. S. Thyagarajan, N. Selvamurugan, M.P Rajesh, R.A Nazeer, Richard W. Thilagarajan, S. Bharathi, M.K. Jaganathan. McGraw Hill Education (India) Ed., 2012

Reference Book(s):

1. Biology (Indian Edition), P.H. Raven and G.B. Johnson. McGraw Hill Education (India) Private Limited.
2. Concepts of Biology, Eldon D. Enger, Feederick C, Ross and David B. Bailey. TMH Publications.
3. Biology. Neil A. Campbell and Jane B. Recee, Pearson Education.
4. Biology Concepts and Application, Cecie Starr, Thomson Books.

CS 1093 Computer Programming Laboratory

Credit: 4
Category: ESLC
Prerequisite(s): Nil

Course Description:

The course aims to provide exposure to problem-solving through programming. It aims to train the student to the basic concepts of the C-programming language. This course involves lab component which is designed to give the student hands-on experience with the concepts.

Course Outcomes: At the end of the course, the students will be able to:

CO1: have fundamental knowledge on basics of computers hardware and number systems
with concept on basics commands in Linux

CO2: write, compile and debug programs in C language

CO3: design programs involving decision structures, loops, and functions

CO4: understand the dynamics of memory by the use of pointers

CO5: use different data structures and create/update basic data files

Topics:

- Basic linux commands
- Operators and Expressions
- Branching statements (if-else, switch).
- Control statements (looping - for, while, do-while).
- Arrays
- Character Arrays (strings).
- Functions.
- Pointers and Dynamic Memory Allocation.
- Structures and Unions
- File Handling

CH 1097 Chemistry Laboratory

Credit: 1.5
Category: BSLC
Prerequisite(s): Nil

Course Description:

The Chemistry laboratory course is designed to develop basic concepts of quantitative analysis by using volumetric as well as instrumental methods. It includes classical titrations to estimate hardness, alkalinity, dissolved oxygen, ferrous ion content, chloride content in water/solution samples. It also gives hands on training to use advanced titration techniques such as potentiometric, pH metric and conductometric titrations which can be used with turbid and colored solutions in incredibly low concentrations. The course also gives an exposure to extensive use of UV-Vis spectroscopy for estimation of different ions in solution phase.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: understand the significance of quantitative chemical analysis
- CO2: prepare solutions of different concentrations and do their standardization
- CO3: get an exposure to different instrumental techniques such as Conductometry, pH-metry, Potentiometry and Colorimetry
- CO4: evaluate the rate constant of pseudo first order reactions
- CO5: analyse basic water quality parameters like hardness, dissolved oxygen, alkalinity, ferrous iron contents
- CO6: rationalize chemical handling and chemical safety in an advanced modern laboratory

Topics:

- Hardness of water sample
- Alkalinity of water
- Estimation of Fe^{2+} iron
- Dissolved Oxygen
- Potentiometric Titration
- Kinetics of Ester Hydrolysis
- Chloride Estimation
- pH metric Titration
- Conductometric Titration
- Concentration of KMnO_4 by Visible spectroscopy

HS 1085 Language Laboratory

Credit: 1
Category: HSMC
Prerequisite(s): Nil

Course Description:

Language Lab is more practical oriented which is designed with an objective to make the learner practice the skills which he/she has learnt in the theory I.e Listening, Speaking, Reading and Writing in order to improve their communication skills. It is basically designed to engage the students to learn to perform group activity or an individual activity. This course is prepared to improve the listening reading, speaking and writing skills . It is expected to orient the students with vocabulary, analogy, sentence completion and sentence correction.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: use English grammar correctly and unambiguously in technical writing
- CO2: apply verbal and non-verbal modes of communication effectively in practical situations
- CO3: have a basic understanding of the communication process and to know the practical implementations in the workplace
- CO4: retain a logical flow while drafting reports and other technical pieces of writing
- CO5: develop competence in reading and comprehension
- CO6: be familiar with English pronunciation and use neutral accent successfully

Topics:

- Reading & Comprehension
- Skit/ Role-Play Practice
- Listening Comprehension
- Time & Tense
- Business Letter
- Business Report
- Subject-Verb Agreement
- Visual Elements in Writing:
- Gadget-Supported Textual Formatting
- Attendance + Lab Record Checking
- Viva Voce

CE 1083 Engineering Graphics

Credit: 2
Category: ESLC
Prerequisite(s): Nil

Course Description:

The course of Engineering Graphics comprises of basics of drafting, projection of points & lines, line inclined to both the planes, projection of planes, Computer Aided Drafting, projection of solids and development of surfaces.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: use common drafting tools properly
- CO2: select, construct and interpret appropriate drawing scale as per the situation
- CO3: draw orthographic projections of points, lines and planes
- CO4: draw orthographic projection of solids like cylinders, cones, prisms and pyramids including sections
- CO5: develop the sections of solids for practical situations
- CO6: communicate ideas effectively using Computer Aided Drafting

Topics:

- Introduction to Engineering graphics
- Lettering
- Projection of points & lines
- Line inclined to both the planes
- Projection of planes
- Introduction to Computer Aided Drafting
- Projection of solids
- Section of solids
- Development of surface

Textbook(s):

1. Engineering Drawing + AutoCAD by K. Venugopal, New Age Publishers, 1st edition, 2011

Reference Book(s):

2. Engineering Drawing with an Introduction to AutoCAD by S. N. Lal, Cengage India Private Limited, 1st edition, 2017

COURSES OF THE PROGRAMME

EC 2005 Semiconductor Devices

Credit: 3

Category: PCC

Prerequisite(s): Analog Electronics Circuit (EC 1004)

Course Description:

This course will give the fundamental concepts of electronics devices that are backbone of all electronics circuits. In this course students will be able to understand the basic semiconductor device physics and how the concepts are used in PN junction, metal semiconductor contacts, BJT, MOSFET, Optoelectronics devices. The course will give in-depth knowledge about the operating principle of the devices with characteristics and how these are related to modern technologies. This course will also help the students to explore various other domains of electronics like VLSI design, Digital electronics etc.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: understand and explain the fundamental semiconductor physics concepts like Fermi level, carrier concentration etc. and analyze them to solve different problems
- CO2: analyze and explain different conduction techniques in semiconductor materials and solve relevant problems
- CO3: comprehend and analyze the operation of different diodes, metal semiconductor contacts and solve different diode problems
- CO4: explain the operation and solve problems associated with of BJT
- CO5: analyze and explain the operation of MOS Transistors and solve relevant problems
- CO6: comprehend and analyze operating principle of different optoelectronic devices and their applications

Topics:

- Energy bands & Current Carriers in Semiconductors
- P-N Junction
- BJT (Bipolar Junction Transistor)
- Metal-Oxide Field Effect Transistor (MOSFET)
- Optoelectronics devices

Textbook(s):

1. Solid State Electronic Devices: Streetman & Banerjee, 7th Edition, Pearson.

Reference Book(s):

1. Semiconductor Devices: Basic Principles, Jasprit Singh John Wiley & Sons,2000
2. Integrated Electronics: Analog And Digital Circuit Systems, Jacob Millman, Christos Halkias, Chetan D Parikh, 2nd Edition, TMH 2010.
3. Semiconductor Physics And Devices: Donald Neaman and Drubesh Biswas,2012, 4thEdition, TMH 2012.

EC 2011 Digital Electronics

Credit: 3
Category: PCC
Prerequisite(s): Nil

Course Description:

This course covers all basic concepts in digital systems. The course starts with fundamentals of Boolean Algebra-different number systems and inter-conversions, binary codes and K-maps. This will be followed by designing of various combinational circuits such as adders, subtractors, decoders, encoders, magnitude comparators, multiplexer and de-multiplexers. Detail concept about memory elements (flip-flops) will be provided that will help the students to learn about various design techniques of sequential circuits like shift registers, counters and FSMs. Fundamentals of digital logic families, ADC and DAC will also be covered that will help the students to learn digital electronics principles comprehensively in today's perspective.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: comprehend, simplify and realize Boolean expression
- CO2: comprehend and analyze combinational circuits using logic gates
- CO3: design various asynchronous & synchronous sequential circuits using Flip-Flops
- CO4: design & implement Mealy and Moore model FSMs for different synchronous sequential circuits
- CO5: analyze and differentiate between different logic families such as TTL & CMOS chips
- CO6: comprehend and analyze the concept of different types of Analog-to-Digital converters and Digital-to-Analog converters

Topics:

- Introduction to Boolean Algebra
- Combinational Circuits
- Sequential Logic
- Finite State Machine (FSM)
- Logic Families
- A/D and D/A

Textbook(s):

1. Fundamentals of Digital Logic – Anand Kumar - PHI, 2nd Edition, 2011
2. Digital Logic and Computer Design – M. Morris Mano – PHI, 2011

Reference Book(s):

1. Digital Principles and Applications – Malvino & Leach – TMH, 7th edition, 2011
2. Digital Fundamentals – T. L. Floyd & Jain – Pearson Education, 10th edition, 2011

EC 2014 Electromagnetic Theory

Credit: 3
Category: PCC
Prerequisite(s): Mathematics-II (MA 1004)

Course Description:

The course provides a basic understanding of electrostatics and magnetostatics using the already known knowledge of vector calculus. This course will also cover different aspects of time varying fields and provide insight to Maxwell's equations. Concepts on the propagation of the EM waves in different media and under boundary conditions will lead to the understanding of transmission line behaviour and impedance matching circuits.

Course Outcomes: At the end of the course, the students will be able to :

- CO1: apply the appropriate coordinate system for a particular vector based problem, and the laws of vector calculus
- CO2: analyze and solve numerical problems involving static charges
- CO3: analyze and solve numerical problems involving constant currents
- CO4: analyze and apply Maxwell's equations for electromagnetism
- CO5: analyze and apply wave behavior during its propagation through multiple media in presence of different boundary conditions
- CO6: design transmission line sections (Length propagation constant and characteristic impedance) along with feeding mechanism for realizing impedance matched conditions

Topics:

- Orthogonal coordinate systems
- Static electric and Static magnetic fields
- Time varying fields and Maxwell's equations
- Plane Electromagnetic waves
- Transmission Lines

Textbook(s):

1. Elements of Electromagnetics (Fourth Edition) by Matthew N.O Sadiku, Oxford University Press, 2009.
2. Field and Wave Electromagnetics (Second Edition) By David K. Cheng, Pearson Education, 1989.

Reference Book(s):

1. Engineering Electromagnetics (Seventh Edition) by William H. Hayt, Jr and John A. Buck, Tata McGraw- Hill Publishing Company Limited, New Delhi, 2007.
2. Electromagnetic Waves and Radiating Systems by Edward C. Jordan and Keith G. Balmain, Prentice Hall of India, New Delhi, 2nd Edition.

EC 2016 Communication Engineering

Credit: 4

Category: PCC

Prerequisite(s): Principles of Signals and Systems (EC 2023)

Course Description:

The course deals with analog and digital communication techniques that includes AM, FM, sampling, pulse modulation techniques, and multiplexing techniques. It also covers fundamentals of modern communication systems such as optical communication, satellite communication and mobile communication.

Course Outcomes: At the end of the course, students will be able to:

- CO1: understand the basic of signal and systems, Fourier transform and their properties, random process, random variable, PSD & ESD of a signal
- CO2: explain the need of communication, its definition & understand the block diagram of different types of communication system
- CO3: classify amplitude modulation, angle modulation, Pulse modulation, Types of digital modulation
- CO4: applying Fourier transform for analysis of radio spectrum, sketch the waveform and interpret the information present
- CO5: design simple systems for generating and demodulating amplitude modulated signals, frequency modulated signal, pulse modulated signal and digital modulation
- CO6: design a communication system and select an appropriate modulation technique for a particular application

Topics:

- Introduction
- Signals
- Amplitude Modulation
- AM Radio Receiver
- Angle Modulation
- FM Radio Receiver
- Pulse Modulation and Demodulation
- Digital Modulation
- Modern Communication Systems

Textbook(s):

1. Introduction to Analog & Digital Communication System, Simon Haykins, 2011, John Wiley.
2. Modern Digital and Analog Communications Systems, B. P. Lathi, Oxford University Press, 4th edition.

Reference Book(s):

1. Principles of Communication System, H. Taub & D. L. Schilling, TMH, 3rd edition

EC 2020 Microprocessors, Microcontrollers & Interfacing

Credit: 4

Category: PCC

Prerequisite(s): Digital Electronics (EC 2011)

Course Description:

The objective of this course is to teach the fundamentals of Microprocessor (like 8085, 8086) and Microcontroller (like 8051) systems to the students. In this course, the students learn about assembly language to program the Microprocessors, Microcontrollers and develop programs to solve simple applications.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: comprehend the basic concept of Bus structure, a basic 8-bit Microprocessor (like 8085) system, its architecture, concept of stack, Addressing modes etc.
- CO2: explain the architecture of a 16-bit Microprocessor like 8086 including the concept of instruction queue, segmented memory structure and address generation
- CO3: explain and analyze the Addressing modes, Assembly language instructions of 8086 and implement them to solve 8086 related design problems
- CO4: design Memory Interfacing using memory chips with proper decoder circuits with a 16-bit processor and analyze the interrupt structure of 8086 Microprocessor
- CO5: explain the features of the peripherals such as PPI, Programmable interrupt control, USART and their interfacing with a 16-bit processor
- CO6: explain and analyze memory organization of a 8-bit Microcontroller (like 8051), its addressing modes, instructions, timers & counters and its serial communication

Topics:

- 8085 (8-bit Microprocessor)
- 8086 (16-bit Microprocessor)
- Interfacing Chips
- 8051 Family of Microcontrollers

Textbook(s):

1. Microprocessors and Interfacing, Programming & Hardware - Douglas V. Hall, McGraw Hill Education Pvt Ltd., 3rd edition.

Reference Book(s):

1. Microprocessor Architecture, Programming and Applications with the 8085 - Ramesh S. Goankar, Penram International Publishing (India).
2. Microprocessors & Microcomputer based System Design - Md. Rafiquzzaman, 2nd edition.
3. Microcontroller Theory & Applications - Deshmukh, McGraw Hill Education Pvt Ltd.

Credit: 3
Category: PCC
Prerequisite(s): Mathematics-II (MA 1004)

Course Description:

This course is designed to establish a strong foundation for communication and signal processing. It will enable students to classify various analog and discrete time signals and visualize the signals after various operations. The course will enable the students to represent various signals in terms of singularity functions and find relationships between signals. It will provide the knowledge of various classifications of systems as well as time and frequency domain analysis of signals and systems using in-depth knowledge of Fourier and Laplace transforms. It will provide the knowledge of linear circuit analysis using Laplace transform to find dynamic and steady state responses. It is designed to provide the concepts of fundamental network theorems and network parameters to analyze linear electrical circuits.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: understand and classify various continuous and discrete signals, understand sampling process and visualize signals after various operations
- CO2: classify and analyze system characteristics and determine output of LTI system in time domain
- CO3: analyze continuous time signals and systems in frequency domain using continuous time Fourier series and continuous time Fourier transform
- CO4: determine the Laplace Transform of various signals and analyze analog systems characteristics using Laplace transform and its properties
- CO5: analyze RLC circuits for AC/DC excitation using Laplace transform
- CO6: analyze and apply network theorems and network parameters to various electrical circuits

Topics:

- Introduction to signal classification and operation and sampling process
- Introduction to system classification and time domain analysis of systems
- Analysis of signals and systems in frequency domain using Fourier analysis
- Analysis of signals and system using Laplace transform
- Linear circuit analysis using Laplace transforms
- Network theorems and network parameters and their applications for analyzing linear circuits

Textbook(s):

1. Signals and Systems by Alan V. Oppenheim, Alan S. Willsky, PHI , edition
2. Circuit Theory, Analysis and Synthesis A, Chakrabarti, Dhanpat Rai Publishing Company (P) Limited 5th edition, 2008.

Reference Book(s):

1. Signals & Systems – P. Ramesh Babu –Scitec,4th edition
2. Network Analysis 3rd edition, by M. E. Van Valkenburg, Pearson Education, 2006

EC 2023 Principle of Signals and Systems

Credit: 2
Category: PCC

Prerequisite(s): Mathematics-II (MA 1004)

Course Description:

The course presents basic concepts for both continuous-time and discrete-time signals and systems. This course also covers Fourier transform, Laplace transform basics of signal and systems.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: comprehend and plot continuous and discrete signals and determine respective characteristics.
- CO2: analyze the concept of vector space and orthogonality
- CO3: classify various types of systems and analyze system characteristics in time domain
- CO4: determine the frequency domain representations of periodic and aperiodic signals using Fourier analysis and its properties
- CO5: analyze LTI systems in frequency domain using Fourier analysis for periodic as well as aperiodic signals
- CO6: determine the Laplace Transform of various signals and analyze analog systems characteristics using Laplace transform and its properties

Topics:

- Introduction to signals and Classification of signals
- Introduction to continuous and discrete time signals and sampling theorem
- Decomposition of signals, Representation of signals in terms of impulses
- Introduction&classification to systems with examples
- Characteristics of LTI systems and derivation of system response
- Causality and stability criteria of discrete and analog LTI IIR, FIR
- Introduction to Fourier Analysis and their need in LTI
- Properties of CTFS with examples &Approximation of Fourier Series to Transform for aperiodic signals
- Properties of Fourier transform with examples
- Analysis of LTI Systems using FT, Establishment of Laplace transform as modification of FT
- Laplace transform. Convergence of Laplace Transform, Properties of Laplace Transform
- Transfer function, Pole-Zero plot and ROC properties

Textbook(s):

1. Signals & Systems, Alan V Oppenheim and Alan S Willsky, PHI publication, 2nd edition.

Reference Book(s):

1. Signals and systems, Ramesh Babu, Scitech Publication, 4th edition.

EC 2025 Principle of Electronics Engineering

Credit: 3
Category: PCC
Prerequisite(s): Nil

Course Description:

The course objective is to make students of Engineering to understand the efficacy of Electronic principles which are pervasive in engineering applications. Students will be able to understand the essence and applications of electronic components used in different electronic circuit. They will understand the working of diode and transistor and their characteristics, benefits of feedback in amplifier, oscillators, design of simple circuits like amplifiers (inverting and non-inverting), adders, integrator and differentiator using OPAMPS, a digital logic and apply it to solve real life problems.

Course Outcomes: At the end of course the students will be able to:

- CO1: understand the properties of semiconductors and current conduction mechanisms
- CO2: comprehend the working of P-N junction diodes; identify different diode circuits and analyze them
- CO3: understand the working of BJT, different modes and configuration, identify and analyze their biasing circuits, understanding the working of CE amplifier and its properties
- CO4: analyze the working of op-amp using either inverting or non -inverting configurations, timing circuit, regulated power supply ICs and their applications
- CO5: comprehend the concept of feedback in electronic circuits, types of feedback, their applications
- CO6: comprehend the working of different logic gates, combinational and sequential circuits, develop a brief idea about microprocessor and microcontrollers

Topics:

- Semiconductors
- Junction Diodes
- Bipolar Junction Transistor (BJT)
- Feedback Concept
- Operational Amplifiers (OPAMP) and 555 timer
- Digital Electronics

Textbook(s):

1. Electronics- Fundamentals & Applications- D. Chattopadhyay and P.C Rakshit- 11th Edition (New Age International)
2. Electronic Devices and Circuits- D. A. Bell- 5th Edition (Oxford)

Reference Book (s):

1. Electronic Devices & Circuits- R. L. Boylestad- 10th Edition(Pearson)
2. Digital Principles and Applications- A. Malvino and Leach-7th Edition(TMH)

EC 2027 Analog Electronics

Credit: 4

Category: PCC

Prerequisite(s): Basic Electrical Engineering (EE 1003)

Course Description:

This course deal with basic circuit components and semiconductor components viz., diode, BJT, FET based circuits and op-amp based practical circuits. Design and analysis of circuits such as rectifier, amplifier, oscillator are covered under this course.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: comprehend the significance of terminology associated with semiconductor devices and solve the different diode circuits
- CO2: explain and analyze different biasing circuits using BJTs and FETs
- CO3: analyze and design different amplifier circuits using BJTs and FETs with the help of their small signal model
- CO4: analyze and design electronic circuits using BJTs or FETs for different feedback topologies depending on applications as amplifier and oscillators
- CO5: explain and analyze different power amplifier circuits, differential amplifier and current mirror circuits
- CO6: explain and design different analog circuits using Operational amplifiers and 555 timer

Topics:

- Semiconductor
- P-N junction
- Transistors
- Transistor biasing circuits
- Small signal analysis of transistor amplifiers
- Feedback and oscillator circuits
- Power amplifiers
- Differential amplifiers
- Operational amplifiers

Textbook(s):

1. Integrated Electronics, Analog and Digital Circuits and Systems, J. Millman & Halkias, C.D. Parikh, Mc-Graw Hill India, 2nd edition, 2013, 10th Reprint.
2. Op-Amps and LIC, Ramakant A. Gayakward, Pearson, 4th edition.

Reference Book(s):

1. Microelectronics circuits, A. S. Sedra and K. C. Smith, Oxford University Press, 5th edition, 2011.
2. Linear Integrated Circuits, D. Roy Choudhury and Shail B. Jain, 4th edition, New Age International Publishers.

EC 2090 Microprocessor and Microcontroller Laboratory

Credit: 1

Category: PCLC

Prerequisite(s): Digital Electronics (EC 2011)

Course Description:

This lab is utilized by 4th semester Electronics and Telecommunication Engineering, Electronics and Computer Science Engineering students, 5th semester Electronics and Electrical Engineering and Electronics and Instrumentation Engineering students. Students develop Assembly language programming skills on 8085, 8086 and 8051 kits. Students do their experiments in both hardware and software platforms. They use TALK software and design some Interfacing circuits on bread board like seven segment display to glow decimal digits 0-9 and four-way traffic control circuits and design of LEDs to glow in proper sequence. They also Interface with CRO to display square wave and interface with Digital to Analog Converter to display Triangular and Saw tooth wave forms.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: develop Assembly language programming skills on 8085, 8086 Microprocessor and 8051 Microcontroller trainer kit
- CO2: utilize PCLink communication software for Intel 8085 & 8086 Assembly language programming to execute programs and design practical circuits
- CO3: design practical circuits like 4 way traffic light system, generation of square wave using CRO, interfacing of seven segment display using PPI
- CO4: utilize 86DRV communication software for Intel 8086 Assembly language programming to execute programs and design practical circuits
- CO5: utilize B30DRVVM communication software for 8051 Microcontroller & Assembly language programming to execute programs and design practical circuits
- CO6: formulate, design and solve real life engineering problems for executing projects

Topics:

- Familiarization with 8085 and 8086 Microprocessor Kit and verification of instruction sets
- Execution of sample Assembly language programs on 8085 MP Kit
- Introduction to TALK communication software and execution of Assembly language programs using Cross Assembler
- Design a circuit and write a suitable program to display decimal digits 0 to 9 using 8085 and seven segment display
- Design a four lane Traffic control system using PC, 8085 MP Kit and additional hardware
- Familiarization with 8051 Microcontroller Kit and execution of basic programs using TALK communication software & Cross Assembler
- Generation of a 2 KHz square wave on Port 1.3 (Pin-4) with Timer 0 interrupt, using TALK software and 8051 MC Kit
- Open Ended Experiments

EC 2091 Electronic Circuits & Network Laboratory

Credit: 1.5

Category: PCLC

Prerequisite(s): Basic Electrical Engineering (EE 1003), Basic Electrical Engineering Lab (EE 1093)

Course Description:

This laboratory course is basically designed to impart essential practical knowledge of electronic devices and its associated circuits for 3rd semester undergraduate Electronics Engineering students. Hardware and Simulation experiments here are designed specifically for augmented learning . This will help students to understand and design various electronic circuits such as rectifiers, amplifiers and oscillators using discrete components like BJT/FET which are essential building blocks for any electronic system. Major equipment include function generator, CRO, multi-meter, Variac, voltmeter, ammeter, breadboard trainer kit and software's like Tina-TI, Lab VIEW and NI My DAQ v. 2016.A well-organized systematic procedure is included in each experiment to facilitate the hardware testing and simulation. This course imbibes the students with necessary practical knowledge which will help them in making their minor and major undergraduate projects.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: identify different discrete components, understand the function of Cathode Ray Oscilloscope ,Function Generator & multi-meter and use these equipment for circuit related learning
- CO2: explain and verify basic linear network theorems
- CO3: plot and demonstrate the V-I characteristics of a P-N junction diode and the Zener diode
- CO4: explain and analyze the input and output characteristics of BJT and JFET
- CO5: design and simulate amplifier, oscillator circuits using BJT and JFET
- CO6: formulate, design and implement different types of low frequency amplifiers and oscillator circuits using BJT/JFET to solve the real life engineering problems by executing mini projects

Topics:

- Basic linear network theorems
- P-N junction diode and Zener diode
- Transistors (BJT and JFET)
- CE amplifier and RC-coupled amplifier
- CS amplifier and CD amplifier
- LC and RC oscillators
- Open ended experiments

EC 2093 Digital Electronics Laboratory

Credit: 1
Category: PCLC
Prerequisite(s): Nil

Course Description:

This lab is utilized by 3rd semester Electronics and Telecommunication Engineering, Electronics & Computer Science Engineering, Computer Science and System Engineering, Computer Science and Communication Engineering students. In this laboratory Analog to Digital converters, Digital to Analog converters, Lab designer Kits, Cathode Ray Oscilloscopes, Function generators and NI-MyRIO Kits are available . The DEC Lab is containing some Verilog simulation experiments along with the hardware implementation of simple digital circuits. Students do their experiments and open ended experiments in both hardware and software platforms. They use discrete components and Xilinx, PSpice, LabVIEW software to design and simulate the combinational and sequential logic circuits. This lab is also used by B. Tech and M. Tech students for executing projects.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: comprehend the significance of terminology associated with Verilog HDL and the procedure to Simulate and Verify combinational logic circuits in EDA Playground and TinkerCAD
- CO2: simulate and design combinational logic circuits like adder using Logic Gates in association with EDA Playground and TinkerCAD
- CO3: simulate and design combinational logic circuits like decoder using Logic Gates in association with EDA Playground and TinkerCAD.
- CO4: simulate and design combinational logic circuits like Multiplexer using Logic Gates in association with EDA Playground and TinkerCAD
- CO5: simulate and design sequential logic circuits of different Flip-Flops and Flip-Flop conversion in association with EDA Playground and TinkerCAD
- CO6: simulate and design sequential logic circuits like Synchronous type counter , Asynchronous type counters and shift registers using flip-flops in association with EDA Playground and TinkerCAD

Topics:

- Logic Gates
- 2-Line-to-4 line Decoder
- 2X1 Multiplexer
- J-K Flip-Flop and D Flip-flop
- 2-bit Synchronous Up Counter
- 2-bit Asynchronous Up Counter
- Serial In-Parallel Out(SIPO) Shift Register
- Open ended experiments

EC 2096 Digital and Linear Integrated Circuit Laboratory

Credit: 1

Category: PCLC

Prerequisite(s): Analog Electronics (EC 2027), Electronic Circuits & Network Laboratory (EC 2091)

Course Description:

This laboratory includes analog to digital converters, digital to analog converters, lab designer kits, Cathode Ray Oscilloscopes, Function generators and NI-MyRIO Kits for different experiments. Verilog, Xilinx, LabVIEW, TinkerCAD and PSpice simulation experiments along with the hardware implementation of simple digital and analog circuits are performed in this laboratory.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: comprehend the significance of terminology associated with Verilog HDL and the procedure to Simulate and Verify combinational logic circuits in EDA Playground and TinkerCAD
- CO2: analyze and simulate combinational logic circuits like adder. using Logic Gates in association with EDA Playground and TinkerCAD
- CO3: analyze and simulate combinational logic circuits like decoder using Logic Gates in association with EDA Playground and TinkerCAD
- CO4: analyze and simulate sequential logic circuits like synchronous type counters and shift registers using flip-flops in association with EDA Playground and TinkerCAD
- CO5: design and simulate the analog circuits like R-C differentiator circuit in association with TinkerCAD
- CO6: design and simulate the analog circuits like practical Integrator and Comparator using operational amplifier IC LM 741 in association with TinkerCAD

Topics:

- Logic Gates
- Half Adder
- 2 Line- to- 4-Line Decoder
- 2 bit Synchronous Up Counter
- Serial In-Parallel Out(SIPO) Shift Register
- R-C Differentiator circuit
- Integrator circuit using Operational Amplifier IC LM 741
- Comparator circuit using Operational Amplifier IC LM 741
- Open ended experiments

EC 2098 Simulation Laboratory

Credit: 1

Category: PCLC

Prerequisite(s): Principle of Signals and Systems (EC 2023), Mathematics-II (MA 1004)

Course Description:

This lab uses Matlab and LABVIEW platform to perform various experiments on generation and analysis of various signals and their behavior to solve different industrial and engineering problems.

Course Outcomes: At the end of the course, students will be able to:

- CO1: comprehend the requirement and analyze the different types of signals using mathematical models in MATLAB
- CO2: apply different control structures to find out the parameters of a signal like PSD, Amplitude etc.
- CO3: simulate and find the transfer function for different circuits to observe the system behavior
- CO4: comprehend, analyze and represent digital system design using graphical system methods in LabVIEW
- CO5: explain and analyze and represent a system equation using MATLAB
- CO6: solve different industrial and engineering problems

Topics:

- Basic familiarization to MATLAB Environment
- Control Flow- conditional and case structure, loop structure
- Finding Correlation and autocorrelation, ESD using MATLAB
- Numerical integration and differentiation using MATLAB
- Implementation of system transfer function and finding the damping factor and natural frequency
- Basic introduction to LabVIEW - Conversion of Celsius scale to Fahrenheit and vice-versa
- Control Flow- conditional and case structure, loop structure with graph and chart, File handling using LabVIEW
- Digital system implementation using LabVIEW
- Open Ended Experiments

EC 3007 Digital Signal Processing

Credit: 4

Category: PCC

Prerequisite(s): Principle of Signals and Systems (EC2023), Signals and Networks (EC2021)

Course Description:

This course begins with the mathematical concepts behind digital processing. It includes implementation of signal processing techniques used in hardware and software systems. The course covers Discrete time signals and systems, Z transform, DFT, FFT and properties. The concepts of digital filter design, realization of systems, multi-rate signal processing and introduction to adaptive filters with their applications will be discussed.

Course Outcomes: At the end of the course, the students will be able to:

CO1: determine and understand appropriate transformation technique for signal analysis

CO2: analyze the signal and its properties in its frequency domain

CO3: apply Fourier transform techniques in real time applications

CO4: apply the knowledge of analog filters to digital filters, design and realization of digital filter

CO5: design and implement multi-rate systems and filter banks

CO6: explain and apply the adaptive filtering concepts for system identification, channel equalization, noise cancellation and line enhancer

Topics:

- Fundamental of Signals and System & Z-Transform
- Fourier Transforms:
- DFT, IDFT and FFT
- Digital filters
- Multi-rate DSP
- Adaptive filters

Textbook(s):

1. Digital Signal Processing – J. G. Proakis & D. G. Manolakes, 4th edition – PHI
2. Digital Signal Processing – T. K. Rawat, Oxford University Press, 1st edition

Reference Book(s):

1. Digital Signal Processing – Oppenheim & Schafer, PHI, 1st edition.
2. Digital Signal Processing – P. Ramesh Babu, Scitech Publication, 4th edition.

EC 3011 VLSI Design

Credit: 3
Category: PCC

Prerequisite(s): Digital Electronics Circuits (EC 2011)

Course Description:

The VLSI design course introduces students to basic theories and techniques of digital VLSI design in CMOS technology, fabrication and layout techniques pertaining to digital integrated circuits domain. The course enables students to analyze and design different VLSI architectures using the fundamental concepts of digital VLSI systems. The domain specific skill sets include deep understanding of CMOS devices and circuits, CMOS design rules, static and dynamic logic structures, interconnect analysis and low power techniques in ultra-deep sub-micron regime.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: understand and explain VLSI design flow, design strategy, role of different methods for chip design and basic fabrication process flow
- CO2: analyze different components of threshold voltage, drain current and scaling strategy
- CO3: evaluate different performance metrics of MOS inverter architecture
- CO4: illustrate the logic design process used for complex combinational circuit and its layout using static CMOS
- CO5: analyze different switch based logic involving pass transistor, complementary pass transistor and transmission gate
- CO6: create different high performance dynamic CMOS logic

Topics:

- VLSI Methodologies
- Unit process in VLSI IC fabrication
- MOSFET Analysis
- CMOS Inverter and its analysis
- Transient characteristics
- CMOS logic design
- CMOS switch-based logic
- Dynamic Logic Circuit

Textbook(s):

1. CMOS digital integrated circuits by Sung –Mo KANG Y. Lebeleci, 4th edition, Mc-Graw Hill publications

Reference Book(s):

1. CMOS Circuit Design, Layout, Simulation R. Jacob baker, Harry W. Li, David E Boyce,4th edition, Wiley publications.

EC 3013 Principles of Digital Signal Processing

Credit: 3
Category: PEC
Prerequisite(s): Mathematics-II (MA 1004)

Course Description:

This course begins with the mathematical concepts behind digital processing. It includes implementation of signal processing techniques used in hardware and software systems. The course covers Discrete time signals and systems, Z transform, DFT, FFT and properties. Techniques to design FIR and IIR filters are discussed.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: comprehend the significance of terminology associated with various components of a digital system
- CO2: analyze the different types of digital systems and linear convolution
- CO3: analyze and apply the discrete Fourier transform (DFT)
- CO4: solve Z-transform and apply it for discrete signals
- CO5: analyze and apply the sectional convolutional methods
- CO6: design digital filters using different techniques

Topics:

- Difference between analog and digital signals
- Types of digital systems
- Linear time invariant system
- Linear convolution
- Discrete Fourier transform (DFT) and its calculation
- Properties of DFT
- Circulation convolution and its significance
- Sectional convolution using overlap-add and overlap save methods
- Fast Fourier transform (FFT) algorithm for fast computation of DFT
- z-transform of digital signals and its applications
- Design of digital filters

Textbook(s):

1. Digital Signal Processing by T. K. Rawat, Oxford Publication 1 st Edition
2. Principle of Signal Processing and Linear System: B.P.Lathi, First Edition, Oxford University Press

Reference Book(s):

1. Digital Signal Processing – J.G.Proakis and D.G.Manolakis , 4th Edition-PHI
2. Signals & Systems: Alan V. Oppenheim & Schafer-2nd Edition 2011 Pearson
3. Digital Signal Processing: P. Ramesh Babu: Scitech,2nd Edition

EC 3015 Microwave Engineering

Credit: 3

Category: PCC

Prerequisite(s): Electromagnetic Waves and Antennas (EC 2022)

Course Description:

The course is intended to describe the principles of operations and design aspects of microwave sources, devices and components. Course includes the propagation characteristics and design parameters of rectangular waveguide, circular waveguide and cavity resonator. Microwave amplifiers and sources like, Klystron amplifier, travelling wave tubes, Reflex Klystron, Magnetron oscillator, backward wave oscillator are part of this course. The operations of microwave solid state devices, like, Gunn diode, Gunn oscillator, PIN diode, READ diode, IMPATT diode and microwave components are described in the course. Different types of microwave measurement techniques are included in the course.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: explain propagation characteristics and design parameters of rectangular waveguide, circular waveguide and cavity resonator
- CO2: comprehend the limitations of conventional vacuum tubes at microwave frequencies
- CO3: analyze the design aspects of Klystron amplifier and Reflex Klystron oscillators, and slow wave structures
- CO4: explain and Analyze the operations of microwave solid state devices, like, Gunn diode, Gunn oscillator, PIN diode, READ diode, IMPATT diode
- CO5: explain the principles of operation and design aspects of various types of microwave components
- CO6: perform power measurements, frequency and impedance measurements, gain and radiation pattern measurement of antennas

Topics:

- Waveguide and Cavity Resonator
- Microwave Vacuum Type Amplifiers and Sources
- Microwave Solid State Devices & Sources
- Microwave Components
- Microwave Measurements

Textbook(s):

1. Microwave Devices & Circuits. S. Y. Liao, PEA Publication, 2009

Reference book(s):

1. Electromagnetic Waves and Radiating Systems by E. C. Jordan and K. G. Balmain, Prentice Hall of India, New Delhi.
2. Microwaves: Introduction to Circuits, Devices & Antennas. M. L. Sisodia and V. L. Gupta, New Age Publication, 2012.

EC 3021 Neural Networks and Machine Learning

Credit: 3

Category: PEC

Prerequisite(s): Mathematics-I (MA 1003) and Mathematics-II (MA 1004)

Course Description:

This course will cover the history of neural networks, study the fundamental structures and state-of-the-art approaches to machine learning. The course will focus on theory and practice of these models, how they are trained and validated, and how they can be deployed in practice. Students will learn to design neural network architectures and training procedures via hands-on assignments. Students will learn how to use neural networks and machine learning algorithms for identifying, classifying and solving different problems related to pattern recognition, function approximation, data visualization etc.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: understand the context of neural networks and develop broad overview of learning strategies
- CO2: explain the fundamental neural network models, their learning strategies and apply them for modeling problems
- CO3: analyze multi-layer feed forward neural networks, recurrent neural networks, radial basis functions and employ them for different applications
- CO4: comprehend the concepts, architecture, training and testing algorithms of associative memory networks and Hopfield networks and apply them to evaluate practical problems
- CO5: develop a comprehensive idea on unsupervised learning networks and advanced neural networks
- CO6: explain the motivation for architectures and models and select the appropriate architecture for a given problem

Topics:

- Artificial neural network architecture
- Applications of neural networks
- Associative memory networks
- Unsupervised learning networks and advanced networks

Textbook(s):

1. Principles of Soft Computing by S. N. Sivanandam and S. N. Deepa - Wiley

Reference Book(s):

1. Neuro-fuzzy and soft computing by J. S. R. Jang, C. T. Sun and E. Mizutani - PHI Publications
2. Neural networks and learning machines by Simon Haykin - Parson, Prentice Hall

EC 3023 Optimization Techniques in Engineering

Credit: 3

Category: PEC

Prerequisite(s): Mathematics-I (MA 1003) and Mathematics-II (MA 1004)

Course Description:

The objective of this course is to give exposure about the different optimization problems and related algorithms to the students. In this course, the students learn about single and multiple variable constrained optimization algorithms. The course includes formulation of optimal problems for real time applications, simple codes for implementing the same and demonstrates convergence with optimal results.

Course Outcomes: At the end of the course, the students will be able to:

CO1: comprehend the need for optimization, formulate fitness/cost functions for simple problems and identify constraints involved (if any)

CO2: analyze the concepts behind single variable optimization algorithms

CO3: apply gradient based optimization algorithms for problem solving

CO4: comprehend the importance of multivariable optimization, different multi-variable optimization techniques and concept of Pareto-front

CO5: analyze the different techniques for constrained optimization algorithms and their applications

CO6: analyze and apply the algorithms for different nature inspired optimization algorithms

Topics:

- Optimal problem formulation, Design variables constraints, Objective function, Variable bounds,
- Engineering optimization problems, Optimization algorithms
- Single-variable Optimization Algorithm
- Gradient-based Methods
- Multivariable Optimization Algorithm
- Constrained Optimization Algorithm
- Advanced Optimization Algorithms

Textbook(s):

1. Optimization for Engineering Design-Algorithms & Examples – K. Deb, PHI, 2nd edition, 2012.
2. Multi-objective Optimization Using Evolutionary Algorithms-K. Deb, John Wiley & Sons, 1st edition, 2001.

Reference Book(s):

1. Optimization: Theory and Applications - S.S. Rao, Wiley Eastern Ltd, 2nd edition, 1979.

EC 3028 Data Communication & Networking

Credit: 3
Category: PCC

Prerequisite(s): Analog Communication Techniques (EC 2012), Digital Communication Technique (EC 3005), Communication Engineering (EC 2016), Introduction to communication Engineering (EC 3044)

Course Description:

Data Communication & Networking course deals with down-to-top approach to TCP/IP protocol stack, OSI layered architecture for packet switched data networks and the TCP/IP stack implements by focusing in details from Physical, Data-Link, Network, Transport, and Quality of Service (QoS) parameters. This course covers different key concepts of networking like physical media dependant layer, MAC, Flow Control, Error Control, IP addressing, Sub-netting, IPv4/ IPv6, Routing, DHCP, ARP, ICMP, NAT, TCP/UDP and QoS.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: analyze, compare and contrast OSI layered Architecture and TCP/IP protocol stack
- CO2: analyze different techniques and algorithms implemented in Logical Link Control (LLC) Media Access Control (MAC) sub-layers associated with data-link layer
- CO3: explain design scenario-specific datagram networks based on IPv4 and IPv6
- CO4: investigate various protocols associated with TCP/IP stack
- CO5: investigate connection-oriented (TCP) and connection-less (UDP) protocols in transport layers to comprehend design features and functionalities
- CO6: analyze data communication networks to differentiate various Quality of Service (QoS) approach

Topics:

- Packet switched network
- OSI Layered Architecture, TCP/IP protocol stack implementation
- Services of Physical Layer, Data-Link Layer
- Error detection and correction techniques, Framing, High level Data-Link Control (HDLC)
- Multiple Access Control (MAC) protocols, Link-Layer Addressing, ARP
- Ethernet IEEE 802.3 Standards Frame format, GIGABIT Ethernet, wireless LAN IEEE 802.11 Architecture, Network Layer
- IPv4 & IPv6 protocol, IPv4 Addressing, Sub-netting, Super-netting, IPv6 Addressing
- Routing Algorithms and protocols, DHCP, ICMP, NAT
- Transport Layer Services, TCP, UDP, QoS

Textbook(s):

1. Data Communications and Networking, B A Forouzan, McGraw-Hill, 4th Edition, 2011.
2. Computer Networking – A top-down approach featuring the Internet, James F. Kurose and Keith W. Ross, 2nd Edition, Pearson Education, Asia, 2004.

Reference Book(s):

1. Internetworking with TCP-IP: Principles, Protocols and Architecture, D. E. Comer, Vol I, 2nd Edition, Prentice Hall, 1991.
2. Data and Computer Communications, William Stalling, 10th edition, Prentice Hall, 2013.
3. Communication Networking – An analytical Approach, Anurag Kumar, D Manjunath and JoyKuri, Morgan Kaufmann, 2004

EC 3029 Optical Communication and Networking

Credit: 3
Category: PEC

Prerequisite(s): Communication Engineering (EC 2016), Introduction to communication Engineering (EC 3044), Analog Communication Technique (EC 2012), Digital communication techniques (EC 3005)

Course Description:

The course intend to introduce the students to light signal propagation through optical fiber, various optical fiber modes, configurations and various signal degradation factors associated with optical fiber and to study about various optical sources and optical detectors and their use in the optical communication system. This course provides a basic understanding of various measurement techniques used for optical communication system. The optical networking system is also explained with the concept of fiber optic network components, variety of networking aspects, topologies, FDDI, SONET/SDH and operational principles WDM.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: comprehend the significance of terminology associated with optical communication, analyze the principle of light propagation through optical fiber with concept of modes and solve problems on this concept
- CO2: analyze various types of losses and dispersions in optical fiber and solve related problems associated with the concept
- CO3: explain and analyze the structure, principle of operation and the characteristics of optical sources and detectors
- CO4: comprehend and analyze the optical communication system link elements and prepare link budget
- CO5: comprehend various measurement techniques for optical communication system
- CO6: comprehend and analyze the fiber optical network components, variety of networking aspects, FDDI, SONET/SDH and operational principles WDM

Topics:

- Transmission characteristics of optical fibers
- Optical sources and detectors
- Optical Communication System and Measurements
- Optical measurements
- Optical networks

Textbook(s):

1. Fiber Optic Communications, Joseph C. Palais, Pearson Education, 5th Edition 2013
2. Optical Fiber Communication, Gerd Keiser, McGraw Hill, Third Edition, 2000.

Reference Book(s):

1. Optical Fiber Communication, John M. Senior, Pearson Education, Second Edition, 2007.
2. Optical Communication System, J. Gower, Prentice Hall of India, 2001.
3. Optical Networks, Rajiv Rama swami, Elsevier ,Second Edition, , 2004.
4. Optical Communication Network, Viswanath Mukherjee, McGraw Hill Publication, 2000.

EC 3031 ARM and Advanced Processors

Credit: 3

Category: PEC

Prerequisite(s): Microprocessors, Microcontrollers & Interfacing (EC 2020)

Course Description:

The objective of this course is to teach the higher level concepts of Advanced Microprocessors (like 80286, 80386, 80486 and Pentium) and Microcontroller (like ARM) to the students. In this course, the students learn about Multitasking, Virtual memory, Memory management, Paging, TLB, RISC features, Pipelining and Branch Prediction like concepts. They develop skills for writing programs on ARM to solve simple problems as well as some real time applications.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: analyze the concepts implemented in higher level Processors like Multitasking, Virtual Memory, Memory Management etc.
- CO2: analyze the mode of Operation of 80286 like Real Address Mode and Protected Virtual Address Mode, Concept of program in visible registers, Segment Descriptors etc.
- CO3: explain the Mode of Operation of 80386, Segment Descriptors, Privilege level and Protection, Virtual'86 Mode, Paging
- CO4: analyze the RISC features implemented in the design of Pentium Processors, Parallel processing through U&V Pipelines/Superscalar Execution and Branch Prediction Techniques
- CO5: analyze the concept of a 32-bit ARM Processor, its RISC features, Registers, Pipelining and Interrupts
- CO6: analyze the 32-bit ARM instruction set vis-a-vis 16-bit Thumb instructions and its applications

Topics:

- Intel higher level Processors, Concept of Multitasking, Virtual memory & Memory management
- Intel 80286 Microprocessor, Real mode, Protected virtual Address mode, Program Invisible Registers, Segment descriptor, Limitation of 80286
- Intel 80386 & 80486 , 80386 Segment descriptor, Privilege level & protection, Task switching, Virtual 86 mode, Paging, TLB, Enhanced features of 80486
- Pentium Processor: Features of RISC processors & Implementation of RISC features in Pentium, Pipelining, Super scalar execution & Branch prediction
- ARM Microcontroller: Introduction to RISC design philosophy and ARM design, Arm Processor Registers, CPSR, Memory map, Pipelines, Exceptions, Interrupt Vector Table
- ARM Instruction set and Thumb instructions

Textbook(s):

1. The 8088 and 8086 Microprocessors : Programming, Interfacing, Software, Hardware and Applications by Triebel and Singh-Pearson Education, 4th Edition.

Reference Book(s):

1. Microprocessors & Interfacing, Programming&Hardware by D.V.Hall-TMH-3rd Edition, 2012.
2. The Intel Microprocessors 8086/8088, 80186/80188, 80386, 80486, Pentium and Processor by B.B.Brey-PHI-8th Edition.
3. Microprocessors&MicrocomputerbasedSystemDesign by Md.Rafiquzzaman-UBS-2nd Edition.
4. An Introduction to the Intel Family of Microprocessors by James L. Antonakos-Pearson Education-3rd Edition.

5. ARM Assembly Language Programming &Architecture- M A Mazidi &others - www.MicroDigitalEd.Com.
6. ARM System Developers Guide Design &Optimizing System Software – Andrew N. Sloss &others-Elsevier

EC 3033 Embedded System Design and Application

Credit: 3

Category: PEC

Prerequisite(s): Microprocessor, Microcontrollers and Interfacing (EC2020)

Course Description:

This course covers fundamentals of embedded system hardware and firmware design. Topics such as embedded processor selection, hardware/firmware partitioning, circuit design, circuit layout, circuit debugging, development tools, firmware architecture, firmware design, and firmware debugging will be discussed. The Intel 8051 and PIC18F series microcontroller with instructions will be studied. The course briefly covers ARM processor architecture, instruction set and programming. The course will culminate with a significant design examples using ARM processor.

Course Outcomes: At the end of the course, the students will be able to:

CO1: understand the architecture, programming, and interface requirements of Embedded System Design

CO2: learn to apply assemblers, compilers, simulators and emulators to help with design and verification for ARM processors

CO3: create Interface of Microcontroller to displays, memories, different I/O ports

CO4: analyse and apply ALP / Embedded C code to solve real-time problems like timers, counters, A2D, Motors, etc. using ARM

CO5: understand and explain RTOS and its functionality, different scheduling for real time application

CO6: design closed and open embedded systems with firmware

Topics:

- Embedded system description and design aspects
- Processor and memory selection for embedded system
- Interrupt service and its uses in the embedded system design
- Embedded system design flow
- Embedded system programming concepts
- Brief introduction to 8051 and PIC18F series architecture and its instruction sets
- ARM architecture and its assembly language programming
- Designing hardware interface with ARM using embedded C programming
- Real Time Operating system and its scheduling

Textbook(s):

1. Embedded Systems: Architecture, Programming & Design, Raj Kamal, TMH, 2011
2. ARM Assembly Language: Fundamentals and Techniques by William Hohl, Christopher Hinds, CRC Press, 2nd Edition, 2015.

Reference Book(s):

1. Embedded System Design : A unified Hardware/Software Introduction by Rank Vahid, Wiley Student Edition, Wiley, 2002
2. Arm Assembly Language Programming & Architecture: Volume 1 by Muhammad Ali Mazidi, Sarmad Naimi, SepehrNaimi, Microdigitaled.com, 2nd Edition, 2016

EC 3035 High Speed Digital System Design

Credit: 3

Category: PEC

Prerequisite(s): Digital Electronics (EC 2011)

Course Description:

This course describes the ASIC design flow and FPGA design flow. It also introduces different design methodology such as top-down and bottom-up methodologies. Here, students will learn different coding styles that can be used in Verilog HDL to design and synthesize digital circuits. Also, it is necessary to verify the correctness of the design by applying different input patterns. Therefore, students will also learn testbench writing strategies to verify the correctness of the design. Several examples that include important arithmetic units of digital systems are covered in this course which demonstrate how to design and test the digital circuits using Verilog HDL. In addition, the course discusses the mapping of Verilog HDL to logic gates. It depicts with examples how Verilog HDL constructs are transformed into logic gates and their interconnections. Finally, a brief introduction on how logic-level circuits are converted into transistor-level circuits is illustrated in this course.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: comprehend and analyze the ASIC-based and FPGA-based design flow and VLSI design methodology
- CO2: design digital systems using Hardware Description Language (HDL)
- CO3: develop test cases to simulate and verify the correctness of the design
- CO4: convert Hardware Description Language to a gate-level netlist
- CO5: implement optimized digital circuits using different HDL-based mechanisms
- CO6: design circuits by using knowledge of translating logic circuits to transistor-level circuits

Topics:

- Digital design methodology
- Coding styles of Verilog HDL
- Synthesis of logic circuits
- Mapping of logic circuits to transistor-level circuits
- Case studies for Verilog HDL

Textbook(s):

1. Verilog HDL: A Guide to Digital Design and Synthesis; Samir Palnitkar; 2nd edition, Pearson Education, 2011.

Reference Books (s) :

1. A System Verilog Primer by J. Bhaskar, BS Publication 2013.
2. Advanced Digital Design with the Verilog HDL; Michael D. Ciletti; 2009,1st edition, PHI,2010.
3. Design Through Verilog HDL by T. R. Padmanabhan (Author), B. Bala Tripura Sundari, Wiley Student Edition, Wiley, 2012.

EC 3044 Introduction to Communication Engineering

Credit: 3
Category: OEC
Prerequisite(s): Nil

Course Description:

The course covers different types of signals and their analysis in time domain and frequency domain, different analog modulation techniques such as Amplitude Modulation (AM), Frequency Modulation (FM) and Phase Modulation (PM). Sampling technique and its application in Pulse Code Modulation (PCM) is discussed. The course further discusses different digital modulation techniques such as Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK) and Phase Shift Keying (PSK), Binary PSK and Quadrature PSK. Data transmission techniques such as frequency division multiplexing, time-division multiplexing and multiple access techniques are covered. Finally fundamentals of several modern communication system viz. satellite communication system, cellular system are explained.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: analyze signals in time domain and frequency domain
- CO2: interpret analog modulation techniques, investigate their limitations, advantages and applications
- CO3: explain sampling theorem and investigate pulse code modulation
- CO4: comprehend digital modulation techniques and multiplexing techniques
- CO5: interpret different types of noise, their sources and investigate their effect on communication systems
- CO6: analyze several modern communication systems

Topics:

- Representation of signals in time and frequency domains
- Understanding of Fourier series and Fourier Transform, Need of modulation and their types
- Amplitude modulation techniques such as AM, DSB-SC, SSB-SC, VSB
- AM modulators and demodulators, Super-heterodyne radio receiver
- Qualitative concepts of different angle modulation techniques such as FM (Narrowband FM and Wideband FM) and PM
- FM modulators and demodulators
- Sampling theorem and Nyquist rate, sampling types, quantization, Pulse code modulation
- Concept of digital modulation (ASK, FSK, PSK, QPSK) probability of error
- Frequency division multiplexing and Time division multiplexing
- Random processes, concept of noise, different types of noises and their sources
- Representation of white noise in frequency domain, concept of signal to noise ratio
- Introduction to satellite communication, wireless and mobile communication

Textbook(s):

1. Principles of Communication System- H. Taub and D.L. Schilling-TMH, 3rd Edition.

Reference Book(s):

1. Introduction to Analog and Digital Communication System-Simon Haykins, Wiley Student Edition 2011-John Wiley.
2. Electronics Communication System by Kennedy and Davis, Tata McGraw-Hill Publishing Company Limited, 4th Edition.

EC 3050 Internet of Things & Applications

Credit: 3

Category: PEC

Prerequisite(s): Microprocessors, Microcontrollers & Interfacing (EC 2020), Principles of Microprocessors and Microcontrollers (EC 3066)

Course Description:

This course is designed to provide essence and applications of Internet of Things and connected devices. This course establishes solution for real-world applications including appropriate modules and instruments. It also describes the IoT industry, the technologies used to create these types of devices, working principles, information storage and the types of distributed networks required to sustain them.

Course Outcomes: At the end of the course, the students will be able to:

CO1: explain different characteristics of IoT and demonstrate the need of appropriate sensors, microprocessor and microcontroller units and communication networks to develop IoT systems

CO2: identify application specific need of suitable sensors and actuators by analyzing the working of various sensors

CO3: design and evaluate application specific IoT prototypes based on Arduino platform by means of hardware interfaces like Digital IO, Analog In, PWM, UART, SPI, I2C and applications using Arduino IDE

CO4: design and evaluate application specific IoT prototypes based on Raspberry Pi Family development boards and develop small scale applications using python in Linux environment

CO5: apply suitable TCP/IP protocols and networking standards for development of IoT projects

CO6: design IoT application based on Client Server Model, HTTP, ThingSpeak, AWS, Cloud MQTT and evaluate the design specifications and requirements from case studies in the context of various IoT applications

Topics:

- Introduction & Overview of IoT.
- Sensors, Actuators & Signal Conditioning.
- Embedded Platforms & Prototyping (Arduino family and relevant topics)
- Advanced Embedded Development Platforms (PI family and relevant topics)
- Data Communication & Networking
- Cloud, Analytics, User interfaces
- IoT Applications and relevant case studies

Textbook(s):

1. "Internet of Things" by Jeeva Jose, 1st Edition-2018, Khanna Publications
2. "Internet of Things: A Hands-On Approach" by Arshdeep Bahga, Vijay Madisetti

Reference Book(s):

1. "Designing the Internet of Things" by Adrian McEwen, Hakim Cassimally, 1st Edition, Wiley Publishers
2. "Getting Started with the Internet of Things" by Cuno Pfister 1st Edition, O'Reilly Media.
3. "IoT: Building Arduino-Based Projects" by Peter Waher, Pradeeka Seneviratne, Brian Russell, Drew Van Duren, 2016 Edition, Packt Publishing Ltd.
4. "Raspberry Pi IoT Projects: Prototyping Experiments for Makers" by John C. Shovic, 2016 Edition,

EC 3056 Speech & Audio Signal Processing

Credit: 3

Category: PEC

Prerequisite(s): Digital Signal Processing (EC 3007), Principle of Digital Signal Processing (EC 3013)

Course Description:

The aim of this subject is to cover fundamental application research areas such as audio and speech signal processing for separation, recognition, transcription, enhancement, coding, synthesis as well as applications to advanced fixed and wireless communication systems. This course begins with preliminaries to digital signal processing and different transformations. Then the course continues to Speech production, Time domain analysis, Frequency domain analysis, LPC analysis, Speech coding, Speech recognition, Speech enhancement. Signal Processing Models of Audio Perception, Psycho-acoustic analysis, Spatial Audio Perception and rendering, Transform coding of digital audio, audio quality analysis are covered. Applications like speaker verification, identification and enhancement of speech quality are discussed.

Course Outcomes: At the end of the course, the students will be able to:

CO1: determine the digital model of speech production

CO2: analyze the spectral characteristics of the speech signal

CO3: distinguish and analyze between different speech coding techniques

CO4: apply various types of algorithms for speech analysis and synthesis

CO5: design different models for speech recognition

CO6: develop to perform speaker verification, identification and enhance the quality of speech signal

Topics:

- Preliminaries of digital Signals processing and different transform techniques
- Digital modelling of speech signal
- Spectral analysis of speech signal
- Speech coding
- Speech transformation
- Speaker verification, identification and enhancement of speech signal

Textbook(s):

1. Lawrence R. Rabiner and Ronald W. Schafer, Theory and Applications of Digital Speech Processing Pearson, 2010.

Reference Book(s):

1. Thomas F. Quatieri , Discrete-time Speech Signal Processing: Principles and Practice, Prentice Hall, Signal Processing Series, 2002.
2. Philipos C. Loizou, Speech Enhancement – Theory and Practice, CRC Press, 2013.

EC 3058 Nanoelectronics

Credit: 3

Category: PEC

Prerequisite(s): Electronics Devices and Circuits (EC 2019), Analog Electronic Circuits (EC 1004)

Course Description:

Nanoelectronics has emerged as a new advanced discipline due to rapid growth in Integrated Circuit (IC) Industry. This course imparts knowledge and understanding of physical background and application of nanoelectronics. To describe electrons at the nanoscale, the course starts with an introduction to the principles of quantum mechanics, including quantization, the wave-particle duality, wave functions and Schrödinger's equation. The course will further discuss different properties of materials and nanostructures, fabrication of nanostructures, nanoelectronic devices including resonant-tunneling devices, transistors, and single-electron transfer devices. The course will also focus on MEMS and NEMS and its applications in Sensors.

Course Outcomes: At the end of the course, the students will be able to:

CO1: understand the basic and advanced concepts of nanoelectronics

CO2: understand and evaluate the use of fundamental science of quantum mechanics in nanoelectronics

CO3: get an idea on nanoelectronics materials and will be able to distinguish from other materials

CO4: analyze the different fabrication and characterization techniques of nanostructure materials

CO5: learn the concepts of few nano electronics devices

CO6: analyze and evaluate the idea of single electron transistors and its further applications

Topics:

- Introduction to Particles and waves
- Nanoelectronics Materials
- Tunnel junction and applications of tunnelling
- Growth, fabrication, and measurement techniques for nanostructures
- Nano structure devices: MEMS AND NEMS
- The Single-Electron Transistor

Textbook(s):

1. Stephen D. Senturia, Microsystem Design, Kluwer Academic Press, 2005
2. Marc Madou, Fundamentals of microfabrication & Nanofabrication, CRC Press, 2011.
3. T. Fukada & W.Mens, Micro Mechanical system Principle & Technology, Elsevier, 1998

Reference Book(s):

1. WR Fahrner, Nano Technology and Nano Electronics – Materials, devices and measurement Techniques, Springer, 2004.

EC 3060 Mobile Communication Engineering

Credit: 3
Category: PEC

Prerequisite(s): Communication Engineering (EC 2016), Introduction to communication Engg.(EC 3044)

Course Description:

The course covers the evolution of mobile communication from first generation to third generation digital communication. The concept of Frequency reuse, handoff, trunking and the interference between mobiles and base stations which are the core of mobile communication for providing service to the subscribers are explained in this course. This course also explains different type of propagation path loss, fading and modulation techniques used in mobile communication, Inter Symbol Interference (ISI) by multipath propagation within time dispersive channel and its mitigation technique by Equalizer. Implementation of different diversity techniques for the compensation of fading is elaborated here. This course also explains various type of multiple access techniques and impacts on capacity for a cellular architecture.

Course Outcomes: At the end of the course, students will be able to:

- CO1: define and explain basic Cellular Architecture, Different propagation models, various modulation schemes, multiple access schemes and GSM technology
- CO2: classify different generation of mobile communications and improvements, different types of Handoff Strategies, different types of System capacity Improvement Techniques , various fading in multipath propagation, Different modulation techniques, various diversity techniques and different type of multiplexing
- CO3: identify different parameters required to improve channel capacity, requirement of Handoff in mobile communication, reasons of Fading, development of transmitter and receiver using different modulation schemes and the requirement of multiplexing
- CO4: analyze improvements in different generation of mobile communications, the reason of considering cellular architecture, generation of ISI (Inter symbol Interference) due to multipath propagation, different modulations e.g. QPSK, Offset QPSK, $\pi/4$ QPSK, MSK, GMSK, QAM and spread spectrum modulation and its properties
- CO5: compare various technologies implemented among different generation of mobile communications
- CO6: solve problems related to different aspects of mobile communication

Topics:

- Mobile Communication Principle
- RF Propagation & Multi-path Model
- Modulation Techniques
- Equalization and Diversity Techniques
- Spread Spectrum modulation
- Multiple Access Techniques

Textbook(s):

1. Wireless Communication – T.S. Rappaport , Pearson Education, 2nd edition, 2012
2. Wireless Communication – Andrea Goldsmith, Cambridge Press, 1st edition, 2005

Reference Book(s):

1. Wireless and Cellular Communication – C. Y. Lee, McGraw Hill, 3rd edition, 2006
2. Mobile Communication – Schillar, Pearson Education, 2nd edition, 2010
3. Wireless Communication-Tse and Viswanath, Cambridge Press, 2010

EC 3066 Principle of Microprocessors and Microcontrollers

Credit: 3

Category: PEC

Prerequisite(s): Digital Electronics (EC 2011)

Course Description:

This subject deals with Microprocessors 8085, 8086, 8255 PPI, 8259 PIC and 8251 USART and basics of 8051 Microcontroller. In this course, the students learn about assembly language programming on Microprocessors, Microcontrollers and develop programs for simple applications.

Course Outcomes: At the end of the course, the students will be able to :

- CO1: understand and explain the concept of Bus structure, a basic 8 bit Microprocessor system
- CO2: explain the architecture of a 16 bit Microprocessor like 8086 including the concept of instruction queue, segmented memory structure and address generation technique
- CO3: explain and analyze the Addressing modes, Assembly language instructions of 8086 and implement them to solve 8086 related design problems
- CO4: design Memory Interfacing using memory chips with proper decoder circuits with a 16-bit processor and analyze the interrupt structure of 8086 Microprocessor
- CO5: explain the peripherals such as PPI, Programmable interrupt control, USART and their interfacing with a 16 bit processor
- CO6: analyze memory organization of a 8 bit Microcontroller (like 8051), its addressing modes, instructions

Topics:

- Semiconductor Memory Chips, Tristate Concept & Bus Structure, A Basic Microprocessor based system
- 8 bit Processor, Bus Structure, 8085 Microprocessor Architecture, Concept of stack, Instructions & Addressing Modes
- 8086 (16 bit Microprocessor) Architecture, Pins & Signals, Minimum & Maximum Mode Configuration, Timing Diagrams; 8086 Addressing Modes and Instructions, Memory Interfacing, Interrupts
- Interfacing chips : 8255 (PPI), 8259 (PIC), 8251 (USART)
- 8051 Family of Microcontrollers, Overview of MCS-51 Family of Microcontrollers Memory Organization Pins & Signals, Addressing Modes, 8051 Instruction set, Interrupts

Textbook(s):

1. Microprocessors and Interfacing, Programming & Hardware - Douglas V. Hall, McGraw Hill Education Pvt Ltd., 3rd Edition

Reference Book(s):

1. Microprocessors & Microcomputer based System Design - Md. Rafiquzzaman, 2nd Edition
2. Advanced Microprocessor and Peripherals - Architecture, Programming and Interfacing by A. K. Ray and K. M. Bhurchandi - McGraw Hill Education Pvt Ltd - 3rd Edition.
3. 8051 Microcontroller - Hardware, Software & Applications - V Udayshankara & M. Mallikarjunswamy - TMH - 1st edition.

EC 3068 Real Time Systems and Application

Credit: 3
Category: PEC
Prerequisite(s): Nil

Course Description:

This course covers the principles of real-time systems, modeling of a real-time system, task assignment and scheduling, resource management, real-time operating systems, RTOS services. Programming language with real-time support, system design techniques, inter task communication, fault tolerant techniques, reliability evaluation methods, performance analysis, and case studies of real-time systems applications are also covered.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: differentiate between a real time system and other systems
- CO2: identify the different parts of hardware needed for real time system
- CO3: analyse and design to interface a microprocessor to displays, memories, different I/O ports
- CO4: analyse and use RTOS for Real Time System design
- CO5: design and Evaluate the function of a real time System
- CO6: apply the knowledge to different real time System for solving engineering and social problems

Topics:

- Basic overview of Operating System
- Real Time concepts and hardware considerations.
- Real Time Operating Systems
- Software requirements and Design process
- Application of Real time systems
- Case study

Textbook(s):

1. Real-Time Systems Design and Analysis by Phillip A. Laplante John Wiley & Sons, Inc.
Publication,3rd edition, 2011.

Reference Book(s):

1. Embedded and Real-Time Operating Systems by K.C. Wang, Springer, 2017
2. Real-Time Systems: Theory and Practice by Rajiv Mall, Pearson Publisher, 1st edition,2017

EC 3070 MANET and WSN

Credit: 3

Category: PEC

Prerequisite(s): Communication Engineering (EC 2016)

Course Description:

The objective of the course is to provide the basic knowledge of MANET and WSN, identify and analyze the goals, challenges, protocols and the issues involved in designing and implementing MANET and WSN for providing a good quality of service.

Course Outcomes: At the end of the course, the students will be able to:

CO1: comprehend the working and features of MANET

CO2: comprehend and explain the goals, challenges, protocols and issues involved in designing MANET and the quality of service required

CO3: comprehend the fundamentals of WSN

CO4: explain the working principles of physical layer of WSN

CO5: explain and analyze the different protocols, transport layer features and routing of WSN

CO6: identify the challenges in WSN and cross layer solutions

Topics:

- MANET
- MAC, routing and QoS in MANET
- Introduction to WSN
- Physical, MAC & Routing for WSN
- Challenges in WSN and cross layer solutions

Textbook(s):

1. C.Sivaraman Murthy and B.S.Manoj, “Ad Hoc Wireless Networks” , Person Education, Second Edition, India,2001
2. Ian F. Akyildiz and MehmetCan Varun, “Wireless Sensor Networks”, John Wiley and Sons Ltd, Publication 2010

Reference Book(s):

1. K Toh, “Adhoc mobile wireless networks, protocols and Systems”, 2nd Edition, Pearson Education,2009
2. Stefano Basangi, “ Mobile Adhoc Networking”, Wiley Inter science, IEEE Press, 2004
3. George Aggelou, “Mobile Adhoc Networks”, McGrawHill, 2004
4. Jun Zhny and Abbas Jama, “ Wireless Sensor Network - a networking perspective” 2009
5. C. Raghavendram, K.Sivalingam and T.Znati, “Wireless Sensor Network”,Springer,ISBN:1-4020-7883-8,August,2005

EC 3072 Introduction to Machine learning

Credit: 3
Category: PCC
Prerequisite(s): Nil

Course Description:

The course objective is to make students of Engineering to understand the basics of machine learning algorithms which are pervasive in engineering applications. Students will be able to understand the essence and applications of various clustering and classification techniques. Further, they will understand how it can be applied in real world problems. Then, the course covers the detailed analysis on artificial neural network along with few ensemble methods.

Course Outcomes: At the end of course, the students will be able to:

- CO1: develop appreciation for various concepts involved in learning models
- CO2: comprehend a wide variety of learning algorithms
- CO3: analyze and evaluate ML models
- CO4: apply ML algorithms to real-world problems
- CO5: optimize the models and report on the expected accuracy
- CO6: comprehend the concepts of bagging and boosting

Topics:

- Foundations for ML
- Clustering
- Classification
- Artificial Neural Networks
- Ensembles methods

Textbook(s) :

1. Shai Shalev-Shwartz and Shai Ben-David “Understanding Machine Learning” Cambridge University Press. 2017.
2. Christopher Bishop “Pattern Recognition and Machine Learning” Springer. 2006.

Reference Book (s):

1. Neural Networks, C.M. Bishop, Oxford Press, 1995.
2. Machine Learning for Audio, Image and Video Analysis, F. Camastra, Vinciarelli, Springer, 2007.

EC 3074 Internet Technologies for Cloud & Edge Computing

Credit: 3
Category: PEC
Prerequisite(s): Computer Programming (CS 1093)

Course Description:

The course objective is to introduce various aspects of internet, cloud computing and edge computing. Through this course student can learn about TCP/IP stack implementation for internet. The objective deals with analyses of could and edge applications and its requirement in the real world. Several tools for application specific cloud and edge computing models are discussed in this subject.

Course Outcomes: At the end of course the students will be able to:

- CO1: comprehend the idea of TCP/IP stack implementation for application specific requirements of Internet
- CO2: comprehend the cloud computing concepts and differentiate between different cloud based services
- CO3: comprehend the design aspects of edge computing and analyze the application specific resource requirements
- CO4: analyze various cloud & edge application design aspects and software technologies
- CO5: evaluate the select tools for application specific cloud and edge computing models
- CO6: design cloud and edge computing frameworks for scenario specific IoT applications

Topics:

- Cloud computing
- Edge Computing
- Feedback Concept
- Cloud & Edge application design aspects
- Application specific design aspects for IoT

Textbook(s):

1. Janakiram, “Grid and Cloud Computing”, TMH, 2016
2. Shailendra Singh, “Cloud Computing”, Oxford University Press, 2018

Reference Book(s):

1. Perry Lea, “IoT and Edge Computing for Architects: Implementing edge and IoT systems from sensors to clouds with communication systems, analytics, and security”, 2nd Edition. Packt.
2. R. Buyya, C. Vecchiola and S. T. Selvi, Mastering Cloud Computing Foundations and Applications Programming, Morgan Kaufmann, Elsevier, 2013.
3. R. Buyya, S.N Srirama “Fog & Edge computing Principles & Paradigms”: Wiley , 2019.
4. R. Buyya, High Performance Cluster Computing: Architectures and Systems, Volume 1, Pearson education, 2008.

EC 3076 IoT & Cyber-Physical System Design

Credit: 3

Category: PEC

Prerequisite(s): Internet of Things and its applications (EC 3050)

Course Description:

The course objective is to introduce the fundamentals of Internet of Things (IoT) and Cyber Physical System (CPS). This course covers identification and evaluation of different entities pertaining to IoT and CPS. This course enables student to model IoT and CPS in general. The course envisages discussing IoT and CPS components from the various perspectives including design, networking, communication protocols and standards. The course objective is to evaluate the highly complex infrastructure of CPS using several parameters such as security, privacy, integrity, reliability and resiliency. Different data analytics and platform have also been introduced in the course.

Course Outcomes: After completion of course, the students will be able to:

CO1: comprehend IoT and Cyber-Physical Systems components and design blocks

CO2: analyze IoT and Cyber-Physical Systems design issues and challenges

CO3: analyze Sensors, Actuators & Embedded System, Network & protocol design aspects and select appropriate components for designing IoT & Cyber-Physical Systems

CO4: evaluate the performance of various scenario specific requirements of IoT & Cyber-Physical Systems

CO5: evaluate and select appropriate computing & analytics platforms for IoT & Cyber-Physical Systems

CO6: design application specific IoT & Cyber-Physical Systems

Topics:

- IoT and CPS Design issues and challenges
- Sensors, Actuators & Embedded System design aspects
- Network & Protocol design aspects
- Computing platforms and Analytics
- Scenario specific applications of CPS

Textbook(s):

1. Complexity Challenges in Cyber Physical Systems, Saurabh Mittal, Andreas Tolk, Wiley.
2. Cyber-Physical Systems: A Computational Perspective, Gaddadevara Matt Siddesh, et. Al, CRC Press.
3. Scalable Computing and Communications: Theory and Practice, Samee U. Khan, et. al., Wiley-IEEE Press

Reference Book(s):

1. Principles of Cyber-Physical Systems, Rajeev Alur, the MIT Press.
2. Security and Privacy in Cyber-Physical Systems: Foundations, Principles, and Applications.
3. Data Analytics for IT Networks: Developing Innovative Use Cases, First Edition, John Garrett, CISCO press
4. Cyber-Physical Systems, Fei Hu, CRC Press

EC 3078 Signal Understanding Using Machine Learning

Credit: 3

Category: PCC

Prerequisite(s): Signals and Networks (EC 2021)

Course Description:

This course gives students a broad knowledge on, and techniques used in contemporary research on computer vision and pattern recognition. It provides an introduction to computer vision including fundamentals of image formation, feature detection and matching, motion estimation and tracking, and classification. Foundations of pattern recognition algorithms and machines learning methods for feature selection, and classification based on supervised and unsupervised learning methods.

Course Outcomes: At the end of course, the students will be able to :

CO1: comprehend signal processing basics

CO2: apprehend supervised and unsupervised learning mechanisms

CO3: design machine learning models by using various mathematical tools

CO4: use machine learning models for audio & music processing applications

CO5: use machine learning models for image processing applications

CO6: apply machine learning methods in signal processing and communication

Topics:

- Basic of Machine learning Techniques
- Artificial Neural Networks
- Applications of ML for Audio, Music and Image Processing
- Deep Learning Models and its application for image and signal processing

Textbook(s) :

1. Pattern Recognition and Machine Learning, C.M. Bishop, 2nd Edition, Springer, 2011.
2. Deep Learning, I. Goodfellow, Y, Bengio, A. Courville MIT Press, 2016.
3. Automatic Speech Recognition: A Deep Learning Approach, D. Yu and L. Deng Springer, 2016.

EC 3095 VLSI Laboratory

Credit: 1
Category: PCLC
Prerequisite(s): Digital Electronics (EC 2011)

Course Description:

The prime objective of this laboratory is to provide a compact idea about recent trends in digital system design, ASIC design and FPGA based hardware design and implementations. The hardware description language (HDL) such as Verilog is used in this lab for FPGA programming. This lab provides exposure to CAD tools used in analog system design.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: understand the basics of XILINX VIVADO tools and HDL for implementation of digital logic
- CO2: implement different combinational circuits using different modeling style
- CO3: implement sequential logic circuit such using Verilog HDL
- CO4: analyze and implement of memory using Verilog
- CO5: model finite state machines (FSM) using HDL and real time applications using HDL and FPGA
- CO6: model of CMOS logic circuits using SPICE

Topics:

- Introduction to XILINX VIVADO tools and Verilog HDL, design flow
- Gate level and data flow modelling
- Behavioral modelling of sequential logic circuits
- Modelling of Finite state machines
- Modelling of memory
- Real time application: Traffic light controller design
- Design and SPICE simulation of MOSFET, CMOS inverter, NAND and NOR gates

EC 3099 Digital signal processing laboratory

Credit: 1

Category: PCLC

Prerequisite(s): Digital signal processing (EC-3007)

Course Description:

This course is designed to teach implementation methods of various aspects related to digital signal processing on OCTAVE. It imparts the knowledge of discrete time LTI signals and systems and theoretical concepts are analyzed on software platforms. Design concepts on various kinds of filters based on the requirements and specifications are also covered. The implementation of basic concepts of multirate signal processing is also explained.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: apply the fundamentals of OCTAVE programming to simulate discrete time signals and systems and compute Circular convolution, linear convolution and correlation of discrete time signals
- CO2: find solution to the causal difference equations and compute step response and impulse response, compute transfer function, poles and zeros and determine stability of the system
- CO3: analyze the signal and its properties in its frequency domain using MATLAB Simulation environment. Use the Discrete time Fourier transform (DTFT) and Discrete Fourier Transform (DFT) in a variety of applications including: signal analysis, circular convolution and long data filtering
- CO4: design digital FIR low pass, high pass and band pass filters using OCTAVE after determining the required specifications for a given scenario
- CO5: design digital FIR low pass, high pass and band pass filters using OCTAVE after determining the required specifications for a given scenario
- CO6: design sampling rate converters, and analyze the effects of the change of sampling rate in the frequency spectrum of the signals

Topics:

- Analysis of an LTI system in time domain using OCTAVE
- Analysis of discrete time signals and system in frequency domain using DFT and DTFT in OCTAVE
- Design of FIR and IIR filters in OCTAVE
- Analysis of multirate signal processing using OCTAVE

EC 4059 Computer Vision & Pattern Recognition

Credit: 3

Category: PEC

Prerequisite(s): Digital Image Processing (EC 6108)

Course Description:

This course gives students a broad knowledge on, and techniques used in contemporary research on computer vision and pattern recognition. It provides an introduction to computer vision including fundamentals of image formation, feature detection and matching, motion estimation and tracking, and classification. Foundations of pattern recognition algorithms and machines learning methods for feature selection, and classification based on supervised and unsupervised learning methods. We focus less on the machine learning aspect of CV and image classification as that is really classify the theory best learned in an ML course.

Course Outcomes: At the end of course, the students will be able to:

CO1: understand basic concepts, terminology, and theories in the field of computer vision

CO2: become familiar with the major technical approaches involved in computer vision

CO3: identify various approaches of computer vision and pattern recognition, and design the components for it

CO4: understand a wide variety of learning algorithm for pattern recognition

CO5: apply machine learning techniques to solve problems of image classification

CO6: exposure to advanced concepts leading to object categorization and segmentation in images

Topics:

- Introduction
- Motion Estimation
- Computer Vision
- Pattern Recognition
- Image Processing
- Segmentation
- Machine Learning Techniques
- Applications: Surveillance, Object detection, classification etc.

Textbook(s):

1. Computer Vision: Algorithms and Applications by Richard Szeliski.
2. Pattern Recognition and Machine Learning, B. Christopher Bishop, Springer, 2008

Reference Book(s):

1. Computer Vision: A modern Approach, David Forsyth and Jean Ponce, Prentice Hall India, 2004
2. Pattern Classification, Richard O. Duda, Peter E. Hart, and David G. Stork, 2nd edition, Wiley Asia, 2002.

EC 4061 AI and Machine Learning for IoT

Credit: 3
Category: PEC

Prerequisite(s): Mathematics-I (MA 1003), Mathematics-II (MA 1004), Internet of Things and its applications (EC 3050)

Course Description:

The course objective is to explain the data sciences including different types of data acquisition methods using IoT and to their statistical analysis. The course describes the fundamentals of machine learning, artificial intelligence, artificial neural network and deep learning. Understanding the rising importance of IoT it intends to design various IoT based applications using artificial intelligence and machine learning.

Course Outcomes: After completion of course, the students would be able to:

- CO1: comprehend data acquisition using IoT and its analysis using mathematical and statistical tool using Machine learning approach
- CO2: analyze & apply different techniques and algorithms used in machine learning like regression, clustering, classification & decision trees
- CO3: analyze fundamentals of artificial neural network (ANN) techniques and apply it
- CO4: analyze fundamentals of AI & deep learning techniques and apply it
- CO5: analyze fundamentals of convolutional neural network (CNN) techniques and apply it
- CO6: design application specific ML & AI modeling on data acquired through IoT & CPS for intelligent system design

Topics:

- Data science, AI and ML
- ML fundamentals
- Artificial Neural Networks
- Deep Learning
- Application of AI and ML for IoT

Textbook(s):

1. Understanding Machine Learning, Shai Shalev-Shwartz and Shai Ben-David, Cambridge University Press, 2017.
2. Deep learning, Bengio, Yoshua, Ian J. Goodfellow, and Aaron Courville, MIT Press, 2015.

Reference Book(s):

1. Pattern Recognition and Machine Learning, Christopher Bishop, Springer, 2006.
2. Machine Learning, Tom Mitchell, McGraw Hill, 1997.

EC 4097 Machine Learning Laboratory

Credit: 1
Category: PCC

Prerequisite(s): Introduction to Machine learning (EC 3072), Deep Learning (EC 3080)

Course Description:

Machine Learning is concerned with computer programs that automatically improve their performance through experience. This course covers the theory and practical algorithms for machine learning from a variety of perspectives. This laboratory introduces the Python software which is very helpful for implementation of machine learning and deep learning techniques. Familiarization of various important machine learning libraries such as NumPy, Pandas, Matplotlib and Keras will be done followed by implementation of clustering and classification problems using traditional machine learning techniques. Further, the lab covers the implementation of solving real life problems using deep learning techniques.

Course Outcomes: At the end of course, the students will be able to:

- CO1: gain knowledge about basic functions of Python
- CO2: identify various useful machine learning libraries
- CO3: understand the implementation procedures for the machine learning algorithms
- CO4: identify and apply machine learning algorithms to solve real world problems
- CO5: analyze basic operation on data such as accessing, plotting etc.
- CO6: design application using deep learning techniques for real-world problems

Topics:

- Python fundamentals
- Machine learning libraries: NumPy, Pandas, Matplotlib, Keras
- Basic operation such as data accessing, data manipulation, plotting etc.
- Implementation of classification using traditional machine learning techniques
- Clustering using different clustering techniques
- Implementation of classification using deep learning techniques

EC 4099 IoT & Connected Intelligent Systems Laboratory

Credit: 2

Category: PCLC

Prerequisite(s): Internet of Things & its Applications (EC3050), Internet technologies for cloud and Edge Computing (EC 3074), Introduction to Machine Learning (EC 3072), AI & Machine Learning for IoT (EC 4061), IoT & Cyber-Physical System Design (EC 3076)

Course Description:

This laboratory is to provide hands-on exposure in IoT and AI-ML based connected-intelligent systems for industry readiness by bolstering the hands-on aspects of technical-Know-how and practical-skill in IoT & ML based a connected intelligent system that is highly demanded in industry. This lab deals with experiments on IoT-based intelligent systems design. Experiments on IoT-based system design using Embedded systems like NodeMCU, Raspberry Pi etc. along with the complete data communication framework based on TCP/IP protocol stack implementation for various application-specific intelligent connected sensors & actuators are covered. It also provides hands-on exposure to IoT and connected intelligent framework with protocols like MQTT/CoAP with sensor and application based device control technique with machine perception techniques (AI & ML) for scenario-specific application requirements of real-world engineering problems on Smart healthcare, smart city, smart home and smart sustainable IoT-based systems.

Course Outcomes: At the end of the course, students will be able to:

- CO1: design different application-specific sensor data acquisition for IoT-cloud using TCP/IP stack
- CO2: implement sensor-data acquisition system and intelligent actuator control application using cloud and MQTT protocol for intelligent IoT-based systems
- CO3: implement computing on Raspberry Pi and equivalent embedded development platform for intelligent IoT-based systems
- CO4: simulate appropriate Machine learning (ML) techniques on acquired sensor data for intelligent application-specific IoT-based systems
- CO5: design intelligent Machine perception technique on cloud data for intelligent IoT-based systems
- CO6: analyze of AI & ML based techniques on acquired IoT-based Sensor data

Topics:

- Data acquisition for IoT-cloud using TCP/IP stack using NodeMCU and Arduino IDE
- Application- sensor data for IoT-cloud using TCP/IP stack, and Raspberry Pi
- Intelligent actuator control application using cloud and MQTT
- Apply Machine learning (ML) techniques on acquired sensor data
- Analyze and implement of AI & ML based techniques on acquired IoT-based Sensor data and intelligent inference management and actuator control for application-specific requirements of real-world Smart healthcare application
- Implement of AI & ML based techniques on Sensor data and intelligent inference management and actuator control for application-specific requirements of real-world smart city, smart home and smart sustainable IoT-based systems
- Open Ended Design problems

EC 6108 Digital Image Processing

Credit: 3

Category: PEC

Prerequisite(s): Digital Signal Processing (EC 3007), Introduction to Digital Signal Processing (EC 3013)

Course Description:

This course introduces the concept of Digital image formation, representation and processing of digital image using digital devices such as computers. The processing or manipulation of digital image is achieved via both spatial and frequency domain with an aim to improve pictorial information for better human interpretation, storage, transmission and representation. Towards this goal the course provides both basic and in-depth coverage of image processing techniques such as image enhancement, restoration, color image processing, compression, segmentation, morphological processing and different mathematical transforms.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: analyze different image processing applications and learn different techniques to create and apply on digital image for better interpretations of an image
- CO2: implement various enhancement and restoration techniques
- CO3: explain and analyze the concept of color image processing
- CO4: evaluate different image compression techniques for various applications
- CO5: explain the concept of morphological operations and image segmentation
- CO6: interpret the effect of applying different image transforms

Topics:

- Fundamentals of image processing
- Spatial domain methods of image enhancement
- Frequency domain methods of image enhancement
- Image degradation model and restoration via Inverse filter, Weiner filter and constrained least square approach
- Color image processing via different color models and inter conversion between them
- Different image transforms such as DFT, DCT, Hadamard, KL and SVD and its importance in processing of a digital image so that different types of redundancy can be overcome ,hence an adequate of image compression can be occurred
- Morphological processing through dialation, erosion, opening and closing and discussion on few applications
- Region and edge based method of image segmentation and discussion on few applications
- Review of matrix algebra, 2-D convolution

Textbook(s) :

1. Digital Image Processing, R. C. Gonzalez and R. E. Woods, Prentice Hall, 3rd edition, 2008

Reference Book(s):

1. Fundamentals of Digital Image Processing, A.K. Jain, Prentice Hall
2. Digital Image Processing, S.Jayaraman, S. Esakkirajan, T. Veerakumar, TMH, 2009.
3. Digital image processing and Analysis, B. Chanda, D. Dutta Majumder, PHI, 2004.

EC 6112 Communication and Network Security

Credit: 3

Category: PEC

Prerequisite(s): Data Communication and Networking (EC 3028)

Course Description:

This course is intended to explain various communication security attacks and counter mechanisms. Design and implementation of the security services and mechanisms are also covered.

Course Outcomes: At the end of the course, the students will be able to:

CO1: analyze different security threats and attacks with reference to ISO/OSI model security

CO2: differentiate between various cryptography, watermarking, steganography methods

CO3: analyze different symmetric and asymmetric cryptographic algorithms

CO4: differentiate various key distribution and digital signature

CO5: analyze the working of various communication security protocols with respect to OSI layer

CO6: analyze different network security systems implementation in wireless systems

Topics:

- Ciphers &Algorithm
- Cryptographic Key distribution system
- Communication Security layer classification
- Network security

Textbook(s):

1. Cryptography & Network Security, B A Forouzan and D Mukhopadhyay, Mc-Graw Hill, India, 2nd edition, 2010.
2. Security of Information and Communication Network, S V. Kartalopoulos, Wiley-IEEE Press, 2009.

Reference Book(s):

1. Handbook of Information and Communication Security, Stavroulakis Peter, Springer, 2010.
2. Secure Broadcast communication in Wired and Wireless Communication, Adrian Perrig & Doug Tygar, Kluwer Publication, 2002.
3. Modern Cryptography: Theory and Practice, W Mao, Pearson Education, India, 1st edition, 2003.

EC 6122 Satellite Communication Systems

Credit: 3

Category: PEC

Prerequisite(s): Electromagnetic Waves and Antennas (EC 2022)

Course Description:

The course offers basic concepts of satellite communication. The satellite subsystems, orbital parameters, orbital placement of satellites, LEO, MEO, GEO, and HEO satellite systems are also covered under this course. The satellite link budget preparation and various satellite communication applications are also explained.

Course Outcomes: At the end of the course, the students will be able to:

CO1: comprehend basic parameters for satellite communication

CO2: explain satellite launching methods and orbital control mechanisms

CO3: comprehend different types of losses in satellite link and satellite link design

CO4: differentiate between different types of noises and interferences associated with satellite link

CO5: evaluate the stability of a satellite in orbit and different satellite sub-systems

CO6: investigate different types of multiple access techniques for digital satellite communication

Topics:

- Frequency spectrum for satellite communication, Types of orbits, Kepler's Laws of planetary motion, Orbital perturbations, Geostationary orbit, Satellite launching, General satellite communication, Block diagram uplink, Downlink frequencies, Types of modulation techniques used orbits, and altitude control Satellite launch vehicles - Arian, SLV space shuttle
- Signal loss on transmission through earth's atmosphere, Atmospheric losses, Ionospheric effects, Rain attenuation, Satellite link budget: Transmission losses, Interference, System noise temperature, Link power budget
- Antenna sub-systems, Altitude and orbit control sub-system, Power sub-system, Communication sub-system, TTC&M sub-systems
- Satellite application in TV, Internet, Mobile telephony, Receive only home TV, Master Antenna, TV, Low earth orbit satellite systems and uses. Multiple access techniques - FDMA, TDMA, SS-TDMA, Interference in FDMA systems

Textbook(s):

1. Satellite Communications, T. Pratt & C.W. Bostia, Wiley, 2003

2. Satellite Communication, D. Roddy, McGraw Hill, 2006

Reference Book(s) :

1. Digital Satellite Communications, T.T. Ha, McGraw Hill, 1990

EC 6224 Low power VLSI Design

Credit: 3

Category: PEC

Prerequisite(s): VLSI Design

Course Description:

This course describes the factors that are responsible for power dissipation in MOSFET devices and circuits. It also teaches how to estimate the average and maximum power dissipations in a circuit. In addition, different design techniques to reduce the power dissipations in VLSI circuits are outlined in this course.

Course Outcomes: At the end of the course, the students will be able to:

CO1: comprehend and analyze different MOS Logic circuits and power dissipation concept

CO2: differentiate and apply scaling techniques in different topology

CO3: optimize the power dissipation in CMOS circuits through switched capacitance minimization approach

CO4: optimize the power dissipation in CMOS circuits through different lower power minimization techniques in architecture level

CO5: optimize the power dissipation in CMOS circuits through different lower power minimization techniques in gate level

CO6: design different low power memory logic

Topics:

- Power dissipation and its types.
- Scaling methods.
- Switched capacitances.
- Leakage power optimization in architecture design.
- Leakage power optimization in design.
- Circuit level implementation for optimum performance

Textbook(s):

1. Low-Power CMOS VLSI Design, Kaushik Roy and Sharat C. Prasad, Wiley-India, 2011.
2. CMOS Digital Integrated Circuits, Sung-Mo Kang and Yusuf Leblebici, 3rd edition, TMH, 2011.

Reference Book(s):

1. CMOS VLSI Design: A circuits and Systems Perspective, West, Harris and Banerjee, 3rd edition, Pearson Education.
2. Low Power VLSI CMOS Circuit Design, A. Bellamour, and M. I. Elmasri, Kluwer Academic Press.
3. Low Power Digital CMOS Design, Anantha P. Chandrakasan and Robert W. Brodersen, Kluwer Academic Publishers, 2002.
4. Essentials of VLSI Circuits and Systems, Eshraghian, Puckness and Eshraghian, 2nd edition, Pearson Education.
5. Digital Integrated Circuits: A Design Perspective, J. M. Rabaey, Anantha Chandrakasan and Borivoje Nikolic, 2nd edition, PHI, 2001.

EE 2015 Electric Circuit Analysis

Credit: 3
Category: PCC

Prerequisite(s): Basic Electrical Engineering (EE 1003)

Course Description:

Type of sources, Theorems, Analysis of circuit with one nonlinear network, Self and Mutual Inductance, Dot convention, Coupled circuits, Transient response for R-L, R-C and R-L-C circuits, Two port network configuration, Interconnection of two port networks, Concepts of graph theory and different incidence matrices, Design of low pass, high pass, band pass, and band elimination filter.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: analyze different electrical circuits using network theorems
- CO2: understand the magnetically coupled circuits.
- CO3: apply time domain and Laplace Transforms for finding transient responses.
- CO4: analyze various parameters of two port networks.
- CO5: analyze the electrical circuits using network topology
- CO6: design the filters for elimination of undesired signals.

Topics:

- Network Theorems
- Magnetic Coupled Circuits
- Transient Response
- Two-Port Networks
- Network Topology
- Filter

Textbook(s):

1. Network Analysis by M. E. Van Valkenburg, Pearson Education, 3rd Edition, 2006.
2. Networks and systems by D.Roy Choudhury, New Age Publication, 2nd Edition, June 2013.

Reference Book(s):

1. Circuits and Networks Analysis and Synthesis (2nd Edition) A Sudhakar Shyammohan and S Palli, McGraw-Hill, 5th Edition, 2011.
2. Basic Circuit Analysis (2nd Edition), John O'Malley, Schaum's Outlines, McGraw-Hill, 2010(Reprint).
3. Fundamentals of Electric Circuits, Charles K. Alexander, Matthew N.O. Sadiku, McGraw Hill Education; 5 edition (1 July 2013).

EE 2017 Transformers and Induction Motors

Credit: 3

Category: PCC

Prerequisite(s): Basic Electrical Engineering (EE 1003)

Course Description:

Construction, Principle of Operation of single phase and three phase transformer, different tests, Regulation, Losses and Efficiency, equivalent circuit and Parallel operation of Transformer. Three Phase Transformer Connections and vector group, parallel operation of three phase transformer, construction and operation of Three-phase induction motor, Equivalent Circuit, different tests and Phasor Diagram, Torque-Slip characteristics, Circle Diagram, Methods of starting and speed control methods.

Course Outcomes: At the end of the course, the students will be able to:

CO1: remember the construction, principle, losses, efficiency and Phasor diagram of transformers and induction motors

CO2: explain the different tests to develop the equivalent circuit of transformer and induction motor

CO3: plan for the parallel operation of single phase and three phase transformers

CO4: compare different connections and conversions of three phase transformers

CO5: evaluate the performance characteristics, different methods of starting and speed control of three phase induction motors

CO6: discuss the construction and principle of operation of different single phase induction motors

Topics:

- Single Phase Transformer
- Three Phase Transformer
- Three Phase Induction Motor
- Single Phase Induction Motor

Textbook(s):

1. Electrical Machinery by P. S Bimbhra, 7th Edition, Khanna Publishers, 2008.
2. Electric Machines, by Kothari. D P and I J Nagrath, 3rd Edition, Tata McGraw-Hill, New Delhi. 2004.
3. Electric Machinery, by E. Fitzgerald, C. M. Kingsley (Jr) and S. D. Umans, Tata McGraw Hill, 6th Edition 2003.

Reference Book(s):

1. Electrical Machines by Ashfaq Hussain, Dhanpat Rai, Delhi, 2nd Edition, 2008.
2. Electrical Machines, by P. K. Mukharjee and S. Chakravorti, Danpat rai Publication, 2nd Edition, 18th reprint 2013.
3. Electrical Machines, by P. Purkait and I. Bandyopadhyay, Oxford University Press. 1st Edition, 2017.

EE 2020 D.C. Machines and Synchronous Machines

Credit: 3

Category: PCC

Prerequisite(s): Transformers and Induction Motors (EE 2017)

Course Description:

Principle of operation, Types of DC Machines, Losses and Efficiency, Characteristics of different DC Machines, Speed control of DC Motor, Necessity of starters, Different testing methods, Principle of operation of synchronous generator, Phasor Diagram, Voltage Regulation, Method of Starting, Equivalent Circuit and Phasor diagram of synchronous motor, Construction of V curve and inverted V curves.

Course Outcomes: At the end of the course, the students will be able to:

CO1: remember the Construction, principle and efficiency of synchronous machines and different DC machines

CO2: understand the armature reaction and characteristics of DC machines and Synchronous machines

CO3: apply phasor diagram to find the voltage regulation of a Synchronous generators

CO4: analyze the concepts of equivalent circuit and power flow diagram of synchronous motors

CO5: evaluate the V and the inverted V curves of synchronous motors

CO6: elaborate the power angle equations for the salient and cylindrical rotor synchronous motors

Topics:

- DC Generator
- DC Motor
- Synchronous Generator
- Three Phase Synchronous Motor

Textbook(s):

1. Electrical Machinery by P. S Bimbhra, 7th Edition, Khanna Publishers, 2008.
2. Electrical Machines by P. Purkait and I. Bandyopadhyay, Oxford University Press, 1st Edition 2017.
3. Electric Machinery by E. Fitzgerald, C. M. Kingsley (Jr) and S. D. Umans, McGraw Hill, 6th Edition 2003.

Reference Book(s):

1. Electrical Machines by Ashfaq Hussain, Dhanpat Rai, Delhi, 2nd Edition, 2008.
2. Electric Machines by C. I. Hubert, Pearson Education, 2nd Edition, 2003.
3. A Text Book of Electrical Technology, Vol. -II, AC and DC Machines, by B. L Theraja, A. K Theraja, S. Chand and Sons, 23rd Edition , 2006.

Credit: 4

Category: PCC

Prerequisite(s): Electrical Circuit Analysis (EE 2015)

Course Description:

Generation of Electric Power from Thermal, Hydro and Nuclear Power plant, Calculation of Line constants, Analysis of short, medium and long Transmission Line, Ferranti effect, Surge Impedance Loading, Sag and Stress calculation, different Insulators, String Efficiency, corona, Types, construction and Grading of Cables, Classification of distribution system, Load curve, Load duration curve, different factors, Classification and types of Substation, Equipment used, Bus-bar arrangement.

Course Outcomes: At the end of the course, the students will be able to:

CO1: remember the operation of conventional generating stations

CO2: outline the utility of the circuit parameters of transmission lines

CO3: analyse the transmission line performance

CO4: examine mechanical design of transmission line

CO5: evaluate the performance analysis of different distribution system

CO6: elaborate the economic aspects of power plants and components of substation

Topics:

- Generation of Electric Power
- Transmission of Electric power
- Line constants
- Performance of Transmission line
- Mechanical Design of over head transmission lines
- Corona
- Distribution Systems
- Economics Aspects and Substation

Textbook(s):

1. Electrical Power System, by C.L. Wadhwa, New Age International (P) Limited, Publishers, 7th Edition, 2009.
2. A Text Book on Power System Engineering, by A. Chakrabarti, M.L. Soni, P.V. Gupta and U.S. Bhatnagar, Dhanpat Rai and Co., 2nd Edition, Reprint 2012.

Reference Book(s):

1. A Course in Power System, by J. B. Gupta, S K Kataria and Sons Publishers and Distributors, 2013th Edition, 2011.
2. Power System Analysis and Design, by B. R. Gupta, S. Chand Publications, 3rd Edition, Reprint, 2003.
3. Principle of Power System, by V.K.Mehta, S.Chand Publishers, 3rd Revised Edition 2012.
4. Elements of Power System Analysis, by W.D. Stevenson Jr, MGH, 4th Edition, 1982.
5. Overhead Power lines planning, design and construction, by F Kiessling, P Nefzger, J F Nolasco and U Kaintzyk, Springer- Verlag, 1st Edition.

EE 2028 Linear Control System

Credit: 3

Category: PCC

Prerequisite(s): Analog Electronic Circuits (EE 2013), Signals and System (EE 2022)

Course Description:

Open loop and closed loop control system, Mathematical modeling of mechanical system and electrical system,

Transfer function from signal flow graph using Mason's gain formula, Time response of first and second order system, Minimization of Errors through P, PI and PID controllers, Routh- Hurwitz stability criterion, Construction of Root Locus and rules, Polar plots, Bode plots, Nyquist stability criterion, Concept of state, State variable, State model for LTI system, Lag, Lead and lag lead compensators.

Course Outcomes: At the end of the course, the students will be able to:

CO1: recall the terminology of control systems

CO2: understand the mathematical model of physical systems

CO3: apply the concepts of time domain analysis of different systems

CO4: analyze the stability of a system by classical methods

CO5: analyze frequency domain response and different compensators

CO6: discuss about the state space modeling of different systems

Topics:

- Introduction to Control System
- Modeling of Physical System
- Time Domain Analysis
- Concept of Stability
- Root Locus Technique
- Frequency Domain Analysis
- Compensators
- State Space Analysis

Textbook(s):

1. Control System Engineering, by Noran S Nise, John Wiley Publication, 6th Edition, 2012.
2. Modern Control Engineering, by K. Ogata PHI publication, 5th Edition, 2010.

Reference Book(s):

1. Control Systems Engineering ,by R. Anandnatarajan and P. Ramesh Babu, SCITECH,4th edition, 2016.
2. Control Systems: Theory and applications, by Smarajit Ghosh, Pearson. Publication ,2nd Edition,2012
3. Automatic control system, by Hasan Saeed, S.K. Kataria and Sons, 6th revised edition 2008
4. Modern Control Engineering, by D. Roy Choudhury PHI publication, 5th Edition,2009.
5. Automatic Control Systems, by Benjamin C. Kuo, Prentice-Hall,7th Edition,2009.
6. Control System Engineering, by I. J. Nagrath and M Gopal ,New age international publication, 4th Edition,2011.
7. Control System, by D N Manik, Cengage Learning India Pvt, 1st Edition,2012.
8. Automatic control systems, by Prof. B.S. Manke and S. N. Verma , Khanna publication,5th Edition, 2012.

EE 2096 Electrical Machines Laboratory

Credit: 1.5

Category: PCLC

Prerequisite(s): Basic Electrical Engineering Laboratory (EE 1093)

Course Description:

The main objective of the Electrical machines laboratory is to provide the practical exposure to the student regarding operation of various electrical machines like DC generators, DC Motors, Alternators, Synchronous motors, Induction Motors, Special Motors and Transformers. Students are allowed to conduct various experiments for the validation of performance characteristics of all the machines. From this laboratory courses student will gain the skill to select correct machine for a specific application.

Course Outcomes: At the end of the course, the students will be able to:

CO1: memorize the working principle and applications of different electrical machines

CO2: understand the challenges in industrial applications of electric motors

CO3: utilize different electrical machines

CO4: analyse different electrical machine according to the requirement in the industrial applications.

CO5: assess the safety precautions to be taken while using electrical equipment

CO6: design the equivalent circuit of the transformer and construct the circle diagram of an induction motor

Topics:

- No Load and Load Characteristics of a (i) D.C Shunt Generator and (ii) Separately Excited Generator
- Design of the equivalent circuit by using the open circuit and short circuit test on a single phase Transformer
- Determination of the voltage regulation of a three phase alternator using the Open circuit and short circuit test
- Design of the circle diagram using the No load and Block rotor test on three phase induction motor

Textbook(s):

1. Electrical Machinery, P. S Bimbhra, 7th Edition, Khanna Publishers, 2008.
2. Electrical Machines, by P. K. Mukherjee and S. Chakravorti, Dhanpat rai Publication, 18th reprint 2013

Reference Book(s):

1. Electrical Machines, Ashfaq Hussain, Dhanpat Rai, Delhi, 2nd Edition, 2008.
2. Electrical Technology, Volume -II. B. L. Theraja, S .Chand Publications. 2010.
3. Electric Machines, C. I. Hubert, , Pearson Education, 2003.
4. Electric Machines ,by Kothari. D P and I J Nagrath, , 3rd Edn, Tata McGraw-Hill, New Delhi. 2004.

EE 2098 Power Electronics Laboratory

Credit: 1.5

Category: PCLC

Prerequisite(s): Basic Electrical Engineering Laboratory (EE 1093)

Course Description:

Utilities of Power Electronic Converters are introduced. The AC-DC converters are examined in details with R and RL loads. Analysis of DC-DC converters are done so that experimental verification can be facilitated. The principle of chopper is applied in the Fly-Back Converters for SMPS. The waveforms and the output voltage equation of SMPS are experimentally verified.

Course Outcomes: At the end of the course, the students will be able to:

CO1: choose an appropriate converter for variety of needs

CO2: comprehend the principles of operation of various converters

CO3: apply AC-DC converters for rectification

CO4: analyze the parameters and the waveforms of the output of the converters

CO5: assess the efficacy of a converter

CO6: discuss about the merits and demerits of the converters

Topics:

- Study of output voltage waveforms and parameters of three phase uncontrolled rectifier
- Study of single phase fully controlled AC-DC converter with R and RL load
- Verify the performance of DC-DC Buck-Boost converters
- Verify the performance of Fly-Back Converters for SMPS

Textbook(s):

1. Power Electronics by M. H. Rashid, Pearson Education, 3rd Edition, 2009.
2. Elements of Power Electronics, by Philip T. Krein, Oxford University Press, 25 Sept 1997.
3. Power Electronics, by P S Bhimbra, Khanna Publishers, 5th Edition, 2011.

Reference Book(s):

1. Power Electronics, Converters, Applications and Design, by N. Mohan, Undeland and Robbins, John Wiley and Sons , 3rd Edition ,2009.
2. Modern Power Electronics by P. C Sen, S Chand Publisher- 2013.
3. Power Electronics, by K.R.Varmah and Chikku Abraham, Cengage Publications- 2014.
4. Power Electronics, by M. D. Singh and K.B. Khanchandani, Tata McGraw - Hill publishers, 2nd edition, 2008.

EE 3002 Power System Operation and Control

Credit: 4

Category: PCC

Prerequisite(s): Generation, Transmission and Distribution of Electric Power (EE 2024), Linear Control System (EE 2028)

Course Description:

Bus classification, Nodal Admittance matrix, Formulation of load flow problem, Optimal operation of generators, Distribution of load on various generating units, Symmetrical components, Symmetrical and Unsymmetrical Fault analysis, Modeling of speed governing system, Steady state analysis, Dynamic response, Excitation system, Dynamics of synchronous machines, Swing equation, Equal area criterion, Effect of clearing time on stability.

Course Outcomes: At the end of the course, the students will be able to:

CO1: understand the automatic generation control

CO2: classify different Power system faults

CO3: solve load flow problems

CO4: analyze economic operation of power system generation

CO5: apply various types of power system stability concept

CO6: elaborate the concepts of generation control and voltage control

Topics:

- Load Flow Analysis
- Economic Operation of Power Generation
- Symmetrical and Unsymmetrical Fault Analysis
- Automatic Generation and Voltage Control
- Stability Analysis

Textbook(s):

1. Modern Power System Analysis, I. J. Nagrath, D. P. Kothari, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 3rd Edition, 2003.
2. Power System Analysis- By John. J. Grainger & W. D. Stevenson, Jr., MGH, 2003 ,4th Edition, (15th Reprint).

Reference Book(s):

1. Power System Analysis by T K Nagarkar and M S Sukhija, 1st Edition, Eighth impression 2012, Oxford University Press.
2. Power System Analysis Operation and Control, Abhijit Chakrabarti, Sunita Halder, Third Edition, 2010, PHI Learning Private Limited

EE 3006 Electric Drives and Control

Credit: 3

Category: PEC

Prerequisite(s): DC Machines and Synchronous Machines (EE 2020), Power Electronics (EE 2026)

Course Description:

Four quadrant operation of an electric drive, Modification of characteristics of DC shunt and series motors, Concept of Electric Braking, Open loop, Closed loop speed control, Hysteresis controller, Chopper and rectifier based DC Separately excited motor and series motor drive control, characteristics of three phase Induction motors, Electric Braking of Induction Motors, Regenerative Braking, DC Dynamic braking, Plugging, Slip Power recovery scheme, PWM Voltage Source Inverter fed induction motor drives, Current source inverter fed induction motor drives, Comparison of VSI and CSI fed drives, Permanent magnet AC motor drives, Sinusoidal PMAC motor drives, Brushless DC motor Drives.

Course Outcomes: At the end of the course, the students will be able to:

CO1: spell the need of Electric Drives in the industry

CO2: understand the characteristics and braking techniques of DC Motor Drives

CO3: apply the knowledge of drives for the Control of DC Motor Drives

CO4: analyze the characteristics of Induction Motor Drives

CO5: analyse the different speed control techniques for various industrial drives

CO6: discuss about the performance of Synchronous Motors and Brushless DC motor drives

Topics:

- Introduction to Electric Drive System
- DC Motor Drives
- Control of DC Motor Drives
- Solid State Control of DC Drive
- Induction Motor Drives
- Speed Control of Induction Motors
- Synchronous and Brushless DC Motor Drives

Textbook(s):

1. G.K. Dubey, Fundamentals of Electric Drives, Second Edition, Narosa Publishers, 2007.
2. S. K. Pillai: A First Course on Electrical Drives, New Age International Publishers, 2nd Edition, 2007.

Reference Book(s):

1. Bimal K. Bose, Power Electronics and Motor Drives: Advances and Trends, Academic Press, Har/Cdr edition (13 September 2006).
2. N. K. De, P. K. Sen: Electric Drives, PHI Learning Pvt. Ltd., 7th Edition, 2004.
3. Modern Power Electronics and AC Drives by Bimal. K. Bose, PHI Publisher, 1st Edition, 2013.
4. S.A. Nasar, Boldea , Electrical Drives, CRC Press, Second Edition, 2006
5. M. A. El-Sharkawi , Fundamentals of Electrical Drives , Thomson Learning, 1st Edition, 2000.
6. R. Krishnan, Electrical Motor Drives, PHI, Second Edition ,

EE 3008 Power System Protection

Credit: 3

Category: PCC

Prerequisite(s): Generation, Transmission and Distribution of Electric Power (EE 2024)

Course Description:

Philosophy of protection, Basic elements in protective scheme, Principle of AC and DC arc interruption, Recovery voltage, Re-striking voltage, Current chopping, Types of circuit breakers, Arc extinction methods, Principle, Characteristics of H.R.C fuse, Method of grounding, Differential protection scheme of alternator, Differential protection scheme of transformer, Differential scheme for Bus Bar Protection, Time graded feeder protection, Circulating current and Merz-Price protection, Surge diverters.

Course Outcomes: At the end of the course, the students will be able to:

CO1: remember the need of protective devices in power system

CO2: explain the classification of different AC and DC Circuit Breakers

CO3: apply the knowledge of Circuit Breakers, protective Elements and Earthing for the Alternator Protection

CO4: analyze the practices of Transformer Protection and Bus Bar Protection

CO5: analyse the protection technique used for Feeder

CO6: discuss about the Surge Protection

Topics:

- Circuit Breakers
- Protective Elements
- Earthing
- Alternator Protection
- Transformer Protection
- Bus Bar Protection
- Feeder protection
- Pilot Wire Protection
- Protection against Surges

Textbook(s):

1. Fundamentals of Power System Protection”, Y. G. Paithankar, S. R. Bhide, 2nd edition, Prentice Hall of India Private Limited, New Delhi, 2011.
2. Power System Protection and Switchgear by B Rabindranath and M Chander , Wiley Eastern 2017, 2nd Edition.

Reference Book(s):

1. A Course in Power Systems, J. B. Gupta, S. K. Kataria and Sons Publishers and Distributors, 2013th Edition,2009.
2. Principles of Relaying”, Van Warrington, Y. G. Paithankar. PHI,1st Edition, 2009.
3. Power system Switchgear and Protection N.Veerappan and S R Krishnamurthy, S Chand Publication, 1st Revised edition 2013.
4. Power system Protection and Switchgear, Badri Ram and D N Vishwakarma McGraw Hill, 2nd reprint 2012
5. Electrical Power System, C.L. Wadhwa, New Age International (P) Limited,, second Edition , 2009.

EE 3017 Renewable Energy Sources

Credit: 3

Category: PCC

Prerequisite(s): Basic Electrical Engineering (EE 1003)

Course Description:

Classification and Importance of Non-Conventional Energy Sources, Solar Radiations Measurement, Solar Cell Characteristics, Solar Cell Classification, Maximum Power Point Tracker (MPPT), Wind Turbine Sitting, Major Application of Wind Power, Wind Turbine Construction, Biomass Resources, Biomass Conversion Technologies, Urban Waste to Energy Conversion, Biomass Gasification, Liquefaction, Ethanol Production, Geothermal Energy, Types of Geothermal Resources, Exploration and Development of Geothermal Resources, Ocean Thermal Electric Conversion (OTEC) systems, Energy from tides, Limitation and scope of tidal energy, Wave energy conversion Devices, Principle of working of various types of fuel cells and their working, Performance and limitations, MHD generation principles.

Course Outcomes: At the end of the course, the students will be able to:

CO1: define the fundamentals of Energy

CO2: explain the concept of Solar Thermal and Photovoltaic Systems

CO3: utilize Wind Energy Systems for the benefit of mankind

CO4: analyze Biomass Energy Resources

CO5: understand the operation of Geothermal Energy and Ocean Energy Systems

CO6: know the principles of Fuel Cells

Topics:

- Fundamentals of Energy
- Basics of Solar Energy, Solar Thermal and Photovoltaic Systems
- Basics of Solar Energy
- Wind and Biomass Energy
- Geothermal and Ocean Energy
- Fuel Cells

Textbook(s):

1. B. H. Khan, "Non – Conventional Energy Resources" Tata Mc Graw Hill, 2nd edition 2009.
2. N. K. Bansal, Manfred Kleemann, Michael Meliss, "Renewable energy sources and conversion technology", Tata Mc Graw Hill, 1st Edition, 1990.

Reference Book(s):

1. Kothari D.P., "Renewable energy resources and emerging technologies", Prentice Hall of India Pvt. Ltd, 2nd Edition, 2006.
2. Rai G.D, "Non-Conventional Energy Sources", Khanna Publishers, 4th Edition 2000.
3. Ashok V. Desai, "Nonconventional Energy", New Age International Publishers Ltd, 1st Edition Reprint 2003.

EE 3035 Energy Storage Technology

Credit: 3

Category: PEC

Prerequisite(s): Chemistry (CH 1007)

Course Description:

Energy availability, Demand and storage, Need for energy storage, Different types of energy storage, Comparison of energy storage technologies, Flywheel storage, Hydro storage, Thermal energy storage, Energy analysis of thermal energy storage, Solar energy and thermal energy storage, Battery fundamentals and technologies, Comparison of Lead-acid, Nickel-Metal hydride, Lithium Ion; Equivalent Circuit of an Electrochemical Cell, Charging and discharging operation of batteries, State-of-charge (SOC) of batteries, battery management systems, Hydrogen as energy carrier and storage, Fuel cells, Application of Energy Storage: Food preservation, Waste heat recovery, Solar energy storage: Greenhouse heating; Drying and heating for process industries.

Course Outcomes: At the end of the course, the students will be able to:

CO1: remember different energy storage systems

CO2: understand the performance of different types of energy storage device

CO3: apply energy storage principles to different electrochemical system

CO4: analyze the principle of different types of fuel cell

CO5: solve the state of charge of batteries using different techniques

CO6: apply the energy storing devices to different types of industries

Topics:

- Energy Availability
- Mechanical, Thermal Energy Storage
- Electrochemical Energy Storage
- Fuel Cells

Textbook(s):

1. Huggins R. A., Energy Storage: Fundamentals, Materials and Applications, second edition, Springer International Publishing, 3rd Edition, 2015.
2. Dincer I., and Rosen M. A., Thermal Energy Storage: Systems and Applications, second edition, Wiley, 2011.

Reference Book(s):

1. Fuel Cell Fundamentals, O'Hayre R., Cha S., Colella W., and Prinz F. B., Wiley, Second Edition, 2009.
2. Chemical and Electrochemical Energy System, Narayan R. and Viswanathan B., Universities Press, (1998).
3. Battery Systems Engineering, Rahn C. D. and Wang C., First Edition, Wiley, 2013.
4. Electrochemical Energy Storage for Renewable Sources and Grid Balancing, Moseley P. T., and Garche J., Elsevier Science, 2014.
5. Compressed Air Energy Storage, Miller F. P., Vandome A. F., and John M. B., VDM Publishing, 2010.

EE 3038 Utilization of Electrical Power

Credit: 3

Category: PEC

Prerequisite(s): Basic Electrical Engineering (EE 1003)

Course Description:

Selection of motor capacity, Equivalent current, Torque and power methods, Various kinds of Tariff, Economics of Generation, Load duration curve, Effect of Load Factor, diversity Factor and power factor on tariff, Heating methods, Resistance Heating, Induction Heating, Dielectric Heating, Resistance furnace, Arc furnace, Welding methods, Resistance, Electric arc, Atomic hydrogen, Ultrasonic and Laser welding, Terminology in illumination, lamp efficiency, Polar curve, Laws of illumination, Co-efficient of utilization, Maintenance factor, Depreciation factor, Solid Angle, Types of Lamps, Arc Lamp, Incandescent lamp, Sodium vapor lamp, Mercury Vapor Lamp, Fluorescent Lamp, Neon Lamp, Types of Lighting Scheme, Faradays law of electrolysis.

Course Outcomes: At the end of the course, the students will be able to:

CO1: remember the considerations for Selecting Motor Power Rating and Capacity

CO2: understand the formulation of Electric Tariff

CO3: apply the knowledge of electric power in the field of Electric Heating and Welding

CO4: analyze various techniques of Illumination

CO5: analyse various types of lamps

CO6: analyse the Electrolytic Processes

Topics:

- Motor power rating and selection
- Electric Tariff
- Electric Heating and Welding
- Illumination
- Electrolytic Processes

Textbook(s):

1. Generation, Distribution and Utilization of Electrical Power by C.L. Wadhwa, Wiley Eastern Ltd, New Delhi, 2nd Edition, 2012.
2. Utilization of Electrical Power and Electric Traction by J B Gupta, S K Kataria and Sons, Delhi, 2nd Edition, 2011.

Reference Book(s):

1. Art & Science of Utilization of Electrical Energy by H. Pratab, Dhanpat Rai & Co.(P) Ltd. 2nd Edition, 2013.
2. Utilization of Electric power by Er. R K Rajput, Lakshmi publications Pvt. Ltd, 1st Edition 2006.
3. Electrical Technology volume – III, by B L Thereja, A.K Thereja, S Chand Publisher, 2nd Edition, 2013.

EE 3048 HVDC and FACTS

Credit: 3
Category: PEC

Prerequisite(s): Generation, Transmission and Distribution of Electric Power (EE 2024), Power Electronics (EE 2026)

Course Description:

Application of HVDC transmission, Choice of converter configuration, Analysis of a twelve pulse converter. Principles of DC Link control, System control hierarchy, Firing angle control, Current and extinction angle control, Power Control, Reactive power requirements in steady state, Conventional control strategies, Alternate control strategies, Sources of Reactive Power, harmonics and filters, Generation of harmonics, types of ac filters, Definition of FACTS, types of FACTS compensators. Principle of SVC scheme, FACTS based shunt compensators: TCR, TSC, STATCOM, FACTS based series compensators, Combined Series –shunt Compensator: Unified Power Flow Controller (UPFC).

Course Outcomes: At the end of the course, the students will be able to:

- CO1: remember the introductory concepts of HVDC Transmission
- CO2: describe the control of HVDC transmission systems
- CO3: analyze the converter faults in HVDC transmission systems
- CO4: analyze the harmonic generation and elimination
- CO5: describe the application of FACTS devices in power system
- CO6: understand shunt and series compensation in a transmission system

Topics:

- HVDC Transmission
- HVDC System Control
- Reactive Power Control in HVDC
- FACTS Controllers and Shunt Compensation
- Principle of Series Compensation

Textbook(s):

1. "HVDC Power Transmission Systems – Technology and System Interactions", K. R. Padiyar, Third Edition, New Age International Publishers, 2015.
2. "Understanding FACTS – Concepts and Technology of Flexible AC Transmission Systems" - Narain G. Hingorani, Laszlo Gyugyi-Wiley India publications 2011.

Reference Book(s):

1. Sang, Y.H. and John, A.T., Flexible AC Transmission Systems, IEEE Press (2006).
2. Ghosh, A. and Ledwich,G., Power Quality Enhancement Using Custom Power Devices, Kluwer Academic Publishers (2005).
3. FACTS Controllers in Power Transmission and Distribution", K. R. Padiyar, New Age International Publishers, 2007.

EE 3058 Energy Audit and Accounting

Credit: 3

Category: PEC

Prerequisite(s): Basic Electrical Engineering (EE 1003)

Course Description:

Indian Energy scenario, Energy audit-need, Types of energy audit, Energy audit instruments, Energy Conservation schemes, Classification of furnace, Controlled atmosphere in furnace, furnace fuels, efficiency of energy in furnace, thermal efficiency, heat losses, Characteristic of prime movers, Resistance heating, Induction heating, arc Heating, dielectric and microwave atmosphere generators, Radiant heating, Lighting: Lamp lifetime, Efficient lighting, Cost of electrical Energy, Power factor improvement, Capacitor rating, setting the capacitor, Effect of power factor improvement, Interest Rate, Inflation Rate, Tax Rate, Cash Flows, Break even charts, Compounding Factors, Payments, Present Worth, Rate of Return Benefit–Cost Ratio, Payback Period, Life-Cycle Cost Analysis Method, Economic Evaluation.

Course Outcomes: At the end of the course, the students will be able to:

CO1: recall the need of energy audit

CO2: understand the concept of energy conservation and audit

CO3: apply the concept of accounting in energy audit

CO4: analyse the capacitor rating for power factor improvement

CO5: evaluate the energy efficiency of furnace & CHP System

CO6: create a report for an Economic Evaluation

Topics:

- General Aspects of Energy Audit
- Energy Utilization and Conversion System
- Economic Analysis

Textbook(s):

1. W.R. Murphy and G. McKay, “Energy management”, Butterworth & Co Publishers, Oxford, UK, 2001.
2. Energy Audit of Building systems: An Engineering approach, by: Moncefkrarti, CRC PRESS, Second Edition, 2009.

Reference Book(s):

1. A Workbook for Energy Management in building by: Tarik Al-Shemmeri, Wiley-Blackwell.
2. Energy audit: Thermal power, combined cycle, and co-generation plants, by: Y. Pabbi, TERI, 2011.
3. Energy Management Handbook, Seventh Edition, (Fairmont Press Inc., 2007) by WC Turner.
4. Bureau of Energy Efficiency (BEE) (2016); Study material for Energy managers and Auditors Examination: Paper I.

EE 3068 Power Converter Analysis and Design

Credit: 3

Category: PEC

Prerequisite(s): Power Electronics (EE 2026)

Course Description:

Single phase Rectifier Circuit: L-C filter design, Non-isolated dc-dc converters: Design and operation of buck-boost, Cuk, SEPIC, Zeta in DCM and CCM, Operation of Flyback Converter, Forward Converter and push-pull Converters in CCM, Design of Magnetic Materials suitable for high frequency transformers, Difference between hard and soft switching, Resonant circuit concept; ZCS and ZVS resonant converters; Electronic Ballasts, Modulation Strategies: Bipolar and Unipolar switching scheme; Performance parameters of 3 phase Sinusoidal PWM Inverters; Harmonic reduction techniques, Multi-level inverters, Gate drive circuits for Thyristor, MOSFET, IGBT, BJT, GTO.

Course Outcomes: At the end of the course, the students will be able to:

CO1: chose appropriate power electronics converters for different applications

CO2: understand the need of high frequency transformers and Inductors

CO3: apply the knowledge of convertors to the operation and application of inverters

CO4: describe resonant converter and SMPS in various industrial applications

CO5: know the power quality improvement strategies using power electronic converters

CO6: design the gate driver circuit for different semiconductor devices

Topics:

- AC to DC Converters
- DC to DC Converters
- Switch Mode Power Supply
- Resonant Converters
- Inverters
- Gate drive Circuits

Textbook(s):

1. Power Electronics By M.H. Rashid Pearson Education, 3rd Edition, 2009.
2. Power Electronics, Converters, Applications and Design, by N. Mohan, Underland and Robbins, John Wiely and Sons, 3rd Edition,2011.

Reference Book(s):

1. Power Electronics By M.D. Singh and K.B. Khanchandani, Tata McGraw - Hill publishers, 2nd edition, 2008.
2. Modern Power Electronics, by P.C Sen, Wheeler publishing Co, First Edition, 2009.
3. Elements of Power Electronics, by Philip T. Krein, Oxford University Press, 25 Sept 1997.

EE 3072 Computer Aided Power System

Credit: 3

Category: PEC

Prerequisite(s): Power System Operation and Control (EE 3002)

Course Description:

Formation of Y_{bus} when regulating transformer present, Network matrices, Network graph, Basic Incidence matrices, Augmented matrices, Primitive networks, Network matrices by Singular and Non-singular transformation , Balance excitation, Un-balance excitation, Transformation matrices for symmetrical components, Incidence and network matrix for 3-phase elements, Formation of Z bus, Addition of branch, and link, Short circuit study of balanced network by Z_{bus} , LG fault, L-L fault, 3-ph fault with and without fault impedance, Problems. Load representation, Network performance equation, Swing equation, Machine equation, Solution techniques in transient stability study.

Course Outcomes: At the end of the course, the students will be able to:

CO1: formulate Bus admittance matrix during load flow study

CO2: model power system components using graph theory

CO3: understand the incidence and network matrix of 3-phase networks

CO4: calculate the Bus impedance (Z_{bus}) using algorithm

CO5: analyze the different fault study of 3-phase network using Z_{bus}

CO6: know the solution methods for transient stability analysis

Topics:

- Load Flow Study using Computer Techniques
- Three Phase Networks
- Representation of Three Phase Elements in Short Circuit Study
- Transient stability Analysis

Textbook(s):

1. Computer Methods in Power System Analysis by Glenn W. Stagg, Ahmed H. El-Abiad, McGraw-Hill Book Company, International Editions, 2009.
2. Advanced Power System Analysis and Dynamics by L. P. Singh, New Age International (P) Limited, Publishers, Revised 4th Edition, 2011.

Reference Book(s):

1. Power System Analysis by N.V.Ramana, Pearson Publication,2011
2. Computer application techniques in Power System by M.A.Pai, TMH, 2006.
3. Electric Vehicle Technology by James and John, John Wiley & Sons, Ltd First Edition, 2004

EE 3092 Power Systems Laboratory

Credit: 1.5

Category: PCLC

Prerequisite(s): Network and Electronics circuit Laboratory (EE 2091)

Course Description:

The main objective of the Power Systems laboratory is primarily used for teaching power system basic and advance modelling of transformers, transmission lines, fault analysis, protective relays characteristics and its schematics. The Power Systems Laboratory is equipped with different Protection Scheme of Alternator, over Current Relay, over voltage relay, Percentage biased Differential Relay, Microcontroller based negative sequence relay, Transmission line simulator kit. From this laboratory courses student will gain the skill to analyse the performance of power system networks, study different power system protective relays & develop computer software programs for analysis of power systems.

Course Outcomes: At the end of the course, the students will be able to:

CO1: spell the characteristics of a transmission line

CO2: comprehend the uses of different relays in power systems

CO3: apply suitable techniques to locate the fault of an underground cable

CO4: analyze the results of short circuit analysis for symmetrical and unsymmetrical faults

CO5: assess the characteristics of a solar PV module

CO6: discuss the procedural steps needed to implement for interpreting the results of the power system software

Topics:

- Determine the ABCD parameters of a transmission lines.
- Study of electromechanical type over current relay & over voltage relay
- Fault location of Under Ground Cable by Varley Loop Test
- Develop software programs for analysis of power systems

Textbook(s):

1. Modern Power System Analysis, I. J. Nagrath, D. P. Kothari, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 4th Edition 2013.
2. Electrical Power System, C.L. Wadhwa, New Age International (P) Limited, Publishers, 2010.

Reference Book(s):

1. Power system analysis by Hadi Sadat Tata McGraw Hill.
2. Power System Protection and Switchgear by B Rabindranath and M Chander, Wiley Eastern (1977)
3. Fundamentals of Power System Protection”, Y. G. Paithankar, S. R. Bhide, 2nd edition, Prentice Hall of India Private Limited, New Delhi, 2011
4. A Text Book on Power System Engineering, A. Chakrabarti, M.L. Soni, P.V. Gupta and U.S. Bhatnagar, Dhanpat Rai and Co., Reprint 2012

EE 3098 Control Laboratory

Credit: 1

Category: PCLC

Prerequisite(s): Basic Electrical Engineering Laboratory (EE 1093)

Course Description:

The main objective of the Control laboratory is design of controllers for different systems. The Control Laboratory is equipped with different modules for DC position control, AC position Control, DC Motor Speed Control, Frequency Response Analysis, Time Response Analysis, Tuning of PID controller, Temperature Controller, Pressure Controller, Flow Rate Controller etc. From this laboratory courses student will gain the skill to evaluate the performance of PID controller with respect to changes in control parameters, study the effect of controllers on different electrical and mechanical systems, analyse the stability of designed controller and develop computer software programs for analysis of controllers.

Course Outcomes: At the end of the course, the students will be able to:

CO1: remembers the modern software tools for feedback controllers

CO2: understand the iterative nature of a successful controller design

CO3: apply the theoretical concepts and computational tools while designing controllers

CO4: analyse the characteristics obtained by varying the input parameters in a SIMULINK environment

CO5: evaluate the electrical and mechanical parameters of a given system and to find the transfer function

CO6: create new programs in MATLAB environment

Topics:

- Time response analysis of linear system
- Tuning of PID controller or a First Order Process with Time Delay (FOPTD) Simulated System by Process Reaction Curve Method
- Lead Compensator design
- Stability analysis using bode plot
- Stability analysis using root locus plot
- Design of Speed Controller for Armature controlled DC motor

Textbook(s):

1. Modern Control Engineering- By D. Roy Choudhury, PHI Publication, 5th Edition, 2009.
2. Control Systems- By Smarajit Ghosh, Pearson, Second Impression, 2013.

Reference Book(s):

1. Automatic Control System- By Hasan Saeed, Sixth Revised Edition, 2008
2. Modern Control Engineering- By K. Ogata, PHI publication, 5th edition 2010
3. Automatic Control Engineering- By B. C. Kuo , Prentice Hall, 7th edition 2009
4. Control System Engineering- By I. J. Nagrath and M. Gopal, New Age International Publication
5. Automatic control systems- By Prof. B.S. Manke & S.N.Verma ,Khanna publication, 2012.

EL 2002 Principle of Control Systems

Credit: 3

Category: PCC

Prerequisite(s): Principle of Signals and Systems (EC 2023), Signals and Networks (EC 2021)

Course Description:

This course covers concepts of open- and closed-loop systems, mathematical modeling of physical system, transfer functions, signal flow graphs, feedback theory, time domain analysis, design specifications & performance indices. This course also deals with time response of 2nd order systems, stability analysis using Routh-Hurwitz criteria and root-locus methods, Nyquist plots, frequency responses, Proportional, PI, PID controllers and Lead-lag compensators.

Course Outcomes: At the end of the course, the students will be able to:

CO1: comprehend open and closed loop control systems

CO2: compare various time domain specifications and describe their significance

CO3: explain the concept of P, PI and PID Controller

CO4: analyze stability using root locus and Routh stability criterion

CO5: determine the stability of the given control system by constructing Nyquist Plot

CO6: plot Bode plots for stability analysis and design lag, lead, lag-lead compensators based on its specifications

Topics:

- Mathematical modeling of physical system
- Feedback Theory
- Time domain analysis, design specification & performance indices
- Time response of Second order system
- Stability Criteria
- Frequency domain Analysis
- Cascade Compensation in Frequency Domain

Textbook(s):

1. Control System Engg, I. J. Nagrath & M. Gopal, New Age International (P) Ltd, 2nd edition, 1996.

Reference book(s):

1. Modern Control Engg, K. Ogata, PHI, 3rd edition, 1997.
2. Control Systems Engineering, Norman Nise, Wiley, 3rd Edition.
3. Automatic Control Systems, Benjamin C. Kuo, Prentice Hall.

EL 3022 Advance Control Systems

Credit: 3

Category: PEC

Prerequisite(s): Principle of Control Systems (EL 3001)

Course Description:

This course is intended for undergraduate students of the Electronics and Control Systems Engineering and Electronics & Electrical Engineering programs. The course will help in forming a strong foundation for the broad areas of Advance control theory. It emphasizes on the basic concepts, lays stress on the fundamental principles and motivates their application to practical problems. Advance Control systems in this introductory course, we will start with the basics of Time and Frequency correlation. Subsequently, we will discuss the theory of Lead & Lag compensator, PID controller tuning, State space Analysis.

Finally, we will introduce the basics of Non linear systems, And Discrete control systems. Wherever possible, applications of the theory in real world scenarios have been provided.

Course Outcomes: At the end of the course, the students will be able to:

CO1: comprehend the importance and design of lead compensator and lag compensator to practical systems

CO2: analyse the importance and design of PID controller and its tuning methods

CO3: analyse the importance of state space approach and realization of physical systems

CO4: apply the knowledge of controllability and observability to perform various tests for finding it

CO5: comprehend the importance of nonlinear elements and apply it to make nonlinear to linear and its stability methods

CO6: design discrete control system and its applications to analyze the real time processes

Topics:

- Cascade and feedback compensation
- Design of Lead, Lag Compensator
- PID controller Tuning
- Introduction to State Space Analysis
- Solution of State equations and State transition matrix
- Nonlinear Control Systems
- Discrete Control Systems

Textbook(s):

1. Control System Engg, J. Negrath& M. Gopal, 3rd Edition, New Age International Publisher
2. Modern Control Engg., By K. Ogata, 3rd Edition, PH

Reference Book(s):

1. Discrete Time Control System, K. Ogata, 2nd Edition, Pearson Education

EL 3024 Industrial Automation and Control

Credit: 3

Category: PEC

Prerequisite(s): Principle of Control System (EL 2002), Linear Control System (EE 2028)

Course Description:

The course discusses a wide range of topics for different types of sensors, actuator, and signal conditioning circuits. This course also discusses about the different types of controllers and its tuning technologies used in the industry. Different automation techniques like PLC including ladder programming, SCADA, DCS are also covered. Different advanced control techniques have also been discussed.

Course Outcomes: At the end of the course, the students will be able to:

CO1: comprehend the working of sensors in signal conditioning circuits and actuators

CO2: determine the effect of gain constant on system performance

CO3: understand different components of PLC and design of the ladder logic

CO4: analyze DCS hardware, its merits/demerits in an industrial automation in comparison with PLC

CO5: analyze SCADA hardware-software and its merits/demerits in industrial automation in comparison with PLC and DCS

CO6: comprehend advanced control techniques

Topics:

- Sensors, Actuators and Signal conditioning
- Controller
- Automation
- PLC
- SCADA
- DCS
- Advanced control techniques

Textbook(s):

1. Computer-Based Industrial Control, Krishna Kant, 2nd edition Prentice Hall of India Ltd.
2. Chemical Process Control – Theory and Practice, Stephanopoulos, Prentice Hall of India Ltd, 1984.
3. Fundamentals of Industrial Instrumentation and Process Control, William C. Dunn, Tata McGraw Hill, 2009.

Reference Book(s):

1. Modern Automation Systems, Muhammad Abdelati, University Science Press, 2009.
2. Modern Control Engineering, 4th edition, Ogata, Prentice Hall of India

EL 3082 Minor Project

Credit: 2
Category: PROJ

Course Description:

Students are required to undertake a minor project either as an individual or in a group in consultation with the project guide which may be completed in one semester. The project work is aligned with the discipline of the student and its allied areas. It is preferably related to certain research objective or advanced technical domain. Students will demonstrate higher level learning outcomes and cognitive skills in the implementation of the project.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: perform a background study on certain technical aspect and formulate a project objective
- CO2: outline a pathway for the implementation of the project within the time line
- CO3: apply fundamental engineering concepts, advanced technical know-how, use modern engineering tools, perform experiments and critically analyze the data
- CO4: provide engineering solutions, design system components or processes with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
- CO5: function effectively as an individual, and as a member or leader in a team under multidisciplinary settings following ethical practices
- CO6: communicate effectively with a range of audiences and prepare technical reports

EL 4081 Project-I

Credit: 3
Category: PROJ

Course Description:

Students are required to undertake a final year major project either as an individual or in a group in consultation with the project guide which may be completed in one year. The project should be related to certain research objective or advanced technical domain. The work encompasses two semesters and to be carried out in two phases (Project-I and Project-II). In Project-I, students are expected to complete detailed literature review, identify their objective and start working on the same; perform experiments, carry out analyses and report their findings to their supervisors and the panel.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: conduct a detailed research survey or background study and summarize the theory and findings
- CO2: formulate a research question or a general objective of the project
- CO3: propose and outline the solution to the research question or a pathway for the implementation of the project with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
- CO4: conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
- CO5: function effectively as an individual, and as a member or leader in a team under multidisciplinary settings following ethical practices
- CO6: communicate effectively with a range of audiences and prepare technical reports

EL 4082 Project-II

Credit: 10
Category: PROJ

Course Description:

Project-II is a continuation of Project-I, the second phase of final year major project. Students should complete all related experiments, develop a final solution, product or system and validate the applicability of the same under real time scenario with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors. They produce a detailed technical report on their work as well as individual contribution reports. Throughout the implementation of the major final year project, students should demonstrate all cognitive skills and attainment of all program outcomes and student outcomes.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: readily apply fundamental concepts in their area of study for executing the projects
- CO2: demonstrate skill in using modern technical tools, apply advanced technical knowledge, integrate information from different sources, perform complex experiments and critically analyze the findings to draw conclusions
- CO3: provide engineering solutions to predefined research question or project objective; design system components or processes with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
- CO4: function effectively as an individual, and as a member or leader in a team under multidisciplinary settings following ethical practices
- CO5: communicate effectively with a range of audiences and prepare detailed technical reports
- CO6: demonstrate knowledge and understanding of the management principles in executing their project as a member or leader of the team, and willingness to engage in life-long learning

COURSES OF OTHER PROGRAMMES

CS 2001 Data Structures And Algorithms

Credit: 4

Category: PCC

Pre-requisite(s): Computer Programming (CS 1093)

Course Description:

This course explores several fundamental algorithms and data structures of computer science. Some of the data structures include arrays, linked lists, stacks, queues, trees, heaps, hash tables, and graphs. Students also study and analyze algorithms for searching, traversing trees, hashing, sorting, finding shortest searching, and much more.

Course Outcomes: At the end of the course, the students will be able to:

CO1: understand the concepts of data structure, data type, abstract data type (ADT) and compute the complexity of different algorithms

CO2: understand, distinguish and implement Array and Linked data structure on different types of problems

CO3: apply different linear data structures such as Stack and Queue to solve various problems

CO4: apply and Evaluate different non-linear data structures such as Tree and Graph on various computing problems

CO5: apply and Evaluate standard algorithms for searching, sorting and hashing

CO6: create the data structure that efficiently models the information in a problem

Topics:

- Introduction
- Arrays
- Linked List
- Stacks and Queues
- Trees
- Graphs
- Sorting
- Searching

Textbook(s):

1. Fundamentals of Data Structures in C, 2nd edition, Horowitz, Sahani, Anderson-Freed, Universities Press.

Reference Book(s):

1. Data Structures, Schaum's OutLines, Seymour Lipschutz, TATA McGRAW HILL
2. Data Structures using C by Aaron M. Tenenbaum, Yedidyah
3. Data Structures A Pseudocode Approach with C, 2nd Edition, Richard F. Gilberg, Behrouz A. Forouzan, CENGAGE Learning, India Edition
4. Data Structures Using C, Second Edition, Reema Thereja, Oxford University Press
5. Data Structures and Algorithm Analysis in C, Mark Allen Weiss, Pearson Education, 2nd Edition.

CS 2091 Data Structures Laboratory

Credit: 1

Category: PCLC

Prerequisite(s): Computer Programming (CS 1093)

Course Description:

The data structure lab is to develop skills for the design, analysis and implementation of operations like search, insertion, deletion, traversal, and other specified problem definition on various linear and nonlinear data structures. It improves the ability to define, apply the appropriate data structure for the real world problem and various techniques for representation of the data in the real world. In addition, it helps them to gain knowledge of data structure applications related to industry.

Course Outcomes: At the end of the course, the students will be able to:

CO1: understand the importance of structure, unions and abstract data type, and their basic usability in different applications through C programming language

CO2: analyze, differentiate and implement different algorithms based on their time and space complexity

CO3: understand and implement the linked implementation, and its uses both in linear and non-linear data structure

CO4: understand and implement various data structures such as stacks, queues, trees, graphs, etc. to solve various computing problems

CO5: understand and implement various kinds of searching and sorting techniques, and know when to choose which technique

CO6: decide and implement the suitable data structure and algorithm to solve a real world problem

Topics:

- Array, pointer with Dynamic Memory Allocation
- Structure, Single Linked List
- Doubly Linked List, Circular Linked List
- Polynomial Representation, Addition & Multiplication, Sparse Matrix Représentation, Addition & Multiplication
- Stack
- More on Stack & Applications of Stack
- Queue
- Tree
- Graph
- Searching & Sorting

EI 2003 Electrical & Electronic Measurement Techniques

Credit: 3
Category: PCC

Prerequisite(s): Basic Electrical Engineering (EE 1003)

Course Description:

The objective of the course is to provide the basic knowledge of Instruments and Measurement techniques providing an in-depth understanding of errors in measurement techniques, Bridge measurements, Function Generator and Spectrum Analyzer, Display devices, watt meters, energy meters and analytical instruments.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: comprehend and explain different measurement techniques and universal instruments
- CO2: explain different measurement techniques for measuring the parameters of various electrical components
- CO3: explain and analyze construction of instruments used for measuring current, voltage, frequency and spectrum
- CO4: measure the power, energy and power factor using watt-meters and energy-meters
- CO5: apply the CRO for various electronic measurements
- CO6: analyze spectral analysis of the signals on spectrum analyzers

Topics:

- Introduction to instrumentation and measurements
- Classification and characteristics of Instruments.
- Overview of electrical and electronic measuring instruments
- DC and AC bridges
- Measurement of Power, Energy
- Function generator and Spectrum analyzer

Textbook(s):

1. A Course in Electrical and Electronic Measurements and Instrumentation, A K Sawhney, Dhanpat Rai & Co, Reprint, 2013.
2. Modern Electronic Instrumentation and Measurement Techniques, Helfrick & Cooper, 2nd Edition, PHI.

Reference Book(s):

1. Electrical Measurements and Measuring Instruments, Golding & Widdis , 5th edition, Reem Publication.
2. Electronic Instrumentation, H S Kalsi, 3rd Edition, TMH.
3. Electronic Instrumentation & Measurements, David A. Bell, 3rd Edition, Oxford University press.
4. Elements of electronic instrumentation and measurement, Joseph J. Carr, 3rd Edition

EI 2012 Sensors & Signal Conditioning

Credit: 3

Category: PCC

Prerequisite(s): Electrical & Electronic Measurement Techniques (EI 2003)

Course Description:

The main aim of introducing this course is to provide the basic concept of instrumentation and its characteristics. It covers the details on identification, classification, construction, working and domestic as well as industrial applications of various transducers. The course also includes sensing principle for the measurement of motion, force, torque using analog, digital transducers and methods for signal conditioning and analysis.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: comprehend the concept of various transducers , sensors and their brief performance specifications
- CO2: analyze different types of errors in measurement and instrumentation
- CO3: explain the principle of operation for various transducers used to measure temperature and pressure
- CO4: explain the principle of operation for various transducers used to measure force, acceleration, displacement etc.
- CO5: analyze various signal conditioning techniques
- CO6: apply various transducers for domestic and industrial uses

Topics:

- Introduction to Sensor and Transducer
- Resistive Transducer
- Displacement transducer
- Proximity sensor
- Digital transducer
- Voltage generating transducer
- Magnetic type transducer
- Signal conditioning circuit
- Transducers for Miscellaneous measurement

Textbook(s):

1. Transducer & Instrumentation, MurthyDVS,2001,Prentice Hall of India.
2. Principle of Measurement Systems- J.P. Bentley 4th edition, Pearson education.

Reference Book(s):

1. Sensors & Transducers, Patranabis. D, 2003,PHI.
2. Introduction to Measurement and Instrumentation- AK.Ghosh, 2012, PHI.

EI 2095 Electrical & Electronic Measurements Laboratory

Credit: 1
Category: PCLC
Prerequisite(s): Nil

Course Description:

In this E&EM laboratory, experiments will be conducted to measure different parameters such as strain, distance, temperature, level, resistance, inductance, capacitance etc.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: calibrate the ammeters and voltmeters using DC potentiometer
- CO2: measure and analyze unknown electrical parameters such as medium and low resistances using DC bridges
- CO3: measure and analyze unknown electrical parameters such as capacitance and inductance using AC bridges
- CO4: measure the frequency of an unknown periodic signal
- CO5: determine the accurate quality factor of an unknown coil
- CO6: analyze and measure of 3-Phase power using 2-wattmeter method

Topics:

- Measurement of resistance using Wheatstone and Kelvin's double bridge
- Measurement of inductance using Maxwell's bridge, Hay's bridge
- Measurement of Capacitance using Schering's bridge
- Measurement of frequency using Wien's bridge
- Calibration of ammeter and voltmeter by using DC potentiometer
- Measurement of 3-Phase power using 2-wattmeter method

EI 3009 Instrumentation Measurement Techniques

Credit: 3

Category: PCC

Prerequisite(s): Electrical & Electronic Measurement Techniques (EI 2003)

Course Description:

This course deals with the construction and operating principles and applications to Industrial Instruments used for measurement of parameters like temperature, pressure, level, flow, viscosity & humidity and its safety precautions during process measurement.

Course Outcomes: At the end of the course, students will be able to:

CO1: explain and analyze the construction and working principle of Industrial Instruments for Temperature, Level, Pressure, Flow, Viscosity & Humidity

CO2: identify and explain sensor, transducer and their performance specifications for measurement of different process variables

CO3: apply different measurement techniques of instruments in industry

CO4: apply specific instruments for the measurement of different process variables

CO5: analyze the industrial application and calibration of Industrial Instruments

CO6: analyze the use of Industrial Instruments in hazardous locations

Topics:

- Temperature measurement
- Pressure Measurement (Gauge and vacuum)
- Level measurement, Flow measurement
- Viscosity, density, conductivity and humidity measurements
- Instrumentation in hazardous locations

Textbook(s):

1. Industrial Instrumentation & Control, S. K. Singh, 3rd Edition, TMH.
2. Industrial Instrumentation, K.Krishnaswamy, S.Vijayachitra, 2nd Edition, New age international.

Reference Book(s):

1. Instrument Engineers Handbook, Vol1, B.G Liptak, CRC Press
2. Measurement System Application and Design E.O Doeblin, 5th Edition, TMH

EI 3022 Bio-Medical Instrumentation

Credit: 3

Category: PEC

Prerequisite(s): Chemistry (CH 1007)

Course Description:

This course focuses on the use of multiple sensors to monitor physiological characteristics of a human or animal. It involves measurement of biological signals like ECG, EMG, or any electrical signals generated in the human body.

Course Outcomes: At the end of the course, students will be able to:

CO1: identify various bio-medical signals and instruments

CO2: analyze various bio-medical transducers, sensors and their brief performance specifications

CO3: analyze the principle of various bio-medical instruments, transducers used to measure temperature, pressure

CO4: analyze the principle of various bio-medical instruments used to measure heart rate

CO5: differentiate between various bio-medical instruments

CO6: analyze applications of various bio-medical instruments in medical purposes

Topics:

- Biomedical Signals & Electrodes
- Blood pressure measurements
- Engineering analog of Heart
- X-ray imaging
- Computer aided tomography (CAT)
- Bio-telemetry
- Patient Safety

Textbook(s):

1. Hand Book of Biomedical Instrumentation- by R. S. Khandpur, 2nd Edition, Tata McGraw Hill.
2. Biomedical Instrumentation and Measurements- by Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, 2nd Edition, PHI learning Pvt. Ltd.

Reference Book(s):

1. Introduction to Biomedical Equipment Technology- by Joseph J. Carr, John M. Brown, 4th Edition, Pearson Education.

EI 3023 Neural Network and Fuzzy Logic Control

Credit: 3

Category: PEC

Prerequisite(s): Mathematics-I (MA 1003), Mathematics-II (MA 1004), Control Systems (EL 3001)

Course Description:

This course is about Artificial Neural Network & Fuzzy Logic models to handle uncertainty and solve engineering problems. Objective of this course is to impart adequate background knowledge so that in future students will be able to design and implement various machine learning algorithms in a range of real-world applications. The course covers learning based solutions for regression and classification, by using error minimization, concept of association, competitive learning, and fuzzy rule based methods. The course also covers applications of ANN and fuzzy logic for solving pattern recognition and control system.

Course Outcomes: At the end of the course, students will be able to:

CO1: analyze supervised and unsupervised learning for regression, classification and clustering

CO2: comprehend the concepts of feed forward neural networks

CO3: identify and describe appropriate Artificial Neural Network techniques in building intelligent machines

CO4: demonstrate the concept of fuzziness involved in various real world phenomena and need of fuzzy set theory

CO5: comprehend fuzzy rule based or expert system

CO6: analyze applications of Neural Network and Fuzzy logic in image processing

Topics:

- Introduction to Machine Learning
- Feed Forward Neural Network and Back-Propagation
- Pattern Association and Adaptive Resonance models
- Learning of ANN models based on Competition
- Fuzzy Set Theory and Fuzzy Membership
- Fuzzy-Inference-Systems
- Applications of Neural Network and Fuzzy Logic

Textbook(s):

1. Fundamentals of Neural Networks, Laurene Fausett, Pearson Education, 2004
2. Fuzzy Logic with Engineering Applications, Timothy Ross, McGraw-Hill, 1998

Reference Book(s):

1. Introduction to Neural Networks Using Matlab, Sivanandam , S. N , Sumathi, S. and Deepa, S. N, 2005, TMH.
2. Fundamentals of Artificial Neural Networks, Mohammad H. Hassoun, 1st edition, 2019, PHI
3. Neural Networks and Fuzzy Systems, Bark Kosko, 1st edition, PHI

EI 3024 Virtual Instrumentation

Credit: 3

Category: PEC

Prerequisite(s): Digital Electronics (EC 2011)

Course Description:

This course provides the basic knowledge of PC based instrumentation systems and to develop concepts of designing virtual instruments along with its applications in various fields ranging from signal processing, image processing to motion control.

Course Outcomes: At the end of the course, the students will be able to :

CO1: identify and explain the components of Virtual instrumentations and use them for PC Based Measurement

CO2: develop programming skills on application development software

CO3: simulate with LabVIEW software for instrument control, measurement, data acquisition and data handling

CO4: differentiate between different data acquisition techniques on virtual instrumentation

CO5: implement different controllers and conduct testing using industry standard software

CO6: differentiate between various Industrial network components and protocols

Topics:

- Sensors and Transducers
- PC Based Measurement
- Introduction to LabVIEW
- Organization of the LabVIEW system and software
- Program elements of LabVIEW
- Data Acquisition & Signal Conditioning
- Remote laboratory for Electrical experiments
- Examples of real time control and measurement applications
- Communication networked modules

Textbook(s):

1. Virtual Instrumentation Using LabView, Jerome, 1st Edition, PHI
2. LabView Graphical Programming, Gary W. Johnson, Richard Jennings, 4th Edition, TMH

Reference Book(s):

1. Practical Data Acquisition for Instrumentation and Control Systems, John Park and Steve Mackay, 2003, Newnes
2. LabVIEW based advanced instrumentation system, Psumathi, 1st edition, 2007, Springer science Elsevier.

EI 3025 Principle of Analytical Instrumentation

Credit: 3

Category: PEC

Prerequisite(s): Chemistry (CH 1007)

Course Description:

This course covers different types of Spectrophotometers such as Infrared Spectrophotometers, Flame Photometers with their instrumentation, Gas Chromatograph and Liquid Chromatography. It also deals with Spectrometers, Radiochemical Instruments and Pollution Monitoring Instruments.

Course Outcomes: At the end of the course, the students will be able to:

CO1: differentiate between various techniques involved to determine the concentration of each component from a mixture

CO2: analyze methods to measure the pH level of a liquid using pH meters

CO3: comprehend different gas analyzers are used in industry

CO4: analyze the different spectrums using spectrometers

CO5: comprehend the operating principle of instruments used for radiation detection

CO6: analyze the operating principle of instruments used for pollution monitoring

Topics:

- Spectrophotometry
- Chromatography
- pH Meters and Ion Analyzers
- Analyzers
- Spectrometers
- Radiochemical Instruments
- Pollution Monitoring Instruments

Textbook(s):

1. Handbook of Analytical Instruments – by R.S. Khandpur, 2nd edition, TMH

Reference Book(s):

1. Instrumental Methods of Analysis, Hobart H. Willard, 2012, 7th edition, CBS publisher
2. Principles of Industrial Instrumentation, D. Patranabis, 3rd edition, TMH.

EI 3027 Industrial Instrumentation

Credit: 3
Category: PEC
Prerequisite(s): Nil

Course Description:

This course is designed to improve knowledge and skills by providing a better understanding of process variables, control systems, sensors, transmitters, and more. It also provides the basic overview of power plant instrumentation and control techniques.

Course Outcomes: At the end of the course, the students will be able to :

- CO1: explain sensor, transducer and their performance specifications for measurement of different process variable
- CO2: analyze the construction and working principle of instruments used in various industries for measurement of different process variables like Temperature, Level and Pressure
- CO3: analyze various instrumentation and control used in power plant
- CO4: identify appropriate analytical instrument for measuring, analyzing and establishing the composition of materials
- CO5: solve design problems of the power plant and its various control mechanisms
- CO6: perform measurements and control of turbine systems and its safety

Topics:

- Principles of various temperature, pressure, and level sensors used in industrial instrumentation.
- Analytical measurements.
- Basics of power plant instrumentation – water circuit, air-fuel circuit.
- Turbine monitoring and control

Textbook(s):

1. Power plant Instrumentation-K. Krishnaswamy, M. Ponnibala, 2ndedition,PHI publication
2. Industrial instrumentation & control, S. K. Singh, 3rd Edition, TMH publication.

Reference Book(s):

1. Instrument Engineers Handbook, Vol-1, B.G Liptak, CRC press.
2. Handbook of Analytical Instruments- by R. S. Khandpur, 2nd edition, TMH

EI 3029 Process Dynamics and Control

Credit: 3

Category: PEC

Prerequisite(s): Principle of Control System (EL 2002)

Course Description:

This course covers the fundamental aspects of process dynamics and control, which includes developing dynamic models of processes, control strategies for linear time-invariant systems and instrumentation aspects. The course deals with the development of models for control system design.

Course Outcomes: At the end of the course, students will be able to:

CO1: develop mathematical model and process

CO2: analyze dynamic behavior of different processes

CO3: design basic control schemes using hydraulic, electronic and pneumatic methods

CO4: tune PID controller to improve the performance

CO5: design various complex control schemes for SISO systems

CO6: design controller for multivariable processes

Topics:

- Process dynamics and modelling
- Dynamic response of processes
- Basic control schemes
- Controller tuning
- Complex control schemes
- Controller design for multivariable process

Textbook(s):

1. Process control: Principles and applications, Surekha Bhanot, Oxford,2008.

Reference Book(s):

1. Modern control engineering, K.Ogata, 5th edition, PHI
2. Process control, Dynamic concepts and applications, S.K.Singh, PHI,2007

EI 3030 Power Plant Instrumentation

Credit: 3
Category: PEC
Prerequisite(s): Nil

Course Description:

This course provides a knowledge of the instruments that are used to measure and control the processes of electric power generation, processes of the generation of electricity from tradition fuel sources. The course covers an overview of power generation covering the various conventional and non-conventional energy sources , instrumentation and control of boilers and turbine monitor.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: comprehend various components of thermal power plants and their operations
- CO2: measure the water flow, steam flow and pressure in the water circuit
- CO3: design control schemes for the water circuit
- CO4: measure flow, pressure, temperature and level in air fuel circuit.
- CO5: measure electrical, mechanical and process turbine parameters
- CO6: design the control schemes for turbines

Topics:

- Overview of Power Generation
- Instrumentation and Control in Water Circuit
- Instrumentation and Control in Air-Fuel Circuit
- Turbine–Monitoring and Control

Textbook(s):

1. Power Plant Instrumentation – K.Krishnaswamy, M.Ponnibala, 2nd edition, PHI publications.
2. Power Plant Engineering - P.K Nag, 3rd edition, Tata McGraw-Hill.

Reference Book(s):

1. Standard Boiler Operations - S.M. Elonka and A.L Kohal, Tata McGraw-Hill.
2. Mechanical and Industrial Measurements - R.K Jain, 2008, Khanna Publishers.
3. Power Plant Engineering – EL. Wakil, Tata McGraw-Hill.

EI 3032 Principle of Sensors & Data Acquisition

Credit: 3

Category: PEC

Prerequisite(s): Electrical & Electronic Measurement Techniques (EI 2003), Principle of Measurement & Instrumentation (EI 2010)

Course Description:

The main aim of introducing the course is to demonstrate a critical understanding of elements of signal conditioning necessary for a number of sensors and transducers. This course includes operation of analog to digital and digital to analog converters. This course includes appropriate techniques and devices for realizing a data acquisition system and function of output drivers and devices also.

Course Outcomes: At the end of the course, the students will be able to:

CO1: comprehend working principle of sensors & transducers

CO2: characterize and calibrate the sensors & transducers

CO3: comprehend the design of motion transducers used for measuring rotational displacement and velocity

CO4: understand the working of industrial automation systems such as PLC, SCADA

CO5: design amplifiers used for signal conditioning

CO6: understand the application of different data acquisition and conversion systems

Topics:

- Introduction to sensors and transducers
- Rotational displacements
- Rotational velocity
- PLC and SCADA
- Signal Conditioning
- Data acquisition systems
- Instrument calibration concepts

Textbook(s):

1. Electronics measurements and Instrumentation, R.K.Rajput, S.Chand, 2nd revised edition, 2011

Reference Book(s):

1. Digital control and state variable methods: Conventional and Intelligent control systems, M.Gopal, 4th edition, 2012.

EI 3091 Instrumentation Laboratory

Credit: 1

Category: PCLC

Prerequisite(s): Basic Electrical Engineering (EE 1003), Analog Electronics (EC 2027)

Course Description:

This lab will deal with various sensors, their operations, different interfacing techniques with microcontrollers and use of LCDs for output.

Course Outcomes: At the end of the course, the students will be able to:

CO1: analyze characterization of strain and force sensors

CO2: measure the level of fluid by capacitive transducers

CO3: design flow sensors for flow measurement

CO4: analyze characterization of temperature sensors

CO5: analyze characterization of the displacement, pressure sensors

CO6: interface sensors with micro-controller for precise measurement

Topics:

- Strain and force sensor
- Capacitive transducers
- Flow sensor
- Temperature sensors
- Displacement, pressure sensors
- Interfacing sensors with microcontroller for precise measurement

EI 3092 Process Control Laboratory

Credit: 1

Category: PCLC

Prerequisite(s): Process Control (EI 3010)

Course Description:

Process control lab deals with automation(PLC/DCS) and different controllers(P, PI, PID) for understanding the characteristics and performance of the level, temperature and flow. PLC platform with HMI is also available through which different on-board applications like conveyor belt control, temperature control, dc motor speed control using ladder logic can be performed. Experiments on pc based level, pressure, flow, temperature loop stations with air compressor using digital PID controller are also conducted.

Course Outcomes: At the end of the course, the students will be able to:

CO1: determine the characteristics of open and close loop systems using PID controller

CO2: apply the concepts of interacting and non-interacting liquid level system

CO3: apply the concepts of PLC, DCS & SCADA and its interfacing with real time system

CO4: control traffic light, water level in tank, speed of DC motor and control conveyor belt with PLC using ladder logic programming

CO5: obtain the response using P, PI & PID controller for a typical flow, level, pressure & temperature process station with air compressor

CO6: analyze the characteristics of control valve, I/p & P/I converter

Topics:

- Introduction to Basic Ladder Logic Programming
- Development of Ladder Logic Using Universal PLC Platform With HMI
- Hardware Verification of Open and Closed Loop Performances of Tank Filling Process Using E-906 PID Controller
- Hardware Verification of Open and Closed Loop Performances of Flow Rate Regulatory Process Using E-906 PID Controller
- Hardware Verification of Open and Closed Loop Performances of Heat Furnace Process Using E-906 PID Controller
- Hardware Verification of Level Control Loop Performance Using Digital PID with Air Compressor
- Hardware Verification of Flow Control Loop Performance Using Digital PID with Air Compressor
- Hardware Verification of Pressure Control Loop Performance Using Digital PID with Air Compressor
- Hardware Verification of Temperature Control Loop Performance Using Digital PID with Air Compressor

HS 2002 Engineering Economics

Credit: 3
Category: HSMC
Prerequisite(s): Nil

Course Description:

The course on Engineering Economics is a specialized need-based extension of applied Economics which is aimed at developing an understanding of the principles governing Economy's vital parameters like market, finance, Production, consumption and distribution.. The course focuses on learning methodical and rational conceptualization and developing the knowledge for effectively implementing these market principles in actual organizational activities and forums. The course intends to develop the ability of taking decisions related to project selection and implementation, optimization of market vitals like sales, revenue, profit, cost etc. It serves as the base of learning all Economics related elective papers offered in higher semesters as well as preparation for any competitive exams like civil services, MAT etc.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: apply economic theory for optimisation of the economic variables of demand, supply, sales, profit, cost and revenue
- CO2: apply the budgeting principles in making economic decisions during project appraisals
- CO3: develop awareness towards all the economic issues related to the financial market, Budget, Money, Credit and Fiscal Policies etc.
- CO4: relate and apply theoretical concepts in Economics with contemporary/modern business practices
- CO5: understand the vitals of the financial market, know the source and methods of raising capital for an organization
- CO6: understand the depreciation of asset principles and efficient inventory/resource management

Topics:

- An Introduction to Economics and Engineering Economics
- Basic Concepts of Economics: Market equilibrium and Consumers and Producer's equilibrium
- Elasticity and Demand Forecasting
- Optimization of Profit and cost
- Break Even Analysis
- Evaluation of Projects: Economic Appraisal Techniques
- Depreciation calculation and Inventory management
- Vitals of Money and capital market

Textbook(s):

1. Managerial Economics: Principles and Worldwide Applications. Dominick Salvatore, Siddartha K. Rastogi, 8th Edition, Pub. Oxford University Press. ISBN: 9780199467068.
2. Engineering Economics – James L. Riggs, David D. Bedworth and Sabah U. Randhawa, 4th Edition, McGraw Hill Education (India) Private Limited, New Delhi, 2016.

Reference Book(s):

1. Principles of Economics, Deviga Vengedasalam and Karunagaran Madhavan, Oxford University Press, New York, 3rd Edition, 2013.
2. Managerial Economics-Principles and Worldwide Applications-Dominick Salvatore, Adapted by Ravikesh Srivastava, 7th Edition, Oxford University Press, 2012.

3. Micro ECON-A South-Asian Perspective-by William A. McEachern and Simrit Kaur, Cengage Learning, 2013.
4. Engineering Economy-Zahid A. Khan, Arshad Noor Siddiquee, BrajeshKumar, Pearson Publication, 2012.
5. Engineering Economics – R.PanneerSelvam, Pub: PHI Learning Private Limited, New Delhi, 9thEdition, 2008.

HS 2008 Economic Environment of India

Credit: 3
Category: HSMC
Prerequisite(s): Nil

Course Description:

The Course on Economic Environment of India is designed to cater encompassing discernment of Indian Economy to the students. The course precisely highlights the role of different sectors in Indian economy and also touches upon the normative aspect of striking balance among different sectors. It covers the status of public economics in Indian context. Besides, it ensures the students to have knowledge on the role of foreign sector.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: develop the analytical understanding of the economic situation of the country
- CO2: develop the skill to interpret the economic indicators during steady growth path and economic crisis
- CO3: acknowledge the role of different policy making bodies in India related to economic affairs
- CO4: develop the ability to analyze the occupational structure of the country and sectoral contribution to growth
- CO5: examine the extent and role played by foreign sector in the form of exchange rate, FDI etc in the domestic economy
- CO6: develop a critical understanding of the fiscal position of the country

Topics:

- Economic Crises and Way out: Economic Crisis of early 1990s-Macro Economic Reforms since 1991
- Primary Sector and Secondary Sector: Agriculture during the Reform Period; New Industrial Policy
- Tertiary Sector and Foreign Sector: Service sector as the engine of growth in India; Trade reforms
- Public Finance: Fiscal reforms in India post 1991; Centre-State Fiscal relationship

Textbook(s):

1. Dutt and Sundaram.Indian Economy. latest edition.

Reference Book(s):

1. Uma Kapila (2019), Indian Economy since Independence, New Delhi, Academic Foundation.
2. Balakrishnan, P. (2010): ‘Economic Growth in India: History and Prospect’. Oxford University Press, New Delhi.
4. Bhagwati Jagdish and Arvind Panagariya(2012): ‘ India’s Tryst with Destiny’. Collins Business, Noida, India.
5. Jean Dereze and Amartya Sen (1996): ‘Indian Development: Selected Regional Perspectives’. Oxford University Press, New Delhi.
7. Ajijava Raychaudhuri and Prabir De (2012), International Trade in Services in India, New Delhi, Oxford University Press.

HS 2010 Financial Institutions, Markets and Regulations

Credit: 3
Category: HSMC
Prerequisite(s): Nil

Course Description:

The course on Financial Institutions, Markets and Regulations is a specialized need-based extension of Financial Economics. This course is designed to present the fundamental concepts and theories in financial market and promote the application to the workplace and professional practice. It introduces current financial concepts and tools towards money management in organizations participating in the local and global economies. The course covers the current best practices in financial analysis and planning through the application of financial concepts in a nutshell. These include financial vitals relate to money and capital markets, time value of money, cost of capital, risks and return, long-term financial budgeting. Inaddition, the course also introduces topics on lease financing, hybrid securities and derivatives, trust funds, mergers and acquisitions and related issues in current financial sector.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: have comprehensive understanding of the nature and functions of the several types of financial institutions operating in the market
- CO2: develop critical skills in applying the principles of finance and financial inter-mediation to the real world situations
- CO3: effectively interact with the financial markets they need to approach for their future economic endeavors and/or in their place of employment
- CO4: make economic decisions and analysis of issues related to security market transactions and policies
- CO5: develop the understanding of the structure and functions of Indian financial institutions, instruments and policies
- CO6: take decisions regarding saving, investments, portfolio contents and diversification to maximize their return and reduce associated risks

Topics:

- Financial systems: Significance of banks and all other Financial institutions
- Financial Innovations
- Overview of Structure of Financial Debts and Equity markets
- Functions of Financial Intermediaries
- Monetary authority: Reserve Bank of India: Its role, structure and functioning
- Subprime crisis
- Derivative markets
- Capital market authority: structure and functions
- Regulation of Capital market, Role of SEBI

Textbook(s):

1. Madura, Jeff (2008), Financial Markets and Institutions, 8th edition, Thomson Publications.

Reference Book(s):

1. Fabozzi, Frank, Modigliani, Franco, Jones, Frank (Feb 2009), Foundations of Financial Markets.
2. Eakins, Stanley G. (2005), Financial Markets and Institutions (5th Edition), Addison Wesley.
3. Howells, Peter, Bain, Keith (2007), Financial Markets and Institutions, 5th Edition.

4. Barth, James R., Caprio, Gerard, and Levine, Ross (2008), Bank Regulations are Changing: For Better or Worse?, Association for Comparative Economic Studies.
5. Goldstein, Morris (2006), Financial Regulation after the Subprime and Credit Crisis, Washington: Peterson institute.

HS 2012 Development Economics

Credit: 3
Category: HSMC
Prerequisite(s): Nil

Course Description:

The course on Development Economics is a specialized need-based extension of Economics dealing with issues related to economic growth and development. It provides an in depth discussion of the different economic description of development and underdevelopment. It will put a deep insight into the most challenging economic issues of poverty, inequality and underdevelopment faced by the humanity. It will deal with the various existing, modern and developing strategies and policies to tackle these issues and foster the economy onto the path of development. The students will be able to assess the pros and cons of a proposed development intervention and its likely impact on the target population.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: develop the understanding of issues related to economic growth and economic development
- CO2: relate and apply the major growth theories in their related academic projects
- CO3: develop the familiarity with major economic issues faced by the country like poverty, inequality, underdevelopment etc.
- CO4: analyse and compare the development paths adopted across countries of the globe
- CO5: analyse the empirical evidence on the pattern of growth and development
- CO6: develop critical understanding of the existing, adopted and needed policies and strategies for sustainable growth and development

Topics:

- Concepts and difference between growth and development.
- Measures of growth and development
- Models of growth and development
- Poverty and Inequality : Perceptions, estimation and measures of improvement
- Impact of poverty and inequality on growth and development
- Cross country perspectives of development

Textbook(s):

1. Todaro, M. P. & Smith, S. C. (2015), Economic Development, Pearson (12th Edition).
2. Thirlwall A. P. Growth and Development (6 th and 7 th edition)

Reference Book(s):

1. Debraj Ray : Development Economics
2. Meier and Rauch,: Leading Issues in Economic Development, OUP, Latest Edition
3. Kaushik Basu :Analytical Development Economics , OUP
4. Human Development Reports, various years
5. Bagchi A. K. The Political Economy of Underdevelopment, Cambridge University Press 1982.

HS 2081 Business Communication

Credit: 1
Category: HSMC
Prerequisite(s): Nil

Course Description:

This course is designed to give students a comprehensive view of communication, its scope and importance in business. This is an interactive course with a view to enhance language and soft skills with the aid of live demonstration within the framework of the syllabus. It is a foundation building measure to enable the students to excel in the corporate world and in day to day life.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: develop competence in reading and comprehension, develop skimming skills for extracting the main idea(s) from the text, and scanning for keywords
- CO2: enrich the fluency of the students with Collocations and Phrasal Verbs
- CO3: use Email effectively and efficiently as per the organization hierarchy. To retain a logical flow while drafting emails, make aware students about the importance of succinct written expression in modern Business Communication
- CO4: write standard and effective Cover Letters and Resume
- CO5: bridge the gap between native language and target language i.e. English, make students communicative competent and develop their fluency in public speaking
- CO6: prepare effective Power Point Slides. Maintain and arrange proper data structure in presentations. To learn skills of making effective presentation (verbal and non-verbal aspects)

Topics:

- Reading Comprehension – Activity based on BEC Training – Matching, Multiple Choice Questions, Open Close, Giving Appropriate Headings
- Collocation – Activity based on Word-Stock, Phrasal Verbs & Vocabulary Building
- E-mail – Activities based on Writing Appropriate Salutation, Paragraphs & Conclusion
- Resume Writing
- Thematic Discussions
- Speaking in Pairs – Everyday Activities & Detailed Introduction
- Activity based on PowerPoint Presentation

HS 3006 Entrepreneurship

Credit: 3
Category: HSMC
Prerequisite(s): Nil

Course Description:

The course has been designed for the students in order to provide basic knowledge of an entrepreneur and opportunities for new entrepreneurship. To provide idea about various financial sources available for small and medium enterprise by different financial institutions. To provide knowledge how to manage working capital of an organization in an efficient manner. To have an idea about motivational tools for increasing the productivity of employees in an enterprise.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: know the contribution of an entrepreneur in growth and development of socioeconomic condition of our country
- CO2: understand the role of SSI units in growth and development of socioeconomic condition of our country
- CO3: learn market survey, sales promotions and management of working capital through costing and book keeping
- CO4: know different decision making technique and benefit of personal management system.
- CO5: learn motivational methods of an enterprise
- CO6: learn how to prepare a project report and knowledge about different tax system of an enterprise

Topics:

- Introduction to entrepreneurship
- SSI Units
- Market survey and research
- Marketing mix
- Financial management
- Working capital management
- Personnel management
- Motivation

Textbook(s):

1. Entrepreneurial Development, S.S.Khanka, S.Chand

Reference Book(s):

1. Industrial Organisation and Engg. Economics, Sharma & Banga, Khanna Publication
2. Entrepreneurship New Venture Creation, David H. Holt, Prentice Hall, PHI

HS 3008 Management Concepts And Practices

Credit: 3
Category: HSMC
Prerequisite(s): Nil

Course Description:

The course curriculum is designed for student in order to provide fundamental knowledge in management area. The students will be able to know about general management concepts and various specialization in management area like marketing, finance, production and strategy management. The marketing management portion of the course will benefit the students to develop their career in marketing line, as most of the organisations give priority for marketing skills. Finance and production management will help the students in their respective domain and serve as a guide in their corporate career. The strategy management portion of this course will serve as a guide for the students to contribute in strategy formulation of the organization and how to achieve that strategy within a stipulated time period.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: perform the critical management functions effectively and develop ideas about implementing principles and theories of management in organizations efficiently
- CO2: develop various marketing skills in order to be successful in corporate world
- CO3: utilize different financial techniques for better management and control of organisational financial resources
- CO4: take strategic decision for day to day operation through proper working capital management.
- CO5: have competency in production planning as well as control measures will become easy in their professional career
- CO6: do strategy formulation of the organization and how to achieve that strategy within a stipulated time period

Topics:

- Introduction to management
- Marketing mix
- Market research
- Financial management
- Working capital management
- Production planning and control
- Inventory management
- Strategy management

Textbook(s):

1. Modern Business Organisation and Management. Sherlekar & Sherlekar, Himalaya Publishing House.
2. Business Organisation and Management. M. C. Shukla, S. Chand

Reference Book(s):

1. Principles & Practices of Management. L. M Prasad
2. A framework for marketing management, Philip Kotler
3. Financial Management. I. M Panday
4. Production and Operation Management, Everett E. Adam Jr. Ronald J. Ebert

HS 3002 Organisational Behaviour

Credit: 3
Category: HSMC
Prerequisite(s): Nil

Course Description:

The course has been designed for the students to provide an understanding about the behaviour of individuals, groups and the system in the organization. The course will help the students how to develop personality and leadership style for achievement of individual and organizational objective. To know about the benefit of motivation for increasing individual and organizational productivity. To Provide knowledge to work in groups and develop techniques for group decision making for organizational development.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: know about organization, organizational behaviour its nature, scope and significance
- CO2: develop their personality as per industry requirement
- CO3: apply motivational techniques to make the employees work with confidence and satisfaction
- CO4: develop different leadership style to adjust themselves in different organizational situations
- CO5: improve the knowledge of group behaviour and techniques of group decision making
- CO6: apply the concepts for managing changes in organization as well as the development of an organization's human resources

Topics:

- Introduction to Organisation and organisational behaviour
- Personality
- Motivation
- Leadership
- Group dynamics
- Organisational change
- Organisational development

Textbook(s):

1. Organisational behaviour. Stephen P. Robbins, Timothy A. Judge, S. Sanghi, Pearson
2. Organizational Behaviour and Work, F. M. Wilson, Oxford University Press.

Reference Book(s):

1. Organizational Behaviour, Dipak Kumar Bhattacharya, Oxford University Press
2. ORGB, Organizational Behaviour, Nelson, Quick, Khandelwal, Cengage
3. Organisational Behaviour. Dr. S. S. Khanka, S. Chand
4. Managing Organisational Behaviour, Moorhead & Griffin, Cengage Learning.

HS 3004 Human Resource Management

Credit: 3
Category: HSMC
Prerequisite(s): Nil

Course Description:

The course has been designed in order to provide knowledge and idea about human resource management and how to become a professional human resource manager. It will help the students to follow different HR processes like recruitment, training, performance appraisal effectively in organizational level. The students will be able to learn how to manage industrial dispute and develop industrial relation in corporate sector. The course will enable the students to understand the workers participation in management concept through employee discipline and the process of effective bargaining system in the organisation.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: develop personal and professional qualities of a manager in order to manage human resource of an organization effectively
- CO2: meet the human resource requirement of the organization for achieving its objective effectively
- CO3: follow different HR processes like recruitment, selection, training, performance appraisal effectively in organizational level
- CO4: inculcate the sense of inter personal relation required in professional front in handling employer-employee relation effectively for achievement of organizational objectives
- CO5: achieve strategic objectives of the organizations, by optimizing the potentiality of the human resource through workers participation in management
- CO6: know the technique of managing and being managed by the organisation

Topics:

- Human resource management
- Human resource planning
- Recruitment
- Selection
- Training
- Performance appraisal
- Industrial relation
- Industrial dispute
- Collective bargaining
- Workers participation in management

Textbook(s):

1. Human Resource Management, P. Jyoti & D. N. Venkatesh, Oxford Publication, 2016
2. Human Resource Management, B. Varkkey & G. Dessler, Pearson, 2017

Reference Book(s):

1. Human Resource Management. K. Aswathappa, Mc Graw Hill Education, 2013.
2. Human Resource Management. S. S. Khanka, S. Chand, 2019
3. Human Resource Management. P. Subba Rao, Himalaya Publishing House, 2018.

HS 4001 Professional Practice, Law and Ethics

Credit: 2
Category: HSMC
Prerequisite(s): Nil

Course Description:

The course on Professional Practice, Law and Ethics is designed to cater comprehensive insight of law and ethics to the students for practicing in their professional life. The course incisively highlights the role of morals and ethics in leading a sustainable profession. Besides, by containing different relevant laws like laws of contracts, intellectual property law and information technology law, the course provides foundation in law to the students which will help them a lot to face the real life situations with ease.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: select appropriate engineering decisions in consideration of professional ethics in realization of more critical impact of engineering compared to general experiments
- CO2: evaluate and prescribe risk reducing measures
- CO3: comprehend the dynamics in engineers' roles and responsibilities with emerging issues in global scene
- CO4: know the various compliance requirements and the regulatory bodies to protect environment
- CO5: have a fair idea to protect their engineering inventions from unauthorized exploitation under intellectual property rights system and laws relating to information communication technologies
- CO6: understand, analyze and prevent misuse of IT related transactions

Topics:

- Morals and ethics in engineering
- Engineering as social experimentation
- Engineer's responsibility for safety
- Global issues
- Law of contracts and law of torts
- Environmental laws
- Intellectual property law
- Information technology law

Textbook(s):

1. R. Subramaniam, Professional Ethics, Oxford University Press, 2013
2. Indian Contracts Act 1872
3. Patents Act 1970 (Unit-3)
4. Designs Act 2000 (Unit-3)
5. Information Technology Act 2000 (Unit-4)

Reference Book(s):

1. Mike Martin and Ronald Schinzinger, "Ethics in Engineering", McGraw Hill New York, 2005.
2. Charles E Harris, Michael S Pritchard and Michael J Rabins, "Engineering Ethics Concepts and Cases", Thomson Learning, 2000

HS 4003 Legal Issues and Requirements in Engineering

Credit: 1
Category: HSMC
Prerequisite(s): Nil

Course description:

It depicts on law of contracts and law of torts, Consumer Protection Act 1986, Environmental Protection Act 1986, Environmental Impact Assessment 2006, standards for emission, discharge of environmental pollutants from various industries, Intellectual Property Law, Protecting engineering invention, the U.S Utility model approach and need for Utility model in India, Protecting Software and other engineering technologies in cyberspace, maintaining data security and technological privacy in Cyberspace, e-contracts, electronic and digital signatures.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: understand the various legal requirements in terms of contracts
- CO2: interpret the product liability which an engineer is required to take care while processing his engineering innovations
- CO3: illustrate the various compliance requirements and the regulatory bodies to protect the environment
- CO4: demonstrate to protect their engineering inventions from unauthorised exploitation under intellectual property rights system and laws relating to information communication technologies
- CO5: identify Legal Issues in a given case
- CO6: analyse and prevent misuse of IT related transactions

Topics:

- Law of contracts and law of torts
- Environmental Laws
- Intellectual Property Law
- Information Technology Law

Textbook(s):

1. Gurdeep Singh "Environmental Laws" Eastern Book Company, 2nd Edition 2016.
2. V K Ahuja "Law Relating To Intellectual Property Rights" Lexis Nexis, 3rd Edition. July 2017.
3. Pavan Duggal "Cyber Law"-Indian Perspective". 2nd Edition 2016.
4. Avtar Singh "Law of Contracts" Eastern Book Company, 12th Edition, Reprinted 2020.
5. Dr. R K Bangia "Law of Torts". Allahabad Law Agency; 24th 2019 edition (2019).

Reference Book(s):

1. Rosencranz "Environmental Law and policy in india". Oxford University Press, 2001.
2. Howard b rockman "Intellectual Property Law for engineers and scientists". ISBN: 978-0-471-69740-4, Wiley-IEEE Press, June 2004.
3. Mireille Hidebrant " smart technologies and the end of law". ISBN: 978 1 78643 022 9.

Credit: 4
Category: BSC
Prerequisite(s): Nil

Course Description:

Students are taught Partial differential equations based on the propagation of heat, wave etc to use in solving engineering problems. The concept of Complex analysis, Residual integration are included to get the knowledge on complex plane. Numerical analysis is included to get approximate solutions to difficult problems for which analytical solution is hard to obtain. Students are given common Probability and Statistical knowledge to use statistical analysis of data.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: solve the PDE problems by separable method, Laplace transform
- CO2: know Complex plane , Complex functions, their differentiation and integration
- CO3: find series expansion of complex functions and evaluate real integrals by residue method
- CO4: determine roots of algebraic/transcendental equations through Newton and Lagrange method and obtain interpolating Polynomials
- CO5: solve ODE numerically by single step and multi step method
- CO6: work out problems related to probability distribution and statistical regression and co- relation

Topics:

- Partial Differential Equation
- Complex Analysis
- Numerical Methods
- Probability

Textbook(s):

1. Advanced Engineering Mathematics(10th edition) by E. Kreyszig , Wiley .

Reference Book(s):

1. Engineering Mathematics by S. Pal and S.C. Bhunia, Oxford University Press.



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ACADEMIC CURRICULA 2021 - 2025

BACHELOR'S DEGREE PROGRAMME

B. Tech in Electronics & Telecommunication Engineering

Curricula & Syllabi



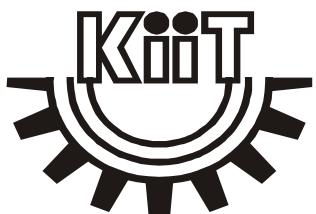
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Bhubaneswar, Odisha, India

ACADEMIC CURRICULA

2021 - 2025

BACHELOR'S DEGREE PROGRAMME
B. Tech in
Electronics & Telecommunication Engineering

**Course Structure and Detailed Syllabi
for students admitted in
2021 - 25
Academic Session**



Kalinga Institute of Industrial Technology (KIIT)
Deemed to be University U/S 3 of UGC Act, 1956
Bhubaneswar, Odisha, India

B. TECH IN ELECTRONICS AND TELECOMMUNICATION ENGINEERING

Programme Educational Objectives (PEOs):

The B.Tech programme in Electronics and Telecommunication Engineering aims to prepare the graduates with the following objectives:

1. Graduates shall be able to provide solutions to Electronics and Telecommunication engineering problems and allied areas involving electronic system design, communication network operation and management issues.
2. Graduates shall be able to perceive the limitation and impact of engineering solutions in social, legal, environmental, economical and multidisciplinary contexts.
3. Graduates shall demonstrate professional and ethical responsibilities and thrive to reinforce their knowledge being a part of higher educational programmes.

Programme Outcomes (POs):

The programme outcomes are:

- a) Engineering knowledge: Ability to apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- b) Problem analysis: Ability to identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- c) Design/Development of solutions: Ability to design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- d) Conduct investigations on complex problems: Ability to use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- e) Modern tool usage: Ability to create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- f) The engineer and society: Ability to apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- g) Environment and sustainability: Ability to understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- h) Ethics: Ability to apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- i) Individual and team: Ability to function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- j) Communication: Ability to communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- k) Project management and finance: Ability to demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- l) Life-long learning: Ability to recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes (PSOs):

The programme specific outcomes are:

- m) Ability to design and implement electronic circuits, signal processing and communication systems in industry.
- n) Ability to carry out research in fields of embedded systems, wireless and high speed communication, and advanced signal processing.
- o) Ability to utilize the knowledge in solving practical problems in real life.

Abbreviations used in describing the category in all the courses are as follows:

BSC:	Basic Science Course
BSLC:	Basic Science Laboratory Course
ESC:	Engineering Science Course
ESLC:	Engineering Science Laboratory Course
HSMC:	Humanities, Social Science & Management Course
PCC:	Professional Core Course
PCLC:	Professional Core Laboratory Course
PEC:	Professional Elective Course
OEC:	Open Elective Course
PROJ:	Project
IEC:	Industry Elective Course

**COURSE STRUCTURE FOR B. TECH IN ELECTRONICS AND TELECOMMUNICATION
ENGINEERING**

**SCHEME-I
SEMESTER - I**

Theory							
S1. No	Course Code	Course Title	L	T	P	Total	Credit
1.	MA 1003	Mathematics – I	3	1	0	4	4
2.	PH 1007	Physics	3	1	0	4	4
3.	EE 1003	Basic Electrical Engineering	3	0	0	3	3
4.	ME 1003	Engineering Mechanics	3	0	0	3	3
Total of Theory							14
Practical							
1.	PH 1097	Physics Lab	0	0	3	3	1.5
2.	EE 1093	Basic Electrical Engineering Lab	0	0	2	2	1
Sessional							
1.	ME 1083	Basic Manufacturing Systems	0	1	2	3	2
2.	CH 1081	Environmental Science	0	0	2	2	1
Total of Practical & Sessional							10
Semester Total							19.5

SCHEME-I
SEMESTER - II

Theory							
Sl. No	Course Code	Course Title	L	T	P	Total	Credit
1.	MA 1004	Mathematics – II	3	1	0	4	4
2.	CH 1007	Chemistry	3	0	0	3	3
3.	HS 1005	Professional Communication	2	0	0	2	2
4.	LS 1001	Biology	2	0	0	2	2
Total of Theory						11	11
Practical							
1.	CS 1093	Computer Programming	0	2	4	6	4
2.	CH 1097	Chemistry Lab	0	0	3	3	1.5
Sessional							
1.	HS 1085	Language Lab	0	0	2	2	1
2.	CE 1083	Engg. Graphics	0	1	2	3	2
Total of Practical & Sessional						14	8.5
Semester Total						25	19.5
	EAA- 1	Extra Academic Activity					P/NP

SEMESTER - III

Sl. No	Course Code	Course Title	L	T	P	Total	Credit
Theory							
1	MA 2009	Mathematics-III (Electronics)	3	1	0	4	4
2	EC 2019	Electronic Devices and Circuits	3	1	0	4	4
3	EC 2021	Signals and Networks	3	0	0	3	3
4	EC 2011	Digital Electronics	3	0	0	3	3
5	CS 2001	Data Structure and Algorithms	3	1	0	4	4
6		HS Elective-I	3	0	0	3	3
Total of Theory							21
Practical							
1	EC 2091	Electronic Circuits & Network Lab	0	0	3	3	1.5
2	EC 2093	Digital Electronics Lab	0	0	2	2	1
3	CS 2091	Data Structures Lab	0	0	2	2	1
Sessional							
1	HS 2081	Business Communication	0	0	2	2	1
Total of Practical & Sessional							9
Semester Total							25.5

SEMESTER - IV

Sl. No	Course Code	Course Title	L	T	P	Total	Credit
Theory							
1	EC 2024	Advanced Electronic Circuits	3	0	0	3	3
2	EC 2020	Microprocessors, Microcontrollers & Interfacing	3	1	0	4	4
3	EC 2012	Analog Communication Techniques	3	0	0	3	3
4	EI 2010	Principle of Measurements and Instrumentation	3	0	0	3	3
5	EC 2022	Electromagnetic Waves and Antennas	3	1	0	4	4
6	EL 2002	Principle of Control System	3	0	0	3	3
Total of Theory							20
Practical							
1	EC 2092	Analog Integrated Circuits Lab	0	0	2	2	1
2	EC 2098	Simulation Lab	0	0	2	2	1
3	EC 2090	Microprocessor and Microcontroller Lab	0	0	2	2	1
Total of Practical							6
Semester Total							26

SEMESTER - V

Sl. No	Course Code	Course Title	L	T	P	Total	Credit
Theory							
1	EC 3015	Microwave Engineering	3	0	0	3	3
2	EC 3028	Data Communication and Networking	3	0	0	3	3
3	EC 3007	Digital Signal Processing	3	1	0	4	4
4	EC 3005	Digital Communication Techniques	3	1	0	4	4
5		Department Elective-I	3	0	0	3	3
6		Department Elective-II	3	0	0	3	3
Total of Theory							20
Practical							
1	EC 2094	Communication Engineering Lab	0	0	3	3	1.5
2	EC 3091	Electronic Measurements and Instrumentation Lab	0	0	2	2	1
3	EC 3093	Microwave and Antenna Lab	0	0	3	3	1.5
Total of Practical							8
Semester Total							28

SEMESTER - VI

Sl. No	Course Code	Course Title	L	T	P	Total	Credit
Theory							
1	EC 3011	VLSI Design	3	0	0	3	3
2	EC 3036	Cellular Communication	3	0	0	3	3
3		Department Elective-III	3	0	0	3	3
4		Department Elective-IV	3	0	0	3	3
5		Department Elective-V	3	0	0	3	3
6		Open Elective -I / (MI-1)	3	0	0	3	3
Total of Theory							18
Practical							
1	EC 3095	VLSI Lab	0	0	2	2	1
2	EC 3099	DSP Lab	0	0	2	2	1
3	EC 3094	Wireless Communication and Networking Lab	0	0	3	3	1.5
Sessional							
1	EC 3082	Minor Project	0	0	4	4	2
Total of Practical & Sessional							11
Semester Total							29

SEMESTER - VII

S.I. No	Course Code	Course Title	L	T	P	Total	Credit
Theory							
1		HS Elective-II	3	0	0	3	3
2	HS 4001	Professional Practice, Law & Ethics	2	0	0	2	2
3		Open Elective-II / (MI-2)	3	0	0	3	3
(4)		(MI-3)	(3)	(0)	(0)	(3)	(3)
(5)		(MI-4)	(3)	(0)	(0)	(3)	(3)
(6)		(HO-1)	(3)	(0)	(0)	(3)	(3)
Total of Theory							8
Sessional							
1	EC 4081	Project -I / Internship					3
2	EC 4083	Practical Training	-	-	-	-	2
(3)		(Project – Minor / Lab)	(0)	(0)	(4)	(4)	(2)
Semester Total							13

SEMESTER - VIII

Sl. No	Course Code	Course Title	L	T	P	Total	Credit
Theory							
(1)		(MI-5)	(3)	(0)	(0)	(3)	(3)
(2)		(MI-6)	(3)	(0)	(0)	(3)	(3)
(3)		(HO-2)	(3)	(0)	(0)	(3)	(3)
(4)		(HO-3)	(3)	(0)	(0)	(3)	(3)
Sessional							
1	EC 4082	Project - II / Internship					10
Semester Total							10

MI – Minor

HO - Honors

LIST OF HS ELECTIVES

HS Elective – I

Sl. No	Course Code	Course Title	Credit
1.	HS 2002	Engineering Economics	3
2.	HS 2008	Economic Environment of India	3
3.	HS 2010	Financial Institutions, Markets and Regulations	3
4.	HS 2012	Development Economics	3

HS Elective – II

1.	HS 3006	Entrepreneurship	3
2.	HS 3008	Management Concepts & Practices	3
3.	HS 3002	Organizational Behaviour	3
4.	HS 3004	Human Resource Management	3

LIST OF DEPARTMENT ELECTIVES

Dept. Elective – I

1.	EC 3023	Optimization Techniques in Engineering	3
2.	EC 3029	Optical Communication and Networking	3
3.	EE 3028	Power Electronic Circuits	3
4.	EI 3025	Principle of Analytical Instrumentation	3

Dept. Elective – II

1.	EC 3033	Embedded System Design & Applications	3
2.	EC 3031	ARM and Advanced Processors	3
3.	EL 3024	Industrial Automation and Control	3
4.	EC 3035	High Speed Digital System Design	3

Dept. Elective - III

1.	EC 3021	Neural Networks and Machine Learning	3
2.	EC 6122	Satellite Communication Systems	3
3.	EI 3032	Principle of Sensors and Data Acquisition	3
4.	EC 3062	Smart Antennas	3

Dept. Elective – IV

1.	EC 3050	Internet of Things and its Applications	3
2.	EC 3056	Speech and Audio Signal Processing	3
3.	EC 6112	Communication and Network Security	3
4.	EC 6108	Digital Image Processing	3

Dept. Elective – V

1.	EC 3058	Nanoelectronics	3
2.	EC 3068	Real Time Systems and Application	3
3.	EC 6128	Wireless Sensor Networks	3
4.	EC 3064	Information Theory and Coding	3

**HONORS COURSES OFFERED BY ELECTRONICS AND TELECOMMUNICATION
ENGINEERING**

Area: Communication Engineering

Sl No	Course Code	Course Title	Prerequisite/s
1	EC 4053	Millimeter Wave and Terahertz Technology	Cellular Communication (EC 3036)
2	EC 4056	Mobile Ad-Hoc Networks	Data Communication and Networking (EC 3028)
3	EC 4058	Cognitive Radio and Cooperative Communications	Cellular Communication (EC 3036)

Area: VLSI and Embedded System

SL No	Course Code	Course Title	Prerequisite/s
1	EC 6203	MOS Device Modeling	VLSI Design (EC 3011)
2	EC 6207	Analog CMOS VLSI Circuits	VLSI Design (EC 3011)
3	EC 6248	VLSI Signal Processing	Digital Signal Processing (EC 3007)

Area: Signal Processing

Sl. No	Course Code	Course Title	Prerequisite/s
1	EC 4047	Biomedical Signal Processing	Digital Signal Processing (EC 3007), Math-III (Electronics) (MA 2009)
2	EC 4050	Computer Vision & Pattern Recognition	Digital Signal Processing (EC 3007), Math-III (Electronics) (MA 2009)
3	EC 4052	Machine learning for Digital Signal Processing	Digital Signal Processing (EC 3007), Math-III (Electronics) (MA 2009)

LIST OF OPEN ELECTIVES OFFERED BY SCHOOL OF ELECTRONICS ENGINEERING

Sl. No	Course Code	Course Title	Prerequisite/s
1	EC 2011	Digital Electronics	NIL
2	EC 2021	Signals & Networks	Math-II (MA 1004)
3	EC 3044	Introduction to Communication Engineering	NIL
4	EC 3066	Principles of Microprocessors and Microcontrollers	Digital Electronics (EC 2011)
5	EI 3027	Industrial Instrumentation	Basic Electrical Engineering (EE 1003)
6	EC 3013	Principle of Digital Signal Processing	Math-II (MA 1004)
7	EL 2002	Principle of Control System	Signals & Networks (EC 2021)
8	EC 3011	VLSI Design	Digital Electronics (EC 2011)
9	EC 3033	Embedded system Design and Applications	Microprocessors and Microcontrollers (EC 2020) /Principles of Microprocessors and Microcontrollers (EC 3066)
10	EL 3024	Industrial Automation & Control	Principle of Control Systems (EL 2002) /Linear Control System (EL 2028)
11	EC 6108	Digital Image Processing	Principle of Digital Signal Processing (EC 3013) / Digital Signal Processing (EC 3007)
12	EC 3060	Mobile Communication Engineering	Communication Engineering (EC 2016) /Introduction to Communication Engineering (EC 3044) / Principle of Digital Communication (EC 2004)
13	EC 3050	Internet of Things and its applications	Microprocessors and Microcontrollers (EC 2020) / Principles of Microprocessors and Microcontrollers (EC 3066)

MINOR IN ELECTRONICS & TELECOMMUNICATION ENGINEERING

Sl. No	Course Code	Course Title	Prerequisite/s
1	EC 2025	Principles of Electronics Engineering	Nil
2	EC 2011	Digital Electronics	Nil
3	EC 3066	Principle of Microprocessors and Microcontrollers	Digital Electronics (EC2011)
4	EC 2021	Signals and Networks	Mathematics-II (MA1004)
5	EC 2014	Electromagnetic Theory	Mathematics-II (MA1004)
6	EC 3011	VLSI Design	Analog Electronic Circuits
7	EC 3031	ARM and Advanced Processors	Principle of Microprocessors and Microcontrollers (EC3066)
8	EC 3035	High speed Digital system Design	Digital Electronics (EC2011)
9	EC 3044	Introduction to Communication Engineering	Nil
10	EC 3015	Microwave Engineering	Nil
11	EC 3028	Data Communication and Networking	Introduction to Communication Engineering (EC3044)
12	EC 3060	Mobile communication Engineering	Introduction to Communication Engineering (EC3044)/Principle of Digital Communication (EC2004)/Communication Engineering (EC2016)
13	EC 3050	Internet of Things and its Applications	Principle of Microprocessors and Microcontrollers (EC3066)
14	EC 6122	Satellite Communication Systems	Introduction to Communication Engineering (EC3044)/Principle of Digital Communication (EC2004)/Communication Engineering (EC2016)
15	EC 3029	Optical Communication and Networking	Introduction to Communication Engineering (EC3044)/Principle of Digital Communication (EC2004)/Communication

			Engineering (EC2016)
16	EC 3021	Neural Networks and Machine Learning	Mathematics-I &II (MA1003 and MA1004)
17	EC 1094	Analog Electronic Circuits Lab	
18	EC 2093	Digital Electronics Lab	
19	EC 3095	VLSI Lab	

MINOR IN ELECTRONICS & INSTRUMENTATION ENGINEERING

Sl. No	Course Code	Course Title	Prerequisite/s
1	EC 2025	Principles of Electronics Engineering	Nil
2	EI 2003	Electrical & Electronic Measurement Techniques	Basic Electrical Engineering (EE 1003)
3	EC 2021	Signals and Networks	Mathematics-II (MA 1004)
4	EL 2002	Principle of Control System	Signals and Networks (EC 2021)
5	EI 2012	Sensors and Signal Conditioning	Electrical and Electronic Measurement Techniques (EI 2003)
6	EI 3009	Instrumentation Measurement Techniques	Electrical & Electronic Measurement Techniques (EI 2003)
7	EI 3029	Process Dynamics and Control	Principle of Control System (EL 2002)
8	EI 3025	Principle of Analytical Instrumentation	Chemistry (CH 1007)
9	EI 3030	Power Plant Instrumentation	Instrumentation Measurement Techniques (EI 3009)
10	EI 3032	Principle of Sensors and Data Acquisition	Electrical and Electronic Measurement Techniques (EI 2003)
11	EI 3023	Neural Network & Fuzzy Logic Control	Mathematics-I (MA 1003), Mathematics-II (MA 1004) and Principle of Control System (EL 2002)
12	EI 2095	Electrical & Electronic Measurements Lab	
13	EI 3091	Instrumentation Lab	
14	EI 3092	Process Control Lab	

MINOR IN VLSI AND EMBEDDED SYSTEM

Sl. No	Course Code	Course Title	Prerequisite/s
1	EC 2025	Principles of Electronics Engineering	Nil
2	EC 2011	Digital Electronics	Principles of Electronics Engineering (EC 2025)
3	EC 2005	Semiconductor Devices	Principles of Electronics Engineering (EC 2025)
4	EC 3066	Principle of Microprocessors and Microcontrollers	Digital Electronics (EC 2011)
5	EC 3011	VLSI Design	Digital Electronics (EC2011)
6	EC 3035	High Speed Digital System Design	Digital Electronics (EC2011)
7	EC3033	Embedded System Design and Applications	Digital Electronics (EC2011)
8	EC 3031	ARM and Advanced Processors	Microprocessors, Microcontrollers& Interfacing (EC 2020) / Principle of Microprocessors and Microcontrollers (EC 3066)
9	EC 3068	Real Time Systems and Application	Digital Electronics (EC 2011)
10	EC 6224	Low Power VLSI Design	VLSI design (EC 3011)
11	EC 3058	Nanoelectronics	Principles of Electronics Engineering (EC 2025)
12	EC 2093	Digital Electronics Lab	
13	EC 2090	Microprocessor and Microcontroller Lab	
14	EC 3095	VLSI Lab	

MINOR IN SENSORS & SIGNALS

Sl. No	Course Code	Course Title	Prerequisite/s
1	EC 2025	Principles of Electronics Engineering	Nil
2	EC 2011	Digital Electronics	Nil
3	EC 2021	Signals and Networks	Mathematics-II (MA1004)
4	EC 3066	Principle of Microprocessors and Microcontrollers	Digital Electronics (EC 2011)
5	EI 2003	Electrical & Electronic Measurement Techniques	Basic Electrical Engineering (EE 1003)
6	EI 2012	Sensors & Signal Conditioning	Electrical and Electronic Measurement Techniques (EI 2003)
7	EC 3013	Principle of Digital Signal Processing	Signals and Network (EC 2021)
8	EI 3032	Principle of Sensors & Data Acquisition	Electrical & Electronic Measurement Techniques (EI 2003)
9	EC 3021	Neural Networks &Machine Learning	Mathematics-I and Mathematics-II (MA1003 and MA1004)
10	EC 3050	Internet of Things and its applications	Principle of Microprocessors and Microcontrollers (EC3066)
11	EC 6108	Digital Image Processing	Principle of Digital Signal Processing (EC 3013)
12	EI 3024	Virtual Instrumentation	Sensors and Signal Conditioning (EI 2012),Digital Electronics (EC 2011)
13	EC 3056	Speech and Audio Signal Processing	Principle of Digital Signal Processing (EC 3013)
14	EC 2093	Digital Electronics Lab	-
15	EI 2095	Measurements and Instrumentation Lab	-
16	EC 3099	DSP Lab	-

MINOR IN “COMMUNICATION NETWORKS, INTELLIGENT IOT & CYBER PHYSICAL SYSTEMS”

S1 No	Course Code	Course Title	Prerequisite/s
1	EC 2025	Principles of Electronics Engineering	Nil
2	EC 2011	Digital Electronics	Nil
3	EC 3044	Introduction to Communication Engineering	Nil
4	EC 3066	Principle of Microprocessors and Microcontrollers	Digital Electronics (EC 2011)
5	EC 3033	Embedded System Design and Applications	Principles of Microprocessors and Microcontrollers (EC 3066)
6	EC 3028	Data Communication and Networking	Introduction to Communication Engineering (EC 3044)
7	EC3050	Internet of Things and its applications	Principles of Microprocessors and Microcontrollers (EC 3066)
8	EC 3070	MANET AND WSN	Data Communication and Networking (EC 3028)
9	EC 6112	Communication & Network Security	Data Communication and Networking (EC 3028)
10	EC 3072	Introduction to machine learning	Mathematics-I & II (MA1003 and MA1004)
11	EC 3074	Internet Technologies for cloud & Edge computing	Computer Programming (CS 1093)
12	EC 3076	IoT & Cyber-Physical System Design	Internet of Things and its applications (EC3050)
13	EC 4061	AI and Machine Learning for IoT	Mathematics-I & II (MA1003 and MA1004) & Internet of Things and its applications (EC3050)
14	EC 2093	Digital Electronics lab	

15	EC 2090	Microprocessor and Microcontroller Lab	
14	EC 4099	Internet of Things & connected intelligent systems Lab	
15	EC XXXX	Project	

MINOR IN “APPLIED MACHINE LEARNING”

Sl No	Course Code	Course Title	Prerequisite/s
1	EC 2025	Principles of Electronics Engineering	Nil
2	EC 2011	Digital Electronics	Nil
3	EC 3044	Introduction to Communication Engineering	Nil
4	EC 3066	Principle of Microprocessors and Microcontrollers	Digital Electronics (EC 2011)
5	EC 3033	Embedded System Design and Applications	Principles of Microprocessors and Microcontrollers (EC 3066)
6	EC 3028	Data Communication and Networking	Introduction to Communication Engineering (EC 3044)
7	EC3007	Digital Signal Processing	
8	EC 6108	Digital Image Processing	Digital Signal Processing
9	EC 3072	Introduction to Machine learning	Computer Programming (CS 1093)
10	EC 3078	Signal Understanding Using Machine Learning	Signal and Network
11	EC 3080	Deep Learning	Introduction to Machine learning (EC 3072)
12	EC 4059	Computer Vision and Pattern Recognition	Digital Image Processing
13	EC 2093	Digital Electronics lab	
14	EC 2090	Microprocessor and Microcontroller Lab	
15	EC 4097	Machine learning Lab	Introduction to Machine Learning (EC3072) and Deep Learning (EC3080)
16	EC XXXX	Project	

COURSES OF FIRST YEAR

MA 1003 Mathematics-I

Credit: 4
Category: BSC
Prerequisite(s): Nil

Course Description:

The laws of nature are expressed as differential equations. The construction of mathematical models to address real-world problems has been one of the most important aspects of each of the branches of science. This course is designed to familiarize the prospective engineers with techniques in ordinary differential equations, multivariate calculus and solution for ODEs numerically. This course also focuses on Linear algebra that covers system of linear equations and properties of matrices. The objective of the course is to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced levels of mathematics and applications that they would find useful in their disciplines.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: model and formulate differential equation of Physical problems
- CO2: apply different methods to solve 1st and 2nd order ODEs
- CO3: apply numerical methods to solve ODEs
- CO4: study differential calculus in engineering problems
- CO5: use the essential tool of matrices and linear algebra
- CO6: analyze Eigenvalue problems

Topics:

- Ordinary Differential Equations.
- Linear differential equations of 2nd order.
- Differential calculus and Numerical methods to solve ODEs
- Vector space and system linear of equations
- Matrix-eigenvalue Problems

Textbook(s):

1. Advanced Engineering Mathematics by Erwin Kreyszig, Wiley, INC, (online) 10th Edition.
2. Differential Calculus, Shanti Narayan and P. K. Mittal, S. Chand, reprint 2009.

Reference Book(s):

1. Grewal B.S., Higher Engineering Mathematics, Khanna Publishers, 36th edition.
2. Dass H.K., Introduction to engineering Mathematics, S.Chand & Co Ltd, 11th edition.
3. Ramana B.V., Higher Engineering Mathematics, TMH, 2007.
4. Sinha Roy and S Padhy, A course on ordinary & Partial Differential Equation, Kalyani Publication, 3rd edition.

PH 1007 **Physics**

Credit: 4
Category: BSC
Prerequisite(s): Nil

Course Description:

This course includes the fundamentals of different types of oscillations and its applications; mathematical expression of waves and its physical interpretation; the concept of interference, diffraction and their applications; the principle, construction and working of different Lasers. The course also gives a flavour of Quantum mechanics, which is the founding stone to the state of the art in modern techniques and paves the way towards the world of nano devices. It covers the formulation of Maxwell's electromagnetic equations, and verification of different properties of electromagnetic waves. Mechanical and magnetic properties of different materials and their applications are also covered in this course.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: utilize the concept of waves and intensity modulation in day to day life through various applications
- CO2: apply the mechanism of LASER technology in different fields
- CO3: formulate and solve engineering problems of electricity and magnetism using Maxwell's electromagnetic equations
- CO4: apply the principles of quantum mechanics to related problems
- CO5: apply the knowledge of magnetic materials in related applications
- CO6: analyze the macroscopic behavior of solids and utilize them in future applications

Topics:

- Oscillation and wave
- Interference and diffraction
- LASER
- Quantum mechanics
- Electromagnetism
- Properties of matter (mechanical)
- Magnetism

Textbook (s):

1. Engineering Physics, B. K. Pandey and S. Chaturvedi, Cengage Publication, New Delhi

Reference Book(s):

1. Introduction to Electrodynamics, D J Griffiths, Pearson Education
2. Quantum Mechanics, L. I. Schiff, Tata McGraw-Hill Publications
3. Optics, A K Ghatak, Tata McGraw-Hill Publications
4. Concepts of Modern Physics, A. Beiser, Tata McGraw-Hill Publications
5. Engineering Physics, R K Gaur and S. L. Gupta, Dhanpat Rai Publications, New Delhi.

ME 1003 Engineering Mechanics

Credit: 2
Category: ESC
Prerequisite(s): Nil

Course Description:

The course on Engineering Mechanics is a specialized need-based extension of applied physics which is aimed at developing an understanding of the principle of statics and dynamics. The course focuses on learning methodical and logical idealization and subsequent implementation of corresponding procedures for analysis of rigid body, frame and machine under the action of force system which is highly essential for effective design. The course intends to develop the ability of drawing and analyzing the free body diagram of a system when at rest or motion using scalar/vector techniques. Further, the course serves as a prerequisite to fundamental machine design courses such as mechanics of solids and design of machine elements.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: draw complete and correct free-body diagrams and write the appropriate equilibrium equations from the free-body diagram
- CO2: use scalar analytical techniques for analyzing forces and moments in mechanical systems
- CO3: analyzing forces in statically determinate structures such as trusses, frames and problems related to friction
- CO4: determine the centroid and second moment of area
- CO5: apply fundamental concepts of kinematics and kinetics of particles to the analysis of simple and practical problems
- CO6: solve real-life problems by using mathematics, physical laws and theorems

Topics:

- Concurrent Forces in a Plane
- Friction
- Parallel Forces in a Plane
- Moment of Inertia
- Force analysis of Plane Trusses
- Principle of Virtual Work
- Kinematics of Rectilinear Motion
- Kinematics of Curvilinear Motion
- Rotation of a rigid body

Textbook(s):

1. Engineering Mechanics (Revised 5th edition), TMH by S. Timoshenko, D.H. Young, J.V Rao and S. Pati.

Reference Book (s):

1. Engineering Mechanics (Statics and Dynamics) - Bear and Johnson, TMH
2. Engineering Mechanics (Statics and Dynamics) by I.H. Shames, Prentice Hall
3. Engineering Mechanics –S.S. Bhavikatti, New Age International
4. Engineering Mechanics (Statics and Dynamics)-S. Rajasekaran & G Sankarasubramanian, Vikas Publishing House.

PH 1097 Physics Laboratory

Credit: 1.5
Category: BSLC
Prerequisite(s): Nil

Course Description:

This lab course covers different measurement techniques of various parameters using the instruments i.e. interferometer, spectrometer, spherometer, Screw gauge, vernier calliper, microspope, and telescope. It includes the application of photoelectric effect and photovoltaic effect in photo cell and solar cell respectively. Evaluation of the mechanical strength of materials by calculating elastic constants such as Young's modulus, rigidity modulus and Poisson's ratio are also included. This course provides hands on training for the usage of electrical, optical and mechanical systems for various measurements with precision and analysis of the experimental data by graphical interpretation and error calculation.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: calculate appropriate structural members using the fundamental concepts of the elastic behavior of materials
- CO2: use the principles of interference and diffraction to find out the wavelength of an unknown monochromatic source of light
- CO3: apply the concept of photoelectric emission to calculate the Planck's constant and analyze some aspects of electron-photon interaction through characteristic curves
- CO4: explore the efficiency in terms of power output of a green energy source i.e. solar cell
- CO5: calculate the acceleration due to gravity 'g' by using the concept of a compound pendulum

Topics:

- Estimation of elastic constants such as Young's modulus, rigidity modulus and Poisson's ratio
- Determination of wavelength of unknown source using Newton's rings and Michelson's interferometer
- Precision length measurement up to the order of 6 A° (distance between sodium D-lines) using Michelson interferometer
- Determination of grating element using a diffraction grating
- Study of photo cell and solar cell by analyzing their characteristic curves
- Determination of acceleration due to gravity using a bar pendulum

EE 1093 Basic Electrical Engineering Laboratory

Credit: 1
Category: ESLC
Prerequisite(s): Nil

Course Description:

Basic Electrical Engineering lab comprises of various equipments and loads i.e voltmeters, ammeters, wattmeters, single phase and three phase transformer, induction motors etc. It is a specialized practical oriented course which intends to develop and understand various principles like Ohm's law and Kirchoff's law. The course focused on learning methodical and logical idealization of various theorems which is highly essential for solving a network. The course intends to make the students familiar with various parts of DC machines and AC machines. The course intends to develop the ability of problem solving by analyzing RL and RLC series circuits. This lab helps the students to understand the principle of operation of a single phase transformer with its no load calculation.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: recall the safety practices in the laboratory and the associated work areas
- CO2: comprehend the skills for working in a team with common objective
- CO3: apply different theorems to find the parameters in DC and AC circuit
- CO4: analyse the different parts of DC and AC machines to describe operational features thereof
- CO5: apprise the experimental results in systematic manner
- CO6: discuss about determination of resistance in incandescent lamp and power factor in fluorescent lamp

Topics:

- measurement of resistance of tungsten filament lamp
- measurement of inductance of a choke coil
- study and use of megger
- study of different parts of dc machine and three phase induction motor
- layout of power system analysis
- determination of voltage ratio of a single phase transformer
- measurement of no load current and core loss of a single phase transformer
- verification of KCL and KVL
- verification of voltage and current ratio of star and delta connection
- study & determine the power factor of the RLC series circuit
- study, connection & determine the power factor of fluorescent tube
- verification of the superposition theorem
- transient analysis of series RL and RC circuit using matlab-simulink with dc excitation

Textbook(s):

1. Basic Electrical Engineering by D.C. Kulshreshtha, Tata Mcgraw publication, 1st Edition 2011.
2. Basic Electrical Engineering, T.K. Nagasarkar and M.S. Sukhija, Oxford University press, 2nd Edition 2011.

Reference Book(s):

1. Basics Electrical Engineering Sanjeev Sharma, I.K. International, New Delhi.(Third Reprint 2010).

ME 1083 Basic Manufacturing Systems

Credit: 2
Category: ESLC
Prerequisite(s): Nil

Course Description:

This laboratory practice is designed to impart students the basic knowledge on manufacturing or developing a given object irrespective of their branch of engineering. While furnishing the given object, students will familiar with various mechanical operations and the respective tools or machines. This course involves four different sections namely Fitting, Welding, Turning and Sheet metal which covers both conventional and advanced tools to provide students the updated manufacturing experience. Students are also advised with various safety precautions to be followed during a specific manufacturing practice. At the end, students will also gain knowledge on different advanced machines such as CNC and 3D printing.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: practice different operations related to fitting shop
- CO2: use different welding tools to prepare a given type of joint
- CO3: demonstrate various turning operations including taper turning and knurling using a conventional lathe machine
- CO4: design a tray and prepare it using sheet metal equipment involving soldering
- CO5: appraise different operations using a CNC machine
- CO6: interpret different advanced machines such as 3D printing/additive manufacturing

Topics:

- Turning operations
- Sheet metal operations
- Fitting
- Welding

CH 1081 Environmental Science

Credit: 1
Category: BSLC
Prerequisite(s): Nil

Course Description:

The course is designed to make the students aware of different environmental components and their composition. It will make the students understand different pollutants, their sources and management. It will also help students to apply the principles of Green Chemistry and implement them in synthesis of advanced materials required for engineering applications. It also outlines the basic steps for developing the EIA statements

Course Outcomes: At the end of the course, the students will be able to:

- CO1: understand the different components and composition of the environment
- CO2: rationalize the different pollutants, their sources, effects and controlling measures
- CO3: quantify water quality parameters
- CO4: apply the systematic environmental impact assessment (EIA) requirements before setup of any project
- CO5: understand and implement the principles of solid waste management
- CO6: conceptualize the principles of green chemistry and implement them in synthesis of advanced material, so as to reduce the pollution

Topics:

- Overview on environment
- Environmental pollution: air pollution, water pollution
- Pollution management

Textbook(s):

1. Environmental Chemistry, A. K. De, New Age International Publishers.

Reference Book(s):

1. Environmental Chemistry- S. Chakroborty, D. Dave, S.S. Katewa, Cengage Publishers
2. Environment Science and Engineering, Aloka Debi. Second Edition ;Universities Press
3. Text Book of Environment studies for under graduate courses, Erach Bharucha : 2nd Edition, Universities Press
4. Fundamentals of Environment and Ecology, D. De, D. De; 2013, S. Chand Group
5. Engineering Chemistry, Jain and Jain, Dhanpat Rai Publishing Company

Credit: 4
Category: BSC
Prerequisite(s): Nil

Course Description :

The course is to familiarize the students with series solutions of ODEs, Laplace Transforms, Fourier series, vector calculus, and numerical integration. For the ODEs with variable coefficients, the situation is more complicated to get their solutions in elementary functions. Legendre and Bessel's equations are important ODEs of this kind and their solutions, the Legendre polynomials and Bessel functions play an important role in engineering applications. Laplace transforms can be used as a mathematical toolbox for engineers to solve linear ODEs and related initial value problems. The Fourier series and vector calculus play a very important role in many engineering areas such as solid mechanics, aerodynamics, fluid flow, heat flow, quantum physics. The applied mathematician, engineer, physicist, or scientist must become familiar with the essentials of numerics and its ideas, such as interpolation and numerical integration.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: understand application of Power series and solution of ODEs
- CO2: use Power series solutions to Legendre and Bessel's equations
- CO3: comprehend Laplace transform and IVPs
- CO4: study periodic and non-periodic functions and their Fourier series expansion
- CO5: develop vector differential and integral calculus and the applications of Green's theorem, Gauss Divergence Theorem & Stokes Theorem
- CO6: apply numerical techniques in interpolation and evaluation of the definite integral

Topics:

- Series Solution of Differential Equations
- Laplace Transforms
- Fourier Series
- Vector Differential and Integral Calculus
- Interpolation and Numerical Integration

Textbook(s):

1. Advanced Engineering Mathematics by Erwin Kreyszig, Wiley, INC, 10th Edition.

Reference Book(s):

1. Higher Engineering Mathematics, Grewal B.S., Khanna Publishers, 36th edition.
2. Introduction to engineering Mathematics, Dass H.K., S.Chand& Co Ltd, 11th edition.
3. Higher Engineering Mathematics, Ramana B.V., TMH, 2007.
4. A course on ordinary & partial differential Equation, Sinha Roy and S Padhy, Kalyani Publication, 3rd edition.

CH 1007 Chemistry

Credit: 3
Category: BSC
Prerequisite(s): Nil

Course Description:

The course is designed to enrich the students with basic concepts in Chemistry to strengthen their fundamentals which will support them for pursuing education and research in engineering. It will help them to develop the idea on feasibility and mechanism of different chemical processes, conceptualize alternative sources of energy, give an exposure for handling instrumental techniques to explore structure of organic molecules and an idea of different methods for synthesis of advanced materials.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: rationalize bulk properties and processes using thermodynamic consideration and apply the knowledge to decide the feasibility of a given process
- CO2: analyze the kinetics of simple and multistep reactions as well as theories of reaction rates
- CO3: evaluate some properties such as pH, solubility product etc. by using electrochemical cell and understand the working of modern batteries
- CO4: able to understand the mechanism of corrosion and its different controlling measures
- CO5: distinguish the different electromagnetic radiations used for exciting different molecular energy levels in various spectroscopic techniques to evaluate the structure of molecules
- CO6: get an exposure to different methods used for synthesis of nanostructured materials

Topics:

- Chemical Equilibrium and Thermodynamics
- Chemical Kinetics
- Electrochemistry
- Spectroscopy
- Chemistry of Nano Materials

Textbook(s):

1. Engineering Chemistry: Fundamentals and Applications- Shikha Agarwal, Cambridge University Press, 2016

Reference Book(s):

1. Textbook of Engineering Chemistry: Sashi Chawala, Dhanpat Rai and Co, 2016
2. Principles of Physical Chemistry- B.R. Puri, L.R Sharma, M.S. Pathania; 42nd Edition, Vishal Publishing Co.
3. Spectrometric Identification of Organic compounds,7th Edition -Robert M. Silverstein, Fransis , Webster, Dravid j. Kiemle; Jhon Wiley& Sons, INC.
4. Nanostructures &Nanomaterials: Synthesis, Properties and Applications- G. Cao and Y. Wang, World Scientific Pvt. Ltd.; 2nd Edition

HS 1005 Professional Communication

Credit: 2
Category: HSMC
Prerequisite(s): Nil

Course Description:

Professional Communication is more emphasized on enhancing the four LSRW skills like Listening, Speaking, Reading and Writing in order to improve students' professional communication. It is basically designed to enhance speaking skills through pronunciation, stress and tone. This course is prepared to improve reading skills through reading, comprehending and retaining information. This course is basically expected to provide the learner an approach to communicate using all the four skills

Course Outcomes: At the end of the course, the students will be able to:

CO1: understand the communication process and practical implementations in the workplace

CO2: apply verbal and non-verbal modes of communication effectively in practical situations

CO3: apply effective conflict management strategies

CO4: use English grammar correctly and unambiguously in technical writing

CO5: bridge the gap between native language and target language i.e. English

CO6: retain a logical flow while drafting reports and other technical pieces of writing

Topics:

- Communication: Process and Methods of Communication
- Basics of Grammar: Time & Tense, Subject-Verb Agreement, Analogy, Active & Passive Voice, Error Detection in Sentences
- Writing Skills: Paragraph Writing-Techniques & Skills, Use of Punctuation, Business Letter-Enquiry, Claim/ Complaint, Order
- Basic Sounds of English: Hearing & Listening, Introduction to Basic Sounds of IPA, Problem Sounds & MTI

Textbook(s):

1. Technical Communication Principles & Practices. Meenakshi Raman and Sangeeta Sharma OUP. Second Edition-2011

Reference Book(s):

1. A Communicative English Grammar. Geoffrey Leech and Jan Svartvik. Third Edition. Routledge Publication. New York. 2013.
2. Effective Technical Communication. M Ashraf Rizvi TMH 2005
3. The Oxford Grammar (English) Sidney Greenbaum, Oxford University Press India. 1st Edition. 2005
4. Verbal Ability and Reading Comprehension for the CAT. Arun Sharma and Meenakshi Upadhyay, TMH, New Delhi, 2007
5. Better English Pronunciation, Cambridge University Press, J D O'Connor, 2nd Edition (Paper Back) 2013

LS 1001 Biology

Credit: 2
Category: BSC
Prerequisite(s): Nil

Course Description:

Biology is important to everyday life because it allows humans to better understand their bodies, their resources and the potential threats existing in the environment. The engineering undergraduates need to be suitably exposed to the biological mechanisms of living organisms from the perspective of engineers. In addition, the course is expected to encourage engineering students to think about solving biological problems with engineering tools.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: comprehend the typical characteristics which distinguish life forms and analyze life process at cellular level
- CO2: apply concepts on structure and function of simple biomolecules in life processes
- CO3: comprehend different biological process involved in life and to analyze their effect
- CO4: understand different biological phenomenon and then relate it with engineering application domains
- CO5: comprehend different physiological functions and then relate it to computer based techniques
- CO6: understand biology and its relevance to engineering and technology

Topics:

- The Cellular organization of a living Organism
- The molecular and biochemical basis of an organism
- Enzymes, photosynthesis, metabolism and bioenergetics
- Molecular machines, biosensor and bioremediation
- Nervous system, immune system and cell signaling

Textbook(s):

1. Biology for Engineers. S. Thyagarajan, N. Selvamurugan, M.P Rajesh, R.A Nazeer, Richard W. Thilagarajan, S. Bharathi, M.K. Jaganathan. McGraw Hill Education (India) Ed., 2012

Reference Book(s):

1. Biology (Indian Edition), P.H. Raven and G.B. Johnson. McGraw Hill Education (India) Private Limited.
2. Concepts of Biology, Eldon D. Enger, Feederick C, Ross and David B. Bailey. TMH Publications.
3. Biology. Neil A. Campbell and Jane B. Recee, Pearson Education.
4. Biology Concepts and Application, Cecie Starr, Thomson Books.

CS 1093 Computer Programming Laboratory

Credit: 4
Category: ESLC
Prerequisite(s): Nil

Course Description:

The course aims to provide exposure to problem-solving through programming. It aims to train the student to the basic concepts of the C-programming language. This course involves lab component which is designed to give the student hands-on experience with the concepts.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: have fundamental knowledge on basics of computers hardware and number systems with concept on basics commands in Linux
- CO2: write, compile and debug programs in C language
- CO3: design programs involving decision structures, loops, and functions
- CO4: understand the dynamics of memory by the use of pointers
- CO5: use different data structures and create/update basic data files

Topics:

- Basic linux commands
- Operators and Expressions
- Branching statements (if-else, switch).
- Control statements (looping - for, while, do-while).
- Arrays
- Character Arrays (strings).
- Functions.
- Pointers and Dynamic Memory Allocation.
- Structures and Unions
- File Handling

CH 1097 Chemistry Laboratory

Credit: 1.5
Category: BSLC
Prerequisite(s): Nil

Course Description:

The Chemistry laboratory course is designed to develop basic concepts of quantitative analysis by using volumetric as well as instrumental methods. It includes classical titrations to estimate hardness, alkalinity, dissolved oxygen, ferrous ion content, chloride content in water/solution samples. It also gives hands on training to use advanced titration techniques such as potentiometric, pH metric and conductometric titrations which can be used with turbid and colored solutions in incredibly low concentrations. The course also gives an exposure to extensive use of UV-Vis spectroscopy for estimation of different ions in solution phase.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: understand the significance of quantitative chemical analysis
- CO2: prepare solutions of different concentrations and do their standardization
- CO3: get an exposure to different instrumental techniques such as Conductometry, pH-metry, Potentiometry and Colorimetry
- CO4: evaluate the rate constant of pseudo first order reactions
- CO5: analyse basic water quality parameters like hardness, dissolved oxygen, alkalinity, ferrous iron contents
- CO6: rationalize chemical handling and chemical safety in an advanced modern laboratory

Topics:

- Hardness of water sample
- Alkalinity of water
- Estimation of Fe^{2+} iron
- Dissolved Oxygen
- Potentiometric Titration
- Kinetics of Ester Hydrolysis
- Chloride Estimation
- pH metric Titration
- Conductometric Titration
- Concentration of KMnO_4 by Visible spectroscopy

HS 1085 Language Laboratory

Credit: 1
Category: HSMC
Prerequisite(s): Nil

Course Description:

Language Lab is more practical oriented which is designed with an objective to make the learner practice the skills which he/she has learnt in the theory I.e Listening, Speaking, Reading and Writing in order to improve their communication skills. It is basically designed to engage the students to learn to perform group activity or an individual activity. This course is prepared to improve the listening reading, speaking and writing skills . It is expected to orient the students with vocabulary, analogy, sentence completion and sentence correction.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: use English grammar correctly and unambiguously in technical writing
- CO2: apply verbal and non-verbal modes of communication effectively in practical situations
- CO3: have a basic understanding of the communication process and to know the practical implementations in the workplace
- CO4: retain a logical flow while drafting reports and other technical pieces of writing
- CO5: develop competence in reading and comprehension
- CO6: be familiar with English pronunciation and use neutral accent successfully

Topics:

- Reading & Comprehension
- Skit/ Role-Play Practice
- Listening Comprehension
- Time & Tense
- Business Letter
- Business Report
- Subject-Verb Agreement
- Visual Elements in Writing:
- Gadget-Supported Textual Formatting
- Attendance + Lab Record Checking
- Viva Voce

CE 1083 Engineering Graphics

Credit: 2
Category: ESLC
Prerequisite(s): Nil

Course Description:

The course of Engineering Graphics comprises of basics of drafting, projection of points & lines, line inclined to both the planes, projection of planes, Computer Aided Drafting, projection of solids and development of surfaces.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: use common drafting tools properly
- CO2: select, construct and interpret appropriate drawing scale as per the situation
- CO3: draw orthographic projections of points, lines and planes
- CO4: draw orthographic projection of solids like cylinders, cones, prisms and pyramids including sections
- CO5: develop the sections of solids for practical situations
- CO6: communicate ideas effectively using Computer Aided Drafting

Topics:

- Introduction to Engineering graphics
- Lettering
- Projection of points & lines
- Line inclined to both the planes
- Projection of planes
- Introduction to Computer Aided Drafting
- Projection of solids
- Section of solids
- Development of surface

Textbook(s):

1. Engineering Drawing + AutoCAD by K. Venugopal, New Age Publishers, 1st edition, 2011

Reference Book(s):

2. Engineering Drawing with an Introduction to AutoCAD by S. N. Lal, Cengage India Private Limited, 1st edition, 2017

COURSES OF THE PROGRAMME

EC 2005 Semiconductor Devices

Credit: 3

Category: PCC

Prerequisite(s): Analog Electronics Circuit (EC 1004)

Course Description:

This course will give the fundamental concepts of electronics devices that are backbone of all electronics circuits. In this course students will be able to understand the basic semiconductor device physics and how the concepts are used in PN junction, metal semiconductor contacts, BJT, MOSFET, Optoelectronics devices. The course will give in-depth knowledge about the operating principle of the devices with characteristics and how these are related to modern technologies. This course will also help the students to explore various other domains of electronics like VLSI design, Digital electronics etc.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: understand and explain the fundamental semiconductor physics concepts like Fermi level, carrier concentration etc. and analyze them to solve different problems
- CO2: analyze and explain different conduction techniques in semiconductor materials and solve relevant problems
- CO3: comprehend and analyze the operation of different diodes, metal semiconductor contacts and solve different diode problems
- CO4: explain the operation and solve problems associated with of BJT
- CO5: analyze and explain the operation of MOS Transistors and solve relevant problems
- CO6: comprehend and analyze operating principle of different optoelectronic devices and their applications

Topics:

- Energy bands & Current Carriers in Semiconductors
- P-N Junction
- BJT (Bipolar Junction Transistor)
- Metal-Oxide Field Effect Transistor (MOSFET)
- Optoelectronics devices

Textbook(s):

1. Solid State Electronic Devices: Streetman & Banerjee, 7th Edition, Pearson.

Reference Book(s):

1. Semiconductor Devices: Basic Principles, Jasprit Singh John Wiley & Sons,2000
2. Integrated Electronics: Analog And Digital Circuit Systems, Jacob Millman, Christos Halkias, Chetan D Parikh, 2nd Edition, TMH 2010.
3. Semiconductor Physics And Devices: Donald Neaman and Drubesh Biswas,2012, 4th Edition, TMH 2012.

EC 2011 Digital Electronics

Credit: 3
Category: PCC
Prerequisite(s): Nil

Course Description:

This course covers all basic concepts in digital systems. The course starts with fundamentals of Boolean Algebra-different number systems and inter-conversions, binary codes and K-maps. This will be followed by designing of various combinational circuits such as adders, subtractors, decoders, encoders, magnitude comparators, multiplexer and de-multiplexers. Detail concept about memory elements (flip-flops) will be provided that will help the students to learn about various design techniques of sequential circuits like shift registers, counters and FSMs. Fundamentals of digital logic families, ADC and DAC will also be covered that will help the students to learn digital electronics principles comprehensively in today's perspective.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: comprehend, simplify and realize Boolean expression
- CO2: comprehend and analyze combinational circuits using logic gates
- CO3: design various asynchronous & synchronous sequential circuits using Flip-Flops
- CO4: design & implement Mealy and Moore model FSMs for different synchronous sequential circuits
- CO5: analyze and differentiate between different logic families such as TTL & CMOS chips
- CO6: comprehend and analyze the concept of different types of Analog-to-Digital converters and Digital-to-Analog converters

Topics:

- Introduction to Boolean Algebra
- Combinational Circuits
- Sequential Logic
- Finite State Machine (FSM)
- Logic Families
- A/D and D/A

Textbook(s):

1. Fundamentals of Digital Logic – Anand Kumar - PHI, 2nd Edition, 2011
2. Digital Logic and Computer Design – M. Morris Mano – PHI, 2011

Reference Book(s):

1. Digital Principles and Applications – Malvino & Leach – TMH, 7th edition, 2011
2. Digital Fundamentals – T. L. Floyd & Jain – Pearson Education, 10th edition, 2011

EC 2012 Analog Communication Techniques

Credit: 3
Category: PCC
Prerequisite(s): Signals and Networks (EC 2021)

Course Description:

This course is offered to 4th semester Electronics and Telecommunication Engineering students. This course provides an adequate knowledge on various analog communication techniques such as amplitude modulation, angle modulation with their spectral characteristics. A conceptual understanding of sampling concept with different analog pulse modulation schemes along with TDM and FDM techniques are also covered in this course. The performance of various analog communication systems in the presence of noise is also analyzed. Moreover this course help the students to perform communication Engineering laboratory and provides a base to understand higher communication based subjects.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: comprehend the basic concept of signals and system, analyze Hilbert Transform, pre-envelope, complex envelope for the representation of band pass signal and its canonical form
- CO2: explain the time and frequency domain analysis of various amplitude modulation schemes with their modulation and demodulation process as well as understanding the concept of super-heterodyne receiver
- CO3: comprehend and analyze the concept of frequency and phase modulation with their spectral characteristics as well as modulation and demodulation processes
- CO4: explain and analyze the process of sampling, sampling techniques with different pulse modulation schemes as well as differentiate between TDM and FDM techniques
- CO5: analyze the noise performance of different analog modulation schemes by evaluating signal power to noise power ratio (SNR)
- CO6: design based problem solving for analog communication system considering different parameters like modulation index, transmitted power, band width and required SNR

Topics:

- Introduction to communication system, concept of Hilbert transform, pre envelope, complex envelope and canonical form of band pass signal representation
- Generation and detection of various amplitude Modulation schemes such as DSB-FC, DSB-SC, SSB-SC, VSB-SC
- Time and frequency domain representation, power calculations of various amplitude modulation techniques, concept of super heterodyne receiver
- Concept of frequency and phase modulation, generation of FM such as direct and indirect method
- FM demodulation using slope detector and Phase locked loop, Concept of pre-emphasis and de-emphasis
- Sampling theorem statement and proof, Various sampling techniques
- Modulation and demodulation of PAM, PWM and PPM, concept of TDM
- Different sources of noise, effect of noise through different filters such as low pass, band pass
- SNR calculation of DSB-SC, SSB-SC, VSB-SC, FM and their comparison

Textbook(s):

1. Modern Digital and Analog Communications Systems, B.P. Lathi, Oxford University Press
2. Communication System, Simon Haykin - John Wiley

Reference Book(s):

1. Principles of Communication System, H. Taub & D.L.Schilling – TMH
2. Analog & Digital Communication, T. L. Singhal - TMH

EC 2014 Electromagnetic Theory

Credit: 3
Category: PCC
Prerequisite(s): Mathematics-II (MA 1004)

Course Description:

The course provides a basic understanding of electrostatics and magnetostatics using the already known knowledge of vector calculus. This course will also cover different aspects of time varying fields and provide insight to Maxwell's equations. Concepts on the propagation of the EM waves in different media and under boundary conditions will lead to the understanding of transmission line behaviour and impedance matching circuits.

Course Outcomes: At the end of the course, the students will be able to :

- CO1: apply the appropriate coordinate system for a particular vector based problem, and the laws of vector calculus
- CO2: analyze and solve numerical problems involving static charges
- CO3: analyze and solve numerical problems involving constant currents
- CO4: analyze and apply Maxwell's equations for electromagnetism
- CO5: analyze and apply wave behavior during its propagation through multiple media in presence of different boundary conditions
- CO6: design transmission line sections (Length propagation constant and characteristic impedance) along with feeding mechanism for realizing impedance matched conditions

Topics:

- Orthogonal coordinate systems
- Static electric and Static magnetic fields
- Time varying fields and Maxwell's equations
- Plane Electromagnetic waves
- Transmission Lines

Textbook(s):

1. Elements of Electromagnetics (Fourth Edition) by Matthew N.O Sadiku, Oxford University Press, 2009.
2. Field and Wave Electromagnetics (Second Edition) By David K. Cheng, Pearson Education, 1989.

Reference Book(s):

1. Engineering Electromagnetics (Seventh Edition) by William H. Hayt, Jr and John A. Buck, Tata McGraw- Hill Publishing Company Limited, New Delhi, 2007.
2. Electromagnetic Waves and Radiating Systems by Edward C. Jordan and Keith G. Balmain, Prentice Hall of India, New Delhi, 2nd Edition.

Credit: 4

Category: PCC

Prerequisite(s): Basic Electrical Engineering (EE 1003)

Course Description:

This course is designed to impart essential background of electronics devices and its associated circuits by incorporating various important topics like semiconductor, junction diodes, transistors & its biasing circuits, small signal analysis of transistors, and their frequency response, feedback and oscillator circuits and power amplifiers. This course prepares the students to analyze analog electronics circuit and empower them to understand the design and working of amplifiers and oscillators. This course will also help students to understand basic concepts of communication systems, VLSI design, Internet of Things etc.

Course Outcomes: At the end of the course, the students will be able to:

CO1: comprehend the concept of semiconductors, diodes and analyze different diode circuits

CO2: analyze and explain the operation of BJT and FET and solve different biasing circuits

CO3: analyze and solve different performance metrics of BJT and FET amplifier circuits with the help of their small signal model

CO4: explain and analyze the performance of amplifier using frequency response and step response method

CO5: analyze and solve different negative feedback topology/circuits and sinusoidal oscillators

CO6: explain and design different power amplifier circuits using BJT

Topics:

- Semiconductor
- PN junction
- Transistors
- Transistor biasing circuits
- Small signal analysis of transistor amplifiers
- Frequency response of transistor amplifiers
- Feedback and oscillator circuits
- Power amplifiers

Textbook(s) :

1. Electronic Devices & Circuits- D. A. Bell- Oxford , 5th edition
2. Integrated Electronics – J. Millman, Halkias & Parikh – MGH , 2nd edition

Reference Book(s):

1. Electronics Devices and Circuits – Robert L. Boylestad and Lewis Nashelsky – Pearson,10th edition

EC 2020 Microprocessors, Microcontrollers & Interfacing

Credit: 4

Category: PCC

Prerequisite(s): Digital Electronics (EC 2011)

Course Description:

The objective of this course is to teach the fundamentals of Microprocessor (like 8085, 8086) and Microcontroller (like 8051) systems to the students. In this course, the students learn about assembly language to program the Microprocessors, Microcontrollers and develop programs to solve simple applications.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: comprehend the basic concept of Bus structure, a basic 8-bit Microprocessor (like 8085) system, its architecture, concept of stack, Addressing modes etc.
- CO2: explain the architecture of a 16-bit Microprocessor like 8086 including the concept of instruction queue, segmented memory structure and address generation
- CO3: explain and analyze the Addressing modes, Assembly language instructions of 8086 and implement them to solve 8086 related design problems
- CO4: design Memory Interfacing using memory chips with proper decoder circuits with a 16-bit processor and analyze the interrupt structure of 8086 Microprocessor
- CO5: explain the features of the peripherals such as PPI, Programmable interrupt control, USART and their interfacing with a 16-bit processor
- CO6: explain and analyze memory organization of a 8-bit Microcontroller (like 8051), its addressing modes, instructions, timers & counters and its serial communication

Topics:

- 8085 (8-bit Microprocessor)
- 8086 (16-bit Microprocessor)
- Interfacing Chips
- 8051 Family of Microcontrollers

Textbook(s):

1. Microprocessors and Interfacing, Programming & Hardware - Douglas V. Hall, McGraw Hill Education Pvt Ltd., 3rd edition.

Reference Book(s):

1. Microprocessor Architecture, Programming and Applications with the 8085 - Ramesh S. Goankar, Penram International Publishing (India).
2. Microprocessors & Microcomputer based System Design - Md. Rafiquzzaman, 2nd edition.
3. Microcontroller Theory & Applications - Deshmukh, McGraw Hill Education Pvt Ltd.

Credit: 3
Category: PCC
Prerequisite(s): Mathematics-II (MA 1004)

Course Description:

This course is designed to establish a strong foundation for communication and signal processing. It will enable students to classify various analog and discrete time signals and visualize the signals after various operations. The course will enable the students to represent various signals in terms of singularity functions and find relationships between signals. It will provide the knowledge of various classifications of systems as well as time and frequency domain analysis of signals and systems using in-depth knowledge of Fourier and Laplace transforms. It will provide the knowledge of linear circuit analysis using Laplace transform to find dynamic and steady state responses. It is designed to provide the concepts of fundamental network theorems and network parameters to analyze linear electrical circuits.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: understand and classify various continuous and discrete signals, understand sampling process and visualize signals after various operations
- CO2: classify and analyze system characteristics and determine output of LTI system in time domain
- CO3: analyze continuous time signals and systems in frequency domain using continuous time Fourier series and continuous time Fourier transform
- CO4: determine the Laplace Transform of various signals and analyze analog systems characteristics using Laplace transform and its properties
- CO5: analyze RLC circuits for AC/DC excitation using Laplace transform
- CO6: analyze and apply network theorems and network parameters to various electrical circuits

Topics:

- Introduction to signal classification and operation and sampling process
- Introduction to system classification and time domain analysis of systems
- Analysis of signals and systems in frequency domain using Fourier analysis
- Analysis of signals and system using Laplace transform
- Linear circuit analysis using Laplace transforms
- Network theorems and network parameters and their applications for analyzing linear circuits

Textbook(s):

1. Signals and Systems by Alan V. Oppenheim, Alan S. Willsky, PHI , edition
2. Circuit Theory, Analysis and Synthesis A, Chakrabarti, Dhanpat Rai Publishing Company (P) Limited 5th edition, 2008.

Reference Book(s):

1. Signals & Systems – P. Ramesh Babu –Scitec,4th edition
2. Network Analysis 3rd edition, by M. E. Van Valkenburg, Pearson Education, 2006

EC 2022 Electromagnetic Waves and Antennas

Credit: 4

Category: PCC

Prerequisite(s): Physics (PH 1007)

Course Description:

Electromagnetic Waves and Antennas covers the basic principles of static fields and time varying fields and understanding those in the form of Maxwell's equations. This course highlights the characteristics of wave propagation in different media and thereby extending it in transmission lines and antennas. This course also emphasizes on design aspects of transmission line components and antennas.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: comprehend and apply the concept of different coordinate systems and vector calculus in solving numerical problems
- CO2: explain and apply concepts of electrostatics and magnetostatics in different contexts and numerical problems
- CO3: comprehend, analyze and apply concepts of time varying electromagnetic fields and Maxwell's equations in different contexts and numerical problems
- CO4: explain and analyze the concepts associated with wave propagation, polarization and power flow; analysis of wave propagation characteristics in different media; transmission and reflection of waves at the boundary of 2 media
- CO5: explain and analyze the transmission line parameters, analysis of lossless lines and design of impedance matching networks
- CO6: comprehend and analyze radiation from antennas, importance of radiation potentials, antenna parameters, and apply concepts associated with working and design of antennas, and its arrays

Topics:

- Coordinate Systems
- Static Electric Field
- Static Magnetic Field
- Time Varying Electromagnetic Fields and Maxwell's Equations
- Plane Electromagnetic Waves
- Transmission Lines
- Electromagnetic Radiation and Thin Linear Antennas
- Antenna Parameters
- Antenna Array
- Types of Antennas

Textbook(s):

1. Elements of Electromagnetics (Fourth edition) by M. N.O. Sadiku, Oxford University Press, 2009.

Reference book(s):

1. Antennas for All Applications - J. D. Kraus & R. J. Marhefka, Tata McGraw Hill.
2. Electromagnetic Waves and Radiating Systems by E. C. Jordan and K. G. Balmain, Prentice Hall of India, New Delhi.

Credit: 3
Category: PCC
Prerequisite(s): Electronic Devices and Circuits (EC2019)

Course Description:

This course is designed to impart essential background of analog electronic circuits by incorporating various important topics like linear wave shaping circuits, OPAMP parameters, OPAMP with negative feedback, frequency response of OPAMP, linear IC applications, negative resistance devices. This course prepares the students to perform the analysis of any analog electronics circuit using op amps and linear wave shaping circuits. It includes measurement of op amps parameters and its frequency response along with its various applications of different linear ICs. It also gives a basic idea of negative resistance devices. This course will also help students to explore various other domains of science and technology like communication systems, VLSI design, Internet of Things etc.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: comprehend the fundamentals of linear integrated circuits, negative resistance devices and op-amp
- CO2: demonstrate and analyze the linear wave shaping circuits, negative resistance devices, differential amplifiers, constant current bias, current mirror, level translator; determine the DC and AC parameters of OPAMP
- CO3: solve different linear wave shaping circuits, open loop and closed loop OPAMP circuits and its performance evaluation by frequency response & stability
- CO4: analyze the response of different linear wave shaping circuits, applications of closed loop and open loop OPAMP and performance of negative resistance devices
- CO5: comprehend the concept of regulated power supply, PLL, multi-vibrator with its different applications using IC 555 timer
- CO6: demonstrate the ability to design practical analog circuits that perform the desired operations

Topics:

- Linear Wave Shaping Circuits
- OPAMP and its parameters
- OPAMP with Negative Feedback
- Frequency Response of an OPAMP
- Linear IC Applications
- Negative Resistance devices

Textbook(s):

1. OPAMP & LIC – R. K. Gayakwad – PHI
2. Pulse, Digital and Switching waveforms –J. Millman & H. Taub – TMH

Reference Book(s):

1. LIC – D. Ray Choudhury & Shail Jain (New Age)
2. Pulse Digital Circuit – Anand Kumar - PHI

EC 2025 Principle of Electronics Engineering

Credit: 3
Category: PCC
Prerequisite(s): Nil

Course Description:

The course objective is to make students of Engineering to understand the efficacy of Electronic principles which are pervasive in engineering applications. Students will be able to understand the essence and applications of electronic components used in different electronic circuit. They will understand the working of diode and transistor and their characteristics, benefits of feedback in amplifier, oscillators, design of simple circuits like amplifiers (inverting and non- inverting), adders, integrator and differentiator using OPAMPS, a digital logic and apply it to solve real life problems.

Course Outcomes: At the end of course the students will be able to:

- CO1: understand the properties of semiconductors and current conduction mechanisms
- CO2: comprehend the working of P-N junction diodes; identify different diode circuits and analyze them
- CO3: understand the working of BJT, different modes and configuration, identify and analyze their biasing circuits, understanding the working of CE amplifier and its properties
- CO4: analyze the working of op-amp using either inverting or non -inverting configurations, timing circuit, regulated power supply ICs and their applications
- CO5: comprehend the concept of feedback in electronic circuits, types of feedback, their applications
- CO6: comprehend the working of different logic gates, combinational and sequential circuits, develop a brief idea about microprocessor and microcontrollers

Topics:

- Semiconductors
- Junction Diodes
- Bipolar Junction Transistor (BJT)
- Feedback Concept
- Operational Amplifiers (OPAMP) and 555 timer
- Digital Electronics

Textbook(s):

1. Electronics- Fundamentals & Applications- D. Chattopadhyay and P.C Rakshit- 11th Edition (New Age International)
2. Electronic Devices and Circuits- D. A. Bell- 5th Edition (Oxford)

Reference Book(s):

1. Electronic Devices & Circuits- R. L. Boylestad- 10th Edition(Pearson)
2. Digital Principles and Applications- A. Malvino and Leach-7th Edition(TMH)

EC 2090 Microprocessor and Microcontroller Laboratory

Credit: 1

Category: PCLC

Prerequisite(s): Digital Electronics (EC 2011)

Course Description:

This lab is utilized by 4th semester Electronics and Telecommunication Engineering, Electronics and Computer Science Engineering students, 5th semester Electronics and Electrical Engineering and Electronics and Instrumentation Engineering students. Students develop Assembly language programming skills on 8085, 8086 and 8051 kits. Students do their experiments in both hardware and software platforms. They use TALK software and design some Interfacing circuits on bread board like seven segment display to glow decimal digits 0-9 and four-way traffic control circuits and design of LEDs to glow in proper sequence. They also Interface with CRO to display square wave and interface with Digital to Analog Converter to display Triangular and Saw tooth wave forms.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: develop Assembly language programming skills on 8085, 8086 Microprocessor and 8051 Microcontroller trainer kit
- CO2: utilize PCLink communication software for Intel 8085 & 8086 Assembly language programming to execute programs and design practical circuits
- CO3: design practical circuits like 4 way traffic light system, generation of square wave using CRO, interfacing of seven segment display using PPI
- CO4: utilize 86DRV communication software for Intel 8086 Assembly language programming to execute programs and design practical circuits
- CO5: utilize B30DRVVM communication software for 8051 Microcontroller & Assembly language programming to execute programs and design practical circuits
- CO6: formulate, design and solve real life engineering problems for executing projects

Topics:

- Familiarization with 8085 and 8086 Microprocessor Kit and verification of instruction sets
- Execution of sample Assembly language programs on 8085 MP Kit
- Introduction to TALK communication software and execution of Assembly language programs using Cross Assembler
- Design a circuit and write a suitable program to display decimal digits 0 to 9 using 8085 and seven segment display
- Design a four lane Traffic control system using PC, 8085 MP Kit and additional hardware
- Familiarization with 8051 Microcontroller Kit and execution of basic programs using TALK communication software & Cross Assembler
- Generation of a 2 KHz square wave on Port 1.3 (Pin-4) with Timer 0 interrupt, using TALK software and 8051 MC Kit
- Open Ended Experiments

EC 2091 Electronic Circuits & Network Laboratory

Credit: 1.5

Category: PCLC

Prerequisite(s): Basic Electrical Engineering (EE 1003), Basic Electrical Engineering Lab(EE 1093)

Course Description:

This laboratory course is basically designed to impart essential practical knowledge of electronic devices and its associated circuits for 3rd semester undergraduate Electronics Engineering students. Hardware and Simulation experiments here are designed specifically for augmented learning . This will help students to understand and design various electronic circuits such as rectifiers, amplifiers and oscillators using discrete components like BJT/FET which are essential building blocks for any electronic system. Major equipment include function generator, CRO, multi-meter, Variac, voltmeter, ammeter, breadboard trainer kit and software's like Tina-TI, Lab VIEW and NI My DAQ v. 2016.A well-organized systematic procedure is included in each experiment to facilitate the hardware testing and simulation. This course imbibes the students with necessary practical knowledge which will help them in making their minor and major undergraduate projects.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: identify different discrete components, understand the function of Cathode Ray Oscilloscope ,Function Generator & multi-meter and use these equipment for circuit related learning
- CO2: explain and verify basic linear network theorems
- CO3: plot and demonstrate the V-I characteristics of a P-N junction diode and the Zener diode
- CO4: explain and analyze the input and output characteristics of BJT and JFET
- CO5: design and simulate amplifier, oscillator circuits using BJT and JFET
- CO6: formulate, design and implement different types of low frequency amplifiers and oscillator circuits using BJT/JFET to solve the real life engineering problems by executing mini projects

Topics:

- Basic linear network theorems
- P-N junction diode and Zener diode
- Transistors (BJT and JFET)
- CE amplifier and RC-coupled amplifier
- CS amplifier and CD amplifier
- LC and RC oscillators
- Open ended experiments

EC 2092 Analog Integrated Circuits Laboratory

Credit: 1
Category: PCLC

Prerequisite(s): Electronic Devices And Circuit (EC 2019), Electronic Circuits & Networks Lab (EC 2091)

Course Description:

This laboratory course focuses on the practical knowledge of operational amplifier (IC 741), IC555, IC 78XX and its associated circuits for the 4th semester undergraduate Electronics& Telecommunication Engineering students that will help the students to have thorough understanding of their workings. Experiments include hardware type, software simulation based (Tina-TI) and hardware-software interfacing type using Lab View, NI My DAQ and My RIO v. 2016. Students can learn the construction of practical circuits in the software as well as the diagnosis of various faults. At the end of the course, an undergraduate student can built various analog circuits using ICs. This laboratory course imbibes the students with practical knowledge which will help them to make their undergraduate projects and to have industry-ready skills and expertise making them a successful professional in the area of Electronics Engineering.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: explain the RC circuits for different inputs and design the passive differentiator & integrator circuits for circuit related learning
- CO2: explain and analyze the DC and AC parameters of Operational Amplifier
- CO3: design and implement the low-pass and high-pass filters, Wien Bridge oscillator, comparators and Schmitt trigger using op-amp
- CO4: analyze, design and implement the a stable and monostable multivibrators using IC 555 and voltage regulator using IC 78XX
- CO5: design and implement various analog electronic circuits and test them using NI My DAQ and Lab VIEW
- CO6: formulate, design and implement different amplifiers and wave generator circuits using op-amp to solve the real life engineering problems by executing mini projects

Topics:

- RC circuits as differentiator and integrator
- DC and AC parameters of Operational Amplifier .
- Low-pass and high-pass Butterworth filter
- Wien Bridge oscillator
- Comparator Circuit and Schmitt Trigger
- Monostable multivibrator and Astable multivibrator using IC 555 timer
- Regulated power supply using IC 7805
- Open ended experiments

EC 2093 Digital Electronics Laboratory

Credit: 1
Category: PCLC
Prerequisite(s): Nil

Course Description:

This lab is utilized by 3rd semester Electronics and Telecommunication Engineering, Electronics & Computer Science Engineering, Computer Science and System Engineering, Computer Science and Communication Engineering students. In this laboratory Analog to Digital converters, Digital to Analog converters, Lab designer Kits, Cathode Ray Oscilloscopes, Function generators and NI-MyRIO Kits are available . The DEC Lab is containing some Verilog simulation experiments along with the hardware implementation of simple digital circuits. Students do their experiments and open ended experiments in both hardware and software platforms. They use discrete components and Xilinx, PSpice, LabVIEW software to design and simulate the combinational and sequential logic circuits. This lab is also used by B. Tech and M. Tech students for executing projects.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: comprehend the significance of terminology associated with Verilog HDL and the procedure to Simulate and Verify combinational logic circuits in EDA Playground and TinkerCAD
- CO2: simulate and design combinational logic circuits like adder using Logic Gates in association with EDA Playground and TinkerCAD
- CO3: simulate and design combinational logic circuits like decoder using Logic Gates in association with EDA Playground and TinkerCAD.
- CO4: simulate and design combinational logic circuits like Multiplexer using Logic Gates in association with EDA Playground and TinkerCAD
- CO5: simulate and design sequential logic circuits of different Flip-Flops and Flip-Flop conversion in association with EDA Playground and TinkerCAD
- CO6: simulate and design sequential logic circuits like Synchronous type counter , Asynchronous type counters and shift registers using flip-flops in association with EDA Playground and TinkerCAD

Topics:

- Logic Gates
- 2-Line-to-4 line Decoder
- 2X1 Multiplexer
- J-K Flip-Flop and D Flip-flop
- 2-bit Synchronous Up Counter
- 2-bit Asynchronous Up Counter
- Serial In-Parallel Out(SIPO) Shift Register
- Open ended experiments

EC 2094 Communication Engineering Laboratory

Credit: 1.5
Category: PCLC
Prerequisite(s): Nil

Course Description:

This lab is utilized by 5th semester Electronics and Telecommunication Engineering students. In this laboratory students are performing experiments based on hardware, software as well as using Trainer Kit. In hardware some design problems are performed by the students using discrete components on breadboard. MATLAB is used for software simulation where the students after conducting the experiment on trainer kit verifying the same using the said software. In this laboratory adequate no of trainer kits, spectrum analyzer and DSO are available for both analog communications and digital communication based Experiments. Moreover this laboratory is also utilized for M. TECH and Ph. D scholars for their research work.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: understand the principle of different types of Amplitude Modulation(AM) and demodulation.
Also gain knowledge on the principle of Superheterodyne receivers
- CO2: generate Frequency Modulated (FM) signals using IC XR2206 with its principle of operation and apply the FM signal to PLL IC 565 circuit for demodulation process
- CO3: analyze the process of sampling and quantization with different Pulse modulation techniques and Waveform Coding techniques. Also acquire some knowledge on multiplexing scheme
- CO4: explain the operating principles of different digital modulation techniques with respective waveforms representations using Trainer Kit and software platform
- CO5: design and implement the Modulator and Demodulator circuits using discrete components
- CO6: simulate the modulated signals using Matlab programs. Formulate design and real life engineering problems for executing minor projects

Topics:

- Generation and detection of various amplitude Modulation and demodulation schemes
- Generation and detection of frequency modulation and demodulation
- Generation and detection of Pulse Modulation and demodulation
- Time division multiplexing, modulation and demodulation of PCM system
- Delta modulation technique
- Data formating, different Digital Modulation and Demodulation Techniques such as BASK, BPSK, BFSK, QPSK
- Open ended experiments

EC 2098 Simulation Laboratory

Credit: 1

Category: PCLC

Prerequisite(s): Principle of Signals and Systems (EC 2023), Mathematics-II (MA 1004)

Course Description:

This lab uses Matlab and LABVIEW platform to perform various experiments on generation and analysis of various signals and their behavior to solve different industrial and engineering problems.

Course Outcomes: At the end of the course, students will be able to:

- CO1: comprehend the requirement and analyze the different types of signals using mathematical models in MATLAB
- CO2: apply different control structures to find out the parameters of a signal like PSD, Amplitude etc.
- CO3: simulate and find the transfer function for different circuits to observe the system behavior
- CO4: comprehend, analyze and represent digital system design using graphical system methods in LabVIEW
- CO5: explain and analyze and represent a system equation using MATLAB
- CO6: solve different industrial and engineering problems

Topics:

- Basic familiarization to MATLAB Environment
- Control Flow- conditional and case structure, loop structure
- Finding Correlation and autocorrelation, ESD using MATLAB
- Numerical integration and differentiation using MATLAB
- Implementation of system transfer function and finding the damping factor and natural frequency
- Basic introduction to LabVIEW - Conversion of Celsius scale to Fahrenheit and vice-versa
- Control Flow- conditional and case structure, loop structure with graph and chart, File handling using LabVIEW
- Digital system implementation using LabVIEW
- Open Ended Experiments

EC 3005 Digital Communication Techniques

Credit: 4

Category: PCC

Prerequisite(s) Analog Communication Techniques (EC 2012)

Course Description:

This course deals with the fundamentals for all digital communication schemes. It describes the different techniques to convert information in analog domain to digital domain. Also, it includes transmission of more than one digital signal using time division multiplexing technique. It covers almost all digital modulation techniques in binary and M-ary forms. Further it includes optimum receiver and bit error rate evaluation in different digital transmissions. The objective of this course is to present the engineering principles, theories and practices, which are fundamental to the successful design of a digital communication system.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: apply the concepts of random process and various probability density functions, cumulative distribution functions in solving problems associated with noise in communication channel
- CO2: understand various blocks in the digital communication system and advantages and disadvantages of digital communication
- CO3: comprehend and analyze the principle of sampling, quantization and encoding in various waveform coding techniques like PCM, DPCM, DM, ADM and apply their principle for problem solving. Understand digital multiplexing schemes
- CO4: evaluate noise performance of various waveform coding techniques and compare them
- CO5: conduct analysis of the modulated signals like ASK, PSK, FSK, MSK, GMSK, QAM,M-ary modulation schemes using or the normal basis functions and signal space representation
- CO6: analyze and evaluate optimum receivers for different modulation schemes

Topics:

- PCM, Delta modulation and demodulation
- Noise in PCM and DM
- Multiplexing
- Digital modulation & demodulation techniques
- Data transmissions

Textbook(s):

1. Principles of Communication Systems – H. Taub & D.L. Schilling, G. Saha – 4th edition,2013- McGraw Hill

Reference Book(s):

1. Communication System – Simon Haykin, John Willey - 4th edition,2011
2. Modern Analog & Digital Communication System – B. P. Lathi, Oxford University Press- 4th edition, 2011

EC 3007 Digital Signal Processing

Credit: 4

Category: PCC

Prerequisite(s): Principle of Signals and Systems (EC 2023), Signals and Networks (EC 2021)

Course Description:

This course begins with the mathematical concepts behind digital processing. It includes implementation of signal processing techniques used in hardware and software systems. The course covers Discrete time signals and systems, Z transform, DFT, FFT and properties. The concepts of digital filter design, realization of systems, multi-rate signal processing and introduction to adaptive filters with their applications will be discussed.

Course Outcomes: At the end of the course, the students will be able to:

CO1: determine and understand appropriate transformation technique for signal analysis

CO2: analyze the signal and its properties in its frequency domain

CO3: apply Fourier transform techniques in real time applications

CO4: apply the knowledge of analog filters to digital filters, design and realization of digital filter

CO5: design and implement multi-rate systems and filter banks

CO6: explain and apply the adaptive filtering concepts for system identification, channel equalization, noise cancellation and line enhancer

Topics:

- Fundamental of Signals and System & Z-Transform
- Fourier Transforms
- DFT, IDFT and FFT
- Digital filters
- Multi-rate DSP
- Adaptive filters

Textbook(s):

1. Digital Signal Processing – J. G. Proakis & D. G. Manolakes, 4th edition – PHI
2. Digital Signal Processing – T. K. Rawat, Oxford University Press, 1st edition

Reference Book(s):

1. Digital Signal Processing – Oppenheim & Schafer, PHI, 1st edition.
2. Digital Signal Processing – P. Ramesh Babu, Scitech Publication, 4th edition.

EC 3011 VLSI Design

Credit: 3
Category: PCC

Prerequisite(s): Digital Electronics Circuits (EC 2011)

Course Description:

The VLSI design course introduces students to basic theories and techniques of digital VLSI design in CMOS technology, fabrication and layout techniques pertaining to digital integrated circuits domain. The course enables students to analyze and design different VLSI architectures using the fundamental concepts of digital VLSI systems. The domain specific skill sets include deep understanding of CMOS devices and circuits, CMOS design rules, static and dynamic logic structures, interconnect analysis and low power techniques in ultra-deep sub-micron regime.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: understand and explain VLSI design flow, design strategy, role of different methods for chip design and basic fabrication process flow
- CO2: analyze different components of threshold voltage, drain current and scaling strategy
- CO3: evaluate different performance metrics of MOS inverter architecture
- CO4: illustrate the logic design process used for complex combinational circuit and its layout using static CMOS
- CO5: analyze different switch based logic involving pass transistor, complementary pass transistor and transmission gate
- CO6: create different high performance dynamic CMOS logic

Topics:

- VLSI Methodologies
- Unit process in VLSI IC fabrication
- MOSFET Analysis
- CMOS Inverter and its analysis
- Transient characteristics
- CMOS logic design
- CMOS switch-based logic
- Dynamic Logic Circuit

Textbook(s):

1. CMOS digital integrated circuits by Sung –Mo KANG Y. Lebeleci, 4th edition, Mc-Graw Hill publications

Reference Book(s):

1. CMOS Circuit Design, Layout, Simulation R. Jacob baker, Harry W. Li, David E Boyce,4th edition, Wiley publications.

EC 3013 Principles of Digital Signal Processing

Credit: 3
Category: PEC
Prerequisite(s): Mathematics-II (MA 1004)

Course Description:

This course begins with the mathematical concepts behind digital processing. It includes implementation of signal processing techniques used in hardware and software systems. The course covers Discrete time signals and systems, Z transform, DFT, FFT and properties. Techniques to design FIR and IIR filters are discussed.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: comprehend the significance of terminology associated with various components of a digital system
- CO2: analyze the different types of digital systems and linear convolution
- CO3: analyze and apply the discrete Fourier transform (DFT)
- CO4: solve Z-transform and apply it for discrete signals
- CO5: analyze and apply the sectional convolutional methods
- CO6: design digital filters using different techniques

Topics:

- Difference between analog and digital signals
- Types of digital systems
- Linear time invariant system
- Linear convolution
- Discrete Fourier transform (DFT) and its calculation
- Properties of DFT
- Circulation convolution and its significance
- Sectional convolution using overlap-add and overlap save methods
- Fast Fourier transform (FFT) algorithm for fast computation of DFT
- z-transform of digital signals and its applications
- Design of digital filters

Textbook(s):

1. Digital Signal Processing by T. K. Rawat, Oxford Publication 1 st Edition
2. Principle of Signal Processing and Linear System: B.P.Lathi, First Edition, Oxford University Press

Reference Book(s):

1. Digital Signal Processing – J.G.Proakis and D.G.Manolakis , 4th Edition-PHI
2. Signals & Systems: Alan V. Oppenheim & Schafer-2nd Edition 2011 Pearson
3. Digital Signal Processing: P. Ramesh Babu: Scitech,2nd Edition

EC 3015 Microwave Engineering

Credit: 3

Category: PCC

Prerequisite(s): Electromagnetic Waves and Antennas (EC 2022)

Course Description:

The course is intended to describe the principles of operations and design aspects of microwave sources, devices and components. Course includes the propagation characteristics and design parameters of rectangular waveguide, circular waveguide and cavity resonator. Microwave amplifiers and sources like, Klystron amplifier, travelling wave tubes, Reflex Klystron, Magnetron oscillator, backward wave oscillator are part of this course. The operations of microwave solid state devices, like, Gunn diode, Gunn oscillator, PIN diode, READ diode, IMPATT diode and microwave components are described in the course. Different types of microwave measurement techniques are included in the course.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: explain propagation characteristics and design parameters of rectangular waveguide, circular waveguide and cavity resonator
- CO2: comprehend the limitations of conventional vacuum tubes at microwave frequencies
- CO3: analyze the design aspects of Klystron amplifier and Reflex Klystron oscillators, and slow wave structures
- CO4: explain and Analyze the operations of microwave solid state devices, like, Gunn diode, Gunn oscillator, PIN diode, READ diode, IMPATT diode
- CO5: explain the principles of operation and design aspects of various types of microwave components
- CO6: perform power measurements, frequency and impedance measurements, gain and radiation pattern measurement of antennas

Topics:

- Waveguide and Cavity Resonator
- Microwave Vacuum Type Amplifiers and Sources
- Microwave Solid State Devices & Sources
- Microwave Components
- Microwave Measurements

Textbook(s):

1. Microwave Devices & Circuits. S. Y. Liao, PEA Publication, 2009

Reference book(s):

1. Electromagnetic Waves and Radiating Systems by E. C. Jordan and K. G. Balmain, Prentice Hall of India, New Delhi.
2. Microwaves: Introduction to Circuits, Devices & Antennas. M. L. Sisodia and V. L. Gupta, New Age Publication, 2012.

EC 3021 Neural Networks and Machine Learning

Credit: 3
Category: PEC

Prerequisite(s): Mathematics-I (MA 1003) and Mathematics-II (MA 1004)

Course Description:

This course will cover the history of neural networks, study the fundamental structures and state-of-the-art approaches to machine learning. The course will focus on theory and practice of these models, how they are trained and validated, and how they can be deployed in practice. Students will learn to design neural network architectures and training procedures via hands-on assignments. Students will learn how to use neural networks and machine learning algorithms for identifying, classifying and solving different problems related to pattern recognition, function approximation, data visualization etc.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: understand the context of neural networks and develop broad overview of learning strategies
- CO2: explain the fundamental neural network models, their learning strategies and apply them for modeling problems
- CO3: analyze multi-layer feed forward neural networks, recurrent neural networks, radial basis functions and employ them for different applications
- CO4: comprehend the concepts, architecture, training and testing algorithms of associative memory networks and Hopfield networks and apply them to evaluate practical problems
- CO5: develop a comprehensive idea on unsupervised learning networks and advanced neural networks
- CO6: explain the motivation for architectures and models and select the appropriate architecture for a given problem

Topics:

- Artificial neural network architecture
- Applications of neural networks
- Associative memory networks
- Unsupervised learning networks and advanced networks

Textbook(s):

1. Principles of Soft Computing by S. N. Sivanandam and S. N. Deepa - Wiley

Reference Book(s):

1. Neuro-fuzzy and soft computing by J. S. R. Jang, C. T. Sun and E. Mizutani - PHI Publications
2. Neural networks and learning machines by Simon Haykin - Parson, Prentice Hall

EC 3023 Optimization Techniques in Engineering

Credit: 3

Category: PEC

Prerequisite(s): Mathematics-I (MA 1003) and Mathematics-II (MA 1004)

Course Description:

The objective of this course is to give exposure about the different optimization problems and related algorithms to the students. In this course, the students learn about single and multiple variable constrained optimization algorithms. The course includes formulation of optimal problems for real time applications, simple codes for implementing the same and demonstrates convergence with optimal results.

Course Outcomes: At the end of the course, the students will be able to:

CO1: comprehend the need for optimization, formulate fitness/cost functions for simple problems and identify constraints involved (if any)

CO2: analyze the concepts behind single variable optimization algorithms

CO3: apply gradient based optimization algorithms for problem solving

CO4: comprehend the importance of multivariable optimization, different multi-variable optimization techniques and concept of Pareto-front

CO5: analyze the different techniques for constrained optimization algorithms and their applications

CO6: analyze and apply the algorithms for different nature inspired optimization algorithms

Topics:

- Optimal problem formulation, Design variables constraints, Objective function, Variable bounds,
- Engineering optimization problems, Optimization algorithms
- Single-variable Optimization Algorithm
- Gradient-based Methods
- Multivariable Optimization Algorithm
- Constrained Optimization Algorithm
- Advanced Optimization Algorithms

Textbook(s):

1. Optimization for Engineering Design-Algorithms & Examples – K. Deb, PHI, 2nd edition, 2012.
2. Multi-objective Optimization Using Evolutionary Algorithms-K. Deb, John Wiley & Sons, 1st edition, 2001.

Reference Book(s):

1. Optimization: Theory and Applications - S.S. Rao, Wiley Eastern Ltd, 2nd edition, 1979.

EC 3028 Data Communication & Networking

Credit: 3
Category: PCC

Prerequisite(s): Analog Communication Techniques (EC 2012), Digital Communication Technique (EC 3005), Communication Engineering (EC 2016), Introduction to communication Engineering (EC 3044)

Course Description:

Data Communication & Networking course deals with down-to-top approach to TCP/IP protocol stack, OSI layered architecture for packet switched data networks and the TCP/IP stack implements by focusing in details from Physical, Data-Link, Network, Transport, and Quality of Service (QoS) parameters. This course covers different key concepts of networking like physical media dependant layer, MAC, Flow Control, Error Control, IP addressing, Sub-netting, IPv4/ IPv6, Routing, DHCP, ARP, ICMP, NAT, TCP/UDP and QoS.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: analyze, compare and contrast OSI layered Architecture and TCP/IP protocol stack
- CO2: analyze different techniques and algorithms implemented in Logical Link Control (LLC) Media Access Control (MAC) sub-layers associated with data-link layer
- CO3: explain design scenario-specific datagram networks based on IPv4 and IPv6
- CO4: investigate various protocols associated with TCP/IP stack
- CO5: investigate connection-oriented (TCP) and connection-less (UDP) protocols in transport layers to comprehend design features and functionalities
- CO6: analyze data communication networks to differentiate various Quality of Service (QoS) approach

Topics:

- Packet switched network
- OSI Layered Architecture, TCP/IP protocol stack implementation
- Services of Physical Layer, Data-Link Layer
- Error detection and correction techniques, Framing, High level Data-Link Control (HDLC)
- Multiple Access Control (MAC) protocols, Link-Layer Addressing, ARP
- Ethernet IEEE 802.3 Standards Frame format, GIGABIT Ethernet, wireless LAN IEEE 802.11 Architecture, Network Layer
- IPv4 & IPv6 protocol, IPv4 Addressing, Sub-netting, Super-netting, IPv6 Addressing
- Routing Algorithms and protocols, DHCP, ICMP, NAT
- Transport Layer Services, TCP, UDP, QoS

Textbook(s):

1. Data Communications and Networking, B A Forouzan, McGraw-Hill, 4th Edition, 2011.
2. Computer Networking – A top-down approach featuring the Internet, James F. Kurose and Keith W. Ross, 2nd Edition, Pearson Education, Asia, 2004.

Reference Book(s):

1. Internetworking with TCP-IP: Principles, Protocols and Architecture, D. E. Comer, Vol I, 2nd Edition, Prentice Hall, 1991.
2. Data and Computer Communications, William Stalling, 10th edition, Prentice Hall, 2013.
3. Communication Networking – An analytical Approach, Anurag Kumar, D Manjunath and JoyKuri, Morgan Kaufmann, 2004

EC 3029 Optical Communication and Networking

Credit: 3
Category: PEC

Prerequisite(s): Communication Engineering (EC 2016), Introduction to communication Engineering (EC 3044), Analog Communication Technique (EC 2012), Digital communication techniques (EC 3005)

Course Description:

The course intend to introduce the students to light signal propagation through optical fiber, various optical fiber modes, configurations and various signal degradation factors associated with optical fiber and to study about various optical sources and optical detectors and their use in the optical communication system. This course provides a basic understanding of various measurement techniques used for optical communication system. The optical networking system is also explained with the concept of fiber optic network components, variety of networking aspects, topologies, FDDI, SONET/SDH and operational principles WDM.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: comprehend the significance of terminology associated with optical communication, analyze the principle of light propagation through optical fiber with concept of modes and solve problems on this concept
- CO2: analyze various types of losses and dispersions in optical fiber and solve related problems associated with the concept
- CO3: explain and analyze the structure, principle of operation and the characteristics of optical sources and detectors
- CO4: comprehend and analyze the optical communication system link elements and prepare link budget
- CO5: comprehend various measurement techniques for optical communication system
- CO6: comprehend and analyze the fiber optical network components, variety of networking aspects, FDDI, SONET/SDH and operational principles WDM

Topics:

- Transmission characteristics of optical fibers
- Optical sources and detectors
- Optical Communication System and Measurements
- Optical measurements
- Optical networks

Textbook(s):

1. Fiber Optic Communications, Joseph C. Palais, Pearson Education, 5th Edition 2013
2. Optical Fiber Communication, Gerd Keiser, McGraw Hill, Third Edition, 2000.

Reference Book(s):

1. Optical Fiber Communication, John M. Senior, Pearson Education, Second Edition, 2007.
2. Optical Communication System, J. Gower, Prentice Hall of India, 2001.
3. Optical Networks, Rajiv Rama swami, Elsevier ,Second Edition, , 2004.
4. Optical Communication Network, Viswanath Mukherjee, McGraw Hill Publication, 2000.

EC 3031 ARM and Advanced Processors

Credit: 3

Category: PEC

Prerequisite(s): Microprocessors, Microcontrollers & Interfacing (EC 2020)

Course Description:

The objective of this course is to teach the higher level concepts of Advanced Microprocessors (like 80286, 80386, 80486 and Pentium) and Microcontroller (like ARM) to the students. In this course, the students learn about Multitasking, Virtual memory, Memory management, Paging, TLB, RISC features, Pipelining and Branch Prediction like concepts. They develop skills for writing programs on ARM to solve simple problems as well as some real time applications.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: analyze the concepts implemented in higher level Processors like Multitasking, Virtual Memory, Memory Management etc.
- CO2: analyze the mode of Operation of 80286 like Real Address Mode and Protected Virtual Address Mode, Concept of program in visible registers, Segment Descriptors etc.
- CO3: explain the Mode of Operation of 80386, Segment Descriptors, Privilege level and Protection, Virtual'86 Mode, Paging
- CO4: analyze the RISC features implemented in the design of Pentium Processors, Parallel processing through U&V Pipelines/Superscalar Execution and Branch Prediction Techniques
- CO5: analyze the concept of a 32-bit ARM Processor, its RISC features, Registers, Pipelining and Interrupts
- CO6: analyze the 32-bit ARM instruction set vis-a-vis 16-bit Thumb instructions and its applications

Topics:

- Intel higher level Processors, Concept of Multitasking, Virtual memory & Memory management
- Intel 80286 Microprocessor, Real mode, Protected virtual Address mode, Program Invisible Registers, Segment descriptor, Limitation of 80286
- Intel 80386 & 80486 , 80386 Segment descriptor, Privilege level & protection, Task switching, Virtual 86 mode, Paging, TLB, Enhanced features of 80486
- Pentium Processor: Features of RISC processors & Implementation of RISC features in Pentium, Pipelining, Super scalar execution & Branch prediction
- ARM Microcontroller: Introduction to RISC design philosophy and ARM design, Arm Processor Registers, CPSR, Memory map, Pipelines, Exceptions, Interrupt Vector Table
- ARM Instruction set and Thumb instructions

Textbook(s) :

1. The 8088 and 8086 Microprocessors : Programming, Interfacing, Software, Hardware and Applications by Triebel and Singh-Pearson Education, 4th Edition.

Reference Book(s):

1. Microprocessors & Interfacing, Programming&Hardware by D.V.Hall-TMH-3rd Edition, 2012.
2. The Intel Microprocessors 8086/8088, 80186/80188, 80386, 80486, Pentium and Processor by B.B.Brey-PHI-8th Edition.
3. Microprocessors&MicrocomputerbasedSystemDesign by Md.Rafiquzzaman-UBS-2nd Edition.
4. An Introduction to the Intel Family of Microprocessors by James L. Antonakos-Pearson Education-3rd Edition.

5. ARM Assembly Language Programming &Architecture- M A Mazidi &others - www.MicroDigitalEd.Com.
6. ARM System Developers Guide Design &Optimizing System Software – Andrew N. Sloss &others-Elsevier

EC 3033 Embedded System Design and Application

Credit: 3

Category: PEC

Prerequisite(s): Microprocessor, Microcontrollers and Interfacing (EC2020)

Course Description:

This course covers fundamentals of embedded system hardware and firmware design. Topics such as embedded processor selection, hardware/firmware partitioning, circuit design, circuit layout, circuit debugging, development tools, firmware architecture, firmware design, and firmware debugging will be discussed. The Intel 8051 and PIC18F series microcontroller with instructions will be studied. The course briefly covers ARM processor architecture, instruction set and programming. The course will culminate with a significant design examples using ARM processor.

Course Outcomes: At the end of the course, the students will be able to:

CO1: understand the architecture, programming, and interface requirements of Embedded System Design

CO2: learn to apply assemblers, compilers, simulators and emulators to help with design and verification for ARM processors

CO3: create Interface of Microcontroller to displays, memories, different I/O ports

CO4: analyse and apply ALP / Embedded C code to solve real-time problems like timers, counters, A2D, Motors, etc. using ARM

CO5: understand and explain RTOS and its functionality, different scheduling for real time application

CO6: design closed and open embedded systems with firmware

Topics:

- Embedded system description and design aspects
- Processor and memory selection for embedded system
- Interrupt service and its uses in the embedded system design
- Embedded system design flow
- Embedded system programming concepts
- Brief introduction to 8051 and PIC18F series architecture and its instruction sets
- ARM architecture and its assembly language programming
- Designing hardware interface with ARM using embedded C programming
- Real Time Operating system and its scheduling

Textbook(s):

1. Embedded Systems: Architecture, Programming & Design, Raj Kamal, TMH, 2011
2. ARM Assembly Language: Fundamentals and Techniques by William Hohl, Christopher Hinds, CRC Press, 2nd Edition, 2015.

Reference Book(s):

1. Embedded System Design : A unified Hardware/Software Introduction by Rank Vahid, Wiley Student Edition, Wiley, 2002
2. Arm Assembly Language Programming & Architecture: Volume 1 by Muhammad Ali Mazidi, Sarmad Naimi, SepehrNaimi, Microdigitaled.com, 2nd Edition, 2016

EC 3035 High Speed Digital System Design

Credit: 3

Category: PEC

Prerequisite(s): Digital Electronics (EC 2011)

Course Description:

This course describes the ASIC design flow and FPGA design flow. It also introduces different design methodology such as top-down and bottom-up methodologies. Here, students will learn different coding styles that can be used in Verilog HDL to design and synthesize digital circuits. Also, it is necessary to verify the correctness of the design by applying different input patterns. Therefore, students will also learn testbench writing strategies to verify the correctness of the design. Several examples that include important arithmetic units of digital systems are covered in this course which demonstrate how to design and test the digital circuits using Verilog HDL. In addition, the course discusses the mapping of Verilog HDL to logic gates. It depicts with examples how Verilog HDL constructs are transformed into logic gates and their interconnections. Finally, a brief introduction on how logic-level circuits are converted into transistor-level circuits is illustrated in this course.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: comprehend and analyze the ASIC-based and FPGA-based design flow and VLSI design methodology
- CO2: design digital systems using Hardware Description Language (HDL)
- CO3: develop test cases to simulate and verify the correctness of the design
- CO4: convert Hardware Description Language to a gate-level netlist
- CO5: implement optimized digital circuits using different HDL-based mechanisms
- CO6: design circuits by using knowledge of translating logic circuits to transistor-level circuits

Topics:

- Digital design methodology
- Coding styles of Verilog HDL
- Synthesis of logic circuits
- Mapping of logic circuits to transistor-level circuits
- Case studies for Verilog HDL

Textbook(s):

1. Verilog HDL: A Guide to Digital Design and Synthesis; Samir Palnitkar; 2nd edition, Pearson Education, 2011.

Reference Books (s) :

1. A System Verilog Primer by J. Bhaskar, BS Publication 2013.
2. Advanced Digital Design with the Verilog HDL; Michael D. Ciletti; 2009,1st edition, PHI,2010.
3. Design Through Verilog HDL by T. R. Padmanabhan (Author), B. Bala Tripura Sundari, Wiley Student Edition, Wiley, 2012.

EC 3036 Cellular Communication

Credit: 3
Category: PCC

Prerequisite(s): Analog Communication Techniques (EC 2012), Digital Communication Techniques (EC 3005), Communication Engineering (EC 2016)

Course Description:

Cellular communication includes different types of channel allocation strategies, propagation path loss and fading in cellular environment. The course is intended to learn design aspects of cellular networks and cellular system where cell splitting, power control, cell sectoring and handoff. Equalization and diversity techniques, Multiple access techniques, multicarrier communications and multiple antenna techniques for understanding and design of cellular networks are parts of this course. Applications of most recent cellular communication techniques like, MIMO and Massive MIMO are also included in the course.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: understand and explain the basics of cellular architecture
- CO2: describe basic propagation models and signal degradation in wireless channels
- CO3: design channel equalization and implement diversity techniques used for practical cellular systems
- CO4: distinguish between different types of multiple access schemes and GSM technology
- CO5: evaluate and analyze the multicarrier communication using OFDM technique
- CO6: design multiple antenna systems in cellular network including MIMO and Massive systems

Topics:

- Cellular Communication Principle
- RF Propagation & Multi-path Model
- Equalization and Diversity Techniques
- Multiple Access Techniques
- Multicarrier Communication
- Multiple Antennas and Space-Time Communications

Textbook(s):

1. Wireless Communication Principle & Practice – T. S. Rappaport, 2nd edition, Pearson Education, 2012.
2. Wireless Communication – Andrea Goldsmith – Cambridge Press, 1st Edition, 2005.

Reference Book(s):

1. Wireless communications – A. F. Molisch-Wiley Publication, 2nd Edition 2010
2. Wireless and Cellular Communication –W. C. Y. Lee – McGraw Hill, 3rd Edition, 2006.
3. Mobile Communication – J. Schiller – Pearson Education, 2nd Edition, 2010.
4. Communication Systems – S. Haykin – John Wiley , 4th Edition, 2001.
5. Fundamentals of Wireless Communication – D. Tse & P. Viswanath –Cambridge, 2010.

EC 3044 Introduction to Communication Engineering

Credit: 3
Category: OEC
Prerequisite(s): Nil

Course Description:

The course covers different types of signals and their analysis in time domain and frequency domain, different analog modulation techniques such as Amplitude Modulation (AM), Frequency Modulation (FM) and Phase Modulation (PM). Sampling technique and its application in Pulse Code Modulation (PCM) is discussed. The course further discusses different digital modulation techniques such as Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK) and Phase Shift Keying (PSK), Binary PSK and Quadrature PSK. Data transmission techniques such as frequency division multiplexing, time-division multiplexing and multiple access techniques are covered. Finally fundamentals of several modern communication system viz. satellite communication system, cellular system are explained.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: analyze signals in time domain and frequency domain
- CO2: interpret analog modulation techniques, investigate their limitations, advantages and applications
- CO3: explain sampling theorem and investigate pulse code modulation
- CO4: comprehend digital modulation techniques and multiplexing techniques
- CO5: interpret different types of noise, their sources and investigate their effect on communication systems
- CO6: analyze several modern communication systems

Topics:

- Representation of signals in time and frequency domains
- Understanding of Fourier series and Fourier Transform, Need of modulation and their types
- Amplitude modulation techniques such as AM, DSB-SC, SSB-SC, VSB
- AM modulators and demodulators, Super-heterodyne radio receiver
- Qualitative concepts of different angle modulation techniques such as FM (Narrowband FM and Wideband FM) and PM
- FM modulators and demodulators
- Sampling theorem and Nyquist rate, sampling types, quantization, Pulse code modulation
- Concept of digital modulation (ASK, FSK, PSK, QPSK) probability of error
- Frequency division multiplexing and Time division multiplexing
- Random processes, concept of noise, different types of noises and their sources
- Representation of white noise in frequency domain, concept of signal to noise ratio
- Introduction to satellite communication, wireless and mobile communication

Textbook(s):

1. Principles of Communication System- H. Taub and D.L. Schilling-TMH, 3rd Edition.

Reference Book(s):

1. Introduction to Analog and Digital Communication System-Simon Haykins, Wiley Student Edition 2011-John Wiley.
2. Electronics Communication System by Kennedy and Davis, Tata McGraw-Hill Publishing Company Limited, 4th Edition.

EC 3050 Internet of Things & Applications

Credit: 3

Category: PEC

Prerequisite(s): Microprocessors, Microcontrollers & Interfacing (EC 2020), Principles of Microprocessors and Microcontrollers (EC 3066)

Course Description:

This course is designed to provide essence and applications of Internet of Things and connected devices. This course establishes solution for real-world applications including appropriate modules and instruments. It also describes the IoT industry, the technologies used to create these types of devices, working principles, information storage and the types of distributed networks required to sustain them.

Course Outcomes: At the end of the course, the students will be able to:

CO1: explain different characteristics of IoT and demonstrate the need of appropriate sensors, microprocessor and microcontroller units and communication networks to develop IoT systems

CO2: identify application specific need of suitable sensors and actuators by analyzing the working of various sensors

CO3: design and evaluate application specific IoT prototypes based on Arduino platform by means of hardware interfaces like Digital IO, Analog In, PWM, UART, SPI, I2C and applications using Arduino IDE

CO4: design and evaluate application specific IoT prototypes based on Raspberry Pi Family development boards and develop small scale applications using python in Linux environment

CO5: apply suitable TCP/IP protocols and networking standards for development of IoT projects

CO6: design IoT application based on Client Server Model, HTTP, ThingSpeak, AWS, Cloud MQTT and evaluate the design specifications and requirements from case studies in the context of various IoT applications

Topics:

- Introduction & Overview of IoT.
- Sensors, Actuators & Signal Conditioning.
- Embedded Platforms & Prototyping (Arduino family and relevant topics)
- Advanced Embedded Development Platforms (PI family and relevant topics)
- Data Communication & Networking
- Cloud, Analytics, User interfaces
- IoT Applications and relevant case studies

Textbook(s):

1. "Internet of Things" by Jeeva Jose, 1st Edition-2018, Khanna Publications
2. "Internet of Things: A Hands-On Approach" by Arshdeep Bahga, Vijay Madisetti

Reference Book(s):

1. "Designing the Internet of Things" by Adrian McEwen, Hakim Cassimally, 1st Edition, Wiley Publishers
2. "Getting Started with the Internet of Things" by Cuno Pfister 1st Edition, O'Reilly Media.
3. "IoT: Building Arduino-Based Projects" by Peter Waher, Pradeeka Seneviratne, Brian Russell, Drew Van Duren, 2016 Edition, Packt Publishing Ltd.
4. "Raspberry Pi IoT Projects: Prototyping Experiments for Makers" by John C. Shovic, 2016 Edition,

EC 3056 Speech & Audio Signal Processing

Credit: 3

Category: PEC

Prerequisite(s): Digital Signal Processing (EC 3007), Principle of Digital Signal Processing (EC 3013)

Course Description:

The aim of this subject is to cover fundamental application research areas such as audio and speech signal processing for separation, recognition, transcription, enhancement, coding, synthesis as well as applications to advanced fixed and wireless communication systems. This course begins with preliminaries to digital signal processing and different transformations. Then the course continues to Speech production, Time domain analysis, Frequency domain analysis, LPC analysis, Speech coding, Speech recognition, Speech enhancement. Signal Processing Models of Audio Perception, Psycho-acoustic analysis, Spatial Audio Perception and rendering, Transform coding of digital audio, audio quality analysis are covered. Applications like speaker verification, identification and enhancement of speech quality are discussed.

Course Outcomes: At the end of the course, the students will be able to:

CO1: determine the digital model of speech production

CO2: analyze the spectral characteristics of the speech signal

CO3: distinguish and analyze between different speech coding techniques

CO4: apply various types of algorithms for speech analysis and synthesis

CO5: design different models for speech recognition

CO6: develop to perform speaker verification, identification and enhance the quality of speech signal

Topics:

- Preliminaries of digital Signals processing and different transform techniques
- Digital modelling of speech signal
- Spectral analysis of speech signal
- Speech coding
- Speech transformation
- Speaker verification, identification and enhancement of speech signal

Textbook(s):

1. Lawrence R. Rabiner and Ronald W. Schafer, Theory and Applications of Digital Speech Processing Pearson, 2010.

Reference Book(s):

1. Thomas F. Quatieri , Discrete-time Speech Signal Processing: Principles and Practice, Prentice Hall, Signal Processing Series, 2002.
2. Philipos C. Loizou, Speech Enhancement – Theory and Practice, CRC Press, 2013.

EC 3058 Nanoelectronics

Credit: 3

Category: PEC

Prerequisite(s): Electronics Devices and Circuits (EC 2019), Analog Electronic Circuits (EC 1004)

Course Description:

Nanoelectronics has emerged as a new advanced discipline due to rapid growth in Integrated Circuit (IC) Industry. This course imparts knowledge and understanding of physical background and application of nanoelectronics. To describe electrons at the nanoscale, the course starts with an introduction to the principles of quantum mechanics, including quantization, the wave-particle duality, wave functions and Schrödinger's equation. The course will further discuss different properties of materials and nanostructures, fabrication of nanostructures, nanoelectronic devices including resonant-tunneling devices, transistors, and single-electron transfer devices. The course will also focus on MEMS and NEMS and its applications in Sensors.

Course Outcomes: At the end of the course, the students will be able to:

CO1: understand the basic and advanced concepts of nanoelectronics

CO2: understand and evaluate the use of fundamental science of quantum mechanics in nanoelectronics

CO3: get an idea on nanoelectronics materials and will be able to distinguish from other materials

CO4: analyze the different fabrication and characterization techniques of nanostructure materials

CO5: learn the concepts of few nano electronics devices

CO6: analyze and evaluate the idea of single electron transistors and its further applications

Topics:

- Introduction to Particles and waves
- Nanoelectronics Materials
- Tunnel junction and applications of tunnelling
- Growth, fabrication, and measurement techniques for nanostructures
- Nano structure devices: MEMS AND NEMS
- The Single-Electron Transistor

Textbook(s):

1. Stephen D. Senturia, Microsystem Design, Kluwer Academic Press, 2005
2. Marc Madou, Fundamentals of microfabrication & Nanofabrication, CRC Press, 2011.
3. T. Fukada & W.Mens, Micro Mechanical system Principle & Technology, Elsevier, 1998

Reference Book(s):

1. WR Fahrner, Nano Technology and Nano Electronics – Materials, devices and measurement Techniques, Springer, 2004.

EC 3060 Mobile Communication Engineering

Credit: 3
Category: PEC

Prerequisite(s): Communication Engineering (EC 2016), Introduction to communication Engg.(EC 3044)

Course Description:

The course covers the evolution of mobile communication from first generation to third generation digital communication. The concept of Frequency reuse, handoff, trunking and the interference between mobiles and base stations which are the core of mobile communication for providing service to the subscribers are explained in this course. This course also explains different type of propagation path loss, fading and modulation techniques used in mobile communication, Inter Symbol Interference (ISI) by multipath propagation within time dispersive channel and its mitigation technique by Equalizer. Implementation of different diversity techniques for the compensation of fading is elaborated here. This course also explains various type of multiple access techniques and impacts on capacity for a cellular architecture.

Course Outcomes: At the end of the course, students will be able to:

- CO1: define and explain basic Cellular Architecture, Different propagation models, various modulation schemes, multiple access schemes and GSM technology
- CO2: classify different generation of mobile communications and improvements, different types of Handoff Strategies, different types of System capacity Improvement Techniques , various fading in multipath propagation, Different modulation techniques, various diversity techniques and different type of multiplexing
- CO3: identify different parameters required to improve channel capacity, requirement of Handoff in mobile communication, reasons of Fading, development of transmitter and receiver using different modulation schemes and the requirement of multiplexing
- CO4: analyze improvements in different generation of mobile communications, the reason of considering cellular architecture, generation of ISI (Inter symbol Interference) due to multipath propagation, different modulations e.g. QPSK, Offset QPSK, $\pi/4$ QPSK, MSK, GMSK, QAM and spread spectrum modulation and its properties
- CO5: compare various technologies implemented among different generation of mobile communications
- CO6: solve problems related to different aspects of mobile communication

Topics:

- Mobile Communication Principle
- RF Propagation & Multi-path Model
- Modulation Techniques
- Equalization and Diversity Techniques
- Spread Spectrum modulation
- Multiple Access Techniques

Textbook(s):

1. Wireless Communication – T.S. Rappaport , Pearson Education, 2nd edition, 2012
2. Wireless Communication – Andrea Goldsmith, Cambridge Press, 1st edition, 2005

Reference Book(s):

1. Wireless and Cellular Communication – C. Y. Lee, McGraw Hill, 3rd edition, 2006
2. Mobile Communication – Schillar, Pearson Education, 2nd edition, 2010
3. Wireless Communication-Tse and Viswanath, Cambridge Press, 2010

EC 3062 Smart Antennas

Credit: 3

Category: PEC

Prerequisite(s) Electromagnetic Waves and Antennas (EC 2022)

Course Description:

The course is intended to describe the design principles of Smart antenna used in cellular communication. The course starts with the descriptions and design aspects of different types of antenna arrays and adaptive processing of signal. For a large antenna array used in Smart antenna system the mutual coupling effect is important which is analyzed in this course considering jamming effect. The compensation methods of mutual coupling during antenna array design are also included. The methods of adaptive signal processing for smart antenna design and the different methods of direction of arrival estimation are described in this course.

Course Outcomes: At the end of the course, the students will be able to:

CO1: analyze linear and circular antenna arrays

CO2: classify adaptive processing for smart antenna using different methods

CO3: solve design problems on smart antenna in presence of mutual coupling between the antennas

CO4: compensate mutual coupling in presence of jammers

CO5: solve design problems on smart antenna by estimating direction of arrival (DOA) of signal

CO6: investigate different types of DOA estimation methods

Topics:

- Introduction to Antenna Arrays of Different Kinds and Principles of Smart Antenna
- Direct Data Domain Least Square Approaches to Adaptive Processing
- Mutual Coupling in Adaptive Smart Antennas
- Direction of Arrival (DOA) Estimation and Adaptive Signal Processing for Smart Antennas

Textbook (s):

1. Smart Antennas – T. K. Sarkar, M. C. Wicks, M. Salazar-Palma and R. J. Bonneau, Wiley-Interscience, 1st edition., 2003.

Reference book(s):

1. Smart Antenna Engineering - Ahmed El-Zooghby, Artech House, 1st Ed., 2005.
2. Smart Antennas for Wireless Communication: With MATLAB- F. Gross, McGraw Hill, 1st edition., 2005.

EC 3064 Information Theory and Coding

Credit: 3

Category: PEC

Prerequisite(s): Digital Communication Techniques (EC 2005)

Course Description:

The course will help in forming a strong foundation for the broad areas of information theory, coding and cryptography. It emphasizes on the basic concepts, lays stress on the fundamental principles and motivates their application to practical problems. This course starts with the basics of information theory and source coding. The theory of linear block codes (including cyclic codes, BCH codes, RS codes), convolutional codes are explained. Basics of secure communications including cryptography and physical layer security are covered.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: explain the mathematical definitions of information, using conditional and unconditional probability theorem
- CO2: demonstrate and differentiate different sources of information and coding techniques
- CO3: explain and analyze channel coding schemes and Shannon's information theory
- CO4: distinguish between various error decoding schemes
- CO5: design and simplify different codes such as cyclic codes, CRC codes (cyclic Redundancy Codes) and BCH codes
- CO6: generate Convolution codes

Topics:

- Source Coding
- Channel Capacity & Coding
- Speech Coding
- Error control coding
- Cyclic codes
- BCH Codes and convolutional Codes

Textbook(s):

1. Information Theory, Coding and Cryptography- Ranjan Bose, Tata Mcgraw Hill, 2nd edition, 2011
2. Principle of Digital Communication- J. Das, P. K. Chatterjee & S. K. Mullick, New age Internationals, 2008

Reference Book(s):

1. Elements of Information Theory- T. M. Cover & J. A. Thomas, Wiley-Interscience-2nd edition 2010.
2. Digital Communication- J. G. Proakis, McGraw Hill Education, 4th edition

EC 3066 Principle of Microprocessors and Microcontrollers

Credit: 3

Category: PEC

Prerequisite(s): Digital Electronics (EC 2011)

Course Description:

This subject deals with Microprocessors 8085, 8086, 8255 PPI, 8259 PIC and 8251 USART and basics of 8051 Microcontroller. In this course, the students learn about assembly language programming on Microprocessors, Microcontrollers and develop programs for simple applications.

Course Outcomes: At the end of the course, the students will be able to :

- CO1: understand and explain the concept of Bus structure, a basic 8 bit Microprocessor system
- CO2: explain the architecture of a 16 bit Microprocessor like 8086 including the concept of instruction queue, segmented memory structure and address generation technique
- CO3: explain and analyze the Addressing modes, Assembly language instructions of 8086 and implement them to solve 8086 related design problems
- CO4: design Memory Interfacing using memory chips with proper decoder circuits with a 16-bit processor and analyze the interrupt structure of 8086 Microprocessor
- CO5: explain the peripherals such as PPI, Programmable interrupt control, USART and their interfacing with a 16 bit processor
- CO6: analyze memory organization of a 8 bit Microcontroller (like 8051), its addressing modes, instructions

Topics:

- Semiconductor Memory Chips, Tristate Concept & Bus Structure, A Basic Microprocessor based system
- 8 bit Processor, Bus Structure, 8085 Microprocessor Architecture, Concept of stack, Instructions & Addressing Modes
- 8086 (16 bit Microprocessor) Architecture, Pins & Signals, Minimum & Maximum Mode Configuration, Timing Diagrams; 8086 Addressing Modes and Instructions, Memory Interfacing, Interrupts
- Interfacing chips : 8255 (PPI), 8259 (PIC), 8251 (USART)
- 8051 Family of Microcontrollers, Overview of MCS-51 Family of Microcontrollers Memory Organization Pins & Signals, Addressing Modes, 8051 Instruction set, Interrupts

Textbook(s):

1. Microprocessors and Interfacing, Programming & Hardware - Douglas V. Hall, McGraw Hill Education Pvt Ltd., 3rd Edition

Reference Book(s):

1. Microprocessors & Microcomputer based System Design - Md. Rafiquzzaman, 2nd Edition
2. Advanced Microprocessor and Peripherals - Architecture, Programming and Interfacing by A. K. Ray and K. M. Bhurchandi - McGraw Hill Education Pvt Ltd - 3rd Edition.
3. 8051 Microcontroller - Hardware, Software & Applications - V Udayshankara & M. Mallikarjunswamy - TMH - 1st edition.

EC 3068 Real Time Systems and Application

Credit: 3
Category: PEC
Prerequisite(s): Nil

Course Description:

This course covers the principles of real-time systems, modeling of a real-time system, task assignment and scheduling, resource management, real-time operating systems, RTOS services. Programming language with real-time support, system design techniques, inter task communication, fault tolerant techniques, reliability evaluation methods, performance analysis, and case studies of real-time systems applications are also covered.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: differentiate between a real time system and other systems
- CO2: identify the different parts of hardware needed for real time system
- CO3: analyse and design to interface a microprocessor to displays, memories, different I/O ports
- CO4: analyse and use RTOS for Real Time System design
- CO5: design and Evaluate the function of a real time System
- CO6: apply the knowledge to different real time System for solving engineering and social problems

Topics:

- Basic overview of Operating System
- Real Time concepts and hardware considerations.
- Real Time Operating Systems
- Software requirements and Design process
- Application of Real time systems
- Case study

Textbook(s):

1. Real-Time Systems Design and Analysis by Phillip A. Laplante John Wiley & Sons, Inc.
Publication,3rd edition, 2011.

Reference Book(s):

1. Embedded and Real-Time Operating Systems by K.C. Wang, Springer, 2017
2. Real-Time Systems: Theory and Practice by Rajiv Mall, Pearson Publisher, 1st edition,2017

EC 3070 MANET and WSN

Credit: 3

Category: PEC

Prerequisite(s): Communication Engineering (EC 2016)

Course Description:

The objective of the course is to provide the basic knowledge of MANET and WSN, identify and analyze the goals, challenges, protocols and the issues involved in designing and implementing MANET and WSN for providing a good quality of service.

Course Outcomes: At the end of the course, the students will be able to:

CO1: comprehend the working and features of MANET

CO2: comprehend and explain the goals, challenges, protocols and issues involved in designing MANET and the quality of service required

CO3: comprehend the fundamentals of WSN

CO4: explain the working principles of physical layer of WSN

CO5: explain and analyze the different protocols, transport layer features and routing of WSN

CO6: identify the challenges in WSN and cross layer solutions

Topics:

- MANET
- MAC, routing and QoS in MANET
- Introduction to WSN
- Physical, MAC & Routing for WSN
- Challenges in WSN and cross layer solutions

Textbook(s):

1. C.Sivaraman Murthy and B.S.Manoj, “Ad Hoc Wireless Networks” , Person Education, Second Edition, India,2001
2. Ian F. Akyildiz and MehmetCan Varun, “Wireless Sensor Networks”, John Wiley and Sons Ltd, Publication 2010

Reference Book(s):

1. K Toh, “Adhoc mobile wireless networks, protocols and Systems”, 2nd Edition, Pearson Education,2009
2. Stefano Basangi, “ Mobile Adhoc Networking”, Wiley Inter science, IEEE Press, 2004
3. George Aggelou, “Mobile Adhoc Networks”, McGrawHill, 2004
4. Jun Zhny and Abbas Jama, “ Wireless Sensor Network - a networking perspective” 2009
5. C. Raghavendram, K.Sivalingam and T.Znati, “Wireless Sensor Network”,Springer,ISBN:1-4020-7883-8,August,2005

EC 3072 Introduction to Machine learning

Credit: 3
Category: PCC
Prerequisite(s): Nil

Course Description:

The course objective is to make students of Engineering to understand the basics of machine learning algorithms which are pervasive in engineering applications. Students will be able to understand the essence and applications of various clustering and classification techniques. Further, they will understand how it can be applied in real world problems. Then, the course covers the detailed analysis on artificial neural network along with few ensemble methods.

Course Outcomes: At the end of course, the students will be able to:

- CO1: develop appreciation for various concepts involved in learning models
- CO2: comprehend a wide variety of learning algorithms
- CO3: analyze and evaluate ML models
- CO4: apply ML algorithms to real-world problems
- CO5: optimize the models and report on the expected accuracy
- CO6: comprehend the concepts of bagging and boosting

Topics:

- Foundations for ML
- Clustering
- Classification
- Artificial Neural Networks
- Ensembles methods

Textbook(s) :

1. Shai Shalev-Shwartz and Shai Ben-David “Understanding Machine Learning” Cambridge University Press. 2017.
2. Christopher Bishop “Pattern Recognition and Machine Learning” Springer. 2006.

Reference Book (s):

1. Neural Networks, C.M. Bishop, Oxford Press, 1995.
2. Machine Learning for Audio, Image and Video Analysis, F. Camastra, Vinciarelli, Springer, 2007.

EC 3074 Internet Technologies for Cloud & Edge Computing

Credit: 3

Category: PEC

Prerequisite(s): Computer Programming (CS 1093)

Course Description:

The course objective is to introduce various aspects of internet, cloud computing and edge computing. Through this course student can learn about TCP/IP stack implementation for internet. The objective deals with analyses of could and edge applications and its requirement in the real world. Several tools for application specific cloud and edge computing models are discussed in this subject.

Course Outcomes: At the end of course the students will be able to:

CO1: comprehend the idea of TCP/IP stack implementation for application specific requirements of Internet

CO2: comprehend the cloud computing concepts and differentiate between different cloud based services

CO3: comprehend the design aspects of edge computing and analyze the application specific resource requirements

CO4: analyze various cloud & edge application design aspects and software technologies

CO5: evaluate the select tools for application specific cloud and edge computing models

CO6: design cloud and edge computing frameworks for scenario specific IoT applications

Topics:

- Cloud computing
- Edge Computing
- Feedback Concept
- Cloud & Edge application design aspects
- Application specific design aspects for IoT

Textbook(s):

1. Janakiram, “Grid and Cloud Computing”, TMH, 2016

2. Shailendra Singh, “Cloud Computing”, Oxford University Press, 2018

Reference Book(s):

1. Perry Lea, “IoT and Edge Computing for Architects: Implementing edge and IoT systems from sensors to clouds with communication systems, analytics, and security”, 2nd Edition. Packt.
2. R. Buyya, C. Vecchiola and S. T. Selvi, Mastering Cloud Computing Foundations and Applications Programming, Morgan Kaufmann, Elsevier, 2013.
3. R. Buyya, S.N Srirama “Fog & Edge computing Principles & Paradigms”: Wiley , 2019.
4. R. Buyya, High Performance Cluster Computing: Architectures and Systems, Volume 1, Pearson education, 2008.

EC 3076 IoT & Cyber-Physical System Design

Credit: 3

Category: PEC

Prerequisite(s): Internet of Things and its applications (EC 3050)

Course Description:

The course objective is to introduce the fundamentals of Internet of Things (IoT) and Cyber Physical System (CPS). This course covers identification and evaluation of different entities pertaining to IoT and CPS. This course enables student to model IoT and CPS in general. The course envisages discussing IoT and CPS components from the various perspectives including design, networking, communication protocols and standards. The course objective is to evaluate the highly complex infrastructure of CPS using several parameters such as security, privacy, integrity, reliability and resiliency. Different data analytics and platform have also been introduced in the course.

Course Outcomes: After completion of course, the students will be able to:

CO1: comprehend IoT and Cyber-Physical Systems components and design blocks

CO2: analyze IoT and Cyber-Physical Systems design issues and challenges

CO3: analyze Sensors, Actuators & Embedded System, Network & protocol design aspects and select appropriate components for designing IoT & Cyber-Physical Systems

CO4: evaluate the performance of various scenario specific requirements of IoT & Cyber-Physical Systems

CO5: evaluate and select appropriate computing & analytics platforms for IoT & Cyber-Physical Systems

CO6: design application specific IoT & Cyber-Physical Systems

Topics:

- IoT and CPS Design issues and challenges
- Sensors, Actuators & Embedded System design aspects
- Network & Protocol design aspects
- Computing platforms and Analytics
- Scenario specific applications of CPS

Textbook(s):

1. Complexity Challenges in Cyber Physical Systems, Saurabh Mittal, Andreas Tolk, Wiley.
2. Cyber-Physical Systems: A Computational Perspective, Gaddadevara Matt Siddesh, et. Al, CRC Press.
3. Scalable Computing and Communications: Theory and Practice, Samee U. Khan, et. al., Wiley-IEEE Press

Reference Book(s):

1. Principles of Cyber-Physical Systems, Rajeev Alur, the MIT Press.
2. Security and Privacy in Cyber-Physical Systems: Foundations, Principles, and Applications.
3. Data Analytics for IT Networks: Developing Innovative Use Cases, First Edition, John Garrett, CISCO press
4. Cyber-Physical Systems, Fei Hu, CRC Press

EC 3078 Signal Understanding Using Machine Learning

Credit: 3

Category: PCC

Prerequisite(s): Signals and Networks (EC 2021)

Course Description:

This course gives students a broad knowledge on, and techniques used in contemporary research on computer vision and pattern recognition. It provides an introduction to computer vision including fundamentals of image formation, feature detection and matching, motion estimation and tracking, and classification. Foundations of pattern recognition algorithms and machines learning methods for feature selection, and classification based on supervised and unsupervised learning methods.

Course Outcomes: At the end of course, the students will be able to :

CO1: comprehend signal processing basics

CO2: apprehend supervised and unsupervised learning mechanisms

CO3: design machine learning models by using various mathematical tools

CO4: use machine learning models for audio & music processing applications

CO5: use machine learning models for image processing applications

CO6: apply machine learning methods in signal processing and communication

Topics:

- Basic of Machine learning Techniques
- Artificial Neural Networks
- Applications of ML for Audio, Music and Image Processing
- Deep Learning Models and its application for image and signal processing

Textbook(s) :

1. Pattern Recognition and Machine Learning, C.M. Bishop, 2nd Edition, Springer, 2011.
2. Deep Learning, I. Goodfellow, Y, Bengio, A. Courville MIT Press, 2016.
3. Automatic Speech Recognition: A Deep Learning Approach, D. Yu and L. Deng Springer, 2016.

EC 3080 Deep Learning

Credit: 3

Category: PCC

Prerequisite(s): Introduction to Machine learning (EC 3072)

Course Description:

The course objective is to cover advanced topics of machine learning in general and deep learning in specific. Deep learning models such as CNN, RNN, LSTM and GRU are covered. This course also covers the brief description of python libraries for implementation of real world problems.

Course Outcomes: At the end of course, the students will be able to:

CO1: gain knowledge about the basic concepts of Deep Learning

CO2: identify deep learning techniques suitable for a given problem

CO3: understand deep learning algorithms

CO4: understand the concept of CNN model

CO5: solve the problems using various deep learning models

CO6: design application using deep learning techniques for real-world problems

Topics:

- Deep Learning Architecture
- Convolution Neural Networks
- LSTM, GRU
- Deep Learning Libraries
- Implementation of Deep Learning Models

Textbook(s):

1. Deep learning: An MIT Press book in preparation, Bengio, Yoshua, Ian J. Goodfellow, and Aaron Courville, 2015.
2. Deep Learning, I Goodfellow, Y Bengio and A Courville, 1st Edition

Reference Book (s):

1. Learning deep architectures for AI, Bengio, Yoshua, 2009
2. Automatic Speech Recognition: A Deep Learning Approach, D. Yu and L. Deng, Springer 2016.

EC 3082 Minor Project

Credit: 2
Category: PROJ

Course Description:

Students are required to undertake a minor project either as an individual or in a group in consultation with the project guide which may be completed in one semester. The project work is aligned with the discipline of the student and its allied areas. It is preferably related to certain research objective or advanced technical domain. Students will demonstrate higher level learning outcomes and cognitive skills in the implementation of the project.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: perform a background study on certain technical aspect and formulate a project objective
- CO2: outline a pathway for the implementation of the project within the time line
- CO3: apply fundamental engineering concepts, advanced technical know-how, use modern engineering tools, perform experiments and critically analyze the data
- CO4: provide engineering solutions, design system components or processes with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
- CO5: function effectively as an individual, and as a member or leader in a team under multidisciplinary settings following ethical practices
- CO6: communicate effectively with a range of audiences and prepare technical reports

EC 3091 Electronic Measurements and Instrumentation Laboratory

Credit: 1
Category: PCLC
Prerequisite(s): Nil

Course Description:

In this EM&I laboratory, experiments will be conducted to measure different parameters such as strain, distance, temperature, level, resistance, inductance, capacitance etc.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: differentiate and measure the unknown medium and low resistance
- CO2: analyze and measure the inductance and capacitance
- CO3: analyze and measure the temperature by different temperature transducers
- CO4: analyze and measure the distance and strain by LVDT and Strain gauge
- CO5: measure the level in a tank using capacitive transducer
- CO6: analyze and measure the Q-factor

Topics:

- Measurement of resistance using Wheatstone and Kelvin's double bridge
- Measurement of inductance and capacitance by using Maxwell's bridge and Schering bridge
- Measurement of strain and displacement
- Measurement of temperature by using different sensors
- Measurement of level in a tank using capacitive type level probe
- Measurement of Q-factor of an unknown coil

EC 3093 Microwave and Antenna Laboratory

Credit: 1.5

Category: PCLC

Prerequisite(s): Microwave Engineering (EC 3015)

Course Description:

This laboratory course will empower the students to apply the knowledge developed in the theory course titled Microwave Engineering. The students will be able to use various microwave components and measure the desired parameters. Students will also get familiar with various antennas and understand their radiation characteristics like radiation pattern, gain and directivity. This laboratory course will also introduce the simulation software named CST studio suite where the students can design various microwave components and antennas.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: apply concepts of transmission lines for determination of unknown frequency of microwave source and determination of unknown load impedance
- CO2: measure coupling coefficient, directivity & insertion loss of a two-hole directional coupler
- CO3: measure the coupling coefficient of waveguide Tees
- CO4: measure the radiation characteristics of various antennas
- CO5: design transmission line matching networks using high frequency simulation software
- CO6: design planar antennas using high frequency simulation software

Topics:

- Measurement of unknown frequency of a microwave source using double minimum method and frequency meter
- Determination of unknown impedance of a given load using shift in the minima method
- Measurement of coupling coefficient, directivity & insertion loss of a two-hole directional coupler
- Measurement of coupling coefficient of E-Plane Tee, H-plane Tee and Magic Tee
- Study the radiation pattern and measurement of gain of wire dipole and Yagi-Uda antenna
- Study the radiation pattern and measurement of gain of pyramidal Horn antenna
- Design of quarter wave transformer for impedance matching in microstrip transmission lines using Electromagnetic simulation platform
- Design of microstrip antenna using Electromagnetic simulation platform
- Open ended experiments

EC 3094 Wireless Communication and Networking Laboratory

Credit: 1.5

Category: PCLC

Prerequisite(s): Data Communication And Networking (EC 3028)

Mobile Communication Engineering (EC 4031), Cellular Communication (EC 3036)

Course Description:

The laboratory course introduces readers to the various aspects of wireless &cellular communication and computer networks. The experiments are performed using open-source and industry accepted simulators such as NS2 and Cisco packet tracer, etc. The experiments cover some of the crucial data communication protocols like TCP, UDP, and CSMA. Both wired and wireless network deployment is performed using CISCO Packet Tracer. Experiments on cellular concept, handoffs, and path loss fundamentals are performed on the simulators.

Course Outcomes: At the end of the course, the students will be able to:

CO1: design, simulate and evaluate the performance of different wired network topologies using NS-2

CO2: design, simulate and evaluate the performance of IEEE 802.11 wireless Local Area Network (LAN) using NS-2

CO3: design, simulate and evaluate the performance of virtual LANs(VLANs)under wired, wireless & heterogeneous network configurations using CISCO® Packet Tracer

CO4: analyze and comprehend the frequency reuse concepts and effects of handover (Mobility Management) in mobile cellular networks (MCN)

CO5: analyze and comprehend effect of shadowing on path-loss formula

CO6: analyze the application and scenario-specific network requirements based on case-study/client requirement, and design and simulate networks using the learned utilities

Topics:

- Design, simulation & calculation of throughput for a star connected network with two TCP and one UDP connection using NS2 Simulator
- Design and simulation of an IEEE 802.3 Ethernet Local Area Network (LAN) and observation of the TCP window using NS2 Simulator
- Simulation and investigation of the impact of ‘Contention Window’ size on the performance of IEEE 802.11 MAC protocol using NS2 Simulator
- Design, configuration and simulation of multiple VLANs implemented using CISCO Packet Tracer
- Design, configuration and simulation of wired and wireless (heterogeneous) networks and traffic analysis using CISCO Packet Tracer
- Understand the cellular frequency reuse concept
- Study the effect of handover (Mobility Management) threshold and margin on SINR and call drop probability and handover probability
- Study the effect of shadowing on path loss formula
- Open ended experiments

EC 3095 VLSI Laboratory

Credit: 1

Category: PCLC

Prerequisite(s): Digital Electronics (EC 2011)

Course Description:

The prime objective of this laboratory is to provide a compact idea about recent trends in digital system design, ASIC design and FPGA based hardware design and implementations. The hardware description language (HDL) such as Verilog is used in this lab for FPGA programming. This lab provides exposure to CAD tools used in analog system design.

Course Outcomes: At the end of the course, the students will be able to:

CO1: understand the basics of XILINX VIVADO tools and HDL for implementation of digital logic

CO2: implement different combinational circuits using different modeling style

CO3: implement sequential logic circuit such using Verilog HDL

CO4: analyze and implement of memory using Verilog

CO5: model finite state machines (FSM) using HDL and real time applications using HDL and FPGA

CO6: model of CMOS logic circuits using SPICE

Topics:

- Introduction to XILINX VIVADO tools and Verilog HDL, design flow
- Gate level and data flow modelling
- Behavioral modelling of sequential logic circuits
- Modelling of Finite state machines
- Modelling of memory
- Real time application: Traffic light controller design
- Design and SPICE simulation of MOSFET, CMOS inverter, NAND and NOR gates

EC 3099 Digital signal processing laboratory

Credit: 1

Category: PCLC

Prerequisite(s): Digital signal processing (EC-3007)

Course Description:

This course is designed to teach implementation methods of various aspects related to digital signal processing on OCTAVE. It imparts the knowledge of discrete time LTI signals and systems and theoretical concepts are analyzed on software platforms. Design concepts on various kinds of filters based on the requirements and specifications are also covered. The implementation of basic concepts of multirate signal processing is also explained.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: apply the fundamentals of OCTAVE programming to simulate discrete time signals and systems and compute Circular convolution, linear convolution and correlation of discrete time signals
- CO2: find solution to the causal difference equations and compute step response and impulse response, compute transfer function, poles and zeros and determine stability of the system
- CO3: analyze the signal and its properties in its frequency domain using MATLAB Simulation environment. Use the Discrete time Fourier transform (DTFT) and Discrete Fourier Transform (DFT) in a variety of applications including: signal analysis, circular convolution and long data filtering
- CO4: design digital FIR low pass, high pass and band pass filters using OCTAVE after determining the required specifications for a given scenario
- CO5: design digital FIR low pass, high pass and band pass filters using OCTAVE after determining the required specifications for a given scenario
- CO6: design sampling rate converters, and analyze the effects of the change of sampling rate in the frequency spectrum of the signals

Topics:

- Analysis of an LTI system in time domain using OCTAVE
- Analysis of discrete time signals and system in frequency domain using DFT and DTFT in OCTAVE
- Design of FIR and IIR filters in OCTAVE
- Analysis of multirate signal processing using OCTAVE

EC 4059 Computer Vision & Pattern Recognition

Credit: 3

Category: PEC

Prerequisite(s): Digital Image Processing (EC 6108)

Course Description:

This course gives students a broad knowledge on, and techniques used in contemporary research on computer vision and pattern recognition. It provides an introduction to computer vision including fundamentals of image formation, feature detection and matching, motion estimation and tracking, and classification. Foundations of pattern recognition algorithms and machines learning methods for feature selection, and classification based on supervised and unsupervised learning methods. We focus less on the machine learning aspect of CV and image classification as that is really classify the theory best learned in an ML course.

Course Outcomes: At the end of course, the students will be able to:

CO1: understand basic concepts, terminology, and theories in the field of computer vision

CO2: become familiar with the major technical approaches involved in computer vision

CO3: identify various approaches of computer vision and pattern recognition, and design the components for it

CO4: understand a wide variety of learning algorithm for pattern recognition

CO5: apply machine learning techniques to solve problems of image classification

CO6: exposure to advanced concepts leading to object categorization and segmentation in images

Topics:

- Introduction
- Motion Estimation
- Computer Vision
- Pattern Recognition
- Image Processing
- Segmentation
- Machine Learning Techniques
- Applications: Surveillance, Object detection, classification etc.

Textbook(s):

1. Computer Vision: Algorithms and Applications by Richard Szeliski.
2. Pattern Recognition and Machine Learning, B. Christopher Bishop, Springer, 2008

Reference Book(s):

1. Computer Vision: A modern Approach, David Forsyth and Jean Ponce, Prentice Hall India, 2004
2. Pattern Classification, Richard O. Duda, Peter E. Hart, and David G. Stork, 2nd edition, Wiley Asia, 2002.

EC 4061 AI and Machine Learning for IoT

Credit: 3
Category: PEC

Prerequisite(s): Mathematics-I (MA 1003), Mathematics-II (MA 1004), Internet of Things and its applications (EC 3050)

Course Description:

The course objective is to explain the data sciences including different types of data acquisition methods using IoT and to their statistical analysis. The course describes the fundamentals of machine learning, artificial intelligence, artificial neural network and deep learning. Understanding the rising importance of IoT it intends to design various IoT based applications using artificial intelligence and machine learning.

Course Outcomes: After completion of course, the students would be able to:

- CO1: comprehend data acquisition using IoT and its analysis using mathematical and statistical tool using Machine learning approach
- CO2: analyze & apply different techniques and algorithms used in machine learning like regression, clustering, classification & decision trees
- CO3: analyze fundamentals of artificial neural network (ANN) techniques and apply it
- CO4: analyze fundamentals of AI & deep learning techniques and apply it
- CO5: analyze fundamentals of convolutional neural network (CNN) techniques and apply it
- CO6: design application specific ML & AI modeling on data acquired through IoT & CPS for intelligent system design

Topics:

- Data science, AI and ML
- ML fundamentals
- Artificial Neural Networks
- Deep Learning
- Application of AI and ML for IoT

Textbook(s):

1. Understanding Machine Learning, Shai Shalev-Shwartz and Shai Ben-David, Cambridge University Press, 2017.
2. Deep learning, Bengio, Yoshua, Ian J. Goodfellow, and Aaron Courville, MIT Press, 2015.

Reference Book(s):

1. Pattern Recognition and Machine Learning, Christopher Bishop, Springer, 2006.
2. Machine Learning, Tom Mitchell, McGraw Hill, 1997.

EC 4081 Project-I

Credit: 3
Category: PROJ

Course Description:

Students are required to undertake a final year major project either as an individual or in a group in consultation with the project guide which may be completed in one year. The project should be related to certain research objective or advanced technical domain. The work encompasses two semesters and to be carried out in two phases (Project-I and Project-II). In Project-I, students are expected to complete detailed literature review, identify their objective and start working on the same; perform experiments, carry out analyses and report their findings to their supervisors and the panel.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: conduct a detailed research survey or background study and summarize the theory and findings
- CO2: formulate a research question or a general objective of the project
- CO3: propose and outline the solution to the research question or a pathway for the implementation of the project with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
- CO4: conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
- CO5: function effectively as an individual, and as a member or leader in a team under multidisciplinary settings following ethical practices
- CO6: communicate effectively with a range of audiences and prepare technical reports

EC 4082 Project-II

Credit: 10
Category: PROJ

Course Description:

Project-II is a continuation of Project-I, the second phase of final year major project. Students should complete all related experiments, develop a final solution, product or system and validate the applicability of the same under real time scenario with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors. They produce a detailed technical report on their work as well as individual contribution reports. Throughout the implementation of the major final year project, students should demonstrate all cognitive skills and attainment of all program outcomes and student outcomes.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: readily apply fundamental concepts in their area of study for executing the projects
- CO2: demonstrate skill in using modern technical tools, apply advanced technical knowledge, integrate information from different sources, perform complex experiments and critically analyze the findings to draw conclusions
- CO3: provide engineering solutions to predefined research question or project objective; design system components or processes with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
- CO4: function effectively as an individual, and as a member or leader in a team under multidisciplinary settings following ethical practices
- CO5: communicate effectively with a range of audiences and prepare detailed technical reports
- CO6: demonstrate knowledge and understanding of the management principles in executing their project as a member or leader of the team, and willingness to engage in life-long learning

EC 4097 Machine Learning Laboratory

Credit: 1
Category: PCC

Prerequisite(s): Introduction to Machine learning (EC 3072), Deep Learning (EC 3080)

Course Description:

Machine Learning is concerned with computer programs that automatically improve their performance through experience. This course covers the theory and practical algorithms for machine learning from a variety of perspectives. This laboratory introduces the Python software which is very helpful for implementation of machine learning and deep learning techniques. Familiarization of various important machine learning libraries such as NumPy, Pandas, Matplotlib and Keras will be done followed by implementation of clustering and classification problems using traditional machine learning techniques. Further, the lab covers the implementation of solving real life problems using deep learning techniques.

Course Outcomes: At the end of course, the students will be able to:

- CO1: gain knowledge about basic functions of Python
- CO2: identify various useful machine learning libraries
- CO3: understand the implementation procedures for the machine learning algorithms
- CO4: identify and apply machine learning algorithms to solve real world problems
- CO5: analyze basic operation on data such as accessing, plotting etc.
- CO6: design application using deep learning techniques for real-world problems

Topics:

- Python fundamentals
- Machine learning libraries: NumPy, Pandas, Matplotlib, Keras
- Basic operation such as data accessing, data manipulation, plotting etc.
- Implementation of classification using traditional machine learning techniques
- Clustering using different clustering techniques
- Implementation of classification using deep learning techniques

EC 4099 IoT & Connected Intelligent Systems Laboratory

Credit: 2

Category: PCLC

Prerequisite(s): Internet of Things & its Applications (EC3050), Internet technologies for cloud and Edge Computing (EC 3074), Introduction to Machine Learning (EC 3072), AI & Machine Learning for IoT (EC 4061), IoT & Cyber-Physical System Design (EC 3076)

Course Description:

This laboratory is to provide hands-on exposure in IoT and AI-ML based connected-intelligent systems for industry readiness by bolstering the hands-on aspects of technical-Know-how and practical-skill in IoT & ML based a connected intelligent system that is highly demanded in industry. This lab deals with experiments on IoT-based intelligent systems design. Experiments on IoT-based system design using Embedded systems like NodeMCU, Raspberry Pi etc. along with the complete data communication framework based on TCP/IP protocol stack implementation for various application-specific intelligent connected sensors & actuators are covered. It also provides hands-on exposure to IoT and connected intelligent framework with protocols like MQTT/CoAP with sensor and application based device control technique with machine perception techniques (AI & ML) for scenario-specific application requirements of real-world engineering problems on Smart healthcare, smart city, smart home and smart sustainable IoT-based systems.

Course Outcomes: At the end of the course, students will be able to:

- CO1: design different application-specific sensor data acquisition for IoT-cloud using TCP/IP stack
- CO2: implement sensor-data acquisition system and intelligent actuator control application using cloud and MQTT protocol for intelligent IoT-based systems
- CO3: implement computing on Raspberry Pi and equivalent embedded development platform for intelligent IoT-based systems
- CO4: simulate appropriate Machine learning (ML) techniques on acquired sensor data for intelligent application-specific IoT-based systems
- CO5: design intelligent Machine perception technique on cloud data for intelligent IoT-based systems
- CO6: analyze of AI & ML based techniques on acquired IoT-based Sensor data

Topics:

- Data acquisition for IoT-cloud using TCP/IP stack using NodeMCU and Arduino IDE
- Application- sensor data for IoT-cloud using TCP/IP stack, and Raspberry Pi
- Intelligent actuator control application using cloud and MQTT
- Apply Machine learning (ML) techniques on acquired sensor data
- Analyze and implement of AI & ML based techniques on acquired IoT-based Sensor data and intelligent inference management and actuator control for application-specific requirements of real-world Smart healthcare application
- Implement of AI & ML based techniques on Sensor data and intelligent inference management and actuator control for application-specific requirements of real-world smart city, smart home and smart sustainable IoT-based systems
- Open Ended Design problems

EC 6108 Digital Image Processing

Credit: 3

Category: PEC

Prerequisite(s): Digital Signal Processing (EC 3007), Introduction to Digital Signal Processing (EC 3013)

Course Description:

This course introduces the concept of Digital image formation, representation and processing of digital image using digital devices such as computers. The processing or manipulation of digital image is achieved via both spatial and frequency domain with an aim to improve pictorial information for better human interpretation, storage, transmission and representation. Towards this goal the course provides both basic and in-depth coverage of image processing techniques such as image enhancement, restoration, color image processing, compression, segmentation, morphological processing and different mathematical transforms.

Course Outcomes: At the end of the course, the students will be able to:

CO1: analyze different image processing applications and learn different techniques to create and apply on digital image for better interpretations of an image

CO2: implement various enhancement and restoration techniques

CO3: explain and analyze the concept of color image processing

CO4: evaluate different image compression techniques for various applications

CO5: explain the concept of morphological operations and image segmentation

CO6: interpret the effect of applying different image transforms

Topics:

- Fundamentals of image processing
- Spatial domain methods of image enhancement
- Frequency domain methods of image enhancement
- Image degradation model and restoration via Inverse filter, Weiner filter and constrained least square approach
- Color image processing via different color models and inter conversion between them
- Different image transforms such as DFT, DCT, Hadamard, KL and SVD and its importance in processing of a digital image so that different types of redundancy can be overcome ,hence an adequate of image compression can be occurred
- Morphological processing through dialation, erosion, opening and closing and discussion on few applications
- Region and edge based method of image segmentation and discussion on few applications
- Review of matrix algebra, 2-D convolution

Textbook(s) :

1. Digital Image Processing, R. C. Gonzalez and R. E. Woods, Prentice Hall, 3rd edition, 2008

Reference Book(s):

1. Fundamentals of Digital Image Processing, A.K. Jain, Prentice Hall
2. Digital Image Processing, S.Jayaraman, S. Esakkirajan, T. Veerakumar, TMH, 2009.
3. Digital image processing and Analysis, B. Chanda, D. Dutta Majumder, PHI, 2004.

EC 6112 Communication and Network Security

Credit: 3

Category: PEC

Prerequisite(s): Data Communication and Networking (EC 3028)

Course Description:

This course is intended to explain various communication security attacks and counter mechanisms. Design and implementation of the security services and mechanisms are also covered.

Course Outcomes: At the end of the course, the students will be able to:

CO1: analyze different security threats and attacks with reference to ISO/OSI model security

CO2: differentiate between various cryptography, watermarking, steganography methods

CO3: analyze different symmetric and asymmetric cryptographic algorithms

CO4: differentiate various key distribution and digital signature

CO5: analyze the working of various communication security protocols with respect to OSI layer

CO6: analyze different network security systems implementation in wireless systems

Topics:

- Ciphers &Algorithm
- Cryptographic Key distribution system
- Communication Security layer classification
- Network security

Textbook(s):

1. Cryptography & Network Security, B A Forouzan and D Mukhopadhyay, Mc-Graw Hill, India, 2nd edition, 2010.
2. Security of Information and Communication Network, S V. Kartalopoulos, Wiley-IEEE Press, 2009.

Reference Book(s):

1. Handbook of Information and Communication Security, Stavroulakis Peter, Springer, 2010.
2. Secure Broadcast communication in Wired and Wireless Communication, Adrian Perrig & Doug Tygar, Kluwer Publication, 2002.
3. Modern Cryptography: Theory and Practice, W Mao, Pearson Education, India, 1st edition, 2003.

EC 6122 Satellite Communication Systems

Credit: 3

Category: PEC

Prerequisite(s): Electromagnetic Waves and Antennas (EC 2022)

Course Description:

The course offers basic concepts of satellite communication. The satellite subsystems, orbital parameters, orbital placement of satellites, LEO, MEO, GEO, and HEO satellite systems are also covered under this course. The satellite link budget preparation and various satellite communication applications are also explained.

Course Outcomes: At the end of the course, the students will be able to:

CO1: comprehend basic parameters for satellite communication

CO2: explain satellite launching methods and orbital control mechanisms

CO3: comprehend different types of losses in satellite link and satellite link design

CO4: differentiate between different types of noises and interferences associated with satellite link

CO5: evaluate the stability of a satellite in orbit and different satellite sub-systems

CO6: investigate different types of multiple access techniques for digital satellite communication

Topics:

- Frequency spectrum for satellite communication, Types of orbits, Kepler's Laws of planetary motion, Orbital perturbations, Geostationary orbit, Satellite launching, General satellite communication, Block diagram uplink, Downlink frequencies, Types of modulation techniques used orbits, and altitude control Satellite launch vehicles - Arian, SLV space shuttle
- Signal loss on transmission through earth's atmosphere, Atmospheric losses, Ionospheric effects, Rain attenuation, Satellite link budget: Transmission losses, Interference, System noise temperature, Link power budget
- Antenna sub-systems, Altitude and orbit control sub-system, Power sub-system, Communication sub-system, TTC&M sub-systems
- Satellite application in TV, Internet, Mobile telephony, Receive only home TV, Master Antenna, TV, Low earth orbit satellite systems and uses. Multiple access techniques - FDMA, TDMA, SS-TDMA, Interference in FDMA systems

Textbook(s):

1. Satellite Communications, T. Pratt & C.W. Bostia, Wiley, 2003

2. Satellite Communication, D. Roddy, McGraw Hill, 2006

Reference Book(s) :

1. Digital Satellite Communications, T.T. Ha, McGraw Hill, 1990

EC 6128 Wireless Sensor Network

Credit: 3

Category: PEC

Prerequisite(s): Data Communication and Networking (EC 3028)

Course Description:

The course gives an overview of wireless sensor network and its applications in military, environment, health care and industrial automation. It describes various physical layer and MAC layer protocols with emphasis on basic requirements of WSN. It further deals with network and transport layer protocols also with emphasis on basic requirements of WSN. Various cross layer effects and optimization techniques are also discussed. Further, localization techniques viz. Range based Localization Protocols and Range free Localization Protocols. Finally, the challenges associated with time synchronization and some protocols are discussed.

Course Outcomes: At the end of the course, the students will be able to:

CO1: find the architecture of WSN and network design factors

CO2: interpret the physical and MAC layer issues in WSN

CO3: choose routing mechanisms in applicable in specific WSN

CO4: analyze logical communication between application processes running on different hosts and interlayer and cross layer effects and solutions for WSN

CO5: estimate localization, ranging techniques and ranging based protocols for WSN

CO6: adapt the concepts of Time Synchronization and challenges involved therein

Topics:

- Basic Concepts, Platforms, Standardization, Architecture, Protocols, Applications, PHY layer standard (IEEE 802.15.4), MAC challenges, MAC protocols, S-MAC, B-MAC, CC-MAC, TRAMA, Zebra MAC, Routing challenges, SPIN, LEACH, MECN, SAR, Challenges of Transport layer, PSFQ, CODA, Interlayer Effects, MAC-Network, MAC-Application, Network - PHY, Transport -PHY, Challenges in localization, Ranging Techniques, Range based Localization Protocols, Range free Localization Protocol, Challenges for Time synchronization, TPSN, TDP, RDP

Textbook(s):

1. Wireless Sensor Networks – Ian F. Akyildiz and Mehmet Can Vuran, John Wiley and Sons Ltd, Publication, 2010.

Reference Book(s):

1. Wireless Sensor Network - a Networking Perspective, Jun Zheng and Abbas Jamalipour, Wiley, 2009.
2. Wireless Sensor Network, C. Raghavendram, K Sivalingam and T. Znati, Kluwer Academic Publishers, 2004.

EC 6224 Low power VLSI Design

Credit: 3

Category: PEC

Prerequisite(s): VLSI Design

Course Description:

This course describes the factors that are responsible for power dissipation in MOSFET devices and circuits. It also teaches how to estimate the average and maximum power dissipations in a circuit. In addition, different design techniques to reduce the power dissipations in VLSI circuits are outlined in this course.

Course Outcomes: At the end of the course, the students will be able to:

CO1: comprehend and analyze different MOS Logic circuits and power dissipation concept

CO2: differentiate and apply scaling techniques in different topology

CO3: optimize the power dissipation in CMOS circuits through switched capacitance minimization approach

CO4: optimize the power dissipation in CMOS circuits through different lower power minimization techniques in architecture level

CO5: optimize the power dissipation in CMOS circuits through different lower power minimization techniques in gate level

CO6: design different low power memory logic

Topics:

- Power dissipation and its types.
- Scaling methods.
- Switched capacitances.
- Leakage power optimization in architecture design.
- Leakage power optimization in design.
- Circuit level implementation for optimum performance

Textbook(s):

1. Low-Power CMOS VLSI Design, Kaushik Roy and Sharat C. Prasad, Wiley-India, 2011.
2. CMOS Digital Integrated Circuits, Sung-Mo Kang and Yusuf Leblebici, 3rd edition, TMH, 2011.

Reference Book(s):

1. CMOS VLSI Design: A circuits and Systems Perspective, West, Harris and Banerjee, 3rd edition, Pearson Education.
2. Low Power VLSI CMOS Circuit Design, A. Bellamour, and M. I. Elmasri, Kluwer Academic Press.
3. Low Power Digital CMOS Design, Anantha P. Chandrakasan and Robert W. Brodersen, Kluwer Academic Publishers, 2002.
4. Essentials of VLSI Circuits and Systems, Eshraghian, Puckness and Eshraghian, 2nd edition, Pearson Education.
5. Digital Integrated Circuits: A Design Perspective, J. M. Rabaey, Anantha Chandrakasan and Borivoje Nikolic, 2nd edition, PHI, 2001.

COURSES OF OTHER PROGRAMMES

CS 2001 Data Structures And Algorithms

Credit: 4

Category: PCC

Pre-requisite(s): Computer Programming (CS 1093)

Course Description:

This course explores several fundamental algorithms and data structures of computer science. Some of the data structures include arrays, linked lists, stacks, queues, trees, heaps, hash tables, and graphs. Students also study and analyze algorithms for searching, traversing trees, hashing, sorting, finding shortest searching, and much more.

Course Outcomes: At the end of the course, the students will be able to:

CO1: understand the concepts of data structure, data type, abstract data type (ADT) and compute the complexity of different algorithms

CO2: understand, distinguish and implement Array and Linked data structure on different types of problems

CO3: apply different linear data structures such as Stack and Queue to solve various problems

CO4: apply and Evaluate different non-linear data structures such as Tree and Graph on various computing problems

CO5: apply and Evaluate standard algorithms for searching, sorting and hashing

CO6: create the data structure that efficiently models the information in a problem

Topics:

- Introduction
- Arrays
- Linked List
- Stacks and Queues
- Trees
- Graphs
- Sorting
- Searching

Textbook(s):

1. Fundamentals of Data Structures in C, 2nd edition, Horowitz, Sahani, Anderson-Freed, Universities Press.

Reference Book(s):

1. Data Structures, Schaum's OutLines, Seymour Lipschutz, TATA McGRAW HILL
2. Data Structures using C by Aaron M. Tenenbaum, Yedidyah
3. Data Structures A Pseudocode Approach with C, 2nd Edition, Richard F. Gilberg, Behrouz A. Forouzan, CENGAGE Learning, India Edition
4. Data Structures Using C, Second Edition, Reema Thereja, Oxford University Press
5. Data Structures and Algorithm Analysis in C, Mark Allen Weiss, Pearson Education, 2nd Edition.

CS 2091 Data Structures Laboratory

Credit: 1

Category: PCLC

Prerequisite(s): Computer Programming (CS 1093)

Course Description:

The data structure lab is to develop skills for the design, analysis and implementation of operations like search, insertion, deletion, traversal, and other specified problem definition on various linear and nonlinear data structures. It improves the ability to define, apply the appropriate data structure for the real world problem and various techniques for representation of the data in the real world. In addition, it helps them to gain knowledge of data structure applications related to industry.

Course Outcomes: At the end of the course, the students will be able to:

CO1: understand the importance of structure, unions and abstract data type, and their basic usability in different applications through C programming language

CO2: analyze, differentiate and implement different algorithms based on their time and space complexity

CO3: understand and implement the linked implementation, and its uses both in linear and non-linear data structure

CO4: understand and implement various data structures such as stacks, queues, trees, graphs, etc. to solve various computing problems

CO5: understand and implement various kinds of searching and sorting techniques, and know when to choose which technique

CO6: decide and implement the suitable data structure and algorithm to solve a real world problem

Topics:

- Array, pointer with Dynamic Memory Allocation
- Structure, Single Linked List
- Doubly Linked List, Circular Linked List
- Polynomial Representation, Addition & Multiplication, Sparse Matrix Représentation, Addition & Multiplication
- Stack
- More on Stack & Applications of Stack
- Queue
- Tree
- Graph
- Searching & Sorting

EE 3028 Power Electronic Circuits

Credit: 3

Category: PEC

Prerequisite(s): Analog Electronic Circuits (EE 2013)

Course Description:

Elements of Power Electronics, Thyristor characteristics, Power BJT, Power MOSFET and IGBT, TRIAC and DIAC Characteristics and applications, controlled rectifiers with R, R-L, R-L-E load and effect of freewheeling diode, Dual converters, Effect of source Inductance, 3-phase half wave and full wave controlled rectifiers Step up and Step Down choppers, 2nd and 4th quadrant choppers for control of DC motor, Switch Mode Power Supply, Fly back converter, Single phase Half Bridge and Full bridge inverters, Concept of multi level inverters, Cyclo-converter with R-L Load, Concept of 3-phase cyclo-converter.

Course Outcomes: At the end of the course, the students will be able to:

CO1: remember the working principles of various power electronic semiconducting devices

CO2: interpret the concepts of single phase and three phase controlled rectifiers

CO3: apply the semiconducting devices for the control of single phase and three phase Inverters

CO4: compare different topologies of DC to DC converters

CO5: evaluate the performance of various single-phase AC to AC converters

CO6: choose a proper converter configuration for industrial suitability

Topics:

- Introduction to Power Electronics
- Power Electronic Devices
- AC to DC Converters
- DC to DC Converters
- Switch Mode Power Supply SMPS
- Inverters
- AC to AC Converters

Textbook(s):

1. Power Electronics By M. H. Rashid, Pearson Education, 3rd Edition, 2014.
2. Power Electronics by P S Bhambhra, Khanna Publishers, 4th Edition, 2012.

Reference Book(s):

1. Power Electronics by M. D. Singh and K. B. Khanchandani, Tata McGraw-Hill publishers, Second Edition, 2007.
2. Power Electronics, Converters, Applications and Design N. Mohan, Undeland& Robbins, John Wiley and Sons, Third Edition, 2002.
3. Modern Power Electronics by P C Sen, S.Chand Publication 2013
4. Fundamental of Power Electronics by S K Bhattacharya, Vikas Publishing, 1st edition-2005.

EI 2003 Electrical & Electronic Measurement Techniques

Credit: 3

Category: PCC

Prerequisite(s): Basic Electrical Engineering (EE 1003)

Course Description:

The objective of the course is to provide the basic knowledge of Instruments and Measurement techniques providing an in-depth understanding of errors in measurement techniques, Bridge measurements, Function Generator and Spectrum Analyzer, Display devices, watt meters, energy meters and analytical instruments.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: comprehend and explain different measurement techniques and universal instruments
- CO2: explain different measurement techniques for measuring the parameters of various electrical components
- CO3: explain and analyze construction of instruments used for measuring current, voltage, frequency and spectrum
- CO4: measure the power, energy and power factor using watt-meters and energy-meters
- CO5: apply the CRO for various electronic measurements
- CO6: analyze spectral analysis of the signals on spectrum analyzers

Topics:

- Introduction to instrumentation and measurements
- Classification and characteristics of Instruments.
- Overview of electrical and electronic measuring instruments
- DC and AC bridges
- Measurement of Power, Energy
- Function generator and Spectrum analyzer

Textbook(s):

1. A Course in Electrical and Electronic Measurements and Instrumentation, A K Sawhney, Dhanpat Rai & Co, Reprint, 2013.
2. Modern Electronic Instrumentation and Measurement Techniques, Helfrick & Cooper, 2nd Edition, PHI.

Reference Book(s):

1. Electrical Measurements and Measuring Instruments, Golding & Widdis , 5th edition, Reem Publication.
2. Electronic Instrumentation, H S Kalsi, 3rd Edition, TMH.
3. Electronic Instrumentation & Measurements, David A. Bell, 3rd Edition, Oxford University press.
4. Elements of electronic instrumentation and measurement, Joseph J. Carr, 3rd edition

EI 2010 Principles of Measurement and Instrumentation

Credit: 3
Category: PCC
Prerequisite(s): Nil

Course Description:

The objective of the course is to provide the basic knowledge of Instrumentation and Measurement, identify and correct errors in measurement techniques, Bridge measurements, Function Generator and Analyzer, Display devices, sensors/transducers and Analytical instruments.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: estimate different types of errors in measurements and interpret the instrument data sheet
- CO2: measure the unknown electrical quantities by selecting the appropriate bridge circuit
- CO3: explain and analyze the working principle of various sensors and transducers
- CO4: comprehend the basic principles of operation for various electrical and electronic measuring instruments
- CO5: describe the operation of wave shaping circuits and spectrum analyzer
- CO6: apply appropriate analytical instruments for measuring and analyzing materials

Topics:

- Introduction to instrumentation and measurements, basic requirements & methods of measurement
- Classification and characteristics of Instruments
- Overview of electrical and electronic measuring instruments
- DC and AC bridges
- Introduction to various types of sensors & transducers
- Function generator and Spectrum analyzer
- Analytical instrumentation: Chromatography, Spectrophotometer, pH meter

Textbook (s):

1. Electrical and Electronic Measurements & Instrumentation By A.K. Sawhney – Dhanpat Rai, 2013.
2. Electronic Measurement & Instrumentation By H. Cooper – PHI, 2nd edition.

Reference Book (s):

1. Electronics Instruments & Measurement by David A. Bell –Oxford, 3rd edition

EI 2012 Sensors & Signal Conditioning

Credit: 3

Category: PCC

Prerequisite(s): Electrical & Electronic Measurement Techniques (EI 2003)

Course Description:

The main aim of introducing this course is to provide the basic concept of instrumentation and its characteristics. It covers the details on identification, classification, construction, working and domestic as well as industrial applications of various transducers. The course also includes sensing principle for the measurement of motion, force, torque using analog, digital transducers and methods for signal conditioning and analysis.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: comprehend the concept of various transducers, sensors and their brief performance specifications
- CO2: analyze different types of errors in measurement and instrumentation
- CO3: explain the principle of operation for various transducers used to measure temperature and pressure
- CO4: explain the principle of operation for various transducers used to measure force, acceleration, displacement etc.
- CO5: analyze various signal conditioning techniques
- CO6: apply various transducers for domestic and industrial uses

Topics:

- Introduction to Sensor and Transducer
- Resistive Transducer
- Displacement transducer
- Proximity sensor
- Digital transducer
- Voltage generating transducer
- Magnetic type transducer
- Signal conditioning circuit
- Transducers for Miscellaneous measurement

Textbook(s):

1. Transducer & Instrumentation, MurthyDVS,2001,Prentice Hall of India.
2. Principle of Measurement Systems- J.P. Bentley 4th edition, Pearson education.

Reference Book(s):

1. Sensors & Transducers, Patranabis. D, 2003,PHI.
2. Introduction to Measurement and Instrumentation- AK.Ghosh, 2012, PHI.

EI 2095 Electrical & Electronic Measurements Laboratory

Credit: 1
Category: PCLC
Prerequisite(s): Nil

Course Description:

In this E&EM laboratory, experiments will be conducted to measure different parameters such as strain, distance, temperature, level, resistance, inductance, capacitance etc.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: calibrate the ammeters and voltmeters using DC potentiometer
- CO2: measure and analyze unknown electrical parameters such as medium and low resistances using DC bridges
- CO3: measure and analyze unknown electrical parameters such as capacitance and inductance using AC bridges
- CO4: measure the frequency of an unknown periodic signal
- CO5: determine the accurate quality factor of an unknown coil
- CO6: analyze and measure of 3-Phase power using 2-wattmeter method

Topics:

- Measurement of resistance using Wheatstone and Kelvin's double bridge
- Measurement of inductance using Maxwell's bridge, Hay's bridge
- Measurement of Capacitance using Schering's bridge
- Measurement of frequency using Wien's bridge
- Calibration of ammeter and voltmeter by using DC potentiometer
- Measurement of 3-Phase power using 2-wattmeter method

EI 3009 Instrumentation Measurement Techniques

Credit: 3

Category: PCC

Prerequisite(s): Electrical & Electronic Measurement Techniques (EI 2003)

Course Description:

Students will analyze the construction and operating principles with applications of Industrial Instruments used for measurement of parameters like temperature, pressure, level, flow, viscosity & humidity and its safety precautions during process measurement.

Course Outcomes: At the end of the course, students will be able to:

CO1: explain and analyze the construction and working principle of Industrial Instruments for Temperature, Level, Pressure, Flow, Viscosity & Humidity

CO2: explain sensor, transducer and their performance specifications for measurement of different process variables

CO3: apply different measurement techniques of instruments in industry

CO4: apply specific instruments for the measurement of different process variables

CO5: analyze the industrial application and calibration of Industrial Instruments

CO6: analyze the use of Industrial Instruments in hazardous locations

Topics:

- Temperature measurement
- Pressure Measurement (Gauge and vacuum)
- Level measurement, Flow measurement
- Viscosity, density, conductivity and humidity measurements
- Instrumentation in hazardous locations

Textbook(s):

1. Industrial Instrumentation & Control, S. K. Singh, 3 rd Edition, TMH.
2. Industrial Instrumentation, K.Krishnaswamy, S.Vijayachitra, 2nd edition, New age international.

Reference Book(s):

1. Instrument Engineers Handbook, Vol1,B.G Liptak, CRC Press
2. Measurement System Application and Design E.O Doeblin, 5th edition, TMH

EI 3023 Neural Network and Fuzzy Logic Control

Credit: 3

Category: PEC

Prerequisite(s): Mathematics-I (MA 1003), Mathematics-II (MA 1004) and Control Systems (EL 3001)

Course Description:

This course is about Artificial Neural Network & Fuzzy Logic models to handle uncertainty and solve engineering problems. Objective of this course is to impart adequate background knowledge so that in future students will be able to design and implement various machine learning algorithms in a range of real-world applications. The course covers learning based solutions for regression and classification, by using error minimization, concept of association, competitive learning, and fuzzy rule based methods. The course also covers applications of ANN and fuzzy logic for solving pattern recognition and control system.

Course Outcomes: At the end of the course, students will be able to:

CO1: analyze supervised and unsupervised learning for regression, classification and clustering

CO2: comprehend the concepts of feed forward neural networks

CO3: identify and describe appropriate Artificial Neural Network techniques in building intelligent machines

CO4: demonstrate the concept of fuzziness involved in various real world phenomena and need of fuzzy set theory

CO5: comprehend fuzzy rule based or expert system

CO6: analyze applications of Neural Network and Fuzzy logic in image processing

Topics:

- Introduction to Machine Learning
- Feed Forward Neural Network and Back-Propagation
- Pattern Association and Adaptive Resonance models
- Learning of ANN models based on Competition
- Fuzzy Set Theory and Fuzzy Membership
- Fuzzy-Inference-Systems
- Applications of Neural Network and Fuzzy Logic

Textbook(s) :

1. Fundamentals of Neural Networks, Laurene Fausett, Pearson Education, 2004
2. Fuzzy Logic with Engineering Applications, Timothy Ross, McGraw-Hill, 1998

Reference Book(s):

1. Introduction to Neural Networks Using Matlab, Sivanandam , S. N , Sumathi, S. and Deepa, S. N, 2005, TMH.
2. Fundamentals of Artificial Neural Networks, Mohammad H. Hassoun, 1st edition, 2019, PHI
3. Neural Networks and Fuzzy Systems, Bark Kosko, 1st edition, PHI

EI 3024 Virtual Instrumentation

Credit: 3

Category: PEC

Prerequisite(s): Digital Electronics (EC 2011)

Course Description:

The objective of the course is to provide the basic knowledge of PC based instrumentation systems and to develop concepts of designing virtual instruments along with its applications in various fields ranging from signal processing, image processing to motion control.

Course Outcomes: At the end of the course, the students will be able to:

CO1: explain the components of Virtual instrumentations and use them for PC Based Measurement

CO2: develop programming skills on application development software

CO3: simulate with LabVIEW software for instrument control, measurement, data acquisition and data handling

CO4: differentiate between different data acquisition techniques on virtual instrumentation

CO5: implement different controllers and conduct testing using industry standard software

CO6: differentiate between various Industrial network components and protocols

Topics:

- Sensors and Transducers
- PC Based Measurement
- Introduction to LabVIEW
- Organization of the LabVIEW system and software
- Program elements of LabVIEW
- Data Acquisition & Signal Conditioning
- Remote laboratory for Electrical experiments
- Examples of real time control and measurement applications
- Communication networked modules

Textbook(s):

1. Virtual Instrumentation Using LabView, Jerome, 1st edition, PHI
2. LabView Graphical Programming, Gary W. Johnson, Richard Jennings, 4th edition, TMH

Reference Book(s):

1. Practical Data Acquisition for Instrumentation and Control Systems, John Park and Steve Mackay, 2003, Newnes
2. LabVIEW based advanced instrumentation system, Psumathi, 1st edition, 2007, Springer science Elsevier.

EI 3025 Principle of Analytical Instrumentation

Credit: 3
Category: PEC
Prerequisite(s) Chemistry (CH 1007)

Course Description:

This course covers analytical instruments are , different types of Spectrophotometers such as Infrared Spectrophotometers and Flame Photometers with their instrumentation are discussed. Gas Chromatograph and Liquid Chromatography, pH Meters and Ion Analyzers are covered. It also includes Spectrometers, Radiochemical Instruments and Pollution Monitoring Instruments. This course enriches the knowledge of students about analytical instruments used in industries.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: differentiate between various techniques involved to determine the concentration of each component from a mixture
- CO2: demonstrate methods to measure the pH level of a liquid using pH meters
- CO3: demonstrate how different gas analyzers are used in industry
- CO4: analyze the different spectrums using spectrometers
- CO5: comprehend the operating principle of instruments used for radiation detection
- CO6: analyze the operating principle of instruments used for pollution monitoring

Topics:

- Fundamentals of Analytical Instruments
- Spectrophotometry
- Chromatography
- pH Meters and Ion Analyzers
- Analyzers
- Spectrometers
- Radiochemical Instruments:
- Pollution Monitoring Instruments

Textbook (s):

1. Handbook of Analytical Instruments – by R.S. Khandpur, 2nd edition, TMH

Reference Book(s):

1. Instrumental Methods of Analysis, Hobart H. Willard, 2012, 7th edition, CBS publisher
2. Principles of Industrial Instrumentation, D. Patranabis, 3rd edition, TMH.

EI 3027 Industrial Instrumentation

Credit: 3
Category: PEC
Prerequisite(s): Nil

Course Description:

This course is designed to improve knowledge and skills by providing a better understanding of process variables, control systems, sensors, transmitters, and more. It also provides the basic overview of power plant instrumentation and control techniques.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: explain sensor, transducer and their performance specifications for measurement of different process variable
- CO2: analyze the construction and working principle of instruments used in various industries for measurement of different process variables like Temperature, Level and Pressure
- CO3: analyze various instrumentation and control used in power plant
- CO4: identify appropriate analytical instrument for measuring, analyzing and establishing the composition of materials
- CO5: solve design problems of the power plant and its various control mechanisms
- CO6: perform measurements and control of turbine systems and its safety

Topics:

- Principles of various temperature, pressure, and level sensors used in industrial instrumentation
- Analytical measurements
- Basics of power plant instrumentation – water circuit, air-fuel circuit
- Turbine monitoring and control

Textbook(s):

1. Power plant Instrumentation-K. Krishnaswamy, M. Ponnibala, 2ndedition,PHI publication
2. Industrial instrumentation & control, S. K. Singh, 3rd Edition, TMH publication.

Reference Book(s):

1. Instrument Engineers Handbook, Vol-1, B.G Liptak, CRC press.
2. Handbook of Analytical Instruments- by R. S. Khandpur, 2nd edition, TMH

EI 3029 Process Dynamics and Control

Credit: 3

Category: PEC

Prerequisite(s): Principle of Control System (EL 2002)

Course Description:

This course covers the fundamental aspects of process dynamics and control, which includes developing dynamic models of processes, control strategies for linear time-invariant systems and instrumentation aspects. The course deals with the development of models for control system design.

Course Outcomes: At the end of the course, students will be able to:

CO1: develop mathematical model and process

CO2: analyze dynamic behavior of different processes

CO3: design basic control schemes using hydraulic, electronic and pneumatic methods

CO4: tune PID controller to improve the performance

CO5: design various complex control schemes for SISO systems

CO6: design controller for multivariable processes

Topics:

- Process dynamics and modelling
- Dynamic response of processes
- Basic control schemes
- Controller tuning
- Complex control schemes
- Controller design for multivariable process

Textbook(s):

1. Process control: Principles and applications, Surekha Bhanot, Oxford,2008.

Reference Book(s):

1. Modern control engineering, K.Ogata, 5th edition, PHI
2. Process control, Dynamic concepts and applications, S.K.Singh, PHI,2007

EI 3030 Power Plant Instrumentation

Credit: 3
Category: PEC
Prerequisite(s): Nil

Course Description:

This course provides a knowledge of the instruments that are used to measure and control the processes of electric power generation, processes of the generation of electricity from tradition fuel sources. The course covers an overview of power generation covering the various conventional and non-conventional energy sources , instrumentation and control of boilers and turbine monitor.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: comprehend various components of thermal power plants and their operations
- CO2: measure the water flow, steam flow and pressure in the water circuit
- CO3: design control schemes for the water circuit
- CO4: measure flow, pressure, temperature and level in air fuel circuit
- CO5: measure electrical, mechanical and process turbine parameters
- CO6: design the control schemes for turbines

Topics:

- Overview of Power Generation
- Instrumentation and Control in Water Circuit
- Instrumentation and Control in Air-Fuel Circuit
- Turbine–Monitoring and Control

Textbook(s):

1. Power Plant Instrumentation – K.Krishnaswamy, M.Ponnibala, 2nd edition, PHI publications.
2. Power Plant Engineering - P.K Nag, 3rd edition, Tata McGraw-Hill.

Reference Book(s):

1. Standard Boiler Operations - S.M. Elonka and A.L Kohal, Tata McGraw-Hill.
2. Mechanical and Industrial Measurements - R.K Jain, 2008, Khanna Publishers.
3. Power Plant Engineering – EL. Wakil, Tata McGraw-Hill.

EI 3032 Principle of Sensors & Data Acquisition

Credit: 3

Category: PEC

Prerequisite(s): Electrical & Electronic Measurement Techniques (EI 2003), Principle of Measurement & Instrumentation (EI 2010)

Course Description:

The main aim of introducing the course is to demonstrate a critical understanding of elements of signal conditioning necessary for a number of sensors and transducers. This course includes operation of analog to digital and digital to analog converters. This course includes appropriate techniques and devices for realizing a data acquisition system and function of output drivers and devices also.

Course Outcomes: At the end of the course, the students will be able to:

CO1: comprehend working principle of sensors & transducers

CO2: characterize and calibrate the sensors & transducers

CO3: comprehend the design of motion transducers used for measuring rotational displacement and velocity

CO4: understand the working of industrial automation systems such as PLC, SCADA

CO5: design amplifiers used for signal conditioning

CO6: understand the application of different data acquisition and conversion systems

Topics:

- Introduction to sensors and transducers
- Rotational displacements
- Rotational velocity
- PLC and SCADA
- Signal Conditioning
- Data acquisition systems
- Instrument calibration concepts

Textbook(s):

1. Electronics measurements and Instrumentation, R.K.Rajput, S.Chand, 2nd revised edition, 2011

Reference Book (s):

1. Digital control and state variable methods: Conventional and Intelligent control systems, M.Gopal, 4th edition, 2012.

EI 3091 Instrumentation Laboratory

Credit: 1

Category: PCLC

Prerequisite(s): Basic Electrical Engineering (EE 1003), Analog Electronics (EC 2027)

Course Description:

This lab will deal with various sensors, their operations, different interfacing techniques with microcontrollers and use of LCDs for output.

Course Outcomes: At the end of the course, the students will be able to :

CO1: analyze characterization of strain and force sensors

CO2: measure the level of fluid by capacitive transducers

CO3: design flow sensors for flow measurement

CO4: analyze characterization of temperature sensors

CO5: analyze characterization of the displacement, pressure sensors

CO6: interface sensors with micro-controller for precise measurement

Topics:

- Strain and force sensor
- Capacitive transducers
- Flow sensor
- Temperature sensors
- Displacement, pressure sensors
- Interfacing sensors with microcontroller for precise measurement

EI 3092 Process Control Laboratory

Credit 1
Category: PCLC
Prerequisite(s): Process Control (EI 3010)

Course Description:

Process control lab deals with automation(PLC/DCS) and different controllers(P, PI, PID) for understanding the characteristics and performance of the level, temperature and flow. PLC platform with HMI is also available through which different on-board applications like conveyor belt control, temperature control, dc motor speed control using ladder logic can be performed. Experiments on pc based level, pressure, flow, temperature loop stations with air compressor using digital PID controller are also conducted.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: determine the characteristics of open and close loop systems using PID controller
- CO2: apply the concepts of interacting and non-interacting liquid level system
- CO3: apply the concepts of PLC, DCS & SCADA and its interfacing with real time system
- CO4: control traffic light, water level in tank, speed of DC motor and control conveyor belt with PLC using ladder logic programming
- CO5: obtain the response using P, PI & PID controller for a typical flow, level, pressure & temperature process station with air compressor
- CO6: analyze the characteristics of control valve, I/p & P/I converter

Topics:

- Introduction to Basic Ladder Logic Programming
- Development of Ladder Logic Using Universal PLC Platform With HMI
- Hardware Verification of Open and Closed Loop Performances of Tank Filling Process Using E-906 PID Controller
- Hardware Verification of Open and Closed Loop Performances of Flow Rate Regulatory Process Using E-906 PID Controller
- Hardware Verification of Open and Closed Loop Performances of Heat Furnace Process Using E-906 PID Controller
- Hardware Verification of Level Control Loop Performance Using Digital PID with Air Compressor
- Hardware Verification of Flow Control Loop Performance Using Digital PID with Air Compressor
- Hardware Verification of Pressure Control Loop Performance Using Digital PID with Air Compressor
- Hardware Verification of Temperature Control Loop Performance Using Digital PID with Air Compressor

EL 2002 Principle of Control Systems

Credit: 3
Category: PCC

Prerequisite(s): Principle of Signals and Systems (EC 2023), Signals and Networks (EC 2021)

Course Description:

This course covers concepts of open- and closed-loop systems, mathematical modeling of physical system, transfer functions, signal flow graphs, feedback theory, time domain analysis, design specifications & performance indices. This course also deals with time response of 2nd order systems, stability analysis using Routh-Hurwitz criteria and root-locus methods, Nyquist plots, frequency responses, Proportional, PI, PID controllers and Lead-lag compensators.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: comprehend open and closed loop control systems
- CO2: compare various time domain specifications and describe their significance
- CO3: explain the concept of P, PI and PID Controller
- CO4: analyze stability using root locus and Routh stability criterion
- CO5: determine the stability of the given control system by constructing Nyquist Plot
- CO6: plot Bode plots for stability analysis and design lag, lead, lag-lead compensators based on its specifications

Topics:

- Mathematical modeling of physical system
- Feedback Theory
- Time domain analysis, design specification & performance indices
- Time response of Second order system
- Stability Criteria
- Frequency domain Analysis
- Cascade Compensation in Frequency Domain

Textbook(s):

1. Control System Engg, I. J. Nagrath & M. Gopal, New Age International (P) Ltd, 2nd edition, 1996.

Reference book(s):

1. Modern Control Engg, K. Ogata, PHI, 3rd edition, 1997.
2. Control Systems Engineering, Norman Nise, Wiley, 3rd Edition.
3. Automatic Control Systems, Benjamin C. Kuo, Prentice Hall.

EL 3024 Industrial Automation and Control

Credit: 3

Category: PEC

Prerequisite(s): Principle of Control System (EL 2002), Linear Control System (EE 2028)

Course Description:

The course discusses a wide range of topics for different types of sensors, actuator, and signal conditioning circuits. This course also discusses about the different types of controllers and its tuning technologies used in the industry. Different automation techniques like PLC including ladder programming, SCADA, DCS are also covered. Different advanced control techniques have also been discussed.

Course Outcomes: At the end of the course, the students will be able to:

CO1: comprehend the working of sensors in signal conditioning circuits and actuators

CO2: determine the effect of gain constant on system performance

CO3: understand different components of PLC and design of the ladder logic

CO4: analyze DCS hardware, its merits/demerits in an industrial automation in comparison with PLC

CO5: analyze SCADA hardware-software and its merits/demerits in industrial automation in comparison with PLC and DCS

CO6: comprehend advanced control techniques

Topics:

- Sensors, Actuators and Signal conditioning
- Controller
- Automation
- PLC
- SCADA
- DCS
- Advanced control techniques

Textbook(s):

1. Computer-Based Industrial Control, Krishna Kant, 2nd edition Prentice Hall of India Ltd.
2. Chemical Process Control – Theory and Practice, Stephanopoulos, Prentice Hall of India Ltd, 1984.
3. Fundamentals of Industrial Instrumentation and Process Control, William C. Dunn, Tata McGraw Hill, 2009.

Reference Book(s):

1. Modern Automation Systems, Muhammad Abdelati, University Science Press, 2009.
2. Modern Control Engineering, 4th edition, Ogata, Prentice Hall of India

HS 2002 Engineering Economics

Credit: 3
Category: HSMC
Prerequisite(s): Nil

Course Description:

The course on Engineering Economics is a specialized need-based extension of applied Economics which is aimed at developing an understanding of the principles governing Economy's vital parameters like market, finance, Production, consumption and distribution.. The course focuses on learning methodical and rational conceptualization and developing the knowledge for effectively implementing these market principles in actual organizational activities and forums. The course intends to develop the ability of taking decisions related to project selection and implementation, optimization of market vitals like sales, revenue, profit, cost etc. It serves as the base of learning all Economics related elective papers offered in higher semesters as well as preparation for any competitive exams like civil services, MAT etc.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: apply economic theory for optimisation of the economic variables of demand, supply, sales, profit, cost and revenue
- CO2: apply the budgeting principles in making economic decisions during project appraisals
- CO3: develop awareness towards all the economic issues related to the financial market, Budget, Money, Credit and Fiscal Policies etc.
- CO4: relate and apply theoretical concepts in Economics with contemporary/modern business practices
- CO5: understand the vitals of the financial market, know the source and methods of raising capital for an organization
- CO6: understand the depreciation of asset principles and efficient inventory/resource management

Topics:

- An Introduction to Economics and Engineering Economics
- Basic Concepts of Economics: Market equilibrium and Consumers and Producer's equilibrium
- Elasticity and Demand Forecasting
- Optimization of Profit and cost
- Break Even Analysis
- Evaluation of Projects: Economic Appraisal Techniques
- Depreciation calculation and Inventory management
- Vitals of Money and capital market

Textbook(s):

1. Managerial Economics: Principles and Worldwide Applications. Dominick Salvatore, Siddartha K. Rastogi, 8th Edition, Pub. Oxford University Press. ISBN: 9780199467068.
2. Engineering Economics – James L. Riggs, David D. Bedworth and Sabah U. Randhawa, 4th Edition, McGraw Hill Education (India) Private Limited, New Delhi, 2016.

Reference Book(s):

1. Principles of Economics, Deviga Vengedasalam and Karunagaran Madhavan, Oxford University Press, New York, 3rd Edition, 2013.
2. Managerial Economics-Principles and Worldwide Applications-Dominick Salvatore, Adapted by Ravikesh Srivastava, 7th Edition, Oxford University Press, 2012.

3. Micro ECON-A South-Asian Perspective-by William A. McEachern and Simrit Kaur, Cengage Learning, 2013.
4. Engineering Economy-Zahid A. Khan, Arshad Noor Siddiquee, BrajeshKumar, Pearson Publication, 2012.
5. Engineering Economics – R.PanneerSelvam, Pub: PHI Learning Private Limited, New Delhi, 9thEdition, 2008.

HS 2008 Economic Environment of India

Credit: 3
Category: HSMC
Prerequisite(s): Nil

Course Description:

The Course on Economic Environment of India is designed to cater encompassing discernment of Indian Economy to the students. The course precisely highlights the role of different sectors in Indian economy and also touches upon the normative aspect of striking balance among different sectors. It covers the status of public economics in Indian context. Besides, it ensures the students to have knowledge on the role of foreign sector.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: develop the analytical understanding of the economic situation of the country
- CO2: develop the skill to interpret the economic indicators during steady growth path and economic crisis
- CO3: acknowledge the role of different policy making bodies in India related to economic affairs
- CO4: develop the ability to analyze the occupational structure of the country and sectoral contribution to growth
- CO5: examine the extent and role played by foreign sector in the form of exchange rate, FDI etc in the domestic economy
- CO6: develop a critical understanding of the fiscal position of the country

Topics:

- Economic Crises and Way out: Economic Crisis of early 1990s-Macro Economic Reforms since 1991
- Primary Sector and Secondary Sector: Agriculture during the Reform Period; New Industrial Policy
- Tertiary Sector and Foreign Sector: Service sector as the engine of growth in India; Trade reforms
- Public Finance: Fiscal reforms in India post 1991; Centre-State Fiscal relationship

Textbook(s):

1. Dutt and Sundaram.Indian Economy. latest edition.

Reference Book(s):

1. Uma Kapila (2019), Indian Economy since Independence, New Delhi, Academic Foundation.
2. Balakrishnan, P. (2010): ‘Economic Growth in India: History and Prospect’. Oxford University Press, New Delhi.
4. Bhagwati Jagdish and Arvind Panagariya(2012): ‘ India’s Tryst with Destiny’. Collins Business, Noida, India.
5. Jean Dereze and Amartya Sen (1996): ‘Indian Development: Selected Regional Perspectives’. Oxford University Press, New Delhi.
7. Ajijava Raychaudhuri and Prabir De (2012), International Trade in Services in India, New Delhi, Oxford University Press.

HS 2010 Financial Institutions, Markets and Regulations

Credit: 3
Category: HSMC
Prerequisite(s): Nil

Course Description:

The course on Financial Institutions, Markets and Regulations is a specialized need-based extension of Financial Economics. This course is designed to present the fundamental concepts and theories in financial market and promote the application to the workplace and professional practice. It introduces current financial concepts and tools towards money management in organizations participating in the local and global economies. The course covers the current best practices in financial analysis and planning through the application of financial concepts in a nutshell. These include financial vitals relate to money and capital markets, time value of money, cost of capital, risks and return, long-term financial budgeting. Inaddition, the course also introduces topics on lease financing, hybrid securities and derivatives, trust funds, mergers and acquisitions and related issues in current financial sector.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: have comprehensive understanding of the nature and functions of the several types of financial institutions operating in the market
- CO2: develop critical skills in applying the principles of finance and financial inter-mediation to the real world situations
- CO3: effectively interact with the financial markets they need to approach for their future economic endeavors and/or in their place of employment
- CO4: make economic decisions and analysis of issues related to security market transactions and policies
- CO5: develop the understanding of the structure and functions of Indian financial institutions, instruments and policies
- CO6: take decisions regarding saving, investments, portfolio contents and diversification to maximize their return and reduce associated risks

Topics:

- Financial systems: Significance of banks and all other Financial institutions
- Financial Innovations
- Overview of Structure of Financial Debts and Equity markets
- Functions of Financial Intermediaries
- Monetary authority: Reserve Bank of India: Its role, structure and functioning
- Subprime crisis
- Derivative markets
- Capital market authority: structure and functions
- Regulation of Capital market, Role of SEBI

Textbook(s):

1. Madura, Jeff (2008), Financial Markets and Institutions, 8th edition, Thomson Publications.

Reference Book(s):

1. Fabozzi, Frank, Modigliani, Franco, Jones, Frank (Feb 2009), Foundations of Financial Markets.
2. Eakins, Stanley G. (2005), Financial Markets and Institutions (5th Edition), Addison Wesley.
3. Howells, Peter, Bain, Keith (2007), Financial Markets and Institutions, 5th Edition.

4. Barth, James R., Caprio, Gerard, and Levine, Ross (2008), Bank Regulations are Changing: For Better or Worse?, Association for Comparative Economic Studies.
5. Goldstein, Morris (2006), Financial Regulation after the Subprime and Credit Crisis, Washington: Peterson institute.

HS 2012 Development Economics

Credit: 3
Category: HSMC
Prerequisite(s): Nil

Course Description:

The course on Development Economics is a specialized need-based extension of Economics dealing with issues related to economic growth and development. It provides an in depth discussion of the different economic description of development and underdevelopment. It will put a deep insight into the most challenging economic issues of poverty, inequality and underdevelopment faced by the humanity. It will deal with the various existing, modern and developing strategies and policies to tackle these issues and foster the economy onto the path of development. The students will be able to assess the pros and cons of a proposed development intervention and its likely impact on the target population.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: develop the understanding of issues related to economic growth and economic development
- CO2: relate and apply the major growth theories in their related academic projects
- CO3: develop the familiarity with major economic issues faced by the country like poverty, inequality, underdevelopment etc.
- CO4: analyse and compare the development paths adopted across countries of the globe
- CO5: analyse the empirical evidence on the pattern of growth and development
- CO6: develop critical understanding of the existing, adopted and needed policies and strategies for sustainable growth and development

Topics:

- Concepts and difference between growth and development.
- Measures of growth and development
- Models of growth and development
- Poverty and Inequality : Perceptions, estimation and measures of improvement
- Impact of poverty and inequality on growth and development
- Cross country perspectives of development

Textbook(s):

1. Todaro, M. P. & Smith, S. C. (2015), Economic Development, Pearson (12th Edition).
2. Thirlwall A. P. Growth and Development (6 th and 7 th edition)

Reference Book(s):

1. Debraj Ray : Development Economics
2. Meier and Rauch,: Leading Issues in Economic Development, OUP, Latest Edition
3. Kaushik Basu :Analytical Development Economics , OUP
4. Human Development Reports, various years
5. Bagchi A. K. The Political Economy of Underdevelopment, Cambridge University Press 1982.

HS 2081 Business Communication

Credit: 1
Category: HSMC
Prerequisite(s): Nil

Course Description:

This course is designed to give students a comprehensive view of communication, its scope and importance in business. This is an interactive course with a view to enhance language and soft skills with the aid of live demonstration within the framework of the syllabus. It is a foundation building measure to enable the students to excel in the corporate world and in day to day life.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: develop competence in reading and comprehension, develop skimming skills for extracting the main idea(s) from the text, and scanning for keywords
- CO2: enrich the fluency of the students with Collocations and Phrasal Verbs
- CO3: use Email effectively and efficiently as per the organization hierarchy. To retain a logical flow while drafting emails, make aware students about the importance of succinct written expression in modern Business Communication
- CO4: write standard and effective Cover Letters and Resume
- CO5: bridge the gap between native language and target language i.e. English, make students communicative competent and develop their fluency in public speaking
- CO6: prepare effective Power Point Slides. Maintain and arrange proper data structure in presentations. To learn skills of making effective presentation (verbal and non-verbal aspects)

Topics:

- Reading Comprehension – Activity based on BEC Training – Matching, Multiple Choice Questions, Open Close, Giving Appropriate Headings
- Collocation – Activity based on Word-Stock, Phrasal Verbs & Vocabulary Building
- E-mail – Activities based on Writing Appropriate Salutation, Paragraphs & Conclusion
- Resume Writing
- Thematic Discussions
- Speaking in Pairs – Everyday Activities & Detailed Introduction
- Activity based on PowerPoint Presentation

HS 3006 Entrepreneurship

Credit: 3
Category: HSMC
Prerequisite(s): Nil

Course Description:

The course has been designed for the students in order to provide basic knowledge of an entrepreneur and opportunities for new entrepreneurship. To provide idea about various financial sources available for small and medium enterprise by different financial institutions. To provide knowledge how to manage working capital of an organization in an efficient manner. To have an idea about motivational tools for increasing the productivity of employees in an enterprise.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: know the contribution of an entrepreneur in growth and development of socioeconomic condition of our country
- CO2: understand the role of SSI units in growth and development of socioeconomic condition of our country
- CO3: learn market survey, sales promotions and management of working capital through costing and book keeping
- CO4: know different decision making technique and benefit of personal management system.
- CO5: learn motivational methods of an enterprise
- CO6: learn how to prepare a project report and knowledge about different tax system of an enterprise

Topics:

- Introduction to entrepreneurship
- SSI Units
- Market survey and research
- Marketing mix
- Financial management
- Working capital management
- Personnel management
- Motivation

Textbook(s):

1. Entrepreneurial Development, S.S.Khanka, S.Chand

Reference Book(s):

1. Industrial Organisation and Engg. Economics, Sharma & Banga, Khanna Publication
2. Entrepreneurship New Venture Creation, David H. Holt, Prentice Hall, PHI

HS 3008 Management Concepts And Practices

Credit: 3
Category: HSMC
Prerequisite(s): Nil

Course Description :

The course curriculum is designed for student in order to provide fundamental knowledge in management area. The students will be able to know about general management concepts and various specialization in management area like marketing, finance, production and strategy management. The marketing management portion of the course will benefit the students to develop their career in marketing line, as most of the organisations give priority for marketing skills. Finance and production management will help the students in their respective domain and serve as a guide in their corporate career. The strategy management portion of this course will serve as a guide for the students to contribute in strategy formulation of the organization and how to achieve that strategy within a stipulated time period.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: perform the critical management functions effectively and develop ideas about implementing principles and theories of management in organizations efficiently
- CO2: develop various marketing skills in order to be successful in corporate world
- CO3: utilize different financial techniques for better management and control of organisational financial resources
- CO4: take strategic decision for day to day operation through proper working capital management.
- CO5: have competency in production planning as well as control measures will become easy in their professional career
- CO6: do strategy formulation of the organization and how to achieve that strategy within a stipulated time period

Topics:

- Introduction to management
- Marketing mix
- Market research
- Financial management
- Working capital management
- Production planning and control
- Inventory management
- Strategy management

Textbook(s)

1. Modern Business Organisation and Management. Sherlekar & Sherlekar, Himalaya Publishing House.
2. Business Organisation and Management. M. C. Shukla, S. Chand

Reference Book(s)

1. Principles & Practices of Management. L. M Prasad
2. A framework for marketing management, Philip Kotler
3. Financial Management. I. M Panday
4. Production and Operation Management, Everett E. Adam Jr. Ronald J. Ebert

HS 3002 Organisational Behaviour

Credit: 3
Category: HSMC
Prerequisite(s): Nil

Course Description:

The course has been designed for the students to provide an understanding about the behaviour of individuals, groups and the system in the organization. The course will help the students how to develop personality and leadership style for achievement of individual and organizational objective. To know about the benefit of motivation for increasing individual and organizational productivity. To Provide knowledge to work in groups and develop techniques for group decision making for organizational development.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: know about organization, organizational behaviour its nature, scope and significance
- CO2: develop their personality as per industry requirement
- CO3: apply motivational techniques to make the employees work with confidence and satisfaction
- CO4: develop different leadership style to adjust themselves in different organizational situations
- CO5: improve the knowledge of group behaviour and techniques of group decision making
- CO6: apply the concepts for managing changes in organization as well as the development of an organization's human resources

Topics:

- Introduction to Organisation and organisational behaviour
- Personality
- Motivation
- Leadership
- Group dynamics
- Organisational change
- Organisational development

Textbook(s) :

1. Organisational behaviour. Stephen P. Robbins, Timothy A. Judge, S. Sanghi, Pearson
2. Organizational Behaviour and Work, F. M. Wilson, Oxford University Press.

Reference Book(s):

1. Organizational Behaviour, Dipak Kumar Bhattacharya, Oxford University Press
2. ORGB, Organizational Behaviour, Nelson, Quick, Khandelwal, Cengage
3. Organisational Behaviour. Dr. S. S. Khanka, S. Chand
4. Managing Organisational Behaviour, Moorhead & Griffin, Cengage Learning.

HS 3004 Human Resource Management

Credit: 3
Category: HSMC
Prerequisite(s): Nil

Course Description:

The course has been designed in order to provide knowledge and idea about human resource management and how to become a professional human resource manager. It will help the students to follow different HR processes like recruitment, training, performance appraisal effectively in organizational level. The students will be able to learn how to manage industrial dispute and develop industrial relation in corporate sector. The course will enable the students to understand the workers participation in management concept through employee discipline and the process of effective bargaining system in the organisation.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: develop personal and professional qualities of a manager in order to manage human resource of an organization effectively
- CO2: meet the human resource requirement of the organization for achieving its objective effectively
- CO3: follow different HR processes like recruitment, selection, training, performance appraisal effectively in organizational level
- CO4: inculcate the sense of inter personal relation required in professional front in handling employer-employee relation effectively for achievement of organizational objectives
- CO5: achieve strategic objectives of the organizations, by optimizing the potentiality of the human resource through workers participation in management
- CO6: know the technique of managing and being managed by the organisation

Topics:

- Human resource management
- Human resource planning
- Recruitment
- Selection
- Training
- Performance appraisal
- Industrial relation
- Industrial dispute
- Collective bargaining
- Workers participation in management

Textbook(s):

1. Human Resource Management, P. Jyoti & D. N. Venkatesh, Oxford Publication, 2016
2. Human Resource Management, B. Varkkey & G. Dessler, Pearson, 2017

Reference Book(s):

1. Human Resource Management. K. Aswathappa, Mc Graw Hill Education, 2013.
2. Human Resource Management. S. S. Khanka, S. Chand, 2019
3. Human Resource Management. P. Subba Rao, Himalaya Publishing House, 2018.

HS 4001 Professional Practice, Law and Ethics

Credit: 2
Category: HSMC
Prerequisite(s): Nil

Course Description:

The course on Professional Practice, Law and Ethics is designed to cater comprehensive insight of law and ethics to the students for practicing in their professional life. The course incisively highlights the role of morals and ethics in leading a sustainable profession. Besides, by containing different relevant laws like laws of contracts, intellectual property law and information technology law, the course provides foundation in law to the students which will help them a lot to face the real life situations with ease.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: select appropriate engineering decisions in consideration of professional ethics in realization of more critical impact of engineering compared to general experiments
- CO2: evaluate and prescribe risk reducing measures
- CO3: comprehend the dynamics in engineers' roles and responsibilities with emerging issues in global scene
- CO4: know the various compliance requirements and the regulatory bodies to protect environment
- CO5: have a fair idea to protect their engineering inventions from unauthorized exploitation under intellectual property rights system and laws relating to information communication technologies
- CO6: understand, analyze and prevent misuse of IT related transactions

Topics:

- Morals and ethics in engineering
- Engineering as social experimentation
- Engineer's responsibility for safety
- Global issues
- Law of contracts and law of torts
- Environmental laws
- Intellectual property law
- Information technology law

Textbook(s):

1. R. Subramaniam, Professional Ethics, Oxford University Press, 2013
2. Indian Contracts Act 1872
3. Patents Act 1970 (Unit-3)
4. Designs Act 2000 (Unit-3)
5. Information Technology Act 2000 (Unit-4)

Reference Book(s):

1. Mike Martin and Ronald Schinzingher, "Ethics in Engineering", McGraw Hill New York, 2005.
2. Charles E Harris, Michael S Pritchard and Michael J Rabins, "Engineering Ethics Concepts and Cases", Thomson Learning, 2000

HS 4003 Legal Issues and Requirements in Engineering

Credit: 1
Category: HSMC
Prerequisite(s): Nil

Course description:

It depicts on law of contracts and law of torts, Consumer Protection Act 1986, Environmental Protection Act 1986, Environmental Impact Assessment 2006, standards for emission, discharge of environmental pollutants from various industries, Intellectual Property Law, Protecting engineering invention, the U.S Utility model approach and need for Utility model in India, Protecting Software and other engineering technologies in cyberspace, maintaining data security and technological privacy in Cyberspace, e-contracts, electronic and digital signatures.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: understand the various legal requirements in terms of contracts
- CO2: interpret the product liability which an engineer is required to take care while processing his engineering innovations
- CO3: illustrate the various compliance requirements and the regulatory bodies to protect the environment
- CO4: demonstrate to protect their engineering inventions from unauthorised exploitation under intellectual property rights system and laws relating to information communication technologies
- CO5: identify Legal Issues in a given case
- CO6: analyse and prevent misuse of IT related transactions

Topics:

- Law of contracts and law of torts
- Environmental Laws
- Intellectual Property Law
- Information Technology Law

Textbook(s):

1. Gurdeep Singh "Environmental Laws" Eastern Book Company, 2nd Edition 2016.
2. V K Ahuja "Law Relating To Intellectual Property Rights" Lexis Nexis, 3rd Edition. July 2017.
3. Pavan Duggal "Cyber Law"-Indian Perspective". 2nd Edition 2016.
4. Avtar Singh "Law of Contracts" Eastern Book Company, 12th Edition, Reprinted 2020.
5. Dr. R K Bangia "Law of Torts". Allahabad Law Agency; 24th 2019 edition (2019).

Reference Book(s):

1. Rosencranz "Environmental Law and policy in india". Oxford University Press, 2001.
2. Howard b rockman "Intellectual Property Law for engineers and scientists". ISBN: 978-0-471-69740-4, Wiley-IEEE Press, June 2004.
3. Mireille Hidebrant " smart technologies and the end of law". ISBN: 978 1 78643 022 9.

MA 2009 Mathematics-III

Credit: 4
Category: BSC
Prerequisite(s): Nil

Course Description:

Students are taught Partial differential equations based on the propagation of heat, wave etc to use in solving engineering problems. The concept of Complex analysis, Residual integration are included to get the knowledge on complex plane. Numerical analysis is included to get approximate solutions to difficult problems for which analytical solution is hard to obtain. Students are given common Probability and Statistical knowledge to use statistical analysis of data.

Course Outcomes: At the end of the course, the students will be able to:

- CO1: solve the PDE problems by separable method, Laplace transform
- CO2: know Complex plane , Complex functions, their differentiation and integration
- CO3: find series expansion of complex functions and evaluate real integrals by residue method
- CO4: determine roots of algebraic/transcendental equations through Newton and Lagrange method and obtain interpolating Polynomials
- CO5: solve ODE numerically by single step and multi step method
- CO6: work out problems related to probability distribution and statistical regression and co- relation

Topics:

- Partial Differential Equation
- Complex Analysis
- Numerical Methods
- Probability

Textbook(s):

1. Advanced Engineering Mathematics(10th edition) by E. Kreyszig , Wiley .

Reference Book(s):

1. Engineering Mathematics by S. Pal and S.C. Bhunia, Oxford University Press.



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ACADEMIC CURRICULA 2024-2025

**B.Tech in Electronics Engineering
VLSI Design and Technology**

**Course Structure and Detailed Syllabi
For students admitted in
2024-25
Academic Session**



Kalinga Institute of Industrial Technology (KIIT)

Deemed to be University U/S 3 of UGC Act, 1956
Bhubaneswar, Odisha, India



Proposed Curriculum
B. Tech in Electronics Engineering (VLSI Design and Technology)
School of Electronics Engineering

SCHEME I
FIRST SEMESTER

Theory							
Sl. No.	Course Code	Subjects	L	T	P	Total	Credit
1	PH10001	Physics	3	0	0	3	3
2	MA11001	Differential Equations and Linear Algebra	3	1	0	4	4
3		Science Elective	2	0	0	2	2
4		Engineering Elective	2	0	0	2	2
5	LS10001	Science of Living Systems	2	0	0	2	2
6	CH10003	Environmental Science	2	0	0	2	2
Total Credit (Theory Subjects)						15	15
Practical							
1	PH19001	Physics Lab	0	0	2	2	1
2	CS13001	Programming Lab	0	2	4	6	4
Sessional							
1	CE18001	Engineering Drawing & Graphics	0	0	2	2	1
Total Credit (Practical & Sessional subject)						10	6
Total Credit (Semester)						25	21

SCHEME I
SECOND SEMESTER (Computer Science and Electronics)

Theory							
Sl. No.	Course Code	Subjects	L	T	P	Total	Credit
1	CH10001	Chemistry	3	0	0	3	3
2	MA11002	Transform Calculus and Numerical Analysis	3	1	0	4	4
3	HS10001	English	2	0	0	2	2
4	EC10001	Basic Electronics	2	0	0	2	2
5	EE10002	Basic Electrical Engineering	2	0	0	2	2
6		HASS Elective I	2	0	0	2	2
Total Credit (Theory Subjects)						15	15
Practical							
1	CH19001	Chemistry Lab	0	0	2	2	1
2	EX19001	Engineering Lab	0	0	2	2	1
Sessional							
1	ME18001	Workshop	0	0	2	2	1
2	YG18001	Yoga	0	0	2	2	1
3	HS18001	Communication Lab	0	0	2	2	1
Total Credit (Practical & Sessional Subjects)						10	5
Total Credit (Semester)						25	20

SCHEME I
SECOND SEMESTER (Civil, Mechanical and Electrical)

Theory							
Sl. No.	Course Code	Subjects	L	T	P	Total	Credit
1	CH10001	Chemistry	3	0	0	3	3
2	MA11002	Transform Calculus and Numerical Analysis	3	1	0	4	4
3	HS10001	English	2	0	0	2	2
4	EC10001	Basic Electronics	2	0	0	2	2
5	ME10001	Engineering Mechanics	2	0	0	2	2
6		HASS Elective I	2	0	0	2	2
Total Credit (Theory Subjects)						15	15
Practical							
1	CH19001	Chemistry Lab	0	0	2	2	1
2	EX19001	Engineering Lab	0	0	2	2	1
Sessional							
1	ME18001	Workshop	0	0	2	2	1
2	YG18001	Yoga	0	0	2	2	1
3	HS18001	Communication Lab	0	0	2	2	1
Total Credit (Practical & Sessional Subjects)						10	5
Total Credit (Semester)						25	20

SCHEME II
FIRST SEMESTER

Theory							
Sl. No.	Course Code	Subjects	L	T	P	Total	Credit
1	CH10001	Chemistry	3	0	0	3	3
2	MA11001	Differential Equations and Linear Algebra	3	1	0	4	4
3	HS10001	English	2	0	0	2	2
4	EC10001	Basic Electronics	2	0	0	2	2
5	EE10002	Basic Electrical Engineering	2	0	0	2	2
6		HASS Elective I	2	0	0	2	2
Total Credit (Theory Subjects)						15	15
Practical							
1	CH19001	Chemistry Lab	0	0	2	2	1
2	EX19001	Engineering Lab	0	0	2	2	1
Sessional							
1	YG18001	Yoga	0	0	2	2	1
2	ME18001	Workshop	0	0	2	2	1
3	HS18001	Communication Lab	0	0	2	2	1
Total Credit (Practical & Sessional Subjects)						10	5
Total Credit (Semester)						25	20



**SCHEME II
SECOND SEMESTER**

Theory							
Sl. No.	Course Code	Subjects	L	T	P	Total	Credit
1	PH10001	Physics	3	0	0	3	3
2	MA11002	Transform Calculus and Numerical Analysis	3	1	0	4	4
3		Science Elective	2	0	0	2	2
4		Engineering Elective	2	0	0	2	2
5	LS10001	Science of Living Systems	2	0	0	2	2
6	CH10003	Environmental Science	2	0	0	2	2
Total Credit (Theory Subjects)						15	15
Practical							
1	PH19001	Physics Lab	0	0	2	2	1
2	CS13001	Programming Lab	0	2	4	6	4
Sessional							
1	CE18001	Engineering Drawing & Graphics	0	0	2	2	1
Total Credit (Practical & Sessional Subjects)						10	6
Total Credit (Semester)						25	21

LIST OF ELECTIVES

Engineering Elective							
Sl. No.	Course Code	Subjects	L	T	P	Total	Credit
1	CE10001	Basic Civil Engineering	2	0	0	2	2
2	ME10003	Basic Mechanical Engineering [#]	2	0	0	2	2
3	EE10001	Elements of Machine Learning*	2	0	0	2	2
4	EC10003	Biomedical Engineering	2	0	0	2	2
5	EE10003	Basic Instrumentation	2	0	0	2	2

Not for students of Mechanical Engineering

* Not for students of Computer Engineering

Science Elective							
Sl. No.	Course Code	Subjects	L	T	P	Total	Credit
1	CH10005	Nanoscience	2	0	0	2	2
2	PH10003	Smart Materials	2	0	0	2	2
3	LS10003	Molecular Diagnostics	2	0	0	2	2
4	PE10002	Science of Public Health	2	0	0	2	2
5	MA10003	Optimization Techniques	2	0	0	2	2

HASS Elective I							
Sl. No.	CourseCode	Subjects	L	T	P	Total	Credit
1	HS10013	Society, Science, and Technology	2	0	0	2	2
2	HS10202	Essential of Management	2	0	0	2	2
3	HS10121	Shades of Economics	2	0	0	2	2
4	HS10123	Indian Economy Post Liberalisation	2	0	0	2	2
5	SO10043	Socio-Political Environment	2	0	0	2	2
6	PS10043	Thinking Perspectives	2	0	0	2	2
7	PS10045	Creativity, Innovation and Entrepreneurship	2	0	0	2	2
8	EX17001	Community/Environment-based Project	0	0	4	2	2

1ST YEAR DETAIL SYLLABUS

PHYSICS

Course Code: PH10001

Credit: 3

L-T-P: 3-0-0

Prerequisite: Nil

COURSE OBJECTIVE

This subject is designed to enrich the basic knowledge of engineering students in the field of physics and to support the engineering and research programs. The subject will also help the students to develop mathematical models to understand the behavior of physical systems and phenomena.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Learn the basic concepts of oscillation, waves, wave function and fields,
- CO 2: Understand the principles of wave phenomena in light and matter, and the quantum mechanics,
- CO 3: Apply the principles of oscillation, superposition of waves, electromagnetic theory, and quantum mechanics in different fields,
- CO 4: Analyze different types of particle motion in different media,
- CO 5: Evaluate the problem-solving skills for the topics learnt, and
- CO 6: Develop critical thinking ability supported by the learned concepts of Physics.

COURSE DETAILS

Oscillation

Damped Harmonic Oscillation (underdamped, overdamped and critically damped), Energy decay, Relaxation time, Quality factor, Forced oscillation, Resonance, Coupled oscillations, Applications.

Waves and Interference

Wave equation, Superposition of waves, Interference of light, Types of interference: Division of wavefront and division of amplitude.

Interference in thin films

Wedge shaped thin film, Newton's rings and their applications, Michelson interferometer, Applications.

Diffraction

Diffraction and its applications, Types of diffraction, Fraunhofer diffraction by a single slit, Plane diffraction grating (condition of maxima, minima), Maximum order of observable spectra, Absent spectra, and Dispersive power, Applications.

Quantum Mechanics

Dual nature of radiation and matter, de Broglie hypothesis for matter waves, Phase velocity and Group velocity, Heisenberg's uncertainty principle and applications, Wave function and its interpretation, Concepts of operators, Schrodinger's time-dependent and time-independent equations, Postulates of Quantum mechanics, Particle in one-dimensional box and applications, Quantum tunnelling and applications.

Electromagnetic Theory

Vector calculus: scalar and vector field, Gradient, divergence and curl, Line, surface and volume integrals, Gauss divergence and Stoke's theorem, Maxwell's equations in differential and integral form with necessary derivations. Electromagnetic wave equations, Transverse nature of electromagnetic waves.

Laser and Fiber Optics

LASER: Properties and applications, Spontaneous and stimulated emission, Meta-stable state, Population inversion, Pumping, Three and four-level Laser, Ruby Laser.

Optical fiber

Principle, Construction, Types of optical fiber, Acceptance angle, Numerical aperture, Applications.

Textbook

1. B. K. Pandey and S. Chaturvedi, Engineering Physics, Cengage Publication, New Delhi, 2nd Edition 2022, ISBN-13: 978-81-953536-7-5.

Reference books

1. D J Griffiths, Introduction to Electrodynamics, Pearson Education, 4th Edition, 2015.
2. L. I. Schiff and J. Bandhyopadhyay, Quantum Mechanics, Tata McGraw-Hill Publications, 4th Edition, 2014, ISBN-9781259062865.
3. A K Ghatak, Optics, Tata McGraw-Hill Publications, 4th Edition, 2008, ISBN: 9780070262157.
4. A. Beiser, Concepts of Modern Physics ,Tata McGraw-Hill Publications, 6th Edition, 2002, ISBN 10: 0071234608.
5. R K Gaur and S. L. Gupta, Engineering Physics, Dhanpat Rai Publications, New Delhi, 2nd Edition, 2012, ISBN-10: 8189928228.

CHEMISTRY

Course Code: CH10001

Credit: 3

L-T-P: 3-0-0

Prerequisite: Nil

COURSE OBJECTIVE

This course is designed to enrich the students with the basic concepts in Chemistry and to strengthen their fundamentals which will support them to pursue education and research in engineering. The course will help the students to conceptualize alternative sources of energy by electrochemical means and use the instrumental techniques to explore chemical products.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Rationalize bulk properties and processes using thermodynamic consideration and apply the knowledge to decide the feasibility of a given process,
- CO 2: Analyze the kinetics of multistep reactions as well as the theories of reaction rates,
- CO 3: Understand the importance of catalysis and their mechanism of action and applications,
- CO 4: Apply the principles of electrochemistry to evaluate properties, such as pH, solubility Product, etc. and understand the working principle of modern batteries,
- CO 5: Apply different spectroscopic techniques, such as UV-Vis, IR and NMR, for structural Elucidation, and
- CO 6: Differentiate between smart and intelligent materials.

COURSE DETAILS

Chemical Equilibrium and Thermodynamics

Introduction, Internal energy, Enthalpy, Entropy and free energy, Dependence of free energy on temperature and pressure, Gibbs-Helmholtz equation, Free energy change and equilibrium constants, Van't Hoff isotherm and isochore, Clapeyron-Clausius equation, Partial molar properties, Chemical potential, and Gibbs-Duhem equation.

Chemical Kinetics

Rate of reaction and rate laws of multiple reactions (steady-state approximation), and of parallel, opposing and consecutive reactions; Theories of reaction rate: Collision theory, Lindemann modification, Absolute reaction rate; Catalysis: Types, theories, and kinetics of enzyme catalysis (Michaelis-Menten mechanism).

Spectroscopy

UV-Vis spectroscopy: Beer-Lamberts law, Types of transition, Concept of auxochrome and chromophores, Factors affecting λ_{max} and, Woodward-Fieser rules for calculation of λ_{max} in diene systems; IR spectroscopy: Types of vibration, Hooks law, detection of functional groups like C=C, -OH, -NH₂ and -C=O;

NMR Spectroscopy

Basics of NMR Spectroscopy: Theory, Chemical shift, Shilding-deshilding effect, Structural elucidation of simple compounds.

Electrochemical Energy Systems

Types of electrodes, electrode/cell potential; Nernst equation and application to: find electrode and cell potential, equilibrium constant, solubility product and pH; Modern batteries: Fuel cells (AFCs, PEMFs, SOFCs, MCFCs), Zn-air battery, Li-ion battery, Na-ion battery, Ni-MH battery.

Smart and Intelligent Materials

Introduction to smart materials, Properties and types of smart materials, Structures, System intelligence- components and classification of smart structures, Common smart materials and associated stimulus-response, Application areas of smart systems.

Textbook

1. S Chawala, Engineering Chemistry, Dhanpat Rai and Co, 4th Edition, ISBN: 9788177001938.

Reference books

1. S Agarwal, Engineering Chemistry: Fundamentals and Applications, Cambridge University Press, ISBN: 9781107476417.
2. S. Chakraborty, S. Sen, and S. Mittal, Engineering Chemistry, Cengage Learning India Pvt. Ltd., ISBN: 9386668645.
3. B.R. Puri, L.R Sharma, and M. S. Pathania, Principles of Physical Chemistry, Vishal Publishing Co., 47th Edition, ISBN: 978-9382956013.
4. R M. Silverstein, Fransis X, Webster, D J Kiemle, Spectrometric Identification of Organic compounds, -Jhon Wiley& Sons, INC, 7th Edition.
5. S Glasstone, Elements of Physical chemistry-, Macmillan publishers, 2nd Edition ISBN: 978-0333038437.
6. D.J. Leo, Engineering Analysis of Smart Material Systems, Wiley 2007, 1st Edition ISBN: 978-0471684770.

ENVIRONMENTAL SCIENCE

Course Code: CH10003

Credit: 2

L-T-P: 2-0-0

Prerequisite: Nil

COURSE OBJECTIVE

This course is designed to create awareness in the students on monitoring, assessment, and management of environmental pollutants. The subject will also make the students aware of more benign chemistry, i.e.,green chemistry, and help them to understand the implementation of Environmental Impact Assessment (EIA).

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Understand the components and composition of the environment along with the radiation balance model,
- CO 2: Rationalize the different types of pollutants, their sources, effects, and control measures,
- CO 3: Develop the idea of water purification strategies,
- CO 4: Identify toxic wastes and conceptualize the principles of solid waste management,
- CO 5: Conceptualize the principles of green chemistry and implement them in the synthesis of advanced material, to reduce pollution, and
- CO 6: Provide for Environmental Impact Assessment (EIA) requirements before planning a project.

COURSE DETAILS

Overview of the Environment

Overview of the environment, terminologies, Components of Earth: Lithosphere, atmosphere, hydrosphere and biosphere, Concept of black body radiation and albedo, eZero-dimensional energy balance model.

Air Pollution and Control

Primary and secondary air pollutants, CFC, Smog (oxidizing and reducing), Important environmental issues: Depletion of the ozone layer, Acid Rain, Greenhouse effect and global warming, Control measures: Baghouse filter, Cyclone separator, Electrostatic precipitator, Catalytic converter, and Scrubber.

Water Pollution and Control

Types and sources of water pollutants, wastewater treatment techniques: Ultrafiltration, aerobic and anaerobic treatment, Reverse osmosis, Electrodialysis, Disinfection by chlorination, Ozonation, Modern water purification system, Water quality parameters like hardness, Water softening process (permutit), WHO guidelines for drinking water.

Soil Pollution and Solid Waste Management

Soil pollution: Sources of pollutants and mitigation measures. Types of solid wastes: Heavy metal, bio-medical and radioactive wastes, Toxic and biochemical effects of solid wastes, Solid waste management (landfilling, incineration, and composting).

Green Chemistry and EIA

Basic principles of green chemistry with examples, Matrices to explain greenness, R⁴M⁴ model, life cycle analysis. Importance, scope and principles of EIA with a case study.

Textbook

1. A. K. De, Environmental Chemistry, New Age International Publishers, 9th Edition.

Reference books

1. S. Chakraborty, D. Dave, and S. S. Katewa, Environmental Chemistry-, Cengage Learning India Pvt. Ltd., 1st Edition.
2. Aloka Debi, Environment Science and Engineering, Universities Press, 2nd Edition.
3. Erach Bharucha, Textbook of Environment studies for undergraduate courses, Universities Press, 2nd Edition.
4. D. De and D. De, Fundamentals of Environment and Ecology, S. Chand & Co, 2013.
5. Jain and Jain, Engineering Chemistry, Dhanpat Rai, Publishing Company.
6. S.C. Santra, Environmental Science, New Central Book Agency, ISBN: 9788173814044.

PHYSICS LABORATORY

Course Code: PH19001

Credit: 1

L-T-P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

This lab course covers different measurement techniques of various parameters using the instruments i.e. interferometer, spectrometer, spherometer, screw gauge, vernier calliper, microscope, and telescope. It includes the application of photoelectric effect and photovoltaic effect in photo cell and solar cell respectively. Evaluation of the mechanical strength of materials by calculating elastic constants such as Young's modulus, rigidity modulus and Poisson's ratio are also included. This course provides hands on training for the usage of electrical, optical and mechanical systems for various measurements with precision and analysis of the experimental data by graphical interpretation and error calculation.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Understand the wave nature of light through experiments based on interference and diffraction Phenomena,
- CO 2: Apply the laws of quantum physics to understand the photoelectric emission using the particle nature of light,
- CO 3: Characterize photovoltaic cells to find out efficiency in terms of power output,
- CO 4: Evaluate mechanical properties of materials using their elastic properties,
- CO 5: Apply the principles of optics such as refraction, total internal reflection to calculate refractive index and related parameters, and
- CO 6: Use the principles of oscillation to understand phenomena such as damping, resonance and to determine the factors (such as gravity, elasticity etc) affecting the time period of various oscillators.

Topics

Measurement by vernier callipers, screw gauge, spherometer: A review

- Determination of wavelength (λ) of a monochromatic light by Newton's ring experiment.
- Determination of wavelength (λ) and difference ($d\lambda$) between wavelengths of sodium D-lines by Michelson's interferometer.
- Determination of grating element ($e+d$) of a plane diffraction grating.
- Determination of Planck's constant using photocell.
- Study of the characteristics of a photo cell.
- Study of the characteristics of a solar cell.
- Determination of Young's modulus (Y) of a material by bending of beam method.
- Determination of Poisson's ratio (σ) of rubber.
- Determination of rigidity modulus (η) of a material by dynamic method.
- Determination of refractive index (μ) of a transparent liquid by Boy's method.
- Determination of numerical aperture of optical fibre.
- Determination of acceleration due to gravity (g) by bar pendulum.
- Determination of damping coefficient, relaxation time and quality factor of damped harmonic oscillation by simple pendulum.
- Measurement of velocity of sound in air using resonance column method.
- Studies on dielectric/multi-ferroic materials (Open ended)
- Diffraction studies using Laser sources (Open ended)

Reference books

1. Physics laboratory instruction manual, School of Applied Sciences, Department of Physics, KIIT Deemed to be University, Bhubaneswar.
2. S. L. Gupta and V. Kumar, 2018, Practical Physics, Pragati Prakashan, 33rd Edition, ISBN: 978-93-87151-58-1.

CHEMISTRY LABORATORY

Course Code: CH19001

Credit: 1

L-T-P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

This lab course covers different types of chemical experiments ranging from volumetric analysis to spectroscopic techniques. This course provides the students with hands-on training in many of the advanced spectroscopic and analytical techniques in chemistry. The experiments in the course span over diverse applications in chemistry. It contains experiments dealing with environmental chemistry, volumetric analysis, organic and inorganic synthesis, electrochemistry, and spectroscopy.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Handle different chemicals with proper safety protocols in an advanced Chemistry laboratory,
- CO 2: Learn and apply basic techniques used in Chemistry laboratory for preparation, purification and identification,
- CO 3: Analyze the kinetics of 1st order reactions and estimate the rate constant,
- CO 4: Use different instrumental techniques such as Conductometry, pH-metry, Potentiometry and Colorimetry,
- CO 5: Analyse basic water quality parameters like hardness, dissolved oxygen, alkalinity, chloride, ferrous iron contents etc, and
- CO 6: Rationalize and learn the spectroscopic and synthesis techniques in chemistry.

Topics

- Estimation of total hardness in a given water sample in terms of calcium and magnesium hardness by EDTA method.
- Estimation of the amount of NaOH and Na₂CO₃ present in a given mixture solution
- (a) Determination of the strength of KMnO₄ solution by using standard sodium oxalate solution. (b) Determination of the amount of Ferrous (Fe²⁺) ions present in the Mohr's salt solution by using standard KMnO₄ solution.
- Determination of the amount of dissolved oxygen present in a given water sample by Winkler's method.
- Finding the strength of Fe²⁺ present in the supplied Mohr's salt solution by potentiometric titration.
- Determination of the rate constant of acid-catalyzed hydrolysis of ethyl acetate.
- Determination of the chloride ion (Cl⁻) present in a given water sample by the argentometric method.
- Finding the strength of supplied acid by pH-metric titration against a standard alkali.
- Finding the strength of a given hydrochloric acid solution by titrating it against standard sodium hydroxide solution conducto-metrically.
- Verification of Beer Lambert's Law and application of this law to determine the unknown concentration of a given solution.
- Determination of the concentration of ferric ions (Fe³⁺) in a given water sample by a spectrometric method using KCNS as color developing agent.
- Determination of the Isoelectric point (pI) of glycine amino acid.
- Synthesis of transition metal complexes and characterization by using IR and ¹H-NMR. (Open ended)
- Determination of the concentration of different ions (cations and anions) in a given water sample by colorimetry. (Open ended).
- Application of potentiometric titrations (Open ended).

Reference books

1. Chemistry laboratory Instruction manual, School of Applied Sciences, KIIT Deemed to be University
2. Vogel's Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J. D. Barnes, M.J.K. Thomas, 6th Edition, Longman
3. Standard methods for examination of water and wastewater, 23rd Edition, APHA.

DIFFERENTIAL EQUATIONS AND LINEAR ALGEBRA

Course Code: MA11001

Credit: 4

L-T-P: 3-1-0

Prerequisite: Nil

COURSE OBJECTIVE

The objective of this course is to familiarize the prospective engineers with techniques in ordinary differential equations and linear algebra. It aims to equip the students to tackle advanced level of mathematics and applications that they would find useful in their disciplines.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Understand the concept of modelling and formulation of Differential equation of physical problems,
- CO 2: Apply different methods to solve ODE problems involving growth-decay, cooling effects and electrical circuits etc,
- CO 3: Develop an ability to solve 2nd and higher order ODEs,
- CO 4: Apply the knowledge of special function in engineering problems,
- CO 5: Use the essential tool of matrices and linear algebra in a comprehensive manner, and
- CO 6: Apply the knowledge of Eigen value and Eigen vector in the field of engineering and also get the concept of complex matrices.

COURSE DETAILS

Ordinary Differential Equations of First Order

Introduction and formation of differential equations, Overview: Variable separable, homogeneous, equations reducible to homogeneous form. Exact differential equations, equations reducible to exact form, linear differential equations, equations reducible to linear form (Bernoulli's equation). Applications of differential equations: Growth-Decay Problem, Newton's Law of Cooling, Mixing problem, Orthogonal trajectories.

Linear Differential Equations of second order

Second order linear homogeneous equations with constant coefficients; differential operators; solutions of homogeneous equations; Euler-Cauchy equation; linear dependence and independence; Wronskian; Solutions of non-homogeneous equations: general solution, complementary function, particular integral; solution by variation of parameters; undetermined coefficients. Applications of 2nd order differential equations in Electric circuit.

Special Functions

Improper Integrals for one variable, some test for convergence of improper integrals, Gamma function, Properties, Beta function, Relation between Gamma and Beta functions. Radius of convergence of power series, Legendre equation. Legendre polynomial. Recurrence relations and Orthogonality property of Legendre polynomial. Bessel's equation, Bessel's function, Recurrence relation.

System of Linear Equations and Vector Space

Linear system of equations; rank of matrix; consistency of linear systems; Solution of system of linear equations: Gauss elimination, inverse of a matrix by Gauss Jordan method, Vector Space, Sub-space, Basis and dimension, linear dependence and independence, Linear transformation.

Matrix-Eigen value problems

Eigen values, Eigen vectors, Eigen basis, quadratic form; Hermitian, Skew-Hermitian forms; similar matrices; Diagonalization of matrices.

Text book

1. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley INC, 10th Edition, 2011.

Reference books

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Edition.
2. H.K. Das, Introduction to Engineering Mathematics, S.Chand & Co Ltd, 11th Edition.
3. B.V. Ramana, Higher Engineering Mathematics, Tata McGraw-Hill Publications 2007.
4. J. Sinha Roy and S. Padhy, A course on ordinary & partial differential Equation, Kalyani Publication, 3rd Edition.

TRANSFORM CALCULUS AND NUMERICAL ANALYSIS

Course Code: MA11002

Credit: 4

L-T-P: 3-1-0

Prerequisite: Nil

COURSE OBJECTIVE

The objective of this course is to familiarize the students with the methods of Laplace and Fourier transformation and various numerical techniques to solve engineering problems.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Apply Laplace Transform to problems in the field of science and engineering,
- CO 2: Use Fourier series and Transform as a tool to solve differential equations,
- CO 3: Estimate the error in the results obtained in the numerical methods,
- CO 4: Solve nonlinear equations that arise in engineering problems and interpolation,
- CO 5: Know various numerical methods of differentiation and integration, and
- CO 6: Apply numerical solution of differential equations and systems of linear equations.

COURSE DETAILS

Laplace Transforms

Laplace Transform, Inverse Laplace Transform, Linearity, Transform of derivatives and integrals, Unit Step function, Dirac delta function, Second shifting theorem, Differentiation and integration of transforms, Convolution, Solution of ODEs and integral equation by Laplace transform.

Fourier Series and Transform: Fourier series, Arbitrary periods, Even and odd functions, Half range expansions, Fourier integral, Cosine and sine transforms, Fourier Transform, Inverse Fourier Transform, Linearity, Fourier Transform of derivative, Convolution.

Approximations & Errors

Approximation of numbers by truncation and rounding-off, Types of errors.

Numerical solution of Nonlinear equations: Solutions by Bisection Method, Fixed Point Iteration Method, Newton-Raphson Method, Regula-Falsi and Secant Method, Rate of Convergence of Secant & Newton-Raphson Method.

Interpolation & Approximation Finite Differences, Operators and Relation between them. Interpolation: Newton's forward and backward difference interpolation, Newton's divided difference interpolation and Lagrange interpolation.

Numerical Differentiation & Integration: Numerical differentiation of first- and second-order equations using difference table. Trapezoidal rule, Simpson's 1/3rd and 3/8th rules, Gauss-Legendre's two-point and three -point formulae. Error in Numerical Integration.

Numerical Solution to ODE

Taylor's (OK?) series Method, Euler's Method, Modified Euler's Method, Runge-Kutta Methods of order 2 and 4, Reduction of second-order ODE to system of first-order ODEs and its solution by R-K method of order four.

Solution of System of Linear Equations, Solutions by Gauss-Seidel and Gauss-Jacobi methods.

Textbooks

1. E Kreyszig, Advanced Engineering Mathematics by Wiley, INC, 10th Edition.
2. Jain, Iyenger and Jain, Numerical Methods for Scientific and Engineering Computation, New age International (P) Ltd., 6th Edition.

Reference books

1. B.S. Grewal, Khanna ,Higher Engineering Mathematics, Publishers, 44th Edition.
2. B.V. Ramana, Higher Engineering Mathematics, Tata McGraw-Hill Publications, 2007.
3. A, Thangapandi and Somasundaram, Numerical Methods, Scitech Publishers, 2nd Edition.

SCIENCE OF LIVING SYSTEMS

Course Code: LS10001

Credit: 2

L-T-P: 2-0-0

Prerequisite: Nil

COURSE OBJECTIVE

The objective of the course is to enrich the basic knowledge of students in the field of biology and use that knowledge to support the engineering and research programs. Besides, the course also helps to learn methodology to establish models for various biological phenomena and apply the aforementioned models to predict/analyse the functionality of various systems.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Learn the typical characteristics that distinguish life forms and analyze life process at cellular level,
- CO 2: Apply concepts on structure and function of simple biomolecules in life processes
- CO 3: Understand different process involved in life and analyse their effects,
- CO 4: Analyse different biological phenomena and relate them to engineering applications,
- CO 5: Comprehend different physiological functions and relate them to computer-based techniques, and
- CO 6: Implement concepts of biology and their relevance to engineering and technology.

COURSE DETAILS

Cellular Organization of a Living Organism

Biology in engineering, The Living World: Biodiversity of living world, Microorganisms, Cell as the basic unit of life, Cell theory, Structure and function of Prokaryotic and Eukaryotic cells, Cell growth and reproduction, Homeostasis, Concept of gene, Basic structure and function of chromosomes.

Molecular and Biochemical Basis of an Organism

Chemical Context of Life: Water, Carbon, Structure and Function, Types of bonding, Bio- macromolecules (Carbohydrates, Proteins, Amino acids, Lipids and Nucleic acids), Protein synthesis, Cell differentiation, Stem cells and their applications.

Enzymes, Photosynthesis, Metabolism and Bioenergetics

Enzymes: Introduction, structure, properties, Classification, Mechanism of enzyme actions, Factors affecting enzyme action, Strategies utilized by enzymes to affect catalysis. Photosynthesis: Introduction, pigments, process of photosynthesis, Mechanism of photosynthesis (light reaction and dark reaction). Metabolism and Bioenergetics: Anabolism and catabolism.

Nervous system, Immune system and Cell Signaling

Nervous system: Introduction, History of neuroscience, Types of glial cells, Nerve cells - Neurons, Organization of the nervous system, Action potential, Diseases of the nervous system, Computer-based Neural Networks. Immune system: Introduction, Innate Immunity, Adaptive or acquired immunity, Diseases of the immune system, Immune engineering. Cell signaling: General principles of cell signaling.

Molecular Machines, Biosensor and Bioremediation

Molecular Machines: Introduction, Molecular motors and Machines, F0F1-ATP synthase motors, Cytoskeleton associated motors. Biosensors: Concept of biosensor, Working principle, Types of biosensors, Glucose biosensors, Bio-detectors: DNA detection biosensor, Detection of pollutants, Biosensor in food industry. Bioremediation: Introduction, Role of microorganisms, Factors determining bioremediation, Types – *in situ/ex situ*, Advantages and disadvantages, Biofuel.

Textbook

1. S. Thyagarajan, N. Selvamurugan, M.P Rajesh, R.A Nazeer, Richard W. Thilagarajan, S. Bharathi and M.K. Jaganathan, Biology for Engineers, McGraw Hill Education (India), 7th Edition, 2022.

Reference books

1. P. H. Raven and G.B. Johnson. Biology (Indian Edition), Tata McGraw Hill Education Publication, 13th Edition, 2023.
2. E D. Enger, Feederick C, Ross and David B. Bailey. Concepts of Biology, Tata McGraw-Hill Publication, 14th Edition, 2011.
3. Neil A. Campbell and Jane B. Recee, Biology, Pearson Education, 8th Edition , December 2007.
4. Cecie Starr, Biology Concepts and Application, Thomson Books, 6th Edition, January 2006.

ENGLISH

Course Code: HS10001

Credit: 2

L-T-P: 2-0-0

Prerequisite: Nil

COURSE OBJECTIVE

The objective of the course is to develop and improve, in the students, the skills of active listening, speaking, reading, and writing in English, through lecture classes and practice sessions, and improve their professional communication abilities. The course will help the students to enhance their critical thinking and situational communicative skills through the study of contemporary social issues depicted in literature.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Apply verbal and non-verbal modes of communication effectively in practical Situations,
- CO 2: Retain a grammatically correct and logical flow while drafting reports and other technical pieces of writing,
- CO 3: Develop competence in reading and comprehension,
- CO 4: Implement active listening responses in professional practice,
- CO 5: Utilize neutral accent in English pronunciation successfully, and

CO 6: Understand situational and conversational English used for different purposes and contents.

COURSE DETAILS

Professional Communication

Process of Communication: Definition, Explanation & Diagram, Difference Between General and Technical Communication; Methods of Communication (Verbal & Non-Verbal); Non-Verbal Communication (Kinesics, Proxemics, Chronemics, Oculistics, Olfactics, Gustorics, Haptics, and Iconics); Paralanguage; Flow of Communication (Formal & Informal); Levels of Communication; and Barriers of Communication (Intrapersonal, Interpersonal, and Organizational).

Basics of Grammar and Writing Skills

Error Detection in Sentences: Articles, Prepositions, Tense, Subject-Verb Agreement, Active and Passive Voice; Use of Punctuation: Full Stop, Comma, Colon, Semi-colon, Single & Double Inverted Commas, Exclamation & Interrogation Marks, Hyphens and Dashes, and Ampersand;

Paragraph Writing – Components; Writing Bias-free English; Business Letters: Enquiry, Claim/Complaint, and Order; Technical Reports: Formats, Style & Referencing; and Reading Techniques: Skimming, Scanning, Intensive & Extensive Reading.

Basic Sounds of English

Hearing & Listening: Types of Listening – Appreciative, Empathetic, Critical, Comprehensive, Superficial, Differences between Listening & Hearing; Introduction to Basic Sounds of IPA: Symbols of IPA, Types of Vowels & Consonants; and Problem Sounds & Mother Tongue Influence: Concept of MTI with Examples.

English Literature

Short Story – O. Henry: ‘Gift of the Magi;’ Short Story – Ismat Chughtai: ‘Sacred Duty;’ Poem – Robert Frost: ‘Stopping by Woods on a Snowy Evening;’ Poem – Tennessee Williams: ‘We Have Not Long to Love;’ and Drama: William Shakespeare: Merchant of Venice.

Textbook

1. M. Ashraf Rizvi, Effective Technical Communication, Tata McGraw Hill Education Publication, 2005.

Reference books

1. Sidney Greenbaum. The Oxford Grammar (English). Oxford University Press, 1st Edition. 2005.
2. S Verma, Technical Communication for Engineers, Vikas Publishing House, 2015.
3. R Dove, The Penguin Anthology of 20th Century American Poetry, Penguin Books. 2013.
4. The Merchant of Venice (The New Cambridge Shakespeare). Mahood & Lockwood eds. CUP. 2018.

COMMUNICATION LABORATORY

Course Code: HS18001

Credit: 1

L-T-P: 0-0-2

Prerequisite: NIL

COURSE OBJECTIVE

This subject is designed to enrich the basic knowledge of engineering students in the field of communication and to support the engineering and research programs.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Use English grammar correctly and unambiguously in technical writing,

CO 2: Apply verbal and non-verbal modes of communication effectively in practical situations,

CO 3: Have a basic understanding of the communication process and to know the practical implementations in the workplace,

CO 4: Retain a logical flow while drafting reports and other technical pieces of writing,

CO 5: Develop competence in reading and comprehension, and

CO 6: Be familiar with English pronunciation and use neutral accent successfully.

COURSE DETAILS

Reading Comprehension

Understanding meaning and sequence of ideas in written language

Activity based on matching, multiple choice questions, open close, appropriate headings.

Time & Tense + Subject-Verb Agreement

Applying correct grammar in everyday writings.

Vocabulary Building (Mind Mapping/Phrasal Verbs)

Developing vocabulary through associating key ideas, and learning idioms and phrases.

Listening Comprehension

Interpreting meaning and syntax in spoken language.

E-mail Writing

Formulating appropriate e-mails with relevant salutation, language & conclusion

Resume Writing/ Video Resume

Creating suitable, job-oriented resume

Thematic Speaking

Practising and implementing theme-based individual speaking skills.

PowerPoint Presentation

Developing skills to design and deliver engaging, informative and impactful presentations

Class Participation.

BASIC ELECTRONICS

Course Code: EC10001

Credit: 2

L-T-P: 2-0-0

Prerequisite: Nil

COURSE OBJECTIVE

The subject is designed to familiarize students of all branches to the all-pervasive field of Electronics, enable them to carry out research in interdisciplinary fields involving semiconductor devices, and utilize the knowledge in solving practical problems in real life in today's age of electronics.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Understand the properties of semiconductor and current conduction mechanism,

CO 2: Comprehend the working of P-N junction diodes; identify different diode circuits and analyze them,

CO 3: Understand the working of different types of transistors,

CO 4: Know about OP-AMP and its applications,

CO 5: Analyze the working of op-amp using either inverting or non-inverting configurations, timing circuit, regulated power supply ICs, and their applications, and

CO 6: Realize the importance of various analog and digital electronic systems and electronic devices.

COURSE DETAILS

Semiconductors, Diodes and Transistors

Properties of semiconductor materials, Applications of semiconductors as p-n junction diode, Diode characteristics and breakdown mechanisms, Half-wave and full-wave rectifiers with filters, Zener diode, Transistor constructions, operations and their characteristics. Transistor biasing, amplifiers, and load line analysis, Concepts of JFET and MOSFET.

Operational Amplifier (Op-amp) and applications

Introduction to Op-amp and its Characteristics. Application of Op-Amp as Inverting amplifier, Non-inverting Amplifier, Summing, Difference amplifier and comparator

Introduction to Digital Electronics

Different number systems and its conversions, Logic gates and truth tables of OR, AND, NAND, EX-OR. Combinational circuit and Sequential circuit.

Miscellaneous Electronic Devices

SCR, Opto-electronic devices and fiber techniques, Introduction and description of sensor performance, Fundamentals of analog communication techniques (AM and FM).

Textbook

1. J Millman, Christos C. Halkias & C D. Parikh, Integrated Electronics: Analog and digital circuits and Systems , 9th Edition, 2021.

Reference books

1. R. L. Boylestad & L. Nashelsky, Electronic Devices & Circuits, PHI, 7th Edition, 2021
2. D. A. Bell. Electronic Devices and Circuits.(Oxford) 5th Edition, 2021.
3. D. Chatopadhyay and P. C. Rakshit. Fundamentals & Applications , New Age International, 15th Edition 2021.

BASIC ELECTRICAL ENGINEERING

Course Code: EE10002

Credit: 2

L-T-P: 2-0-0

Prerequisite: Nil

COURSE OBJECTIVE

The course is designed to provide to the students a comprehensive overview of the basics of the electrical engineering discipline. In particular, the course includes fundamental aspects of DC, AC and magnetic circuit analysis, working principles and applications of machines, and safety measures used in various electrical apparatus and appliances.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Analyze the concept of DC circuit,
- CO 2: Understand the concepts of AC circuits,
- CO 3: Analyze the three phase circuit,
- CO 4: Interpret the behavior of magnetic circuits,
- CO 5: Remember the principles and operation of electrical machines, and
- CO 6: Know the concepts of electrical safety and protection systems.

COURSE DETAILS

D. C. Circuits

Kirchhoff's law, Source transformation, Star-delta transformation and equivalent resistance of the circuits, Mesh and Nodal analysis, Superposition theorem.

A.C. Circuits

Peak, average, R.M.S. values of sinusoidal quantities, Peak factor, Form factor, Phase difference, Phasor representation, AC through R, L, C, AC Series Circuit (RL, RC, RLC), Three-phase AC circuits: Voltage, current and power in star and delta connections.

Electromagnetic Circuits

Magnetizing Force, Reluctance, Permeance, Magnetic field, Magnetic permeability, Analogy between Electric Circuits and Magnetic Circuits. Series magnetic circuit, BH curve.

Scope and Safety Measures

Electrical Energy Scenario in India, Application of Transformer, Three-phase and single-phase induction Motors, Power ratings of air conditioners, PCs, laptops, printers, refrigerator, washing machine, different lamps, electricity tariff, calculation of electricity bill for domestic consumer.

Personal Safety Measures

Electric Shock, Earthing and its types, Safety Precautions to avoid shock.

Equipment Safety Measures

Working principles of fuse and miniature circuit breaker (MCB), Residual Current Circuit Breaker (RCCB).

Text books

1. V K Mehta, Rohit Mehta, Principles of Electrical Engineering and Electronics S Chand and Company, New Delhi ,Revised Edition 2013.
2. D.C. Kulshreshtha, Basic Electrical Engineering Tata Mcgraw publication, 1st Edition 2011.
3. T.K. Nagasarkar and M.S. Sukhija Basic Electrical Engineering, , Oxford University press, 3rd Edition 2017.

Reference book

1. Sanjeev Sharma, Basics Electrical Engineering I.K.International, New Delhi ,Third Reprint 2010.

ENGINEERING MECHANICS

Course Code: ME10001

Credit: 2

L-T-P: 2-0-0

Prerequisite: Nil

COURSE OBJECTIVE

Engineering Mechanics is a specialized need-based extension of Applied Physics and uses the principles of Statics and Dynamics. The objective of this course is to build the foundational knowledge of the students which is required for the design of mechanical systems. In particular, the course will cover aspects of analysis of rigid body, frame and machine under the action of force system, and analysis of free body diagram of a system whether at rest or in motion.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Draw complete and correct free-body diagrams and write the appropriate equations from the free-body diagram,
- CO 2: Use scalar analytical techniques for analyzing forces and moments in mechanical systems,
- CO 3: Analyze forces in statically determinate structures such as trusses, frames and problems related to friction,
- CO 4: Determine the centroid and second moment of area,
- CO 5: Apply fundamental concepts of kinematics and kinetics of particles to the analysis of simple and practical problems, and
- CO 6: Solve real life problems by using mathematics, physical laws and theorems.

COURSE DETAILS

Concurrent Forces in a Plane

Introduction to Engineering Mechanics, Free-body diagrams, Composition and resolution of forces, Methods of moments. Friction: Concept of friction, Wedge friction.

Force Analysis of Plane Trusses

Methods of joints, Method of Sections,Centroid: Parallel forces in a plane, Centroid of plane figures, Theorem of Pappus, and Centroid of composite plane figures.

Moment of Inertia

Moment of Inertia of plane figures, Parallel axis theorem, Perpendicular axis theorem, and Moment of Intertia of composite figures.

Principle of Virtual Work

Equilibrium of Ideal Systems, Virtual work.

Dynamics of Particles

Differential equations of rectilinear motion, Free vibration, D'Alembert's Principle, Momentum and Impulse, Work & Energy, Conservation of energy, Impact.

Curvilinear Motion

Normal and tangential acceleration, Motion of a projectile, Work and Energy in curvilinear motion.

Rotation of a Rigid Body

Kinematics of rotation, Rotation under the action of a constant moment.

Textbook

1. S Timoshenko, D. H Young & J.V. Rao, Engineering Mechanics, Tata McGraw-Hill Publication 5th Edition, 2017.

Reference books

1. I H Shames, Engineering Mechanics (Statics and Dynamics) , Prentice Hall, 4th Edition, 2005.
2. S.S. Bhavikatti, Engineering Mechanics –New Age International,8th Edition, 2021.
3. S. Rajasekaran and G. Sankarasubramanian Engineering Mechanics (Statics and Dynamics),Vikas publishing House, 3rd Edition, 2017.

WORKSHOP

Course Code: ME18001

Credit: 1

L-T-P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

This workshop practice is designed to impart students the basic knowledge on manufacturing or developing a given object irrespective of their branch of engineering. While furnishing the given object, students will familiar with various mechanical operations and the respective tools or machines. This course involves four different sections namely Fitting, Welding, Turning and Sheet metal which cover both conventional and advanced tools to provide students the updated manufacturing experience. Students are also advised with various safety precautions to be followed during a specific manufacturing practice. At the end, students will also gain knowledge on different advanced machines such as CNC machine tools and 3D printing.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Practice different operations related to fitting shop,
- CO 2: Use different welding tools to prepare a given type of joint,
- CO 3: Demonstrate various turning operations including taper turning and knurling using a conventional lathe machine,
- CO 4: Design a tray and prepare it using sheet metal equipment involving soldering,
- CO 5: Appraise different operations using a CNC machines, and
- CO 6: Interpret different advanced machines such as 3D printing/additive manufacturing.

Topics

- Turning operations
- Sheet metal operations

- Fitting
- Welding

ENGINEERING DRAWING & GRAPHICS

Course Code: CE18001

Credit: 1

L-T-P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

The objective of this course is to provide students with knowledge and abilities to design a 3D object on 2D paper by hand sketching method and by means of computer aided drafting software.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Use common drafting tools properly,
- CO 2: Select, construct and interpret appropriate drawing scale as per the situation,
- CO 3: Draw orthographic projections of points, lines and planes,
- CO 4: Draw orthographic projection of solids like cylinders, cones, prisms and pyramids,
- CO 5: Develop the section of solids for practical situations, and
- CO 6: Communicate ideas effectively using Computer Aided Drafting.

Topics

- Introduction to Engineering graphics
- Lettering
- Projection of points & lines
- Line inclined to both the planes
- Projection of planes
- Introduction to Computer Aided Drafting
- Projection of solids
- Section of solids
- Development of surface

Textbook

1. K. Venugopal,Engineering Drawing + AutoCAD New Age Publishers, 1st Edition, 2011.

Reference book

1. S. N. Lal Engineering Drawing with an Introduction to AutoCAD, Cengage India Private Limited, 1st Edition, 2017.

PROGRAMMING LABORATORY

Course Code: CS13001

Credit: 4

L-T-P: 0-2-4

Prerequisite: Nil

COURSE OBJECTIVE

The course aims to provide exposure to problem-solving through programming. It aims to train the student to the basic concepts of the C-programming language. This course involves lab component which is designed to give the student hands-on experience with the concepts.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Have fundamental knowledge of computers hardware and number systems with commands in Linux,
- CO 2: Write, compile and debug programs in C language.
- CO 3: Design programs involving decision structures, loops, and functions.
- CO 4: Construct arrays to store, manipulate, search and display data.
- CO 5: Apply the dynamics of memory by the use of pointers.
- CO 6: Use different data structures and create/update basic data files.

Topics

- Basic linux commands
- Operators and Expressions
- Branching statements (if-else, switch).
- Control statements (looping - for, while, do-while).
- Arrays
- Character Arrays (strings).
- Functions.
- Pointers and Dynamic Memory Allocation.
- Structures and Unions
- File Handling

SCIENCE ELECTIVE

NANOSCIENCE

Course Code: CH10005

Credit: 2

L-T-P: 2-0-0

Prerequisite: Nil

COURSE OBJECTIVE

This course is designed to educate, inspire, and motivate young students about nanoscience, nanotechnology, and their applications. The course provides information on the latest innovations in this field to get insights into the nanomaterials synthesis/fabrication and applications that can be achieved at a nanoscale.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Learn fundamental aspects of nanoscience,
- CO 2: Classify different types of nanomaterials based on their dimension and composition
- CO 3: Understand different synthesis techniques to grow nanomaterials,
- CO 4: Analyse nanomaterials using different characterisation techniques,
- CO 5: Apply the acquired knowledge to design new materials, and
- CO 6: Evaluate the importance of nanoscience in engineering applications.

COURSE DETAILS

Introduction

Concept and Classifications based on dimensions and compositions, Significance of nanosize: Surface area to volume changes; Properties changing with size (reactivity, melting point, catalytic, electrical, optical), Nanoscience in nature, and Quantum dots as data storage.

Synthesis of nanomaterials

Top-down synthesis (Mechanical method-ball milling, Photolithography, Laser ablation, sputtering), Bottom up (pyrolysis, sol-gel, CVD, self-assembly), Green synthesis (metallic nanoparticles, metal oxides), Biosynthesis.

Characterization

XRD-X-ray generation, Working principle (Bragg's law), Peak broadening in nanomaterials (Scherrer formula), Electron microscopy (SEM, TEM)—high energy electron generation, electron optics, Scanning Electron Microscopy (SEM)—secondary, back scattered, EDX, Transmission Electron Microscopy (TEM)—bright field imaging, dark field imaging, and Selected area diffraction pattern.

Applications

Cosmetics—ZnO, SiO₂, TiO₂ Nanoparticles in cosmetics, SiO₂ TiO₂ in toothpaste, silver, gold, copper nanoparticles in skin care product; *Medical Fields*—MRI, CT scan contrast enhancement agent, Drug and gene delivery system, Magnetic hyperthermia treatment; *Agriculture*—Nano-pesticides, herbicides, and fungicides, Food packaging; *Aerospace and Aviation Industries*—Carbon nanotubes (CNT)nanocomposites, Metal Nanoparticle-Polymer composites, SiC Nanoparticle reinforced alumina (high temperature strength, creep resistance); and *Nanomaterials for Environmental Remediation*—Degradation/removal of pollutants.

Textbook

1. B S Murty, P Shankar, Baldev Raj, B B Rath and James Murday, Textbook of Nanoscience and Nanotechnology, 1st Edition, 2012, ISBN-13: 978-8173717383.

Reference books

1. Luisa Filippini and Duncan Sutherland.,Nanotechnologies: Principles, Applications, Implications and Hands-on Activities, Edited by the European Commission Directorate-General for Research and Innovation Industrial technologies (NMP) program, 2012, ISBN: 978-92-79-21437-0.
2. Charles P. Poole Jr., Frank J. Owens., Introduction to Nanoscience and Nanotechnology, An Indian Adaptation, 3rd Edition, 2020, ISBN-13: 978-9354240201.
3. P. I. Varghese, T. Pradeep. A Textbook of Nanoscience and Nanotechnology, Tata McGraw Hill Education, 2017, ISBN: 9781259007323.

SMART MATERIALS

Course Code: PH10003

Credit: **2**

L-T-P: **2-0-0**

Prerequisite: Nil

COURSE OBJECTIVE

This course is designed with the objective of enabling engineering students to get a flavour of advances in materials science. The knowledge of smart materials learnt by the students in the course will let them to realize the usefulness of various new-age materials for technological advances and allow them to explore further in their higher semesters. This course will help them bridge the gap between traditional text book science put into physics, chemistry, etc. and the state-of-the-art science of materials.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO1 : Learn about smart materials, their properties and applications,
- CO2 : Understand types of smart material based on their electrical and magnetic properties,
- CO3 : Characterize piezoelectric, ferroelectric and multiferroic materials,
- CO4 : Identify novel functions of smart materials,
- CO5 : Apply the acquired knowledge of smart materials in different applications, and
- CO6 : Evaluate the importance of smart materials in day-to-day life.

Introduction to Smart Materials

common smart materials and associated stimulus-response, Classification: active and passive, Piezoelectric, Shape-memory alloys, Photo-responsive polymers, Electroactive polymers, Magnetostriction and Electro-striction, Thermo-responsive polymers, Dielectric elastomers, Halochromic, Thermoelectric materials; Application areas of smart materials: Space, health care and biomedical sectors.

Piezoelectric Materials: Piezoelectric Effect

Direct and Converse, Piezoelectric coefficients, Piezoceramics, Piezopolymers, Piezoelectric Materials as Sensors, Actuators etc.

Shape-memory Alloys

Shape memory alloys (SMAs) and properties, Phase change in SMAs, Shape memory effect: One-way and two-way, binary, and ternary alloy systems, Applications.

Chromic Materials

Photochromic, Thermochromic, Electrochromic, Magneto-chromic and Piezo-chromic Materials.

Multiferroic Materials

Multiferroics definitions, Ferroic phases, Magnetoelectric coupling; Type-I and Type-II multiferroics, Mechanism: Charge ordering, lone pair, geometric effect, and spin driven mechanism; Multiferroic materials, Applications.

Textbook

1. B. K. Pandey and S. Chaturvedi, Engineering Physics, Cengage Publication, New Delhi, 2nd Edition 2022, ISBN-13: 978-81-953536-7-5.

Reference books

1. Mohsen Shahinpoor, Fundamentals of Smart Materials, 2020, Royal Society of Chemistry, ISBN: 9781782626459.
2. M. Schwartz, Smart Materials, 1st Edition, 2008, CRC Press, ISBN 9781420043723.

MOLECULAR DIAGNOSTICS

Course Code: LS10003

Credit: 2

L-T-P: 2-0-0

Prerequisite: Nil

COURSE OBJECTIVE

The objective of the course is to understand methods and techniques that are used to study biological processes in living beings. They include experimental and methodological approaches, protocols and tools for biological research.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Learn the basics of Genes, Chromosomes, DNA, RNA and proteins along with their Aberrations,
- CO 2: Understand the principles and working mechanisms of various instruments used in the study of biological processes in living things,
- CO 3: Apply the knowledge of different diagnostics methods for quantitative estimation of xenobiotics (drugs and their metabolites) and biotics (proteins, DNA, metabolites) in biological systems,
- CO 4: Analyze the recent developed techniques which are required for gene editing and their Applications,
- CO 5: Evaluate the role of various bio-analytical techniques in environmental studies, biomedical sciences, life sciences, molecular biology, and biotechnological research, and
- CO 6: Implement the knowledge of diagnostics in designing point-of-care instruments for different diseases.

COURSE DETAILS

Biomolecules

Overview of DNA, RNA, and Proteins, Chromosomal structure & mutations, DNA polymorphisms; and Gene and Genetic errors.

Molecular Basis of Diseases

Infectious, non-infectious; Diagnosis- traditional, modern tools, Concepts of molecular diagnostics.

Molecular Diagnosis and Techniques

DNA fingerprinting, Auto-antibody fingerprinting, Southern blotting, PCR, Real-time PCR and variations; Nucleic acid sequencing: New generations of automated sequencers, CRISPR technology and its use in diagnostics and gene editing.

Protein Diagnostics Techniques

Antigen-antibody reactions, ELISA, variations of ELISA; Western blotting.

Point-of-Care Devices

Biosensors and nano-biosensors for disease and metabolites detection.

Textbook

1. M K. Campbell, S O. Farrell, O M. McDougal, AE Biochemistry, Cengage Publisher, 9th Edition 2017, ISBN-13: 9789814846448.

Reference books

1. N Rifai, Andrea Rita Horvath and Carl T. Wittwer, Principles and Applications of Molecular Diagnostics, 2018, Elsevier Publisher, 1st Edition, 2018.
2. K G Ramawat & Shaily Goyal, Molecular Biology and Biotechnology, ISBN 9788121935128 Publisher S Chand & Co., 2nd Edition, 2010.
3. H Lodish, Arnold Ber, Molecular Cell Biology, WH Freeman Publisher, 8th Edition, 2016, ISBN-10 9781464187445.

SCIENCE OF PUBLIC HEALTH

Course Code: PE10002

Credit: 2

L-T-P: 2-0-0

Prerequisite: Nil

COURSE OBJECTIVE

The objective of this course is to orient the students to core scientific disciplines in public health practice.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Understand and enlist the scientific approaches in public health,
- CO 2: Understand and apply the epidemiologic and biostatistical science in evidence synthesis,
- CO 3: Understand and apply the environmental health science in public health practice,
- CO 4: Understand and apply the social and behavioral science in public health practice,
- CO 5: Understand and apply the health economic and health management principles in setting priority for resource allocation, and
- CO 6: Understand and apply the health economic and health management principles in health system optimization.

COURSE DETAILS

Scientific Approaches to Public Health

Health and public health concepts, Science and practice of applied public health: Scientific disciplines as part of interdisciplinary public health, Examples of use of behavioral model in changing the community perception of public health interventions

Social and Behavioral Sciences in Public Health

Social and behavioral determinants of health and disease, WHO and CDC models of social determinants of health, Disease and social status, Disease and poverty, Social interventions for good health.

Health behavior change models for public health interventions, Health Belief Model, Transtheoretical Model. The theory of planned behavior, Health communication to improve the outcome of public health interventions

Environment Health Sciences in Public Health

Environment & climate change, Ecosystem, Lifestyle and dietary effects on health, food safety and sanitation, Environmental pollution, waste disposal and treatment.

Epidemiology and Data Science in Public Health

Epidemiology and achievements in public health, Measurements in Epidemiology—Incidence and prevalence, Causation and association, and Measures of association.

Outline of study designs (including cross-sectional study design, case-control study design, cohort study design and randomized control trials); Introduction to confounding and bias; Screening tests- validity and reliability methods.

Management and Economic Sciences in Public Health

Systems approach (input, process and outcome) in public health. Health management information system, Horizontal and vertical integration of public health interventions, Public-Private mix.

Understanding community, Community health related needs assessment, Community orientation and Community mobilization, Introduction to digital health.

Textbooks

1. R Detal, Oxford Textbook of Global Public Health, Oxford, 7th Edition, 2021.
2. K Parks, Textbook of Preventive and Social Medicine, M/S Banarsidas Bhanot Publishers, . 26th Edition, 2021.

Reference books

1. Robert H. Friis,. Essentials of Environmental Health, Jones & Bartlett Publishers, 2018
2. Warrier S,. Information and Communication Technologies in Public Health ASociological Study,CBS Publishers, 2020.
3. Baker JJ. Baker RW, Dworkin NR, Health Care Finance: Basic Tools for Non-financial Managers., Jones and Bartlett Publishers, Inc, 5th edition. 2017.
4. Ross TK, Practical Budgeting For Health Care: A Concise Guide, Jones andBartlett Publishers, Inc, 2020.

OPTIMIZATION TECHNIQUES

Course Code: MA10003

Credit: 2

L-T-P: 2-0-0

Prerequisite: Nil

COURSE OBJECTIVE

To familiarise the students with a few rudimentary and popular optimization techniques to enable them to solve resource-constrained real world problems.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Know the concept of Linear programming problem (LPP) and will able to formulate linear programming problem,
- CO 2: Understand the basic terminology and concepts of solving LPP,
- CO 3: Solve LPP by simplex method,
- CO 4: Know the concept of duality in Optimization technique,
- CO 5: Apply optimization technique to solve transportation problem, and
- CO 6: Solve assignment problem.

COURSE DETAILS

Linear Programming

Mathematical foundations and basic definitions, Linear optimization: Formulation and graphical solution of linear programming problems, Simplex method, Duality.

Transportation

General structure of a transportation problem, Finding initial basic feasible solution by North-West corner rule, Least-Cost method and Vogel's Approximation Method, and Testing for optimality.

Assignment Problem

Hungarian assignment method, Unbalanced assignment problems, Restrictions in assignment, Travelling Salesman model.

Textbook

1. H.A. Taha, Operation Research, An Introduction, Pearson Education, 10th Edition.

Reference books

1. K. Gupta, Kanti Swarup, and Man Mohan ,Operations Research, P., S.Chand &Co, 2004.
2. N. S. Kambo, Mathematical Programming Techniques.,East West Press, 1997.
3. R. Fletcher., Practical Methods of Optimization, 2nd Ed., John Wiley, 1987.
4. Hanif D, Sherali, M. S. Bazaraa. & J.J. Jarvis, Linear Programming and Network Flows, Wiley Publication. 2nd Edition.

ENGINEERING ELECTIVE**BASIC CIVIL ENGINEERING**

Course Code: CE10001

Credit: 2

L-T-P: 2-0-0

Prerequisite: Nil

COURSE OBJECTIVE

The course is designed to provide an overview of different aspects of civil engineering profession , namely, surveying, materials, structural, and geotechnical engineering, hydraulics and water resources, environmental engineering, and transportation engineering and their roles in the societal development.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Understand the importance and practical applications of different types of surveying,
- CO 2: Learn about the different construction materials and understand the philosophy of structural analysis and design,
- CO 3: Understand engineering behaviour of soil and types of foundations,
- CO 4: Understand different hydraulics, hydrological and water resources engineering applications,
- CO 5: Learn about the management strategies of wastewater and solid waste, and
- CO 6: Understand the basics of different types of highways, railways, ports and harbours.

COURSE DETAILS**Introduction**

Role of civil engineers in designing, building, and maintaining infrastructure and improving quality of life,Specializations in the civil engineering and their specific roles.

Surveying

Plans, maps, scales, divisions of surveying, classification of surveying, leveling, and advanced methods of surveying.

Construction Materials & Structural Engineering

Different construction materials and their uses, **structural analysis and design philosophy**.

Geotechnical Engineering

Overview on origin of soil, engineering properties and their classification; Soil exploration; Foundations: Their importance and purpose; Factors to consider in foundation design and stability of slopes; and Improving site soils for foundation use.

Hydraulics & Water Resources Engineering

Overview of fluid properties, open channel flow, surface and groundwater hydrology, and irrigation infrastructures.

Environmental Engineering

Types of waste water, Principles of wastewater management, Types of solid waste, and Principles of solid waste management.

Transportation Engineering

Classification of highways, Typical construction methods of roads, traffic surveys and their applications in traffic planning, Railways, Ports and Harbours.

Textbook

1. Er. Shrikrishna A. Dhale and Er. Kiran M. Tajne, Basics of Civil Engineering, S. Chand & Co., 1st Edition, 2014.

Reference books

1. S. S. Bhavikati, "Basic Civil Engineering" by New Age International Publisher, 1st Edition, 2021.
2. M. S. Palanichamy "Basic Civil Engineering", Tata McGraw-Hill Publication.

BASIC MECHANICAL ENGINEERING

Course Code: ME10003

Credit: 2

L-T-P: 2-0-0

Prerequisite: Nil

COURSE OBJECTIVE

The course is designed to give an overview of the fundamental aspects of mechanical engineering so that a student pursuing any branch of engineering will realize the possibilities that the branch of mechanical engineering offers.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Understand the basic principles of thermodynamics,
- CO 2: Develop an understanding of fluid machines like turbine and pump,
- CO 3: Determine stress and strains in a component subject to a load,
- CO 4: Understand the working and design aspect of power drives,
- CO 5: Recognize appropriate material for a particular engineering application, and
- CO 6: Understand the fundamentals of manufacturing processes.

COURSE DETAILS

Concepts of Thermodynamics

Systems, properties, state, and cycle, Thermodynamic equilibrium and quasi-static process, First law of thermodynamics for closed system, First law of thermodynamics for open/flow systems, Second law of thermodynamics, Kelvin Plank statement, Clausius statement, and Basic concept of entropy

Fluid Mechanics and Hydraulic Machines

Introduction to fluids, Properties of fluids, Pressure variation with depth, Bernoulli's equation and its applications, and Introduction to hydraulic turbines and pumps.

Mechanics of Materials

Stress, Strain, Stress-Strain diagrams for ductile and brittle materials, Elastic constants, Hooks Law, Factor of Safety, One-dimensional loading of members of varying cross sections.

Power Transmission

Gear, , Belt, and Chain Drives, Shaft under varying loading conditions, Introduction to robots, Applications of robotics, Basic robot motions, Sensors and Actuators.

Manufacturing Processes

Introduction to engineering materials, Types and classification of materials, Properties of materials, Introduction to casting, forming, forging, rolling, extrusion and welding, Introduction to machine tools, NC, CNC, and 3-D Printing.

Textbook

1. P Kumar, Basic mechanical Engineering, Pearson Education, 2nd Edition, 2018

Reference books

1. J K Kittur and G D Gokak, Elements of Mechanical Engineering Willey, 1st Edition, 2015.
2. B Agrawal, C M Agrawal ,Basic Mechanical Engineering, Willey, 1st Edition, 2011.

ELEMENTS OF MACHINE LEARNING

Course Code: EE10001

Credit: 2

L-T-P: 2-0-0

Prerequisite: Nil

COURSE OBJECTIVE

Today, we have access to massive data which get generated through information and computer technology in our connected world. Most of these data lie unused and often overwhelm us due to their size and variety. The objective of this course is to introduce to the students to the field of learning from data, discovering data patterns, converting them into knowledge, and applying it to solve real-world problems.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Demonstrate fundamentals of machine learning,
- CO 2: Identify data types, apply suitable processing and visualize using suitable methods,
- CO 3: Describe Unsupervised Learning and apply clustering techniques,
- CO 4: Describe Supervised Learning and apply classification techniques,
- CO 5: Demonstrate perceptron and Multi-layer Perceptron models, and
- CO 6: Apply machine learning techniques for real world requirement.

COURSE DETAILS

Introduction

Importance and Applications of Machine Learning, Supervised, Unsupervised, Reinforcement Learning and Evolutionary Learning.

Data Analysis

Measurement Scales and Data Types; Visualization, Pre-processing and Transformation of Data; Dimensionality Reduction; and Data (Dis)Similarity.

Unsupervised Learning

K-means and Density-based,Clustering Methods.

Supervised Learning

K-Nearest Neighbour, Decision Tree by Qualitative and Quantitative(information Gain method); Evaluation by Confusion Matrix of Supervised Learning Methods.

Learning with Neural Networks

Perceptron, Multi-layer Perceptron and, Error Backpropagation Learning.

Textbooks

1. Gopal, M., Applied Machine Learning, McGraw Hill Education, 2018
2. Pradhan, M. and U. D. Kumar,Machine Learning Using Python,Wiley India Pvt.Ltd, 2019.

Reference books

1. Alpaydin, E., Introduction to Machine Learning, 3rd Edition, The MIT Press, 2014.
2. Bishop. C M, Pattern Recognition and Machine Learning, Springer, 2006.
3. Jain, V. K., Big Data Science Analytics and Machine Learning, Khanna Publishers, 2021
4. Mitchell, T. M.,Machine Learning, McGraw Hill, 1997.
5. Müller, A. C.,Introduction to Machine Learning with Python, O'Reilly Media, Inc, 2016
6. Raschka, S. and V. Mirjalili, Python Machine Learning, 3rd Edition, Packt Publishing, 2019.
7. Shalev-Shwartz, S. and S. Ben-David ,Understanding Machine Learning: From Theory to Algorithms, Cambridge University Press, 2014.

BIOMEDICAL ENGINEERING

Course Code: EC10003

Credit: 2

L-T-P: 2-0-0

Prerequisite: Nil

COURSE OBJECTIVE

Biomedical Engineering is a multidisciplinary field that combines knowledge available in a wide range of disciplines such as engineering, medicine, and societal science. The course focuses on innovating newer equipment and technologies to improve human health and enhance health care facilities in a holistic manner.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Apply knowledge of basic engineering and biology to solve the problems,
- CO 2: Knowledge of human body about cell, potential and organs of body,
- CO 3: Develop a thorough understanding on principles of bio-instrumentation,
- CO 4: Explain the role of bio-potential electrodes, and design of sensors,
- CO 5: Differentiate and analyse the biomedical signal sources, and
- CO 6: Knowledge about imaging techniques used in hospital.

COURSE DETAILS

Introduction and Overview

Introduction to biomedical engineering, Applications of biomedical engineering.

The Human Body

cClI-structure and function, Tissue & organs, Bio-potentials, Action potential, Major human systems (musculoskeletal, circulatory, nervous, and respiratory system)

Bio-instrumentation

Instruments in medical practice, Man-instrumentation system, Basic components, Linear network analysis, Bioelectric amplifier (OpAmp, isolation amplifier, instrumentation amplifier), Bio-instrumentation design, and Intelligent medical instrumentation.

Biomedical Electrodes and Sensors

Ssignal acquisition, Bio-potential measurements, Active and passive sensors, and Electrodes for biophysical sensing (Ag-AgCl, surface electrodes, microelectrodes), transducers, sensors.

Biomedical Signals, Imaging and Informatics

Bioelectric phenomena, Sources of biomedical signals, Origin of biopotentials, Basics of bio-signal processing, noise, Interference, Electrical safety issues, Principle of medical imaging techniques, such as X-ray, US, MRI, CT scan, and nuclear imaging, and Fundamentals of bio-informatics.

Textbook

1. John D. Enderle & Joseph D. Bronzino Introduction to Biomedical Engineering, Academic press, 3rd Edition, 2012.

Reference books

1. Joseph D. Bronzino, Donald R. Peterson, The Biomedical Engineering Handbook, CRC press, 4th Edition 2015.
2. G.S. Sawhney, Fundamentals of Biomedical Engineering, New Age International (P) Ltd, 2011.

BASIC INSTRUMENTATION

Course Code: EE10003

Credit: 2

L-T-P: 2-0-0

Prerequisite: Nil

COURSE OBJECTIVE

The course is designed to impart, to the students, the principles of analog and digital measuring instruments which include the working mechanisms of sensors and transducers and their applications in industrial and biomedical systems.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Know the basics of measuring instruments,
- CO 2: Measure different electrical quantities,
- CO 3: Understand the working principles of optical and electrical transducers and sensors,
- CO 4: Understand the working of electrical transducers and sensors,
- CO 5: Apply the transducers in industrial applications, and
- CO 6: Use instruments in biomedical applications.

COURSE DETAILS

Analog and Digital Instruments

Basics of measuring instruments, Types of analog instruments, Measurement of voltage, current, power and energy in single and three phase circuits; Digital Instruments: Digital voltmeter, Digital multimeter, Timer/counter, and Time, phase and frequency measurements in oscilloscope.

Sensors and Transducers

Optical sources and detectors: LED, photo-diode, light dependent resistor; Basics of fiber optic sensing, IR Sensors. Resistive, capacitive, inductive, piezoelectric, and Hall effect sensors, Temperature transducers: Thermocouple, RTD , and thermistor.

Transducers in Industrial Applications

Measurement of displacement (linear and angular), velocity, acceleration, force, torque, vibration, shock, pressure, flow, liquid level, pH, conductivity and viscosity.

Instruments in biomedical applications

ECG, Blood Pressure measurement, CT Scan, and Sonography

Textbook

1. R. K. Rajput ,Electrical and Electronic Measurements and Instruments,S Chand Publication, 4th Edition, 2015,William David Cooper,Electronic Instrumentation and Measurement Techniques, by PHI, 2010.

Reference books

1. Er. R.K. Jain, Mechanical and Industrial Measurements (Process Instrumentation and Control), Khanna Publishers, 1995.
2. A.K Sawhney, A course in Electrical and Electronics Measurements and Instrumentation Dhanpat Rai Publication, 10th Edition, 2012.
3. D Patranabis, Sensors And Tranducers, PHI Publication, 2ndEdition, 2017.

HASS ELECTIVE I

SOCIETY, SCIENCE AND TECHNOLOGY

Course Code: HS10013

Credit: 2

L-T-P: 2-0-0

Prerequisite: Nil

COURSE OBJECTIVE

There is a circular relationship between society, science, and technology. Society creates a need and an ambience to develop science and technology, and science and technology create means to meet societal needs and new opportunities to make human life better. Studying this relationship is the objective of this subject. The subject will expose, before the students, the past developments of science and technology and the social forces that played a dominant role in making these developments possible and the way these were used in the society. The subject will also present the ethical principles that underlie the development and use of science and technology in the society.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Understand the forces that shape the development of science and technology,
- CO 2: Understand the major milestones of scientific discoveries have impacted human thought processes,
- CO 3: Understand the effect of technological developments in societal transformation,
- CO 4: Analyse the contribution of Science and Technology in solving societal and Environmental problems,
- CO 5: Evaluate the ethical issues related to abuse of science and technology, and
- CO 6: Apply the skills learned to suggest solutions to global problems linked to science and Technology.

COURSE DETAILS

Introduction

Human Curiosity to Know the Truth of Nature, Need to Improve Quality of Life, Emergence of Science and Technology, Characteristics of Society, Science, and Technology, and Impact of Science and Technology on the Society.

Scientific Discoveries

Milestone Scientific Discoveries of the Past and the Ways They Impacted Human Thought Process and Culture; Scientific Method, Developing a Theory, and Making of a Discovery; Discoveries in the Physical, Biological, and Mathematical Sciences; Normal Science, Paradigms, Anomalies, Crisis and Emergence of Scientific Theories, and Scientific Revolutions.

Technological Developments

Milestone Developments of Technologies and the Ways They Transformed the Society. Stories of Technological Developments such as Steam Engines, Electricity, Semiconductors, and IoT.

Science and Technology in the Service of the Society

Contributions of Science and Technology to Solving Societal, Environmental, and Global Problems. Successes and Limitations, and Abuses and Control of Science and Technology; Ethical Considerations.

Textbook

1. Bucchi, M., Science In Society: An Introduction to Social Studies of Science, Routledge Publication, 1st Edition,2004.

Reference books

1. Collins, H. and T. Pinch, The Golem: What You Should Know about Science, 2nd Edition, New York: Cambridge University Press,1998.
2. Collins, H. and T. Pinch,The Golem: What You Should Know about Technology, 2nd Edition. New York: Cambridge University Press, 2014.
3. Kuhn, T. S.,The Structure of Scientific Revolutions, 4th Edition, Chicago University Press, 2012.
4. Hatton, J. and P. B. Plouffe, Eds., Science and Its Ways of Knowing, New Jersey: Prentice Hall,1997.
5. Moskovites, M., Ed., Science and Society, Ontario: House of Anansi Press Limited,1997
6. Sismondo, S. An Introduction to Science and Technology Studies, 2nd Edition. Maldon, MA: Blackwell Publishing, 2009.
7. Sarukkai, S. What Is Science?, New Delhi: National Book Trust, India, 2012.
8. USSR Academy of Sciences Science and Society, Moscow: Nauka Publishers, 1989.

SOCIO-POLITICAL ENVIRONMENT

Course Code: SO10043

Credit: 2

L-T-P: 2-0-0

Prerequisite: Nil

COURSE OBJECTIVE

The objective of this course is providing basic knowledge on socio-political environment of India and to equip the students with an understanding of their roles, duties and responsibilities in a democratic set up.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Understand contemporary Indian social problems,
- CO 2: Understand the roles and functions of the three political institutions in our democratic up,
- CO 3: Familiarize the students with the Rights and Duties enlisted in the Indian Constitution,
- CO 4: Grasp the interrelationships among political, social and economic issue,
- CO 5: Visualize contemporary changes in Political Institutions, and
- CO 6: Realize the importance of equity, equality, and dignity in a democratic system.

COURSE DETAILS

Social Problem in India

Meaning and Definition of Social Problems, Characteristics, Causes and Consequences, Problems of Poverty, Unemployment, Population growth, Problems of Women and Aged, Corruption and Nepotism, Illiteracy, Substance Abuse, and Terrorism.

Social Stratification

Equity and Equality, Caste, Religion, Class, Gender Discrimination, UrbanSlums.

Political Institutions

Meaning and Basic Concepts of PoliticalInstitutions: Legislative, Executive and Judiciary Systems of the Indian Constitution.

Fundamental Rights and Duties

Fundamental Rights and Duties in Indian Constitution, Directive Principles of State Policy.

Contemporary Changes in Political Institutions

Changing Role of the Government in Contemporary India, Role of Government in the Formation of National and International Policies and Their Impact on Business and Trade.

Textbooks

1. C. N. Shankar Rao, S. Chand., Indian Social Problems, by S. Chand Publication, 2017
2. M. Laxmikanth., Constitution of India, Cengage Learning, 2020.
3. Himanshu Roy & M.P Singh Indian Political System, Pearson publisher, 4th Edition, 2018.
4. Ram Ahuja, Social Problems in India, Rawat publisher, 4th Edition, 2014.

Reference books

1. Our Parliament, Subhash C Kashyap, NBT, 2021.
2. Social Stratification, Dipankar Gupta (Ed), Oxford India Publication, 1997.
3. Modernisation of Indian Tradition, Yogendra Singh, Rawat Publication, 1986.

THINKING PERSPECTIVES

Course Code: PS10043

Credit: 2

L-T-P: 2-0-0

Prerequisite: Nil

COURSE OBJECTIVE

Cognition plays a significant role in **accumulation and processing of information**. This subject provides an in-depth understanding of some of the cognitive processes in terms of current theories, models and applications. It helps learners to understand the importance of these cognitive processes and the rationale behind cognition, problem solving, critical thinking, and scientific thinking. It facilitates students to identify and analyze the key conceptual and theoretical frameworks underpinning cognitive process.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Understand the definition and scope of cognition, problem solving, and creativity,
- CO 2: Understand the theories related to cognition, decision making, and critical thinking,
- CO 3: Understand the classic and current experimental research in cognitive processes,
- CO 4: Develop skills essential in designing and conducting experiments in cognition, reasoning, and problem solving,
- CO 5: Understand various aspects of critical thinking, scientific thinking, and design thinking process, and
- CO 6: Apply the knowledge of cognitive processes to one's own personal life and to real life issues.

COURSE DETAILS

Basics of Cognition

A Brief History, Emergence of Modern Cognitive Approach, Thinking, Basic Elements of Thought: Forming Concepts, Propositions, Images.

Reasoning, some Basics sources of error, Information-processing approach, connectionist approach, evolutionary approach, ecological approach.

Memory Processes and Critical Thinking

Organization of Long Term Memory, Forgetting, Retrieval and Metamemory; Proactive and Retroactive inference; Amnesia and Retrieval, Flashbulb Memory, Eyewitness Memory, Traumatic Memory, False Memories.

Phases of Critical Thinking

Intellectualization, Suggestion, Hypothesis, Reasoning, and Testing, Critical Thinking Abilities: Thinking, Observational, and Questioning and Dispositions, Critical Thinking Skills: Analysis, Communication, Creativity, Problem-solving Skills, and Open-mindedness.

Systems Thinking and Scientific Thinking

System Definition and Characteristics, Approaches to System Modelling, Causal-Loop Diagramming, System Archetypes, Micro world and Learning Laboratory, The Learning Organization and the Fifth Discipline, Systems Thinking Study, Examples.

Characteristics of Science

Systematic observation and experimentation, Inductive and deductive reasoning, Lessons from Scientific Thinking: Empirical Evidence, Logical Reasoning.

Creativity and Designing Thinking

Creative Thinking, Stages in Creative Thinking, Nature of Creative Thinking, Features of Creativity—Novelty, Originality and Usefulness, Guilford's Measure of Creativity—Fluency, Flexibility, and Originality, Barriers to Creativity, Enhancing Individual and Organizational Creativity.

Designing Thinking as a Process of Problem Solving: Defining Problems, Challenging Assumptions, Developing Concepts, identifying Alternative Strategies and Solutions, Prototyping, and Experimenting Problem Solving through Innovative Solutions, Stages of Design Thinking—Empathize, Define, Ideate, Prototype and Test.

Textbooks

1. Solso, R. L., Cognitive Psychology, Pearson Education, 6th Edition. 2004.
2. Baron, R. A. Psychology, Pearson Education, 5th Edition, 2002
3. Rathus, S.A. Introductory Psychology Wadsworth Cengage, 5th Edition, 2016.
4. Ciccarelli, S. & White, N.J, Psychology 5th Edition, Pearson Education. 2017
5. The Fifth Discipline: The Art & Practice of the Learning Organization, Cengage Publication, 2nd Edition, 2006.
6. Cross, N., Design Thinking: Understanding How Designers Think and Work, Berg Publishers.

Reference books

1. Baddeley, A., Human memory: Theory and practice. New York Psychology Press, 1997.
2. Treror, A., The psychology of language: From data to theory. Taylor Francis, 2002
3. Smith, E.E. & Kosslyn, Cognitive psychology: Mind and brain. Prentice Hall, 2007.
4. Tripathi, A.N. & Babu, Nandita (2008). Cognitive processes. In Misra, G. Psychology in India: Advances in Research, Vol. 1, Pearson Education.
5. Vaid, J., & Gupta, Ashum, Exploring word recognition in a semi-alphabetic script: the case of Devanagari. Brain and Language, 81, 679-690.

CREATIVITY, INNOVATION AND ENTREPRENEURSHIP

Course Code: PS10045

Credit: 2

L-T-P: 2-0-0

Prerequisite: Nil

COURSE OBJECTIVE

The course is designed for students who want to enhance their creative and innovative skills and apply them to prepare business plans to form entrepreneurial enterprises. More specifically, the course is designed to help students to stimulate creativity in themselves and learn the impact of innovation on growth creation and design thinking in real-world business situations. In this course, the concepts of entrepreneurship and the environment in which the entrepreneurs act will be developed along with business plans and business models for start-ups.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Understand the key elements of creativity and innovation,
- CO 2: Visualize the impact of innovation on growth creation,
- CO 3: Apply creative and design thinking to real-world business situations,
- CO 4: Create a foundation of entrepreneurship development and its theories,
- CO 5: Develop business plans and business models to start entrepreneurial enterprises, and
- CO 6: Analyze the business plan and implement it in real field.

COURSE DETAILS

Introduction

Definitions, Importance, and Relationships among Creativity, Innovation, and Entrepreneurship; Examples.

Creativity

Definitions, Importance, and Relationships among Creativity, Innovation, and Entrepreneurship; Examples, Creative Thinking and Stages of Creative Thinking, Barriers to Creativity, Enhancing Individual Creativity, Guilford's Usual Unusual Test, Psychometric Approaches to Tests of Creativity, Structured tools of Creativity (Developing Creative Focus, Exercising Mind, Setting Directions, Suspending Rules, Thinking Differently, Establishing Formatted Work Space, Stimulating Mechanisms, Utilizing Experiences.

Innovation

Innovation, Benefits, Keys to Successful Innovations, Types of Innovation, Barriers to Innovation, Methods of Generating Ideas, Design Thinking. Creative Problem Solving, and Measures of Innovation.

Entrepreneurship

Entrepreneur, Functions of an Entrepreneur, Types of Entrepreneur, Intrapreneur, Social Entrepreneur, Case Study on the Entrepreneurial Excellence of N. R. Narayan Murthy, Introduction to Agricultural, Rural, Tourism, Social and Digital Entrepreneurship, Entrepreneurial Motivational Behavior (Creativity, Self-Efficacy, Locus of Control, Risk Taking, Leadership, Communication),

Converting Ideas into Products/Services with Differentiating Features, Niche Market, Design of the Products/Services, Bootstrap Marketing, Formulation of Business Plan, Business Model, Financial Planning, and Sources of Finance.

Practical classes will be devoted to organizing practicing sessions on creativity, case study discussion sessions and market analysis sessions on generating novel ideas, and developing and presenting business plans. Students, in groups, will design a new product/service, do a bootstrap market study, develop a business plan, and make an elevator pitch.

Textbooks

1. Khanka, S. S. Creativity, Innovation, and Entrepreneurship, S.Chand .
2. Praveen Gupta, Business Innovation, S. Chand , 2007

Reference books

1. Barringer B. R. and R. Duane, Entrepreneurship: Successfully Launching New Ventures: Pearson Prentice Hall, Ireland, 3rd Edition 2009.
2. Duening, T. N., R. D. Hisrich, and M. A. Lechter , Technology Entrepreneurship: Taking Innovation to the Marketplace, Elsevier, Amsterdam, 2nd Edition 2015.
3. Harrington, H. J., Creativity, Innovation, and Entrepreneurship: The Only Way to Renew Your Organization, Routledge, 2019.

ESSENTIALS OF MANAGEMENT

Course Code: HS10202

Credit: 2

L-T-P: 2-0-0

Prerequisite: Nil

COURSE OBJECTIVE

This course explores the basic concepts and processes of management. Students will learn the importance of management in their professional life from the stories on the evolution and practices of management. Students will examine the fundamental roles and processes of planning, organizing, staffing, directing and controlling that comprise the managers' role. This course also examines the fundamentals of marketing and financial management for the success of the organization. This course will make an attempt to introduce students to the business environment and strategic management process to understand the nuances of business. Students will develop skills related to the manager's function as required in today's competitive environment.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO1: Learn different approaches, theories and stories of various practitioners of management and know how such knowledge could be applied to achieve goals of Organizations within the changing environment,
- CO 2: Understand the core functions of management in order to facilitate efficient effective decision making both at individual and organizational level,
- CO 3: Identify the human resource requirement of the organization for achieving its objective effectively,
- CO 4: Synthesize various marketing and financial skills and techniques in order to be successful in corporate world,
- CO 5: Assess the business environment and understand the importance of various types of business environment for better decision making, and
- CO 6: Acquire the lesson learnt in strategic management process for strategic decision making by leveraging the core competencies of the organization.

COURSE DETAILS

Evolution of Management Thoughts

Concept, Scope and Significance of Management; Classical Approach; Scientific, Bureaucratic & Administrative theory of Management; Neo-classical and Modern Approach; Contribution of Management Practitioners

Functions of Management (Part I)

Nature, scope and significance of Planning; Types of Planning; Process of Planning; Barriers to effective planning; Decision making: concept, types and process; Organizing: concept and significance; Delegation of authority; Authority vs. Responsibility; Structure of Organization: departmentalization, Centralization vs. Decentralization

Functions of Management (Part II)

Concept of Staffing, Manpower planning and Job design; Recruitment and selection; Training and development; Performance Appraisal; Directing: Concept, Direction and Supervision; Controlling: Concept, Importance and levels; Process and types of controlling

Marketing and Financial Management

Marketing Mix (Product, place, price, Promotion); Market Segmentation; Introduction, scope, importance and functions of Financial management; Introduction to Financial statements: Profit and loss account; balance sheet

Business Environment and Strategic Management

Business environment: concept, importance, elements; Types of business environment; Strategic Management: Concept, Importance and levels of strategy; Process of Strategic Management

Textbooks

1. S.A. Sherlekar & V.S. Sherlekar, Modern Business Organization & Management (Systems Approach) by Himalaya Publishing House, 2018.
2. Harold Koontz and Heinz Weihrich ,Essentials of Management: an International Perspective by, McGraw Hills, 2020

Reference books

1. K. Ashwathappa, Essentials of Business Environment, Himalaya Publishing House, 2017.
2. Joseph L. Massie, Essentials of Management Pearson Education India, Fourth edition, 2015.
3. Azhar Kazmi & Adela Kazmi, Strategic Management, McGrawHill, 5th edition 2020.

Course Code: HS10121

Credit: 2

L-T-P: 2-0-0

Prerequisite: Nil

COURSE OBJECTIVE

This course will provide technical students with knowledge in concepts of environmental economics, resource economics, and circular economy, allowing prosperity for present and future generations. The course will equip future engineers with skill to handle resources efficiently and effectively. Acquaint them with the contemporary trends in business settings and thereby innovate novel solutions to existing problems.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Understand the economic drivers that shape the future of India,
- CO 2: Understand sustainability issues related to usage of factor endowment,
- CO 3: Ability to create linkage between Economics, Science and Technology,
- CO 4: Apply knowledge, reasons and the need for regulating circular economy,
- CO 5: Assess and analyses scope for global market opportunities, and
- CO 6: Explore yet to be unearthened employment opportunities.

COURSE DETAILS

Purple Economy: Economics of Glocalization

Introduction to colours and world of economics (including White, Blue, Black, Green, Purple, Grey, Red, Pink, Silver); Concept and definition of purple economy; Cultural footprint; Local and global cultural economy; Culture and well being; Rethinking employment and training in the purple economy; Vocal for Local; Make in India.

Grey Economy: Economics of Informal Sector

Concept and definition of grey economy; Introduction to formal and informal Sector; Formal and informal sector linkage; Labour absorption and dualism in economy; Theoretical and policy issues; Migration in informal sector.

Green Economy: Economics of Reduce, Reuse, and Recycle

Concept and definition of green economy; Green investment and green bond; Green technology and renewable resources; Carbon footprint; Waste management.

Blue Economy: Economics of Ocean Resources

Concept and definition of blue economy; The marine environment; Fisheries and aquaculture; Tourism; Ocean-based renewable sources of energy; Transportation and the blue economy; ; Pollution of water resources; Water resource management.

Black Economy: Economics of Unsanctioned Sector

Concept and definition of black money; Causes and consequences of black economy; Global black income generation; Extent of black money in India. Government measures to curb black money.

Textbook

1. S.K Mishra and V. K. Puri, Indian Economy. Himalaya Publishing House,2022, ISBN: 978-93-5596-423-6

Reference books

1. Uma Kapila. Indian Economy:Economic Development and Policy. Academic Foundation ISBN-10 : 9332705550 and ISBN-13 : 978-9332705555,2022.
2. Taneja and Myer :Economics of development and Planning, Vishal Publishing Co. ISBN-13 978-9382956068: .
3. Datt Gaurav & Mahajan Ashwani , Indian Economy, S Chand & Company Limited. 2017.
4. Adrian C. Newton, Elena Cantarello, An Introduction to the Green Economy. Science, Systems and Sustainability,2014 Circular Economy- (Re) Emerging Movement. (2020). Shalini Goyal Bhalla.
5. Shalini Goyal Bhalla. Circular Economy- (Re) Emerging Movement.,2020.

6. Somnath Hazra & Anindya Bhukta, The Blue Economy. An Asian Perspective. The Informal Economy: an Employer's Approach. The Informal Economy: an Employer's Approach. 2021.
7. The Purple Economy: An Objective, An Opportunity, 2013.
8. Tom Tietenberg, Lynne Lewis, Environmental and Natural Resource Economics. 2018.

INDIAN ECONOMY POST LIBERALISATION

Course Code: HS10123

Credit: 2

L-T-P: 2-0-0

Prerequisite: Nil

COURSE OBJECTIVE

Study of this course provides an extensive understanding of changing structure of Indian economy over time. This course targets to put emphasis on inclusive growth, reducing poverty, inequality and creating decent employment in the economy. This course will give an understanding about the issues faced by an economy in achieving sustainable development.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Interpret the changing structure of Indian economy,
- CO 2: Perceive the issues and challenges faced by Indian economy,
- CO 3: Evaluate the policies and programmes required to achieve inclusive growth,
- CO 4: Realise the importance of human capital in triggering economic development,
- CO 5: Comprehend the state and role of external sector in strengthening Indian economy, and
- CO 6: Help in achieving sustainable development for the economy.

COURSE DETAILS

Introduction and features

Changing structure of the Indian economy Changing paradigms of Development Strategies and Economic Reforms.

Poverty, Inequality and Employment

Various concepts and estimates of poverty; Income inequality; Problem of unemployment; Interface among growth, poverty and employment; Inclusive growth and Human Development; Sustainable Development Goals—Targets for reduction in Poverty, Inequality and Decent Employment.

Demographic Issues

Demographic trends, size and structure of population; Health and Education; Skill challenges and demographic dividends; Sustainable Development Goals—Targets for Greater Wellbeing and Better Human Capital.

Perspectives in Agriculture, Industry and Services

Agricultural growth performance and food security; Growth, trends and changing pattern of Indian industries, industrial reforms and policies; Services in India's growth process; Sustainable Development Goals—Targets for Inclusive and Sustainable Growth.

External Sector and Issues in Indian Public Finance

Foreign trade and trade policy; fiscal devolution, Indian Union Budget and Tax System

Textbook

1. Uma Kapila, Indian Economy Performance and Policies, Academic Foundation, 2020, ISBN: 978-933270545

Reference books

1. S.K. Mishra, and V. K. Puri, Indian Economy, Himalaya Publishing House, 2022, ISBN: 978-93-5596-423-6
2. Gaurav Datt and Ashwani Mahajan, Indian Economy, GENERIC Classic Edition, 2022 ISBN-10 9352531299: ISBN-13 : 978-9352531295

COMMUNITY / ENVIRONMENT-BASED PROJECT

Course Code: EX17001

Credit: 2

L-T-P: 0-0-4

Prerequisite: Nil

COURSE OBJECTIVE

This course is offered to give the students an opportunity to connect with the community and the environment, learn and prioritize their problems, and define the problems in ways that make them amenable to scientific analysis and pragmatic solution. Appreciating the community problems, visualizing and experiencing them in person, self-learning, applying to realities, searching for and finding implementable solutions are the primary benefits of this project-based subject.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Identify need of the community,
- CO 2: Formulate objective of a project,
- CO 3: Communicate orally and through formal technical write-ups,
- CO 4: Analyze and interpret data wherever essential,
- CO 5: Provide an implementable solution to the problem, and
- CO 6: Work in team following ethical manners.

The projects will be applied to problems uppermost in the minds of the community regarding the problems that they confront regularly. The problems may range from social inequality and social justice to lack of common services such as health, education, water, power, banking, and from lack of access to government subsidies and policies to deforestation and environmental problems.

B. Tech. Honors/ Research Degree in Electronics Engineering (VLSI Design and Technology)

B.Tech in Electronics Engineering (VLSI Design and Technology) Program Educational Objectives (PEOs):

1. Lead a successful career in industries or undertake entrepreneurial endeavors and provide solutions in the areas of designing and developing VLSI circuits and systems, utilizing industry-standard tools and methodologies.
2. Utilize their knowledge, skills and resources to design, invent and find creative and innovative solutions to engineering problems in a multidisciplinary work environment following appropriate ethical practices.
3. Develop attitude in lifelong learning, apply and adapt new ideas as the technology evolves.

Program Outcomes (POs):

The program outcomes are:

- a) **Engineering knowledge:** Ability to apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- b) **Problem analysis:** Ability to identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- c) **Design/Development of solutions:** Ability to design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- d) **Conduct investigations on complex problems:** Ability to use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- e) **Modern tool usage:** Ability to create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- f) **The engineer and society:** Ability to apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- g) **Environment and sustainability:** Ability to understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- h) **Ethics:** Ability to apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- i) **Individual and team:** Ability to function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- j) **Communication:** Ability to communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- k) **Project management and finance:** Ability to demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- l) **Life-long learning:** Ability to recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

The program specific outcomes are:

- a) Proficiency to design, simulate, and analyze VLSI circuits and systems using industry-standard tools and techniques, demonstrating a deep understanding of VLSI design principles, methodologies, and emerging technologies.

- b) Ability to carry out research in the fields of SoC Design, microfabrication and related technologies.
 - c) Ability to design and develop complex products using suitable tools for societal and engineering needs with skills to communicate effectively in groups.

CURRICULUM

The total minimum credits required for completing the B.Tech in Electronics Engineering (VLSI Design and Technology) Program is 160

PROFESSIONAL ELECTIVE COURSES

Professional elective-I, II, III are offered during semester five and six. Professional elective IV and V are offered during semester seven and eight. List of electives to be offered during an academic year is announced at the beginning of respective semesters. An elective will be offered only if ten or more students are interested in it. Not that all the electives will be offered in every academic year. Some electives may have seat limitations and will be offered in first cum first serve basis. In order to accommodate more aspiring students, electives having high demand may be offered twice, that is during autumn as elective-I or II and again as elective-III during spring semester.

Students can select electives based on their interest in a domain. Areas of specialization or domain are optional, however electives can be grouped to provide learning around a functional area. Students may qualify for a maximum of one area of Specialization. Completion of the specialization will not be reflecting on transcripts or degree certificate.

THIRD SEMESTER

1		Vocational Elective	0	0	2	2	1
Total Credit (Practical & Sessional subject)						8	4
Total Credit (Semester)						27	23

FOURTH SEMESTER

Theory							
Sl No.	Course Code	Subjects	L	T	P	Total	Credit
1	MA21006	Vectors, Differential Equations and Complex Analysis	3	1	0	4	4
2	EV20002	Digital VLSI Circuits	3	0	0	3	3
3	EV20004	Digital Logic Design with Verilog	3	0	0	3	3
4	EV20006	Embedded Design and Computer Architecture	3	0	0	3	3
5	EX20001	Industry 4.0 Technologies	2	0	0	2	2
6		HASS Elective-II	3	0	0	3	3
Total Credit (Theory subjects)						18	18
Practical							
1	EV29002	Digital VLSI Lab	0	0	2	2	1
2	EV29004	Verilog Lab	0	0	2	2	1
3	EV29006	Embedded Lab	0	0	2	2	1
Sessional							
1							
Total Credit (Practical & Sessional subject)						6	3
Total Credit (Semester)						24	21

FIFTH SEMESTER

1		K-Explore Open Elective-I	0	0	2	2	1
2	EC38001	Electronics Product Development	0	0	2	2	1
Total Credit (Practical & Sessional subject)						8	4
Total Credit (Semester)						26	22

SIXTH SEMESTER

Theory							
Sl No.	Course Code	Subjects	L	T	P	Total	Credit
1	EV30002	VLSI for Signal Processing	3	0	0	3	3
2	EV30004	SoC Design	3	0	0	3	3
3	EV30006	VLSI Verification and Testing	3	0	0	3	3
4	HS30401	Universal Human Values	3	0	0	3	3
5		Professional Elective-III	3	0	0	3	3
6		Open Elective-II	3	0	0	3	3
Total Credit (Theory subjects)						18	18
Practical							
1	EV39002	SoC Design Lab	0	0	2	2	1
2	EV39004	VLSI Testing and Verification Lab	0	0	2	2	1
	EV39006	VLSI Signal Processing Lab	0	0	2	2	1
Sessional							
1		Minor Project	0	0	2	2	2
Total Credit (Practical & Sessional subject)						8	5
Total Credit (Semester)						26	23

SEVENTH SEMESTER

Theory							
Sl No.	Course Code	Subjects	L	T	P	Total	Credit
1	EX40003	Engineering Professional Practice	2	0	0	2	2
2		Professional Elective-IV	3	0	0	3	3
3		Open Elective-III	3	0	0	3	3
4							
5							
6							
Total Credit (Theory subjects)							8
Practical							
1							
2							

Sessional						
1	EV47001	Project-I				5
		Internship/Training				2
Total Credit (Practical & Sessional subject)						7
Total Credit (Semester)						15

EIGHTH SEMESTER

Theory							
Sl No.	Course Code	Subjects	L	T	P	Total	Credit
1		Professional Elective-V	3	0	0	3	3
2		Open Elective-IV	3	0	0	3	3
3							
4							
5							
6							
Total Credit (Theory subjects)							6
Practical							
1							
2							
Sessional							
1	EV47002	Project-II					9
Total Credit (Practical & Sessional subject)							9
Total Credit (Semester)							15

PROFESSIONAL ELECTIVES – I/II/III

Sl. No	Course Code	Course Title	L	T	P	Total	Credits
1.	CS20002	Operating Systems	3	0	0	3	3
2.	CS20006	Database Management Systems	3	0	0	3	3
3.	CS30010	Cloud Computing	3	0	0	3	3
4.	CS30011	Computational Intelligence	3	0	0	3	3
5.	CS30019	Web Technology and Applications	3	0	0	3	3
6.	CS30029	Computer Vision and Pattern Recognition	3	0	0	3	3
7.	EC30007	ARM and Advanced Processors	3	0	0	3	3
8.	EC30008	Wireless Sensor Networks	3	0	0	3	3
9.	EC30009	Compound Semiconductor Basics	3	0	0	3	3
10..	EC30010	Mobile Ad Hoc Network	3	0	0	3	3
11.	EC30012	Nanoelectronics	3	0	0	3	3
12.	EC30013	Optical and Satellite Communication	3	0	0	3	3
13.	EC30015	Hardware and Software Co-Design of Embedded System	3	0	0	3	3
14.	EC30017	Audio and Speech Processing	3	0	0	3	3
15.	EC30019	Information Theory and Coding	3	0	0	3	3

16.	EC30021	Industrial IoT	3	0	0	3	3
17.	EE30012	Sensors & Actuators	3	0	0	3	3
18.	EE30022	Special Machines & Control	3	0	0	3	3
19.	EE30038	Introduction to Electrical Machines	3	0	0	3	3
20.	EE30047	Power Electronics Circuits	3	0	0	3	3
21.	EL30001	Industrial Automation	3	0	0	3	3
22.	EM30007	Machine Learning based Signal Processing	3	0	0	3	3
23.	EM30008	Deep Learning: Algorithms and Implementation	3	0	0	3	3
24.	EM30009	Data Analytics	3	0	0	3	3
25.	EM30011	Data Mining	3	0	0	3	3
26.	EV30003	Semiconductor Optoelectronics	3	0	0	3	3
27.	EV30005	Semiconductor Material Synthesis and Characterization	3	0	0	3	3

PROFESSIONAL ELECTIVE –IV/ V

1.	CS30023	Software Defined Networking	3	0	0	3	3
2.	CS40010	Augmented and Virtual Reality	3	0	0	3	3
3.	CS40015	Cryptography and Network Security	3	0	0	3	3
4.	EC40001	Optimization Techniques in Engineering	3	0	0	3	3
5.	EC40002	Millimetre Waves and Terahertz Technology	3	0	0	3	3
6.	EC40003	Cognitive Radio and Cooperative Communication	3	0	0	3	3
7.	EC40004	Quantum Communication	3	0	0	3	3
8.	EC40006	Advanced VLSI and SoC	3	0	0	3	3
9.	EC40007	Low Power VLSI Design	3	0	0	3	3
10.	EC40008	Advanced Computer Architecture and RISC-V Processor Design	3	0	0	3	3
11.	EC40009	Biomedical Signal Processing	3	0	0	3	3
12.	EE30024	Electric Drives and Control	3	0	0	3	3
13.	EE40010	Electric Vehicles Technology	3	0	0	3	3
14.	EL40001	Process Control & Robotics	3	0	0	3	3
15.	EL40003	Advanced Control System	3	0	0	3	3
16.	EM40001	ML for Language Processing	3	0	0	3	3
17.	EM40006	Cybersecurity	3	0	0	3	3
18.	EM40008	Bioinformatics	3	0	0	3	3
19.	EM40010	Optimization Methods in Machine Learning	3	0	0	3	3
20.	EV40001	High Speed Interface Design	3	0	0	3	3

Elective Baskets (Specialization)

PE I	PE II	PE III	PE IV	PE V	Specialization
CS20002	CS20006 / CS30019	EM30009 / EM30011 / CS30010	CS30023 / CS40015	EM40006 / CS40010	Computer Engineering
EC30019	EC30013	EC30010 / EC30008	EC40003 / CS40015	EC40004 / EC40002	Communication & Networking
EC30009 / EC30007	EV30003 / EV30005	EC30015	EC40007 / EV40001	EC40006 / EC40008	VLSI & Embedded Design
CS30011 / EM30007	CS30029 / EC30017	EM30008 / EM30009 / EM30011	EC40009 / EM40010	EM40001 / EM40008	Machine Learning and Applications
EE30038 / EC30021	EE30047 / EE30012	EE30022 / EL30001	EE30024 / EL40003	EL40001 / EE40010	Automation

LIST OF HASS ELECTIVES

HASS Elective-II

Sl. No	Course Code	Subjects	L	T	P	Total	Credit
1.	HS20120	Economics of Development	3	0	0	3	3
2.	HS20122	International Economic Cooperation	3	0	0	3	3
3.	HS20220	Organizational Behaviour	3	0	0	3	3
4	HS20222	Human Resource Management	3	0	0	3	3

HASS Elective-III

Sl. No	Course Code	Subjects	L	T	P	Total	Credit
1.	HS30125	Market Structure and Pricing Policies	3	0	0	3	3
2.	HS30127	Pragmatic Inquiry	3	0	0	3	3
3.	HS30129	Economic Analysis of Decision Rules	3	0	0	3	3
4.	HS30131	Economics of Health and Education	3	0	0	3	3
5.	HS30223	Business Ethics and Corporate Governance	3	0	0	3	3
6.	HS30225	Leadership and Team Effectiveness	3	0	0	3	3
7.	HS30421	Gender Studies	3	0	0	3	3
8.	HS30423	Tribal Resource Management	3	0	0	3	3
9.	HS30425	Indian Knowledge System	3	0	0	3	3

RESEARCH ELECTIVE - I (OFFERED BY SCHOOL OF ELECTRONICS ENGINEERING)

Sl. No.	Course Code	Subjects	L	T	P	Total	Credit
1.	EC30009	Compound Semiconductor Basics	3	0	0	3	3
2.	EC40007	Low Power VLSI Design	3	0	0	3	3
3.	CS30023	Software Defined Networking	3	0	0	3	3
4.	EC40015	5G Supportive Technologies	3	0	0	3	3
5.	EC40017	Planner Antenna	3	0	0	3	3
6.	EC40019	Solar Cell Device and Material Technology	3	0	0	3	3

RESEARCH ELECTIVE – II (OFFERED BY SCHOOL OF ELECTRONICS ENGINEERING)

Sl. No.	Course Code	Subjects	L	T	P	Total	Credit
1.	EC40003	Cognitive Radio and Cooperative Communication	3	0	0	3	3
2.	EC40006	Advanced VLSI and SoC	3	0	0	3	3
3.	EC40010	Massive MIMO Technology	3	0	0	3	3
4.	EC40014	RF CMOS VLSI	3	0	0	3	3
5.	EC40016	VLSI Signal Processing	3	0	0	3	3
6.	EC40018	Smart Antennas	3	0	0	3	3

VOCATIONAL ELECTIVES

Vocational courses offered by School of Civil Engineering

Sl. No.	Course Code	Subjects	L	T	P	Total	Credit
1.	CE28001	Building Drawing, Estimation & Costing (for Civil Engineering Students)	0	0	2	1	1

2.	CE28003	GIS & GPS Applications (For other branch students)	0	0	2	1	1
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Vocational courses offered by School of Computer Science Engineering

Sl. No.	Course Code	Subjects	L	T	P	Total	Credit
1.	CS28001	Web Design	0	0	2	1	1

Vocational courses offered by School of Electrical Engineering

Sl. No.	Course Code	Subjects	L	T	P	Total	Credit
1.	EE28011	Industrial wiring and control panel design	0	0	2	1	1
2.	EE28013	Installation, operation and maintenance of solar power system	0	0	2	1	1
3.	EE28015	Domestic wiring and home automation	0	0	2	1	1
4.	EE28017	Cyber physics application in industrial IOT	0	0	2	1	1
5.	EE28019	Industrial Control and Remote Monitoring	0	0	2	1	1

Vocational courses offered by School of Electronics Engineering

Sl. No.	Course Code	Subjects	L	T	P	Total	Credit
1.	EC28001	Computational Photography	0	0	2	1	1
2.	EC28003	Sound Engineering	0	0	2	1	1
3.	EC28005	Sensors for Automation	0	0	2	1	1
4.	EC28007	PCB Design	0	0	2	1	1

Vocational courses offered by School of Mechanical Engineering

Sl. No.	Course Code	Subjects	L	T	P	Total	Credit
1	ME28011	Additive Manufacturing(3-D Printing)	0	0	2	1	1
2	ME28013	Die development by CNC milling	0	0	2	1	1
3	ME28015	Concept Car Manufacturing	0	0	2	1	1
4	ME28017	Development of Autonomous Wheeled	0	0	2	1	1
5	ME28019	Modelling of Micro-Wind turbine by 3D	0	0	2	1	1

K-EXPLORE OPEN ELECTIVE - I

Sl. No.	Course Code	Subjects	L	T	P	Total	Credit
1.	SA38001	Robotics	0	0	2	2	1

2.	SA38003	Web Designing	0	0	2	2	1
3.	SA38005	Civil-Tech	0	0	2	2	1
4.	SA38007	Circuit Design & Control	0	0	2	2	1
5.	SA38009	Indian Classical, Folk & Bollywood Dance	0	0	2	2	1
6.	SA38011	Indian Classical & Western Music	0	0	2	2	1
7.	SA38013	Graphic Designing & Editing	0	0	2	2	1
8.	SA38015	Art & Craft	0	0	2	2	1
9.	SA38017	Theatre & Street Play	0	0	2	2	1
10.	SA38019	Film Making	0	0	2	2	1
11.	SA38021	Debating,Public Speaking& Anchoring	0	0	2	2	1
12.	SA38023	Creative Writing	0	0	2	2	1
13.	SA38025	Photography & Videography	0	0	2	2	1
14.	SA 38027	Fashion Styling	0	0	2	2	1
15.	SA 38029	Culinary Arts	0	0	2	2	1
16.	SA 38031	Quiz Activity	0	0	2	2	1
17.	SA 38033	Social Outreach	0	0	2	2	1
18.	SA 38035	Health & Emergency Care	0	0	2	2	1

SIGNALS AND SYSTEMS

Course Code: EC20001

Credit: 3

L-T-P: 3-0-0

Prerequisites: Nil

COURSE OBJECTIVE

This course will begin with an introduction to analog and digital signal processing, then elaborates on various transformation techniques to signals, and finally presents an idea about actual implementations of these methods in today's hardware and software systems. The course includes analog-time, discrete-time signals and, systems. The syllabus revisits the continuous time transform methods like Fourier and Laplace. This will be followed by discrete time transform methods like the Z transform, DFT, and its properties and system theoretic implications. Later, the concepts and foundations of digital filter design and its realization are built up for FIR and IIR filters.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Analyze continuous and discrete signals, apply sampling process, determine related characteristics.
- CO 2: Distinguish and classify various types of systems and analyze system characteristics in time domain.
- CO 3: Apply appropriate continuous time transformation technique for signal analysis.

CO 4: Analyze the signal and its properties in its frequency domain using discrete time transformation techniques.

CO 5: Apply Fourier transform techniques in real time applications.

CO 6: Apply the knowledge of analog filters to digital filters, design and realization of digital filter.

COURSE DETAILS

Introduction to Signals and System

Representation of continuous and discrete time signals, Basic operations, Sampling Theorem, Linear convolution, Correlation.

Revision of Fourier and Laplace Analysis

Significance of Fourier series in LTI system, Continuous time Fourier series formula. Dirichlet conditions & properties, S-plane mapping, ROC properties and examples, Relationship between Fourier and Laplace Transform, Pole-zero Plot.

Discrete Time Fourier Transforms

Discrete Time Fourier Transform, Conditions and properties of DTFT, Discrete Fourier Transform, Properties of DFT, Inverse Discrete Fourier Transform, Circular Convolution, Properties of Circular Convolution, Sectioned convolution, Fast Fourier Transform.

Z-Transform

Z transform, ROC, Properties, Applications

Digital Filters

Introduction to Digital FIR Filter, Design of FIR Filter: Rectangular, Digital IIR filters: Introduction to Digital IIR Filter, Conversion to digital IIR Filter using impulse invariance technique, Bilinear Transformation, Realization of Digital Filters, Direct form – I realization Direct form – II.

Introduction to Adaptive Filter and applications.

Textbooks

1. Proakis J.G. and Manolakes D. G. *Digital Signal Processing* (4th Edition). Pearson.
2. Oppenheim A. V. and Willsky A. S. (2015). *Signals & Systems* (2nd Edition), Pearson.

Reference books

1. Lathi B. P. *Principle of Signal Processing and Linear System* (1st Edition). Oxford University Press.
 2. Babu P. R. *Digital Signal Processing* (2nd Edition). Scitech.
- Mitra S. K. *Digital Signal Processing - Computer Based Approach* (4th Edition). MGH.

COMMUNICATION ENGINEERING

Course Code: EC20008

Credit: 3

L-T-P: 3-0-0

Prerequisite: Nil

COURSE OBJECTIVE

The objective of the course is to learn the concepts of various analog and digital communication systems. Students will also be able to analyze and develop the problem solving abilities related to communication Engineering.

COURSE OUTCOMES

CO 1: Analyze signal attributes and apply the concept of Fourier transform and series to observe signal in frequency and time domain, and explore the concepts of stochastic processes.

CO 2: Select appropriate analog modulation techniques for specified broadcasting requirements and design corresponding transmission and reception systems with their spectral representations.

- CO 3: Apply the concept of sampling theorem to develop and analyze different Pulse Modulation based communication systems including PCM and their integration with TDM system for signal transmission and reception.
- CO 4: Apply problem solving skills to recommend appropriate digital communication techniques considering the principle of operation of ASK,FSK,PSK,QPSK and QAM.
- CO 5: Analyze the significance of various terminologies associated with Wireless and Satellite Communication and evaluate the performance
- CO 6: Analyze the significance of signal communication with Optical Communication technology and various and various applications.

COURSE DETAILS

Introduction

Basic communication system , Signals in time and frequency domain, Fourier transform and Series, properties of FT and FS, Various Signal functions, Brief Idea of Probability, Cumulative Distributive Function, Probability Density Function, Gaussian and Rayleigh PDF.Concept of Signal to Noise Ratio.

Amplitude Modulation Techniques

Need of Modulation, Frequency Translation, Principle of AM, side bands, Power Relationship, Assignable Frequency spectrum, Side band Transmission, DSB, SSB, VSB, AM modulators and demodulators, AM Radio Receiver,Super heterodyne Principle.

Frequency Modulation Techniques

Principle of FM, Frequency Deviation, Spectrum of FM wave, Power in Modulated wave, Narrow band FM, Pre-emphasis and De-emphasis, Block Diagram of FM Transmitter,FM Detector,Block Diagram of FM Receiver,

Pulse Modulation Techniques

Analog vs Digital modulation, Sampling Process, Pulse Amplitude Modulation, Pulse Width Modulation,Pulse Position Modulation,Time Division Multiplexing, Frequency Division Multiplexing, The Quantization Process, Pulse Code Modulation, Bandwidth vs SNR trade-off in PCM.

Digital Modulation

Data Form, Principles involved in ASK, PSK (BPSK, QPSK, $\pi/4$ QPSK), FSK.

Different Communication Systems

Introduction to Modems, Brief concept of satellite communication, Fiber optic communication and Mobile communication.

Textbooks:

1. B.P. Lathi, Modern Digital and Analog Communications Systems, Oxford Univ Press, 4th Edition.
2. Simon Haykin, Introduction to Analog & Digital Communication System, .Wiley Student edition 2011

Reference book:

1. H. Taub, and D.L.Schilling, Principles of Communication System, McGraw Hill, 3rd Edition

COMPUTATIONAL PHOTOGRAPHY

Course Code: EC28001

Credit: 1

L-T-P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

Computational photography (CP) is the fusion of computer graphics, computer vision, optics and imaging. The role of CP is to overcome the limitations of traditional cameras by combining imaging and computing to enable new and improved ways to capture, represent and interact with the physical world. The course provides an overview of elements of photography, which includes digital image capturing mechanisms, lighting controls, effect of focal length and aperture and various lossy and lossless image storage mechanisms. Objective is to briefly explain computational methods used to enhance photographs.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Appreciate concept of photography, and digital camera technology
- CO 2: Understand types of cameras and their mechanisms
- CO 3: Demonstrate computational image processing
- CO 4: Apply computational photography methods for photo composition and panoramic
- CO 5: Apply computational image processing for photography quality enhancement
- CO 6: Comprehend various image filtering techniques

COURSE DETAILS

Introduction to Computational Photography

History of Photography and Computational Photography, Digital Representation of Images, Cameras, Difference between Full frame, APSC and Medium format sensors, scaling, crop sensor advantages/disadvantages

Digital photography

Principle of Operation of DSLR camera, Aperture, ISO, Shutter speed and Angle Control, Camera Calibration and Tethering, Computational Cameras, Image Storage formats: Compressed vs uncompressed formats, Basics of Lenses: Wide angle, Telephoto, Prime lenses, Macro lenses. Difference in angle, Depth of field control

Computational Techniques

Concept of Color, color models , noise, its types, image histogram, Image Processing software: Licensed and Open Source

Training on Computational Photography

Shooting with wide angle lenses, Shooting with Telephoto lens, zooming, changes in angle , Shooting with Prime lenses and constant aperture lenses, Shooting with Macro lenses, microscopic photography

Training on Digital Imaging-I

Photography Genres, Scene Composition, Dynamic Range improvement, Portraits, Photographing scenes, crowd and people, Shooting Portraits, group photos and events

Training on Digital Imaging-II

Long exposure, Brenizer's Method, Sports High Shutter speed, Burst, fisheye, architecture photography, Macro, Basics of Long exposures, using polarizing filters Shooting panorama, Brenizer's method and other photographing techniques Shooting sports, high shutter speed

Training on Digital Imaging-III

Use of lights, soft box and flashes, guide number etc. , product photography, computational photography,E-commerce photography, Use of Lights, Flash, wireless flash, Basics of product photography, photography for e-commerce and computational photography

Training on Post Processing-I

RAW image processing, Basic adjustments and correction, Lens Distortion and color correction using Adobe Photoshop, Monochrome image processing, color image processing batch processing using Light-room

Training on Post Processing-II

Image enhancement operations, noise removal, Artistic filtering, cosmetic filtering, and other post processing methods. Post Processing III: Background removal, artificial coloring.

Training on Post Processing-III

Open Source and free software for image post processing and computational photography, their usage and capabilities.

Photography Ethics

Photography ethics: empathy, consent, integrity, ethical decision making, privacy

Textbook

1. Richard Szeliski, Computer Vision: Algorithms and Applications, 2nd ed

Reference books

1. Ayush Bansai, Achuta Kadambi, and Ramesh Raskar, Computational Imaging Book
2. Richard Hartley and Andrew Zisserman., Multiple View Geometry in Computer Vision
3. David Forsyth and Jean Ponce., Computer Vision: A Modern Approach

4. Steven Gortler., Foundations of 3D Computer Graphics
5. Rafael Gonzalez and Richard Woods., Digital Image Processing
6. Barbara London and John Upton, Photography

SOUND ENGINEERING

Course Code: EC28003

Credit: 1

L-T-P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

It elaborately covers in various aspects of sound(physical and mechanical behavior), equipment used for recording/reproducing and basic idea for the preparation of final sound track in film or television production.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Recognize, define, and explain the principles of sound engineering related to signal flow, microphones, recording, mixing, production, and mastering.
- CO 2: Demonstrate practical, imaginative understanding and fluency on sound engineering technologies and procedures .
- CO 3: Solve problems independently, imaginatively, and creatively in the field of sound engineering will be demonstrated by students.
- CO 4: Learn how to conduct research and have a critical comprehension of sound engineering and its related fields.
- CO 5: Understand the basic techniques of sound recording.
- CO 6: Understand the working of different types microphone and louspeakers and their applications in industry.

COURSE DETAILS

- Introduction to technology of sound
- Analysis of prerecorded speech, music and effects
- Observation of the installation of PA System in a large auditorium
- Study and analysis of different microphones
- Study the feature of 2 channel digital sound recorder
- Study about the effect of loudness in relation with the distance from source to the listener
- Sound recording and reproduction practice by using recorder in PA system chain
- Study of sound in different environmental situation
- Study and analysis on Modulated Radio wave AM and FM in Live streaming radio stations
- Study the effect of Bass and Treble (Concept of Equalization)

Textbook

1. Glyn Alkin, Sound Recording and Reproduction

Reference book

1. Michael Talbot Smith, Sound Assistance

SENSORS FOR AUTOMATION

Course Code: EC28005

Credit: 1

L-T-P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

Sensors and automation are revolutionizing the technology in the areas like consumer electronics, automotive industry, healthcare, and in other settings. The course will provide an opportunity for students to learn different sensors and its application in real world problems. It will empower the students to develop their knowledge regarding operation, application and integration of sensors to enable the design and realization a complete systems.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Learn about the microcontroller, its hardware interfacing and programming
- CO 2: Understand the working principle and characteristics of different types of sensor
- CO 3: Interface various sensor interfacing with microcontroller and display devices
- CO 4: Understand the basic principles of analog to digital conversion and its application with different sensors
- CO 5: Gain knowledge about various types of automation system
- CO 6: Develop and implement sensor for final products in real time applications

COURSE DETAILS

1. Introduction to microcontroller, platform of operations with basic programming techniques
2. Interfacing of serial and parallel device with microcontroller
3. Interfacing of microcontroller with display devices
4. Use of ADC to interface various analog sensors with microcontroller
5. Introduction to sensor, measurement of physical parameters like temperature and humidity
6. Application of ultrasonic and proximity sensor
7. Application of gas and pressure sensor
8. Application of IR sensor and RFID
9. Interfacing actuators to drive DC motor (application of touch switch as actuators)
10. Implement sensor in final products for real time solution

Textbook

1. T. Karvinen, and K. Karvinen, Getting started with sensors, Shroff Publishers, Kindle , Edition, 2014.

Reference books

1. J. S. Katre, Sensors in Automation, Tech Knowledge Publications, 1st Edition, 2023
2. D. Patranabis, Sensors and Transducers, PHI Learning, 2nd Edition, 2003.

PCB DESIGN

Course Code: EC28007

Credit: 1

L-T-P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

Over the years, printed circuit board manufacturing has continued to grow in order to keep up with the increasing demands of newer, faster, and more complex electronic circuitry. This course will familiarize students to design, simulate electronics circuit and fabricate PCB for prototyping using CAD tool. This program is designed to provide a balanced foundation of theoretical knowledge and practical skills in printed circuit board design.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Understand and evaluate different electronics components.
- CO 2: Create schematic and simulate the circuit using OrCAD or any other CAD tools.
- CO 3: Understand single- and double-layer PCB.
- CO 4: Create and fabricate PCB and analyze the PCB using screen printing method.
- CO 5: Understand assembly of electronics component by soldering.
- CO 6: Analyze and test the circuit for any error.

COURSE DETAILS

Description of different Electronics Component and their Identification

Passive and active components, component identification, Color code for resistor and disc capacitors, Inductor and their types, simple air core and iron core inductor design.

Circuit Design and Simulation using CAD tool (OrCAD)

Design of a simple electronics circuit using data sheet and circuit schematic and simulation.

Schematic to PCB transfer and routing

Schematic to PCB transfer (assigning foot prints to various components, transfer to PCB), routing, DRC, ERC, EMC

Screen Printing Procedure

Preparation of screen, mask transfer

PCB preparation and Checking of Routing

transfer of layout to PCB using screen printing methods, etching, cleaning, error checking of routing, component mounting, soldering

Testing and Verification

Testing the circuit with the help of multi-meter and CRO

Textbooks

1. Chris Robertson, Printed Circuit Board, PHI, 2003
2. Elaine Rhodes, Developing Printed Circuit Assemblies: From Specifications to Mass Production, 2008, ISBN: 978-1435718760.

Reference books

1. Douglas Brooks, Signal Integrity Issues and Printed Circuit Board Design, PHI, 2003.
2. Kraig Mitzner, Complete PCB Design Using OrCAD Capture and PCB Editor, Newnes, 2009
3. Open source EDA Tool KiCad Tutorial : <http://kicad-pcb.org/help/tutorials/>

ELECTRONIC CIRCUITS LAB

Course Code: EC29001

Credit: 2

L-T-P: 0-0-4

Prerequisites: Nil

COURSE OBJECTIVE

Students will be able to gain knowledge and implement as well as simulate basic analog and digital electronic circuits (amplifier, oscillator, voltage regulator, decoder, multiplexer, counter) using discrete components and ICs. Students will have the ability to analyse, and resolve engineering problems associated with component selection, assembly and testing and get familiarization to PCB designing

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Design and simulate amplifier circuit using BJT/FET and ICs .

CO 2: Design and simulate oscillator circuit using BJT/FET and ICs .

CO 3: Design and simulate filter circuit using discrete components/ICs .

CO 4: Design and simulate voltage regulator circuit using discrete components/ICs .

CO 5: Simulate and design combinational logic circuits like adders, decoders and multiplexers in Xilinx ISE and logic gate ICs.

CO 6: Simulate and design sequential logic circuits like Synchronous type counters and Asynchronous type counters in Xilinx ISE and Flip-flop ICs.

ARM AND ADVANCED PROCESSORS

Course Code: EC30007

Credit: 3

L-T-P: 3-0-0

Prerequisites: Nil

COURSE OBJECTIVE

The objective of this course is to teach the higher-level concepts of Advanced Microprocessors and ARM to the students. The students learn about Multitasking, Virtual memory, Memory management, Paging, TLB, RISC features, Pipelining and Branch Prediction like concepts. They develop skills for writing programs on ARM to solve simple problems as well as

some real time applications.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Appraise the concepts implemented in higher level Processors like Multitasking, Virtual Memory, Memory Management etc.
- CO 2: Examine the mode of Operation of 80286, Concept of program invisible registers, Segment Descriptors etc.
- CO 3: Analyze Segment Descriptors, Privilege level and Protection, Virtual '86 Mode and Paging in 80386, enhanced features incorporated in 80486
- CO 4: Analyze the RISC features implemented in the design of Pentium Processors, Parallel processing through U & V Pipelines / Superscalar Execution and Branch Prediction Techniques
- CO 5: Acquire the knowledge of a 32-bit ARM Processor, its RISC features, Registers, Pipelining and Interrupts
- CO 6: Evaluate the 32-bit ARM instruction set, 16-bit Thumb instructions and Interfacing

COURSE DETAILS

Introduction

Overview of Intel higher level Processors, Concept of Multitasking, Virtual memory & Memory management.

Intel 80286 & 80386

Brief outline of Processor Architecture, Mode of operation, Segment descriptor, Privilege level & protection and Task switching in 80286, Virtual 86 mode, Paging and TLB in 80386

Pentium Processor

Features of RISC processors & Implementation of RISC features in Pentium, Pipelining, Superscalar execution & Branch prediction Technique

ARM & Interfacing

ARM design, ARM Processor fundamentals: Registers, CPSR, Memory map, Pipelines, Exceptions, Interrupt Vector Table, Introduction to ARM Instruction set and Thumb instructions, Interfacing – LCD, ADC, DAC, Stepper motor, UART

Textbooks

1. K. Ray and K. M. Bhurchandi - Advanced Microprocessor and Peripherals - Architecture, Programming and Interfacing, McGraw Hill Education Pvt Ltd - 3rd Edition
2. Muhammad Ali Mazidi, Sarmad Naimi, Sepehr Naimi, Shujen Chen - ARM Assembly Language Programming & Architecture - Micro Digital Ed, ISBN: 9780997925906 - 2nd Edition.

Reference books

1. B. B. Brey - The Intel Microprocessors 8086/8088, 80186/80188, 80386, 80486, Pentium and Pentium Pro - PHI - 8th Edition
2. D. V. Hall - Microprocessors & Interfacing, Programming & Hardware - TMH - 3rd Edition.
3. William Hohl, Christopher Hinds - ARM Assembly Language: Fundamentals and Techniques - Taylor & Francis - 2nd Edition.
4. M A Mazidi & others, ARM System Developers Guide Design & Optimizing System Software – Andrew N. Sloss & others - Elsevier.

WIRELESS SENSOR NETWORK

Course Code: EC30008

Credit: 3

L-T-P: **3-0-0**

Prerequisites: Nil

COURSE OBJECTIVE

This course describes the functioning of a wireless sensor network, the layered architecture and auxiliary units viz., time synchronization and localization.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Identify the different elements of Wireless Sensor Network (WSN), network designing factors including the characteristics, and constraints.
- CO 2: Make use of different techniques in physical and MAC layer in WSN.
- CO 3: Apply different routing mechanisms in WSN.
- CO 4: Analyze Transport layer, Application layer protocols and cross layer effects and solutions for WSN.
- CO 5: Estimate the position of sensor nodes using different ranging techniques and ranging based protocols for WSN.
- CO 6: Elaborate the time synchronization challenges and discuss some approaches that have been designed to address these challenges.

COURSE DETAILS

Introduction

Basic concepts, Platforms, Standardization, Architecture and protocols, Applications in military, Environment, Healthcare, Industry and Energy, Factors influencing WSN Design.

Physical & MAC Layer

PHY layer standard (IEEE 802.15.4), MAC challenges, MAC protocols for Sensor Network, Contention based MAC (S-MAC, B-MAC, CC-MAC), Reservation based MAC (TRAMA) & Hybrid MAC (Zebra MAC).

Network & Transport layer

Routing challenges, Data centric and flat architecture protocol (SPIN), Hierarchical protocol (LEACH), Geographical routing protocol (MECN), QoS based Protocol (SAR), Challenges of Transport layer, Transport layer protocols (PSFQ & CODA).

Application Layer

Source Coding, Query Processing, Network Management

Cross Layer Solutions

Interlayer Effects, Cross layer Interactions (MAC-Network, MAC-Application, Network and PHY, Transport – PHY), Cross layer module.

Localization

Challenges in localization, Ranging techniques, Range based localization protocols, Range free localization protocol.

Time Synchronization

Challenges for time synchronization, Timing Sync Protocol for Sensor Network (TPSN), Time Diffusion Synchronization Protocol (TDP), Rate based Diffusion Protocol (RDP).

Textbook

1.Ian F. Akyildiz and Mehmet Can Vuran, Wireless Sensor Networks, John Wiley and Sons Ltd, Publication, 2010.

Reference books

1. Jun Zheny and Abbas Jamalipour, Wireless Sensor Network - a networking perspective, Wiley, 2009.
2. C. Raghavendram, K. Sivalingam and T. Znati, Wireless Sensor Network, Springer, 2005.

COMPOUND SEMICONDUCTORS BASICS

Course Code: EC30009
Credit: 3
L-T-P: 3-0-0
Prerequisite: Nil

COURSE OBJECTIVE

This course is an introduction to properties of Compound Semiconductors highlighting the theoretical and practical aspects of their device physics and suitability for high speed devices. Beginning with an introduction to the basics of semiconductor devices and characteristics, it presents an overview compound semiconductor materials, as well as a detailed look at the electrical and optical properties of compound semiconductor hetero-structures.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Analyze the basic concepts of Semiconductor Devices and characteristics.
- CO 2: Assess the requirements of Compound Semiconductors.
- CO 3: Evaluate of the Performance measure of high speed devices
- CO 4: Analyze principle of operation and the unique features of HBT, HEMT, TFET.
- CO 5: Evaluate the issues and targeted performances of Compound Semiconductor Devices.
- CO 6: Develop critical thinking ability supported by the learned concepts of Compound Semiconductors: Device Properties & Applications.

COURSE DETAILS

Introduction

Fundamentals of Semiconductor Devices, P-N Junction Diode and MOSFET, Introduction of Compound Semiconductors, Crystal structure, Properties of Compound semiconductors, Merits of III –V binary and ternary compound semiconductors (GaAs, InP, InGaAs, AlGaAs, SiC, GaN etc.), different SiC structures, silicon-germanium alloys and silicon carbide for high speed devices, as compared to silicon based devices, Band Diagrams, Pinch off voltage and threshold voltage, D.C. Characteristics and Analysis of Drain Current. Sub threshold Characteristics, Short Channel Effects.

Important parameters governing for the high speed and high power device performance

Transit time of charge carriers, junction capacitances, ON-resistances, the device geometry and size, carrier mobility, doping concentration and temperature break down voltage.

Hetero junction Bipolar Transistors (HBTs)

Principle of operation and the benefits of hetero junction BJT for high speed applications. GaAs and InP based HBT device structure, SiGe HBTs and the concept of strained layer devices.

High Electron Mobility Transistors (HEMT)

Hetero-junction devices. The generic Modulation Doped FET(MODFET) structure for high electron mobility realization. Principle of operation and the unique features of HEMT, InGaAs/InP HEMT structures. Tunneling devices: Principle of operation and the unique features of TFET, Resonant-tunneling hot electron transistors

Textbooks

1. S.M. Sze, High Speed Semiconductor Devices, Wiley (1990) ISBN 0-471-62307-5
2. G.A. Armstrong, C.K. Maiti, TCAD for Si, SiGe and GaAs Integrated Circuits, The Institution of Engineering and Technology, London, United Kingdom, 2007, ISBN 978-0-86341-743-6.

Reference books

1. Ralph E. Williams, Modern GaAs Processing Methods, Artech (1990), ISBN 0-89006-343-5,
2. Sandip Tiwari, Compound Semiconductor Device Physics, Academic Press (1991), ISBN 0-12-691740-X.

MOBILE AD HOC NETWORKS

Course Code: EC30010
Credits: 3

L-T-P: **3-0-0**
Prerequisites: **Nil**

COURSE OBJECTIVE

Wireless networks play an increasingly important role in the world of communications. This course provides an introduction to operation and developing standards for mobile networks, such as Vehicular Networks, Unmanned Air Vehicles, and Small Satellites, and students will learn to analyze the performance of these cutting-edge networks. Related protocols and their performance are studied using formal analytical tools and realistic simulations.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Analyze and evaluate characteristics, Architecture, features, factors and challenges related to Mobile Ad Hoc Networks (MANET).
- CO 2: Compare different Medium Access Control (MAC) protocols in the context of MANET and choose apt MAC protocol based on application requirements and network design specifications.
- CO 3: Compare different Routing protocols in the context of MANET and choose apt Routing protocol based on network scenario.
- CO 4: Assess issues and challenges for providing Quality of Service (QoS) in Ad Hoc wireless Networks and plan required QoS solutions in MAC and Network layers.
- CO 5: Evaluate various Energy Management schemes in Ad Hoc Wireless Networks and would be able to judge the best scheme based on network specifications.
- CO 6: Perceive various Ad Hoc Nomadic Mobile Applications to acquire skills required for designing and creating scenario specific Ad Hoc Mobile Applications.

COURSE DETAILS

Introduction

Origin Of Ad Hoc :Packet Radio Networks - Technical Challenges - Architecture of PRNETs - Components of Packet Radios - Introduction to Ad Hoc networks - Definition, characteristics features - Issues in Mobile Ad Hoc networks- Types of Ad Hoc Mobile Communications - Types of Mobile Host Movements - Ad Hoc wireless Internet. Characteristics of Wireless channel Mobility models - Indoor and Outdoor.

Medium Access Protocols

MAC protocols: design issues, goals and classification. Contention based protocols - With reservation, scheduling algorithms, protocols using direction antennas - Distributed packet reservation - Multiple access protocol, collision avoidance time allocation protocol. IEEE standards: 802.11 a, 802.11 b, 802.11g.

Routing Protocols and Multicast Routing in Ad Hoc Networks

Introduction - Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks - Classifications of Routing Protocols Table Driven routing protocols: Destination Sequenced Distance Vector Routing Protocol - Cluster head Gateway switched routing protocol. On Demand routing protocol: Dynamic source routing protocol, AODV routing protocol, temporarily ordered routing algorithm. Hybrid routing protocols: Zone routing protocol, Zone based Hierarchical link state routing protocol. Architecture Model for Multicast Routing Protocols - Classifications of Multicast Routing Protocols - Tree Based Multicast Routing Protocols - Mesh-Based Multicast Routing Protocols - Energy-Efficient Multicasting - Comparisons of Multicast Routing Protocols.

QOS and Energy Management

Issues and Challenges in Providing QoS in Ad Hoc Wireless Networks - Classifications of QoS Solutions - MAC Layer Solutions - Network Layer Solutions. Need for Energy Management in Ad Hoc Wireless Networks - Classification of Energy Management Schemes - Battery Management Schemes - Transmission Power Management Schemes - System Power Management Schemes.

Ad Hoc Nomadic Mobile Applications

In the Office, While Traveling, Arriving Home, In the Car, Shopping Malls, The Modern battlefield, Car-to-Car Mobile Communications, Mobile Collaborative Applications - Location/context based mobile services - Introduction to wireless mesh networks and vehicular Ad Hoc networks.

Textbook

1. C.Sivaram Murthy and B.S Manoj, Ad Hoc Wireless Networks, Pearson Education, Second Edition India, 2001.

Reference books

1. K Toh, Ad Hoc mobile wireless networks, Protocols and Systems, Pearson Education, 2nd Edition, 2009.
2. Stefano Basagni, Mobile Ad hoc Networking, Wiley Inter science, IEEE Press, 2004.
3. George Aggelou, Mobile Ad Hoc Networks, McGrawHill, 2004.

Thomas Krag and Sebastin Buetrich, Wireless Mesh Networking, O'Reilly Publishers, 2nd Edition, 2007.

NANO ELECTRONICS

Course Code: EC30012

Credit: 3

L-T-P: 3-0-0

Prerequisites: Nil

COURSE OBJECTIVE

In this course the students will be introduced to the basic concepts of Nanoelectronics, Nanodevices, Spintronic and also able to learn the quantum mechanics that governs the operation of Nanoelectronics devices.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Analyze the basic and advanced concepts of Nano electronics.
- CO 2: Apply and evaluate the use of fundamental science of quantum mechanics in Nano electronics.
- CO 3: Identify Nanoelectronics materials and will be able to distinguish from other materials.
- CO 4: Analyze the different fabrication and characterization techniques of nanostructure materials.
- CO 5: Apply the concepts of few Nano electronics devices.
- CO 6: Analyze and evaluate the idea of single electron transistors and its further applications

COURSE DETAILS

Particles and Waves

Introduction to Particles and waves, Wave Particle duality, Schrodinger Wave equation, Wave Mechanics of particle with suitable examples, Atoms and atomic orbitals

Density of states, quantum transport and tunneling effect.

Tunnel Junction and Applications of Tunneling

Tunneling Through a Potential Barrier, Metal-Semiconductor, and Metal-Insulator-Metal Junctions, Tunnel Junctions, Tunnel Junction Excited by a Current Source. Spintronics and Foundations of nano-photonics.

Field Emission, Gate—Oxide Tunneling and Hot Electron Effects in nano MOSFETs, Growth, Fabrication, and Measurement Techniques for Nanostructures: Introduction, Bulk crystal and heterostructure growth, Nanolithography, etching, and other means for fabrication of nanostructures and nano-devices, Techniques for characterization of nanostructures (FESEM, STM).

Nanostructure Devices

Quantum dots and nanoparticles, Carbon nanotubes and nanowires, Nano pillars, Nano sensors and Nano medicines, MEMS, Single Electron Transistor, Carbon Nanotube Transistors (FETs and SETs), Semiconductor Nanowire FETs and SETs. Applications of Nano electronic devices, 12

Textbooks

1. Vladimir V. Mitin , Viatcheslav A. Kochelap and Michael A. Stroscio, Introduction to Nano electronics (Science, Nanotechnology, Engineering, and Applications); Cambridge University Press, 2008
2. T Pradeep, NANO: The Essentials Understanding Nanoscience and Nanotechnology, McGraw Hill, 2018

Reference books

1. George W Hanson, Fundamentals of Nan electronics, Pearson 2008
2. WR Fahrner, Nanotechnology and Nano electronics – Materials, Devices and Measurement Techniques Springer, 2005
3. Stephen D. Senturia, Microsystem Design, Springer, 2001
4. Marc Madou, Fundamentals of Microfabrication & Nanofabrication, 3rd Edition, CRC Press, 2011.

OPTICAL & SATELLITE COMMUNICATION

Course Code: EC30013

Credits: 3

L-T-Pl: 3-0-0

Prerequisites: Nil

COURSE OBJECTIVE

The course intend to make the students to learn the Optical Communication and Networking Concept, primarily signal propagation through optical fiber, Modulation for optical Communication, Losses, Dispersion, Link Budget and Networking. The knowledge of Satellite Communication and Systems are also very important for a communication Engineering student. The aim of the course is to develop the industry identified competencies within the students like Maintenance of optical communication systems and Satellite communication systems through various teaching and learning processes.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Explain the significance of terminology associated with optical communication, analyze the principle of light propagation through optical fiber with concept of modes and solve problems on this concept.
- CO 2: Analyze various types of losses and dispersion in optical fiber and solve related problems associated with the concept.
- CO 3: Analyze the structure, principle of operation and the characteristics of optical sources and detectors.
- CO 4: Identify the optical communication system link elements, preparation of link budget and estimate basic entities of optical Networking.
- CO 5: Identify the Satellite communication elements and analyze the principles.
- CO 6: Analyse the Satellite Communication Systems and design the satellite Link budget.

COURSE DETAILS

Principles of Optical Communication and Wave Propagation in Optical Fiber

Optical frequencies used in optical fibers, Principle of light propagation in optical fibers, Advantages of optical fiber communication. Relation, Basic structure of optical fibers and ray diagram of optical path in an optical fiber, Acceptance angle, Numerical aperture. Concept of modes, Different types of modes in optical fibers, Relation between modes and rays, Cut-off condition for guided modes, Boundary conditions, single mode / multi-mode fibers, Concept of V number and its importance.

Losses in Fiber and Dispersion

Intrinsic / Extrinsic losses, Material or impurity losses, Rayleigh scattering loss, Absorption loss, Bending loss. Loss versus wavelength plot, Concept of dispersion, Intermodal dispersion, Intramodal dispersion, Wave guide and material dispersion, minimization of dispersion.

Optical Sources, Detectors, and Fiber Optic Links

Characteristics of optical sources, Principle of operation of LED and LASER diode, Intensity modulation circuits for LED and Laser diode. Principle of operation of PIN diode and APD, Basic structures, Current characteristics, SNR calculation and Noise equivalent power, Bit error rate, fiber optic links - power budget, rise-time budget.

Single-wavelength networks

SONET/SDH, FDDI, WDM networks - Broadcast- and-select WDM LAN, Wavelength-routed metro and wide-area networks, passive optical networks for access segment.

Principle and elements of Satellite Communication

Introduction, Frequency spectrum for satellite communication, Types of orbits, Kepler's Laws of planetary motion, Orbital perturbations, Geostationary orbit, Satellite launching, General satellite communication, Block diagram uplink, Downlink frequencies, Types of modulation techniques used

Losses, Attenuation and Satellite Link Budget

Signal loss on transmission through earth's atmosphere, Atmospheric losses, Ionosphere effects, Rain attenuation. Satellite link budget : Transmission losses, Interference, System noise temperature, Link power budget

Satellite sub-systems

Antenna sub-systems, Attitude and orbit control sub-system, Power sub-system, Communication sub-system, TTC&M sub-systems.

Textbooks

1. J. C. Palais, Optical Fiber Communication, Pearson Education, 2022 reprint
2. Pratt, Bostien, Allnut, Satellite Communication, John Wiley Publications, 2nd edition, 2013

Reference books

1. G. Kaiser, Optical Fiber Communication, McGraw Hill, - 5th edition, 2013
2. Denish Roddy, Satellite Communication, McGraw Hill, 3rd edition, 2001

HARDWARE AND SOFTWARE CO-DESIGN FOR EMBEDDED SYSTEM

Course Code: EC30015

Credit: 3

L-T-P: 3-0-0

Prerequisites: Nil

COURSE OBJECTIVE

This course will make the student understand the concept of an embedded system, to get the clarity of various design metrics for a system, and learn the concept of improving productivity by presenting a unified view of software & hardware. Further they will be exposed to general purpose processors, standard single purpose processors and to grasp the advanced techniques for embedded system modelling using the RTOS and task scheduling algorithms.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Interpret the HW /SW co design issues and challenges
- CO 2: Apply different embedded system modelling techniques.
- CO 3: Analyse different methods of software design for embedded system
- CO 4: Apply knowledge to create different architecture for es
- CO 5: Create prototyping of an embedded system
- CO 6: Apply knowledge to optimize the performance of embedded system

COURSE DETAILS

Introduction to Embedded System & Co-Design

Embedded System & Future trend, Problem description, goals of co-design, co-design steps, existing co-design approaches, and present challenges.

System Modelling and Specification

Models of computation (Signal flow graphs, Data flow model, Task graphs, Finite State Machines, hierarchical models), Petri net, UML.

Software Design

Embedded System Software, ES Software Consideration, Dealing with Data Que and Interrupt, Computation and communication model of software, consideration ES with OS, Memory and shared memory issues.

Architectures for Embedded Systems & Synthesis

Single processor – coprocessor architecture, mixed-signal architectures, multiprocessor architectures, reconfigurable architectures, Systems on Chip, I/O System, Peripherals and buses, Partitioning and Architecture Selection, Software

Synthesis, cost Estimation Hardware Synthesis.

Prototyping and Verification of ES

prototyping phases- simulation & emulation, prototyping with development boards, rapid prototyping, Testing- Goals and scope of testing, testing approaches, design for testability, Verification- functional, timing and formal verification, debugging.

Textbook

1. Bashir I. Morshed, Embedded Systems – A Hardware-Software Co-Design Approach Springer, 2021.

Reference books

1. Felice Balarin, Massimiliano Chiodo, Paolo Giusto, Harry Hsieh, Attila Jurecska, Luciano Lavagno, Claudio Passerone, Alberto Sangiovanni-Vincentelli, Ellen Sentovich, Kei Suzuki, Bassam Tabbara, Hardware-Software Co-Design of Embedded Systems, Springer, 1997
2. D. Gajski, F. Vahid, S. Narayan, and J. Gong, Specification and Design of Embedded Systems, Prentice Hall, 1994.
3. Wayne Wolf, Jorgen Staunstrup, "Hardware / Software Co- Design Principles and Practice", , Springer.2009
4. Giovanni De Micheli, Mariagiovanna Sami, "Hardware / Software Co- Design", Kluwer Academic Publishers, 2002.

AUDIO AND SPEECH PROCESSING

Course Code: EC30017

Credits: 3

L-T-P: 3-0-0

Prerequisites: Nil

COURSE OBJECTIVE

This course will be able to provide the basic concepts and methodologies for the analysis, modeling, synthesis and coding of speech and music. Also the students will get a foundation for developing applications and for future study in this field. Further it introduces software tools for the analysis and manipulation of speech and music and to gain practical experience in the design and implementation of speech and music processing algorithms.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Explain the fundamental concepts of speech production, perception, and auditory psychoacoustics.
- CO 2: Analyse and extract features from speech signals using various digital models and linear prediction techniques.
- CO 3: Design and implement speech coding and synthesis algorithms for various applications.
- CO 4: Apply speech transformations, such as time scale modification and voice morphing.
- CO 5: Implement and evaluate automatic speech recognition systems using various models and techniques, including speaker recognition systems.
- CO 6: Apply speech enhancement techniques to real-world applications, such as digital hearing aids.

COURSE DETAILS

Introduction

Mechanism of speech production and perception, acoustic and articulatory phonetics,

Digital models for the sampled speech signal

Acoustic Theory, lossless tube models – digital models.

Linear prediction of speech

Time domain processing of speech signals: short-time energy, magnitude, zero-crossing rate, auto correlation - formulation of LPC equation - solution of LPC equations - Levinson Durbin algorithm - Levinson recursion - Schur algorithm - lattice formulations and solutions – PARCOR coefficients

Spectral analysis of speech

Short Time Fourier analysis - filter bank design.

Auditory Perception

Psychoacoustics- Frequency Analysis and Critical Bands - Masking properties of human ear.

Speech coding

Sub band coding of speech - transform coding - channel vocoder - formant vocoder - cepstral vocoder -vector quantizer coder- Linear predictive Coder.

Speech synthesis

Pitch extraction algorithms - Gold Rabiner pitch trackers - auto correlation pitch trackers - voice/unvoiced detection - homomorphic speech processing – homomorphic systems for convolution - short-time cepsturm and complex cepsturm - pitch extraction using homomorphic speech processing.

Speech Transformations

Time Scale Modification - Voice Morphing. Automatic speech recognition systems – isolated word recognition - connected word recognition -large vocabulary word recognition systems - pattern classification – Dynamic Time Warping – Hidden Markov Modeling - speaker recognition systems - speaker verification systems – speaker identification. Speech Enhancement Techniques — Approaches and Challenges in the design of Digital Hearing Aids.

Textbooks

1. L.R. Rabiner and R.W. Schafer, Digital Processing of Speech Signals Pearson Education, Delhi, India, 2004
2. D. O'Shaughnessy, Speech Communications: Human and Machine, Second Edition, University Press, 2005.

Reference books

1. Thomas F. Quatieri, Discrete-time Speech Signal Processing: Principles and Practice, Prentice Hall, Signal Processing Series, 2002
2. Philipos C. Loizou, Speech Enhancement – Theory and Practice, CRC Press, 2013
3. John N. Holmes, Wendy J. Holmes, Speech Synthesis and Recognition, Taylor and Francis, 2nd Edition, 2003.
4. J. R. Deller, Jr., J. H. L. Hansen and J. G. Proakis Discrete-Time Processing of Speech Signals, Wiley-IEEE Press, NY, USA, 1999.

INFORMATION THEORY & CODING

Course Code: EC30019

Credit: 3

L-T-P: 3-0-0

Prerequisites: Nil

COURSE OBJECTIVE

The course will help in forming a strong foundation for the broad areas of information theory, coding and cryptography. It emphasizes on the basic concepts, lays stress on the fundamental principles and motivates their application to practical problems. This course starts with the basics of information theory and source coding. The theory of linear block codes (including cyclic codes, BCH codes, RS codes), convolution codes are explained. Basics of secure communications including cryptography and physical layer security are covered.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Explain the mathematical definitions of information, using conditional and unconditional probability theorem
- CO 2: Analyze and differentiate several sources of information and coding techniques
- CO 3: Explain and analyze channel coding schemes and Shannon's information theory
- CO 4: Distinguish between various error decoding schemes
- CO 5: Design and simplify different codes such as cyclic codes, CRC codes (cyclic Redundancy Codes) and BCH codes, generate Convolution codes
- CO 6: Discuss practical applications of coding for secure communication

COURSE DETAILS

Introduction

Introduction to Information Theory, Entropy, Mutual Information, Conditional and Joint Entropy, Measures for Continuous Random Variable, Relative Entropy

Source Coding

Variable Length Codes, Prefix Codes, Source Coding Theorem, Various source coding techniques: Huffman, Arithmetic, Lempel Ziv, Run Length, Rate Distortion Functions, Entropy rate of Stochastic Proces. Introduction to Image Compression, JPEG Standards.

Channel Capacity & Coding

Channel models, Channel Capacity, Shannon Limit, Channel capacity of MIMO systems,

Error control coding

Linear Block Codes, Hamming Codes, parity chech coding, Cyclic code for burst error correction, BCH Codes and convolutional Codes, Trellies Coded Modulation

Coding for Secure Communication

Introduction to Cryptography, Overview of Encryption Techniques, Symmetric (Secret Key) Cryptography, Data Encryption Standard (DES), Hashing techniques, quantum cryptography, Biometric Cryptography

Textbooks

1. Ranjan Bose, Information Theory, Coding and Cryptography, McGraw Hill, 2nd edition, 2011
2. J. Das, P. K. Chatterjee & S. K. Mullick, Principle of Digital CommunicationNew age Internationals, 2008

Reference books

1. T. M. Cover & J. A. Thomas, Elements of Information Theory, Wiley-Interscience-2nd edition 2010.
2. J. G. Proakis, Digital Communication, McGraw Hill Education, 4th edition

INDUSTRIAL INTERNET OF THINGS

Course Code: **EC30021**

Credit: **3**

L-T-P: **3-0-0**

Prerequisites: **Nil**

COURSE OBJECTIVE

The course is intended to introduce the students, the basics of Industrial Internet of Things, its architecture, protocols, design requirements, and key technologies. The learner will be able to understand the key concepts of industrial data transmission and acquisition. Application of data analytics and machine learning methods provides insights into IIoT data science. Some case studies will help the reader to understand the application of IIoT in various industrial sectors.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Analyze the basic concepts of IIoT and Industry 4.0
- CO 2: Explain key technologies for IIoT and Industry 4.0
- CO 3: Apply the sensors and actuators in industrial applications
- CO 4: Develop industrial data transmission and acquisitions systems
- CO 5: Develop machine learning and data science methods for IIoTs.
- CO 6: Analyze case studies on IIoT use cases in Industries and develop allied methods and applications.

COURSE DETAILS

Introduction

Overview of IoT, architecture, application-based IOT protocols, cloud computing, Big Data IIoT and Industry 4.0, Industry 4.0 Basics, Design requirements, Sustainability, Cybersecurity and Impacts of Industry 4.0, IIoT Basics, Industrial Internet systems, Industrial Sensing, Processes. Business models of IIoT, Reference architecture of IIoT

Industrial Process and Devices: Technical requirements, The industrial process, The CIM pyramid, The I-IoT data flow

Industrial Data Flow and Devices

Technical requirements, The I-IoT data flow in the factory, Controllers. Sensors: Introduction, Characteristics, Categories. Actuators: Introduction, Thermal, Hydraulic, Pneumatic, and Electromechanical Actuators.

Industrial data transmission

Foundation Fieldbus, Profibus, HART, Interbus, Bitbus, CC-Link, Modbus, Batinbus, DigitalSTORM, CAN, DeviceNet, LonWorks, ISA 100.11, LoRa. Acquisition: Distributed control system, PLC, SCADA. Inventory management and quality control

Case Studies

Manufacturing, Automotive, and Mining Industry

Industrial IoT Security

Cyber security vs cyber physical IoT security, Divergence in IT and OT security fundamentals, Industrial threats, Vulnerabilities, and Risk factors. Evolution of cyber-physical attacks. Securing Connectivity and Communications, Distinguishing features of IIoT, Connectivity, Security Assessment of IIoT Connectivity and Protocols.

Textbooks

1. Sudip Misra, Chandana Roy, Anandrup Mukherjee, Introduction to Industrial Internet of Things and Industry 4.0 published , CRC Press, First Edition 2021
2. Giacomo Veneri and Antonio Capasso, Hands-On Industrial Internet of Things, Packet Publishing Ltd.

Reference books

1. Alasdair Gilchrist, Industry 4.0: The Industrial Internet of Things published, Apress 2016
2. Sravani Bhattacharjee, Practical Industrial Internet of Things Security: Packt Publishing 2018
3. D. Pyo, , J. Hwang, , and Y. Yoon, Tech Trends of the 4th Industrial Revolution, Mercury Learning & Information

ELECTRONICS PRODUCT DEVELOPMENT

Course Code: EC38001

Credit: 1

L-T-P: 0-0-2

Prerequisites: Nil

COURSE OBJECTIVE

This course provides an overview of the process and considerations involved in the development of electronics products. It covers the key stages of product development planning, including ideation, concept design, prototyping, testing, manufacturing, and commercialization. Students will gain hands-on experience with tools, techniques, and methodologies used in electronics product development through practical projects and case studies.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Appreciate the product development lifecycle and the role of electronics in product design.
- CO 2: Gain knowledge of design principles, requirements, and constraints for electronics products.
- CO 3: Develop skills in prototyping, testing, and refining electronics product designs.
- CO 4: Learn about manufacturing processes, quality control, and regulatory compliance in electronics product development.
- CO 5: Explore strategies for commercialization, market analysis, and intellectual property protection.
- CO 6: Apply knowledge and skills acquired to successfully complete a product development project.

COURSE DETAILS

Overview of the product development lifecycle

Role of electronics in product design, Market analysis and identifying customer needs, Design Principles for Electronics Products

Product design considerations

form factor, user interface, power requirements, Component selection, sourcing, and supply chain management, Design for manufacturability and assembly, Circuit Design and Simulation

Circuit design techniques and best practices

Simulation tools for electronics design and analysis, PCB layout and routing considerations

Prototyping and Testing

Rapid prototyping techniques

Breadboarding, soldering, 3D printing, Test and measurement tools for electronics verification
Design verification and iteration process, Manufacturing and Quality Control

Manufacturing processes for electronics products

Assembly, soldering, and surface mount technology, Quality control, testing, and inspection methodologies, Regulatory Compliance and Certification

Standards and regulations for electronics products (FCC, CE)

Product safety, electromagnetic compatibility (EMC), and environmental considerations
Certification processes and documentation requirements, Intellectual Property and Commercialization

Intellectual property rights and protection

Market analysis and competitive landscape, Business models, pricing strategies, and market entry considerations, Project Development and Presentation

Team-based product development project

Project management techniques and tools, Final presentation and documentation of the product development project.

Textbooks

1. R.G. Kaduskar, and V.B. Baru, Electronic Product Design, 2ed, Wiley India Pvt. Limited.
2. V.S.Bagad, Electronic Product Design - A Conceptual Approach, Technical Publication, ISBN: 9789350993620

Reference books

1. Kim R. Fowler , Electronic Instrument Design, Architecting for the Life Cycle, Oxford University Press, ISBN: 9780195083712
2. Karl T. Ulrich, Steven D. Eppinger, Maria C. Yang, Product Design and Development| 7th Edition ,Mc Graw Hill Education, ISBN13: 9781260043655
3. S D Mehta , Electronic Product Design, S.Chand Publication

COMPOUND SEMICONDUCTORS BASICS

Course Code: EC30009

Credit: 3

L-T-P: 3-0-0

Prerequisite: Nil

COURSE OBJECTIVE

This course is an introduction to properties of Compound Semiconductors highlighting the theoretical and practical aspects of their device physics and suitability for high speed devices. Beginning with an introduction to the basics of semiconductor devices and characteristics, it presents an overview compound semiconductor materials, as well as a detailed look at the electrical and optical properties of compound semiconductor hetero-structures.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Analyze the basic concepts of Semiconductor Devices and characteristics.
- CO 2: Assess the requirements of Compound Semiconductors.
- CO 3: Evaluate of the Performance measure of high speed devices
- CO 4: Analyze principle of operation and the unique features of HBT, HEMT, TFET.
- CO 5: Evaluate the issues and targeted performances of Compound Semiconductor Devices.
- CO 6: Develop critical thinking ability supported by the learned concepts of Compound Semiconductors: Device Properties & Applications.

COURSE DETAILS

Introduction

Fundamentals of Semiconductor Devices, P-N Junction Diode and MOSFET, Introduction of Compound Semiconductors, Crystal structure, Properties of Compound semiconductors, Merits of III –V binary and ternary compound semiconductors (GaAs, InP, InGaAs, AlGaAs, SiC, GaN etc.), different SiC structures, silicon-germanium alloys and silicon carbide for high speed devices, as compared to silicon based devices, Band Diagrams, Pinch off voltage and threshold voltage, D.C. Characteristics and Analysis of Drain Current. Sub threshold Characteristics, Short Channel Effects.

Important parameters governing for the high speed and high power device performance

Transit time of charge carriers, junction capacitances, ON-resistances, the device geometry and size, carrier mobility, doping concentration and temperature break down voltage.

Hetero junction Bipolar Transistors (HBTs)

Principle of operation and the benefits of hetero junction BJT for high speed applications. GaAs and InP based HBT device structure, SiGe HBTs and the concept of strained layer devices.

High Electron Mobility Transistors (HEMT)

Hetero-junction devices. The generic Modulation Doped FET(MODFET) structure for high electron mobility realization. Principle of operation and the unique features of HEMT, InGaAs/InP HEMT structures. Tunneling devices: Principle of operation and the unique features of TFET, Resonant-tunneling hot electron transistors

Textbooks

1. S.M. Sze, High Speed Semiconductor Devices, Wiley (1990) ISBN 0-471-62307-5
2. G.A. Armstrong, C.K. Maiti, TCAD for Si, SiGe and GaAs Integrated Circuits, The Institution of Engineering and Technology, London, United Kingdom, 2007, ISBN 978-0-86341-743-6.

Reference books

1. Ralph E. Williams, Modern GaAs Processing Methods, Artech (1990), ISBN 0-89006-343-5,
2. Sandip Tiwari, Compound Semiconductor Device Physics, Academic Press (1991), ISBN 0-12-691740-X.

OPTIMIZATION TECHNIQUES IN ENGINEERING

Course Code: **EC40001**

Credit: **3**

L-T-P: **3-0-0**

Prerequisites: **Nil**

COURSE OBJECTIVE

Students will gain expertise in designing algorithms based on conventional techniques and be able to deal with intractable problems and implement algorithms given the description. At the end of this course, students will be able to comprehend and apply various optimization techniques for numerical analysis of different engineering and design related problems. Course modules include various methods to obtain the extremum (minimum or maximum) of a non-dynamic system and the use of these methods in various engineering applications.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Analyze the need for optimization, the concepts of design variables and constraints.
- CO 2: Apply various unconstrained optimization techniques and develop corresponding Python/MATLAB codes.
- CO 3: Apply various multi-variable optimization techniques and develop corresponding Python/MATLAB codes.
- CO 4: Analyze various constrained optimization techniques and utilize them for evaluating engineering problem statements.
- CO 5: Investigate various complex problems using dynamic programming algorithms.
- CO 6: Analyze various advanced metaheuristic techniques and develop Python/MATLAB codes for analysis.

COURSE DETAILS

Introduction

Design variables, constraints, variable bounds, local and global optimization, classification of optimization techniques.

Unconstrained Optimization Techniques

Single-variable optimization techniques - Concepts of Bracketing (Exhaustive Search) and Region Elimination (Interval Halving), Programming in Python/MATLAB. Gradient Based techniques - Newton-Raphson method and its application, Programming in Python/MATLAB. Multi-variable optimization techniques - Concepts of Direct Search (Hooke-Jeeves pattern search method) and Gradient based search (Cauchy's method, Newton's method).

Constrained Optimization Techniques

L1 and L2 norm based optimization, Kuhn-Tucker (KT) necessity and sufficiency theorems, Penalty function method, Method of multiplier.

Dynamic Programming

Dynamic programming algorithms, shortest path problems, time optimal control.

Metaheuristics

Genetic Algorithm, Particle Swarm Optimization, Simulated Annealing, Differential Evolution - Grey Wolf Optimization, Programming in Python/MATLAB.

Textbook

1. Deb, Kalyanmoy, Optimization for engineering design: Algorithms and examples. PHI Learning Pvt. Ltd., 2012.

Reference books

1. Stephen P. Boyd, and Lieven Vandenberghe. Convex optimization. Cambridge university press, 2004.
2. Deb, Kalyanmoy, Multi-objective optimization using evolutionary algorithms: an introduction. Springer London, 2011.
3. Rao, S. S.,Engineering optimization: theory and practice. John Wiley & Sons,2019.
4. Bellman, R. E. and Dreyfus, S. E., Applied dynamic programming (Vol. 2050). Princeton university press, 2015.

MILLIMETER-WAVES AND TERAHERTZ TECHNOLOGY

Course Code: **EC40002**

Credit: **3**

L-T-P: **3-0-0**

Prerequisites: **Nil**

COURSE OBJECTIVE

This course deals with the fundamental theory of millimeter wave multiple access techniques and the fundamentals of Terahertz technology. The course will comprehensively discuss the channel modelling for mm Waves and multiple access techniques.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Analyze the various communication technologies, difference between sub-6GHz 5G and mm-Wave 5G, characteristics of mm-Wave and standards
- CO 2: Apply the channel models for mm-Wave systems and design them.
- CO 3: Analyze the different modulation schemes and multiple access technologies for mm-Wave systems.
- CO 4: Analyze the beam forming concept and apply water filling algorithm for channel capacity improvement in mm-Waves.
- CO 5: Explain the sources of THz and the means of detecting it
- CO 6: Explain the application of THz for future wireless communication systems.

COURSE DETAILS

Introduction to Millimeter Wave (mm-Wave) Technology

Overview of communication technologies (1G to 5G), 5G requirements, sub-6GHz 5G, mm-Wave 5G, mm-Wave characteristics, mm-Wave standards, mm-Wave MIMO systems.

Channel Modelling for mm-Wave Technology

Channel modelling challenges, mm-Wave propagation loss due to atmospheric Oxygen, and water vapor (especially, at 60GHz), path loss models, Channel models for mm-Wave MIMO systems.

Modulation and Multiple-Access Techniques

Modulation techniques: Orthogonal frequency division multiplexing (OFDM), filter bank multi-carriers (FBMC), generalized frequency, division multiplexing (GFDM), and universal filtered multi-carrier (UFMC)

Orthogonal Frequency Division

Multiple accesses (OFDMA), generalized frequency division multiple accesses (GFDMA), non-orthogonal multiple accesses (NOMA).

MIMO and Beam Steering Technology

mm-Wave transmission and reception, antennas for mm-Wave beam-steering concept, MIMO requirements, noise in MIMO mm-Wave, spatial diversity.

Overview of Terahertz (THz) Technology

Introduction to THz radiation, Overview of THz generation and detection: THz pulses, and continuous THz wave generation, Overview of THz components (waveguides, filters, and modulations)

THz Communications

Ultra fast THz communication, Short distance THz communications, 6G communications with THz, Space communication with THz

Textbooks

1. Theodore S.Rappaport, Robert W. Heath Jr., Robert C. Daniels and James N. Murdock, Millimeter Wave Wireless Communication, Prentice Hall, 2014.
2. Yun-Shik Lee, Principles of Terahertz Science and Technology, Springer 2009

Reference books

1. Kao- Cheng Huang and Zhoacheng Wang, Millimeter Wave Communication Systems, Wiley IEEE Press, 2011.
2. Athanasios G.Kanatos, Konstantina S.Nikita, Panagiotis Mathiopoulos, New Directions in Wireless Communication Systems from Mobile to 5G, CRC Press,2017
3. Erik Bründermann, et al., Terahertz Techniques, Springer, 2012.
4. R. A. Lewis, Terahertz Physics, Cambridge University Press, 2012

COGNITIVE RADIO AND COOPERATIVE COMMUNICATIONS

Course Code: EC40003

Credit: 3

L-T-P: 3-0-0

Prerequisites: Nil

COURSE OBJECTIVE

Cognitive radio is an exciting emerging technology that has the potential of dealing with the stringent requirement and scarcity of the radio spectrum. Aim of this course is to familiarize students with the technology that allows the agile and efficient utilization of the radio spectrum by offering distributed terminals or radio cells the ability of radio sensing, self-adaptation, and dynamic spectrum sharing.

COURSE OUTCOMES

After successfully completing the course, the students will be able to:

- CO 1: Analyze Cooperative Communication Concepts and Cooperation protocols.
- CO 2: Differentiate between Distributed space-time coding (DSTC) - Distributed space-frequency coding (DSFC) and analyze Differential modulation for DF and AF cooperative communication.
- CO 3: Analyze the features of cooperative Networking like energy efficiency, distributed routing, source channel coding etc.
- CO 4: Analyze the concept of Software Defined Radio and Cognitive Radio.
- CO 5: Model various cognitive Radio tasks.
- CO 6: Explain the recent trends and challenges in Cognitive Radio.

COURSE DETAILS

Introduction

Cooperative Communication, Cooperation protocols - Hierarchical cooperation, Cooperative communications with single relay, Multi-node cooperative communications.

Distributed Space-Time Coding (Dstc) - Distributed Space-Frequency Coding (Dsfc)

Distributed space-time coding (DSTC) - Distributed space-frequency coding (DSFC); Relay selection-Differential modulations for DF cooperative communications - Differential modulation for AF cooperative communications.

Cooperative Networking

Energy efficiency in cooperative sensor networks, Cognitive multiple access via cooperation, Content-aware cooperative multiple access, Distributed cooperative routing, Source-channel coding with cooperation.

Introduction to Software Defined Radio and Cognitive Radio

Characteristics and Benefits of Software Radio; Dynamic Spectrum Access; Digital dividend; Types of Cognitive Radio; Spectrum policies and Regulations; Information theoretic perspective on Cognitive Radio networks.

Cognitive Radio Tasks

Spectrum sensing and its methods; Cooperative Spectrum sensing; Spectrum sharing; spectrum mobility; spectrum management; spectrum trading.

Recent Trends and Challenges in Cognitive Radio

OFDM based Cognitive Radio; Security issues in cognitive radio; Game theory in Cognitive radio; applications of cognitive radio; IEEE 802.22 WRAN standard.

Textbook

1. Rayliu K J, Sadek A K, Weifeng Su and Andres Kwasinski, Cooperative Communications and Networking, Cambridge University Press, 2009.

Reference books

1. Jeffrey H Reed, Software Radio: A Modern Approach to Radio Engineering, PEA Publication, 2002.
2. Bruce A Fette, Cognitive Radio Technology, Elsevier Publication, Burlington, 2009.
3. Joseph Mitola III, Cognitive Radio Architecture: The Engineering Foundations of Radio XML, Wiley Interscience Publication, NEW JERSEY, 2006.
4. Kwang-Cheng Chen and Ramjee Prasad, Cognitive Radio Networks, John Wiley & Sons, 2009.

QUANTUM COMMUNICATION

Course Code: **EC40004**
Credit: **3**

L-T-P: **3-0-0**
Prerequisites: **Nil**

COURSE OBJECTIVE

This course introduces students to basic laws of quantum mechanics and provides an introduction to the revolutionary quantum technologies. This course is about the potential for quantum technologies, a field that promises to revolutionize the way we compute by using the dynamics of quantum mechanics. The boundary between classical and quantum physics, quantization of EM field and its consequences, quantum electromagnetic and atomic physics and their applications in quantum communication, quantum computations and quantum sensing are discussed. The course aims to develop conceptual understanding of quantum phenomena and identifies engineering challenges of various quantum technologies.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Identify fundamental differences between quantum and classical technologies
- CO 2: Analyze mathematically simple quantum phenomena
- CO 3: Explain quantum signatures in experimental data
- CO 4: Discuss quantum errors and error correction methods
- CO 5: Analyze engineering challenges of quantum technologies
- CO 6: Discuss methods of fault-tolerant quantum computation

COURSE DETAILS

Overview of Quantum Technologies

Quantum Engineering, Motivation: Quantum Computing, Quantum Communication, Motivation: Quantum sensing, Fundamentals of Quantum Mechanics

Essential Concepts in Quantum Mechanics

The Birth of quantum mechanics, Postulates of quantum mechanics, Hamiltonian and Schrodinger Equation, Dirac notation, Density operator

Quantum Resources

EM waves: Quantum EM fields, Polarization of optical fields, EM resonators, Single photon detection, E-field detection, Quantum light.

Atoms: Two-level atom, Introduction to light-atom interactions, Trapping and cooling atoms, Three-level atoms, Rydberg atoms, Trapped ions

Superconducting Devices: Fundamentals of superconductors, Superconducting two-level systems, Superconducting qubits, Superconducting qubits and challenges

Quantum Sensing and Communication

Light interferometry-LIGO, Particle interferometry- Ramsey measurement, Sensing via defects in diamond, Quantum cryptography, Quantum teleportation, Quantum Memory, Entanglement distribution

Quantum Computing

Introduction to classical computing, Introduction to quantum computing, Experimental implementation of quantum computation, Deterministic two-qubit logic gates, Single and two-qubit photonic gates, Superconducting gates, Quantum logic operation using trapped ions, Quantum logic operation using Rydberg atoms, Linear optics quantum computing, Engineering Quantum Systems

Textbook

1. Nielsen, M., & Chuang, I., Quantum Computation and Quantum Information: 10th Anniversary Edition. Cambridge: Cambridge University Press, 2010, doi:10.1017/CBO9780511976667;

Reference books

1. David A. B. Miller, Quantum Mechanics for Scientists and Engineers Illustrated Edition, Advanced Quantum Communications: An Engineering Approach Sandor Imre, Laszlo Gyongyosi, ISBN: 978-1-118-00236-0, December 2012 Wiley-IEEE Press
2. A.M. Zagoskin, Quantum Engineering: Theory and Design of Quantum Coherent Structures, Cambridge, Cambridge University Press, 2011, ISBN 978-0-521-11369-4.

Course Code: EC40006
Credit: 3
L-T-P: 3-0-0
Prerequisites: Nil

COURSE OBJECTIVE

This course focuses on data path interconnects aware design methodologies, SoC design flow, bus architecture, hardware security and IP protection.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Analyze the basic arithmetic building blocks used in VLSI Circuits.
- CO 2: Apply knowledge to implement arithmetic blocks for data path design
- CO 3: Analyze the partitioning technique for component placement.
- CO 4: Solve the VLSI interconnects and clock routing issues.
- CO 5: Discuss the SoC design method and soft- and hard-core processors.
- CO 6: Evaluate and analyze the method of SoC Verification and IP protection methods.

COURSE DETAILS

Design of arithmetic building blocks

Introduction to processor design and digital arithmetic, Carry select adder, Manchester carry-chain, Carry bypass adder, carry-save adder, Array multiplier, carry save multiplier, Wallace tree multiplier, Booth's multiplier, Delay optimization of adders and multipliers, Area-time trade-off, power consumption issues, Optimization for speed, Low-power design and high-speed logic.

Design automation tools and partitioning

Constructive and iterative partitioning, Kernighan-Lin algorithm, ratio-cut algorithm, Placement, floor planning and pin assignments
Global routing, Lee's algorithm, Channel routing, clock and power routing algorithms.

Clocking and interconnect issues

Clocking and Crosstalk, system noise, complexity management, Signal integrity issues, high speed interconnects, Clock, clock skew, clock distribution and routing, Clock buffering, gated clock and clock tree, Design of buffers and I/O pad and memory design interconnect issues.

Introduction to SoC

Soc Design Flow, Overview of SoC Design methodologies, SoC Components- Processor and Memory, On chip interconnect- AMBA Bus, soft and hard core development process.

SoC Verification & SoC Security

Overview of verification techniques, Verification flow, HW/SW Multi-Level Security, Overview of hardware security, IP protection, Encryption

Textbooks

1. Weste and Eshraghian "Principles of CMOS VLSI Design", Second Edition,Pearson Education, 2001
2. Farzad Nekoogar, Faranak Nekoogar, "From ASICs to SOCs: A Practical Approach", PHI, 2003

Reference books

1. Neil H.E. Weste, David F. Harris, "CMOS VLSI Design ", Pearson Education, 2010
2. Jan M. Rabaey, Anant Chandrakasan, and Borivoje Nikoli, "Digital Integrated Circuits", Prentice Hall (India), 2016

LOW POWER VLSI DESIGN

Course Code: EC40007
Credit: 3
L-T-P: 3-0-0
Prerequisite: Nil

COURSE OBJECTIVE

This course focuses on Optimization of VLSI design prototype in architecture, gate and in cell level of abstraction.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Explain various power dissipation mechanisms in a CMOS logic
- CO 2: Estimate and analyse the various components power dissipation in VLSI circuits.
- CO 3: Apply and analyse various low power optimization techniques in architecture level
- CO 4: Apply and analyse various low power optimization techniques in gate level
- CO 5: Analyse various low power optimization techniques in cell level
- CO 6: Analyse various low power optimization techniques in layout level

COURSE DETAILS

Basic MOS inverters, MOS combinational circuits

Sources of power dissipation in CMOS circuits: static power dissipation - diode leakage power, subthreshold leakage power, gate and other tunnel currents; dynamic power dissipation - short circuit power, switching power, gliching power; degrees of freedom, energy delay product, power delay product.

Supply voltage scaling approaches

Technology Level - feature size scaling, threshold voltage scaling; logic level - gate sizing for voltage scaling; architecture level - parallelism and pipelining; algorithm level - transformations to exploit concurrency; dynamic voltage scaling. Switched capacitance minimization approaches: system level - power down, system partitioning;

Algorithm level

Concurrency, locality, regularity, data representation; architecture level - concurrency, signal correlation; logic level - gate sizing, logic styles; layout level - layout optimization; technology level - advanced packaging, SOI.

Leakage power minimization techniques:

Threshold voltage scaling: MTCMOS, VTCMOS and Multiple-V_t CMOS circuits.

Textbook

1. Ajit Pal, Low-Power VLSI Circuits and Systems, Springer, 2015

Reference books

1. Anantha P. Chandrakasan and Robert W. Brodersen, Low Power Digital CMOS Design, Kluwer Academic Publishers,2002.
2. Kaushik Roy and Sharat C. Prasad, Low-Power CMOS VLSI Design, Wiley-India,2011.

ADVANCED COMPUTER ARCHITECTURE AND RISC-V PROCESSOR DESIGN

Course Code: EC40008

Credit: 3

L-T-P: 3-0-0

Prerequisite: Nil

COURSE OBJECTIVE

This course focuses on instruction pipeline and their hazards, branching, pipeline scheduling mechanisms, cache memory organization and mapping techniques and also teaches about RISC-V Architecture and instruction formats and Brief overview to ARM.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Interpret the performance of a processor based on metrics such as execution time, cycles per instruction (CPI), Instruction count etc
- CO 2: Explain instruction pipeline and pipeline hazards
- CO 3: Analyze pipeline scheduling and different scheduling mechanisms.
- CO 4: Apply the concept of memory hierarchy for efficient memory design
- CO 5: Discuss the RISC V instruction sets and addressing modes used in RISC -V processors.
- CO 6: Evaluate RISC -V processor instructions and their usage.

COURSE DETAILS

Introduction

Review of basic computer architecture, RISC vs CISC, Performance evaluation methods, Introduction RISC pipeline, Instruction pipeline and performance.

Instruction Pipeline Principles

Pipeline hazards, Pipeline hazard control and branching, MIPS pipeline for multi-cycle operation.

Pipeline scheduling mechanism

Compiler technique, dynamic scheduling, static and dynamic scheduling.

Cache memory and its organization

Cache memory basics, Cache memory mapping replacement algorithms, cache memory optimization.

RISC-V Processor

Introduction to RISC-V Processor, RISC -V instruction format and RIC-V Instruction sets, RISC-V Addressing Modes and Synchronization, Overview of a basic RISC Processor- ARM.

Textbooks

1. J.L.Hennessy, D.A.Patterson, Computer Architecture: a quantitative approach, Morgan Kaufmann, 5th edition, 2011, ISBN: 978-1558605961.
2. David A. Patterson & John L. Hennessy, Computer Organization and Design RISC-V Edition, Elsevier, 2nd Edition, 2020

Reference books

1. Bernard Goossens, Guide to Computer Processor Architecture, springer, 1st edition, 2023
2. Sivarama P. Dandamudi, Guide to RISC Processors for Programmers and Engineers, 1st Edition, 2005
3. Sarah L. Harris & David Harris, Digital Design and Computer Architecture- RISC-V Edition, Morgan Kaufmann, 2012, ISBN: 9780123978165
3. Daniel Page, A Practical Introduction to Computer Architecture, Springer London, 1st edition 2009
4. William Stallings, Computer Organization and Architecture, Prentice Hall, 10th edition, 2015, ISBN-10: 013293633X, ISBN-13: 978-0132936330

BIOMEDICAL SIGNAL PROCESSING

Course Code: EC40009

Credit: 3

L-T-P: 3-0-0

Prerequisites: Nil

COURSE OBJECTIVE

Biomedical signals are acquired from a medical or biological source which can be at the cell level, molecular level, or organ level. Several biomedical signals are generally employed in the research laboratory, and hospitals. The aim this course covers the application of signal processing and stochastic methods to detect or diagnosis of disease or physiological states in the human body.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Appraise various techniques for acquiring bio-medical signals.
- CO 2: Investigate and interpret bio-medical signal characteristics.
- CO 3: Apply signal processing techniques for noise reduction and artefact removal.
- CO 4: Demonstrate skills in analyzing bio-medical signals using time-frequency analysis.
- CO 5: Implement appropriate signal processing algorithms for disease diagnosis.
- CO 6: Evaluate feature extraction and feature selection techniques to identify abnormal patterns.

COURSE DETAILS

Introduction to Biomedical Signals

Generation of Bio-signals, Sources of bio-signals, Bio electric potential/ action potential, Types of bio-signals (ECG, EEG, EMG, EOG), Study of diagnostically significant bio-signal parameters, Acquisition of bio-signals (signal conditioning).

Filtering Techniques

Classification of signals and noise, Digital filtering, Spectral analysis of deterministic, stationary random signals and non-stationary signals, Coherent treatment of various biomedical signal processing methods and applications. Biomedical signal processing by Fourier analysis, wavelet (time-frequency) analysis.

Analysis of Bio-signals

Cardiological signal processing: Basic Electrocardiography, ECG data acquisition, Power spectrum of the ECG, filtering techniques, Template matching, QRS detection algorithm, Estimation of R-R Interval, Real-time ECG processing.

Neurological signal processing: The brain and its potentials, origin of brain waves, EEG signal and its characteristics (EEG rhythms, waves, and transients), Detection of EEG rhythms, spike and wave detection. Analysis of EMG signal and PCG Signal. Deep learning for bio-signal analysis.

Applications of BSP

Analysis of chaotic signals Application areas of BSP: Multi-resolution analysis (MRA) and wavelets, Principal component analysis (PCA), Independent component analysis (ICA), Adaptive segmentation of ECG and PCG signals, Time varying analysis of heart rate variability, Detection of Coronary Artery Disease , Analysis of Ectopic ECG beats. Pattern classification on biomedical signal analysis.

Textbooks

1. Rangaraj M. Rangayyan, Biomedical Signal Analysis, IEEE Press, 2001. Charu C. Aggarwal. Neural Networks and Deep Learning: A Textbook. Springer. 2019.
2. W. J. Tompkins, Biomedical Digital Signal Processing, Prentice Hall, 1993.

Reference books

1. Eugene N Bruce, Biomedical Signal Processing and Signal Modeling, John Wiley & Son's publication, 2001.
2. Myer Kutz, Biomedical Engineering and Design Handbook, Volume I, McGraw Hill, 2009.
3. D C Reddy, Biomedical Signal Processing, McGraw Hill, 2005.
4. A V Oppenheim & R W Schafer, Discrete-time Digital Signal Processing, 2009, 3rd edition, Prentice-Hall

MASSIVE MIMO TECHNOLOGY

Course Code: EC40010

Credit: 3

L-T-P: 3-0-0

Prerequisites: Nil

COURSE OBJECTIVE

The course is intended to make the research students understand the massive MIMO system, Principle and working of massive MIMO system, means and modes of communication. They will able to analyze the Principle and working of different massive MIMO network scenarios and application to Millimeter wave communication. Also they will able to comprehend and analyze the power control in massive MIMO system and its applications for small cells and device to device communications.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Compare and contrast the concepts of MIMO and massive MIMO techniques.

- CO 2: Analyze and optimize the performance of massive MIMO for capacity and SNR improvement of various Network Scenarios.
- CO 3: Apply and analyze the Massive MIMO Aided millimeter communication Technology
- CO 4: Analayze the power control in massive MIMO system.
- CO 5: Discuss case studies on massive MIMO applications.
- CO 6: Apply MIMO and Massive MIMO techniques for real world scenarios and applications.

Introduction

Evolution of cellular systems from 1G to 4G and the principles underlying different generations, Engineering requirements and application scenarios for 5G, Role of massive MIMO as a key 5G solution, Characteristics and benefits of massive MIMO systems, signal and channel models, Difference between traditional MIMO and Massive MIMO.

Massive MIMO Technology

Main Application Scenarios: Homogeneous Network Scenarios, Heterogeneous Network Scenarios, Physical Layer Technology, Recorders and detectors in multi cell environments, Networking Technology, Scheduling

Massive MIMO Aided millimeter communication Technology

Back ground, deployment of Millimeter Wave Communication, Physical Layer Challenges and solutions, CSI acquisition and beam forming schemes.MAC and Networking Design

Power control in massive MIMO systems

Single cell, multiple cells, max-min fairness; Propagation channels: Conditions for favorable propagation, independent Rayleigh fading, uniformly random line-of-sight channels;

Case studies

Examples of single and multiple cell deployment; Recent research results: Pilot Decontamination, Effects of hardware impairments, Massive MIMO with FDD operation, Cell-free Massive MIMO;

Other potential 5G technologies such as device to device communications and applicability of massive MIMO to small cells.

Textbooks

1. T. L. Marzetta, E. G. Larsson, H. Yang, and H. Q. Ngo, *Fundamentals of Massive MIMO*, Cambridge University Press, 2016
2. Long Zhao, Hui Zhao, Kan Zheng, Wei Xiang ,*Massive MIMO in 5G Networks: Selected Applications*, Springer,2018

References books

1. R. S. Kshetrimayum, *Fundamentals of MIMO Wireless Communications*, Cambridge University Press, 2017.
2. W. Xiang, K. Zheng, and X. Xuemin, *5G Mobile communications*, Springer, 2017
3. J. Rodriguez, *Fundamentals of 5G Mobile Networks*, John Wiley & Sons, 2015
4. H. Yang and T. S. Quek, *Massive MIMO meets Small Cell: Backhaul and Cooperation*, Springer, 2016.

RF CMOS VLSI

Course Code: EC40014
Credit: 3
L-T-P: 3-0-0
Prerequisite: Nil

COURSE OBJECTIVE

This course introduces the design parameters of integrated radio front-end circuits for given specifications. The course imparts knowledge on RF modulation, RF CMOS circuit design and testing.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Evaluate the performance parameters of RF and wireless systems
- CO 2: Analyze performance issues and trade-offs based on a knowledge of different passive and active devices.
- CO 3: Select appropriate modulation technique for a specified RF circuit implementation.
- CO 4: Investigate and select device topology for specified RF circuit implementation.
- CO 5: Examine the operation and parameters of basic functional blocks of RF systems.
- CO 6: Analyze different designs of PLLs for RF circuit applications.

COURSE DETAILS

Introduction to RF & Wireless Technology

Complexity, design and applications. Choice of Technology. Basic concepts in RF Design: Nonlinearity and Time Variance, intersymbol Interference, random processes and Noise. Definitions of sensitivity and dynamic range, conversion Gains and Distortion.

Passive and Active Devices

Passive devices: monolithic capacitors, resistors, inductors, RLC networks, transmission lines, lumped and distributed resonators, impedance matching networks, transformers, and baluns. Active devices: MOSFET operations (in both long channel and deep submicron regimes), practical limitations, and other various silicon transistors and technologies (Si/SiGe Bipolar, SOI, etc.).

Analog & Digital Modulation for RF Circuits

Comparison of various techniques for power efficiency. Coherent and Non coherent detection. Mobile RF Communication systems and basics of Multiple Access techniques. Receiver and Transmitter Architectures and Testing Heterodyne, Homodyne, Image-reject, Direct-IF and sub-sampled receivers. Direct Conversion and two steps transmitters

RF Device Modeling

BJT and MOSFET behavior at RF frequencies. Modeling of the transistors and SPICE models. Noise performance and limitation of devices. Integrated Parasitic elements at high frequencies and their monolithic implementation.

Basic Blocks in RF Systems

Low Noise Amplifiers design in various technologies, Design of Mixers at GHz frequency range. Various Mixers, their working and implementations, Oscillators: Basic topologies VCO and definition of phase noise. Noise-Power trade-off. Resonator less VCO design.

VLSI Implementations of RF Systems

Quadrature and single-sideband generators, Radio Frequency Synthesizers: PLLS, Various RF synthesizer architectures and frequency dividers, Power Amplifiers design. Linearisation techniques, Design issues in integrated RF filters.

Textbook

1. B.Razavi, RF Microelectronics, 2nd edition, Prentice-Hall PTR,
2. T.H.Lee, The Design of CMOS Radio-Frequency Integrated Circuits, Cambridge University Press, 2nd Edition, 2003

Reference books

1. Frank Gustrau, RF and Microwave Engineering: Fundamentals of Wireless Communications, Wiley
2. Reinhold Ludwig, RF Circuit Design Theory And Application, 2nd Edition, Pearson Education, 2000
3. Valeria Teppati, Andrea Ferrero, Mohamed Sayed, Modern RF and Microwave Measurement Techniques, Cambridge Univ. Press, 2013

5G SUPPORTIVE TECHNOLOGIES

Course Code:	EC40015
Credit:	3
L-T-P :	3-0-0
Prerequisite:	Nil

COURSE OBJECTIVES

This course provides the comprehensive overview of the of the 5G supportive Technologies. The key supportive technologies like D2D, mm-wave communications, massive MIMO, wireless network coding, interference management and spectrum utilization issues are emphasized. Various 5G application domains such as automotive, building, energy and manufacturing economic sectors are addressed. The relationship between IoT, machine type communications, and cyber-physical systems under 5G standard are include. Glimps for future e6G communication is also provided with it's base technologies.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Comprehend and Analyze the 5G Concept and Architecture.
- CO 2: Comprehend and analyze the concept behind Machine to Machine and Device to Device based Communication.
- CO 3: Comprehend and analyze various 5G radio access technologies for wireless communication.
- CO 4: Comprehend and analyze the concept of Massive MIMO technology in the context of 5G Communication.
- CO 5: Comprehend and analyze the concept of Interference Management , Mobility Management and Dynamic network reconfiguration in 5G systems.
- CO 6: Comprehend and analyze concept of Spectrum ,standard and technologies for 5G and future 6G communication.

COURSE DETAILS

Introduction

Background History, Mobile Communication generations from 1G to 4G, IOT: relation to 5G,5G capacity and Volume, Global Initiatives, Standardization activities

5G System concept and Architecture

5G use cases and requirements, Basic concepts of 5G system, Basics of RAN architecture, High level requirements for 5G architecture, Functional architecture and 5G flexibility, Physical architecture and 5G deployments.

Machine Type Communications (MTC) and Device to Device(D2D) Communication

MTC categorization and requirements, Fundamental Technologies for MTC, Massive MTC, Ultra reliable and Low Latency MTC, Device to Device communication from 4G to 5G,4G LTE D2D, 5G D2D, Radio resource management for Mobile Broad band D2D.

5G Radio Access Technologies

Access design principles for Multi User Communications: Orthogonal Multiple Access Systems, Spread Spectrum Multiple access Systems,Capacity Limits for multiple access systems, Multi carrier with filtering:Filter bank based Multi carrier,Universal Filtered OFDM,Non-Orthogonal Schemes for efficient Multiple Access: Non-Orthogonal Multiple Access(NOMA), Sparse Code Multiple Access (SCMA)

Massive Multiple Input Multiple Output(MIMO) Systems

MIMO in LTE,Single user MIMO,Multi-User MIMO,Capacity of Massive MIMO, Resource allocation and Transceiver Algorithms for Massive MIMO, Fundamentals of base band and RF Implementations in Massive MIMO.

Interference Management and Mobility Management and Dynamic reconfiguration in 5G

Network Deployment Types, Interference Management in 5G, Mobility Management in 5G,Dynamic network reconfiguration in 5G.

Spectrum for 5G

Spectrum for 4G, Spectrum Challenges for 5G,Bandwidth requirements, Spectrum access nodes and sharing scenarios,5G spectrum Technologies, Spectrum ,standard and technologies for future 6G communication.

Textbook:

1. Afif Qsseiran, Jose F Monserrat, Patrick Marsch, 5G Mobile and Wireless Communications Technology, Cambridge University Press, 2016

Reference books

1. Jonathan Rodriguez,Fundamentals of 5G mobile networks, WILEY,2015
2. 5G NR the next generation Wireless Access Technology, Academic Press, Second Edition,2020

VLSI SIGNAL PROCESSING

Course Code: **EC40016**

Credit: **3**

L-T-P: **3-0-0**

Prerequisite: **Nil**

COURSE OBJECTIVE

This subject is designed to represent DSP systems and covers some of the important techniques for designing efficient VLSI architectures for its applications. The subject will also help students to develop high throughput system for real time applications, with an intention to reduce power consumption and chip area.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Interpret DSP Architectures and Algorithms.

CO 2: Apply pipelining and parallel processing to FIR filters for Low Power application

CO 3: Compare different technique of retiming, folding and unfolding of DSP architecture to reduce critical path delay.

CO 4: Appraise systolic array design of DSP architecture.

CO 5: Apply Fast convolution technique for Filtering Application.

CO 6: Analyze different arithmetic architecture for addition, subtraction and multiplications technique applicable to DSP.

COURSE DETAILS

Introduction

Graphical representation of DSP algorithms, Block Diagram, signal flow graph (SFG), data flow graph (DFG) and dependence graph (DG), critical path, loop bound and iteration bound.

Pipelining and Parallel Processing

Introduction, Pipelining and parallel processing of FIR digital filters, Pipelining and Parallel Processing for Low Power.

Retiming, Unfolding and Folding

Retiming techniques; algorithm for unfolding, Folding transformation

Systolic architecture design

Systolic array design methodology, FIR Systolic Arrays, Selection of Scheduling Vectors, 2D Matrix Multiplication Systolic Array Design.

Fast Convolution

Cook-Toom algorithm, modified Cook-Toom algorithm, Winograd algorithm, iterated convolution

Bit level Arithmetic Architectures

Parallel Multipliers- Parallel Multiplication with sign extension (Parallel Carry Ripple Array and Parallel Carry Save Multipliers), Bit Serial Multipliers.

Textbook

1. Keshab K. Parhi, VLSI Digital Signal Processing Systems, Design and Implementation, John Wiley, Indian Reprint, 2007.

Reference books

1. Magdy A. Bayoumi, VLSI Design Methodologies for Digital Signal Processing Architectures , Springer/BSP Books, 2005.
2. S.Y. Kuang, H.J. White house, T. Kailath,VLSI and Modern Signal Processing, Prentice Hall, 1995.
3. U. Meyer, Baese, Digital Signal Processing with Field Programmable Gate Arrays, Springer, Second Edition, 2004.

PLANAR ANTENNAS

Course Code: **EC40017**

Credit: **3**

L-T-P: **3-0-0**

Prerequisite: **Nil**

COURSE OBJECTIVE

The objective of the course is to understand the theory and the design principles of planar antennas for the applications to small devices. The subject focuses to learn the design methods of microstrip antenna, planar monopole antenna, planar antenna arrays, slot antenna, millimeter wave and TeraHertz antennas for the applications to miniaturized devices.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Identify the antenna basics for the design of small planar antennas.
- CO 2: Analyze the characteristics and design principles of microstrip antennas for small and low gain antenna applications.
- CO 3: Construct the circularly polarized patch antennas and microstrip antenna arrays for small and high gain antenna applications.
- CO 4: Design planar slot antennas and planar monopole antennas for the applications to small and omnidirectional antennas.
- CO 5: Evaluate the characteristics and design aspects of electrically small antennas.
- CO 6: Make use of planar antennas for special applications to wireless access.

COURSE DETAILS

Introduction to Antennas and Planar Antennas

Radiation, Antenna parameters, Basics of antenna array, Different types of planar antennas, Brief description of fabrication process of planar antennas.

Microstrip Patch Antennas-I

Characteristics of microstrip patch antennas, radiation from microstrip antenna, field configurations, different types of feeding techniques. Design equations for rectangular and circular microstrip patches, analysis of microstrip antennas using transmission line model and cavity method. Broadband techniques using stacked patch antennas, proximity-coupled and aperture-coupled microstrip antennas, slot-loaded and slit-loaded microstrip antennas, microstrip antennas with shorted pin, effect of finite ground plane on the performance of microstrip antennas, principle of planar fractal antennas.

Microstrip Patch Antennas-II

Methods of generating circular polarization in microstrip antennas using single feed and double feed, methods of generating multiple frequencies using microstrip antennas, miniaturization techniques for microstrip antennas. Design techniques of microstrip antenna arrays with feed network, effect of mutual coupling, microstrip phased array antenna design.

Planar Slot Antennas

Geometry and design of microstrip slot antenna, radiation pattern, CPW-fed slot antennas, design of folded slot antenna, annular slot antenna.

Planar Monopole Antennas

Feeding methods and characteristics of planar triangle monopole, Sierpinski monopole, planar bi-conical monopole antenna and roll monopole antenna.

Electrically Small Antennas

Electrically small antennas and their limitations, planar inverted F antenna (PIFA), PIFA for wireless potable sets, ground-plane effects on PIFA performance, different types of PIFA, multi-frequency PIFA, Printed notch antennas, small fractal antennas, dielectric resonator antennas, small TeraHertz antennas.

Planar Antennas for Special Applications

Planar mobile handset antennas, planar laptop computer antennas, planar antennas for USB modem, planar antennas for WLAN and UWB communication.

Textbooks

1. R. Garg, P. Bhartia, I. Bahl and A. Ittipiboon, Microstrip Antenna Design Handbook, Artech House, 1st Ed., 2001.
2. Z. N. Chen & M. Y. W. Chia, Broadband Planar Antennas-Design & Applications, John Wiley & Sons, 1st Ed., 2006.

Reference book

1. K-L. Wong, Compact and Broadband Microstrip Antennas, John Wiley & Sons, 1st Ed., 2002.

SMART ANTENNAS

Course Code: EC40018

Credit: 3

L-T-P: 3-0-0

Prerequisite: Nil

COURSE OBJECTIVE

This course focuses on advanced topics in design of smart antennas systems, including antenna array principles and smart antenna algorithms such as angle of arrival estimation and antenna beam forming. The course provides the student with the basic principles of smart antenna systems, which is an adaptive antenna array consisting of multiple antennas. Objective is to use intelligent algorithms to calculate the optimal antenna combination to make optimal use of beam forming and antenna array technologies, thereby reaping better benefits.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Analyze linear and circular antenna arrays.
- CO 2: Classify adaptive processing for smart antenna using different methods.
- CO 3: Solve design problems on smart antenna in presence of mutual coupling between the antennas.
- CO 4: Minimize mutual coupling in presence of jammers.
- CO 5: Solve design problems on smart antenna by estimating direction of arrival (DOA) of signal.
- CO 6: Investigate different types of DOA estimation methods..

COURSE DETAILS

Introduction

Analysis of linear and circular antenna arrays, phased array antenna, Array synthesis methods, Adaptive antennas and smart antennas, adaptive processing using minimum variance distortion less technique.

Direct Data Domain Least Square Approaches to Adaptive Processing

Direct data domain least square procedures, eigenvalue method, forward method, backward method, forward-backward method, main beam construction for prevention of signal cancellation.

Mutual Coupling in Adaptive Smart Antennas

Mutual coupling among an array of dipoles (qualitative), compensation using open-circuit voltages and minimum norm formulation, effect of mutual coupling for constant jammers and constant signals, compensation for mutual coupling for constant jammers and constant signals.

Direction of Arrival (DOA) Estimation and Adaptive Signal Processing for Smart Antennas

Problem formulation, transformation matrix to compensate undesired electromagnetic effects, DOA estimation for a semicircular array, adaptive processing using a single snapshot from a non-uniformly spaced array in presence of mutual coupling and near-field scatterers, DOA estimation using a phased array on a conformal hemispherical surface, DOA estimation using cyclostationarity, Optimization of base station location for indoor wireless communication.

Textbook

1. T. K. Sarkar, M. C. Wicks, M. Salazar-Palma and R. J. Bonneau, Smart Antennas, Wiley-Interscience, 1st Ed., 2003

Reference books

1. Ahmed El-Zooghby, Smart Antenna Engineering, Artech House, 1st Ed., 2005.
2. F. Gross, Smart Antennas for Wireless Communication: With MATLAB, McGraw Hill, 1st Ed., 2005.

SOLAR CELL DEVICE AND MATERIALS TECHNOLOGY

Course Code: EC40019

Credits: 3
L-T-P: 3-0-0
Pre-requisites: Nil

COURSE OBJECTIVE

This course is an introductory course on solar photovoltaic materials and devices covering fundamentals of operation of solar cells, physics of semiconducting materials, P-N junction device characteristics in dark and light. We will also discuss various solar photovoltaic technologies and their status with a brief discussion of the fabrication and characterization aspects of the devices. The course will also discuss the simulation aspects of designing and the PV module design basics.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Interpret the basics of Semiconductor Properties and working principle of solar cell.
- CO 2: Explain the basic operation of a photovoltaic cell; explain the optical and electrical mechanisms that limit efficiency and methods for improving these limits
- CO 3: Design, analyze and simulate basic homojunction and heterojunction photovoltaic cells.
- CO 4: Design and analyze different types of photovoltaic solar cells.
- CO 5: Apply different fabrication and characterization process involved in thin film solar cell.
- CO 6: Estimate the performance metrics of PV modules.

COURSE DETAILS

The Physics of Solar Cell

Review of Semiconductor Physics, Electrons and holes; density of states; drift and diffusion; conductivity; carrier generation and recombination; optical phenomena in solids; carrier generation by photon absorption.

Solar Spectrum and Air Mass Concepts, Semiconductors as basic solar cell material, materials and properties, P – N junction , I-V curves in dark and under illumination and solar cell. Sources of Losses and prevention.

Principles of solar energy conversions, open circuit voltage; short circuit current, maximum power, fill factor, conversion efficiency.

Photovoltaic Technology

a) Silicon Solar cell technologies

Mono- crystalline and poly – crystalline cells, wafer production, Si-wafers, commercial Si solar cells, process flow of commercial Si cell technology, Metal contacts. Monocrystalline materials and design issues;

b) Thin Film Solar Cells

Substrate and Super-state configuration, Thin film module manufacturing, Amorphous Si Solar cell technology.

Principles of homojunction and heterojunction solar cells. Cadmium Telluride Cell Technology, CIGS, CZTS based thin film solar cell. 2D materials for solar cell fabrication.

Strategies for improving solar cell efficiency, light trapping, bandgap engineering, multi-junction concepts.

New Generation Solar Cells

Dye-sensitized solar cells (DSSC), Perovskite solar cells (PSC), Organic photovoltaics (OPV), Nano Materials for Solar Cell

Fabrication and Simulation Methodology

Thin Film Solar Cells, Advantage of thin film, Thin film deposition techniques: Evaporation, Sputtering, Atomic Layer Deposition (ALD), Spin Coating, Doctor Blade, Spray pyrolysis.

Open source software for solar cell modeling: SCAPS-1D, TCAD, WXAMPS

Introduction To PV Module Design

PV Modules: Series Resistance and shunt resistances, optimization, module design basics, interconnection schemes, PV arrays, associated system electronics components.

Life cycle analysis, impact on air, water and soil pollution.

Textbook:

1. Chetan Singh Solanki, Solar Photovoltaics, Fundamentals, Technologies and Applications
Third Eds, PHI, 2015

Reference books

1. U. P. Singh and N. B. Chaure, Recent Advances in Thin Film PV Eds., Springer, 2022
2. A. Luque and S. Hegedus, eds., Handbook of Photovoltaic Science and Engineering, 2nd Edition, John Wiley & Sons, Inc., 2011, ISBN: 978-0-470-72169-8.
3. Gavin J. Conibeer and Arthur Willoughby, eds., Solar Cell Materials: Developing Technologies, John Wiley & Sons, Inc., 2014, ISBN: 978-0-470-06551-8
4. J. Poortmans and V. Arkhipov, eds., Thin Film Solar Cells: Fabrication, Characterization, and Applications, John Wiley & Sons, Ltd., 2006,

INDUSTRIAL AUTOMATION

COURSE CODE: EL30001

Credit: 3

L-T-P : 3-0-0

Prerequisites: Nil

COURSE OBJECTIVE

Understand automation technologies and identify advantages, limitations and applications of the same. Selection of proper sensor and its working. Design of controller using different controlling methods. Develop ability to recognize, articulate and solve industrial problems using automation technologies.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Understand the need of automation in real world and Industry 4.0 challenges
- CO 2: Analyze the need of transducer and working of different transducers and actuators
- CO 3: Determine the effects of different controllers and design of controllers using analog and digital platform
- CO 4: Analyze the different advanced control schemes applied to different industrial processes.
- CO 5: Analyze the Architecture of PLC, and design different process control applications through ladder logic.
- CO 6: Understand DCS, SCADA hardware and software and its merits/demerits in industrial automation.

COURSE DETAILS**Introduction to Industry 4.0**

History of industrial revolutions, Concept of IR4.0, Typical architecture of IR4.0, Design principles and major role players in IR4.0, Advantages and Challenges.

Sensors, Actuators and Signal conditioning

Displacement sensors, Force sensors, Ultrasonic sensors, Temperature sensors, Pressure sensors, Dc motors, Servo motors, Stepper motors, Piezo electric actuators, Pneumatic actuators etc. Estimation of errors and calibration, Filtering, Amplification, Isolation, ADC, DAC, Sensor protection circuits, Signal transmission and noise suppression,

Controller tuning

Need of controller, Effects P, I, D, PI, PD and PID controller, Design of controller parameters using Ziegler-Nichols tuning method, Cohen coon tuning method, Implementation of Analog and Digital PID controller.

Advanced control techniques

Feed forward control, Ratio control, Cascade control, Adaptive control, Duplex or split range control, Override control, Model predictive Control.

Programmable Logic Controller (PLC)

An overview of PLC, Introduction, definitions and history of PLC, Architecture of PLC system, input and output modules, Ladder logic, PLC Programming, Application Examples.

Introduction to Distributed Control System, SCADA

DCS architecture, Functional requirements of Distributed control systems, Communication Protocol, Introduction to SCADA, SCADA system components, architecture and communication, Application examples

Textbooks

1. Krishna Kant, Computer-Based Industrial Control, 2nd edition Prentice Hall of India Ltd.
2. John R. Hackworth, Fredrick D. Hackworth Jr., Programmable Logic Controllers: Programming Methods and Applications, Pearson.

Reference books

1. Surekha Bhanot, Process Control Principles & Applications, OXFORD, 1st Edition
2. Ogata, Modern Control Engineering, 4th edition, Prentice Hall of India
3. William C. Dunn, Fundamentals of Industrial Instrumentation and Process Control, McGrawHill, 2009

PROCESS CONTROL AND ROBOTICS

Course Code: EL40001

Credits: 3

L-T-P: 3-0-0

Prerequisites : Nil

COURSE OBJECTIVE

To introduce the fundamental concepts of robotic system and its control that provides opportunity to learn mathematical modeling of kinematics and dynamics of robots and practice controller design for different robotic applications.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Learn and describe brief history, basic elements, different types and applications of robots
- CO 2: Understand and explain the kinematics and dynamics associated mathematics of robots
- CO 3: Employ and demonstrate basic techniques for computed torque control of robots
- CO 4: Analyze stability of control systems employed for robotic applications
- CO 5: Apply advanced and intelligent control techniques to formulate suitable control systems for robotics
- CO 6: Evaluate and interpret the performance robotics and associated control systems

COURSE DETAIL

Fundamentals Concepts in Robotics

Basic Elements and Anatomy of Robots, Classification of Commercial Robots, History of Robotics, Design and Control Issues, Applications of Robotics

Kinematics of Robotic System

Basic manipulator Geometries, Robot Kinematics, Homogeneous Transformation, Forward Kinematics, Inverse Kinematics, Manipulator Jacobians

Dynamics of Robotic System

Lagrange-Euler Dynamics, Structure and Properties of the Robot Equation, State-Variable Representations and Feedback Linearization, Cartesian and Other Dynamics, Actuator Dynamics

Basic Control of Robotic System

Basic Control Theory: Linear and Nonlinear State-Variable Systems, Nonlinear Systems and Equilibrium Points, Stability Theory and Lyapunov Theorems, Linear Controller Design

Computed Torque Control, Digital Robot control, Optimal Outer-Loop Design, Cartesian Control

Advanced Control Techniques for Robots

Robust Control: Feedback - Linearization Controllers, Nonlinear Controller, Dynamics Redesigns

Adaptive Control: Adaptive Control by a Computed-Torque Approach, Adaptive Control by an Inertia-Related Approach, Composite Adaptive Controller

Intelligent Control for Robots

Fundamentals of Fuzzy Logic and Neural Networks, Fuzzy Logic Control, Tracking Control Using Static Neural Networks, Tuning Algorithms for Linear-in-the-Parameters NN, Tuning Algorithms for Nonlinear-in-the-Parameters NN

Textbooks

1. Lewis, Frank L., Darren M. Dawson, and Chaouki T. Abdallah, Robot Manipulator Control: Theory and Practice by 2nd Ed., CRC Press, 2003.
2. K. R. Guruprasad, Robotics: Mechanics and Control, PHI Learning Pvt. Ltd. 2019.

Reference books

1. John Craig, Introduction to Robotics: Mechanics and Control, 4th Ed. Pearson, 2017
2. R. K. Mittal and I. J. Nagrath, Robotics and Control, 1st Ed. McGraw Hill Education, 2003

ADVANCED CONTROL SYSTEM

Course Code: EL40003

Credits: 3

L-T-P: 3-0-0

Pre-requisites: Nil

COURSE OBJECTIVE

This course introduces students to developed and advanced techniques for solving complex control problems. The course presents theory and methodology for analysis and modelling of systems and signals, and methods for design and synthesis of feedback controllers. The emphasis of this course will be on robust control and optimal control of dynamical systems.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO1: Comprehend state variable representation of continuous and discrete time LTI systems.
- CO2: Analyze state models for linear continuous time and discrete time systems.
- CO3: Apply vector and matrix algebra to find the solution of state equations
- CO4: Evaluate controllability and observability conditions of a given system.
- CO5: Design control systems using state feedback and pole placement techniques.
- CO6: Develop Lyapunov function for the stability analysis of nonlinear systems.

COURSE DETAIL

State Variable Analysis and Design

Introduction, Concept of State, State Variables and State Model, State Models for Linear Continuous – Time Systems,

State Variable Analysis and Design

Diagonalization, Solution of State Equations, Concepts of Controllability and Observability.

Pole Placement Design and State Observers

Introduction, Stability Improvements by State Feedback, Necessary and Sufficient Conditions for Arbitrary Pole Placement, State Regulator Design, Design of State Observer.

Non-linear systems Analysis

Introduction, Common Nonlinear System Behaviours, Common Nonlinearities in Control Systems, Fundamentals, Describing Functions of Common Nonlinearities, , Concept of Phase Plane Analysis, Construction of Phase Portraits, System Analysis on the Phase Plane.

Non-linear systems Analysis

Simple Variable Structure Systems, Lyapunov Stability Definitions, Lyapunov Stability Theorems, Lyapunov Functions for Nonlinear Systems.

Textbooks

1. I.J. Nagarath and M.Gopal, Control Systems Engineering, New Age 5th Edition, 2007
2. M.Gopal, Digital Control and State Variable Methods: Conventional and Intelligent Control Systems, McGraw Hill 3rd Edition, 2008

Reference books

1. K. Ogata, Discrete Time Control System, 2nd Edition Pearson Education
2. Hasan Khalil, Non linear systems, 3rd Edition PHI

MACHINE LEARNING BASED SIGNAL PROCESSING

Course Code: EM30007

Credits: 3

L-T-P: 3-0-0

Prerequisite: Nil

COURSE OBJECTIVE

Traditionally, signal characterization is performed with mathematically driven transforms and statistical tools. On the other hand, machine learning aims to design algorithms that learn from data. This course discusses the use of machine learning techniques to process and understand signals. This course focuses on, firstly to acquaint students with the representation and characterization of speech, images, and other important signals. Thereafter, designing of ML models for classifying and retrieving information from signals is engrossed. Content delivery will be conceptual oriented and not cover mathematical or optimization methods in detail.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Conceptualize the difference between deterministic and stochastic processes
- CO 2: Appreciate various spectral analysis methods
- CO 3: Comprehend the methods and underlying challenges in extracting hidden information from various signals
- CO 4: Explain clustering methods, fuzzy set, rough set and neural network topology.
- CO 5: Explain Neural Network topology and learning algorithms.
- CO 6: Apply ML methods for speech, seismic, image analysis and other similar applications.

COURSE DETAILS

Introduction to Various Signals

Audio and Speech Signal, Image Acquisition and Storage, Radar, Sonar & Seismic signals, Signal decomposition using Fourier & Wavelet transforms,

Estimation and Detection

Introduction, Bayesian Hypothesis Testing, Maximum Likelihood Hypothesis, Maximum likelihood estimator, Least Square Estimator, Parametric estimation, Wiener Filter, Kalman Filter, Non-parametric estimation, Filter Bank Methods.

Spectral Analysis Stochastic Processes

Adaptive Spectral Analysis, Multivariate Signal Processing, Independent Component Analysis, Principal Component Analysis, Markov Process, Gaussian Mixture Model, Linear Prediction Analysis.

Machine Learning

Unsupervised Learning: Clustering Principles, K-Means, Expectation Maximization, GMM Clustering

Basics of Fuzzy Logic and Rough Sets, Fuzzy Clustering, Fuzzy Probabilities

Supervised Neural Network and Ensemble Methods: Perceptron, Multi Layer Perceptron, Stochastic Gradient Descent and Backpropagation algorithm, Deep learning, Linear sequential model using Keras, Transfer learning,

Applications

Selected applications of Machine Learning techniques for speech, image and manifold learning of radar and seismic signals.

Textbooks

1. Francesco Camastra, Alessandro Vinciarelli, Machine Learning for Audio, Image and Video Analysis Theory and Applications, 2nd Edition, 2015, Springer
2. Deepika Ghai, Suman Lata Tripathi, Sobhit Saxena, Manash Chanda, Mamoun Alazab, Machine Learning Algorithms for Signal and Image Processing, 2022, Wiley Online, ISBN:9781119861829.

Reference books

1. Max A. Little, Machine Learning for Signal Processing: Data Science, Algorithms, and Computational Statistics, Oxford University Press
2. Valliappa Lakshmanan, Martin Görner, Ryan Gillard, Practical Machine Learning for Computer Vision, Released July 2021, Publisher(s): O'Reilly Media, Inc., ISBN: 9781098102364

DEEP LEARNING: ALGORITHMS AND IMPLEMENTATION

Course Code: EM30008

Credit: 3

L-T-P: 3-0-0

Prerequisites: Nil

COURSE OBJECTIVE

In this course, students will learn the fundamental principles, underlying mathematics, and implementation details of deep learning. This includes the concepts and methods used to optimize these highly parameterized models (gradient descent and backpropagation, and more generally computation graphs), the modules that make them up (linear, convolution, and pooling layers, activation functions, etc.), and common neural network architectures (CNN, RNN, etc.). Applications ranging from computer vision to natural language processing and generative models will be demonstrated. Through in-depth programming assignments, students will learn how to implement these fundamental building blocks as well as how to put them together using popular deep learning libraries, Keras & PyTorch.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Describe the functional roles of DNN sequential blocks.
- CO 2: Demonstrate skills in selecting deep learning architecture for computer vision tasks.
- CO3: Develop critical thinking skills to evaluate and analyze generative models for computer vision applications
- CO 4: Appraise and apply transfer learning and the concepts of fine-tuning
- CO 5: Implement deep learning techniques on sequential data
- CO 6: Design deep learning techniques to perform efficient analysis for real-world applications

COURSE DETAILS

Foundations of Deep Learning

Overview of ANN, Feed forward, MLP, Gradient descent, back propagation algorithm, evolution of DL, Regularization

Convolution Neural Networks

CNN Architectures: Convolution, Pooling Layers, Transfer Learning, GAN, Popular CNN Model Architectures (Imagenet, LeNet architecture, AlexNet, VGGNet, GoogLeNet, ResNet architecture

Recurrent Neural Network

RNN architecture, LSTM, GRU, Encoder Decoder architecture

Applications of Deep Learning

Applications of Deep Learning to Computer Vision: Image segmentation, Object detection, Image Captioning, Medical imaging, Image Classification using Transfer Learning, Applications of Deep Learning to NLP.

Advance Models

Auto-encoders, Generative Adversarial Network

Implementation

Tensor Flow, PyTorch, Comparing TensorFlow & PyTorch, Configuring and Running Jupyter notebooks on an AWS EC2 GPU Instance.

Textbooks

1. Ian J. Goodfellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2017.
2. Charu C. Aggarwal. Neural Networks and Deep Learning: A Textbook. Springer. 2019.

Reference books

1. Phil Kim, Matlab Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence, Apress, 2017.
2. Ragav Venkatesan, Baoxin Li, Convolutional Neural Networks in Visual Computing, CRC Press, 2018.
3. Navin Kumar Manaswi, Deep Learning with Applications Using Python, Apress, 2018.
4. Francois Chollet, Deep Learning with Python, Manning Publications, 2018

DATA ANALYTICS

Course Code: EM30009

Credit: 3

L-T-P: 3-0-0

Prerequisites: Nil

COURSE OBJECTIVE

Objective of this course is to familiarize students with the concepts of data science, gain knowledge on Big data technologies and tools, become familiar with statistical concepts and apply data analytics techniques.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Make use of data science concepts to handle big data.
- CO 2: Examine the statistical concepts for finding relationships among variables and estimate data samplings.
- CO 3: Select the data analytics techniques&models for both data prediction and performance analysis.
- CO 4: Develop rules using frequent item sets and association mining.
- CO 5: Solve real-time problems using classification and clustering techniques.
- CO 6: Apply the mining techniques for data streams.

COURSE DETAILS

Introduction to Data Science

Introduction to data, Data science, Challenges of traditional systems, Evolution of analytic scalability, Types of computing (Distributed, Parallel, Grid), Data analytics life-cycle, Introduction to Big Data (Characteristics) and Hadoop (Hadoop Ecosystem, MapReduce, Hbase, Pig, Hive, Sqoop, NOSQL), Visualizations

Statistical Concepts

Data exploration: Distribution of a single variable, Basic concepts (populations and samples, Data sets, variables, and observations, types of data), Descriptive measures for categorical variables, Descriptive measures for numerical variables, Outliers and missing values. Finding relationships among variables: Categorical variables, Numerical variables, Sampling and distributions: Terminology, Estimation, Confidence interval estimation, Sampling distributions, Confidence interval, Hypothesis testing, Chi-square test for independence

Data Analytic

Introduction, Types of data analytic, Importance of data analytics, Data analytics applications, Regression modelling techniques: Linear regression, Multi-variable regression, Non linear regression, Logistic regression, Time series analysis, Performance analysis (RMSE, MAPE).

Frequent Item-sets and Association

Introduction to frequent itemsets, Market-basket model, Algorithm for finding frequent, Itemsets, Association rule mining, Apriori algorithm and correlations.

Classification & Clustering

Introduction to classification and clustering, Distance-based algorithms: K-Nearest Neighbour (KNN), Decision Tree-based algorithms: Decision Tree (ID3 Algorithm), Linear Support Vector Machines, Naves Bayes. Overview of clustering techniques, Hierarchical clustering, Partitioning methods, K- means algorithm.

Data Streams

Introduction to mining data streams, Data stream management systems, Data stream mining, Examples of data stream applications, Stream queries, Issues in data stream query, Processing, Sampling in data streams, Filtering streams, Counting distinct elements in a stream, Estimating moments.

Textbook

1. Radha Shankarmani, M.Vijayalaxmi, Data Analytics, Wiley India Private Limited, ISBN: 9788126560639.

Reference books

1. S. Christian Albright and Wayne L. Winston, Business Analytics: Data Analysis & Decision Making . 6th Edition, Cengage Learning. (ISBN: 9781305947542)
2. Jiawei Han, Micheline Kamber, and Jian Pei, Data Mining: Concepts and Techniques 3rd Edition. Morgan Kaufmann. (ISBN: 9780123814791)
3. Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data by EMC Education Services (Editor), Wiley, 2014
4. DT Editorial Services, Big Data, Black Book, Dreamtech Press, 2015

DATA MINING

Course Code: EM30011

Credit: 3

L-T-P: 3-0-0

Prerequisites: NIL

COURSE OBJECTIVE

This course is an introductory course on data mining. It introduces the basic concepts, principles, methods, implementation techniques, and applications of data mining, with a focus on two major data mining functions: (1) pattern discovery and (2) cluster analysis.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Articulate the role of data mining in decision-making
- CO 2: Perform data processing and analysis.
- CO 3: Recall important pattern discovery concepts, methods, and applications, such as frequent pattern, and association rules
- CO 4: Recall basic concepts, methods, and applications of cluster analysis.
- CO 5: Evaluate the output of data mining for decisions and practical application
- CO 6: Demonstrate the benefits of data mining from business perspective.

COURSE DETAILS

Introduction

What is data mining? Why data mining? Data mining process, Introduction to data mining tasks (Classification, Clustering, Association Analysis, Anomaly Detection).

Data Pre-processing

Understanding of data, Types of attributes, Properties of attribute values, Types of data, Data quality, Sampling, Data normalization, Data cleaning, Similarity measures, Feature selection/Instance selection, Importance of feature selection/instance selection in various big data scenarios

Classification

Decision-Tree based approach (e.g. C4.5), Rule-based approach (e.g. Ripper), Instance-based classifiers (e.g. k-Nearest Neighbor). Support Vector Machines (SVMs), Ensemble learning, Classification model Selection and evaluation, Applications: B2B customer buying stage prediction, Recommender systems

Clustering

Partition and hierarchical clustering methods, Graph-based method, Density-based methods, Cluster validation applications: Customer profiling, Market segmentation.

Association Analysis

Apriori algorithm and its extensions, Association pattern evaluation, Sequential patterns and frequent sub-graph mining, Applications: B2B customer buying path analysis, Medical informatics, Telecommunication alarm diagnosis.

Anomaly Detection

Statistical-based and density-based methods, Ethics of data mining, Privacy in data mining

Case Studies

Big data analytics in mobile environments, Fraud detection and prevention with data mining techniques, Big data analytics in business environments

Textbook

1. Han, J., Kamber, M., & Pei, J., Data mining: Concepts and techniques, 3rd ed., Waltham: Morgan Kaufmann

Reference books

1. Foster Provost and Tom Fawcett, O'REILLY, Data Science for Business, ISBN: 978-1-449-36132-7, 2013
2. Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Introduction to Data Mining, Addison Wesley, ISBN: 0-321-32136-7

ML FOR LANGUAGE PROCESSING

Course Code: EM40001

Credit : 3

L-T-P: 3-0-0

Prerequisites : EM30007

COURSE OBJECTIVE

- To understand the steps involved in Natural language processing
- To learn about the lexical, syntactic and semantic analysis of natural language processing

- To explore the various parsing techniques for natural languages
- To understand the statistical models for Natural language processing
- To learn about the various applications involved in Natural language processing

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Evaluate different computing architectures for natural language processing for various parameters
- CO 2: Justify the various steps necessary for processing natural language
- CO 3: Suggest appropriate lexical and parsing techniques for a given natural language
- CO 4: Apply appropriate statistical models for a given natural language application
- CO 5: Modify existing algorithms to suit any natural language for processing
- CO 6: Suggest appropriate pre-processing steps essential for the various applications involving natural language processing

COURSE DETAIL

Lexical Analysis

Lexical Analysis, Regular expression and Automata for string matching, Words and Word Forms, Morphology fundamentals, Morphological Diversity of Indian Languages, Morphology Paradigms, Finite State Machine, Transducers Based Morphology, Automatic Morphology Learning, Parts of Speech, N-gram Models, Hidden Markov Models.

Speech Processing

Biology of Speech Processing, Place and Manner of Articulation, Word Boundary Detection, Argmax based computations, HMM and Speech Recognition, Text to Speech Synthesis, Rule based, Concatenative based approach.

Parsing

Theories of Parsing, Parsing Algorithms, Earley Parser, CYK Parser, Probabilistic Parsing, CYK, Resolving attachment and structural ambiguity, Shallow Parsing, Dependency Parsing, Named Entity Recognition, Maximum Entropy Models, Conditional Random Fields.

Lexical Knowledge Networks

Meaning: Lexical Knowledge Networks, Wordnet Theory, Indian Language Wordnets and Multilingual Dictionaries, Semantic Roles, Word Sense Disambiguation, WSD and Multilinguality, Metaphors, Coreference and Anaphora Resolution.

Applications

Applications: Sentiment Analysis, Text Entailment, Machine Translation, Question Answering System, Information Retrieval, Information Extraction Cross Lingual Information Retrieval (CLIR).

Textbook

1. Christopher Manning, Schutze Heinrich, Foundations of Statistical Natural Language Processing, MITPress, 1999.

Reference book

1. Allen James, Natural Language Understanding, Second Edition, Benjamin Cumming, 1995.

CYBERSECURITY

Course Code: EM40006

Credit: 3

L-T-P: 3-0-0

Prerequisites: Nil

COURSE OBJECTIVE

This course aims to provide a comprehensive introduction and effective defence to distinct challenges like; securing the infrastructure, securing devices, and securing local networks.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Understand what cybercrime is and appreciate the importance of legal perspective on cybercrime and organizational implications
- CO 2: Explain types of cyberattacks, role of cybercafes and what is cyberstalking
- CO 3: Understand the security challenges in mobile devices, removable medias, and organizational measures needed to protect information systems.
- CO 4: Describe tools and methods used in cybercrime
- CO 5: Learn about phishing-pharming-pharming and different types of ID thefts
- CO 6: Understand global and Indian IT Act in cybercrime perspective

COURSE DETAILS

Introduction of Cybersecurity

Cybercrime, Classifications, Legal perspectives, Ethics of Hacking and Cracking

Cyber offenses

Active and Passive Attacks, Cyberstalking, Botnets, Benefits of Cloud Computing

Vulnerability

Authentication Security and Attacks on Mobile Devices, Email Attacks and Browser based vulnerabilities, Server Vulnerability, TCP/IP Vulnerability, Incident handling, Organizational Security Policy

Tools and Methods Used in Cybercrime

Proxy Servers, Phishing, Spoofing, Encryption & Password Cracking, Session Hijacking, Hacking Network Devices, Trojan Horses, Malware in Action

Prevention and Mitigation

Buffer overflow detection and Prevention, Organizational Security Policies, Digital Forensic tools, , Incident Handling

Social, Political, Ethical and Physiological Dimensions

Intellectual property in Cyberspace, Ethical Dimensions, Legal Perspective, Information Technology Act

Textbook

1. Nina Godbole, Sunit Belapure, Kamlesh Bajaj, Cyber Security: Understanding Cyber Crimes, Computer Forensics And Legal Perspectives Paperback – January 1, 2011, Wiley India
2. Alfred Basta, Cyber Security And Cyber Laws, Cengage Learning India Pvt Ltd

Reference books

1. Yuri Diogenes and Dr. Erdal Ozkaya, Cybersecurity – Attack and Defense Strategies: Counter modern threats and employ state-of-the-art tools and techniques to protect your organization against cybercriminals.
2. Ashish Mishra, Modern Cybersecurity Strategies for Enterprises: Protect and Secure Your Enterprise Networks, Digital Business Assets, and Endpoint Security with Tested and Proven Methods

BIOINFORMATICS

Course Code: EM40008

Credit: 3

L-T-P: 3-0-0

Prerequisite: Nil

COURSE OBJECTIVE

Bioinformatics is a rapidly evolving interdisciplinary field in which computational resources are necessary to investigate and interpret complex biological data. The students will gain the basic knowledge of sources of sequences and protein

structure data, an understanding of the relevance and importance of this data, and some exposure to basic algorithms used for processing this data.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Understand fundamental concepts and application of Bioinformatics
- CO 2: Have an overview of the most important methods and tools that are used
- CO 3: Understand how some of the basic methods for biological sequence analysis works
- CO 4: Understand the need for methods to be accurate and efficient
- CO 5: Implement some of the algorithms
- CO 6: Using existing tools to perform simple sequence analyses

COURSE DETAILS

Introduction to Bioinformatics

Introduction to Bioinformatics; Biological databases: Nucleotide databases, Protein databases, Specialized databases; Laboratory data submission and data retrieval; Various file formats for biomolecular sequences: Genbank, EMBL, FASTA, GCG, msf, nbrf-pir etc.; Basic concepts of sequence similarity: identity and homology, definitions of homologues, orthologues, paralogues; Sequence patterns and profiles

Sequence Alignment and Database Searching

Introduction, Evolutionary Basis of Sequence Alignment, Optimal alignment method, Statistical Significance of Alignment. Database searching Artifacts; Database similarity searching: FASTA, BLAST, Various basic and advance version, Multiple sequence alignment: progressive method and Iterative method; Applications of pairwise and multiple sequence alignment; Tools for multiple sequence alignment: CLUSTALW and Pileup (Algorithmic concepts).

Introduction to Genes and Proteins

Genome Sequences, ORFs, Genes, Introns, Exons, Splice Variants, DNA/RNA Secondary Structure Triplet Coding, Protein Sequences, Protein Structure: Secondary, Tertiary, Quaternary, The notion of Homology. Scoring matrices: Basic concept of a scoring matrix, Similarity and distance matrix, Predictive Method using Nucleotide Sequence: Introduction, Marking repetitive DNA, Database search, Codon bias detection, detecting functional site in DNA.

Phylogenetics

Phylogeny and concepts in molecular evolution; nature of data used in taxonomy and phylogeny; definition and description of Phylogenetic trees and various types of trees; Different methods of Phylogenetic tree construction: UPGMA and Fitch-Margoliash Algorithm; case studies in phylogenetic sequence analysis.

Machine learning for Bioinformatics

Unsupervised learning, K-means clustering, Hierarchical clustering, Heatmap representations. Dimensionality reduction, Principal Component Analysis (PCA). Hands-on session with unsupervised learning analysis of cancer cells further highlighting practical considerations and best practices for the analysis and visualization of high dimensional datasets.

Textbooks

1. A. M. Lesk, Introduction to Bioinformatics, Oxford University Press, 2022

Reference books

1. T. K. Attwood & D. J. Parry-Smith, Introduction to Bioinformatics, Pearson Education Ltd, Low Price Edition, 2001.
2. D.W. Mount, Bioinformatics: Sequence and Genome Analysis, Cold Spring Harbor Laboratory Press, 2001.
3. D. Baxevanis and F. Ouellette, Bioinformatics : A practical guide to the analysis of genes and proteins, Wiley Indian Edition, 2002.
4. M.D.B. Bergeron, Bioinformatics Computing, Prentice Hall India (Economy Edition), 2003.

OPTIMIZATION METHODS IN MACHINE LEARNING

Course Code: EM40010

Credit: 3

L-T-P: 3-0-0

Prerequisite: Nil

COURSE OBJECTIVE

This course introduces students to the fundamental concepts, techniques, and algorithms in optimization for machine learning. Students will learn how optimization plays a crucial role in the design and analysis of machine learning models. The course will cover a broad range of optimization methods, with a focus on understanding their theoretical properties and practical implementation.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Understand the foundational concepts of optimization and their importance in the context of machine learning, including the role of loss functions, performance metrics, and optimization problems.
- CO 2: Analyze and implement a variety of optimization techniques, including gradient descent and its variants, adaptive learning rate methods, second-order optimization methods, and metaheuristic optimization algorithms.
- CO 3: Apply regularization techniques to prevent over fitting and improve the generalization performance of machine learning models.
- CO 4: Design and implement optimization algorithms for deep learning models, including proper initialization, back propagation, and fine-tuning strategies.
- CO 5: Employ model selection and hyperparameters optimization techniques to enhance the performance of machine learning models on real-world tasks.
- CO 6: Utilize distributed and parallel optimization algorithms to scale up optimization processes for large-scale machine learning applications.

COURSE DETAILS

Introduction to Optimization and Machine Learning/Deep Learning

Introduction to optimization, Machine learning basics, The role of optimization in machine learning, Loss functions and performance metrics, Deep learning basics, Back propagation algorithm, Initialization techniques, Transfer learning and fine-tuning

Convex and Non Convex Optimization Techniques

Convex sets and functions, Convex optimization problems, First-order and second-order optimality conditions, Introduction to gradient descent ,Batch gradient descent, Stochastic gradient descent (SGD), Mini-batch gradient descent, Momentum and Nesterov accelerated gradient (NAG) , Adagrad, RMSprop, Adam and its variants, Learning rate scheduling, Early stopping, Dropout, Cross-validation techniques, Grid search, Random search, Bayesian optimization

Second-Order Optimization Methods

Newton's method, Quasi-Newton methods (BFGS, L-BFGS), Conjugate gradient method,

Non -Convex Optimization Techniques

Local and global minima, Saddle points and plateaus, Strategies for escaping saddle points,

Constrained Optimization

L1 and L2 regularization, Elastic net regularization, Equality and inequality constraints, Lagrange multipliers, Karush-Kuhn-Tucker (KKT) conditions Sequential quadratic programming (SQP)

Metaheuristic Optimization Algorithms

Genetic algorithms, Simulated annealing, Particle swarm optimization, Ant colony optimization

Multi-objective Optimization

Pareto optimality, Scalarization methods, Evolutionary multi-objective optimization algorithms (NSGA-II, MOEA/D)

Distributed and Parallel Optimization

Data and model parallelism, Synchronous and asynchronous updates, Distributed optimization algorithms (ADMM, Federated Learning)

Textbooks

1. Goodfellow, I., Bengio, Y., & Courville, A. Deep Learning. MIT Press. (Link: <https://www.deeplearningbook.org/>)
2. Deb, Kalyanmoy. Optimization for engineering design: Algorithms and examples. PHI Learning Pvt. Ltd., 2012.

Reference books

1. Boyd, S., & Vandenberghe, L. Convex Optimization. Cambridge University Press. (Link: <https://web.stanford.edu/~boyd/cvxbook/>)
2. K. Deb.- Multi-Objective Optimization Using Evolutionary Algorithms— (Chichester, U.K.: Wiley, 2001)
3. Ruder, S. , An Overview of Gradient Descent Optimization Algorithms. arXiv preprint arXiv:1609.04747. (Link: <https://arxiv.org/abs/1609.04747>)
4. Sra, S., Nowozin, S., & Wright, S. J. (Eds.). Optimization for Machine Learning. MIT Press.

5. Nocedal, J., & Wright, S., Numerical Optimization. Springer Science & Business Media.

MICROFABRICATION

Course Code: EV20001

Credit: 3

L-T-P: 3-0-0

Prerequisites: Nil

COURSE OBJECTIVE:

The basic objective of the course is to enable the students to get a fair idea of VLSI fabrication steps and latest happenings around different unit processes like clean room environment, crystal growth, oxidation and its types, diffusion and its shortcoming that leads to ion implantation, deposition techniques, etching process and VLSI interconnect via realization using metallization step.

COURSE OUTCOMES:

After successfully completing the course, the students will be able to

CO1: to be aware about the trends in semiconductor technology in clean room environment

CO2: to understand the process of Silicon crystal growth and wafer preparation

CO3: to grasp the idea of different oxidation and lithography process

CO4: to understand basic diffusion and ion implantation techniques

CO5: to understand the various steps involved during process of deposition and etching during IC manufacturing

CO6: to comprehend etching and metalization process for chip fabrication

COURSE DETAILS

Introduction

Brief History of Semiconductor technology, Scaling Trends and Scaling Methodologies, Scaling Challenges, ITRS Roadmap. Electronic Materials: Crystal Structures, Defects in Crystals, Si Crystal Growth, Czochralski and Float Zone crystal growth, GaAs growth Clean room and Wafer Cleaning: Definition, Need of Clean Room, types of cleaning , standard RCA cleaning of Si.

Oxidation and Photo lithography

Silicon oxidation methods and properties: dry and wet, Kinetics of Oxidation, Oxidation Rate Constants, Dopant Redistribution, Oxide Charges, Photo-lithography: pattern transfer techniques, Radiation Sources, Masks, photoresist, Introduction to Advanced Lithography: E-beam Lithography, X-ray Lithography, Ion Beam Lithography.

Diffusion and Ion implantation

Types of diffusion, Pre-Deposition and Drive-in Diffusion Modeling, Dose, 2-Step Diffusions, Successive Diffusion, Lateral Diffusion, stopping mechanisms, Junction Depth, Irvin's Curves, Diffusion System. Ion Implantation: Problems in Thermal Diffusion, Advantages of Ion Implantation, Ion Implantation System, Mask, Energy Loss Mechanisms, Depth Profile, Range & Straggle, Lateral Straggle, Dose,, Ion Implantation Damage and Annealing

Deposition,Etching and Metalization

Deposition requirements and techniques :Physical Vapor Deposition: Thermal evaporation,Electron beam evaporation, Sputtering Chemical Vapor Deposition,Different types of CVD techniques: APCVD, LPCVD, Metalorganic CVD (MOCVD), Plasma Enhanced CVD,Anisotropy, Selectivity, Wet Etching, Plasma Etching, Reactive Ion Etching,Metallization: Overview of Copper and Aluminum interconnects, Contacts, Metal gate/Poly Gate, Electromigration,Metal Silicides, Multi-Level Metallization

Text Book:

1. Gary. S. May and S. M. Sze, "Fundamentals of semiconductor fabrication", Wiley India,2004 Edition.

Reference Books:

1. Silicon VLSI Technology, Plummer, Deal and Griffin ,1st Edition, Pearson Education,2009
2. Marc J. Madou, "Fundamentals of Microfabrication and Nanotechnology – Volume II", CRC Press, Third Edition, 2011.

DIGITAL VLSI CIRCUITS

Course Code: EV20002

Credit: 3

L-T-P: 3-0-0

Prerequisites: Nil

COURSE OBJECTIVE:

In this course on Digital VLSI Circuits, students will delve into the intricate realm of Very Large Scale Integration with a focus on digital design. The primary objective is to equip participants with the knowledge and skills necessary to understand, design, and implement complex digital systems on integrated circuits. Through a combination of theoretical lectures and demonstration through simulation, students will gain a comprehensive understanding of CMOS logic families, transistor-level design, layout methodologies, CMOS combinational and sequential circuits, high performance CMOS logic, semiconductor memories used in modern VLSI design.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Recall the key concepts and principles of digital VLSI circuit design, including CMOS logic families, transistor-level design, and layout methodologies,
- CO 2: Interpret the behavior and characteristics of MOS transistor by analyzing threshold voltage, current and impact of scaling,
- CO 3: Apply knowledge to analyze the different MOS inverter architecture in terms of performance metrics such as speed, power and area,
- CO 4: Evaluate the performance of digital VLSI circuits through transistor sizing, parasitic capacitances and delay.
- CO 5: Design and implement high performance digital VLSI circuits to meet specified requirements, integrating advanced techniques such as pipelining, area reduction, and power optimization for efficient and reliable operation
- CO 6: Critique the trade-offs involved in different design choices for semiconductor memories.

COURSE DETAILS

Introduction to VLSI Design flow

Overview and Introduction to VLSI design, Moore's Law.VLSI Design flow,Y-chart, Design hierarchy, concept of regularity, modularity and locality.VLSI Design style: Full custom and semi-custom design style (standard cell and gate array based design), Field programmable devices: FPGA architecture.

Physics of MOSFET

Two terminal MOS Structure, concept of band diagram of two terminal MOS structure. Qualitative description of accumulation, depletion and inversion condition. Concept of flat band voltage. Threshold voltage and its components. Substrate bias effect.Estimination of drain current, Channel length modulation, MOSFET scaling and overview of short geometry effects.

MOS Inverters:

Introduction to MOS inverter, concept of voltage transfer characteristics (VTC) curve, qualitative analysis of MOS inverters with passive and active load, CMOS inverter: structure and operation, switching threshold voltage of inverter, symmetrical CMOS inverter design.

Transient Analysis of MOS Inverters:

Qualitative description of different components of parasitic load capacitances. Definition of delay times (rise time, fall time, 50% delay time), Power dissipation in CMOS circuits, dynamic, short circuit and leakage power dissipation and its analysis.

Combinational Logic Circuits

CMOS combinational circuits. Properties of CMOS combinational circuits. Basic structure of CMOS logic cells. 2 input NAND circuit. 2 input NOR circuit. Transistor size definition. Drive strength and logic effort. Delay of scaled cell. Estimation of logic effort. Complex CMOS logic design, Layout and design rules overview, stick diagram with examples.

Sequential Logic Circuits

Main structure of RS-latch. Clocked latch. D latch. JK flip-flops (FFs). T FF. T and D FFs built on JK FF. Racing in FFs. Edge clocking. Master-slave (MS) RS latch. MS D latch. CMOS FF.

Dynamic CMOS and Pass Transistor based Logic

Pre-charge evaluate logic, cascading and charge sharing problems and solutions, DOMINO, NORA logic. NMOS and PMOS as pass gate, pass transistor based logic design examples, CMOS transmission gate based logic design.

Semiconductor Memories

Random access memories (RAM). Static memories (SRAM 6T static memory cell),DRAM (1T and 2T) overview of (ROM,EPROM),Flash memory programming.

Text Book:

1. CMOS Digital Integrated Circuits Analysis & Design by Sung-Mo Kang, Yusuf Leblebici, Chul Woo, Kim, 4th Edition, McGraw Hill, 2014
2. CMOS VLSI Design: A Circuits and Systems Perspective by Neil Weste, David Harris, 4th edition, Pearson, 2010.

Reference books:

1. Jan M.. Rabaey, Chandrakasan, A. P., & Nikolić, B. (2003). Digital integrated circuits: a design perspective. Pearson Education, Incorporated..

DIGITAL LOGIC DESIGN WITH VERILOG

Course Code: EV20004

Credit: 3

L-T-P: 3-0-0

Prerequisites: EC10001

COURSE OBJECTIVE:

This course imparts in designing digital circuits and abstracting their behavior using Verilog HDL. It also emphasizes on RTL modeling of digital circuits, verifying these Models and synthesizing RTL models to standard cell libraries and FPGAs. This course aims to provide students with the understanding of the different technologies related to HDLs, construct, compile and execute Verilog HDL programs using provided .

COURSE OUTCOMES:

After successfully completing the course, the students will be able to

CO1: Understand the language constructs and programming fundamentals of Verilog HDL

CO2: Choose the suitable abstraction level for a particular digital design

CO3: Construct Combinational and sequential circuits in different modelling styles using Verilog HDL

CO4: Synthesize the RTL design and analyze the synthesis output

CO5: Analyze and Verify the functionality of digital circuits/systems using test benches

CO6: Design and verify digital system using Verilog HDL

COURSE DETAILS

Introduction to Logic Design with Verilog: Verilog as HDL, Levels of Design Description, Concurrency, Program structure, Top-down and Bottom-up design methodology, differences between modules and module instances, parts of a simulation, design block, stimulus block, Verilog Data types and Operators, system tasks, compiler directives

Data-flow and Gate-Level Modelling: Continuous assignments, Delay specification, expressions, operators, Design of Decoders, Multiplexers, Flip-flops, Registers & Counters in dataflow model, Modelling using basic Verilog gate Primitives, Description of and/or and buf/not type gates, rise, fall and turn-off delays, min, max, and typical delays, Design of Decoders, Multiplexers, Flip-flops, Registers & Counters in Gate-level Modelling.

Behavioral Models of Combinational and Sequential Logic: Behavioral modeling, data types for behavioral modeling, behavioral models of combinational logic, propagation delay and continuous assignments, latches and level sensitive circuits in verilog, behavioural models of flip flops and latches, functions and Tasks.

Logic Synthesis and Simulation: synthesis of combinational logic, synthesis of sequential logic with latches, synthesis of three state devices and bus interfaces, synthesis of sequential logic with flip flops, synthesis of explicit state machines registered logic, Test Bench – components of testbench, Combinational Circuits Testing, Sequential Circuits Testing.

Text Book:

1. Padmanabhan, Tripura Sundari -Design through Verilog HDL, Wiley, paperback, 2016

Reference books:

1. Stephen Brown and Zvonko Vranesic - Fundamentals of Digital Logic with Verilog, 2nd Edition, TMH, 2008.
2. Samir Palnitkar-Verilog HDL: A Guide to Digital Design and Synthesis, Pearson Education, 2nd Ed., 2009.
3. Z Navabi - Verilog Digital System Design, 2nd Edition, McGraw Hill, 2005.

EMBEDDED DESIGN AND COMPUTER ARCHITECTURE

Course Code: EV20006

Credit: 3

L-T-P: 3-0-0

Prerequisites: Nil

COURSE OBJECTIVE:

This course will give an insight into embedded system design and their perspectives, Embedded System modelling. This will teach students about ALP and Embedded C Coding for embedded system design using ARM processor. This course focuses on HW/SW Codesign Methods.

COUSE OUTCOMES:

After completion of the course the students will be able to

- CO1: Understand basic computer architectures and its use in embedded systems
- CO2: understand the difference between embedded systems and general-purpose systems.
- CO3: Analyse and designs hardware using single-purpose processors.
- CO4: comprehend different peripheral interfaces to embedded systems.
- CO5: Analyse and comprehend the design trade-offs made by different models of embedded systems.
- CO6: apply knowledge gained in software-hardware integration in team-based projects.

COURSE DETAILS

Introduction To Computer Architecture:

Introduction, basic architecture, Non-Neumann and Harvard Architecture, Internal processor design: ALU – registers – control unit - clock – on chip memory – processor i/o – interrupts – processor buses – processor performance, logic micro-operations and instruction level parallelism, microprogrammed control.

Introduction: Introduction to embedded systems, Design Standards, Characteristics of embedded Systems

Modelling techniques: Finite State Machines Model, State Charts and Petri-nets, Data driven and control driven concurrency

Hardware/ Software Co-Design: Hardware software portioning and scheduling, hardware and software estimation models, Co-Simulation

Peripherals: parallel and Serial communication protocols (RS232, USB, I2C, SPI,)

Embedded Processors: Brief introduction to MIPS, PowerPC and other RISC Processors, ARM SoC and its programming (using Assembly and Embedded C)

Text Book:

1. Computer as Component: Principle of Embedded Computing System Design by Wayne Wolf, Morgan-Kaufmann, 2012
2. Embedded System Design: A Unified Hardware/Software Introduction by Frank Vahid & Tony Givagis, , John Wiley, 2011.

Reference Book:

1. Embedded System Design, Peter Marwedel, Springer, 2009
2. Embedded Systems, Raj Kamal, 2nd Edn., TMH, 2011.

ANALOG AND DIGITAL ELECTRONIC DEVICES AND CIRCUITS

Course Code: EV21001

Credit: 4

L-T-P: 3-1-0

Prerequisites: Nil

COURSE OBJECTIVE:

By the end of this analog electronics course, students will gain a comprehensive understanding of the principles, theories, and applications underlying analog and digital electronic circuits. Through theoretical lessons and tutorial sessions, participants will develop the skills necessary to design, analyze, and troubleshoot analog and digital circuits effectively. Emphasizing fundamental analog and digital circuits such as MOSFET amplifiers, Boolean algebra, number systems, different combinational and sequential logic circuits, this course aims to equip learners with the proficiency to design and implement various electronic systems. Additionally, students will cultivate problem-solving abilities and critical thinking skills essential for addressing real-world challenges in both analog and electronics engineering.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Understanding fundamentals of MOSFET and digital electronics,

CO 2: Apply knowledge to solve MOS amplifier using small signal model,

CO3: Simplify and realize Boolean expressions and design various combinational Circuits,

CO 4: Able to design and implement digital circuits using various components such as logic gates, flip-flops, registers, and counters ,

CO 5: Judge the performance of analog to digital and digital to analog converters used in electronic circuits,

CO 6: Develop the ability to model the behavior of digital circuit using state Machines.

COURSE DETAILS

Introduction to MOS Transistor and Amplifiers:

MOSFET structure and operation, voltage-current characteristics, Threshold voltage, enhancement and depletion mode devices. Low and high frequency small signal model of MOSFET, concept of unity-gain cut-off frequency of transistor, analysis of common source and common drain amplifiers, voltage gain and output resistance calculation at low frequency operation.

Introduction to Digital fundamentals

Boolean Algebra axioms and basic theorems; De. Morgan's Theorem, Standard and canonical representations of logic functions, Conversion between SOP and POS; Simplification of logic functions, Karnaugh Map, Don't Care Conditions, Number systems-binary, Signed binary, Octal, hexadecimal number; Binary arithmetic, One's and two's complements arithmetic, BCD arithmetic.

Combinational circuits:

Multiplexer; Demultiplexer / Decoder, BCD to 7-segment decoder driver; Encoder, Priority encoder; Parity generator and checker, Codes, Code converters; Adder, Subtractor, Carry look ahead adder; Magnitude comparator.

Sequential circuits:

Bistable latch, SR, D, JK, T Flip-Flop: level triggered, edge triggered, master – slave, Various representations of flip-flops, flip-flop conversions. Shift register, Universal shift register; Application of shift register: ring counter, Johnson counter. Up and down counter, Ripple (asynchronous) counters, Synchronous counters. Design of synchronous sequential circuit using Mealy model and Moore model: state transition diagram.

Data Converters:

Digital to analog converters: weighted resistor/converter, binary ladder, converter, accuracy and resolution; Analog to digital converter (Flash type, Counter type & Successive approximation type).

Text Book:

1. Millman, J., Halkias, C. & Parikh, C. D. (2017). Integrated Electronics (2nd Edition). McGraw-Hill Publications. ISBN 13: 978-0-07-015142-0.
2. Mano, M. M. (2016). Digital Logic and Computer Design (1st Edition), Pearson Education. ISBN-13:978-93-325-4252-5.

Reference books:

1. Boylestad, R. L. & Nashelsky, L. (2021). Electronics Devices and Circuits (11th Edition). Pearson Education. ISBN 13: 978-0-13-262226-4.
2. Anand Kumar, A. (2016). Fundamentals of Digital Circuits (4th Edition). PHI. ISBN: 9788120352681

DIGITAL VLSI LAB

Course Code: EV29002

Credit: 1

L-T-P: 0-0-2

Prerequisites: Nil

COURSE OBJECTIVE:

The basic objective of the course is to enable the students to get a fair idea of VLSI circuit simulation using dedicated EDA tool. Using these engine tools, spice program provides facility to the use to design & simulate new ideas in circuit design before going to the time consuming & costly process of chip fabrication.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO1: to be aware about different EDA tool and their functions.
- CO2: to design and verify the operations of CMOS logic
- CO3: to grasp the idea of design and simulate Transmission Gate based design
- CO4: to understand the basic building gates for Flip-flop design
- CO5: to design and verify various gates using CMOS
- CO6: to accomplish the layout of CMOS inverter

LIST OF EXPERIMENTS:

Experiment 1

Introduction to circuit design tool and its different functionalities.

Experiment 2

Design and simulation of CMOS inverter logic

Experiment 3

Design and simulation of user defined logic using PTL

Experiment 4

Design and simulate a flip-flop.

Experiment 5

Design and simulate of MUX logic using Transmission Gate.

Experiment 6

Design and simulation user defined boolean expression (upto 3i/p) using CMOS logic

Experiment 7

Layout CMOS inverter.

Experiment 8

Automatic layout generation.

Experiment 9

Open ended Experiment 1

Experiment 10

Open ended Experiment 2

VERILOG LAB

Course Code: EV29004

Credit: 1

L-T-P: 0-0-2

Prerequisites: Digital Electronics

COURSE OBJECTIVE

The Verilog HDL lab introduces students to the world of hardware description languages (HDLs) and their powerful role in designing digital circuits. Through hands-on labs, students will gain a solid understanding of Verilog's core syntax, data types, operators, and other essential building blocks. The course equips students with the skills to design, simulate, and implement Verilog HDL circuits. This valuable skillset opens doors to exciting careers in fields like integrated circuit design, FPGA programming, and embedded system development.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Design and simulate the simple Boolean functions using dataflow style Verilog code.
- CO 2: Design and simulate the combinational logic circuits using dataflow style Verilog code.
- CO 3: Design and simulate the arithmetic circuits using structural style Verilog code.
- CO 4: Design and simulate the sequential logic circuits using behavioral style Verilog code.
- CO 5: Deploy the combinational and sequential circuits into the FPGA board.
- CO 6: Design, test and deploy complex circuits into FPGA board.

LIST OF EXPERIMENTS

1. Write dataflow style and structural style Verilog codes to design the half-adder and full-adder circuits. Write testbenches to simulate the half-adder and full-adder circuits.
2. Write a Verilog code to design a 4-bit ripple-carry adder. Write a testbench to simulate the 4-bit ripple-carry adder.
3. A) Write a dataflow style Verilog code to design a 2x1 multiplexer. Write a testbench to simulate the 2x1 multiplexer.
B) Write a dataflow style Verilog code to design a 4x1 multiplexer. Write a testbench to simulate the 4x1 multiplexer.
C) Write a structural style Verilog code to design an 8x1 multiplexer. Write a testbench to simulate the 8x1 multiplexer.
4. A) Write a behavioral style Verilog code to design a JK flip-flop. Write a testbench to simulate the JK flip-flop.
B) Write Verilog codes to realize a T flip-flop using a JK flip-flop. Write a testbench to simulate the T flip-flop.
C) Write Verilog codes to realize a D flip-flop using a JK flip-flop. Write a testbench to simulate the D flip-flop.
5. Write a behavioral style Verilog code to design a 1K x 8 RAM. Write a testbench to simulate the design.
6. Write a behavioral style Verilog code to design a 4-bit synchronous Up-Down counter. Write a testbench to simulate the synchronous counter.
7. Write a Verilog code to design a Mealy machine for a 4-bit sequence detector. Write a testbench to simulate the sequence detector. The design must be able to detect overlapped sequences.
8. A) Implement and test the combinational logic circuits into FPGA board.
B) Implement and test the sequential logic circuits into FPGA board.
9. Open Ended Experiment 1.
10. Open Ended Experiment 2.

EMBEDDED LAB

Subject Code: EV29006

Credit: 1

L-T-P: 0-0-2

Prerequisites:

COURSE OBJECTIVE:

This course will make students to interface various sensors and peripherals using PIC18F and ARM Cortex Processors using embedded C programming style. It also able make student build their own embedded project alone or in group.

COURSE OUTCOMES:

After completion of the course student will be able to

CO1: Write a program to configure I/O ports and used to drive LEDs using PIC18F microcontroller

- CO2: Write program interface 16x2 character LCD using PIC18F microcontroller
- CO3: Write program to interface OLED display ARM Cortex processor and display characters of suitable size.
- CO4: Write program to stepper motor driving with/without PWM with ARM Cortex processor.
- CO5: Write program to interface ADC/DAC with ARM Cortex processor.
- CO6: Make students to work as an individual or in group for designing a Embedded System based project.

TENTATIVE EXPERIMENT LIST:

1. Configuring I/O ports and LED glowing using PIC18F microcontroller
2. 16x2 character LCD interface with PIC18F microcontroller to display a message.
3. Configuring I/O ports and LED glowing using ARM Cortex Processor
4. LED intensity control using PWM with ARM Cortex processor
5. Interfacing I2C OLED display with ARM Cortex Processor to display characters of suitable size.
6. ADC and LCD interface with ARM Cortex Processor
7. Stepper Motor interfacing using ARM Cortex processor with PWM/without PWM.
8. Interfacing UART to send and receive messages with ARM Cortex Processor.
9. Open Ended experiment I*
10. Open Ended experiment II*

**The open ended experiment will be based on interfacing Bluetooth module, RF Module, temperature sensor, generating different waveforms using DAC (Triangular, Square wave with suitable duty cycle, sine wave etc.)*

MIXED SIGNAL IC DESIGN

Course Code: EV30001

Credit: 3

L-T-P: 3-0-0

Prerequisites: Nil

COURSE OBJECTIVE:

Analog and mixed-signal integrated circuits play an important role in many modern emerging system-on-chip (SoC) design applications. With the expansion in the markets of these applications, the demands of analog/mixed-signal ICs have dramatically increased. Although analog/mixed-signal ICs have gained more importance and demands in modern SoC applications the design complexities have further increased. The analog circuits being prone to noise and electromagnetic interference, ensuring noise immunity without compromising on performance parameters

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Apply a knowledge of the operation of MOSFET transistors and circuits to the analysis and design of small signal model of a circuit
- CO 2: Select the most appropriate design configuration for a specified single stage amplifier implementation.
- CO 3: Evaluate performance issues and trade-offs based on a knowledge of different current mirror circuits.

- CO 4: Choose the most appropriate operational amplifier configuration for a specified analog circuit implementation.
- CO 5: Model noiseless analog circuits based on the knowledge of different types of noises and their compensation
- CO 6: Analyze different designs based on comparator and opamp

COURSE DETAILS

1. Analog circuits in VLSI, Overview of circuit performance parameters
 - a. analog design octagon
 - b. Small signal model of MOS
 - c. Second order effects
2. Single stage Amplifiers
 - a. Basic amplifier topologies and their characteristics,
 - b. common-source stage amplifier with different loads
 - c. Cascode stage
3. Biasing circuits
 - a. Basic and Cascode current mirrors,
 - b. Current and Voltage references; bandgap reference,
 - c. Folded Cascode current mirror
 - d. cascode current mirror for low voltage applications
4. Differential amplifier
 - a. advantages of differential signaling, simple differential amplifier
 - b. differential amplifier with tail current source
 - c. qualitative and quantitative analysis
 - d. Gilbert cell
5. High frequency response and Noise
 - a. Association of poles with nodes, Miller poles
 - b. Transfer function of common source, common gate and cascode amplifiers
 - c. Pole zero compensation
 - d. Types of noise and noise compensation
6. OPAMP
 - a. Ideal characteristics of opamp
 - b. Single ended and differential opamp with cascode load
 - c. Two stage opamp, gain boosting
 - d. Frequency response and pole compensation
7. comparator and oscillator
 - a. Simple comparator, Switch-based comparator, Latch-based comparator.
 - b. Nyquist rate ADC and DAC design
 - c. sigma delta modulator
 - d. Ring oscillator, LC oscillator, Voltage control oscillator, PLL

Textbook:

1. Design of Analog CMOS Integrated Circuits; Behad Razavi; 2nd edition, TMH, 2017
2. Analog Integrated Circuit Design (2nd edition) By Tony Chan Carusone, David Johns and Kenneth Martin Publisher: Wiley; 2 edition (December 13, 2011)

VLSI FOR SIGNAL PROCESSING

Course Code: EV30002
Credit: 3
L-T-P: 3-0-0

Prerequisites: EC20001

COURSE OBJECTIVE

This course offers an extensive overview of key techniques essential for crafting efficient VLSI architectures tailored for Digital Signal Processing (DSP). Emphasis will be placed on architectural optimization across multiple levels of the design to create efficient hardware implementations.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Apply the signal flow graphs and data flow graphs to represent signal processing algorithms.
- CO 2: Apply the techniques of pipelining and parallel processing to design VLSI architectures for high-speed and low-power applications.
- CO 3: Analyze the critical path using the concepts of re-timing.
- CO 4: Analyze the unfolding and folding in signal processing architectures.
- CO 5: Design and evaluate architectural transformations used to translate signal processing algorithms into efficient hardware architectures.
- CO 6: Design and optimize the performance of the VLSI architectures for signal processing.

COURSE DETAILS

Representation Methods of Signals and System

Graphical representation of signals, Signal flow graph, Data flow graph, Loop bound, Iteration bound, Algorithms for computing iteration bound, iteration bound of multi rate data flow graphs.

Pipelining and Parallel Processing

Pipelining of FIR Digital Filters, Parallel processing, Design of first order IIR filter using pipelining and parallel processing, Pipelining and parallel processing for low power.

Retiming

Definition and Properties, Solving Systems of Inequalities, Retiming Techniques.

Unfolding and Folding

Algorithm for unfolding, Properties of unfolding, critical path, unfolding and retiming, Application of unfolding, Folding transformation, Register minimization techniques, Register Minimization in folded architectures, Folding of Multi-rate Systems.

Systolic Architecture Design

Systolic array design methodology, FIR systolic array, Matrix-Matrix multiplication, 2D systolic array design.

Fast Convolution

Cook-Toom algorithm, Winograd algorithm, Iterated convolution, Cyclic convolution.

Textbooks

3. Parhi, K. K. (2007). *VLSI Digital Signal Processing Systems: Design and Implementation*. John Wiley & Sons.

Reference books

3. Kung, S. Y., Kailath, T., & Whitehouse, H. J. (1984). *VLSI and Modern Signal Processing*. Prentice Hall Professional Technical Reference.
4. Ismail, M., & Fiez, T. (1994). *Analog VLSI: Signal and Information Processing* (Vol. 166). New York: McGraw-Hill.

SEMICONDUCTOR OPTOELECTRONICS

Course Code: EV30003

Credit: 3

L-T-P: **3-0-0**

Prerequisites: Nil

COURSE OBJECTIVE:

The Semiconductor Optoelectronics course covers principles, design, and applications of semiconductor devices interacting with light. Students study band theory, carrier dynamics, and photon generation, understanding underlying physics. They analyze LEDs, photodetectors, and lasers, learning operational mechanisms and practical applications. Through design projects, they apply knowledge to create tailored optoelectronic systems, considering performance metrics like efficiency and reliability. Problem-solving exercises bridge theory with real-world scenarios. Critically evaluating research literature enhances analytical skills. By course end, students grasp semiconductor optoelectronics' significance in technology.

COURSE OUTCOMES:

After successfully completing the course, the students will be able to

- CO-1** Able to recognize and articulate the fundamental principles underlying semiconductor optoelectronics, including band theory, photon generation, and carrier dynamics
- CO-2** Analyze various semiconductor optoelectronic devices such as light-emitting diodes (LEDs), photodetectors, and lasers, evaluating their operating principles, performance characteristics, and applications
- CO-3** Design semiconductor optoelectronic systems tailored to specific applications
- CO-4** Assess the performance metrics of semiconductor optoelectronic devices and systems, including efficiency, speed, spectral characteristics
- CO-5** Apply theoretical concepts of semiconductor physics and quantum mechanics to solve practical problems in optoelectronics
- CO-6** Critically analyze research literature in semiconductor optoelectronics, identifying trends, evaluating methodologies, and synthesizing findings to advance their understanding of current developments in the field

COURSE DETAILS

Review of Semiconductor Device Physics

Energy bands in solids, the E-k diagram, Density of states, Occupation probability, Fermi level, and quasi-Fermi levels, p-n junctions, Schottky junction, and Ohmic contacts. Semiconductor optoelectronic materials, Bandgap modification, Heterostructures, and Quantum Wells. Interaction of photons with electrons and holes in a semiconductor, Rates of emission and absorption, Condition for amplification by stimulated emission, the laser amplifier.

Semiconductor Photon Sources

Electroluminescence. The LED: Device structure, materials and characteristics. The semiconductor Laser: Basic structure, theory, and device characteristics, direct current modulation, Quantum-well lasers; DFB-, DBR- and vertical-cavity surface-emitting lasers (VCSEL), Laser diode arrays, Device packages, and handling.

Semiconductor Optical Amplifiers & Modulators

Semiconductor optical amplifiers (SOA), SOA, characteristics and some applications, quantum-confined Stark Effect and Electro-Absorption Modulators.

Semiconductor Photodetectors

Types of photodetectors, Photoconductors, Single junction under illumination: photon and carrier-loss mechanisms, Noise in photodetection; Photodiodes, PIN diodes, and APDs: structure, materials, characteristics, and device performance. Photo-transistors, solar cells, and CCDs. Optoelectronic integrated circuits - OEICs.

Text book:

1. P. Bhattacharya, Semiconductor Optoelectronic Devices, Prentice Hall of India (1997).
2. J. Singh, Semiconductor Optoelectronics: Physics and Technology, McGraw-Hill Inc. (1995).

Reference book:

1. B. E. A. Saleh and M. C. Teich, Fundamentals of Photonics, John Wiley & Sons, Inc., 2nd Ed. (2007),

SYSTEM-ON-CHIP DESIGN

Course Code: EV30004

Credit: 3

L-T-P: 3-0-0

Prerequisites: Nil

COURSE OBJECTIVE:

With technological advances that allow us to integrate complete multi-processor systems on a single die, Systems-on-Chip (SoCs) are at the core of most embedded computing and consumer devices, such as cell phones, media players and automotive, aerospace or medical electronics. This course will provide an understanding of the concepts, issues, and process of designing highly integrated SoCs following systematic hardware/software co-design & co-verification principles.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO1: Analyze the functional and nonfunctional performance of the system early in the design process to support design decisions.

CO2: Analyze hardware/software tradeoffs, algorithms, and architectures to optimize the system based on requirements and implementation constraints.

CO3: Understand hardware, software, and interface synthesis and issues in interface design.

CO4: Use co-simulation to validate system functionality.

CO5: Describe examples of applications and systems developed using a co-design approach.

CO6: Appreciate issues in system-on-chip design associated with co-design, such as intellectual property, reuse, and verification.

1. Introduction to SOC

- a. Architecture of the present-day SoC
- b. - Design issues of SoC- Hardwar-Software Codesign – Core Libraries – EDA Tools

2. DESIGN METHODOLOGY FOR LOGIC CORES

- a. SoC Design Flow – guidelines for design reuse
- b. Design process for soft and firm cores – Design process for hard cores – System Integration

3. DESIGN METHODOLOGY FOR MEMORY AND ANALOG CORES

- a. Embedded memories
- b. – design methodology for embedded memories
- c. Specification of analog circuits – High speed circuits

4. DESIGN VALIDATION

- a.Core-Level validation –
- b.Core Interface verification - SoC design validation

5. STA and CTS

- a. STA-critical path, set up and hold time violations
- b. Clock tree synthesis

6. CORE AND SoC DESIGN EXAMPLES

- a. Microprocessor Cores – Core Integration
- b. On-chip bus – Examples of SoC

Textbook:

1. Rochit Rajsuman, 'System-on-a-Chip: Design and Test', Artech House, 2000

SEMICONDUCTOR MATERIALS SYNTHESIS AND CHARACTERIZATION

Course Code: EV30005

Credit: 3

L-T-P: 3-0-0

Prerequisites: Nil

COURSE OBJECTIVE:

The Semiconductor Material Synthesis and Characterization course explores methods for creating and analyzing semiconductor materials crucial to modern technology. Students delve into synthesis techniques such as epitaxy, chemical vapor deposition, and molecular beam epitaxy, learning to control material properties for specific applications. Characterization methods including X-ray diffraction, electron microscopy, and spectroscopy are studied to analyze material structure, composition, and electronic properties. Hands-on laboratory sessions enable students to apply theoretical knowledge in practical settings, synthesizing and characterizing semiconductor materials. By course completion, students develop a deep understanding of semiconductor material synthesis and characterization, vital for advancing technology in fields like electronics, photonics, and renewable energy.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO1 Understand the silicon extraction and purification process
- CO2 Understand Crystallography of Si and various methods of growth
- CO3 Understand key methods of physicochemical and morphological techniques
- CO4 Apply knowledge to characterize materials using different standard methods
- CO5 Analyzing interface instability and convection effect in different growth technique
- CO6 Create production grade semiconductor for IC design

COURSE DETAILS

Introduction to characterization methodologies

Principles of extraction, pyrometallurgical processes, material and heat balance of processes, thermodynamics of processes; introduction to laws, thermodynamic equilibrium, thermochemistry, Ellingham diagram. Process kinetics; introduction to chemical kinetics and rate processes, heterogeneous kinetics, kinetics of liquid-liquid reactions, concepts of reactor design. Structure & properties of molten liquids.

Production of metallurgical grade (MG) Silicon

Carbothermic reduction, principle, operation and practice of sub-merged arc furnace, energy and process calculation, refining & impurities control in molten MG Si. Production of electronic grade (EG) Si: Concept of fluidized bed reactor, Siemens Process.

Crystal Growth technique

Crystal growth processes (Bridgman and its variants, Czochralski), heat and species transfer during non-steady and steady state plane-front growth, interface instability and effect of convection on interface stability

Analysis and Characterization methods

XRD (Bulk and thin film), Microscopy (Optical, SEM, TEM, SPM), UV-Visible spectroscopy, Photoluminescence, Raman spectroscopy

Text Books:

1. Principles of Extractive Metallurgy, Terkel Rosenqvist, McGraw-Hill Book Company, 1973

2. Stoichiometry and Thermodynamics of Metallurgical Processes: Y K Rao, Cambridge University Press, 2009

Reference Books:

1. Handbook of Extractive Metallurgy: Fathi Habashi; Wiley-VCH , 1997
2. Solar-Grade Silicon: Refining and Recycling: L Zhang et al, CRC Press, 2013
3. Scheel and Capper: Crystal Growth Technology: From Fundamentals and Simulation to Large- scale Production, John Wiley & Sons, 2008

VLSI VERIFICATION AND TESTING

Course Code: EV30006

Credit: 3

L-T-P: 3-0-0

Prerequisites: Digital Electronics

COURSE OBJECTIVE

This course offers a thorough understanding of the principles governing the verification process. It equips students with essential skills to build effective Verification code, enabling them to evaluate functional coverage through thorough analysis of verification results. **Additionally, the course explores the foundational principles and challenges of VLSI testing, covering topics like fault models, design for testability, and built-in self-test.**

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Distinguish between the VLSI verification process and the VLSI testing process.

CO 2: Formulate properties of the digital design for the purpose of verification.

CO 3: Apply the assertions and temporal logic for verifying digital design.

CO 4: Utilize the concepts of fault modeling and testing for digital VLSI circuits.

CO 5: Apply design-for-testability and built-in self-test techniques to test complex sequential circuits.

CO 6: Develop verification programs and test approaches for verifying and testing complex digital circuits.

COURSE DETAILS

Introduction to Verification

Verification versus validation, Verification versus simulation, Verification process, Basic test bench functionality, Constrained random stimulus, Randomization, Functional coverage, Test bench components, Layered testbench.

Formal Equivalence Checking

Types of equivalence checking (combinational, sequential and transaction-based), RTL to netlist equivalence, Netlist to netlist equivalence, Assertion-based equivalence checking.

Formal Property Checking

Property definition, Invariants, Safety properties, Liveness properties, Semantics of Linear Temporal Logic, SystemVerilog Linear Temporal Logic operators.

Introduction to Fault Models

Different types of faults (stuck-at, stuck-open, stuck-short, bridging, delay faults), Memory fault models, Fault equivalence, Fault dominance.

Design For Testability

Scan cell designs, Scan architectures, Scan design rules, Scan design flow.

Built-In Self-Test (BIST)

BIST design rules, Test pattern generation, Output response analysis, Logic BIST architecture.

Textbooks

4. Kropf, T. (2013). *Introduction to Formal Hardware Verification*. Springer Science & Business Media.
5. Zwolinski, M. (2009). *Digital System Design with SystemVerilog*. Pearson Education.
6. Wang, L. T., Wu, C. W., & Wen, X. (2006). *VLSI Test Principles and Architectures: Design for Testability*. Elsevier.

Reference books

1. Seligman, E., Schubert, T., & Kumar, M. A. K. (2023). *Formal Verification: An Essential Toolkit for Modern VLSI Design*. Elsevier.
2. Jha, N. K., & Gupta, S. (2003). *Testing of Digital Systems*. Cambridge University Press.

ANALOG IC DESIGN LAB

Course Code: EV39001

Credit: 1

L-T-P: 0-0-2

Prerequisites: Nil

COURSE OBJECTIVE:

Analysis, design and applications of modern analog circuits. Gain the understanding of implementing the design based on given specification. To be able to draw trade-offs among analog design performance parameters.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO1: Analyze VTC characteristics of CMOS Invererter
- CO2: Understand biasing requirements for maintaining the region of operation
- CO3: Design Single stage amplifier with different types of load
- CO4: Design simple and cascode current mirror
- CO5: Design differential amplifier with tail current source
- CO6: Design OP-AMP with different specifications

LIST OF EXPERIMENTS:

1. Analysis of CMOS Inverter VTC characteristics
2. Design of CS stage amplifier with resistive load and diode connected load
3. Design of CS stage amplifier with current source load
4. Design of CS stage amplifier with source degeneration
5. Design of CG and source follower circuit
6. Design of Cascode load amplifier
7. Design of simple and cascode current mirror circuits
8. Design of bandgap references
9. Design of Differential amplifier with tail current source and analysis of common mode and differential mode response
10. Design of single stage,two stage and gain boosted OPAMP design

SOC DESIGN LAB

Course Code: EV39002

Credit: 1
L-T-P: 0-0-2
Prerequisites: Nil

COURSE OBJECTIVE:

Impart the skill of design and analysis of modern day SOC architecture.RTL and system level integration of SOC cores via appropriate bus architecture.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO1: Design basic modules using system C
- CO2: Design UART based serial interface
- CO3: Design dynamic memory allocation scheme
- CO4: Design and program IO interface
- CO5: Integrate different cores through AHB peripheral
- CO6: Design PLL and clock tree for SOC application

LIST OF EXPERIMENTS:

1. Design of leaf module and structural netlist using system C
2. System C abstracted data modeling, Threads and methods
3. Design of glue logic for memory map,
4. Design of event driven UART device
5. RTL design of DMA controller
6. Design of 8-bit GPIO controller
7. Building a System on Chip- Integrating AHB peripherals to ARM using Verilog HDL for Timer, MEMORY and GPIO
8. Synthesis of AHB peripherals on the Spartan FPGA Kits
9. Clock Frequency Multiplier PLL
10. Design of basic inter-core interruptor

SCRIPTING LANGUAGE AND PYTHON LABORATORY

Course Code: EV39003
Credit: 1
L-T-P: 0-0-2
Prerequisites: Nil

COURSE OBJECTIVE

The objective of the Python and TCL Programming Lab for VLSI (Very Large Scale Integration) is to equip participants with essential skills and knowledge required for effective VLSI design automation. This lab aims to provide hands-on experience in utilizing Python and TCL scripting languages for various aspects of VLSI design, including synthesis, simulation, verification, and physical design. Through a combination of theoretical learning and practical exercises, participants will gain proficiency in writing scripts to automate design tasks, analyze circuit behavior, debug errors, and optimize design performance. Furthermore, the lab will emphasize the integration of Python and TCL with industry-standard VLSI design tools, ensuring participants are equipped with practical skills applicable in professional settings. By the end of the lab, participants will have the ability to efficiently leverage Python and TCL programming to streamline VLSI design processes, contributing to enhanced productivity and innovation in the field of semiconductor design and fabrication.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO1: Memorize the data types, operators and string operation in Python and TCL
- CO2: Understand the concept of arrays, list and dictionaries
- CO3: Solve complex problems using different operators and loops

- CO4: Experiment with file operation in Python and TCL
- CO5: Construct Functions, classes and Procedures in Python and TCL
- CO6: Create custom script to automate the design flow in specific CAD tools

LIST OF EXPERIMENTS:

1. Introduction to Python: data types and operators, loops, strings
2. Working with Array , list, tuples, set and dictionaries in Python
3. File operation in Python: Read, write, append.
4. Function and classes in Python
5. Basics of TCL: data types, variables, operators, decisions
6. Working with Loops, arrays, strings and dictionaries in TCL
7. Procedures in TCL, File operation: open, read, write and append in TCL
8. FPGA design flow in VIVADO using TCL
9. Open Ended Experiment-I
10. Open Ended Experiment-II

Text book:

- 1. Martelli, A., Ravenscroft, A., & Ascher, D. (2011). Python Cookbook. O'Reilly Media.
- 2. Welch, B., Glover, D., & Cohen, M. (1990). Practical Programming in Tcl and Tk. Prentice Hall.

VLSI TESTING AND VERIFICATION LAB

Course Code: EV39004

Credit: 1

L-T-P: 0-0-2

Prerequisites: Digital Electronics

COURSE OBJECTIVE

The primary objective of this lab is to equip students with the knowledge and practical skills to ensure that VLSI designs function as intended before being manufactured. The lab will provide a solid foundation for applying verification and testing methodologies used in real-world VLSI design environments.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Design and verify digital circuits using immediate assertions.
- CO 2: Design and verify digital circuits using concurrent assertions.
- CO 3: Formulate and verify the properties of the digital circuits using assertion-based property verification.
- CO 4: Test the presence of stuck-at faults in the combinational logic circuits.
- CO 5: Test the presence of bridging faults in the digital circuits.
- CO 6: Design digital circuits for testability.

LIST OF EXPERIMENTS

1. Write a Verilog code to design a full-adder circuit using basic gates only. Write another Verilog code to design a full-adder circuit using two half-adders and an OR gate. Using immediate assertions, verify whether both the designs are equivalent or non-equivalent.
2. Write a Verilog code to design a D flip-flop. Using concurrent assertions, verify the properties of the flip-flop.
3. Using assertion-based verification, verify whether an FSM consisting of 3 states satisfies all the properties or not. (The FSM and the properties will be given during the lab session).

4. Using assertion-based property verification, verify whether a 4-bit up-down counter satisfies all the properties or not. (The properties will be defined by the students during the lab session).
5. Write a Verilog code to design a full-adder circuit using two half-adders and an OR gate. Inject single stuck-at 0 and stuck-at fault 1 into the design and simulate the effects of the faults into the circuit.
6. Generate test patterns and simulate the effects of the single stuck-at faults into a 3-bit ripple carry adder circuit.
7. Generate test patterns to detect bridging faults into a combinational circuit (to be given during the lab session).
8. Using design-for-testability approach, test a 3-bit serial-in, serial-out (SISO) shift register for detecting stuck-at faults in the circuit.
9. Open Ended Experiment 1.
10. Open Ended Experiment 2.

VLSI SIGNAL PROCESSING LAB

Subject Code: EV39006

Credit: 1

L-T-P: 0-0-2

Prerequisites:

COURSE OBJECTIVE:

This course will enable student to fixed point and floating point operations using FPGA. It also enable students to design different filters architecture using Matlab and their implementation in FPGA.

COURSE OUTCOMES:

After successfully completing the course, the students will be able to

CO1: Implement fixed-point and floating-point operations using MATLAB and HDL.

CO2: Implement DFT and IDFT for signal processing applications in MATLAB and HDL

CO3: Design and implement FIR filter for signal processing application with different frequency in FPGA.

CO4: Design and implement IIR filter for signal processing application with different frequency in FPGA.

CO5: Design and implement LMS adaptive filter for noise cancellation inn FPGA.

CO6: Implement and debug a FIR Filter using hardware-in-loop simulation with FPGA

TENTATIVE EXPERIMENT LIST:

1. Implementation of Fixed-point and floating point arithmetic using Matlab and HDL. (1 class)
2. Design and implementation of 8-poit DFT and IDFT of a sequence using MATLAB and HDL. (2 class)
3. Design and implementation of FIR filter architecture in FPGA. (2 class)
4. Design and implementation of an adaptive filter in FPGA. (2 class)
5. Open ended Experiment (2 class)

HIGH SPEED INTERFACE DESIGN

Course Code: EV40001

Credit: 3

L-T-P: 3-0-0

Prerequisites: Nil

COURSE OBJECTIVE:

Analysis and design of link architectures and circuits for wireline communication systems. Emphasis on design intuition, link budgeting and power/performance trade-offs in implementation of data links in advanced CMOS process. Topics include channel characterization, noise analysis, equalization, transmitter and receiver circuits, signaling schemes, clocking, synchronization and timing recovery circuits.

COURSE OUTCOMES:

After successfully completing the course, the students will be able to

- CO1: Understanding fundamentals of high-speed data link design
- CO2: Apply knowledge to model system architecture using modeling tools
- CO3: Understanding the challenges of designing high-speed wireline circuits
- CO4: Be exposed to several link standards, including USB-Type C, Thunderbolt, PCIe and DDR
- CO5: Construct timing recovery and power and clock distribution network
- CO6: Create dedicated interfacing circuits for high speed data transmission

COURSE DETAILS

SYLLABUS OUTLINE:

1. Introduction to high-speed links
2. Channel characterization
3. Noise and jitter
4. Equalization
5. Signaling schemes
6. Transmitter circuit design
7. Receiver circuit design
8. Different clocking schemes
9. Timing recovery
10. Power and Clock Distribution

INDUSTRIAL WIRING AND CONTROL PANEL DESIGN

Course Code: EE28011

Credit: 1

L-T-P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

This vocational course will provide an overview of electrical occupations, including the training and the employment options available in electrical industry. It is also designed to provide related training in the electrical trade that will give students the proper coursework in installation and designing of control panel.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Realise the purpose and general principles of control components and circuits, CO 2: Install Industrial wiring circuits according to given specification and plan,
- CO 3: Analyze circuit operations on basic motors (3ø induction Motor),
- CO 4: Interpret and install circuits according to rules and regulations of the National Electrical Codebook,
- CO 5: Connect motor controllers for specific applications with emphasis on safety practices and in accordance with National Electrical Code (NEC) requirements, and
- CO 6: Select and size contactors, relays and timing relays and overload relays both physically and schematically and describe their operating principles.

COURSE DETAILS

- Design multiwire circuit for a direct motor starter (DoL) with one operating (forward) direction using QElectrotech software.
- Design multiwire circuit for a direct motor starter (DoL) with two operating (forward & reverse) direction using QElectrotech software.
- Design multiwire circuit for a Star – Delta motor stator with one operating (forward) direction using QElectrotech software.
- Design multiwire circuit for a Star – Delta motor stator with two operating (forward & reverse) direction using QElectrotech software.
- Design & connect for a direct motor starter (DoL) with one operating (forward) direction in modular set up.
- Design & connect for a direct motor starter (DoL) with two operating (forward & reverse) direction in modular setup.
- Design & connect for a Star – Delta motor stator with one operating (forward) direction in modular set up.
- Design & connect for a Star – Delta motor stator with two operating (forward& reverse) direction in modular set up.
- Install & wire for a direct motor starter (DoL) with one operating (forward) direction in Industrial Control Panel.
- Install & wire for a direct motor starter (DoL) with two operating (forward & reverse) direction in Industrial Control Panel.
- Install & wire for a Star – Delta motor stator with one operating (forward) direction in Industrial Control Panel.
- Install & wire for a Star – Delta motor stator with two operating (forward & reverse) direction in Industrial Control Panel.

Reference Books

1. Tarlok Singh, Installation, commissioning and maintenance of electrical equipment.
2. B.P. Patel and M.A. Chaudhari, Industrial Electrical Systems.

INSTALLATION, OPERATION AND MAINTENANCE OF SOLAR POWER SYSTEM

Course Code: EE28013

Credit: 1

L-T-P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

To impart job-oriented training to students and make them well convergent on Installation, operation & maintenance of solar PV system. This vocational course is based on study of solar photovoltaic (PV) cells, modules, and system components; electrical circuits; PV system design and sizing for use on homes, commercial building etc., understanding energy conversion from sunlight to electricity, and working with solar conversion equipment. This Course will give students the book knowledge and hands on experience needed to become entrepreneur / self-employed.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Demonstrate and apply the knowledge of solar electric systems terms and concepts,
- CO 2: Size and design a photo voltaic system,
- CO 3: Mount, ground, position, install, wire and connect a photo voltaic system,
- CO 4: Test voltage generated by photo voltaic system,
- CO 5: Learn different types of solar PV modules and batteries used in solar PV plant, and
- CO 6: Design of solar PV plant based on estimated loads.

COURSE DETAILS

- To demonstrate the I-V and P-V Characteristics of PV module with varying radiation and temperature level.
- To demonstrate the I-V and P-V characteristics of series and parallel combination of PV modules.
- To show the effect of variation in tilt angle on PV module power.
- To demonstrate the effect of shading on module output power.
- To demonstrate the working of diode as bypass diode and blocking diode.
- To draw the charging and discharging characteristics of battery.
- Observe the output waveform of the inverter in auto mode.
- Workout power flow calculations of standalone PV system of AC load with battery.
- Workout power flow calculations of standalone PV system of DC load with battery.
- Find the MPP manually by varying the resistive load across the PV panel.

Reference Books

1. Chetan Singh Solanki, Solar Photo Voltaic Technology and Systems.
2. B.H. Khan, Non-Conventional Energy Resources.
3. P. Sukhatme, Solar Energy - Principles of Thermal Collection and Storage.
4. G.N. Tiwari, Solar Energy: Fundamentals, Design, Modelling and Applications.

DOMESTIC WIRING AND HOME AUTOMATION

Course Code: **EE28015**

Credit: **1**

L-T-P: **0-0-2**

Prerequisite: **Nil**

COURSE OBJECTIVE

This vocational course will provide an overview of electrical occupations, including the training and the employment options available in electrical consultancy. It is also designed to provide related training in the electrical wing that will give students the proper coursework in installation and designing of domestic wiring and home automation. To develop electrical wiring skills in students through systematic training that would enable the students to construct and test various electrical circuits using appropriate electrician tools, wires, protective devices and wiring accessories as per IS standards.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Use appropriate electrician tools, wires, protective devices and wiring accessories,
- CO 2: Rig up wiring diagrams using conduit system of wiring,
- CO 3: Apply IS standards for electrical wiring,
- CO 4: Prepare different types of wiring joints,
- CO 5: Well convergent in drawing electrical wiring circuit, and
- CO 6: Enhancement of knowledge regarding specification and application of different electrical devices.

COURSE DETAILS

- Perform the assembly, wiring and implementation of a single switch (SPST Switch) in circuit.
- Perform the assembly, wiring and implementation of a Double switch (SPST Switch) in circuit.
- Perform the assembly, wiring and implementation of a power socket in circuit.
- Perform the assembly, wiring and implementation of a controlled power socket circuit in housing.
- Perform the assembly, wiring and implementation of a two ways switches (SPDT Switch) in circuit.
- Perform the assembly, wiring and implementation of a impulse relay in circuit.
- Perform the assembly, wiring and implementation of a time switch in circuit
- Perform the assembly, the wiring and the implementation of a timer lighting in circuit.
- Perform the assembly, the wiring and the implementation of a twilight switch in circuit in house or in a shop.
- Perform the assembly, wiring and implementation of a controlled lighting in circuit (time switch, timer, twilight switch).
- Perform the assembly, the wiring and the implementation of a water heater in circuit.
- Perform the assembly, wiring and implementation of a central impulse relay in circuit.
- Study and implementation of Light sensitive switch.
- Perform the assembly, wiring and implementation of a fan in circuit.
- Perform the assembly, wiring and implementation of a distribution panel.
- Home automation using KNX technology.
- Application of Load shedding contactor and programmable time switch.

Reference Books

1. Frederic Marsh, Home Automation - A Smart Home Guide: The Beginner's Manual Including Google Home, Echo Dot and Amazon Alexa. Easy Instructions, Directions and Commands ... and Home Automation Guide Series Book 1, Kindle Edition.
2. James Gerhart, Home Automation and Wiring.

CYBER PHYSICS APPLICATION IN INDUSTRIAL IOT

Course Code: EE28017
Credit: 1
L-T-P: 0-0-2
Prerequisite: Nil

COURSE OBJECTIVE

The students will utilize the principles of Cyber-Physical Systems (CPS) and Internet of Things (IoT) to develop applications, implement IoT applications by selecting appropriate hardware and software platform and also Develop IoT applications using open-source platforms.

COURSE OUTCOMES

After successfully completing the course, the students will be able to CO 1: Basics of cyber physics components,

CO 2: Understanding of sensors and actuators,

CO 3: Layout diagram of open source microcontroller board,

CO 4: Understanding of analog and digital I/O for cyber-physics, CO 5: Understanding of different protocols for IoT connectivity, and CO 6: Basic architecture for IoT enabled Cyber Physics.

COURSE DETAILS

1. CYBER PHYSICAL SYSTEM (THEORY)

- CPS Realworld.
- Design and Validation of CPS.
- Smart city application CPS.
- CPS Hardware Platforms (Process, Sensors and Actuators).

2. Industry 4.0

- IOT Fundamentals and protocols including layers.
- Sensor and Interfacing.

Hands on Practice

- Architecture and pin diagram of Arduino UNO/MEGA and ESP8266
- IDE installation for open source C++ or Python
- Analog and Digital voltage sensing and processing through Firmware.
- Analog and Digital voltage based actuator through Firmware
- Display OLED/Seven segment integration through IDE
- PCB Design Concept and implementation with uC.
- Implementation of UI/UX through RestAPI based Thing speak
- DATA logging and Generating CSV through Rest API
- Writing a Firmware for ESP-8266 or NODEMCU (programming based knowledge)
- IoT based transformer / condition monitoring system

Reference Books

1. Adrian McEwen, Hakim Cassimally, Designing the Internet of Things.
2. Asoke K Talukder and Roopa R Yavagal, Mobile Computing, Tata McGraw Hill, 2010.
3. Tanenbaum, Andrew S, Computer Networks, Pearson Education Pte. Ltd., Delhi, 4th Edition
4. Stallings, William, Data and Computer Communications, Pearson Education Pte. Ltd., Delhi, 6th Edition.
5. F. Adelstein and S.K.S. Gupta, "Fundamentals of Mobile and Pervasive Computing," McGraw Hill, 2009.

INDUSTRIAL CONTROL AND REMOTE MONITORING

Course Code: EE28019

Credit: 1

L-T-P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

To provide hands on experience in developing Industrial Control and remote monitoring by using PLC (Programmable logic Controller), thus by utilizing it in Process control applications.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Know about typical components of a Programmable Logic Controller,

CO 2: Know the concept of Electrical ladder logic and its relationship to PLC instructions, CO 3: Understand the concept of digital electronics and data acquisition,

CO 4: Program PLC logical switching circuits for industrial applications,

CO 5: Choose and utilize Timer, Counter, and other intermediate programming functions, and CO 6: Design and program automated industrial production line.

COURSE DETAILS

1. Programmable logic Controller SYSTEM. (THEORY)

- Introduction to Industrial Automation.
- Introduction to PLC programmable logic controller
- PLCs & related software and its major Components
- Relay logic Hardware Platforms (Switches, Sensors and Actuators).
- Study of Contactors, Timers, Counter and Comparator

2. Human Machine interface

- Introduction to HMI Communication with PLC
- HMI tags and Assignments
- Project on Industrial load sequential feedback control Using PLC HMI

Hands on Practice

- Introduction of PLC SOFTWARE as TIA Portal
- Ladder Programming for Basic gates logics by using SPST Contacts
- Ladder Programming on SPDT
- Latching Concept and related Latching program
- Study of program memory and Programming on Memory Bits
- Study of TIMER BLOCKs and its Programming
- Introduction to COMPARATOR BLOCK and its Programming
- Introduction to COUNTER BLOCK and its Types with Programming
- Project on Industrial Load OFF/ON control Using PLC and HMI
- Introduction to analog Logic in PLC and its Programming

Reference Books

1. Vijay R. Jadhav, Programmable logic Controller, KHANNA PUBLISHERS, 2nd Edition, 2012.
2. R.G Jamkar, Industrial Automation Using PLC, SCADA and DCS, Laxmi Publications Private Limited.
3. PLC and SCADA by Prof Rajesh Mehra and Er. Vikrant Vij Published by University Science Press.
4. John R Hackworth and Frederick D. Hackworth Jr., Programmable logic Controller: Programming methods and Applications, PEARSON Edition: 1st Edition, 2006.

SENSORS AND ACTUATORS

Course Code: EE30012

Credit: 3

L-T-P: 3-0-0

Prerequisite: EE20001

COURSE OBJECTIVE

This course helps the students to have an exposure to sensors and its importance in the real world. Student will be able to understand basics of sensors, actuators and their operating principle and also have knowledge about simulation and characterization of different sensors.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Understand components of sensor and selection criteria.
- CO 2: select suitable sensor for measuring displacement and velocity.
- CO 3: Select suitable sensor for force, weight and pressure measurement.
- CO 4: Select suitable sensor to measure temperature, level and flow.
- CO 5: Know about different actuators and Electrical actuating systems.
- CO 6: Use micro sensor and micro actuators in different applications.

COURSE DETAILS

Introduction

Definition of sensor and transducer, classification, characteristics. Selection criteria of transducers. Smart sensor: Block diagram, features.

Displacement and velocity Measurement

Linear and rotary displacement sensors: Potentiometer, capacitive, inductive, Position measurement: Optical Encoder, proximity sensors.

Velocity measurement: Tachometer types, Stroboscope, Encoder.

Measurement of Force, Weight and Pressure

Force and weight measurement : Strain gauge, load cell. Pressure measurement: Manometer types, Strain gauge, diaphragm gauge, capsule, bellows, bourdon tube, piezoelectric sensor.

Temperature measurement

Temperature scales, Mechanical thermometers: Filled insystems, Metallic expansion, Electrical thermometers: RTD, Thermo-couple, Semiconductor temperature sensors.

Level& Flow measurement

Mechanicalmethods:floatanddisplacer.Electricalmethods:Resistance,inductive, capacitance type.Ultrasonic level gauging. Basic principles of flow measurement. Differential pressure devices: orifice, venturi, flow nozzle, pitot tube, annubar.

Actuators

Definition, types and selection of Actuators; linear; rotary; Logical and Continuous Actuators, Pneumatic actuator- Electro-Pneumatic actuator; cylinder, rotary actuators, Mechanical actuating system: Hydraulic actuator - Control valves; Construction, Characteristics and Types, Selection criteria.

Electrical actuating systems

Solid-state switches, Solenoids, Electric Motors- Principle of operation and its application: D.C motors - AC motors - Single phase & 3 Phase Induction Motor; Synchronous Motor; Stepper motors - Piezoelectric Actuator.

Micro Sensors

Principles and examples, Force and pressure micro sensors, position and speed micro sensors, acceleration micro sensors, chemical sensors, biosensors, temperature micro sensors and flow micro sensors. Simulation and characterization of various sensors using COMSOL Multiphysics.

Micro actuators

Actuation principle, shape memory effects-one way, two way and pseudo elasticity. Types of microactuators: Electrostatic, magnetic, fluidic, inversepiezoeffect.

Textbook

1. S.K.Singh- Industrial instrumentation and control, 3rdEdition,TMH

Reference books

1. Murthy.D.V.S- Transducers and Instrumentation, ,2001,Prentice Hall of India.
2. Patranabis. D- Sensors and transducers, , 2003, PHI.
3. Sergej Fatikow and Ulrich Rembold- Microsystem Technology and Microrobotics, ,1st edition, Springer-Verlag Berlin Heidelberg.
4. Manfred Kohl- Shape memory actuators, first edition, Springer.

SPECIAL MACHINES AND ITS CONTROL

Course Code: EE30022

Credit: 3

L-T-P: 3-0-0

Prerequisite: Nil

COURSE OBJECTIVE

To understand the working of special machines like stepper motor, switched reluctance motor, BLDC motor & PMSM and Linear induction motor with proper design of controller for smart inverter used to control the above special machine.

COURSE OUTCOMES

After successfully completing the course, the students will be able t:

- CO 1: Understand the operation of different special machines.
- CO 2: Select different special machines as part of control system components.
- CO 3: Analysis of Linear induction motor and its control.
- CO 4: Design digital controllers for different machines.
- CO 5: Apply the knowledge of axial and radial flux motor into a way of thinking to solve in real time applications.
- CO6: Design Smart Inverters and Sizing for Grid Connection and Off Grid.

COURSE DETAILS

Stepper Motors

Introduction, Hybrid stepping motor, Construction, Principles of operation, Energization with two phase at a time, essential

conditions for the satisfactory operation of a 2-phase hybrid steper motor, very slow speed synchronous motor for servo control-different configurations for switching the phase windings-control circuits for stepping motors, an open-loop controller for a 2-phase stepping motor.

Linear Induction Motor

Development of a double-sided LIM from rotary type IM- A schematic of LIM drive for electric traction development of one-sided LIM with back iron-field analysis of a DSLIM fundamental assumptions.

Synchronous Motors

Construction- Principle of operation of Permanent Magnet Synchronous Motors – EMF and torque equations – Starting – Rotor configurations –Dynamic model, Synchronous Reluctance Motors: Constructional features–axial and radial flux motors – operating principle – characteristics.

Control of PMSM, BLDC and Switched Reluctance Motor

Bipolar optical sensor based control of Trapezoidal BLDC Motor, Sensorless control of BLDC motor, Torque ripple control of BLDC motor, Unipolar control for SRM, Torque ripple control of SRM.

Smart Inverters

Selection of power conditioning unit (PCU), Sizing of solar inverter for roof top and grid connected projects, Passive and active protection, IEC/IEEE /Grid Compliance of inverters, Grid-Connected Inverters vs. Stand-Alone Inverters.

Textbooks

1. Miller, T. J. E., Brushless Permanent Magnet and Reluctance Motor Drives, Oxford Science Publications, 1989.
2. Kenjo, T., and Sugawara, A., Stepping Motors and their Microprocessor Controls, Oxford Science Publications, 1984.

Reference books

1. Krishnan, R., Electric Motor Drives: Modeling, Analysis, and Control. Prentice Hall, (2001).
2. Krishnan, R., "Permanent Magnet and BLDC Motor Drives", CRC Press, 2009.
3. Chang-liang, X., "Permanent Magnet

ELECTRIC DRIVES AND CONTROL

Course Code: EE30024

Credit: 3

L-T-P: 3-0-0

Prerequisite: Nil

COURSE OBJECTIVE

It aims to familiarize readers with steady-state performance, starting, dynamic and regenerative braking, plugging and reverse direction operation, speed control, sudden and temporary overloads, ambient conditions and mechanical coupling of machines.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1. Learn the need of Electric Drives in the industry.
- CO 2. Understand the various braking methods of electrical drives.
- CO 3. Know the applications of different electric motors.
- CO 4. Analyze the open loop and closed loop control techniques of different drives.
- CO 5. Understand different speed control techniques for various industrial drives.
- CO 6. Analyze the performance of Permanent Magnet Synchronous and Brushless DC motor drives.

COURSE DETAILS

Introduction

Basic elements of an electric drive, Four quadrant operation of an electric drive, Dynamics of motor load combination, Types of loads, Stable operating condition of various motor load combinations, Fundamental load torque equation, Speed and current limit control, Load curve, load equalization, motor selection and rating calculations.

DC Motor Drives

Review of characteristics of DC motors, Modification of characteristics of DC shunt and series motors, Concept of Electric

Braking, Regenerative, Dynamic and Counter current braking of DC motors.

Control of DC motor drives

Open loop speed control, Closed loop Speed control, Closed loop speed and current control, Closed loop Torque control, Hysteresis controller, PI controller.

Solid State Control of DC drive

Chopper and rectifier based DC Separately excited motor and series motor drive control, four quadrant drive using dual converter.

Induction Motor Drives

Review of characteristics of three phase Induction motors, Modification of speed torque characteristics due to variation of stator voltage, Stator frequency and rotor resistance, Electric Braking of Induction Motors: Regenerative Braking, DC Dynamic braking and Plugging, Slip Power recovery.

Speed Control of Induction Motors

Control of IM by three phase AC-AC Voltage controller, PWM Voltage Source Inverter fed induction motor drives, Current source inverter fed induction motor drives, Comparison of VSI and CSI fed drives, slip compensation schemes, closed loop control (V/f control).

Synchronous and Brushless DC Motor Drives

Synchronous motors, cylindrical rotor, salient pole synchronous motor, permanent magnet synchronous motor, synchronous reluctance motor, Transients due to load disturbances, Braking, Permanent magnet AC motor drives, Sinusoidal PMAC motor drives, Brushless DC motor Drives.

Textbooks

1. G.K. Dubey, Fundamentals of Electric Drives, Second Edition, Narosa Publishers, 2007.
2. S. K. Pillai, A First Course On Electrical Drives, New Age International Publishers, 2nd Edition, 2007.

Reference books

1. Bimal K. Bose, Power Electronics and Motor Drives: Advances and Trends, Academic Press, Har/Cdr edition (13 September 2006).
2. N. K. De, P. K. Sen: Electric Drives, PHI Learning Pvt. Ltd., 7th Edition, 2004.
3. Bimal. K. Bose, Modern Power Electronics and AC Drives, PHI Publisher, 1st Edition, 2013.
4. S.A. Nasar, Boldea , Electrical Drives, CRC Press, Second Edition, 2006
5. M. A. El-Sharkawi , Fundamentals of Electrical Drives , Thomson Learning, 1st Edition, 2000.
6. R. Krishnan, Electrical Motor Drives, PHI, 2003

INTRODUCTION TO ELECTRICAL MACHINES

Course Code: EE30038

Credit: 3

L-T-P: 3-0-0

Prerequisite: Nil

COURSE OBJECTIVE

The objective of this course to enable the efficient and effective conversion of one form of energy into another form by using various DC and AC machine.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO1: Know the principle of electromechanical Energy conversion system.

CO2: Understand the principle of operation and characteristics of DC generator.

CO3: Analyze the performance of DC motor through its characteristics

CO4: Analyze the performance of transformer by equivalent circuit

CO5: Know the operation principle, torques and starting of 3 phase induction motor.

CO6: Understand the construction, operating principle and application of Synchronous Machine

COURSE CONTENT

Electromechanical Energy Conversion

Principle, Singly Excited Magnetic System and Doubly Excited Magnetic system, Physical concept of torque production, Electromagnetic torque and Reluctance torque.

DC Machines

DC Generator: EMF equation of dc generator, methods of excitation, armature reaction, interpoles and compensating winding, commutation, characteristics of separately excited and self excited dc generator, losses, condition for maximum efficiency. DC Motor: Working principle, voltage equation, condition for maximum power, characteristics, operating characteristics of dc motor, torque developed, speed control methods.

Transformers

Single Phase Transformer: Working principle, types, EMF equation, Transformer on no load and full load, vector diagram, exact and approximate equivalent circuit, O.C and S.C.test on transformer, Voltage regulation of transformer, losses and efficiency, condition for maximum efficiency, Auto transformer, 3 Phase transformers: connections (Y-Y, Y-Δ, Δ- Δ, Δ-Y).

3 Phase Induction Motor

Types, rotating magnetic field, principle of operation, slip, frequency of rotor current, rotor emf, rotor current, vector diagram and equivalent circuit, expression for torque, conditions for maximum torque, torque slip characteristics, starting torque in squirrel cage and slip ring motors, effect of change in supply voltage on torque, slip and speed , relation between full load torque and maximum torque, Power stages in induction motor, starting methods for 3 phase induction motor.

Synchronous Machine

Alternator: Basic principle, pitch factor, distribution factor, emf equation, alternator on load, voltage regulation: Synchronous impedance method. Synchronous motor: Basic principle.

Textbooks

1. Electrical Machines, Ashfaq Hussain, Dhanpat Rai, Delhi, 2nd Edition, 2008.
2. Electrical Machinery, P. S Bimbhra, 7th Edition, Khanna Publishers, 2008.

Reference Books:

1. Principles of Electrical power systems by J. B. Gupta
2. Text book of Electrical Machine by K R Sidhapura and D B Raval, Vikash, 1st edition, 2013.

POWER ELECTRONIC CIRCUITS

Course Code: EE30047

Credits: 3

L-TP: 3-0-0

Prerequisites: Nil

COURSE OBJECTIVE

It aims to familiarize the switching devices, Power converters and Its applications in various systems for power control.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Understand the working principles of different power electronics devices.
- CO 2: Analyze the concepts of single phase and three phase controlled rectifiers.
- CO 3: Compare different topologies of DC to DC converters.
- CO 4: Realize the control of single phase and three phase Inverters
- CO 5: Know the operation of power factor correction circuit and MLI
- CO 6: Comprehend the concepts of AC to AC converters

COURSE DETAILS

Introduction to Power Electronics

Comparison of power devices operating in the switch mode to those operating in the active region.

Power Electronic Devices

Thyristor characteristics, Turn ON methods, Dynamic Characteristics of thyristors, Two Transistor Model of thyristor, Characteristics and construction of Power MOSFETS, Characteristics and construction of IGBT, SiC based power devices and applications.

AC to DC Converters

Single Phase Converters – Half Wave with R, RL, RLE load and effect of free Wheeling diode, Single Phase half and full controlled full Wave converters with R and RLE Load, 3 Phase half and fully controlled rectifiers, Power factor correction circuit.

DC to DC Converters:

Step up and Step Down choppers, 4 quadrant choppers for control of DC motor, Basic concepts of bi-directional converter, Forward and Flyback converters.

Inverters

Single Phase Half Bridge and Full Bridge Inverters, 3 Phase Inverters, 180° and 120° conduction, Voltage Control of inverters, Concept of multi level inverters, modulation techniques.

AC to AC Converters:

Single phase AC Voltage regulator with R and RL load, Single phase mid-point type cyclo-converter with R-L Load.

Textbooks

1. M. H. Rashid, Power Electronics, Devices, Circuits & Applications Pearson Education, 4thEdition, 2017.
2. Philip T. Krein, Elements of Power Electronics, Oxford University Press, 2nd Edition, 2017.
3. P S Bhimbra, Power Electronics, Khanna Publishers, 7thEdition, 2022.

Reference books

1. N. Mohan, Undeland and Robbins, Power Electronics, Converters, Applications and Design, John Wiley and Sons , 3rd Edition ,2009.
2. P. C Sen, Modern Power Electronics S Chand Publisher, 2013.
3. K.R.Varmah and Chikku Abraham, Power Electronics, Cengage Publications, 2014.
4. M. D. Singh and K.B. Khanchandani, Power Electronics, McGraw - Hill, 2nd edition, 2017.

GIS & GPS APPLICATIONS

Course Code: CE28003

Credit: 1

L-T-P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

The objective of the course is to understand the GIS principles, applications, preparation of study maps, creation of interpolation maps, delineation of watershed, explain the functions of GPS and operation of GPS.

COURSE OUTCOMES

After successfully completing the course, the students will be able to CO 1: Explain the fundamentals of GIS, CO 2: Comprehend the operations of ArcGIS tools and prepare the layout of study area, CO 3: Create interpolation maps,

CO 4: Delineate watershed using ArcGIS,

CO 5: Describe the principles and functions of GPS, and CO 6: Operate GPS in the field for navigation.

COURSE DETAILS

- Overview of Geographic Information System (GIS)
- Familiarization to ArcGIS Interface
- Layout of study area
- Preparation of interpolation map

- Watershed delineation
- Remote sensing satellites
- Basics of Global position system
- Basic operations of GPS Handset
- GPS field surveying and data processing

Reference Books

1. Principles of geographical information systems by P.A. Burrough and R. A. McDonnell, Oxford University Press, UK.
2. Geographic information systems and science by M.F. Goodchild, P.A. Longley, D.J. Maguire and D.W. Rhind, John Wiley & Sons Ltd., England.
3. Global Positioning system: Principles and Applications by Satheesh Gopi, McGraw Hill Education.

CONCEPTS OF DATA STRUCTURES AND ALGORITHMS

Course Code: CS20001

Credit: 3

L-T-P: 3-0-0

Prerequisites: Nil

COURSE OBJECTIVE

The objective is to familiarize students with the Time Complexity and Space Complexity of algorithms. In addition, students will be acquainted with various techniques of sorting and searching, and implementing arrays, stacks, queues, and linked lists. This course also includes complex data structures like tree sand graphs related to real-life problems

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Apply the concepts of data structure and abstract data type (ADT).
- CO 2: Synthesize the algorithm for real-life problems with time and space complexity analysis.
- CO 3: Implement a linked data structure to solve various problems.
- CO 4: Comprehend and apply stacks and Queues for applications such as expression evaluation, etc.
- CO 5: Develop and implement Trees data structure.
- CO 6: Implement and apply standard algorithms for searching and Sorting.

COURSE DETAILS

Introduction

Notations, Abstract Data Type, Algorithms and Types, Time complexity and Space complexity.

Arrays

Arrays, Sparse matrices, Polynomials.

Linked List

Linked Lists, Doubly linked lists, Circularly linked lists, Applications

Stacks and Queues

Stacks, Queues, Circular Queues, Double ended Queues, Applications in evaluation of expressions.

Trees

Tree representation, Binary Trees, Binary search trees, Tree traversal, Height balanced trees, AVLtrees.

Sorting and Searching

Sorting Techniques: Selection, Bubble, Insertion, Merge, Heap, Quick, Radix sort, Linear search, Binary search, Hash table methods.

Textbooks

1. M.Tenenabaum, Augestien, Data Structures using C, 3rd Edition, Pearson Education, 2007.
2. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, 2nd Edition, Addison-Wesley Educational Publishers, 2006.

Reference book

1. Sahni Horowitz,Fundamentals of Data Structure in C, Universities Press, 2nd Ed
2. J.P.Tremblay,P.G.Sorenson, An Introduction to Data Structures with Applications, 2nd Edition,Tata McGrawHill,1981.

OPERATING SYSTEMS

Course Code: CS20002

Credit: 3

L-T-P: 3 0-0

Pre-requisites: Nil

Course Objectives

- To provide knowledge about the services rendered by operating systems
- To explore the various scheduling policies and to provide solutions for critical section and deadlock problems
- To provide a detailed discussion of the various memory management techniques
- To discuss the various file-system design and implementation issues
- To discuss how the protection domains, help to achieve security in a system
- To explore the design and implementation issues of Distributed OS

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Distinguish between different types of modern operating systems, virtual machines
CO 2: Comprehend the techniques used to implement the process manager
CO 3: Comprehend virtual memory abstractions in operating systems
CO 4: Design and develop file system and I/O system
CO 5: Apply various mechanisms in storage management
CO 6: Design and develop OS modules for Distributed Environment

COURSE DETAIL

Introduction

Need for Operating Systems, Computer Systems, OS Operations, Abstract view of OS, Virtualization, Computing Environments, OS Services, OS Structures, System Calls, Building and Booting OS, Process, Threads, Multithreading.

Process Management

Process Scheduling, Process Co-ordination, Synchronization, Semaphores, Monitors, Hardware Synchronization, Deadlocks, Methods for Handling Deadlocks.

Memory Management

Memory Management Strategies, Contiguous and Non-Contiguous allocation, Virtual memory Management, Demand Paging, Page Placement and Replacement Policies.

File Management

File System, Basic concepts, File System design and Implementation, Case Study: Linux File Systems, Mass Storage Structure, Disk Scheduling, Disk Management, I/O Systems, System Protection and Security.

Distributed Systems

Distributed Systems, Distributed operating systems, Distributed file systems, Distributed Synchronization, OS architecture, Case study on LINUX and Windows OS.

Textbook

1. Silberschatz, Galvin, Gagne, "Operating System Concepts", John Wiley and Sons, Tenth Edition, 2018.

Reference books

1. William Stallings, "Operating Systems – Internals and Design Principles", Pearson Publications, Eighth Edition, 2014.
2. Andrew S. Tanenbaum, "Modern Operating Systems", Pearson Publications, Fourth Edition, 2014.
3. Dhananjay M. Dhamdhere, "Operating Systems, A Concept-Based Approach", McGraw Hill Education, Third Edition, 2012.

DATABASE MANAGEMENT SYSTEMS

Course Code: CS20006

Credit: 3

L-T-P: 3-0-0

Prerequisites: Nil

COURSE OBJECTIVE

- To learn data models, conceptualize and depict a database system using ER diagram
- To understand the internal storage structures in a physical DB design
- To know the fundamental concepts of transaction processing techniques
- To understand the concept of Database Design in Normalization techniques
- To know the manipulation of SQL Queries

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Install, configure, and interact with a relational database management system

CO 2: Conceptualize and depict a database system using ER diagram.

CO 3: Master the basics of SQL and construct queries using SQL

CO 4: Design and develop a large database with optimal query processing

CO 5: Develop efficient storage scheme of saving and retrieving Records and Files

CO 6: Design the database with normalization techniques

COURSE DETAILS

Introduction

Purpose of Database System, Views of data, Data Models, Database Languages, Database System Architecture, Components of DBMS, Entity, Relationship model (E-R model), E-R Diagram notation, EER notations, Examples.

Relational Model

Relational Data Model, Concept of relations, Schema-instance distinction, keys, integrity rules, Relational algebra operators, SQL: Data definition, Data manipulation, Aggregate function, Null Values, Nested sub queries, Joined relations.

Database Design

Dependencies and Normal forms, Dependency theory, Functional dependencies, Armstrong's axioms for FD's, Closure of a set of FD's, minimal covers, Definitions of 1NF, 2NF, 3NF and BCNF, 4NF, 5NF, Decomposition and desirable properties of them.

Transaction Management

ACID properties, Serializability and concurrency control, Lock based concurrency control (2PL), Timestamp ordering protocol, Database recovery management.

Implementation Techniques

Overview of Physical Storage Media, Magnetic Disks, RAID, Tertiary storage, Organization of Records in Files, Indexing and Hashing, Ordered Indices, primary, Secondary index structures.

Textbooks

1. Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", Fifth Edition, Tata McGraw Hill, 2006.
2. C. J. Date, A. Kannan, S. Swamynathan, "An Introduction to Database Systems", Eighth Edition, Pearson Education, 2006.

Reference books

1. Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", Fourth Edition, Pearson/Addision Wesley, 2007.
2. Raghu Ramakrishnan, "Database Management Systems", Third Edition, McGraw Hill, 2003.
3. S. K. Singh, "Database Systems Concepts, Design and Applications", First Edition, Pearson Education, 2006.

WEB DESIGN

Course Code: CS28001

Credit: 1

L-T-P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

Web design and programming is a large field, with different types of technologies implemented by different tools. HTML, CSS, and JavaScript are known to be the three pillars of client-side web programming. After finishing this course, a student should be prepared to write nicely formatted, interactive web pages, with no dependencies on server-side technologies.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO1: Understand the basics of web page design,

CO2: Use formatting instructions of HTML,

CO3: Apply the style formats using CSS,

CO4: Write basic scripts using JavaScript,

CO5: Apply DOM in web pages, and

CO6: Create dynamic web pages using HTML and JavaScript.

COURSE DETAILS

HTML Fundamentals

HTML: Structure of a program, various tags and their roles in HTML programs, Lists: ordered, unordered, definition, Table.

More with HTML

Form design, Frames, link and it's types, Images.

CSS Essentials

Style sheets: Inline, Internal, External.

JavaScript Basics

Introduction, characteristics, Variables, Data types, Type casting and conversion Functions. Primitives, operators, Control statements, Array, Function, Function – Parameter Passing and dynamic argument and return statement

More with JavaScript

DOM - browser, window, document, image and form object, Properties and Methods of different objects, Predefined Java Script Object - Array, String and Date Object and their methods, Event handling – Link, Body, Image and events associated with different HTML tags

Textbook

- MASTERING HTML, CSS & Java Script Web Publishing, Laura Lemay, Rafe Colburn and Jennifer Kyrnin, BPB Publications.

Reference Books

- HTML, CSS and JavaScript All in One, Sams Teach Yourself, Julie C. Meloni and Jennifer Kyrnin, Pearson Education.
- HTML 5 Black Book, DT Editorial Services, Dreamtech Press.

DATA STRUCTURES LAB

Course Code: CS29001

Credit: 1

L-T-P 0-0-2

Pre-requisites: Nil

COURSE OBJECTIVE

The fundamental objective of this course is to develop linear and non-linear data structures algorithms for practical application and analyze the algorithm in their time and space complexity.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Apply and implement the learned algorithm for problem-solving.
- CO 2: Develop the program for real-time application of the algorithm.
- CO 3: Design, develop, and implement optimal algorithms using appropriate data structures.
- CO 4: Implementation of priority queue for optimal algorithms.
- CO 5: Implement Binary Tree, Binary Search Tree, and AVL Trees for problem-solving
- CO 6: Analyze the different sorting and searching algorithm for real-time applications.

CLOUD COMPUTING

Course Code: CS30010

Credit: 3

L-T-P: 3-0-0

Prerequisites: CS20002

COURSE OBJECTIVE

- To provide an in-depth and comprehensive knowledge of the deployment models in Cloud Computing
- To understand the enabling technologies needed for establishing cloud environment
- To motivate students to do programming and experiment with the various cloud computing environments
- To shed light on the cloud providers and software platforms
- To introduce about different programming models in cloud computing

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Articulate the main concepts, key technologies, strengths, and limitations of cloud computing and the possible applications for state-of-the-art cloud computing
- CO 2: Compare the various cloud services and cloud platforms
- CO 3: Identify the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, Public cloud, Private cloud, Hybrid cloud
- CO 4: Adopt suitable computing mechanisms for establishing a cloud environment
- CO 5: Examine various cloud applications and issues.
- CO 6: Provide the appropriate cloud computing solutions and recommendations according to the applications used

COURSE DETAILS

Introduction

Evolution: Clustering, Grid computing, Virtualization, Basic concepts, Benefits and Risks, Roles and Boundaries, Characteristics, XaaS based service offerings, Basic Deployment models.

Enabling Technologies

Networks: ISPs, Connection less Packet Switching, Router-based Inter-connectivity, Technical and Business Considerations, Data Center: Standardization and Modularity, Automation, Remote Operation, High Availability, Hardware Virtualization: Hardware Independence, Server Consolidation, Resource Replication, OS and hardware based Virtualization, Web Technology, Multitenant Technology, Service Technology.

Computing Mechanisms

Infrastructure: Logical Network Perimeter, Virtual Server, Storage Device, Usage Monitor, Resource Replication, Specialized: Automated Scaling Listener, Load Balancer, Monitors, Failover System, Hypervisor, Resource Cluster, Multi-Device Broker, State Management Database, Management: Resource, SLA, Billing, Remote Administration, Security.

Cloud Providers & Software Platforms

Globally available public clouds (Microsoft Azure, Amazon Web Services, Google Cloud Platform): Overview and Comparison, Instances, Images, Networking and Security, Storage, Monitoring and Automation, Introduction to Open-source softwares: Eucalyptus, Open Nebula, Open Stack, Apache Cloud Stack.

Programming Models & Advances

Introduction to Map Reduce, Apache Spark, Tensor Flow, Inter cloud: Architecture, Resource Provisioning, Billing, Security, Mobile Cloud Computing: Resource Allocation, Security, Business Aspects, Application, Future Scope, Introduction to Edge and Fog Computing.

Textbook

1. Kai Hwang, Geoffrey C. Fox, and Jack J. Dongarra, "Distributed and Cloud Computing from Parallel Processing to the Internet of Things", Morgan Kaufmann, Elsevier, 2012.

Reference books

1. Barrie Sosinsky, "Cloud Computing Bible", John Wiley & Sons, 2010.
2. Tim Mather, Subra Kumaraswamy, Shahed Latif, "Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance", O'Reilly, 2009.
3. James Turnbull, "The Docker Book: Containerization is the New Virtualization", E-Book, 2015.

COMPUTATIONAL INTELLIGENCE

Course Code: CS30011

Credit: 3

L-T-P: 3-0-0

Prerequisites: Nil

COURSE OBJECTIVE

- To understand the basic concepts and characteristics of soft computing
- To understand and analyse fuzzy rules, fuzzy reasoning and various fuzzy inference systems
- To be able to know derivative free optimization and apply genetic algorithms to optimization problems
- To apply neural networks to various classification problems.
- To know some hybrid models such as adaptive Neuro-fuzzy inference systems

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO1: Identify the basic concepts and characteristics of soft computing and also its associated methodologies.

CO2: Apply various set theoretic operations in fuzzy sets.

CO3: Analyze fuzzy rules, fuzzy reasoning and various fuzzy inference systems.

CO4: Choose derivative free optimization and apply genetic algorithms to optimization problems.

CO5: Assess concepts of artificial neural networks and apply neural networks to various classification problems.

CO6: Analyze some hybrid models such as adaptive neuro-fuzzy inference systems.

COURSE DETAILS

Introduction

Introduction, Soft Computing constituents and Conventional AI, Neuro-Fuzzy and Soft Computing characteristics

Artificial Neural Networks

Introduction to ANN, Perceptrons and MLP, Adaline and Madaline, Back-propagation Multilayer Perceptrons (BPMLP), Radial Basis Function Networks (RBF), Kohonen Self-Organizing Networks, Learning Vector Quantization, Hebbian Learning, Hopfield networks.

Fuzzy Set Theory

Fuzzy sets, Basic Definition and Terminology, Set-theoretic Operations, Member Function Formulation and Parameterization, More on Union, Intersection and Complement, Extension Principle and Fuzzy Relations, Fuzzy If-Then Rules, Fuzzy Reasoning, Fuzzy Inference Systems, Mamdani Fuzzy Models, Sugeno Fuzzy Models, Tsukamoto Fuzzy Models, Adaptive Neuro-Fuzzy Inference Systems(ANFIS), ANFIS Architecture, Hybrid Learning Algorithm

Particle Swarm Optimization

PSO Model, Global Best, Local Best, Velocity Update Equations, Position Update Equations, Velocity Clamping, Inertia Weight, Constriction Coefficients, Synchronous and Asynchronous Updates, Binary PSO.

Differential Evolution

DE as modified GA, generation of population, operators and their implementation.

Ant Colony Optimization

Basic Concepts, Ant System, Application.

Artificial Bee Colony

Historical Development, Types of Bees and Their Role in the Optimization Process.

Textbooks:

1. Jang, Sun, Mizutani, Neuro-Fuzzy and Soft Computing, Pearson Education

Reference Books:

1. Adam Slowik, Swarm Intelligence Algorithms: A Tutorial, Ed: CRC Press, 2020
2. Simon Haykin, Neural Networks: A Comprehensive Foundation, Pearson Education
3. David E. Goldberg, Genetic Algorithms, Pearson Publication, 2003

WEB TECHNOLOGY AND APPLICATIONS

Course Code: CS30019

Credits: 3

L-T-P: 3-0-0

Pre-requisites: Nil

COURSE OBJECTIVES

- To understand the basics of Web Designing using HTML, DHTML, and CSS
- To learn the basics about Client side scripts and Server side scripts

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO1: Describe and interpret standard web technologies

CO2: Apply the basics of Web Designing using HTML, DHTML, and CSS

CO3: Build real world applications using client side and server side scripting languages

CO4: Design and develop applications using web technologies

CO5: Create the database connectivities

CO6: Suggest appropriate web technologies for any application

COURSE DETAILS

HTML, Introduction, HTML Formatting, Hyper-Links, Lists, Tables, Images, Forms, Frames, Cascading Style sheets, Types, XML, Document type definition, XML Schemas, Document Object model.*

Introduction to Client Side scripting, JavaScript, Control statements, Functions, Arrays, Objects, Events, Dynamic HTML with Java Script, AJAX: Ajax Client Server Architecture, XML Http Request Object, Call BackMethods.

NodeJS and Express, Introduction to AngularJS and Fundamentals of ReactJS, Web servers, IIS (XAMPP, LAMPP) and Tomcat Servers, Server Side Scripting, Java Servlets, Java Server Pages, Java Server Faces, JSFComponents, Session Tracking, Cookies.

PHP, Basic Syntax, Defining variable and constant, PHP Data types, Operator and Expression, Operator Precedence, Decisions and Loop, Functions & Recursion, String Processing and Regular Expressions, Form Processing, Working with file and Directories, Cookies

Database Connectivity with MySQL, Servlets, JSP, PHP, MongoDB, NOSQL Database*, Fundamentals of JQuery and Bootstrap

Textbooks:

1. Paul J. Deitel, Harvey M. Deitel, Abbey Deitel, "Internet & World Wide Web How to Program", Fifth Edition, Deitel Series, 2012.
2. Jason Gilmore, "Beginning PHP and MySQL from Novice to Professional", Fourth Edition, Apress Publications, 2010.(Foreign books with available in the publisher site)
3. Brown, Ethan, "Web Development with Node and Express: Leveraging the JavaScript Stack",Second Edition O'ReillyMedia,.
4. Anthony, Accomazzo, Murray Nathaniel, Lerner Ari, "Fullstack React: The Complete Guide to React JS and Friends", Fullstack.io, 2017.(Not available in the publisher site)

Reference books:

1. Robert W. Sebesta, "Programming with World Wide Web", Fourth Edition, Pearson, 2008.
2. David William Barron, "The World of Scripting Languages", Wiley Publications, 2000.
3. Dayley B., "Node.js, MongoDB, and AngularJS Web Development", Addison-Wesley Professional, 2014.
4. Vainikka J., "Full-Stack Web Development using Django REST Framework and React", 2018.

SOFTWARE DEFINED NETWORKING

Course Code: CS30023
Credit: 3
L-T-P: 3-0-0
Prerequisite: CS30003/EC30004

COURSE OBJECTIVES

- Analyze reduced Complexity of Network Operation
- Describe and understand the concepts of minimize Layer and maximize Network Resources
- Evaluate and understand the Faster Time to Revenue for New Applications
- Memorize Data center and its usage
- Illustrate about Big data

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Comprehend Software Defined Networks
CO 2: Analyze reduced Complexity of Network Operation
CO 3: Compare and analyze the advantages of SDN over traditional network
CO 4: Design and implement software defined network
CO 5: Design algorithm for virtualization
CO 6: Design algorithm for big data analytics

COURSE DETAILS

Introduction

Introduction, Control Plane, Data Plane, Distributed Control Planes, IP and MPLS, Creating the IP Underlay, Convergence Time, Load Balancing High Availability, Creating the MPLS Overlay, Replication, Centralized Control Planes, Logical Versus Litera, ATM/LANE, Route Servers, Wire Protocol, FAWG, Config and Extensibility, Architecture, Hybrid Approaches, Ships in the Night, Dual Function Switches.*

Interface

VMWare, Nicira, Mininet, NOX/POX, Trema, Ryu, Big Switch Networks/Floodlight, Layer 3 Centric, L3VPN, Path Computation Element Server, Plexxi Affinity, Cisco OnePK, Management Interface, Network Divide, Modern Programmatic Interfaces, Modern Orchestration.*

Data Center

Multitenant Data Center, Virtualized Multitenant Data Center, SDN Solutions for Data Center Network, VLANs, EVPN, VxLan, NVGRE, Virtualization and Data Plane I/O, Services Engineered Path, Service Locations and Chaining, NEV at ETSI, Non-ETSI NEV Work.*

Topology

Network Topology, Traditional Methods, LLDP, BGP-TE/LS, ALTO, I2RS, Build Code First, The Juniper SDN Framework(s), Open Daylight Controller/Framework, Policy.*

Technology:

Bandwidth Scheduling, Manipulation, Calendaring, Bandwidth Calendaring, Big Data and Application Hyper, Virtualization for Instant CSPF, Expanding Technology, Use Cases for Data Center Overlays, Big Data, Network Function Virtualization, Data Center Orchestration, Puppet, Network Function Virtualization, Optimized Big Data, Firewall as Service, Network Access Control Replacement, Virtual Firewall, Feed Back and Optimization, Intrusion Detection/Threat Mitigation.*

*Programming Assignments are mandatory

Textbooks

1. Thomas D. Nadeau, Ken Gray, "Software Defined Networks", First Edition, O' Reilly Media Inc., 2013.
2. FEI HU, "Network Innovation through Open Flow and SDN: Principles and Design", CRC Press, 2014.

Reference Books

1. Azodolmolky, Siamak, "Software Defined Networking with OpenFlow", Packt Publishing Ltd., 2013.
2. Nadeau, Thomas D., Ken Gray, "SDN: Software Defined Networks: An Authoritative Review of Network Programmability Technologies", O'Reilly Media Inc., 2013.
3. Dillinger, Markus, Kambiz Madani, Nancy Alonistioti, "Software Defined Radio: Architectures, Systems and Functions", John Wiley & Sons, 2005.
4. Goransson, Paul, Chuck Black, Timothy Culver, "Software Defined Networks: A Comprehensive Approach", Morgan Kaufmann, 2016.

COMPUTER VISION AND PATTERN RECOGNITION

Course Code: CS30029

Credit: 3

L-T-P: 3-0-0

Prerequisites: Nil

COURSE OBJECTIVE

The challenge of computer vision is to develop a computer based system with the capabilities of the human eye-brain system. It is therefore primarily concerned with the problem of capturing and making sense of digital images. The field draws heavily on many subjects including digital image processing, artificial intelligence, computer graphics and psychology. The objectives are to develop students' understanding of the basic principles and techniques of image processing, image understanding, and to develop skillsets in the design and implementation of computer vision techniques.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO1: Explain the image formation and camera technologies
- CO2: Perform feature extraction using different image processing techniques.
- CO3: Differentiate between image formats
- CO4: Perform image transformation based on different types of transformation techniques.
- CO5: Design filters to perform image analysis using spatial and frequency domain methods.
- CO6: Design systems to detect and track various objects.

COURSE DETAILS

Digital Image Fundamentals

Elements of visual perception, A simple image model, Sampling and Quantization, Relationship between pixels, image geometry: Translation, Rotation.

Image Analysis

Introduction spatial domain methods, Frequency domain method, Enhancement by point processing : Histogram equalization, Spatial filtering : Mean & Median filter, Sharpening filter, High boost filters, Derivative filters, Enhancement in frequency domain, Homomorphic filtering.

Image Transform Review of mathematical preliminaries

Toepplitz and Circulant matrices, Orthogonal and Unitary matrices, Block matrices and Kronecker products, Separable operators, Introduction to image transforms, Two dimensional orthogonal and Unitary transforms,

Properties of unitary transforms, 2-D DFT, Walsh Transforms, Hadamard transform, Discrete Cosine Transform (DCT), Karhunen-Lauve (K-L) Transform, SVD Transform.

Feature Extraction

Edges Canny, Sobel, Line detectors (Hough Transform), Corners -Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, Feature analysis, Feature vectors, Distance/similarity measures.

Object Representation and Tracking

Object detection, Face detection, Pedestrian detection, Face recognition: Eigenfaces, Active appearance and 3D shape models. Object representation, Motion detection and Tracking, Background Subtraction and Modelling, Optical Flow. Point tracking, Kernel tracking, Introduction to Yolo.

Machine Learning for Computer Vision

Neural Architecture, deep learning use cases, Datasets for Machine perception, Training Pipeline, Building sequential model using Keras and CV2, Transfer learning.

Textbooks

1. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited 2011.
2. Valliappa Lakshmanan, Martin Görner, Ryan Gillard, Practical Machine Learning for Computer Vision, Released July 2021, Publisher(s): O'Reilly Media, Inc., ISBN: 9781098102364
3. D. A. Forsyth, J. Ponce, Computer Vision: A Modern Approach, Pearson Education, 2003.

Reference Books

1. E.R Davis, Computer and Machine Vision Theory, Algorithms, Practicalities, Academic Press, 4th Edition
2. R.C. Gonzalez and R.E. Woods, Digital Image Processing, Addison- Wesley, 1992.
3. Bradski, G., & Kaehler, A. (2008). Learning Open CV: Computer vision with the OpenCV library. " O'Reilly Media, Inc."
4. Hartley, R., & Zisserman, A. (2003). Multiple view geometry in computer vision. Cambridge university press.

AUGMENTED AND VIRTUAL REALITY

Course Code: CS40010

Credits: 3

L-T-P 3-0-0

Prerequisites: CS30015/CS30029

COURSE OBJECTIVE:

- To know basic concepts of virtual reality
- To understand visual computation in computer graphics
- To understand interaction between system and computer
- To know application of VR in Digital Entertainment
- To know basic concepts of augmented reality

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Discuss the fundamentals and I/O components of the augmented and virtual reality system

CO 2: Evaluate different computing architectures for virtual reality

CO 3: Provide opportunity to explore the research issues in Augmented Reality and Virtual Reality (AR & VR)

CO 4: Apply the different modeling concepts to visual virtualization

CO 5: Explore the role of virtual reality in traditional & emerging applications

CO 6: Develop prototypes using the concepts for virtual reality

COURSE DETAILS

Introduction of Virtual Reality

Fundamental Concept and Components of Virtual Reality, Primary Features and Present Development on Virtual Reality, Multiple Models of Input and Output Interface in Virtual Reality: Input, Tracker, Sensor, Digital Glove, Movement Capture, Video-based Input, 3D Menus & 3DScanner, Output, Visual /Auditory / Haptic Devices.

Visual Computation in Virtual Reality

Fundamentals of Computer Graphics, Software and Hardware Technology on Stereoscopic Display, Advanced Techniques in CG: Management of Large Scale Environments & Real Time Rendering.

Interactive Techniques in Virtual Reality

Body Track, Hand Gesture, 3D Manus, Object Grasp.

Development Tools and Frameworks in Virtual Reality: Frameworks of Software Development Tools in VR. X3DStandard; Vega, MultiGen, Virtools.

Application of VR in Digital Entertainment

VR Technology in Film & TV Production, VR Technology in Physical Exercises and Games, Demonstration of Digital Entertainment by VR.

Augmented and Mixed Reality

Taxonomy, Technology and Features of augmented reality, Difference between AR and VR, Challenges with AR, AR systems and Functionality, Augmented reality methods, Visualization techniques for augmented reality, Wireless displays in educational augmented reality applications, Mobile projection interfaces, Marker-less tracking for augmented reality, Enhancing interactivity in AR environments, Evaluating AR systems.

Textbooks

1. Burdea, G. C., P.Coffet., "Virtual Reality Technology", Second Edition, Wiley-IEEE Press, 2003/2006.
2. Alan B. Craig, "Understanding Augmented Reality, Concepts and Applications", Morgan Kaufmann, 2013.

Reference book

1. Alan Craig, William Sherman, Jeffrey Will, "Developing Virtual Reality Applications, Foundations of Effective Design", Morgan Kaufmann, 2009.

CRYPTOGRPHY AND NETWORK SECURITY

Course Code: CS40015

Credit: 3

L-T-P 3-0-0

Prerequisites: EC30004/CS30003

COURSE OBJECTIVE

The main objective of this course is to cover the cryptography algorithms for network security in communication and to introduce students to the areas of cryptography and crypt-analysis attacks and security goals. This course develops the understanding of the algorithms Symmetric and Asymmetric Algorithms and used to protect users online and to understand some of the design choices behind these algorithms.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Analyze different security threats and attacks with reference to ISO/OSI model security.

CO 2: Differentiate between various cryptography, watermarking, steganography methods.

CO 3: Analyze different Symmetric and Asymmetric cryptographic algorithms

CO 4: Differentiate various key distribution and Digital Signature.

CO 5: Analyze the working of various communication security protocols with respect to OSI layer.

CO 6: Analyze different network security systems implementation in Wireless systems.

COURSE DETAILS

Introduction

Cryptography, Watermarking, Steganography, Escrow and Crypt Analysis, ISO/OSI reference model and Security, Security Goals, Security threatening attacks, Security Services, Security Mechanisms.

Symmetric Key Mono-Alphabetic Cryptography

Symmetric key cipher, Traditional Ciphers, Substitution Cipher, Mono-Alphabetic Ciphers, Additive Cipher/ Shift Cipher/ Caesar Cipher, Multiplicative Cipher, Affine Cipher (combination of Additive Multiplicative Cipher).

Symmetric Key Poly-Alphabetic Cryptography

Poly-Alphabetic, Auto-key, Play-fair, Vigenere, Hill Cipher, Rotor Cipher- Enigma Machine

Symmetric Key Transposition Cryptography

Introduction to Traditional Transposition, Key-less Transposition, Keyed Transposition, Combined Two Approach, Double Transposition, Stream/ Block.

Asymmetric Key Cryptography

Introduction to asymmetric key cryptography, Keys, General Idea, Plain- text, Cipher-text, Encryption, Decryption.

RSA Cryptosystem

Rivest-Shamir-Adleman (RSA), RSA Procedure, RSA key generation, RSA Encryption and Decryption, Attacks on RAS, Cryptography key distribution system (KDS).

Network Security

Network Security at Application Layer (PGP and S/MIME), Network Security at Transport Layer (SSL and TSL), Security at Network Layer (IPSec).

Textbooks

1. B A Forouzan and D Mukhopadhyay, Cryptography & Network Security Mc-Graw Hill, India, 2nd Edition, 2010.
2. S V. Kartalopoulos, Security of Information and Communication Network Wiley-IEEE Press., 2009.

Reference books

1. Stavroulakis, Peter, Handbook of Information and Communication Security ; Springer, 2010.
2. Adrian Perrig& Doug Tygar, Secure Broadcast communication in Wired and Wireless Communication. Kluwer Publication, 2002.
3. W Mao,Modern Cryptography: Theory and Practice, Pearson, 1st Edition, 2003.

INDUSTRY 4.0 TECHNOLOGIES

Course Code: EX20001

Credits: 2

L-T-P: 2-0-0

Pre-requisites: Nil

COURSE OBJECTIVES

The current manufacturing industries and businesses are moving from the third industrial revolution of the computers and automation to the fourth where the automation becomes even smarter fueled by data analytic and artificial intelligence. This course is designed to offer learners an introduction to use of Internet and Digital technology for better manufacturing and business. Learners will gain deep insights into how smartness is being harnessed from data and appreciate what needs to be done in order to overcome some of the challenges.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Understand the key components and enablers of Industry 4.0 Technology
- CO 2: Appreciate the smartness in Smart Factories, smart products and smart Services.
- CO 3: Outline Smart Factory technologies and their role in an Industry 4.0 world
- CO 4: Outline IoT technology and scope of implementing IoT in Industries and businesses.
- CO 5: Comprehend distributed cyber-physical and digital manufacturing system
- CO 6: Demonstrate the opportunities, challenges brought about by Industry 4.0 and how organizations and individuals should prepare to reap the benefits

COURSE DETAILS

Introduction

The Fourth Industrial Revolution, Difference between conventional automation and Industry 4.0, Case Studies: Health, Agriculture, Manufacturing

Industry 4.0 and its components

Internet of Things (IoT) & Industrial Internet of Things (IIoT), Internet of Services, Value chains in manufacturing companies, Digital Twins

Digital Manufacturing and Design

Cyber Physical Systems and Next Generation sensors, Collaborative Platform and Product Life-cycle Management, Robotics and Automation

Industrial IoT

Cloud Computing, Big Data Analytic, AI & ML, Virtual and Augmented Reality, Block-chain

Challenges & Opportunities in Industry 4.0

A Digital Strategy alongside Resource Scarcity, Standards and Data security, Financing conditions, availability of skilled workers, Comprehensive broadband infra-structure, Legal framework, Protection of corporate data, liability, Handling personal data.

Textbooks

1. D. Pyo, J. Hwang, and Y. Yoon, *Tech Trends of the 4th Industrial Revolution*, Mercury Learning & Information publisher, 2021.
2. Bruno S. Sergi, Elena G. Popkova, Aleksei V. Bogoviz, and Tatiana N. Litvinova *Understanding Industry 4.0 : AI, the Internet of Things, and the Future of Work*, Pub: Emerald Publishing Limited, 2019

Reference books

1. S. Misra, A. Mukherjee, and A. Roy *Introduction to IoT*. Cambridge University Press, 1st edn. 2021
2. Dac-Nhuong Le, Chung Van Le, Jolanda G. Tromp , Gia Nhu Nguyen, *Emerging Technologies for Health and Medicine: Virtual Reality, Augmented Reality, Artificial Intelligence, Internet of Things, Robotics, Industry 4.0*, John Wiley publisher, 2018
3. Alasdair Gilchrist, *Industry 4.0: The Industrial Internet of Things*, Apress Berkeley publisher, CA 1st ed 2016.

SCIENTIFIC AND TECHNICAL WRITING

Course Code: EX20003

Credit: 3

L-T-P: 3-0-0

Prerequisite: NIL

COURSE OBJECTIVE

Technical documents take many forms depending on their purpose and the audience. A technical document can be a project proposal, minutes of a meeting, an advertisement in a newspaper, or even a research paper. A scientific document is a form of technical document where both the author and the audience are experts. The writing styles and the document density of technical documents depend on the nature of the document. The

objective of this subject is to train the students in the art and science of writing a range of scientific and technical documents.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Realize the need to articulate the purpose of the document, identify its audience, and decide the density of information to be included in scientific and technical documents;
- CO 2: Internalize the art and science of scientific and technical writing;
- CO 3: Make appropriate use of crisp language, illustrations, and symbols.
- CO 4: Distinguish between bad and good writing. (Analyze and Evaluate)
- CO 5: Prepare a variety of scientific and technical documents, including laboratory and project reports; and
- CO 6: Write these documents in an accurate, clear, concise, coherent, appropriate, and readable manner.

COURSE DETAILS

Introduction

Forms and features of creative, technical, scientific, and science writing; Audience types (general and specific experts, technicians, managers, laypersons, and mixed audience); Examples of documents for technical, professional, and scientific communications; Characteristics of effective technical writing: Accuracy, clarity, conciseness, coherence, appropriateness, and readability.

Language Issues

Revisiting English grammar; Punctuation (period, comma, colon, semicolon, question mark, exclamatory mark, apostrophe, quotation marks, hyphen, dash, parentheses, and brackets); Mechanics (capitalization, italics, abbreviations, acronyms); Latin terms used popularly in English texts; Informal and colloquial English; Dangling modifiers, Faulty parallelism, Judicious use of common words and phrases; Active and passive voice; Nominalization; Common English errors; Pitfalls in writing; Adapting texts to issues of gender, race, and ethnicity; and Guarding against Plagiarism.

Paragraphing: Unity of idea, topic sentence, logical and verbal bridges through use of signposts, transitions, and link words; Patterns of development of an idea; and Lists.

Structure of Scientific Documents

Prefatory Materials

Title, Copyright Notice, Declaration and Certificates, Abstract, Keywords, Acknowledgements and Conflict of Interest Statement, Symbols and Abbreviations, and Table of Contents.

Body of Scientific Documents

Introductory Materials—Context, Problem and Current response, Research questions, Hypotheses, and Objectives and Scope; Literature Review—Presentation styles, Citations and Referencing systems, Quoting, paraphrasing, and summarizing; Materials and Methods—Mathematical Materials: Methodology, methods, tools, and techniques; Quantitative, Qualitative, Experimental and Mixed methods; Numbers and Numerals, Engineering and Scientific notations of numbers, Mathematical operators, Equations, Flowcharts, Algorithms, SI units, Significant digits and Order of magnitude, Figures, Tables, and Photographs; Experimental apparatus, Materials, Specifications, Measuring instruments, Procedure, Data analysis; Concluding Materials—Conclusions, Implications, Generalization, Limitations, Scope for further work and Contributions of the work.

End Matters

References, Appendixes, and Supplementary materials.

Structure of Selected Technical Documents

PowerPoint presentation, Abstract of a paper, Laboratory reports, Progress report, Project proposal, Minutes of a meeting, Brochure, and News items.

Textbooks

1. Lecture notes on Scientific and Technical Writing
2. Alred, G. J., C. T. Brusaw, and W. E. Oliu (2008), *Handbook of Technical Writing*, St. Martin's Press, New York, Ninth Edition.
3. Angelika H. Hofmann (2014), *Scientific Writing and Communication, Papers, Proposals, and Presentations*, Oxford: Oxford University Press.
4. Duke Graduate School Scientific Writing Resource (<https://sites.duke.edu/scientificwriting/>).

5. Gerald. J. Alred, Charles. T. Brusaw, and Walter. E. Oliu (2008), *Handbook of Technical Writing*, St. Martin's Press, New York, Ninth Edition.
6. OWL, The Purdue Online Writing Laboratory, <https://owl.english.purdue.edu/owl/>.
7. Perelman, L. C., J. Paradis, and E. Barrett (1998), [The Mayfield Handbook of Technical and Scientific Writing](http://www.mhhe.com/mayfieldpub/tsw/toc.htm), Mayfield Publishing (ed.), Available free at <http://www.mhhe.com/mayfieldpub/tsw/toc.htm>, Mayfield Publishing Company, Inc., 1280 Villa Street, Mountain View, CA 94041, 415.960.3222, <http://www.mayfieldpub.com>, <mailto:hypertext@mayfieldpub.com>
8. Rubens, P. (2001), Science and Technical Writing: A Manual of Style, 2nd Edition, Routledge, New York.

ENGINEERING PROFESSIONAL PRACTICE

Subject Code: EX40003

Credit: 2

L-T-P: 2-0-0

Prerequisite: Nil

COURSE OBJECTIVE

Engineers are expected to perform their tasks responsibly and ethically, following professional standards and guidelines. This subject allows the students to understand the roles and responsibilities of engineers in society, learn professional standards, codes of ethics, issues concerning employment contracts and other legal matters, and skills of working in teams, and to effectively communicate. The subject will be offered jointly by the faculty members of various schools of technology and will be coordinated by the School of Mechanical Engineering.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO1: Know (a) the features of engineering as a profession, (b) the roles and responsibilities of engineers in society, and (c) the skills for working in teams,
- CO2: Realize the use of professional standards, codes of ethics, legal provisions surrounding engineering functions,
- CO3: Apply the above-stated standards, codes, legal provisions, and group communication skills in their decision-making situations,
- CO4: Break down a complex problem into smaller manageable tasks,
- CO5: Compare among alternatives in situations of uncertainty, risk, and ambiguity, and
- CO6: Design engineering solutions to industrial environmental and social problems.

COURSE DETAILS

Engineering and Engineer

Engineering as a discipline and a profession; Attributes and functions of a practicing engineer and Engineer as a problem solver, designer, and change agent.

Selected Functions of Engineering

Designing for safety and reliability; Quality and Productivity management; Dealing with problem complexity, Uncertainty, Risk and Ambiguity; Project management and Managerial functions such as planning, Organizing, Motivating and Controlling; Costing and Accounting.

Professional Aspects of Engineering

Accreditation, Certification and Licensing; Ethical issues: Ethics and morality, Ethical dilemmas, Codes of ethics, Professional conduct, Nature and Role of professional societies, Engineering standards; Legal issues—Legal forms of business organizations, Employment contracts, Trademarks, Copyrights, Trade secrets, Professional liability, Contractual agreements, Environment and Information technology laws and International legal framework such as WTO.

Group Dynamics

Individual cognition; Dynamics of working in teams/groups; Interacting with stakeholders; Dealing with multicultural environments; Team and group communication; and Negotiation and conflict resolution.

Text Book

1. Shrestha, R. K. and Shrestha, S. K. (2020), Text Book of Engineering Professional Practice, 3rd Edition, Heritage Publishers and Distributors Pvt. Ltd.

Reference Books

1. Habash, R. (2019), Professional Practice in Engineering and Computing: Preparing for Future Careers, 1st Edition, Boca Raton: CRC Press.
2. Welsh, S. G. (2012), Engineering Your Future: The Professional Practice of Engineering, 3rd Edition, Wiley.
3. Subramaniam, R. (2017), Professional Ethics, 2nd Edition, Oxford University Press
4. Lectures note on Engineering Professional Practice provide by Concerned faculty members.

ECONOMICS OF DEVELOPMENT

Course Code: HS20120

Credit: 3

L-T-P: 3-0-0

Prerequisite: Nil

COURSE OBJECTIVE

The objective of this course is to provide students with the essential tools and concepts of development economics, to prepare them to understand what makes underdevelopment persist and what helps development succeed. Students will explore diverse dimension and measures of development, as well as the application of microeconomic analysis to issues of development in poor countries, including the study of household decisions and the analysis of institutions and norms influencing development. And To enhance students understanding of the SDGs to create a better- informed citizenry, which will lead to a more sustainable action by all and for all.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Understand key factors and issues in the process of economic development,
- CO 2: Enhance their ability in applying economic models to study development Problems,
- CO 3: Learning the role of the three basic components of ecosystems and environment and underlying causes of their degradation,
- CO 4: Understand the policy scenario and the existing environmental conventions/ regulations/ laws,
- CO 5: Development of sustainable planning for sustainable development of environment, economy and firms,
- CO 6: Select and apply appropriate economic techniques to solve environmental problems and measure the value of environmental goods.

COURSE DETAILS

Economic Growth and Development

Meaning of development and Economic growth, Characteristics of less developed countries. Factors in Economic development, Measuring development and development gap — per capita income, inequality of income and wealth, Gini coefficient, Human Development Index , Physical Quality of Life Index, and other indices of development.

Theories of Economic Growth and Development

Theories of Economic Development: Classical (Smith, Ricardo, Malthus), Marxian – Theory of Social change, immutable laws, Crisis in capitalism, Schumpeter and capitalist development, Rostow's stages of growth. Partial theories of growth and development: Vicious circle of Poverty, Big push, balanced growth, unbalanced growth,

International aspects of Economic Development

International trade as an engine of growth; Static and dynamic gains from trade; Prebisch, Singer and Myrdal theses vs. free trade; Export-led growth; Tariffs and effective protection; WTO and developing countries. External resources; FDI; Aid vs. trade;

Development and Environment

Economy linkage; Environment as a necessity and luxury; Population environment linkage. Allocation problem; Market failure for environmental goods; environment as a public good.

Sustainable Development

Concept and indicators of sustainable development. Common Property Resources, Property right approach to environmental problem-property rights approach, property rights and environmental problems, Externalities and Pigovian tax, Coase theorem, Coase theorem and transaction cost. Prevention, control and abatement of pollution.

Textbooks

1. S.Ghatak, An Introduction to Development Economics, Allen and Unwin, London,2003
2. Kindleberger, C. P. Economic Development, McGraw Hill, New York, 1958
3. Todaro, M. P. Economic Development, Longman, London.

References books

1. Thirwal, A. P. Growth and Development, Macmillan, U. K,2017.
2. Adelman, I. Theories of Economic Growth and Development. Stanford University Press, Stanford, 1966.
2. Chenery, H. and T.N. Srinivasan (Eds) Handbook of Development Economics, Vols 1 & 2 Elsevier, Amsterdam, 2002.
3. Myint, H. Economic Theory and Underdeveloped Countries, Oxford University Press, New York,1971.

INTERNATIONAL ECONOMIC COOPERATION

Course Code: HS20122

Credit: 3

L-T-P: 3-0-0

Prerequisite: Nil

COURSE OBJECTIVE

This course's overarching objective is to equip students with knowledge of both the theoretical concepts and the actual procedures involved in international trade. The specific purpose is to increase the knowledge of importing and exporting essentials and to offer the skills for understanding the international trading process.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Learn theories of international trade,
- CO 2: Understand free trade, protection, and BOP,
- CO 3: Analyse the role of international organisations,
- CO 4: Understand the working of foreign exchange,
- CO 5: Study the EXIM policies, and
- CO 6: Analyse secondary data relating to international trade.

COURSE DETAILS

Theories of International Trade

Classical Theories of International Trade- Mercantilism, Absolute Advantage, Comparative advantage Theory, Gains from international trade; Terms of trade; Theory of Reciprocal Demand; Modern Theories of International Trade-Heckscher-Ohlin theory

Free Trade, Protection and Balance of Payment

Free trade and Protection in developing countries; Forms, Methods and Effects of protection; Introduction of BoP; Structure of BoP; Disequilibrium in BoP; Measures to overcome disequilibrium in BoP., Tariff; Trade creation vs Trade diversion.

International Organizations

International Monetary Fund; World Trade Organisation; Regional Trade Agreements; Trade Blocs.

Foreign Exchange

Foreign Exchange Market; Theories of foreign exchange; Factors affecting exchange rate; Fixed and flexible exchange rate; FERA and FEMA.

EXIM Policies

Recent budgetary policies and Programs relating to inequality; Analysis of Economic Survey data.

Textbooks

1. R. R Paul, *Money Banking and International Trade*, Kalyani Publishers; 12th edition, 2015, ISBN-10 : 932725774X ISBN-13 : 978-9327257748
2. Bo Södersten and Geoffrey Reed, Palgrave Macmillan, International Economics. 1994, ISBN-10 : 0333612167 ISBN-13 : 978-0333612163

Reference books

1. Dominick Salvatore, International Economics: Trade and Finance, Wiley; Eleventh edition, 2017, ISBN-10 : ISBN-13 8126552344 978-8126552344
2. Paul R. Krugman, Maurice Obstfeld, Marc Melitz, *International Trade: Theory and Policy*, 2017, ISBN-10 : 9789332585768 ISBN-13 : 978-9332585768

ORGANIZATIONAL BEHAVIOUR

Course Code: HS20220

Credit: 3

L-T-P: 3-0-0

Prerequisite: NIL

COURSE OBJECTIVE

This course shall guide the students to learn the basic concepts of Organizational Behaviour and its applications in contemporary organizations. Further, it help them to describe how people behave under different conditions and understand why people behave as they do. The students would be in a position to synthesize related information and evaluate options for the most logical and optimal solution such that they would be able to predict and control human behaviour and improve results. Lastly, this course would help the students to understand how individual, groups and structure have impacts on the organizational effectiveness and efficiency.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Know about organization, organizational behaviour, its nature, scope and significance,
- CO 2: Develop their personality as per industry requirement,
- CO 3: Apply motivational techniques to make the employees work with confidence and satisfaction,
- CO 4: Develop different leadership styles to adjust themselves in different organizational situations,
- CO 5: Improve the knowledge of group behaviour and techniques of group decision making, and
- CO 6: Apply the concepts for managing changes in organization as well as the development of an organization's human resources.

COURSE DETAILS

Introduction to Organizational Behaviour

Organizational Behaviour- nature and scope; Need for studying OB; contributing disciplines to OB; evolution of OB; OB approaches and models; OB opportunities and disruptions

Individual Perspective

Introduction to Individual behaviour; Personality- concept, determinants, types and theories/models; Personality and OB; Perception- meaning, perceptual process, factors affecting perception; perception and Its application in OB; Attitude- nature, Components, Formation and Types; Values- concepts, Types and Formation; Attitude, Values and Behaviour

Individual Perspective

Learning- meaning, Determinants, Theories and Principles; Learning and Behaviour; Motivation- nature, importance, process and theories; managerial implication of motivation- job design, quality of work life and employee engagement; organizational citizenship behaviour- meaning, theoretical perspective, determinants and predictors

Group Perspective

Foundation of group behaviour; meaning and characteristics of group; why do people form and join groups; types and groups; stages of group development; group decision making; Team building- meaning and types of team; team building

process; Meaning, sources and types of conflict; conflict management and negotiation strategies; Leadership- meaning and importance; differentiating between leader and manager; leadership styles; leadership theories

Organizational Perspective

Organizational structure- meaning and elements; Organizational culture- meaning, types and functions of culture; creating, sustaining and changing a culture; Organizational change- meaning and need; ; managing resistance to change; Organizational development- meaning, objectives, models and interventions

Textbooks

1. Dr. S.S. Khanka, Organizational behaviour texts and cases Sultan Chand, OB text and cases S.S. Khanka, S chand, 2022
2. Stephen P. Robbins, Timothy A. Judg, Neharika Vohra Organizational Behaviour, Pearson, 18th edition, 2018

Reference books

1. Fiona M. Wilson,Organizational Behaviour and Work Oxford University Press,2014
2. K. Aswathappa ,Organizational Behaviour, , Himalaya Publishing House, 2013

HUMAN RESOURCE MANAGEMENT

Course Code: HS20222

Credit: 3

L-T-P: 3-0-0

Prerequisite: NIL

COURSE OBJECTIVE

This course aims at providing conceptual knowledge on human resource management that will be useful for a manager of an organization. It also understands employer and employee relationship in order to achieve organizational objectives effectively. It starts with hiring and continues till retention. It also focuses on enabling the students to integrate the understanding of various HR concepts along with the domain concept in order to take correct business decisions.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Learn the various functions of management, personal and professional qualities of a manager in order to manage human resource of an organization effectively,
- CO 2: Understand the process of acquiring human resource through effective planning, recruitment and selection process,
- CO 3: Apply different training and development methods for organizational effectiveness,
- CO 4: Analyse the importance of performance appraisal and equitable pay for the growth of both individual and organization,
- CO 5: Inculcate the sense of inter personal relation required in professional front in handling employer-employee relation effectively for achievement of organizational objectives and
- CO 6: Know the technique of managing and being managed by the organization.

COURSE DETAILS

Introduction to HRM

Introduction, scope, Objectives; Managerial and Operational functions of Management; HRM as a source of competitive advantage; Qualities and role of HR managers

Planning and Acquiring Manpower

Human resource planning- Introduction, objectives, need, importance; Factors, Process and barriers of HRP; Job analysis-concept, objective and Process; Meaning, process and sources of recruitment; Factors of effective recruitment; Meaning and process of selection; Competency mapping for selection decision; Induction and socialization; recent trends in recruitment and selection

Developing Manpower

Training- nature, need, objectives, importance; areas of training; training process- identifying training need, designing a training program; methods and techniques of training; evaluating training effectiveness; Role specific and competency based training; career planning and development- meaning, objective and process

Managing Performance and Compensation

Performance appraisal- concept, objectives and importance of performance appraisal; Process of performance appraisal; Methods of performance appraisal; Problems in performance appraisal; Potential Appraisal; Components of compensation; objectives and factors affective Wage and salary administration; methods of wage payment; process of wage determination; Pay band compensation system

Maintaining and Retaining Human Resources

Industrial Relation- concept, objective and approaches: Reasons for poor industrial relation; Measures for improving industrial relation; Industrial Dispute- nature, causes, prevention and settlement; meaning, objectives, importance and conditions for successful collective bargaining; Workers Participation in management- concept, objectives, forms and measures; Discipline and Grievance- Statutory provisions concerning discipline; causes and machinery for redressal of grievances

Textbooks

1. P. Jyoti & D. N. Venkatesh ,Human Resource Management, Oxford Publication.
2. Gary Dessler and Biju Varkkey ,Human Resource Management, , Pearson Education, 2020

Reference books

1. S S Khanka Human Resource Management Text and Cases by, S.Chand and company Limited, 2022
2. K. Aswathappa,Human Resource Management. Mc Graw Hill Education, 2013
3. P. Subba Rao Personnel and Human Resource Management., Himalaya Publishing House, 2022

ENGINEERING ECONOMICS

Course Code: HS30101

Credit: 3

L-T-P: 3-0-0

Prerequisite: Nil

COURSE OBJECTIVE

The objective of Engineering Economics is to aid in decision-making by focusing on the economic implications of technical analysis. It is committed to making operational level decisions and solving problems.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Comprehend the significance of different components of Engineering Economics,
- CO 2: Analyze the basic economic concepts required for engineers and managers,
- CO 3: Develop the problem solving aptitude in the students through practical and case problems,
- CO 4: Decide the feasibility of a particular project by the application of different project evaluation Techniques,
- CO 5: Use the economic tools in the decision making process, and
- CO 6: Survey the current macroeconomic situations in the economy.

COURSE DETAILS

Introduction to Economics and Engineering Economics

Basic concepts of Engineering Economics: Demand Analysis, Supply Analysis, Market Equilibrium. Revenue Analysis. Demand Forecasting- Quantitative Methods, Consumer's Equilibrium.

Production and Cost Analysis

Short Run and Long Run Production Functions, Producer's Equilibrium condition. Cobb-Douglas Production Function.

Cost Concepts: Short Run and Long Run Cost analyses. Break-Even Analysis.

Market: Concepts and Types;Perfect Competition, Monopoly

Time Value of Money

Interest Formulae and their applications with cash flow diagram. Evaluation of Investment Proposals - Present Worth, Future worth and Annual Equivalent Method of comparison

Economic Appraisal Techniques

Net Present Value (NPV), Internal Rate of Return(IRR) ,Cost Benefit analysis.Depreciation calculation; Meaning and Definition, Methods.

Macroeconomic policies

Functions of commercial banks and central bank, Fundamentals of Business cycle, Macroeconomic policies for stabilization.

Textbooks

1. Dominick Salvatore, Siddartha K. Rastogi, Managerial Economics: Principles and Worldwide Applications, Oxford University Press, ISBN 9780199467068, 9th Edition,2020
2. D N Dwivedi, H L Bhatia, & S N Maheswari,Engineering Economics:, Vikas Publishing House, Noida, ISBN:978-93-5674-625-1, 2nd Edition 2023.
3. James Riggs, David D.Bedworth and Sabah U.Randhwara ,Engineering Economics–, 4th Edition, McGraw Hill Education (India) Private Limited, New Delhi, 2016.

Reference book

1. William A. McEachern and Simrit Kaur Micro ECON-A South-Asian Perspective-, Cengage Learning, 2013.
2. Yogesh Maheshwari, Managerial Economics- 3rd Edition, PHI Learning Private Limited,2014.
3. A. Khan, Arshad Noor Siddiquee, Brajesh Kumar,Engineering Economy-Zahid Pearson Publication, 2012.
4. R.Panneer selvam Engineering Economics –, Pub: PHI Learning Private Limited, New Delhi, 9th Edition, 2008.
5. G.S Gupta Managerial Economics, , Tata McGraw Hill Education Private Limited, 2nd Edition, 2011.
6. D.M.Mithani, Managerial Economics – Theory and Applications –Himalaya Publication, New Delhi, 6th Edition, 2009.
7. S.B.Gupta, R7. Monetary Economics-Institutions, Theory and Policy- Publication: S.Chand, 1995.
8. R.D. Gupta R8. Macro – Economics –, Publication: Kalyani Publication, 1994.

MARKET STRUCTURE AND PRICING POLICIES

Course Code: HS30125

Credit: 3

L-T-P: 3-0-0

Prerequisite: Nil

COURSE OBJECTIVE

Develop the ability for getting conceptual clarity about the various types of markets along with their functions and understand the pricing policy operations in the different markets.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Comprehend the significance of different components of market,
- CO 2: Analyze the basic economic concepts required for various types of market and their policies,
- CO 3: Develop the problem solving aptitude through practical and case study problems faced by the economy,
- CO 4: Able to use the economic tools in the decision making process of fixing prices and quantities in different Market,
- CO 5: Differentiate between different markets and the policy measures to regulate it, and
- CO 6: Survey and map the impact of the current micro and macro-economic situations in the economy.

COURSE DETAILS

Cost and Revenue Analysis

Concepts of cost (economic cost, production cost, real cost, opportunity cost, private & social cost), Cost function, Output maximisation and Cost minimisation, Derivation of cost function, Traditional and Modern theories of costs.

Concepts of revenue (total, average, marginal revenue), Relationship between TR, AR and MR.

Market Structures and Perfect Competition

Meaning of market, Characteristics of market, and Types of market.

Perfectly competitive market and Features, Equilibrium of the firm and industry under perfect competition (short run and long run).

Monopoly Market

Meaning, concepts and characteristics of monopoly market. Equilibrium price and output determination under monopoly market in short and long run. Monopoly price discrimination. Degree of monopoly power and its measure. Control and regulation of monopoly power.

Duopoly and Oligopoly Market

Non-collusive oligopoly: Cournot's duopoly and Kinked-Demand Model. Collusive oligopoly: Cartel; Cartels aiming at joint profit maximization and market sharing cartels. Price leadership; low-cost price leadership, dominant firm price leadership and barometric price leadership.

Monopolistic Competition

Meaning, price determination of a firm under monopolistic competition; Chamberlin's group equilibrium; theory of excess capacity; selling costs; difference between perfect competition and monopolistic competition; difference between monopoly and monopolistic competition.

Textbooks:

1. Koutsoyiannis, Modern Microeconomics, St. Martin's Press, New York, 2nd Edition 1979, ISBN 978-0-333-25349-6
2. G. S. Maddala, Ellen M. Miller, Microeconomics: Theory and Applications, , McGraw-Hill Inc., US-Publisher, 1989, 0070394156-ISBN
3. H L Ahuja, Modern Microeconomics: Theory & Applications, S Chand Publishing, 2022, ISBN : 9789355011015,

Reference books:

1. Robert Pindyck, Daniel Rubinfeld, Microeconomics, Eighth Edition, 2017, 9789332585096-ISBN, Pearson Education Publication
2. G. Fransico Stigler, Theory of Price, Prentice Hall of India, New Delhi, 4th Edition 1996.
3. H. Gravelle and R. Rees, Microeconomics, Person Education U.K. 3rd Edition 2007, 2007ISBN: 9788131716557, 8131716554
4. H. R. Varian, Micro Economic Analysis, W W Norton & Company; New York, 3rd edition 2019, ISBN-13 : 978-8130908632

PRAGMATIC INQUIRY

Course Code: HS30127

Credit: 3

L-T-P: 3-0-0

Prerequisite: Nil

COURSE OBJECTIVE

As a foundation for lifelong inquiry, this course introduces students to research techniques and how they are used in both liberal arts, technical and professional courses.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Understand the meaning and importance of research in behavioral science,
- CO 2: Describe in detail different types of research methodologies,
- CO 3: Identify the strengths and weaknesses of the different study designs,
- CO 4: Assess whether research studies are using the most appropriate study design,
- CO 5: Discuss why various approaches may be appropriate/ inappropriate for their work-based research Question, and
- CO 6: Apply the concepts in research related activity.

COURSE DETAILS

Pragmatic Inquiry

Meaning, Characteristics, Need, Type and Approaches.

Research Problem

Meaning, definition, Selection and Framing of problem statement.

Research Design

Meaning, Characteristics, Need, Type, Approaches and Problems of research design.

Sampling Design

Meaning, Characteristics, Need, Type, Approaches and Problems.

Data Collection Method and Analysis

Types of data, Source of data, Methods of data collection, data analysis.

Textbook

1. Deepak Chawla & Neena Sodhi, Research Methodology: Concepts and Cases, Vikas Publishing House,2018, ISBN-10: ISBN-13: ,9325982390 978-9325982390.

Referencebooks

1. C R Kothari and Gaurav Garg, Research Methodology, New Age International Publishers,2019,ISBN-10 9386649225, ISBN-13- 978-9386649225
2. S.K. Mangal, Research Methodology in Behavioural Sciences, Prentice Hall India Learning Private Limited, 2013, ISBN-10 : : 9788120348080, ISBN-138120348080-978
3. Sameer S. Phanse, Research Methodology-Logic, Methods, and Cases,OUP, Sameer S. Phanse,2016 ISBN: 9780199453788

ECONOMIC ANALYSIS OF DECISION RULES

Course Code: HS30129

Credit: 3

L-T-P: 3-0-0

Prerequisite: Nil

COURSE OBJECTIVE

Analyze and understand investment decisions under the conditions of risk and uncertainty. Particular economic models are not the ends, but the means for illustrating the method of applying mathematical techniques to economic theory in general.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Analyze and understand investment decisions under the conditions of risk and uncertainty,
- CO 2: Explain how game theory brings out the strategy used by the oligopoly firms to determine the best possible action to maximize profit-maximizing objective,
- CO 3: Understand functional formulation of the problem and application of linear programming,

- CO 4: Describes different concepts used in analysing the national income and the different methods applied to measure the national income,
- CO 5: Describe and explain the main channels of the monetary transmission mechanism through monetary and fiscal policy, and
- CO 6: Describe managerial decisions through the application of some economic concepts, theories and principles.

COURSE DETAILS

Investment Decisions under Risk and Uncertainty

Concepts of Risk and Uncertainty; Investment Decisions under Risk: The Pay-Off Matrix Method, Risk-Adjusted Discount Rate Method, Certainty-Equivalent Approach, Probability Theory Approach, Decision Tree Method, Simulation, Sensitivity Analysis.

Game Theory and Strategic behaviour of Firms

Basics of Game Theory, Prisoners' Dilemma: The Problem of Oligopoly Firms; Application of Game Theory to Oligopolistic Strategy; Nash Equilibrium: Pure and Mixed Strategy

Optimization: Constrained & Extrema

Free and constrained optimization, Extrema of a function of two variables: graphical analysis, Lagrange method. Utility maximization & Cost minimization.

Linear and Non-Linear Programming for Business Decisions

Conditions for Application of Linear Programming; Concept of Feasible Solution; Assumptions of Linear Programming Application of Linear Programming Technique: Profit Maximization Problem, Formulation of Profit Maximization Problem in Linear Programming Mode; Graphical Method of Solving Linear Programming Problems; Simplex Method: Algebraic Solution, Simplex Tableau Method. Introduction to Non-Linear Programming

Input-Output Analysis

Input-output model, its structure and its derivation. The use of input output model in Economics.

Textbook

1. D. N. Dwivedi, H L Bhatia, S N Maheshwari, VIKAS® PUBLISHING HOUSE PRIVATE LIMITED, 2022

Reference books

1. C. Chiang and K. Wainwright, *Fundamental Methods of Mathematical Economics*, McGraw Hill International Edition, 2017
2. K. Sydsaeter and P. J. Hammond:, *Mathematics for Economic Analysis*, Pearson Educational Asia, 2002

ECONOMICS OF HEALTH AND EDUCATION

Course Code: HS 30131

Credit: 3

L-T-P: 3-0-0

Prerequisite: Nil

COURSE OBJECTIVE

The United Nations member states' adoption of the Millennium Development Goals, which include among other objectives achieving universal primary education, reducing child mortality, enhancing maternal health, and combating diseases, reflects the significance of education and health in enhancing wellbeing. This course offers a microeconomic framework to examine, among other things, individual preference in the demand for health and education, governmental involvement, and elements of inequality and discrimination in both sectors. An outline of India's health and education system is also provided.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Understanding role of health and education in human development,
- CO 2: Analysing microeconomic foundations of health economics,
- CO 3: Assessing the growth of health sector in India,
- CO 4: Appraising the benefits of investment in human capital,
- CO 5: Assessing the growth of education health sector in India, and
- CO 6: Examining the underling discrepancies in both sectors.

COURSE DETAILS

Role of Health and Education in Human Development

Importance of health and education outcomes and their relationship with macroeconomic performance.

Health Economics Market

Demand for health; Uncertainty and health insurance market; Alternative insurance mechanisms; market failure and rationale for public intervention; equity and inequality.

Education: Investment in Human Capital

Rate of return to education: Private and Social; Quality of education; Signaling or human capital; Theories of discrimination; Gender and Caste discrimination in India.

Health and Education Sectors in India: An Overview

Health outcomes; health systems; health financing. Cost effectiveness and cost-benefit analysis; burden of disease. Literacy rates, school participation, school quality measures.

Trend in Health and Education Sector in India

Secondary data analysis pertaining to health and education sector. Trend analysis and forecasting using time series data. Simple growth rate calculations.

Textbook

1. S. K. Mishra, and V. K. Puri, *Indian Economy*, Himalaya Publishing House, 2022, ISBN: 978-93-5596-423-6

Reference books

1. William, Jack, *Principles of Health Economics for Developing Countries*, World Bank Institute Development Studies, 1999.
2. World Development Report, *Investing in Health*, The World Bank, 1993.
3. G.Ronald, Ehrenberg and S.Robert, Smith, *Modern Labor Economics: Theory and Public Policy*, Addison Wesley, 2005.

BUSINESS ETHICS AND CORPORATE GOVERNANCE

Course Code: HS30223

Credit: 3

L-T-P: 3-0-0

Prerequisite: NIL

COURSE OBJECTIVE

This course focuses upon the fundamental principles and standards that should govern the business organizations. The objective of this paper is to make the students aware about the importance of ethics, corporate governance and role of CSR & sustainable development goals in the business to encourage moral practices and sensitivity towards the ethical dimension of managerial problems.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Familiarize the learners with the concept and relevance of Business Ethics in the modern era,
- CO 2: Understand the value of business ethics which will guide them in maintaining firm moral values while taking managerial decision,
- CO 3: Apply the ability to make moral judgments in dilemmatic situations across the work domains,
- CO 4: Analyse the application of management practices by adhering to corporate law and ethics,
- CO 5: Evaluate the scope, opportunity and complexity of Corporate Social responsibility in the global and Indian context, and
- CO 6: Create an opportunity to understand the sustainable development goals in maintaining a balance between the economic, environmental and social needs.

COURSE DETAILS

Business Ethics: Concept, Principles & Theories

Meaning, objective and types of Ethics; Business ethics- concept, need, scope, objectives and importance; factors influencing business ethics; Principles of Business ethics; Relationship between ethics and business ethics; theories of business ethics; Ethical dilemma and ethical decision making

Ethics in Practice across the domain

Ethics in marketing- introduction, ethical dilemma in marketing, unethical marketing practices, measures to stop unethical practices in marketing; Ethics in Finance- introduction, code of ethics in finance, unethical practices in finance or frauds, measures to stop unethical practices in finance; Ethics in HRM- introduction, ethical issues in HRM (job discrimination, sexual harassment, employee privacy, whistle blowing, affirmative action); importance of workplace ethics and employee code of conduct

Corporate Governance

Corporate Governance- concept, objective and need. Role of law in corporate governance; important issues in corporate governance; Corporate governance in India-past, present and Future; Importance and principles of Corporate Governance

Introduction to Corporate Social Responsibility

CSR- Concept, evolution and development; Why CSR; Apprehensions against CSR; Forms and dimensions of CSR; making business corporations socially responsible; CSR in India

Sustainable Development

Introduction, meaning, history, features, objectives of sustainable development; The pillars and principles of sustainable development; SDG and its relevance in business

Textbooks

1. Dr. K. Nirmala, Dr. B.A. Karunakara Reddy & N. Aruna Rani, Business Ethics and Corporate Governance, Himalaya Publication House
2. C.S.V. Murthy, Business Ethics and Corporate Governance, Himalaya Publishing, 2022

Reference books

1. Prabhakaran Paleri, Corporate Social Responsibility (concept, cases and trends Cengage Learning India Pvt. Limited, 2020)
2. Dr. S.S. Khanka, Business Ethics and Corporate Governance, Sultan Chand, 2019
3. C.U. Saraf, Corporate Social Responsibility (CSR), Corporate Governance, Sustainable Development and Corporate Ethics/Business Ethics Himalaya Publishing House 2017

LEADERSHIP AND TEAM EFFECTIVENESS

Course Code: HS30225

Credit: 3

L-T-P: 3-0-0

Prerequisite: NIL

COURSE OBJECTIVE

An effective leader understands the team dynamics, stimulates the morale of the followers and always aims at creating a participative workforce by enhancing team work. This course mainly focuses on individual, group and organization factors associated with leadership. There is a strong connection between emotional intelligence and leadership because the technical skills and knowledge will definitely help the students to fulfil the entry level requirements. Similarly, understanding employee empowerment would assist the students in acquiring the desirable professional skills.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Learn the characteristics and need of an effective leader,
- CO 2: Understand the effectiveness of different leadership styles in different contexts from an instrumental, political and ethical perspective,
- CO 3: Apply leadership theories to the real business scenario,
- CO 4: Analyse group dynamics and importance of team work,
- CO 5: Evaluate the ways to handle emotions and stress and manage work-life flexibility, and
- CO 6: Create organizational environment that is psychologically safe and make the employees feel empowered.

COURSE DETAILS

Leadership: concepts and practices

Meaning, Definition and understanding of leadership; the role and functions of a leader; Differentiation between leadership and management; ; what makes a leader effective; characteristics of an effective leader; leadership in Indian organization

Leadership Perspectives

Trait perspective of leadership (Great man theory and trait theory); Behavioural perspective of leadership (mangerial grid and likert system - four management); Studies on leadership (Hawthorne, IOWA, Michigan and Ohio); Contingency perspective of leadership (fiedler's contency theory, path goal, hersey blanchard situational theory); contemporary perspective to leadership (transformational, transactional, charismatic, servant and Nurturant-task leadership style)

Team effectiveness and Leadership

Characteristics and types of teams; types and functions of group; Group vs team; understanding an effective team; who is a team leader; tuckman's team development stages; team development and team building; team meetings and leadership; team effectiveness leadership model; high-performance teams and leadership;team cohesiveness; common threats to groups

Emotional Intelligence and Leadership

What are emotions; Meaning, type and source of emotions; Concept and competencies of emotional intelligence; Elements of emotional intelligence; importance of EI; EI at workplace; Emotional intelligence and leadership; Significance of EI for leaders; strategies to enhance EQ in our jobs; EQ vs. IQ; developing EQ; obstacles to the development of EQ

Leadership and empowerment

Employee empowerment- concept, need and importance; approaches to empowerment; advantages and disadvantages of empowerment; empowerment skills of a leader; empowering vs. Dis-empowering; leader as a coach (coaching skill); delegation (advantages and levels of delegation, steps and principles of effective delegation); empowering interpersonal skills

Textbook

1. Ranjana Mittal,Leadership Personal effectiveness and Team Building, Vikas Publishing House Pvt Ltd, 2015

Reference book

1. S. Bhargava and Gourav Bhargava,Team Building and Leadership Neelam Himalaya Publishing House, 2015.

UNIVERSAL HUMAN VALUES

Course Code: HS30401

Credits: 3

L-T-P: 3-0-0

Pre-requisites: Nil

COURSE OBJECTIVE

The objective of the course is to develop a holistic perspective based on self-exploration, understand the harmony in the human being, strengthen self-reflection, and develop commitment and courage to act.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Understand the concept of value education and its need,
- CO 2: Apply their knowledge on value education for apt self-assessment,
- CO 3: Comprehend human-human relationship,
- CO 4: Build holistic perception of harmony at all levels of existence,
- CO 5: Develop the sense of natural acceptance of human values, and
- CO 6: Create people friendly and eco-friendly environment.

COURSE DETAILS

Need, Basic Guidelines, Content and Process for Value Education

Purpose and motivation for the course, recapitulation from Universal Human Values-I. Self-Exploration—what is it? - Its content and process; ‘Natural Acceptance’ and Experiential Validation- as the process for self-exploration. Continuous Happiness and Prosperity- A look at basic Human Aspirations. Right understanding, Relationship and Physical Facility- the basic requirements for fulfillment of aspirations of every human being with their correct priority. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario. Method to fulfil the above human aspirations: understanding and living in harmony at various levels. Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking

Understanding Harmony in the Human Being - Harmony in Myself!

Understanding human being as a co-existence of the sentient ‘I’ and the material ‘Body’. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer). Understanding the characteristics and activities of 'I' and harmony in 'I'. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail. Programs to ensure Sanyam and Health. Include practice sessions to discuss the role others have played in making material goods available to

me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease

Understanding Harmony in the Family and Society- Harmony in HumanHuman Relationship

Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfillment to ensure mutual happiness; Trust and Respect as the foundational values of relationship . Understanding the meaning of Trust; Difference between intention and competence . Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family. Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives

Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

Understanding the harmony in the Nature. Interconnectedness and mutual fulfilment among the four orders of naturerecyclability and selfregulation in nature. Understanding Existence as Co-existence of mutually interacting units in allpervasive space. Holistic perception of harmony at all levels of existence. Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

Implications of the above Holistic Understanding of Harmony on Professional Ethics

Natural acceptance of human values. Definitiveness of Ethical Human Conduct. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order. Competence in professional ethics: a) Ability to utilize the professional competence for augmenting universal human order b) Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c) Ability to identify and develop appropriate technologies and management patterns for above production systems. Case studies of typical holistic technologies, management models and production systems. Strategy for transition from the present state to Universal Human Order: a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers b) At the level of society: as mutually enriching institutions and organizations . Sum up. Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. To discuss the conduct as an engineer or scientist etc.

Textbook

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010

Reference books

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. A.N. Tripathi, Human ValuesNew Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. Mohandas Karamchand Gandhi ,The Story of My Experiments with Truth -
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj - PanditSunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

GENDER STUDIES

Course Code: HS30421

Credit: 3

L-T-P: 3-0-0

Prerequisite: Nil

COURSE OBJECTIVE

The objective of this course is to make student understand the concepts of masculinity and femininity as analytical categories via analysing the role of communalism, patriarchy, violence as major hurdles to women's rights globally. Further, this course will enhance their understanding over the current health and education status of women to analyze

impact of government health policy on women. Additionally, it will bring greater understanding over the integration of gender concerns and perspectives in policies and programmes for sustenance of environment at international, national, regional levels.

COURSE OUTCOME

After successfully completing the course, the students will be able to

- CO 1: Familiarise the students with the concepts of sex, gender and sexuality commonly used in gender studies,
- CO 2: Identifying major human rights violations faced by women worldwide,
- CO 3: Learn about women's health movements and government health policies,
- CO 4: Develop an insight into policy perspective issues, and concerns of girl's education in India,
- CO 5: Delineate the characteristics and the issues of environment and the involvement of women in balancing ecosystem, and
- CO 6: Understand on sustainable development, millennium development goal, and other global level development initiatives taken for uplifting women status in society.

COURSE DETAILS

Understanding Basic Concepts in Gender Studies

Concepts: Sex, Gender, Sexuality, Femininities, Masculinities and other sexualities, Patriarchy; WID: Women in Development; WAD: Women and Development; GAD: Gender and Development

Gender and Human Rights Discourse

Women's Rights as Human Rights (FGM, FF, Rape, Honour Killing, IVP, Witch Hunting, Virginity Test, Communalism, Trafficking, Immigration); National Commission for Women and other State Commissions, Ministry and Department of Women and Child.

Gender and Health

Sexual and reproductive health (ICPD, B.P.A. Family planning and Abortion); Impact of violence on women's health; Women's health movement: National and International; National health and population policy; National Family Health Survey (NFHS)

Gender and Education

Women's Education in Free India: Gender Disparity in Enrolment; Constraints of Women's Education: Social, Economic, Cultural, Geographical, other Factors; Important Committees and Commissions on Women's Education: Radhakrishnan Commission (1948), Mudaliar commission (1952), Kothari Commission (1964-1966), Ramamurthy Commission (1991).

Gender and Environment

Role of women in environment conservation; Role of Women in Waste Management; Women's Resistance to Environmental Destruction: Joint Forest Management – CHIPKO Movement – Narmada Bachao Aandolan

Reading Materials

1. Gerda Lerner, Creation of Patriarchy, Oxford University Press, 1985
2. Menon, Nivedita. ed. 2007. Sexualities. Women Unlimited. New Delhi.
3. Gnew, Sneja, A Reader in Feminist Knowledge, Routledge, New York, 1991
4. Marjorie Agosin (ed.), Women, Gender and Human Rights: A Global Perspective, Rawat Publications, 2000
5. Monica Chawla, Gender Justice: women and law in India, Deep and Deep pub., New Delhi, 2006, 2013
6. P D Kaushik, Women's rights; access to justice, Bookwell Publications, New Delhi, 2007
7. Paola Monzini, Sex Traffic, Prostitution, Crime and Exploitation, Zed Pub., 2005
8. Chloe E. Bird, Patricia P. Rieker, Gender and Health, Cambridge University Press, 2008.
9. Jasmine Gideon, Ed., Handbook on Gender and Health (International Handbooks on Gender series), Development Studies, Birkbeck, University of London, UK, 2016.
10. Nelson E, Zimmerman C. Household survey on domestic violence in Cambodia. Ministry of Women's Affairs, Project Against Domestic Violence, Cambodia, 1996.
11. Parker B, McFarlane J, Soeken K. Abuse during pregnancy: effects on maternal complications and birth weight in adult and teenage women. *Obstetrics and gynaecology*, 1994, 84(3):323-328.
12. Madeleine Arnot and Mairtin Mac, An Ghaill, (2006) "Gender and Education" Routledge, New York
13. Aruna Goel, (2004) "Education and Socio-Economic Perspective of Women Development and Empowerment" Deep and Deep Publications, New Delhi
14. Eileen M. Byrne, (1978) "Women and Education" Tevi Stock Publications, Michigan

15. Payal Mago and Isha Gunwal, (2019). Role of Women in Environment Conservation.
16. M.S Swaminathan. (1998). "Gender Dimensions in Biodiversity management". Konark Publisher's Pvt. Ltd, New Delhi.
17. P.K.Rao. (2000). "Sustainable Development – Economics and Policy". Blackwell, New Delhi.
18. Swarup, Hemlata and Rajput, Pam. (2000). "Gender Dimensions of Environmental and Development Debate: The Indian Experience" in Stuart S. Nagel, (ed.) "India's Development and Public Policy". Ashgate, Burlington.

TRIBAL RESOURCE MANAGEMENT

Course Code: HS30423

Credit: 3

L-T-P: 3-0-0

Prerequisite: Nil

COURSE OBJECTIVE

The course intends to impart a comprehensive knowledge about the reality, pertaining to economic alleviation of the poor and downtrodden. It is inter-disciplinary and based on utilization of natural resources employing traditional means of approach, conducive for societal growth and development. This shall hone socioeconomic environmental development for uplifting the condition of tribal population for igniting new ideas in the new economy.

COURSE OUTCOME

After successfully completing the course, the students will be able to

- CO 1: Identify the concept of sustainable natural resource management,
- CO 2: Recognize agribusiness management, its opportunities and risks,
- CO 3: Discuss adequate skills to prepare and implement integrated development plan & projects for the optimal use of tribal renewable resources for the sustainable development of the environment,
- CO 4: Illustrate the nuances of environmental policies and Laws in India and understand the core competencies required for resource mobilization and policy formulation based on the research insight,
- CO 5: Prioritize the role of health and education for the development of tribal community, considering tribal people as resources, and
- CO 6: Develop trainees or volunteers as competent change agent in the field of tribal resource management.

COURSE DETAILS

Natural Resource Management

Introduction to Natural Resources and their management: Natural Resource Management (NRM): Concept, Issue and Approaches; Need for developing extension strategies for NRM; Issues in management of NRM; Problems encountered while advocating strategies for NRM; Monitoring and auditing in Natural Resource Management (NRM); Triple Bottom Line (TBL) and concept of Sustainable Natural Resource Management; NRM of Water, land and forests: Water resources and their management, Overview of irrigation management, Integrated Watershed management and rainwater harvesting, River Basin management; Scope of market mechanism in NRM

Agribusiness Management

Agricultural value chains and their relevance; Managerial Insights: Identifying agribusiness opportunities; Assessing feasibility – technical, commercial and financial and thereby identify feasible opportunities for projects; Analyzing influences of external environment factors and associated risks; Discussions on illustrative agribusiness projects; select models and opportunities of agribusiness opportunities and ventures.

Environmental Resource Management of Tribals

Environment and Development-Theories of optimal use of exhaustible and renewable resources; Sustainable Development - The concept of sustainable development; strong and weak sustainability; Mechanism for environment regulation in India; environmental laws and their implementation; Environmental Policy in India-Policy instruments for controlling water and air pollution and forestry policy; Institution for forest Management- The institutions of joint forest management , social forestry-rationale and benefits

Tribal Health and Education Management

Role of Health and Education in Tribal Development: Importance in poverty alleviation; health and education outcomes and their relationship with macroeconomic performance; Tribal Health in India: An Overview Health outcomes; health systems; health; Evaluation of Health Programs for tribals: Costing, cost-effectiveness and cost benefit analysis; burden of disease; Tribal Education in India: An Overview Literacy rates, school participation, school quality measures

Agro forestry Management

Multiplicity of Agroforestry products and services- ecological and economic and cultural considerations- gender equality-preservation of indigenous knowledge. Socioeconomic benefits of agroforestry; Smallholder livelihood and the role of agroforestry- Food and nutritional security Fulfillment of food, fodder, fuelwood and shelter based needs- income generation vs. subsistence production; Adoption of AF- Determinants of adoption: feasibility, profitability, and acceptability; . Self-efficacy in farmer decision-making - policy aspects.

Text Books

1. Madhusudan Bandi ,Tribals and Community Forest Management , Rawat Publication, 2013
2. Jumyir Basar,Indigenous Knowledge and Resource Management Shipra Publications, 2014
3. Laishram Herojit, Rethinking Resource Management: Sustainability and Indigenous Peoples, A.K. Publications, 2012.

Reference Book

1. G.K. Bera, Tribal India's Traditional Wisdom and Indigenous Resource Management by, Abhjeet Publishers.

INDIAN KNOWLEDGE SYSTEM

Course Code: HS30425

Credit: 3

L-T-P: 3-0-0

Prerequisite: Nil

COURSE OBJECTIVE

The objective of the course is to promote interdisciplinary study on all aspects of the Indian Knowledge System (IKS), preserve and disseminate IKS for further study and societal applications. It will actively help students to engage in spreading the rich heritage of our country and traditional knowledge in the field of Liberal Arts, Literature, Basic Sciences, Engineering and Technology, Economics, mental and physical well being etc.

COURSE OUTCOME

At successfully completing the course, the student will be able to

- CO 1: Understand the concept of Indian traditional knowledge and its importance,
CO 2: Know the need and importance of protecting traditional knowledge,
CO 3: Develop an appreciation among the students for ancient scriptures,
CO 4: Contrast and compare characteristics and important kinds of traditional knowledge,
CO 5: Evaluate social change on traditional knowledge and
CO 6: Create innovative ways of bringing forward ancient knowledge to the forefront.

COURSE DETAILS

Meaning of Traditional Knowledge System

Overview of the Vedas, the Upanishads, the Puranas, and the Itihasas. Main Schools of Darshana/ Philosophy: Astika (Vedanta, Nyaya, Vaisheshika, Sankhya, Mimamsa, Yoga) and Nastika (Buddhist, Jainist, Lokayata). Types of Shastra (Vyakarana, Kavya, Alamkara, Shilpa, Vastu, Natya and Sangita). Types of Kavya (Drishya, Shravya, Chitra). Theory of Rasa: Natyashastra by Bharata (Chapter 6). Applied Traditional Knowledge: Myths, Rituals, Taboos and Superstitions, Folktales, Proverbs. Fundamental Concept of Dharma and Its Role in Various Streams of Indian Knowledge System

Yoga and Spiritualism

Definition and Origin of Yoga. Significance of spirituality in Yoga, Historical development of Yoga; Yogic philosophy: The eight limbs of yoga according to Patanjali, Mind, body & spirit connection in yoga; Relevance of Asana, Pranayama & Dhyana in Yoga: Physical posture for physical, mental and spiritual development, Breathing techniques for energy restoration & consciousness, Meditation for inner stillness and mindfulness, Meditation for spiritual growth & self-discovery; Ethics & Moral Values in Yoga: Exploring the ethical principles Yama and Niyama, Application of yogic principles to daily life for spiritual growth; Yoga & Spirituality in modern life.

Fun with mathematics without calculator

Arithmetic- Quick calculation with 11 and 12, Multiplication with 99999 in seconds, multiplication with numbers near the bases, vertical and cross multiplication, Magic squares and square roots, cubes, fractions, divisions, HCF and LMC in

ancient style. Algebra- Factorising quadratic expressions, One variable linear equation, Simultaneous linear equations. Implementation of Vedic mathematics tools during competitive examinations.

Ancient Indian Science and Technology

Technological development in India: Agriculture (Origin and development, ancient crops, Traditional practices), Water management (Overview, Harappan water management, other case studies, Medieval Water structures), Pottery (Overview, Technical aspects), Silpasastra (Architecture and Construction- An introduction to Silpasastra, Construction Technology), Metallurgy (Copper/Bronze/Zinc, Iron and Steel Technology in India).

Trade and Commerce in Ancient India

Internal, External, Trade routes Indo-Roman contacts and Maritime Trade of South India; Silk and Cotton Textiles, the Principal Maritime Trade Commodities of Ancient India; Trade routes in Ancient India: Silk Route and Spice Route.

Reading Materials

1. Dasgupta, Surendranath. A History of Sanskrit Literature, Motilal Banarsi das
2. Banerji, Suresh Chandra. A Companion to Sanskrit Literature, Motilal Banarsi das
3. Chatterjee, Satischandra. An Introduction to Indian Philosophy, Motilal Banarsi das
4. Sharma, Chandradhar. A Critical Survey of Indian Philosophy, Motilal Banarsi das
5. A Text Book on Yoga and Health by Dr. Sajib Kumar Bhowmik, Sports Publication, 2020.
6. Light on the Yoga Sutras of Patanjali, B.K.S Iyengar, Element, 2005.
7. The Complete Book of Yoga: Karma Yoga, Bhakti Yoga, Raja Yoga, Jnana Yoga by Swami Vivekananda, Fingerprint Publishing, 2019.
8. Singhal, Aditi. How to Become A Human Calculator. ISBN : 9789352836543. S Chand Publishing
9. M. Tyra and K Kundan. Magical Book on Quicker Maths . ASIN : B07X93W2FC. BSC Publishing Co Pvt Ltd.
10. Singh, Balram. Science and Technology in Ancient texts. DK Print World Ltd, 2012. ISSN 9788124606322.
11. Chandra Moti, Trade and Trade Routes in Ancient India. New Delhi: Abhinav Publications, 1977
12. Textiles in Ancient India: From Indus Valley Civilization to Maurya Period. Vishwavidyalaya Prakashan, 1994.
13. Duraiswamy, D. Silk and Cotton Textiles, the Principal Maritime Trade Commodities of Ancient India. ACTA VIA SERICA, Vol. 6, No. 2, Dec. 2021: 91-116, 6(2), 91–116.

PROBABILITY AND STATISTICS

Subject Code: MA21001

Credit: 4

L-T-P: 3-1-0

Prerequisite: Intermediate mathematics

COURSE OBJECTIVE

The objective of this course is to familiarize the students with the foundation of probability and statistics and to use it in solving the problems arises in engineering and real life applications.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Understand basic probability and its applications

CO 2: Study probability distributions and can use it in real life data analysis

CO 3: Have a knowledge on univariate and bivariate distributions and their properties

CO 4: Measure the central tendency and dispersion of a data set to draw conclusion from the data and interpret the data with the appropriate pictorial representation.

CO 5: Have good understanding of the Central Limit Theorem and its applications

CO6: analyze the statistical inference

COURSE DETAILS

Probability and random variables

Basic concepts of sample space, events(with example), Axiom of Probability, Conditional Probability, Bayes' Theorem and its applications. Discrete random variable, probability mass function, cumulative distribution

function and Moment Generating function for discrete random variable, some special distributions like Uniform distribution, Geometric distribution, Binomial distribution, Negative Binomial distribution, Poisson distribution, Hypergeometric distribution, mean and variance. Continuous random variable, density function, cumulative distribution function and Moment Generating function. Uniform distribution, normal distribution, mean, variance, percentile and critical value of normal distribution, normal approximation of the binomial distribution and exponential distribution.

Joint probability and distributions

Joint probability mass function and marginal probability mass function, joint probability density function and marginal probability density function, concept of independent random variable(joint probability), conditional probability mass function and conditional probability density function. Expected value, covariance and correlation for jointly distributed random variable(both continuous and discrete).

Descriptive Statistics

Frequency distribution, pictorial and tabular representation of data, stem and leaf display, dot plots, histogram, box plots and comparative box plots. Basic concepts on mean, median and mode, Skewness, Kurtosis, Correlation, Coefficient of Correlation, rank correlation, Regression Analysis: Least square method.

Inferential statistics

Population, sample, random sample, sampling distribution, distribution of sample mean, central limit theorem, point estimator, point estimation of parameter using method of maximum likelihood estimation, confidence interval, confidence interval for the mean of a normal population with known and unknown variance, confidence interval for the variance of a normal population, hypothesis testing, one sided and two sided alternatives, Tests for mean of the normal distribution with known variance, Tests for mean of the normal distribution with unknown variance, tests for variance of the normal distribution.

Textbooks

1. J. L. Devore, Probability and Statistics for Engineers and Sciences, CENGAGE Learning, 9th Edition.
2. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley, INC, 10th Edition.

Reference Books:

1. S.M. Ross, Introduction to Probability and Statistics for Engineers and Scientists, Elsevier/AP, 6th Edition.
2. J.S. Milton & J.C. Arnold, Introduction to Probability and Statistics, Mc Graw Hill, 4th Edition.
3. H.J. Larson, Introduction to Probability Theory and Statistical Inference, John Wiley & Sons Inc, 3rd Edition.
4. S.C. Gupta & V. K. Kapoor, Fundamental of Mathematical Statistics, S. Chand, 12th Edition.

VECTORS, DIFFERENTIAL EQUATIONS AND COMPLEX ANALYSIS

Subject Code: MA21006

Credit: 4

L-T-P: 3-1-0

Prerequisite: MA11001, MA11002

COURSE OBJECTIVE

The objective of this course is to empower the students to design and solve branch prospective problems by the use of Vector calculus, partial differential equations, Complex variables.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Understand the physical significance of the concepts like divergence, curl and gradient.
- CO 2: Apply vector integration theorems like Gauss divergence, Stokes and Greens theorem in different engineering applications like work done by force, evaluation of flux etc.
- CO 3: Know the basic analytical techniques for solving the classical wave, heat and Laplace equation
- CO 4: Know the concepts of analytic functions, its differentiation and its series representation
- CO 5: Understand the fundamental concepts of contour integration to evaluate complicated real integrals via residue calculus

CO 6: Apply multi steps numerical methods to solve initial and boundary value problems

COURSE DETAILS

Vector Calculus

Brief concepts of vectors, gradient of a scalar field, directional derivatives, divergence and curl of a vector field. Vector line integral, surface integral, Green's theorem, Gauss divergence theorem, Stoke's theorem, engineering applications of above integral theorems like work done by force, flux integration, independence of path etc.

Partial Differential Equations (PDE)

Basic concepts of PDE like order, degree, linear, nonlinear, homogeneous and non-homogeneous PDE. Solution of PDE by Variable Separable method. Classification of PDE and their reduction to normal form. One dimensional Wave equation, D'Alembert and Fourier series solution of 1-D wave equation. Solution of 1-D heat equation by Fourier series method. Solution of 2-D Laplace equation and 2-D heat equations. (steady state) with different types of boundary conditions using Fourier series. Laplace equation in polar co-ordinate and its application to find the electrostatic potential/steady state temperature in a disk with appropriate boundary conditions. Solution of PDE by Laplace Transform.

Complex Analysis

Basic concepts of complex number. Complex functions, derivatives, analytic function, Cauchy Riemann equations, harmonic functions, harmonic conjugate, elementary functions like exponential, trigonometric, hyperbolic, logarithmic functions and general powers. Curves in complex plane and their parametric representation. Line integrals, Cauchy integral theorem, Cauchy integral formula, Derivatives of analytic function. Power series, Taylor's series, Maclaurin's series, Laurent's series, singularities, Residues, Residue Integration, Real Integrals and Cauchy's Principal Value integrals.

Numerical Solution of ODEs

Solution of Linear Difference Equations; IVP (Multi Steps Method): (Predictor-Corrector method) Adams-Bashforth Method, Adam-Moulton Method; BVP: Shooting methods.

Textbooks:

1. Erwin Kreyszig, Advanced Engineering Mathematics by Wiley, INC, 10th Edition.
2. Jain, Iyenger and Jain, Numerical Methods for Scientific and Engineering Computation
New age International (P) Ltd.,6th Edition.

Reference books:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers,36th Edition.
2. B.V. Ramana, Higher Engineering Mathematics TMH, 2017 Edition.
3. H. K. Dass, Advanced Engineering Mathematics S. Chand, 2007 Edition

ADDITIVE MANUFACTURING (3D PRINTING)

Course Code: ME28011

Credit: 1

L-T-P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

Additive Manufacturing (AM) is a modern manufacturing technology also known as 3D printing process, will provide a clear understanding about the process, acceptability and usability in various field. AM technologies classified on the basis material types will be focused with its real-life applications with advantages and disadvantages. Different types of errors associated with AM and CAD technology will be discussed with suitable error minimization processes. Various reverse engineering process will be discussed and practically implemented with its real-life applications.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Understand the concept of additive manufacturing, its benefits and applications in various fields,

- CO 2: Know the various liquid, powder and solid material based technologies in Rapid Prototyping and Rapid Tooling process,
- CO 3: Know the application of AM process in the field of Bioedical,
- CO 4: Design solid models and converting it to 3D printing readable file format required for part fabrication, CO 5: Focus on the various types of errors in the RP parts and errors during CAD file conversion, and
- CO 6: Apply reverse engineering process to generate data for fabrication of RP part.

COURSE DETAILS

Introduction to Additive Manufacturing Technologies

Need & Development of AM systems, AM process chain, Impact of AM and Tooling on Product Development, Benefits, Applications, Digital prototyping, Virtual prototyping.
Model Preparation using Solid Modelling Software.

Classification of Additive Manufacturing Technologies

Classification of AM technologies on the basis of Materials types. Discussion on various AM processes based solid, liquid and semi solid type of materials along with its application, advantages and disadvantages.
Hands on practice for model creation and saving on particular file format.

Data Processing for AM Technologies

Process planning for AM, CAD model preparation, data requirements & geometric modelling techniques: Wire frame, surface and solid modelling data formats.
Hands on practice for the fabrication of Single components and Assembly components.

Rapid Tooling

Classification: Soft tooling, Production tooling, Bridge tooling; direct and indirect, Fabrication processes, Applications, Rapid tooling techniques such as laminated metallic tooling, direct metal laser sintering, vacuum casting.
Hands on practice for the fabrication of pattern and mould preparation.

Reverse Engineering Processes

Introduction to reverse engineering, Integration of reverse engineering with AM technology.
Hands on practice to generate model data in reverse engineering process integrated with AM process

Reference Books

1. Rafiq I Noorani, Rapid Prototyping: Principle and Applications, Wiley & Sons, 2006.
2. Chua C.K., Leong K.F., and Lim C.S., Rapid prototyping: Principles and applications, Yes Dee Publishing Pvt. Ltd, Third Edition, 2010.
3. Frank W. Liou, Rapid Prototyping and Engineering Applications, CRC Press, Special Indian Edition, 2007.
4. R.B. Choudhary, Additive manufacturing, Khanna Publication, 2022.

DIE DEVELOPMENT BY CNC MILLING

Course Code: ME28013

Credit: 1

L-T-P: 0-0-2

Prerequisite: Workshop (ME18001)

COURSE OBJECTIVE

The objective of the course is to provide basic knowledge on various tools and precision instruments used during CNC milling operation. It helps in understanding the usage of various machining cycles to reduce the manufacturing lead time. Moreover, it explains the usage of various standards and programming methods to be followed during CNC machining operation. Finally, the students can develop/generate the programs used to produce the geometries with complex contours using CNC milling machine.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Understand the usage of different tools and precautions to be followed during machining,
CO 2: Know the principle and operation of precision instruments,
CO 3: Understand the technological advancements in NC and aimed to achieve JH pillar,
CO 4: Understanding the programming methods and programming in simulators,
CO 5: Planning for optimized CNC programming by estimating suitable process parameters, and
CO 6: Programming of die contours and executing on CNC milling machine.

COURSE DETAILS

Tools and Safety

List of tools used on Milling Machine to perform various operations. Safety: Introduction to safety equipment and their uses.

Measuring instruments

Vernier caliper, Micrometer, Bevel protractor, Coordinate measuring machine (CMM): Construction, principle graduation and reading, least count.

Introduction to CNC

Introduction to CNC technology, Conventional Vs. CNC machine tool, CNC clamping system. Implementation of JH for CNC.

CNC programming

Introduction to CNC programming, Introduction and demonstration of line programs milling machine using ISO codes into the CNC simulator. Part programming methods, Cutting process parameter selection, Process planning issues and path planning, G & M Codes, Interpolations, Tool compensations.

CNC Programming-Milling

Calculations of parameters like speed feed, depth of cut etc. and set a references for the various operations. Prepare & set CNC Milling operations and dry run on the machine. Execute program and inspect simple geometrical forms / standard parts.

Reference Books

1. Yoram Koren, Computer Control of Manufacturing Systems, Mc Graw Hill Publication.
2. Mikell P. Groover, CAD/CAM.
3. P.C. Sharma, A textbook of Manufacturing Technology-II.
4. R.K. Jain, Engineering Metrology, Khanna Publishers.

CONCEPT CAR MANUFACTURING

Course Code: ME28015
Credit: 1
L-T-P: 0-0-2
Prerequisite: Nil

COURSE OBJECTIVE

Objective of the course is to give the students hands on experience on building a racing car. Students find it very interesting to develop important parts of a racing car and then assemble and take part in various national and international events. In this process they meet the requirement set by the authorities. Therefore the students learn here how to propose a new car body and prove the feasibility by computational analysis of the body and other important parts.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Remember the fundamentals of concept car characteristics,

CO 2: Understand the aerodynamic requirements in racing vehicles,
CO 3: Use the concepts of chassis behaviour of concept car,
CO 4: Illustrate the suspension characteristics of the concept car,
CO 5: Understand the problems faced in drives and braking systems in motor sports, and
CO 6: Build a concept car body.

COURSE DETAILS

Car Development

Constraints And Specifications – Performance, Handling, Structure; Driver Accommodation and Safety.

Tyres

Adjustable Features, Preliminary Design and Analysis; Driver-Vehicle Relationship. Desirable Vehicle Characteristics, Fundamentals of Track and Lap.

Racing Car Aerodynamics

Aerodynamic Force and Moment, Race Car Drag; Spoilers, Dams, Wings - Effectiveness Of Wings In Steady State Cornering.

Chassis Design

Conditions For Traversing a 90° Corner, Effects Of High Speed Braking, Cornering, Combined Braking Cornering; Steady State Cornering, Throttle Behaviour, Steering Wheel Force And Kick Back; Moving CG Position, Roll Centre Position Changing.

Suspension System

Front Suspension- General Design Issues, Camber Effects; SLA Suspension, McPherson Struts; Independent Rear Suspension- Trailing Arm Types, Instant Axis Concept; Suspension Springs- Torsion Springs, Coil Springs.

Textbook

1. Advanced Race Car Chassis Technology HP1562: Winning Chassis Design and Setup for Circle Track and Road Race Cars Bob Bolles, HP Books; Revised, Updated Edition, 2010.

Reference Books

1. William F. Milliken and Douglas L. Milliken, Race car vehicle dynamics, 11th Edition, SAE, 1995.
2. Peter Wright, Formula 1Technology, Sae Intl; 1st Edition, 2001.

DEVELOPMENT OF AUTONOMOUS WHEELED ROBOTS

Course Code: ME28017

Credit: 1

L-T-P: 0-0-2

Prerequisite: Basic Electronics (EC10001)

COURSE OBJECTIVE

Nowadays, robotics is playing a vital role in industry 4.0, and autonomous wheeled robots are being applied to minimize human efforts and to improve the production rate. This course gives fundamental knowledge about wheeled robotics and its different hardware and software components. Moreover, the course discusses kinematics equations, which will be implemented to control the motion of wheeled robots through the actuators. Further, the present course also describes the integration of various sensors and their programming, which will be used to make an autonomous control system for a robot.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Understand the fundamentals of wheeled robotics and its different components,
CO 2: Apply locomotion constraint features to travel the wheeled robots in different surface conditions,
CO 3: Apply various sensors integration on wheeled robots for autonomous navigation,
CO 4: Analyze the kinematics of wheeled robots,

CO 5: Create a robot programming to make an autonomous sensor-actuator control system, and
CO 6: Design of automation solutions using wheeled robots.

COURSE DETAILS

About Locomotion for Wheeled Robot

Key issues for locomotion, wheeled mobile robot's locomotion, Legged wheeled robots.

Wheeled Robots Kinematics

Kinematic models and constraints, Representing robot position, Forward kinematic models, Wheel kinematic constraints, Degree of freedom.

Sensors for Autonomous Wheeled Robots

Various sensors for wheeled robots, Sensor classification, Ultrasonic sensor, Infrared sensor, Vision sensor, Inertial measurement unit (IMU).

Actuators for Autonomous Wheeled Robots

Various actuators for wheeled robots, DC motor, Servo motor, Stepper motor, Motor controller.

Wheeled Robots Programming

Robot programming language features, Computer control and robot software (monitor mode, run mode and editor mode), Arduino microcontroller programming, Raspberry Pi programming, Complete design of an autonomous wheeled robot.

Reference Books

1. R. Siegwart, I.R. Nourbakhsh, D. Scaramuzza, *Introduction to Autonomous Mobile Robots*, MIT Press, 2011
2. S.G. Tzafestas, *Introduction to Mobile Robot Control*, Elsevier Science, 2013.
3. G. Dudek, M. Jenkin, *Computational Principles of Mobile Robotics*, Cambridge University Press, 2010.
4. T. Bräunl, *Embedded Robotics Mobile Robot Design and Applications with Embedded Systems*, Springer Berlin Heidelberg, 2013.
5. U. Nehmzow, *Mobile Robotics: A Practical Introduction*, Springer, London, 2012.

MODELLING OF MICRO-WIND TURBINE BY 3D CAD DESIGN

Course Code: ME28019

Credit: 1

L-T-P: 0-0-2

Prerequisite: Differential Equations and Linear Algebra (MA11001)

COURSE OBJECTIVE

Introduce computer-based solid, parametric, and assembly modeling as a tool for engineering design; enhance critical thinking and design skills. This course introduces the technology and economics of converting wind energy to electricity and other kinds of energy. Both utility scale horizontal axis wind turbines and small-scale horizontal are addressed, as well as the economical and environmental issues associated with wind energy.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Learn about the basic concepts of wind energy conversion system,
- CO 2: Understand the engineering design process and the implementation of different design phases,
- CO 3: Create a 3D solid model with high degree of confidence,
- CO 4: Develop the ability to extract 2D orthographic views from the 3D model for fabrication,
- CO 5: Learn the basics of assembly and associative constraints, and
- CO 6: Understand the importance of standalone, grid-connected, and hybrid operation in renewable energy systems.

COURSE DETAILS

Introduction to Wind Energy, Wind Power, State of the art technology

Introduction to renewable sources, Wind energy, Types of wind turbines, State of the art technology in wind energy.

Design and development of small wind turbines

Small wind technology, blade element momentum theory, design of tail fin, Wind turbine tower structure design stiffness and strength consideration, Aerodynamics of wind turbine rotor blade design, angle of attack, profile.

3D modelling of wind turbine using CAD tools (SOLIDWORKS)

Introduction to 3D modeling, Parametric modeling, feature-based modeling, Design Intent; Solid modeling commands: Sketching, Extrusion, Revolve, fillet, pattern.; Solid Modeling: reference geometry, Sweeps and Lofts;

Assembling of the 3D model of the Wind turbine

Assembly modeling; Top-down and bottom-up, Mates in assembly, exploded view,

Creation of 2D drawings for production/manufacturing processes

Extract 2D orthographic views from the 3D model for fabrication by specifying the proper dimensions, according to industry standards, for parts to be fabricated and to extract section and auxiliary views, Dimensioning standards and conventions. 3D assembly drawing of the wind turbine, exploded view of the tower, 3D drawings of all 3D printed parts.

Simulation of wind turbine using SOLIDWORKS using CAD tools (SOLIDWORKS and ANSYS)

Engineering analysis with SolidWorks, Stress and deflection of the wind turbine tower, Simulation of wind turbine using SolidWorks

Reference Books

1. James F. Manwell, Jon G. McGowan, and Anthony L. Rogers, Wind Energy Explained: Theory, Design, and Application, Wiley, 2010.
2. Gasch, Robert, Twele, Jochen (Eds.), Wind Power Plants: Fundamentals, Design, Construction and Operation, Springer-Verlag Berlin Heidelberg; 2nd Edition, 2012.
3. Open source SOLIDWORKS Tutorial: <https://my.solidworks.com/training/video/40d7a678-3293-4d7b-ba18-2113ff114b2a>.

K-Xplore **(Practice Oriented Open Elective – I)**

The B. Tech. curriculum provides for a 1-Credit practice-oriented Open Elective K-Xplore in Semester V to make our undergraduate engineering programme holistic, multidisciplinary, skill-based, and balanced. This course allows the students to explore the opportunity that the KIIT University offers to them to sharpen their skills in areas which excite them the most.

Offered in a self-learning mode, this subject allows the students to hone their skills in areas they are passionate about which they select from a wide spectrum of subjects in art, literature, technology, community engagement and service, health, and environment and sustainability. In addition, the students develop soft skills that are important for them in their professional life. This course, thus, allows students to explore and grow in areas outside of core academics and provides a channel for complementing the lessons learned in the classroom, offering them the opportunity to apply academic skills in a real-world context and providing a truly well-rounded education.

This course is designed on the basis of the guiding philosophy of student-centered learning where the students define problems, evaluate alternatives, design solutions, and self-learn by performing certain assigned activities with limited guidance from faculty facilitators.

Each student selects an area of his (or her) choice from a specified list of areas. All the students with choice in a particular area are assigned to one or more faculty facilitators. Faculty facilitators assign the activities and tasks necessary for the course to the students and decide the desired mode of skills training. They may decide to make small groups of students of varying group sizes to carry out the assigned activities and tasks. They also make the required facilities available to the students to enable them to carry out the assigned activities and tasks.

The timetable will earmark specific hours for the subject. But the students are expected to use their spare time (including holidays and after-lecture hours on working days) to learn the required skills and use these skills to accomplish the assigned activities and tasks. The students, however, have to meet the faculty supervisors on the specified hours every week to appraise them of their progress, clear their doubts, if any, and chart their future plan.

The Head of KIIT Student Activity Centre (KSAC) will coordinate offering of the course.

COURSE OUTCOMES

At successfully completing the course, the student will be able to

- CO 1 : Develop the needed technical skills in their chosen fields of interest,
- CO 2 : Develop higher levels of self-confidence and soft skills such as communication, writing, discussion and debate, time-management, and leadership skills,
- CO 3 : Apply the learned skills to give shape to their passionate ideas,
- CO 4 : Develop Innovation and entrepreneurial mindset,
- CO 5 : Analyze and judge a problem situation for deploying the learnt knowledge and skills and develop problem solving strategies and
- CO 6 : Build new products and services using the learned knowledge and skills.

ROBOTICS

Subject Code: SA38001

Credit: 1

L_T_P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

To assist students develop the knowledge of robotics and circuitry, build circuits, bots and robots, and participate in different Robotics events such as Robo Wars.

WEB DESIGNING

Subject Code: SA38003

Credit: 1

L_T_P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

To help a student learn and develop front-end and back-end web development skills and create websites.

CIVIL-TECH

Subject Code: SA38005

Credit: 1

L_T_P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

To make a student ready to plan and design selected aspects of real life construction projects with relation to environment, transport & connectivity, water resource engineering & soil exploration and gain pre-, present-, and post- construction experience.

CIRCUIT DESIGN & CONTROL

Subject Code: SA38007

Credit: 1

L_T_P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

To let the students learn the required skills to design and develop electrical circuits and implement controllers for use in robotics, automation, voice recognition, gesture recognition, etc.

INDIAN CLASSICAL, FOLK & BOLLYWOOD DANCE

Subject Code: SA38009

Credit: 1

L_T_P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

To encourage and boost the confidence of the students to choreograph and perform in classical, semi classical / folk and bollywood dance forms.

INDIAN CLASSICAL & WESTERN MUSIC

Subject Code: SA38011

Credit: 1

L_T_P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

To give confidence to the students to participate and perform as a vocalist and/or instrumentalist in different forms of Indian classical and western music.

GRAPHIC DESIGNING & EDITING

Subject Code: SA38013

Credit: 1

L_T_P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

To nurture the students' skills in creative designing, photo and video editing activities, and digital sketching and painting, using Designing & Editing software such as Photoshop, Illustrator and video editing software.

ART & CRAFT

Subject Code: SA38015

Credit: 1

L_T_P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

To endow the students with the skills to do various types of painting such as portrait painting, landscape painting, abstract painting, pencil sketching, and doodling and craft, using various Painting and Sketching tools.

THEATRE & STREET PLAY

Subject Code: SA38017

Credit: 1

L_T_P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

To give students the confidence to perform in Theatres, Nukkad, Mono Acts and skits based on written scripts.

FILM MAKING

Subject Code: SA38019

Credit: 1

L_T_P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

To impart skills for film making in areas such as cinematography, script writing, audio recording, and editing.

DEBATING, PUBLIC SPEAKING & ANCHORING

Subject Code: SA38021

Credit: 1

L_T_P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

To develop the students' skills for performing oratory activities such as extempore speech, debate, poetry reading, open topic speech, public speaking, interviewing, open dialogue, anchoring, and presentation.

CREATIVE WRITING

Subject Code: SA38023

Credit: 1

L_T_P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

To develop the students' skills in creative writing, content writing, article writing, and poem composition.

PHOTOGRAPHY & VIDEOGRAPHY

Subject Code: SA38025

Credit: 1

L_T_P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

To provide the technical knowledge required to create photos and videos that tell a story or capture a real-world occurrence.

FASHION STYLING

Subject Code: SA38027

Credit: 1

L_T_P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

To impart the basic skills of costume design, styling, grooming, and presentation relevant to a specified theme.

CULINARY ARTS

Subject Code: SA38029

Credit: 1

L_T_P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

To help the students learn the skills of cooking, knowing ingredients, and preparing cuisines of Pan India and 65 countries

QUIZ ACTIVITY

Subject Code: SA38031

Credit: 1

L_T_P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

To give the students the confidence to participate in, and conduct, various forms of quiz, such as Technical Quiz and Business Quiz.

SOCIAL OUTREACH

Subject Code: SA38033

Credit: 1

L_T_P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

To sensitize the students on the social issues and giving them an opportunity to connect with the community and the environment through outreach activities, community projects, and volunteering.

HEALTH & EMERGENCY CARE

Subject Code: SA38035

Credit: 1

L_T_P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

To let the students learn about health issues, basic Life-saving skills and participate in health awareness and sensitization programs.



KALINGA INSTITUTE OF INDUSTRIAL TECHNOLOGY
Deemed to be University U/S 3 of the UGC Act, 1956
SCHOOL OF ELECTRONICS ENGINEERING



School of Electronics Engineering, KIIT

Information Brochure

Welcome to the School of Electronics Engineering, KIIT

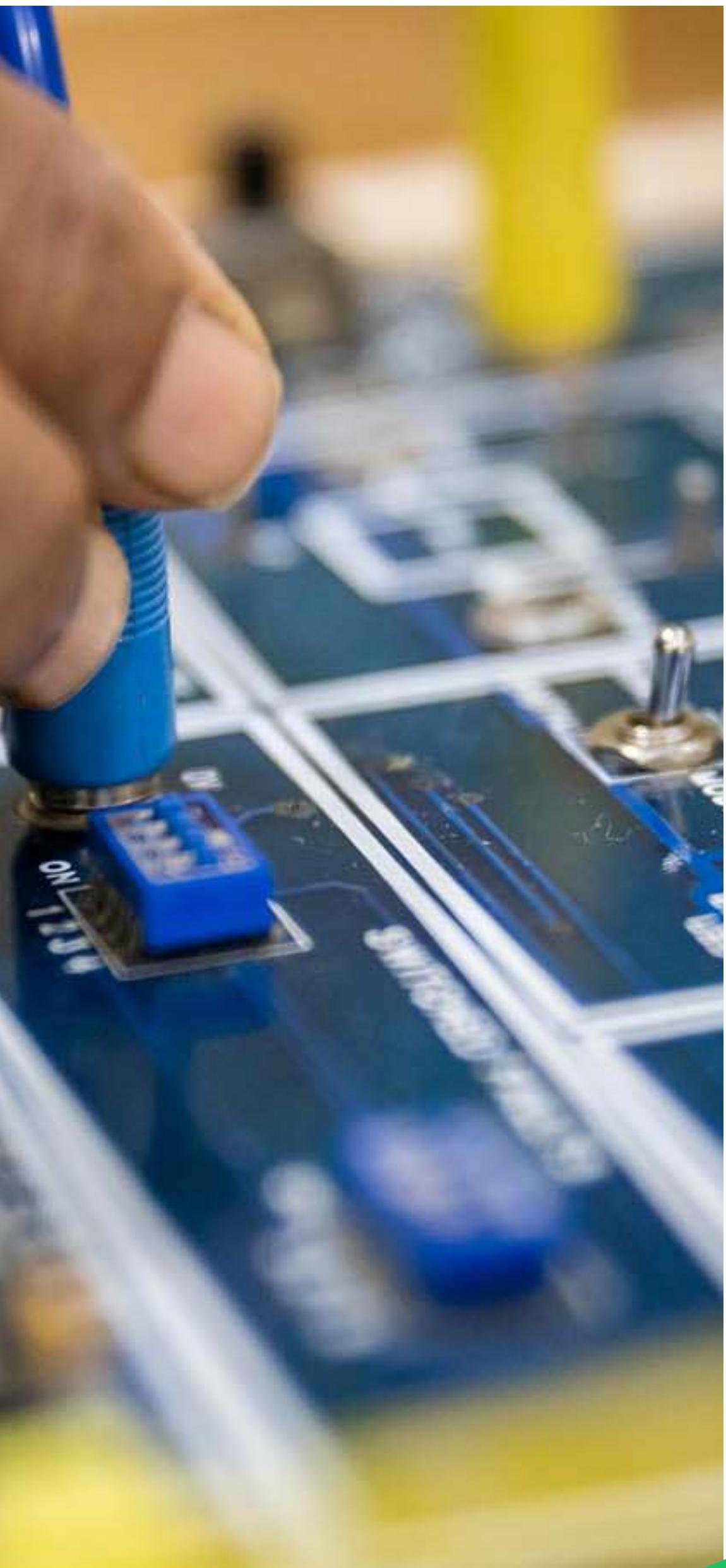


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We firmly believe that knowledge of Electronics is not only valuable but also instrumental in shaping the future across numerous trust areas, extending far beyond 5G, IoT, Wearable Tech, Artificial Intelligence, Automotive, Graphene, Quantum, and Smart Grid technology. In recognition of this, the School of Electronics at KIIT DU offers a diverse range of programs tailored to meet the demands of rapidly evolving technologies.

Our undergraduate programs encompass a broad spectrum of disciplines, including Electronics and Electrical Engineering, Electronics and Telecommunication, and Electronics and Computer Science. For those seeking to delve deeper into specialized areas, we offer M.Tech programs with specializations in Communication Engineering and VLSI Design.

Staying ahead of the curve is a core principle for us. That's why our curriculum is continuously updated to address the state-of-the-art demands of both the IT sector and core industries. Additionally, we provide students with the flexibility to align their passions and gain deeper specialized knowledge by selecting electives from domains of Electrical vehicles, Embedded design, Networking, Computing & Analytics, IoT & Cyberphysical Systems, and more.



Recognizing the importance of interdisciplinary learning, we encourage our students to explore beyond the boundaries of Electronics. As part of our open elective offerings, students have the opportunity to select courses from Law, Management, and other Schools of KIIT DU, broadening their horizons and enhancing their skill sets.

Our state-of-the-art facilities include air-conditioned classrooms, a library stocked with plenty of e-resources, academic labs equipped with the latest technology, and research facilities where students can engage in cutting-edge research projects. Furthermore, we provide opportunities for students to gain real-world experience through industry internships, research works, and collaborative projects, allowing them to build prototypes and develop solutions to real-world challenges as part of their capstone projects. KIIT Technology Building and Incubation Centers add an extra mile in shaping students' careers as entrepreneurs.

In essence, our school is dedicated to providing a 360-degree holistic learning experience that prepares students to excel in the dynamic field of Electronics and beyond. Whether it's through rigorous academics, practical experiences, or interdisciplinary opportunities, we strive to empower our students to become the innovators and leaders of tomorrow. **Welcome to the School of Electronics, where the possibilities are endless.**



Ranking, Accreditation, & Recognition



University Ranking

- ARIIA: Rank-1 among Private Higher Education Institutions
- NIRF: Rank-16th
- NAAC A++
- World University Ranking 401-500



FACILITIES CREATED FROM EXTERNAL GRANTS

- 5G Use case Lab in collaboration with DOT, Govt of India
- DST FIST Grant for sustainable research in the field of Energy Harvesting
- Thin Film Photovoltaic Research Setup
- Grants received under DST Schemes: BIRAC, BDTC, etc



ACCREDITATION

- Tier-1 NBA accreditation
- Washington Accord
- ABET USA
- Accreditation (2021 – 2026)
- IET UK
- Accreditation



RESEARCH OUTCOME:

- Publications
- Patents
- International Collaboration
- Industry Collaboration

Programs Offered

➤ **B.Tech**

- Electronics & Telecommunication
- Electronics & Computer Science
- Electronics and Electrical
- B.Tech Electronics (VLSI Design and Technology)

➤ **M.Tech**

- VLSI Design & Embedded Systems
- Communication System Engineering

Co Branded And Joint M.Tech Programs

- Next Generation Wireless Technologies (Co branded With Ericsson)
- Automotive Electronics And Software (Co branded With KPI)
- Telecommunication System & Management
(Jointly With The School Of Management & Ericsson)

➤ **Ph.D**

- in Electronics & Allied Fields



Academic Support System



Faculty Choice

Air-conditioned
Classroom & Labs

Dedicated Computer
lab with GPU support

Study Abroad and
Semester Exchange
Program

Industry Internships

GATE Practice

Academic Research
Labs &
Center of Excellence

Faculty retention:
95%, Student
Placement: 97%

Testimonials



Sai Susrut Das

ENSEA(Ecole Nationale Superieure de l'Electronique et de ses Applications)
Cergy, France



Snehadeep Kumar

Affiliation: Youngest Indian ever to be a fellow of the Royal Astronomical Society, the most prestigious learned society for space science in the world.



Archishman Ghosh

Received DAAD -WISE Summer Internship in German higher education institution



Madhura Chattopadhyay

Received fellowship for the Mitacs Global Research Internship 2024 at the University of Manitoba, Canada

Top Recruiters

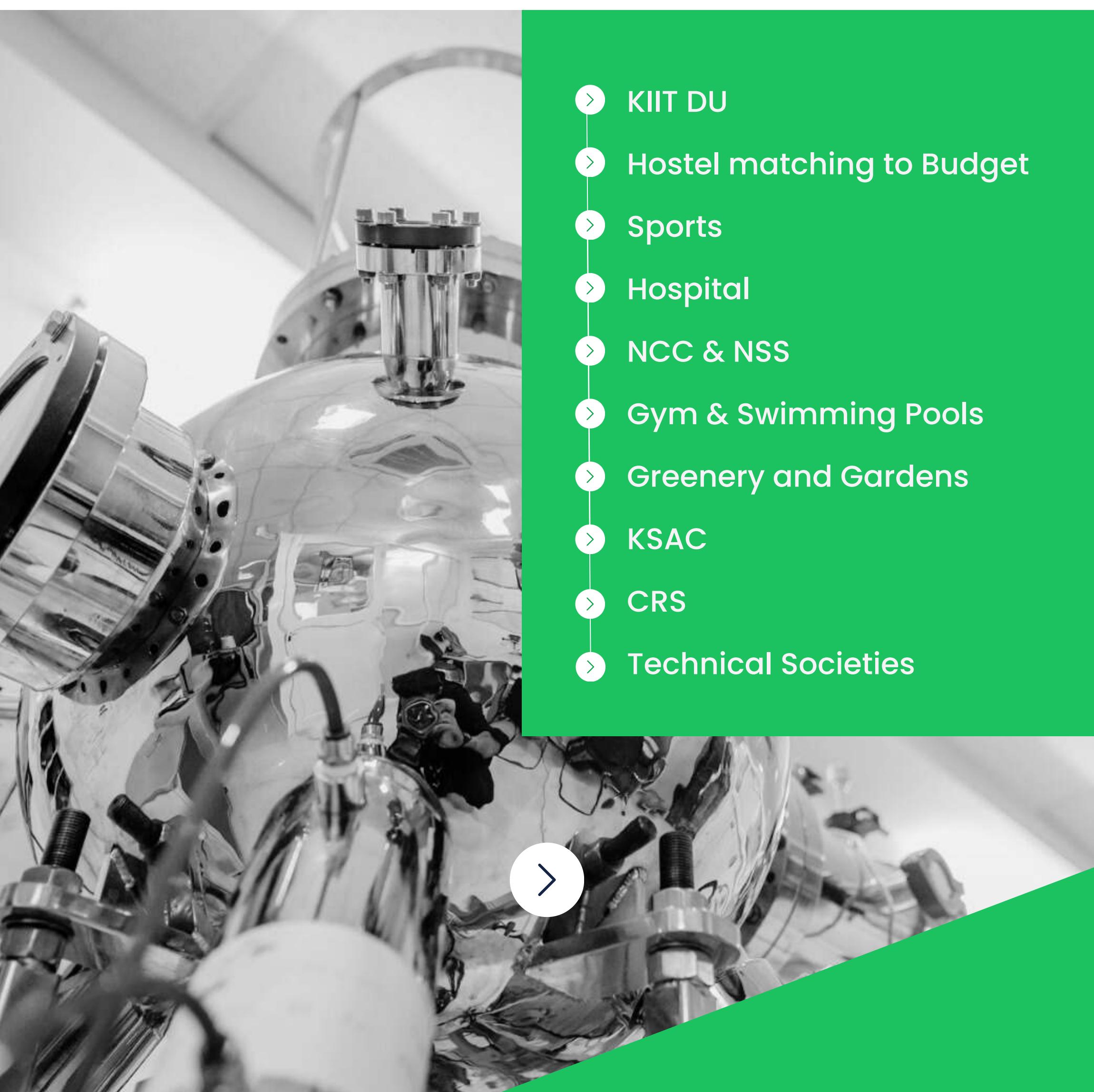


Placement Highlights

- **88%** Placement (2023 graduated batch)
- The highest CTC of **27 LPA** (offered by Intel Technology India Pvt Ltd)
- Second highest CTC of **17.50 LPA** (offered by CISCO)
- Average CTC **8.31 LPA**



Student Support System



- KIIT DU
- Hostel matching to Budget
- Sports
- Hospital
- NCC & NSS
- Gym & Swimming Pools
- Greenery and Gardens
- KSAC
- CRS
- Technical Societies

Notable Alumni



Mr. Pankaja Sahu, IES

Asst. Director(Technology), DoT, Ministry of Communications, Govt. of India



Shashank Shekhar, IES

IES in Indian Railways



Saswati Das

Postdoctoral Fellow at NASA Jet Propulsion Lab



KAUSAL NAHATA

Co-founder and CEO at FarEye

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SYLLABUS

ACADEMIC CURRICULA 2023-24



**SCHOOL OF ELECTRONICS ENGINEERING
KALINGA INSTITUTE OF INDUSTRIAL TECHNOLOGY
BHUBANESWAR – 751024
ODISHA, INDIA**

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Guidelines for UG Engineering Curriculum

The curricula for B.Tech. programmes have been designed following the general principles of curricular design and developing certain guiding strategies in order to build in the engineering graduate attributes in the courses.

Principles in Designing the Curricula

The overriding principles in designing the new curricula are that the curricula must (1) Impart specialized and interdisciplinary knowledge and creative problem-solving skills; (2) Reflect aspirations of the society to turn out technology-ready and socially conscious graduates to anticipate and avoid future problems; (3) Leverage the strengths and help making up the weaknesses of the university; (4) Inform the students about new technologies and the emerging social, environmental, and global forces, and (5) Give students the confidence to work in teams and in multi-cultural settings.

Key Graduate Attributes

Engineers are agents of social change. They interact with the common man to know and define the current and the looming future problems, develop sustainable design solutions using their science and engineering skills, and implement sustainable solutions. Thus, the graduating students must (1) Acquire knowledge and skills—both technical and soft skills such as communication, leadership, and skills of working in multi-cultural, interdisciplinary teams; (2) Develop the mental disposition to understand, conceptualize, and define complex, real-world problems; (3) Be independent, critical thinkers to inquire into the root causes of the problems; (4) Analyse the relevant data and social, economic, and political forces influencing these problems; (5) Synthesize knowledge and diverse perspectives and approaches to find technically and financially viable, sustainable, creative, ethical solutions by evaluating novel alternatives; (6) Use project planning and scheduling methods, establish institutional mechanisms, and communicate the plans and schedules and inspire the concerned individuals to implement the solutions; (7) Imbibe professional values and ethics, and (8) Be life-long learners with empathy for others.

Strategies for Curriculum Design

Strategies to design the curricula include (1) Understanding the dominant technological and social changes in the world, (2) Incorporating recommendations of the National Education Policy 2020 with respect to design of curricula, (3) Adding the novel features and best curricular practices of leading universities and institutes in India and abroad, (4) Recognizing the UGC and AICTE guidelines and ABET recommendations; (5) Using the opportunities that KIIT offers for multi- and inter-disciplinary education, and (6) Delivering the key attributes and skills which the graduating students should be equipped with.

The Structure of the Curricula

The undergraduate engineering curricula are designed to inculcate in the students the graduate attributes indicated above. The curricula include (1) foundational subjects in the fields of humanities, social sciences, science, engineering science, and vocational courses, (2) depth subjects—both core and electives related to the respective disciplines, (3) open electives in diverse fields of humanities, arts, science, engineering, social science, management, law, public policy, media studies, etc., and (4) practice-based subjects. These subjects reflect a mix of theory, hands-on laboratory practice, short- and long-duration projects, field visits, internship, and extra- and co-curricular activities. The Institute has created many avenues for students to organize, lead, and actively participate in social, cultural, and techno-management functions to develop behavioural skills.

UG Programmes Offered by the Schools of Technology

The B. Tech. (Hons.) and B. Tech. (Res.) programmes offered by various Schools of Technology are tabulated below.

Name of the School	B. Tech. (Hons.) and B. Tech. (Res.) Programmes Offered
School of Civil Engineering	Civil Engineering
School of Computer Engineering	Computer Science and Engineering Information Technology Computer Science and Communication Engineering Computer Science and Systems Engineering
School of Electrical Engineering	Electrical Engineering
School of Electronics Engineering	Electronics and Telecommunication Engineering Electronics and Computer Science Engineering Electronics and Electrical Engineering
School of Mechanical Engineering	Mechanical Engineering Mechanical (Automobile Engineering) Mechatronics Engineering Aerospace Engineering

Highlights of the Curricula

1. The curricula allow the students to opt for either a B. Tech. (Hon.) degree or a B. Tech. (Res.) degree.
2. All the B. Tech. curricula have total of 160 – 165 credits.
3. The curricula provide option for a Minor in selected areas if students fulfill additional credit requirements.
4. With the inclusion of many Humanities, Arts, and Social Science (HASS) subjects, the curricula are HASS-rich.
5. The curricula provide flexibility in many forms. The students can choose subjects from a large number science, HASS, and engineering electives. They can also choose subjects from lists of professional electives and open electives. The professional electives allow the students to concentrate in selected areas, whereas the open electives allow the students to gain multidisciplinary knowledge
6. To ensure all-round development of students, the curricula have included subjects like Yoga, Universal Human Values, a Community/Environment-based Project, a Vocational Elective, Industry 4.0 Technologies, and K-Explore that consider students' co- and extra-curricular activities for evaluation.
7. The curricula have included subjects like Scientific and Technical Writing and Research Methods and Ethics to instill research and research communication skills in the students.
8. The curricula have also provided for independent projects in the last three semesters to train the students in the art and science of identifying pressing problems and finding their sustainable solutions.

Notes and Guidelines

Science Core

Science forms the foundation of engineering. Subjects related to physical, chemical, biological, environmental, and mathematical sciences are covered in the first four semesters in the form core and elective subjects. The core subjects in science are the following:

Semester I/II: Physics, Chemistry, Science of Living Systems, Environmental Science, Differential Equations and Linear Algebra, Transform Calculus and Numerical Analysis, Physics Lab, and Chemistry Lab.

Semester III: Probability & Statistics

Semester IV: Selected Topics in Mathematics (Syllabi to be different for different Programmes)

Engineering Science Core

Engineering science subjects provide a bridge between science and engineering. The related subjects are included as both core and electives. The semester-wise distribution of the core engineering science subjects is given below.

- Semester I/II: Basic Electronics, Programming Lab, Engineering Drawing & Graphics, Workshop Practice, and Engineering Lab
Half the number of experiments in Engineering Lab will relate to Basic Electronics and the other half will relate to Basic Electrical Engineering.
- Semester III: Industry 4.0 Technologies

HASS Core

The curricula include HASS subjects as both core and electives. The HASS subjects that improve the written and rhetoric skills, life skills and research skills of students are included as core subjects. Semester-wise distribution of these subjects are given below:

The semester-wise distribution of language- and human values-related subjects is given below:

- Semester I/II: English (to develop language skills and skills for making critical analysis of English literature)
- Semester I/II: Communication Lab (to develop skills of Listening, Speaking, and Writing)
- Semester I/II: Yoga (to bring about unity of mind and body)
- Semester III: Scientific and Technical Writing (to develop skills of writing varieties of scientific and technical documents)
- Semester VI: Universal Human Values (to develop and respect human values) and Engineering Professional Practice (to understand roles and responsibilities of engineers and the ethical and selected legal issues)
- Semester VIII: Research Methods and Ethics (for B. Tech. (Res.) students)

Professional Core

Professional core subjects form the backbone of an engineering discipline. Every School of Technology decides the list of core subjects that its students must credit. These can be theory and laboratory subjects. These subjects are diffused in Semester III through Semester VI.

Engineering Professional Practice, a professional core subject, is included as a HASS Elective but will be taught by engineering faculty.

Research Core

Students pursuing B. Tech. (Res.) programme have to go through a course on Research Methods and Ethics, which is offered in Semester VII.

Science, Engineering Science, and HASS Electives

Options are available to the students to choose subjects from lists of science, engineering science, and HASS electives. Their distributions in the curricula are as under:

- Semester I/II: Science Elective, Engineering Elective, and HASS Elective I.
- Semester IV: HASS Elective II
- Semester V: HASS Elective III
- Semester VI: HASS Elective IV

HASS Elective I includes Community/Environment-based project as one of the subjects. Done as a group work, the subject gives the students an opportunity to connect with the community and the environment, learn and prioritize their problems, and define them in ways that make them amenable to scientific analysis and pragmatic solution.

The lists of Science, Engineering Science, and HASS electives will be available in the ERP. Before a semester begins the Institute will announce the subjects that will be offered in that semester and the students will have to give their choice of electives out of the offered subjects.

Vocational Elective

Vocational Elective courses provide engineering students a deeper appreciation of the practical aspects of engineering and allow them to relate their theoretical knowledge with practical skills. This subject is included in Semester III. A student must opt for one of the vocational electives which will be announced at the beginning of the semester.

Open Electives

Open electives allow students to choose subjects from lists of subjects offered by all the Schools. It is through these subjects that a student can pursue his or her latent interests in specific areas and work towards earning a Minor in an area which is outside his (or her) major engineering branch (if the subjects are selected in specific designated areas). These subjects are offered in Semester V through Semester VIII:

Semester V: K-Explore—Practice-based Open Elective I

Semester VI – VIII: Open Electives II, III, and IV

K-Explore is a 1-Credit Practice-based Open Elective that allows the students to use the scope that the Clubs and the Societies of KIIT University provides to learn the skills of Dance, Music, Photography, etc. and of conducting seminars and conferences through training, practice, and direct involvement.

Minor

The curricula allow a student to earn a Minor in an area outside the core discipline in which he (or she) has registered. For example, a student doing B. Tech in Mechanical Engineering (his/her parent branch) can choose to have a Minor in Computer Science Engineering. To get a Minor, a student must

- (i) Get the fourth semester CGPA of 7.0 or more,
- (ii) Successfully fulfill the coursework requirement for at least six theory subjects and two credit Lab/project subjects in an area or discipline other than the one for which he (or she) is registered, and
- (iii) Complete at least 20 Credits of coursework in that area.

Thus, if a student has taken three Open Electives in one area other than his (or her) own then he (or she) must choose three more theory subjects and two Lab (or a 2 credit project) subjects in that area in the Fourth year.

If no Lab subject is available in that Minor, then the student must choose an additional theory subject with at least 2 Credits. Students having no backlogs till the end of Semester 4 and a minimum CGPA of 7.0 will only be allowed to opt for the Minor scheme. Students opting for Minor have to mandatorily attend a minimum of 75% Theory and Lab classes (as the case may be) failing which the Minor option will be withdrawn.

Professional Electives

Professional elective subjects provide the students the opportunity to concentrate in certain specific areas of their interest. These subjects are offered in Semester V through Semester VIII for B. Tech. (Hons.) students (total 15 credits) and in Semester V through Semester VI for B. Tech. (Res.) students (total 9 credits). The distribution of these subjects is given below:

Semester V: Professional Electives (6 Credit),

Semester VI: Professional Electives (3 Credit),

Semester VII: Professional Elective (3 Credits) for only B. Tech (Hons.) students

Semester VIII: Professional Elective (3 Credits) for only B. Tech (Hons.) students

Research Electives

The students pursuing B. Tech. (Res.) degree may need specialized knowledge in the areas of their theses. For this reason, the curriculum provides for two research electives to be selected in Semester VII and Semester VIII. Every School prepares a list of Research Electives and announces, at the beginning of every semester, the subject which will be offered in that semester. The student is required to select the electives from out of these offered lists.

Summer Internship

Internship exposes the students to the realities of engineering systems. Every student must go through at least 60 days of internship. It can be taken in an industrial organization or at an institute of higher learning in the summer breaks after the second year and/or after the third year. Internship carries 2 Credits. And the grade secured by a student appears in the Semester VII Grade Sheet of the student.

Projects

Projects allow the students to work under the supervision of a faculty advisor and apply their acquired knowledge to solve the real-world problems. They define problems, mine information from past works, conceptualize forces and factors that impact the problems, develop design solutions, and demonstrate the effectiveness of the solutions. Semester-wise distribution of this subject is given below:

Semester VI: Miner Project (2 Credits)

Semester VII: Project I (5 Credits)

Semester VIII: Project II (9 Credits for B. Tech. (Hons.) and 12 Credits for B. Tech. (Res.))

Semester-away Provision for Project II

The Institute sometimes allows a student to carry out the fourth-year project (Project II) away from the University campus if the following conditions are satisfied:

- This provision applies to Project II.
- That means a student can avail of this provision in Semester VIII.
- The project must be done either in an industrial unit or in an academic institution.
- The organization in which the student wishes to carry out the project must give in writing that it will provide all facilities (office space, equipment, instrument, data, and travel and stay facilities, if possible) for the student to do the project. In addition, it will also identify a senior and competent employee of the organization to whom the student will report.
- The faculty supervisor must recommend the student's application for availing the semester-away provision.
- A co-supervisor from the organization may be appointed for the project.
- The intending student gives an undertaking that he (or she) will
 - Remain in constant touch with the faculty supervisor,
 - Send monthly progress reports to the supervisor,
 - Give seminar presentations, whenever required.
 - Collect class notes, read books, and prepare for and appear at the examinations (online, if necessary). The student must also do and submit all home assignments given by the teachers and give seminar presentation (online) if necessary.
- Since Semester VIII curricula have one theory subject (B. Tech. (Res.)) and two theory subjects (B. Tech. (Hons.)) students, a student applying for this provision will be exempted from attending the lectures on these subjects. But the student must give an undertaking that it will be his (or her) responsibility to collect class notes, read books and other reading materials, submit all home assignments, give seminar presentations (online if required) and prepare for and appear at the examinations.

SCHEME I
FIRST SEMESTER

Theory							
Sl. No.	Course Code	Subjects	L	T	P	Total	Credit
1	PH10001	Physics	3	0	0	3	3
2	MA11001	Differential Equations and Linear Algebra	3	1	0	4	4
3		Science Elective	2	0	0	2	2
4		Engineering Elective	2	0	0	2	2
5	LS10001	Science of Living Systems	2	0	0	2	2
6	CH10003	Environmental Science	2	0	0	2	2
Total Credit (Theory Subjects)						15	15
Practical							
1	PH19001	Physics Lab	0	0	2	2	1
2	CS13001	Programming Lab	0	2	4	6	4
Sessional							
1	CE18001	Engineering Drawing & Graphics	0	0	2	2	1
Total Credit (Practical & Sessional subject)						10	6
Total Credit (Semester)						25	21

SCHEME I
SECOND SEMESTER (Computer Science and Electronics)

Theory							
Sl. No.	Course Code	Subjects	L	T	P	Total	Credit
1	CH10001	Chemistry	3	0	0	3	3
2	MA11002	Transform Calculus and Numerical Analysis	3	1	0	4	4
3	HS10001	English	2	0	0	2	2
4	EC10001	Basic Electronics	2	0	0	2	2
5	EE10002	Basic Electrical Engineering	2	0	0	2	2
6		HASS Elective I	2	0	0	2	2
Total Credit (Theory Subjects)						15	15
Practical							
1	CH19001	Chemistry Lab	0	0	2	2	1
2	EX19001	Engineering Lab	0	0	2	2	1
Sessional							
1	ME18001	Workshop	0	0	2	2	1
2	YG18001	Yoga	0	0	2	2	1
3	HS18001	Communication Lab	0	0	2	2	1
Total Credit (Practical & Sessional Subjects)						10	5
Total Credit (Semester)						25	20

SCHEME I
SECOND SEMESTER (Civil, Mechanical and Electrical)

Theory							
Sl. No.	Course Code	Subjects	L	T	P	Total	Credit
1	CH10001	Chemistry	3	0	0	3	3
2	MA11002	Transform Calculus and Numerical Analysis	3	1	0	4	4
3	HS10001	English	2	0	0	2	2
4	EC10001	Basic Electronics	2	0	0	2	2
5	ME10001	Engineering Mechanics	2	0	0	2	2
6		HASS Elective I	2	0	0	2	2
Total Credit (Theory Subjects)						15	15
Practical							
1	CH19001	Chemistry Lab	0	0	2	2	1
2	EX19001	Engineering Lab	0	0	2	2	1
Sessional							
1	ME18001	Workshop	0	0	2	2	1
2	YG18001	Yoga	0	0	2	2	1
3	HS18001	Communication Lab	0	0	2	2	1
Total Credit (Practical & Sessional Subjects)						10	5
Total Credit (Semester)						25	20

SCHEME II
FIRST SEMESTER

Theory							
Sl. No.	Course Code	Subjects	L	T	P	Total	Credit
1	CH10001	Chemistry	3	0	0	3	3
2	MA11001	Differential Equations and Linear Algebra	3	1	0	4	4
3	HS10001	English	2	0	0	2	2
4	EC10001	Basic Electronics	2	0	0	2	2
5	EE10002	Basic Electrical Engineering	2	0	0	2	2
6		HASS Elective I	2	0	0	2	2
Total Credit (Theory Subjects)						15	15
Practical							
1	CH19001	Chemistry Lab	0	0	2	2	1
2	EX19001	Engineering Lab	0	0	2	2	1
Sessional							
1	YG18001	Yoga	0	0	2	2	1
2	ME18001	Workshop	0	0	2	2	1
3	HS18001	Communication Lab	0	0	2	2	1
Total Credit (Practical & Sessional Subjects)						10	5
Total Credit (Semester)						25	20

SCHEME II
SECOND SEMESTER

Theory		Sl. No.	Course Code	Subjects	L	T	P	Total	Credit
1	PH10001	Physics	3	0	0	3		3	
2	MA11002	Transform Calculus and Numerical Analysis	3	1	0	4		4	
3		Science Elective	2	0	0	2		2	
4		Engineering Elective	2	0	0	2		2	
5	LS10001	Science of Living Systems	2	0	0	2		2	
6	CH10003	Environmental Science	2	0	0	2		2	
Total Credit (Theory Subjects)							15	15	
Practical									
1	PH19001	Physics Lab	0	0	2	2		1	
2	CS13001	Programming Lab	0	2	4	6		4	
Sessional									
1	CE18001	Engineering Drawing & Graphics	0	0	2	2		1	
Total Credit (Practical & Sessional Subjects)							10	6	
Total Credit (Semester)							25	21	

LIST OF ELECTIVES

Engineering Elective							
Sl. No.	Course Code	Subjects	L	T	P	Total	Credit
1	CE10001	Basic Civil Engineering	2	0	0	2	2
2	ME10003	Basic Mechanical Engineering [#]	2	0	0	2	2
3	EE10001	Elements of Machine Learning*	2	0	0	2	2
4	EC10003	Biomedical Engineering	2	0	0	2	2
5	EE10003	Basic Instrumentation	2	0	0	2	2

Not for students of Mechanical Engineering

* Not for students of Computer Engineering

Science Elective							
Sl. No.	Course Code	Subjects	L	T	P	Total	Credit
1	CH10005	Nanoscience	2	0	0	2	2
2	PH10003	Smart Materials	2	0	0	2	2
3	LS10003	Molecular Diagnostics	2	0	0	2	2
4	PE10002	Science of Public Health	2	0	0	2	2
5	MA10003	Optimization Techniques	2	0	0	2	2

HASS Elective I							
Sl. No.	CourseCode	Subjects	L	T	P	Total	Credit
1	HS10013	Society, Science, and Technology	2	0	0	2	2
2	HS10202	Essential of Management	2	0	0	2	2
3	HS10121	Shades of Economics	2	0	0	2	2
4	HS10123	Indian Economy Post Liberalisation	2	0	0	2	2
5	SO10043	Socio-Political Environment	2	0	0	2	2
6	PS10043	Thinking Perspectives	2	0	0	2	2
7	PS10045	Creativity, Innovation and Entrepreneurship	2	0	0	2	2
8	EX17001	Community/Environment-based Project	0	0	4	2	2

1ST YEAR DETAIL SYLLABUS

PHYSICS

Course Code: **PH10001**

Credit: **3**

L-T-P: **3-0-0**

Prerequisite: **Nil**

COURSE OBJECTIVE

This subject is designed to enrich the basic knowledge of engineering students in the field of physics and to support the engineering and research programs. The subject will also help the students to develop mathematical models to understand the behavior of physical systems and phenomena.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Learn the basic concepts of oscillation, waves, wave function and fields,
- CO 2: Understand the principles of wave phenomena in light and matter, and the quantum mechanics,
- CO 3: Apply the principles of oscillation, superposition of waves, electromagnetic theory, and quantum mechanics in different fields,
- CO 4: Analyze different types of particle motion in different media,
- CO 5: Evaluate the problem-solving skills for the topics learnt, and
- CO 6: Develop critical thinking ability supported by the learned concepts of Physics.

COURSE DETAILS

Oscillation

Damped Harmonic Oscillation (underdamped, overdamped and critically damped), Energy decay, Relaxation time, Quality factor, Forced oscillation, Resonance, Coupled oscillations, Applications.

Waves and Interference

Wave equation, Superposition of waves, Interference of light, Types of interference: Division of wavefront and division of amplitude.

Interference in thin films

Wedge shaped thin film, Newton's rings and their applications, Michelson interferometer, Applications.

Diffraction

Diffraction and its applications, Types of diffraction, Fraunhofer diffraction by a single slit, Plane diffraction grating (condition of maxima, minima), Maximum order of observable spectra, Absent spectra, and Dispersive power, Applications.

Quantum Mechanics

Dual nature of radiation and matter, de Broglie hypothesis for matter waves, Phase velocity and Group velocity, Heisenberg's uncertainty principle and applications, Wave function and its interpretation, Concepts of operators, Schrodinger's time-dependent and time-independent equations, Postulates of Quantum mechanics, Particle in one-dimensional box and applications, Quantum tunnelling and applications.

Electromagnetic Theory

Vector calculus: scalar and vector field, Gradient, divergence and curl, Line, surface and volume integrals, Gauss divergence and Stoke's theorem, Maxwell's equations in differential and integral form with necessary derivations. Electromagnetic wave equations, Transverse nature of electromagnetic waves.

Laser and Fiber Optics

LASER: Properties and applications, Spontaneous and stimulated emission, Meta-stable state, Population inversion, Pumping, Three and four-level Laser, Ruby Laser.

Optical fiber

Principle, Construction, Types of optical fiber, Acceptance angle, Numerical aperture, Applications.

Textbook

1. B. K. Pandey and S. Chaturvedi, Engineering Physics, Cengage Publication, New Delhi, 2nd Edition 2022, ISBN-13: 978-81-953536-7-5.

Reference books

1. D J Griffiths, Introduction to Electrodynamics, Pearson Education, 4th Edition, 2015.
2. L. I. Schiff and J. Bandhyopadhyay, Quantum Mechanics, Tata McGraw-Hill Publications, 4th Edition, 2014, ISBN- 9781259062865.
3. A K Ghatak, Optics, Tata McGraw-Hill Publications, 4th Edition, 2008, ISBN: 9780070262157.
4. A. Beiser, Concepts of Modern Physics ,Tata McGraw-Hill Publications, 6th Edition, 2002, ISBN 10: 0071234608.
5. R K Gaur and S. L. Gupta, Engineering Physics, Dhanpat Rai Publications, New Delhi, 2nd Edition, 2012, ISBN-10: 8189928228.

CHEMISTRY

Course Code: CH10001

Credit: 3

L-T-P: 3-0-0

Prerequisite: Nil

COURSE OBJECTIVE

This course is designed to enrich the students with the basic concepts in Chemistry and to strengthen their fundamentals which will support them to pursue education and research in engineering. The course will help the students to conceptualize alternative sources of energy by electrochemical means and use the instrumental techniques to explore chemical products.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Rationalize bulk properties and processes using thermodynamic consideration and apply the knowledge to decide the feasibility of a given process,
- CO 2: Analyze the kinetics of multistep reactions as well as the theories of reaction rates,
- CO 3: Understand the importance of catalysis and their mechanism of action and applications,

- CO 4: Apply the principles of electrochemistry to evaluate properties, such as pH, solubility Product, etc. and understand the working principle of modern batteries,
CO 5: Apply different spectroscopic techniques, such as UV-Vis, IR and NMR, for structural Elucidation, and
CO 6: Differentiate between smart and intelligent materials.

COURSE DETAILS

Chemical Equilibrium and Thermodynamics

Introduction, Internal energy, Enthalpy, Entropy and free energy, Dependence of free energy on temperature and pressure, Gibbs-Helmholtz equation, Free energy change and equilibrium constants, Van't Hoff isotherm and isochore, Clapeyron- Clausius equation, Partial molar properties, Chemical potential, and Gibbs-Duhem equation.

Chemical Kinetics

Rate of reaction and rate laws of multiple reactions (steady-state approximation), and of parallel, opposing and consecutive reactions; Theories of reaction rate: Collision theory, Lindemann modification, Absolute reaction rate; Catalysis: Types, theories, and kinetics of enzyme catalysis (Michaelis-Menten mechanism).

Spectroscopy

UV-Vis spectroscopy: Beer-Lambers law, Types of transition, Concept of auxochrome and chromophores, Factors affecting λ_{max} and, Woodward-Fieser rules for calculation of λ_{max} in diene systems; IR spectroscopy: Types of vibration, Hooks law, detection of functional groups like C=C, -OH, -NH₂ and -C=O;

NMR Spectroscopy

Basics of NMR Spectroscopy: Theory, Chemical shift, Shilding-deshilding effect, Structural elucidation of simple compounds.

Electrochemical Energy Systems

Types of electrodes, electrode/cell potential; Nernst equation and application to: find electrode and cell potential, equilibrium constant, solubility product and pH; Modern batteries: Fuel cells (AFCs, PEMFs, SOFCs, MCFCs), Zn-air battery, Li-ion battery, Na-ion battery, Ni-MH battery.

Smart and Intelligent Materials

Introduction to smart materials, Properties and types of smart materials, Structures, System intelligence-components and classification of smart structures, Common smart materials and associated stimulus-response, Application areas of smart systems.

Textbook

1. S Chawala, Engineering Chemistry, Dhanpat Rai and Co, 4th Edition, ISBN: 9788177001938.

Reference books

1. S Agarwal, Engineering Chemistry: Fundamentals and Applications, Cambridge University Press, ISBN: 9781107476417.
2. S. Chakraborty, S. Sen, and S. Mittal, Engineering Chemistry, Cengage Learning India Pvt. Ltd., ISBN: 9386668645.
3. B.R. Puri, L.R Sharma, and M. S. Pathania, Principles of Physical Chemistry, Vishal Publishing Co., 47th Edition, ISBN: 978-9382956013.
4. R M. Silverstein, Fransis X, Webster, D J Kiemle, Spectrometric Identification of Organic compounds, - Jhon Wiley& Sons, INC, 7th Edition.

5. S Glasstone, Elements of Physical chemistry-, Macmillan publishers, 2nd Edition ISBN: 978-0333038437.
6. D.J. Leo, Engineering Analysis of Smart Material Systems, Wiley 2007, 1st Edition ISBN: 978-0471684770.

ENVIRONMENTAL SCIENCE

Course Code: CH10003

Credit: 2

L-T-P: 2-0-0

Prerequisite: Nil

COURSE OBJECTIVE

This course is designed to create awareness in the students on monitoring, assessment, and management of environmental pollutants. The subject will also make the students aware of more benign chemistry, i.e., green chemistry, and help them to understand the implementation of Environmental Impact Assessment (EIA).

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Understand the components and composition of the environment along with the radiation balance model,
- CO 2: Rationalize the different types of pollutants, their sources, effects, and control measures,
- CO 3: Develop the idea of water purification strategies,
- CO 4: Identify toxic wastes and conceptualize the principles of solid waste management,
- CO 5: Conceptualize the principles of green chemistry and implement them in the synthesis of advanced material, to reduce pollution, and
- CO 6: Provide for Environmental Impact Assessment (EIA) requirements before planning a project.

COURSE DETAILS

Overview of the Environment

Overview of the environment, terminologies, Components of Earth: Lithosphere, atmosphere, hydrosphere and biosphere, Concept of black body radiation and albedo, eZro-dimensional energy balance model.

Air Pollution and Control

Primary and secondary air pollutants, CFC, Smog (oxidizing and reducing), Important environmental issues: Depletion of the ozone layer, Acid Rain, Greenhouse effect and global warming, Control measures: Baghouse filter, Cyclone separator, Electrostatic precipitator, Catalytic converter, and Scrubber.

Water Pollution and Control

Types and sources of water pollutants, wastewater treatment techniques: Ultrafiltration, aerobic and anaerobic treatment, Reverse osmosis, Electrodialysis, Disinfection by chlorination, Ozonation, Modern water purification system, Water quality parameters like hardness, Water softening process (permutit), WHO guidelines for drinking water.

Soil Pollution and Solid Waste Management

Soil pollution: Sources of pollutants and mitigation measures. Types of solid wastes: Heavy metal, bio-medical and radioactive wastes, Toxic and biochemical effects of solid wastes, Solid waste management (landfilling, incineration, and composting).

Green Chemistry and EIA

Basic principles of green chemistry with examples, Matrices to explain greenness, R⁴M⁴ model, life cycle analysis. Importance, scope and principles of EIA with a case study.

Textbook

1. A. K. De, Environmental Chemistry, New Age International Publishers, 9th Edition.

Reference books

1. S. Chakraborty, D. Dave, and S. S. Katewa, Environmental Chemistry-, Cengage Learning India Pvt. Ltd., 1st Edition.
2. Aloka Debi, Environment Science and Engineering, Universities Press, 2nd Edition.
3. Erach Bharucha, Textbook of Environment studies for undergraduate courses, Universities Press, 2nd Edition.
4. D. De and D. De, Fundamentals of Environment and Ecology, S. Chand & Co, 2013.
5. Jain and Jain, Engineering Chemistry, Dhanpat Rai Publishing Company.
6. S.C. Santra, Environmental Science, New Central Book Agency, ISBN: 9788173814044.

PHYSICS LABORATORY

Course Code: PH19001

Credit: 1

L-T-P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

This lab course covers different measurement techniques of various parameters using the instruments i.e. interferometer, spectrometer, spherometer, screw gauge, vernier calliper, microscope, and telescope. It includes the application of photoelectric effect and photovoltaic effect in photo cell and solar cell respectively. Evaluation of the mechanical strength of materials by calculating elastic constants such as Young's modulus, rigidity modulus and Poisson's ratio are also included. This course provides hands on training for the usage of electrical, optical and mechanical systems for various measurements with precision and analysis of the experimental data by graphical interpretation and error calculation.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Understand the wave nature of light through experiments based on interference and diffraction Phenomena,
- CO 2: Apply the laws of quantum physics to understand the photoelectric emission using the particle nature of light,
- CO 3: Characterize photovoltaic cells to find out efficiency in terms of power output,
- CO 4: Evaluate mechanical properties of materials using their elastic properties,
- CO 5: Apply the principles of optics such as refraction, total internal reflection to calculate refractive index and related parameters, and
- CO 6: Use the principles of oscillation to understand phenomena such as damping, resonance and to determine the factors (such as gravity, elasticity etc) affecting the time period of various oscillators.

Topics

Measurement by vernier callipers, screw gauge, spherometer: A review

- Determination of wavelength (λ) of a monochromatic light by Newton's ring experiment.
- Determination of wavelength (λ) and difference ($d\lambda$) between wavelengths of sodium D-lines by Michelson's interferometer.
- Determination of grating element ($e+d$) of a plane diffraction grating.
- Determination of Planck's constant using photocell.
- Study of the characteristics of a photo cell.
- Study of the characteristics of a solar cell.
- Determination of Young's modulus (Y) of a material by bending of beam method.
- Determination of Poisson's ratio (σ) of rubber.
- Determination of rigidity modulus (η) of a material by dynamic method.
- Determination of refractive index (μ) of a transparent liquid by Boy's method.
- Determination of numerical aperture of optical fibre.
- Determination of acceleration due to gravity (g) by bar pendulum.
- Determination of damping coefficient, relaxation time and quality factor of damped harmonic oscillation by simple pendulum.
- Measurement of velocity of sound in air using resonance column method.
- Studies on dielectric/multi-ferroic materials (Open ended)
- Diffraction studies using Laser sources (Open ended)

Reference books

1. Physics laboratory instruction manual, School of Applied Sciences, Department of Physics, KIIT Deemed to be University, Bhubaneswar.
2. S. L. Gupta and V. Kumar, 2018, Practical Physics, Pragati Prakashan, 33rd Edition, ISBN: 978-93-87151-58-1.

CHEMISTRY LABORATORY

Course Code: CH19001

Credit: 1

L-T-P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

This lab course covers different types of chemical experiments ranging from volumetric analysis to spectroscopic techniques. This course provides the students with hands-on training in many of the advanced spectroscopic and analytical techniques in chemistry. The experiments in the course span over diverse

applications in chemistry. It contains experiments dealing with environmental chemistry, volumetric analysis, organic and inorganic synthesis, electrochemistry, and spectroscopy.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Handle different chemicals with proper safety protocols in an advanced Chemistry laboratory,
- CO 2: Learn and apply basic techniques used in Chemistry laboratory for preparation, purification and identification,
- CO 3: Analyze the kinetics of 1st order reactions and estimate the rate constant,
- CO 4: Use different instrumental techniques such as Conductometry, pH-metry, Potentiometry and Colorimetry,
- CO 5: Analyse basic water quality parameters like hardness, dissolved oxygen, alkalinity, chloride, ferrous iron contents etc, and
- CO 6: Rationalize and learn the spectroscopic and synthesis techniques in chemistry.

Topics

- Estimation of total hardness in a given water sample in terms of calcium and magnesium hardness by EDTA method.
- Estimation of the amount of NaOH and Na₂CO₃ present in a given mixture solution
- (a) Determination of the strength of KMnO₄ solution by using standard sodium oxalate solution. (b) Determination of the amount of Ferrous (Fe²⁺) ions present in the Mohr's salt solution by using standard KMnO₄ solution.
- Determination of the amount of dissolved oxygen present in a given water sample by Winkler's method.
- Finding the strength of Fe²⁺ present in the supplied Mohr's salt solution by potentiometric titration.
- Determination of the rate constant of acid-catalyzed hydrolysis of ethyl acetate.
- Determination of the chloride ion (Cl⁻) present in a given water sample by the argentometric method.
- Finding the strength of supplied acid by pH-metric titration against a standard alkali.
- Finding the strength of a given hydrochloric acid solution by titrating it against standard sodium hydroxide solution conducto-metrically.
- Verification of Beer Lambert's Law and application of this law to determine the unknown concentration of a given solution.
- Determination of the concentration of ferric ions (Fe³⁺) in a given water sample by a spectrometric method using KCNS as color developing agent.
- Determination of the Isoelectric point (pI) of glycine amino acid.
- Synthesis of transition metal complexes and characterization by using IR and ¹H-NMR. (Open ended)
- Determination of the concentration of different ions (cations and anions) in a given water sample by colorimetry. (Open ended).
- Application of potentiometric titrations (Open ended).

Reference books

1. Chemistry laboratory Instruction manual, School of Applied Sciences, KIIT Deemed to be University
2. Vogel's Quantitative Chemical Analysis, J. Mendham, R.C. Denney J. D. Barnes, M.J.K. Thomas, 6th Edition, Longman
3. Standard methods for examination of water and wastewater, 23rd Edition, APHA.

DIFFERENTIAL EQUATIONS AND LINEAR ALGEBRA

Course Code: MA11001

Credit: 4

L-T-P: 3-1-0

Prerequisite: Nil

COURSE OBJECTIVE

The objective of this course is to familiarize the prospective engineers with techniques in ordinary differential equations and linear algebra. It aims to equip the students to tackle advanced level of mathematics and applications that they would find useful in their disciplines.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Understand the concept of modelling and formulation of Differential equation of physical problems,
- CO 2: Apply different methods to solve ODE problems involving growth-decay, cooling effects and electrical circuits etc,
- CO 3: Develop an ability to solve 2ndand higher order ODEs,
- CO 4: Apply the knowledge of special function in engineering problems,
- CO 5: Use the essential tool of matrices and linear algebra in a comprehensive manner, and
- CO 6: Apply the knowledge of Eigen value and Eigen vector in the field of engineering and also get the concept of complex matrices.

COURSE DETAILS

Ordinary Differential Equations of First Order

Introduction and formation of differential equations, Overview: Variable separable, homogeneous, equations reducible to homogeneous form.Exact differential equations, equations reducible to exact form, linear differential equations, equations reducible to linear form (Bernoulli's equation). Applications of differential equations: Growth-Decay Problem, Newton's Law of Cooling, Mixing problem, Orthogonal trajectories.

Linear Differential Equations of second order

Second order linear homogeneous equations with constant coefficients; differential operators; solutions of homogeneous equations; Euler-Cauchy equation; linear dependence and independence; Wronskian; Solutions of non-homogeneous equations: general solution, complementary function, particular integral; solution by variation of parameters; undetermined coefficients. Applications of 2nd order differential equations in Electric circuit.

Special Functions

Improper Integrals for one variable, some test for convergence of improper integrals, Gamma function, Properties, Beta function, Relation between Gamma and Beta functions. Radius of convergence of power series, Legendre equation. Legendre polynomial. Recurrence relations and Orthogonality property of Legendre polynomial. Bessel's equation, Bessel's function, Recurrence relation.

System of Linear Equations and Vector Space

Linear system of equations; rank of matrix; consistency of linear systems; Solution of system of linear equations: Gauss elimination, inverse of a matrix by Gauss Jordan method, Vector Space, Sub-space, Basis and dimension, linear dependence and independence, Linear transformation.

Matrix-Eigen value problems

Eigen values, Eigen vectors, Eigen basis, quadratic form; Hermitian, Skew-Hermitian forms; similar matrices; Diagonalization of matrices.

Text book

1. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley INC, 10th Edition, 2011.

Reference books

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Edition.
2. H.K. Das, Introduction to Engineering Mathematics, S.Chand & Co Ltd, 11th Edition.
3. B.V. Ramana, Higher Engineering Mathematics, Tata McGraw-Hill Publications 2007.
4. J. Sinha Roy and S. Padhy, A course on ordinary & partial differential Equation, Kalyani Publication, 3rd Edition.

TRANSFORM CALCULUS AND NUMERICAL ANALYSIS

Course Code: MA11002

Credit: 4

L-T-P: 3-1-0

Prerequisite: Nil

COURSE OBJECTIVE

The objective of this course is to familiarize the students with the methods of Laplace and Fourier transformation and various numerical techniques to solve engineering problems.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Apply Laplace Transform to problems in the field of science and engineering,
- CO 2: Use Fourier series and Transform as a tool to solve differential equations,
- CO 3: Estimate the error in the results obtained in the numerical methods,
- CO 4: Solve nonlinear equations that arise in engineering problems and interpolation,
- CO 5: Know various numerical methods of differentiation and integration, and
- CO 6: Apply numerical solution of differential equations and systems of linear equations.

COURSE DETAILS

Laplace Transforms

Laplace Transform, Inverse Laplace Transform, Linearity, Transform of derivatives and integrals, Unit Step function, Dirac delta function, Second shifting theorem, Differentiation and integration of transforms, Convolution, Solution of ODEs and integral equation by Laplace transform.

Fourier Series and Transform: Fourier series, Arbitrary periods, Even and odd functions, Half range expansions, Fourier integral, Cosine and sine transforms, Fourier Transform, Inverse Fourier Transform, Linearity, Fourier Transform of derivative, Convolution.

Approximations & Errors

Approximation of numbers by truncation and rounding-off, Types of errors.

Numerical solution of Nonlinear equations: Solutions by Bisection Method, Fixed Point Iteration Method, Newton-Raphson Method, Regula-Falsi and Secant Method, Rate of Convergence of Secant & Newton-Raphson Method.

Interpolation & Approximation Finite Differences, Operators and Relation between them. Interpolation: Newton's forward and backward difference interpolation, Newton's divided difference interpolation and Lagrange interpolation.

Numerical Differentiation & Integration: Numerical differentiation of first- and second-order equations using difference table. Trapezoidal rule, Simpson's 1/3rd and 3/8th rules, Gauss-Legendre's two-point and three - point formulae. Error in Numerical Integration.

Numerical Solution to ODE

Taylor's (OK?) series Method, Euler's Method, Modified Euler's Method, Runge-Kutta Methods of order 2 and 4, Reduction of second-order ODE to system of first-order ODEs and its solution by R-K method of order four.

Solution of System of Linear Equations, Solutions by Gauss-Seidel and Gauss-Jacobi methods.

Textbooks

1. E Kreyszig, Advanced Engineering Mathematics by Wiley, INC, 10th Edition.
2. Jain, Iyenger and Jain, Numerical Methods for Scientific and Engineering Computation, New age International (P) Ltd., 6th Edition.

Reference books

1. B.S. Grewal, Khanna ,Higher Engineering Mathematics, Publishers, 44th Edition.
2. B.V. Ramana, Higher Engineering Mathematics, Tata McGraw-Hill Publications, 2007.
3. A, Thangapandi and Somasundaram, Numerical Methods, Scitech Publishers, 2nd Edition.

SCIENCE OF LIVING SYSTEMS

Course Code: LS10001

Credit: 2

L-T-P: 2-0-0

Prerequisite: Nil

COURSE OBJECTIVE

The objective of the course is to enrich the basic knowledge of students in the field of biology and use that knowledge to support the engineering and research programs. Besides, the course also helps to learn methodology to establish models for various biological phenomena and apply the aforementioned models to predict/analyse the functionality of various systems.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Learn the typical characteristics that distinguish life forms and analyze life process at cellular level,
- CO 2: Apply concepts on structure and function of simple biomolecules in life processes
- CO 3: Understand different process involved in life and analyse their effects,

- CO 4: Analyse different biological phenomena and relate them to engineering applications,
- CO 5: Comprehend different physiological functions and relate them to computer-based techniques, and
- CO 6: Implement concepts of biology and their relevance to engineering and technology.

COURSE DETAILS

Cellular Organization of a Living Organism

Biology in engineering, The Living World: Biodiversity of living world, Microorganisms, Cell as the basic unit of life, Cell theory, Structure and function of Prokaryotic and Eukaryotic cells, Cell growth and reproduction, Homeostasis, Concept of gene, Basic structure and function of chromosomes.

Molecular and Biochemical Basis of an Organism

Chemical Context of Life: Water, Carbon, Structure and Function, Types of bonding, Bio- macromolecules (Carbohydrates, Proteins, Amino acids, Lipids and Nucleic acids), Protein synthesis, Cell differentiation, Stem cells and their applications.

Enzymes, Photosynthesis, Metabolism and Bioenergetics

Enzymes: Introduction, structure, properties, Classification, Mechanism of enzyme actions, Factors affecting enzyme action, Strategies utilized by enzymes to affect catalysis. Photosynthesis: Introduction, pigments, process of photosynthesis, Mechanism of photosynthesis (light reaction and dark reaction). Metabolism and Bioenergetics: Anabolism and catabolism.

Nervous system, Immune system and Cell Signaling

Nervous system: Introduction, History of neuroscience, Types of glial cells, Nerve cells - Neurons, Organization of the nervous system, Action potential, Diseases of the nervous system, Computer-based Neural Networks. Immune system: Introduction, Innate Immunity, Adaptive or acquired immunity, Diseases of the immune system, Immune engineering. Cell signaling: General principles of cell signaling.

Molecular Machines, Biosensor and Bioremediation

Molecular Machines: Introduction, Molecular motors and Machines, F0F1-ATP synthase motors, Cytoskeleton associated motors. Biosensors: Concept of biosensor, Working principle, Types of biosensors, Glucose biosensors, Bio-detectors: DNA detection biosensor, Detection of pollutants, Biosensor in food industry. Bioremediation: Introduction, Role of microorganisms, Factors determining bioremediation, Types – *in situ/ex situ*, Advantages and disadvantages, Biofuel.

Textbook

1. S. Thyagarajan, N. Selvamurugan, M.P Rajesh, R.A Nazeer, Richard W. Thilagarajan, S. Bharathi and M.K. Jaganathan, Biology for Engineers, McGraw Hill Education (India), 7th Edition, 2022.

Reference books

1. P. H. Raven and G.B. Johnson. Biology (Indian Edition), Tata McGraw Hill Education Publication, 13th Edition, 2023.
2. E D. Enger, Feederick C, Ross and David B. Bailey. Concepts of Biology, Tata McGraw-Hill Publication, 14th Edition, 2011.
3. Neil A. Campbell and Jane B. Reece, Biology, Pearson Education, 8th Edition , December 2007.
4. Cecie Starr, Biology Concepts and Application, Thomson Books, 6th Edition, January 2006.

ENGLISH

Course Code: HS10001

Credit: 2

L-T-P: 2-0-0

Prerequisite: Nil

COURSE OBJECTIVE

The objective of the course is to develop and improve, in the students, the skills of active listening, speaking, reading, and writing in English, through lecture classes and practice sessions, and improve their professional communication abilities. The course will help the students to enhance their critical thinking and situational communicative skills through the study of contemporary social issues depicted in literature.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Apply verbal and non-verbal modes of communication effectively in practical Situations,
- CO 2: Retain a grammatically correct and logical flow while drafting reports and other technical pieces of writing,
- CO 3: Develop competence in reading and comprehension,
- CO 4: Implement active listening responses in professional practice,
- CO 5: Utilize neutral accent in English pronunciation successfully, and
- CO 6: Understand situational and conversational English used for different purposes and contents.

COURSE DETAILS

Professional Communication

Process of Communication: Definition, Explanation & Diagram, Difference Between General and Technical Communication; Methods of Communication (Verbal & Non-Verbal); Non-Verbal Communication (Kinesics, Proxemics, Chronemics, Oculistics, Olfactics, Gustorics, Haptics, and Iconics); Paralanguage; Flow of Communication (Formal & Informal); Levels of Communication; and Barriers of Communication (Intrapersonal, Interpersonal, and Organizational).

Basics of Grammar and Writing Skills

Error Detection in Sentences: Articles, Prepositions, Tense, Subject-Verb Agreement, Active and Passive Voice; Use of Punctuation: Full Stop, Comma, Colon, Semi-colon, Single & Double Inverted Commas, Exclamation & Interrogation Marks, Hyphens and Dashes, and Ampersand;

Paragraph Writing – Components; Writing Bias-free English; Business Letters: Enquiry, Claim/Complaint, and Order; Technical Reports: Formats, Style & Referencing; and Reading Techniques: Skimming, Scanning, Intensive & Extensive Reading.

Basic Sounds of English

Hearing & Listening: Types of Listening – Appreciative, Empathetic, Critical, Comprehensive, Superficial, Differences between Listening & Hearing; Introduction to Basic Sounds of IPA: Symbols of IPA, Types of Vowels & Consonants; and Problem Sounds & Mother Tongue Influence: Concept of MTI with Examples.

English Literature

Short Story – O. Henry: ‘Gift of the Magi;’ Short Story – Ismat Chughtai: ‘Sacred Duty;’ Poem – Robert Frost: ‘Stopping by Woods on a Snowy Evening;’ Poem – Tennessee Williams: ‘We Have Not Long to Love;’ and Drama: William Shakespeare: Merchant of Venice.

Textbook

1. M. Ashraf Rizvi, Effective Technical Communication, Tata McGraw Hill Education Publication, 2005.

Reference books

1. Sidney Greenbaum. The Oxford Grammar (English). Oxford University Press, 1st Edition. 2005.
2. S Verma, Technical Communication for Engineers, Vikas Publishing House, 2015.
3. R Dove, The Penguin Anthology of 20th Century American Poetry, Penguin Books. 2013.
4. The Merchant of Venice (The New Cambridge Shakespeare). Mahood & Lockwood eds. CUP. 2018.

COMMUNICATION LABORATORY

Course Code: HS18001

Credit: 1

L-T-P: 0-0-2

Prerequisite: NIL

COURSE OBJECTIVE

This subject is designed to enrich the basic knowledge of engineering students in the field of communication and to support the engineering and research programs.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Use English grammar correctly and unambiguously in technical writing,
- CO 2: Apply verbal and non-verbal modes of communication effectively in practical situations,
- CO 3: Have a basic understanding of the communication process and to know the practical implementations in the workplace,
- CO 4: Retain a logical flow while drafting reports and other technical pieces of writing,
- CO 5: Develop competence in reading and comprehension, and
- CO 6: Be familiar with English pronunciation and use neutral accent successfully.

COURSE DETAILS

Reading Comprehension

Understanding meaning and sequence of ideas in written language

Activity based on matching, multiple choice questions, open close, appropriate headings.

Time & Tense + Subject-Verb Agreement

Applying correct grammar in everyday writings.

Vocabulary Building (Mind Mapping/Phrasal Verbs)

Developing vocabulary through associating key ideas, and learning idioms and phrases.

Listening Comprehension

Interpreting meaning and syntax in spoken language.

E-mail Writing

Formulating appropriate e-mails with relevant salutation, language & conclusion

Resume Writing/ Video Resume

Creating suitable, job-oriented resume

Thematic Speaking

Practising and implementing theme-based individual speaking skills.

PowerPoint Presentation

Developing skills to design and deliver engaging, informative and impactful presentations

Class Participation.**BASIC ELECTRONICS**

Course Code: EC10001

Credit: 2

L-T-P: 2-0-0

Prerequisite: Nil

COURSE OBJECTIVE

The subject is designed to familiarize students of all branches to the all-pervasive field of Electronics, enable them to carry out research in interdisciplinary fields involving semiconductor devices, and utilize the knowledge in solving practical problems in real life in today's age of electronics.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Understand the properties of semiconductor and current conduction mechanism,
- CO 2: Comprehend the working of P-N junction diodes; identify different diode circuits and analyze them,
- CO 3: Understand the working of different types of transistors,
- CO 4: Know about OP-AMP and its applications,
- CO 5: Analyze the working of op-amp using either inverting or non-inverting configurations, timing circuit, regulated power supply ICs, and their applications, and
- CO 6: Realize the importance of various analog and digital electronic systems and electronic devices.

COURSE DETAILS**Semiconductors, Diodes and Transistors**

Properties of semiconductor materials, Applications of semiconductors as p-n junction diode, Diode characteristics and breakdown mechanisms, Half-wave and full-wave rectifiers with filters, Zener diode, Transistor constructions, operations and their characteristics. Transistor biasing, amplifiers, and load line analysis, Concepts of JFET and MOSFET.

Operational Amplifier (Op-amp) and applications

Introduction to Op-amp and its Characteristics. Application of Op-Amp as Inverting amplifier, Non-inverting Amplifier, Summing, Difference amplifier and comparator

Introduction to Digital Electronics

Different number systems and its conversions, Logic gates and truth tables of OR, AND, NAND, EX-OR. Combinational circuit and Sequential circuit.

Miscellaneous Electronic Devices

SCR, Opto-electronic devices and fiber techniques, Introduction and description of sensor performance, Fundamentals of analog communication techniques (AM and FM).

Textbook

1. J Millman, Christos C. Halkias & C D. Parikh, Integrated Electronics: Analog and digital circuits and Systems , 9th Edition, 2021.

Reference books

1. R. L. Boylestad & L. Nashelsky, Electronic Devices & Circuits, PHI, 7th Edition, 2021
2. D. A. Bell. Electronic Devices and Circuits. (Oxford) 5th Edition, 2021.
3. D. Chattopadhyay and P. C. Rakshit. Fundamentals & Applications , New Age International, 15th Edition 2021.

BASIC ELECTRICAL ENGINEERING

Course Code: EE10002

Credit: 2

L-T-P: 2-0-0

Prerequisite: Nil

COURSE OBJECTIVE

The course is designed to provide to the students a comprehensive overview of the basics of the electrical engineering discipline. In particular, the course includes fundamental aspects of DC, AC and magnetic circuit analysis, working principles and applications of machines, and safety measures used in various electrical apparatus and appliances.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Analyze the concept of DC circuit,
- CO 2: Understand the concepts of AC circuits,
- CO 3: Analyze the three phase circuit,
- CO 4: Interpret the behavior of magnetic circuits,
- CO 5: Remember the principles and operation of electrical machines, and
- CO 6: Know the concepts of electrical safety and protection systems.

COURSE DETAILS

D. C. Circuits

Kirchhoff's law, Source transformation, Star-delta transformation and equivalent resistance of the circuits, Mesh and Nodal analysis, Superposition theorem.

A.C. Circuits

Peak, average, R.M.S. values of sinusoidal quantities, Peak factor, Form factor, Phase difference, Phasor representation, AC through R, L, C, AC Series Circuit (RL, RC, RLC), Three-phase AC circuits: Voltage, current and power in star and delta connections.

Electromagnetic Circuits

Magnetizing Force, Reluctance, Permeance, Magnetic field, Magnetic permeability, Analogy between Electric Circuits and Magnetic Circuits. Series magnetic circuit, BH curve.

Scope and Safety Measures

Electrical Energy Scenario in India, Application of Transformer, Three-phase and single-phase induction Motors, Power ratings of air conditioners, PCs, laptops, printers, refrigerator, washing machine, different lamps, electricity tariff, calculation of electricity bill for domestic consumer.

Personal Safety Measures

Electric Shock, Earthing and its types, Safety Precautions to avoid shock.

Equipment Safety Measures

Working principles of fuse and miniature circuit breaker (MCB), Residual Current Circuit Breaker (RCCB).

Text books

1. V K Mehta, Rohit Mehta, Principles of Electrical Engineering and Electronics S Chand and Company, New Delhi ,Revised Edition 2013.
2. D.C. Kulshreshtha, Basic Electrical Engineering Tata Mcgraw publication, 1st Edition 2011.
3. T.K. Nagasarkar and M.S. Sukhija Basic Electrical Engineering, , Oxford University press, 3rd Edition 2017.

Reference book

1. Sanjeev Sharma, Basics Electrical Engineering I.K.International, New Delhi ,Third Reprint 2010.

ENGINEERING MECHANICS

Course Code: ME10001

Credit: 2

L-T-P: 2-0-0

Prerequisite: Nil

COURSE OBJECTIVE

Engineering Mechanics is a specialized need-based extension of Applied Physics and uses the principles of Statics and Dynamics. The objective of this course is to build the foundational knowledge of the students which is required for the design of mechanical systems. In particular, the course will cover aspects of analysis of rigid body, frame and machine under the action of force system, and analysis of free body diagram of a system whether at rest or in motion.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Draw complete and correct free-body diagrams and write the appropriate equations from the free-body diagram,
- CO 2: Use scalar analytical techniques for analyzing forces and moments in mechanical systems,
- CO 3: Analyze forces in statically determinate structures such as trusses, frames and problems related to friction,
- CO 4: Determine the centroid and second moment of area,
- CO 5: Apply fundamental concepts of kinematics and kinetics of particles to the analysis of simple and practical problems, and
- CO 6: Solve real life problems by using mathematics, physical laws and theorems.

COURSE DETAILS

Concurrent Forces in a Plane

Introduction to Engineering Mechanics, Free-body diagrams, Composition and resolution of forces, Methods of moments. Friction: Concept of friction, Wedge friction.

Force Analysis of Plane Trusses

Methods of joints, Method of Sections, Centroid: Parallel forces in a plane, Centroid of plane figures, Theorem of Pappus, and Centroid of composite plane figures.

Moment of Inertia

Moment of Inertia of plane figures, Parallel axis theorem, Perpendicular axis theorem, and Moment of Intertia of composite figures.

Principle of Virtual Work

Equilibrium of Ideal Systems, Virtual work.

Dynamics of Particles

Differential equations of rectilinear motion, Free vibration, D'Alembert's Principle, Momentum and Impulse, Work & Energy, Conservation of energy, Impact.

Curvilinear Motion

Normal and tangential acceleration, Motion of a projectile, Work and Energy in curvilinear motion.

Rotation of a Rigid Body

Kinematics of rotation, Rotation under the action of a constant moment.

Textbook

1. S Timoshenko, D. H Young & J.V. Rao, Engineering Mechanics, Tata McGraw-Hill Publication 5th Edition, 2017.

Reference books

1. I H Shames, Engineering Mechanics (Statics and Dynamics) , Prentice Hall, 4th Edition, 2005.
2. S.S. Bhavikatti, Engineering Mechanics –New Age International, 8th Edition, 2021.

3. S. Rajasekaran and G. Sankarasubramanian Engineering Mechanics (Statics and Dynamics),Vikas publishing House, 3rd Edition, 2017.

WORKSHOP

Course Code: ME18001

Credit: 1

L-T-P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

This workshop practice is designed to impart students the basic knowledge on manufacturing or developing a given object irrespective of their branch of engineering. While furnishing the given object, students will familiar with various mechanical operations and the respective tools or machines. This course involves four different sections namely Fitting, Welding, Turning and Sheet metal which cover both conventional and advanced tools to provide students the updated manufacturing experience. Students are also advised with various safety precautions to be followed during a specific manufacturing practice. At the end, students will also gain knowledge on different advanced machines such as CNC machine tools and 3D printing.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Practice different operations related to fitting shop,
- CO 2: Use different welding tools to prepare a given type of joint,
- CO 3: Demonstrate various turning operations including taper turning and knurling using a conventional lathe machine,
- CO 4: Design a tray and prepare it using sheet metal equipment involving soldering,
- CO 5: Appraise different operations using a CNC machines, and
- CO 6: Interpret different advanced machines such as 3D printing/additive manufacturing.

Topics

- Turning operations
- Sheet metal operations
- Fitting
- Welding

ENGINEERING DRAWING & GRAPHICS

Course Code: CE18001

Credit: 1

L-T-P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

The objective of this course is to provide students with knowledge and abilities to design a 3D object on 2D paper by hand sketching method and by means of computer aided drafting software.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Use common drafting tools properly,
- CO 2: Select, construct and interpret appropriate drawing scale as per the situation,
- CO 3: Draw orthographic projections of points, lines and planes,
- CO 4: Draw orthographic projection of solids like cylinders, cones, prisms and pyramids,
- CO 5: Develop the section of solids for practical situations, and
- CO 6: Communicate ideas effectively using Computer Aided Drafting.

Topics

- Introduction to Engineering graphics
- Lettering
- Projection of points & lines
- Line inclined to both the planes
- Projection of planes
- Introduction to Computer Aided Drafting
- Projection of solids
- Section of solids
- Development of surface

Textbook

1. K. Venugopal,Engineering Drawing + AutoCAD New Age Publishers, 1st Edition, 2011.

Reference book

1. S. N. Lal Engineering Drawing with an Introduction to AutoCAD, Cengage India Private Limited, 1st Edition, 2017.

PROGRAMMING LABORATORY

Course Code: CS13001

Credit: 4

L-T-P: 0-2-4

Prerequisite: Nil

COURSE OBJECTIVE

The course aims to provide exposure to problem-solving through programming. It aims to train the student to the basic concepts of the C-programming language. This course involves lab component which is designed to give the student hands-on experience with the concepts.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Have fundamental knowledge of computers hardware and number systems with commands in Linux,
- CO 2: Write, compile and debug programs in C language.
- CO 3: Design programs involving decision structures, loops, and functions.
- CO 4: Construct arrays to store, manipulate, search and display data.
- CO 5: Apply the dynamics of memory by the use of pointers.
- CO 6: Use different data structures and create/update basic data files.

Topics

- Basic linux commands
- Operators and Expressions
- Branching statements (if-else, switch).
- Control statements (looping - for, while, do-while).
- Arrays
- Character Arrays (strings).
- Functions.
- Pointers and Dynamic Memory Allocation.
- Structures and Unions
- File Handling

SCIENCE ELECTIVE

NANOSCIENCE

Course Code: CH10005

Credit: 2

L-T-P: 2-0-0

Prerequisite: Nil

COURSE OBJECTIVE

This course is designed to educate, inspire, and motivate young students about nanoscience, nanotechnology, and their applications. The course provides information on the latest innovations in this field to get insights into the nanomaterials synthesis/fabrication and applications that can be achieved at a nanoscale.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Learn fundamental aspects of nanoscience,

CO 2: Classify different types of nanomaterials based on their dimension and composition

CO 3: Understand different synthesis techniques to grow nanomaterials,

CO 4: Analyse nanomaterials using different characterisation techniques,

CO 5: Apply the acquired knowledge to design new materials, and

CO 6: Evaluate the importance of nanoscience in engineering applications.

COURSE DETAILS

Introduction

Concept and Classifications based on dimensions and compositions, Significance of nanosize: Surface area to volume changes; Properties changing with size (reactivity, melting point, catalytic, electrical, optical), Nanoscience in nature, and Quantum dots as data storage.

Synthesis of nanomaterials

Top-down synthesis (Mechanical method-ball milling, Photolithography, Laser ablation, sputtering), Bottom up (pyrolysis, sol-gel, CVD, self-assembly), Green synthesis (metallic nanoparticles, metal oxides), Biosynthesis.

Characterization

XRD-X-ray generation, Working principle (Bragg's law), Peak broadening in nanomaterials (Scherrer formula), Electron microscopy (SEM, TEM)—high energy electron generation, electron optics, Scanning Electron Microscopy (SEM)—secondary, back scattered, EDX, Transmission Electron Microscopy (TEM)—bright field imaging, dark field imaging, and Selected area diffraction pattern.

Applications

Cosmetics—ZnO, SiO₂, TiO₂ Nanoparticles in cosmetics, SiO₂ TiO₂ in toothpaste, silver, gold, copper nanoparticles in skin care product; *Medical Fields*—MRI, CT scan contrast enhancement agent, Drug and gene delivery system, Magnetic hyperthermia treatment; *Agriculture*—Nano-pesticides, herbicides, and fungicides, Food packaging; *Aerospace and Aviation Industries*—Carbon nanotubes (CNT)nanocomposites, Metal Nanoparticle-Polymer composites, SiC Nanoparticle reinforced alumina (high temperature strength, creep resistance); and *Nanomaterials for Environmental Remediation*—Degradation/removal of pollutants.

Textbook

1. B S Murty, P Shankar, Baldev Raj, B B Rath and James Murday, Textbook of Nanoscience and Nanotechnology, 1st Edition, 2012, ISBN-13: 978-8173717383.

Reference books

1. Luisa Filippini and Duncan Sutherland.,Nanotechnologies: Principles, Applications, Implications and Hands-on Activities, Edited by the European Commission Directorate-General for Research and Innovation Industrial technologies (NMP) program, 2012, ISBN: 978-92-79-21437-0.
2. Charles P. Poole Jr., Frank J. Owens., Introduction to Nanoscience and Nanotechnology, An Indian Adaptation, 3rd Edition, 2020, ISBN-13: 978-9354240201.
3. P. I. Varghese, T. Pradeep. A Textbook of Nanoscience and Nanotechnology, Tata McGraw Hill Education, 2017, ISBN: 9781259007323.

SMART MATERIALS

Course Code: PH10003

Credit: 2

L-T-P: 2-0-0

Prerequisite: Nil

COURSE OBJECTIVE

This course is designed with the objective of enabling engineering students to get a flavour of advances in materials science. The knowledge of smart materials learnt by the students in the course will let them to realize the usefulness of various new-age materials for technological advances and allow them to explore further in their higher semesters. This course will help them bridge the gap between traditional text book science put into physics, chemistry, etc. and the state-of-the-art science of materials.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO1 : Learn about smart materials, their properties and applications,

CO2 : Understand types of smart material based on their electrical and magnetic properties,

- CO3 : Characterize piezoelectric, ferroelectric and multiferroic materials,
- CO4 : Identify novel functions of smart materials,
- CO5 : Apply the acquired knowledge of smart materials in different applications, and
- CO6 : Evaluate the importance of smart materials in day-to-day life.

Introduction to Smart Materials

common smart materials and associated stimulus-response, Classification: active and passive, Piezoelectric, Shape-memory alloys, Photo-responsive polymers, Electroactive polymers, Magnetostriction and Electrostrictive, Thermo-responsive polymers, Dielectric elastomers, Halochromic, Thermoelectric materials; Application areas of smart materials: Space, health care and biomedical sectors.

Piezoelectric Materials: Piezoelectric Effect

Direct and Converse, Piezoelectric coefficients, Piezoceramics, Piezopolymers, Piezoelectric Materials as Sensors, Actuators etc.

Shape-memory Alloys

Shape memory alloys (SMAs) and properties, Phase change in SMAs, Shape memory effect: One-way and two-way, binary, and ternary alloy systems, Applications.

Chromic Materials

Photochromic, Thermochromic, Electrochromic, Magneto-chromic and Piezo-chromic Materials.

Multiferroic Materials

Multiferroics definitions, Ferroic phases, Magnetoelectric coupling; Type-I and Type-II multiferroics, Mechanism: Charge ordering, lone pair, geometric effect, and spin driven mechanism; Multiferroic materials, Applications.

Textbook

1. B. K. Pandey and S. Chaturvedi, Engineering Physics, Cengage Publication, New Delhi, 2nd Edition 2022, ISBN-13: 978-81-953536-7-5.

Reference books

1. Mohsen Shahinpoor, Fundamentals of Smart Materials, 2020, Royal Society of Chemistry, ISBN: 9781782626459.
2. M. Schwartz, Smart Materials, 1st Edition, 2008, CRC Press, ISBN 9781420043723.

MOLECULAR DIAGNOSTICS

Course Code: LS10003

Credit: 2

L-T-P: 2-0-0

Prerequisite: Nil

COURSE OBJECTIVE

The objective of the course is to understand methods and techniques that are used to study biological processes in living beings. They include experimental and methodological approaches, protocols and tools for biological research.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Learn the basics of Genes, Chromosomes, DNA, RNA and proteins along with their Aberrations,
- CO 2: Understand the principles and working mechanisms of various instruments used in the study of biological processes in living things,
- CO 3: Apply the knowledge of different diagnostics methods for quantitative estimation of xenobiotics (drugs and their metabolites) and biotics (proteins, DNA, metabolites) in biological systems,
- CO 4: Analyze the recent developed techniques which are required for gene editing and their Applications,
- CO 5: Evaluate the role of various bio-analytical techniques in environmental studies, biomedical sciences, life sciences, molecular biology, and biotechnological research, and
- CO 6: Implement the knowledge of diagnostics in designing point-of-care instruments for different diseases.

COURSE DETAILS

Biomolecules

Overview of DNA, RNA, and Proteins, Chromosomal structure & mutations, DNA polymorphisms; and Gene and Genetic errors.

Molecular Basis of Diseases

Infectious, non-infectious; Diagnosis- traditional, modern tools, Concepts of molecular diagnostics.

Molecular Diagnosis and Techniques

DNA fingerprinting, Auto-antibody fingerprinting, Southern blotting, PCR, Real-time PCR and variations; Nucleic acid sequencing: New generations of automated sequencers, CRISPR technology and its use in diagnostics and gene editing.

Protein Diagnostics Techniques

Antigen-antibody reactions, ELISA, variations of ELISA; Western blotting.

Point-of-Care Devices

Biosensors and nano-biosensors for disease and metabolites detection.

Textbook

1. M K. Campbell, S O. Farrell, O M. McDougal, AE Biochemistry, Cengage Publisher, 9th Edition 2017, ISBN-13: 9789814846448.

Reference books

1. N Rifai, Andrea Rita Horvath and Carl T. Wittwer, Principles and Applications of Molecular Diagnostics, 2018, Elsevier Publisher, 1st Edition, 2018.
2. K G Ramawat & Shaily Goyal, Molecular Biology and Biotechnology, ISBN 9788121935128 Publisher S Chand & Co., 2nd Edition, 2010.
3. H Lodish, Arnold Ber, Molecular Cell Biology, WH Freeman Publisher, 8th Edition, 2016, ISBN-10 9781464187445.

SCIENCE OF PUBLIC HEALTH

Course Code: PE10002

Credit: 2

L-T-P: 2-0-0

Prerequisite: Nil

COURSE OBJECTIVE

The objective of this course is to orient the students to core scientific disciplines in public health practice.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Understand and enlist the scientific approaches in public health,
- CO 2: Understand and apply the epidemiologic and biostatistical science in evidence synthesis,
- CO 3: Understand and apply the environmental health science in public health practice,
- CO 4: Understand and apply the social and behavioral science in public health practice,
- CO 5: Understand and apply the health economic and health management principles in setting priority for resource allocation, and
- CO 6: Understand and apply the health economic and health management principles in health system optimization.

COURSE DETAILS

Scientific Approaches to Public Health

Health and public health concepts, Science and practice of applied public health: Scientific disciplines as part of interdisciplinary public health, Examples of use of behavioral model in changing the community perception of public health interventions

Social and Behavioral Sciences in Public Health

Social and behavioral determinants of health and disease, WHO and CDC models of social determinants of health, Disease and social status, Disease and poverty, Social interventions for good health.

Health behavior change models for public health interventions, Health Belief Model, Transtheoretical Model. The theory of planned behavior, Health communication to improve the outcome of public health interventions

Environment Health Sciences in Public Health

Environment & climate change, Ecosystem, Lifestyle and dietary effects on health, food safety and sanitation, Environmental pollution, waste disposal and treatment.

Epidemiology and Data Science in Public Health

Epidemiology and achievements in public health, Measurements in Epidemiology—Incidence and prevalence, Causation and association, and Measures of association.

Outline of study designs (including cross-sectional study design, case-control study design, cohort study design and randomized control trials); Introduction to confounding and bias; Screening tests- validity and reliability methods.

Management and Economic Sciences in Public Health

Systems approach (input, process and outcome) in public health. Health management information system, Horizontal and vertical integration of public health interventions, Public-Private mix.

Understanding community, Community health related needs assessment, Community orientation and Community mobilization, Introduction to digital health.

Textbooks

1. R Detal, Oxford Textbook of Global Public Health, Oxford, 7th Edition, 2021.
2. K Parks, Textbook of Preventive and Social Medicine, M/S Banarsidas Bhanot Publishers, . 26th Edition, 2021.

Reference books

1. Robert H. Friis,. Essentials of Environmental Health, Jones & Bartlett Publishers, 2018
2. Warrier S,. Information and Communication Technologies in Public Health A Sociological Study,CBS Publishers, 2020.
3. Baker JJ. Baker RW, Dworkin NR, Health Care Finance: Basic Tools for Non-financial Managers., Jones and Bartlett Publishers, Inc, 5th edition. 2017.
4. Ross TK, Practical Budgeting For Health Care: A Concise Guide, Jones andBartlett Publishers, Inc, 2020.

OPTIMIZATION TECHNIQUES

Course Code: MA10003

Credit: 2

L-T-P: 2-0-0

Prerequisite: Nil

COURSE OBJECTIVE

To familiarise the students with a few rudimentary and popular optimization techniques to enable them to solve resource-constrained real world problems.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Know the concept of Linear programming problem (LPP) and will able to formulate linear programming problem,
- CO 2: Understand the basic terminology and concepts of solving LPP,
- CO 3: Solve LPP by simplex method,
- CO 4: Know the concept of duality in Optimization technique,
- CO 5: Apply optimization technique to solve transportation problem, and
- CO 6: Solve assignment problem.

COURSE DETAILS

Linear Programming

Mathematical foundations and basic definitions, Linear optimization: Formulation and graphical solution of linear programming problems, Simplex method, Duality.

Transportation

General structure of a transportation problem, Finding initial basic feasible solution by North-West corner rule, Least-Cost method and Vogel's Approximation Method, and Testing for optimality.

Assignment Problem

Hungarian assignment method, Unbalanced assignment problems, Restrictions in assignment, Travelling Salesman model.

Textbook

1. H.A. Taha, Operation Research, An Introduction, Pearson Education, 10th Edition.

Reference books

1. K. Gupta, Kanti Swarup, and Man Mohan ,Operations Research, P., S.Chand &Co, 2004.
2. N. S. Kambo, Mathematical Programming Techniques.,East West Press, 1997.
3. R. Fletcher., Practical Methods of Optimization, 2nd Ed., John Wiley, 1987.
4. Hanif D, Sheralli, M. S. Bazaraa. & J.J. Jarvis, Linear Programming and Network Flows, Wiley Publication. 2nd Edition.

ENGINEERING ELECTIVE

BASIC CIVIL ENGINEERING

Course Code: CE10001

Credit: 2

L-T-P: 2-0-0

Prerequisite: Nil

COURSE OBJECTIVE

The course is designed to provide an overview of different aspects of civil engineering profession , namely, surveying, materials, structural, and geotechnical engineering, hydraulics and water resources, environmental engineering, and transportation engineering and their roles in the societal development.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Understand the importance and practical applications of different types of surveying,
- CO 2: Learn about the different construction materials and understand the philosophy of structural analysis and design,
- CO 3: Understand engineering behaviour of soil and types of foundations,
- CO 4: Understand different hydraulics, hydrological and water resources engineering applications,
- CO 5: Learn about the management strategies of wastewater and solid waste, and
- CO 6: Understand the basics of different types of highways, railways, ports and harbours.

COURSE DETAILS

Introduction

Role of civil engineers in designing, building, and maintaining infrastructure and improving quality of life,Specializations in the civil engineering and their specific roles.

Surveying

Plans, maps, scales, divisions of surveying, classification of surveying, leveling, and advanced methods of surveying.

Construction Materials & Structural Engineering

Different construction materials and their uses, **structural analysis and design philosophy**.

Geotechnical Engineering

Overview on origin of soil, engineering properties and their classification; Soil exploration; Foundations: Their importance and purpose; Factors to consider in foundation design and stability of slopes; and Improving site soils for foundation use.

Hydraulics & Water Resources Engineering

Overview of fluid properties, open channel flow, surface and groundwater hydrology, and irrigation infrastructures.

Environmental Engineering

Types of waste water, Principles of wastewater management, Types of solid waste, and Principles of solid waste management.

Transportation Engineering

Classification of highways, Typical construction methods of roads, traffic surveys and their applications in traffic planning, Railways, Ports and Harbours.

Textbook

1. Er. Shrikrishna A. Dhale and Er. Kiran M. Tajne, Basics of Civil Engineering, S. Chand & Co., 1st Edition, 2014.

Reference books

1. S. S. Bhavikati, “Basic Civil Engineering” by New Age International Publisher, 1st Edition, 2021.
2. M. S. Palanichamy “Basic Civil Engineering”, Tata McGraw-Hill Publication.

BASIC MECHANICAL ENGINEERING

Course Code: ME10003

Credit: 2

L-T-P: 2-0-0

Prerequisite: Nil

COURSE OBJECTIVE

The course is designed to give an overview of the fundamental aspects of mechanical engineering so that a student pursuing any branch of engineering will realize the possibilities that the branch of mechanical engineering offers.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Understand the basic principles of thermodynamics,
- CO 2: Develop an understanding of fluid machines like turbine and pump,
- CO 3: Determine stress and strains in a component subject to a load,
- CO 4: Understand the working and design aspect of power drives,
- CO 5: Recognize appropriate material for a particular engineering application, and
- CO 6: Understand the fundamentals of manufacturing processes.

COURSE DETAILS

Concepts of Thermodynamics

Systems, properties, state, and cycle, Thermodynamic equilibrium and quasi-static process, First law of thermodynamics for closed system, First law of thermodynamics for open/flow systems, Second law of thermodynamics, Kelvin Plank statement, Clausius statement, and Basic concept of entropy

Fluid Mechanics and Hydraulic Machines

Introduction to fluids, Properties of fluids, Pressure variation with depth, Bernoulli's equation and its applications, and Introduction to hydraulic turbines and pumps.

Mechanics of Materials

Stress, Strain, Stress-Strain diagrams for ductile and brittle materials, Elastic constants, Hooks Law, Factor of Safety, One-dimensional loading of members of varying cross sections.

Power Transmission

Gear, , Belt, and Chain Drives, Shaft under varying loading conditions, Introduction to robots, Applications of robotics, Basic robot motions, Sensors and Actuators.

Manufacturing Processes

Introduction to engineering materials, Types and classification of materials, Properties of materials, Introduction to casting, forming, forging, rolling, extrusion and welding, Introduction to machine tools, NC, CNC, and 3-D Printing.

Textbook

1. P Kumar, Basic mechanical Engineering, Pearson Education, 2nd Edition, 2018

Reference books

1. J K Kittur and G D Gokak, Elements of Mechanical Engineering Willey, 1st Edition, 2015.
2. B Agrawal, C M Agrawal ,Basic Mechanical Engineering, Willey, 1st Edition, 2011.

ELEMENTS OF MACHINE LEARNING

Course Code: EE10001

Credit: 2

L-T-P: 2-0-0

Prerequisite: Nil

COURSE OBJECTIVE

Today, we have access to massive data which get generated through information and computer technology in our connected world. Most of these data lie unused and often overwhelm us due to their size and variety. The objective of this course is to introduce to the students to the field of learning from data, discovering data patterns, converting them into knowledge, and applying it to solve real-world problems.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Demonstrate fundamentals of machine learning,
- CO 2: Identify data types, apply suitable processing and visualize using suitable methods,
- CO 3: Describe Unsupervised Learning and apply clustering techniques,
- CO 4: Describe Supervised Learning and apply classification techniques,
- CO 5: Demonstrate perceptron and Multi-layer Perceptron models, and
- CO 6: Apply machine learning techniques for real world requirement.

COURSE DETAILS

Introduction

Importance and Applications of Machine Learning, Supervised, Unsupervised, Reinforcement Learning and Evolutionary Learning.

Data Analysis

Measurement Scales and Data Types; Visualization, Pre-processing and Transformation of Data; Dimensionality Reduction; and Data (Dis)Similarity.

Unsupervised Learning

K-means and Density-based, Clustering Methods.

Supervised Learning

K-Nearest Neighbour, Decision Tree by Qualitative and Quantitative (information Gain method); Evaluation by Confusion Matrix of Supervised Learning Methods.

Learning with Neural Networks

Perceptron, Multi-layer Perceptron and, Error Backpropagation Learning.

Textbooks

1. Gopal, M., Applied Machine Learning, McGraw Hill Education, 2018
2. Pradhan, M. and U. D. Kumar, Machine Learning Using Python, Wiley India Pvt.Ltd, 2019.

Reference books

1. Alpaydin, E., Introduction to Machine Learning, 3rd Edition, The MIT Press, 2014.
2. Bishop, C M, Pattern Recognition and Machine Learning, Springer, 2006.
3. Jain, V. K., Big Data Science Analytics and Machine Learning, Khanna Publishers, 2021

4. Mitchell, T. M., Machine Learning, McGraw Hill, 1997.
5. Müller, A. C., Introduction to Machine Learning with Python, O'Reilly Media, Inc, 2016
6. Raschka, S. and V. Mirjalili, Python Machine Learning, 3rd Edition, Packt Publishing, 2019.
7. Shalev-Shwartz, S. and S. Ben-David, Understanding Machine Learning: From Theory to Algorithms, Cambridge University Press, 2014.

BIOMEDICAL ENGINEERING

Course Code: EC10003

Credit: 2

L-T-P: 2-0-0

Prerequisite: Nil

COURSE OBJECTIVE

Biomedical Engineering is a multidisciplinary field that combines knowledge available in a wide range of disciplines such as engineering, medicine, and societal science. The course focuses on innovating newer equipment and technologies to improve human health and enhance health care facilities in a holistic manner.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Apply knowledge of basic engineering and biology to solve the problems,
- CO 2: Knowledge of human body about cell, potential and organs of body,
- CO 3: Develop a thorough understanding on principles of bio-instrumentation,
- CO 4: Explain the role of bio-potential electrodes, and design of sensors,
- CO 5: Differentiate and analyse the biomedical signal sources, and
- CO 6: Knowledge about imaging techniques used in hospital.

COURSE DETAILS

Introduction and Overview

Introduction to biomedical engineering, Applications of biomedical engineering.

The Human Body

cClL-structure and function, Tissue & organs, Bio-potentials, Action potential, Major human systems (musculoskeletal, circulatory, nervous, and respiratory system)

Bio-instrumentation

Instruments in medical practice, Man-instrumentation system, Basic components, Linear network analysis, Bioelectric amplifier (OpAmp, isolation amplifier, instrumentation amplifier), Bio-instrumentation design, and Intelligent medical instrumentation.

Biomedical Electrodes and Sensors

Signal acquisition, Bio-potential measurements, Active and passive sensors, and Electrodes for biophysical sensing (Ag-AgCl, surface electrodes, microelectrodes), transducers, sensors.

Biomedical Signals, Imaging and Informatics

Bioelectric phenomena, Sources of biomedical signals, Origin of biopotentials, Basics of bio-signal processing, noise, Interference, Electrical safety issues, Principle of medical imaging techniques, such as X-ray, US, MRI, CT scan, and nuclear imaging, and Fundamentals of bio-informatics.

Textbook

1. John D. Enderle & Joseph D. Bronzino Introduction to Biomedical Engineering, Academic press, 3rd Edition, 2012.

Reference books

1. Joseph D. Bronzino, Donald R. Peterson, The Biomedical Engineering Handbook, CRC press, 4th Edition 2015.
2. G.S. Sawhney, Fundamentals of Biomedical Engineering, New Age International (P) Ltd, 2011.

BASIC INSTRUMENTATION

Course Code: EE10003

Credit: 2

L-T-P: 2-0-0

Prerequisite: Nil

COURSE OBJECTIVE

The course is designed to impart, to the students, the principles of analog and digital measuring instruments which include the working mechanisms of sensors and transducers and their applications in industrial and biomedical systems.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Know the basics of measuring instruments,
- CO 2: Measure different electrical quantities,
- CO 3: Understand the working principles of optical and electrical transducers and sensors,
- CO 4: Understand the working of electrical transducers and sensors,
- CO 5: Apply the transducers in industrial applications, and
- CO 6: Use instruments in biomedical applications.

COURSE DETAILS

Analog and Digital Instruments

Basics of measuring instruments, Types of analog instruments, Measurement of voltage, current, power and energy in single and three phase circuits; Digital Instruments: Digital voltmeter, Digital multimeter, Timer/counter, and Time, phase and frequency measurements in oscilloscope.

Sensors and Transducers

Optical sources and detectors: LED, photo-diode, light dependent resistor; Basics of fiber optic sensing, IR Sensors. Resistive, capacitive, inductive, piezoelectric, and Hall effect sensors, Temperature transducers: Thermocouple, RTD , and thermistor.

Transducers in Industrial Applications

Measurement of displacement (linear and angular), velocity, acceleration, force, torque, vibration, shock, pressure, flow, liquid level, pH, conductivity and viscosity.

Instruments in biomedical applications

ECG, Blood Pressure measurement, CT Scan, and Sonography

Textbook

1. R. K. Rajput ,Electrical and Electronic Measurements and Instruments,S Chand Publication, 4th Edition, 2015,William David Cooper,Electronic Instrumentation and Measurement Techniques, by PHI, 2010.

Reference books

1. Er. R.K. Jain, Mechanical and Industrial Measurements (Process Instrumentation and Control), Khanna Publishers, 1995.
2. A.K Sawhney, A course in Electrical and Electronics Measurements and Instrumentation Dhanpat Rai Publication, 10th Edition, 2012.
3. D Patranabis, Sensors And Tranducers, PHI Publication, 2ndEdition, 2017.

HASS ELECTIVE I

SOCIETY, SCIENCE AND TECHNOLOGY

Course Code: HS10013

Credit: 2

L-T-P: 2-0-0

Prerequisite: Nil

COURSE OBJECTIVE

There is a circular relationship between society, science, and technology. Society creates a need and an ambience to develop science and technology, and science and technology create means to meet societal needs and new opportunities to make human life better. Studying this relationship is the objective of this subject. The subject will expose, before the students, the past developments of science and technology and the social forces that played a dominant role in making these developments possible and the way these were used in the society. The subject will also present the ethical principles that underlie the development and use of science and technology in the society.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Understand the forces that shape the development of science and technology,
- CO 2: Understand the major milestones of scientific discoveries have impacted human thought processes,
- CO 3: Understand the effect of technological developments in societal transformation,
- CO 4: Analyse the contribution of Science and Technology in solving societal and Environmental problems,
- CO 5: Evaluate the ethical issues related to abuse of science and technology, and
- CO 6: Apply the skills learned to suggest solutions to global problems linked to science and Technology.

COURSE DETAILS

Introduction

Human Curiosity to Know the Truth of Nature, Need to Improve Quality of Life, Emergence of Science and Technology, Characteristics of Society, Science, and Technology, and Impact of Science and Technology on the Society.

Scientific Discoveries

Milestone Scientific Discoveries of the Past and the Ways They Impacted Human Thought Process and Culture; Scientific Method, Developing a Theory, and Making of a Discovery; Discoveries in the Physical, Biological, and Mathematical Sciences; Normal Science, Paradigms, Anomalies, Crisis and Emergence of Scientific Theories, and Scientific Revolutions.

Technological Developments

Milestone Developments of Technologies and the Ways They Transformed the Society. Stories of Technological Developments such as Steam Engines, Electricity, Semiconductors, and IoT.

Science and Technology in the Service of the Society

Contributions of Science and Technology to Solving Societal, Environmental, and Global Problems. Successes and Limitations, and Abuses and Control of Science and Technology; Ethical Considerations.

Textbook

1. Bucchi, M., Science In Society: An Introduction to Social Studies of Science, Routledge Publication, 1st Edition,2004.

Reference books

1. Collins, H. and T. Pinch, The Golem: What You Should Know about Science, 2nd Edition, New York: Cambridge University Press,1998.
2. Collins, H. and T. Pinch,The Golem: What You Should Know about Technology, 2nd Edition. New York: Cambridge University Press, 2014.
3. Kuhn, T. S.,The Structure of Scientific Revolutions, 4th Edition, Chicago University Press, 2012.
4. Hatton, J. and P. B. Plouffe, Eds., Science and Its Ways of Knowing, New Jersey: Prentice Hall,1997.
5. Moskovites, M., Ed., Science and Society, Ontario: House of Anansi Press Limited,1997
6. Sismondo, S. An Introduction to Science and Technology Studies, 2nd Edition. Maldon, MA: Blackwell Publishing, 2009.
7. Sarukkai, S. What Is Science?, New Delhi: National Book Trust, India, 2012.
8. USSR Academy of Sciences Science and Society, Moscow: Nauka Publishers, 1989.

SOCIO-POLITICAL ENVIRONMENT

Course Code: SO10043

Credit: 2

L-T-P: 2-0-0

Prerequisite: Nil

COURSE OBJECTIVE

The objective of this course is providing basic knowledge on socio-political environment of India and to equip the students with an understanding of their roles, duties and responsibilities in a democratic set up.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Understand contemporary Indian social problems,

CO 2: Understand the roles and functions of the three political institutions in our democratic up,

- CO 3: Familiarize the students with the Rights and Duties enlisted in the Indian Constitution,
CO 4: Grasp the interrelationships among political, social and economic issue,
CO 5: Visualize contemporary changes in Political Institutions, and
CO 6: Realize the importance of equity, equality, and dignity in a democratic system.

COURSE DETAILS

Social Problem in India

Meaning and Definition of Social Problems, Characteristics, Causes and Consequences, Problems of Poverty, Unemployment, Population growth, Problems of Women and Aged, Corruption and Nepotism, Illiteracy, Substance Abuse, and Terrorism.

Social Stratification

Equity and Equality, Caste, Religion, Class, Gender Discrimination, Urban Slums.

Political Institutions

Meaning and Basic Concepts of Political Institutions: Legislative, Executive and Judiciary Systems of the Indian Constitution.

Fundamental Rights and Duties

Fundamental Rights and Duties in Indian Constitution, Directive Principles of State Policy.

Contemporary Changes in Political Institutions

Changing Role of the Government in Contemporary India, Role of Government in the Formation of National and International Policies and Their Impact on Business and Trade.

Textbooks

1. C. N. Shankar Rao, S. Chand., Indian Social Problems, by S. Chand Publication, 2017
2. M. Laxmikanth., Constitution of India, Cengage Learning, 2020.
3. Himanshu Roy & M.P Singh Indian Political System, Pearson publisher, 4th Edition, 2018.
4. Ram Ahuja, Social Problems in India, Rawat publisher, 4th Edition, 2014.

Reference books

1. Our Parliament, Subhash C Kashyap, NBT, 2021.
2. Social Stratification, Dipankar Gupta (Ed), Oxford India Publication, 1997.
3. Modernisation of Indian Tradition, Yogendra Singh, Rawat Publication, 1986.

THINKING PERSPECTIVES

Course Code: PS10043

Credit: 2

L-T-P: 2-0-0

Prerequisite: Nil

COURSE OBJECTIVE

Cognition plays a significant role in accumulation and processing of information. This subject provides an in-depth understanding of some of the cognitive processes in terms of current theories, models and applications. It helps learners to understand the importance of these cognitive processes and the rationale behind cognition,

problem solving, critical thinking, and scientific thinking. It facilitates students to identify and analyze the key conceptual and theoretical frameworks underpinning cognitive process.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Understand the definition and scope of cognition, problem solving, and creativity,
- CO 2: Understand the theories related to cognition, decision making, and critical thinking,
- CO 3: Understand the classic and current experimental research in cognitive processes,
- CO 4: Develop skills essential in designing and conducting experiments in cognition, reasoning, and problem solving,
- CO 5: Understand various aspects of critical thinking, scientific thinking, and design thinking process, and
- CO 6: Apply the knowledge of cognitive processes to one's own personal life and to real life issues.

COURSE DETAILS

Basics of Cognition

A Brief History, Emergence of Modern Cognitive Approach, Thinking, Basic Elements of Thought: Forming Concepts, Propositions, Images.

Reasoning, some Basics sources of error, Information-processing approach, connectionist approach, evolutionary approach, ecological approach.

Memory Processes and Critical Thinking

Organization of Long Term Memory, Forgetting, Retrieval and Metamemory; Proactive and Retroactive inference; Amnesia and Retrieval, Flashbulb Memory, Eyewitness Memory, Traumatic Memory, False Memories.

Phases of Critical Thinking

Intellectualization, Suggestion, Hypothesis, Reasoning, and Testing, Critical Thinking Abilities: Thinking, Observational, and Questioning and Dispositions, Critical Thinking Skills: Analysis, Communication, Creativity, Problem-solving Skills, and Open-mindedness.

Systems Thinking and Scientific Thinking

System Definition and Characteristics, Approaches to System Modelling, Causal-Loop Diagramming, System Archetypes, Micro world and Learning Laboratory, The Learning Organization and the Fifth Discipline, Systems Thinking Study, Examples.

Characteristics of Science

Systematic observation and experimentation, Inductive and deductive reasoning, Lessons from Scientific Thinking: Empirical Evidence, Logical Reasoning.

Creativity and Designing Thinking

Creative Thinking, Stages in Creative Thinking, Nature of Creative Thinking, Features of Creativity—Novelty, Originality and Usefulness, Guilford's Measure of Creativity—Fluency, Flexibility, and Originality, Barriers to Creativity, Enhancing Individual and Organizational Creativity.

Designing Thinking as a Process of Problem Solving: Defining Problems, Challenging Assumptions, Developing Concepts, identifying Alternative Strategies and Solutions, Prototyping, and Experimenting Problem Solving through Innovative Solutions, Stages of Design Thinking—Empathize, Define, Ideate, Prototype and Test.

Textbooks

1. Solso, R. L., Cognitive Psychology, Pearson Education, 6th Edition. 2004.
2. Baron, R. A. Psychology, Pearson Education, 5th Edition, 2002
3. Rathus, S.A. Introductory Psychology Wadsworth Cengage, 5th Edition, 2016.
4. Ciccarelli, S. & White, N.J, Psychology 5th Edition, Pearson Education. 2017
5. The Fifth Discipline: The Art & Practice of the Learning Organization, Cengage Publication, 2nd Edition, 2006.
6. Cross, N., Design Thinking: Understanding How Designers Think and Work, Berg Publishers.

Reference books

1. Baddeley, A., Human memory: Theory and practice. New York Psychology Press, 1997.
2. Treror, A., The psychology of language: From data to theory. Taylor Francis, 2002
3. Smith, E.E. & Kosslyn, Cognitive psychology: Mind and brain. Prentice Hall, 2007.
4. Tripathi, A.N. & Babu, Nandita (2008). Cognitive processes. In Misra, G. Psychology in India: Advances in Research, Vol. 1, Pearson Education.
5. Vaid, J., & Gupta, Ashum, Exploring word recognition in a semi-alphabetic script: the case of Devanagari. Brain and Language, 81, 679-690.

CREATIVITY, INNOVATION AND ENTREPRENEURSHIP

Course Code: PS10045

Credit: 2

L-T-P: 2-0-0

Prerequisite: Nil

COURSE OBJECTIVE

The course is designed for students who want to enhance their creative and innovative skills and apply them to prepare business plans to form entrepreneurial enterprises. More specifically, the course is designed to help students to stimulate creativity in themselves and learn the impact of innovation on growth creation and design thinking in real-world business situations. In this course, the concepts of entrepreneurship and the environment in which the entrepreneurs act will be developed along with business plans and business models for start-ups.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Understand the key elements of creativity and innovation,
- CO 2: Visualize the impact of innovation on growth creation,
- CO 3: Apply creative and design thinking to real-world business situations,
- CO 4: Create a foundation of entrepreneurship development and its theories,
- CO 5: Develop business plans and business models to start entrepreneurial enterprises, and
- CO 6: Analyze the business plan and implement it in real field.

COURSE DETAILS

Introduction

Definitions, Importance, and Relationships among Creativity, Innovation, and Entrepreneurship; Examples.

Creativity

Definitions, Importance, and Relationships among Creativity, Innovation, and Entrepreneurship; Examples, Creative Thinking and Stages of Creative Thinking, Barriers to Creativity, Enhancing Individual Creativity, Guilford's Usual Unusual Test, Psychometric Approaches to Tests of Creativity, Structured tools of Creativity (Developing Creative Focus, Exercising Mind, Setting Directions, Suspending Rules, Thinking Differently, Establishing Formatted Work Space, Stimulating Mechanisms, Utilizing Experiences.

Innovation

Innovation, Benefits, Keys to Successful Innovations, Types of Innovation, Barriers to Innovation, Methods of Generating Ideas, Design Thinking. Creative Problem Solving, and Measures of Innovation.

Entrepreneurship

Entrepreneur, Functions of an Entrepreneur, Types of Entrepreneur, Intrapreneur, Social Entrepreneur, Case Study on the Entrepreneurial Excellence of N. R. Narayan Murthy, Introduction to Agricultural, Rural, Tourism, Social and Digital Entrepreneurship, Entrepreneurial Motivational Behavior (Creativity, Self-Efficacy, Locus of Control, Risk Taking, Leadership, Communication),

Converting Ideas into Products/Services with Differentiating Features, Niche Market, Design of the Products/Services, Bootstrap Marketing, Formulation of Business Plan, Business Model, Financial Planning, and Sources of Finance.

Practical classes will be devoted to organizing practicing sessions on creativity, case study discussion sessions and market analysis sessions on generating novel ideas, and developing and presenting business plans. Students, in groups, will design a new product/service, do a bootstrap market study, develop a business plan, and make an elevator pitch.

Textbooks

1. Khanka, S. S. Creativity, Innovation, and Entrepreneurship, S.Chand .
2. Praveen Gupta, Business Innovation, S. Chand , 2007

Reference books

1. Barringer B. R. and R. Duane, Entrepreneurship: Successfully Launching New Ventures: Pearson Prentice Hall, Ireland, 3rd Edition 2009.
2. Duening, T. N., R. D. Hisrich, and M. A. Lechter , Technology Entrepreneurship: Taking Innovation to the Marketplace, Elsevier, Amsterdam, 2nd Edition 2015.
3. Harrington, H. J., Creativity, Innovation, and Entrepreneurship: The Only Way to Renew Your Organization, Routledge, 2019.

ESSENTIALS OF MANAGEMENT

Course Code: HS10202

Credit: 2

L-T-P: 2-0-0

Prerequisite: Nil

COURSE OBJECTIVE

This course explores the basic concepts and processes of management. Students will learn the importance of management in their professional life from the stories on the evolution and practices of management. Students will examine the fundamental roles and processes of planning, organizing, staffing, directing and controlling

that comprise the managers' role. This course also examines the fundamentals of marketing and financial management for the success of the organization. This course will make an attempt to introduce students to the business environment and strategic management process to understand the nuances of business. Students will develop skills related to the manager's function as required in today's competitive environment.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO1: Learn different approaches, theories and stories of various practitioners of management and know how such knowledge could be applied to achieve goals of Organizations within the changing environment,
- CO 2: Understand the core functions of management in order to facilitate efficient effective decision making both at individual and organizational level,
- CO 3: Identify the human resource requirement of the organization for achieving its objective effectively,
- CO 4: Synthesize various marketing and financial skills and techniques in order to be successful in corporate world,
- CO 5: Assess the business environment and understand the importance of various types of business environment for better decision making, and
- CO 6: Acquire the lesson learnt in strategic management process for strategic decision making by leveraging the core competencies of the organization.

COURSE DETAILS

Evolution of Management Thoughts

Concept, Scope and Significance of Management; Classical Approach; Scientific, Bureaucratic & Administrative theory of Management; Neo-classical and Modern Approach; Contribution of Management Practitioners

Functions of Management (Part I)

Nature, scope and significance of Planning; Types of Planning; Process of Planning; Barriers to effective planning; Decision making: concept, types and process; Organizing: concept and significance; Delegation of authority; Authority vs. Responsibility; Structure of Organization: departmentalization, Centralization vs. Decentralization

Functions of Management (Part II)

Concept of Staffing, Manpower planning and Job design; Recruitment and selection; Training and development; Performance Appraisal; Directing: Concept, Direction and Supervision; Controlling: Concept, Importance and levels; Process and types of controlling

Marketing and Financial Management

Marketing Mix (Product, place, price, Promotion); Market Segmentation; Introduction, scope, importance and functions of Financial management; Introduction to Financial statements: Profit and loss account; balance sheet

Business Environment and Strategic Management

Business environment: concept, importance, elements; Types of business environment; Strategic Management: Concept, Importance and levels of strategy; Process of Strategic Management

Textbooks

1. S.A. Sherlekar & V.S. Sherlekar, Modern Business Organization & Management (Systems Approach) by Himalya Publishing House, 2018.

2. Harold Koontz and Heinz Weihrich ,Essentials of Management: an International Perspective by, McGraw Hills, 2020

Reference books

1. K. Ashwathappa, Essentials of Business Environment, Himalaya Publishing House, 2017.
2. Joseph L. Massie, Essentials of Management Pearson Education India, Fourth edition, 2015.
3. Azhar Kazmi & Adela Kazmi, Strategic Management, McGrawHill, 5th edition 2020.

SHADES OF ECONOMICS

Course Code: HS10121

Credit: 2

L-T-P: 2-0-0

Prerequisite: Nil

COURSE OBJECTIVE

This course will provide technical students with knowledge in concepts of environmental economics, resource economics, and circular economy, allowing prosperity for present and future generations. The course will equip future engineers with skill to handle resources efficiently and effectively. Acquaint them with the contemporary trends in business settings and thereby innovate novel solutions to existing problems.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Understand the economic drivers that shape the future of India,
- CO 2: Understand sustainability issues related to usage of factor endowment,
- CO 3: Ability to create linkage between Economics, Science and Technology,
- CO 4: Apply knowledge, reasons and the need for regulating circular economy,
- CO 5: Assess and analyses scope for global market opportunities, and
- CO 6: Explore yet to be unearthened employment opportunities.

COURSE DETAILS

Purple Economy: Economics of Glocalization

Introduction to colours and world of economics (including White, Blue, Black, Green, Purple, Grey, Red, Pink, Silver); Concept and definition of purple economy; Cultural footprint; Local and global cultural economy; Culture and well being; Rethinking employment and training in the purple economy; Vocal for Local; Make in India.

Grey Economy: Economics of Informal Sector

Concept and definition of grey economy; Introduction to formal and informal Sector; Formal and informal sector linkage; Labour absorption and dualism in economy; Theoretical and policy issues; Migration in informal sector.

Green Economy: Economics of Reduce, Reuse, and Recycle

Concept and definition of green economy; Green investment and green bond; Green technology and renewable resources; Carbon footprint; Waste management.

Blue Economy: Economics of Ocean Resources

Concept and definition of blue economy; The marine environment; Fisheries and aquaculture; Tourism; Ocean-based renewable sources of energy; Transportation and the blue economy; ; Pollution of water resources; Water resource management.

Black Economy: Economics of Unsanctioned Sector

Concept and definition of black money; Causes and consequences of black economy; Global black income generation; Extent of black money in India. Government measures to curb black money.

Textbook

1. S.K Mishra and V. K. Puri, Indian Economy. Himalaya Publishing House,2022, ISBN: 978-93-5596-423-6

Reference books

1. Uma Kapila. Indian Economy:Economic Development and Policy. Academic Foundation ISBN-10 : 9332705550 and ISBN-13 : 978-9332705555,2022.
2. Taneja and Myer :Economics of development and Planning, Vishal Publishing Co. ISBN-13 978-: 9382956068.
3. Datt Gaurav & Mahajan Ashwani , Indian Economy, S Chand & Company Limited. 2017.
4. Adrian C. Newton, Elena Cantarello, An Introduction to the Green Economy. Science, Systems and Sustainability,2014 Circular Economy- (Re) Emerging Movement. (2020). Shalini Goyal Bhalla.
5. Shalini Goyal Bhalla. Circular Economy- (Re) Emerging Movement.,2020.
6. Somnath Hazra & Anindya Bhukta,The Blue Economy. An Asian Perspective. The Informal Economy: an Employer's Approach. The Informal Economy: an Employer's Approach. 2021.
7. The Purple Economy: An Objective, An Opportunity, 2013.
8. Tom Tietenberg, Lynne Lewis, Environmental and Natural Resource Economics. 2018.

INDIAN ECONOMY POST LIBERALISATION

Course Code: HS10123

Credit: 2

L-T-P: 2-0-0

Prerequisite: Nil

COURSE OBJECTIVE

Study of this course provides an extensive understanding of changing structure of Indian economy over time. This course targets to put emphasis on inclusive growth, reducing poverty, inequality and creating decent employment in the economy. This course will give an understanding about the issues faced by an economy in achieving sustainable development.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Interpret the changing structure of Indian economy,
- CO 2: Perceive the issues and challenges faced by Indian economy,
- CO 3: Evaluate the policies and programmes required to achieve inclusive growth,
- CO 4: Realise the importance of human capital in triggering economic development,
- CO 5: Comprehend the state and role of external sector in strengthening Indian economy, and
- CO 6: Help in achieving sustainable development for the economy.

COURSE DETAILS

Introduction and features

Changing structure of the Indian economy Changing paradigms of Development Strategies and Economic Reforms.

Poverty, Inequality and Employment

Various concepts and estimates of poverty; Income inequality; Problem of unemployment; Interface among growth, poverty and employment; Inclusive growth and Human Development; Sustainable Development Goals—Targets for reduction in Poverty, Inequality and Decent Employment.

Demographic Issues

Demographic trends, size and structure of population; Health and Education; Skill challenges and demographic dividends; Sustainable Development Goals—Targets for Greater Wellbeing and Better Human Capital.

Perspectives in Agriculture, Industry and Services

Agricultural growth performance and food security; Growth, trends and changing pattern of Indian industries, industrial reforms and policies; Services in India's growth process; Sustainable Development Goals—Targets for Inclusive and Sustainable Growth.

External Sector and Issues in Indian Public Finance

Foreign trade and trade policy; fiscal devolution, Indian Union Budget and Tax System

Textbook

1. Uma Kapila, Indian Economy Performance and Policies, Academic Foundation, 2020, ISBN: 978-933270545

Reference books

1. S.K. Mishra, and V. K. Puri, Indian Economy, Himalaya Publishing House, 2022, ISBN: 978-93-5596-423-6
2. Gaurav Datt and Ashwani Mahajan, Indian Economy, GENERIC. Classic Edition, 2022 ISBN-10 : 9352531299 ISBN-13 : 978-9352531295

COMMUNITY / ENVIRONMENT-BASED PROJECT

Course Code: EX17001

Credit: 2

L-T-P: 0-0-4

Prerequisite: Nil

COURSE OBJECTIVE

This course is offered to give the students an opportunity to connect with the community and the environment, learn and prioritize their problems, and define the problems in ways that make them amenable to scientific analysis and pragmatic solution. Appreciating the community problems, visualizing and experiencing them in person, self-learning, applying to realities, searching for and finding implementable solutions are the primary benefits of this project-based subject.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Identify need of the community,
- CO 2: Formulate objective of a project,
- CO 3: Communicate orally and through formal technical write-ups,
- CO 4: Analyze and interpret data wherever essential,
- CO 5: Provide an implementable solution to the problem, and
- CO 6: Work in team following ethical manners.

The projects will be applied to problems uppermost in the minds of the community regarding the problems that they confront regularly. The problems may range from social inequality and social justice to lack of common services such as health, education, water, power, banking, and from lack of access to government subsidies and policies to deforestation and environmental problems.

SCHOOL OF ELECTRONICS ENGINEERING

Vision

To impart world-class education and research in Electronics Engineering, with particular regard to their applications in industry, healthcare and commerce in a diverse society.

Mission

To prepare students for professional career, higher studies or entrepreneurship.

To facilitate students to utilize fundamental technical knowledge and skills in Electronics engineering, to analyze and solve problems, and apply these abilities to generate new knowledge, ideas or products in academia, industry or Government.

To encourage and facilitate students, to involve themselves in research work through continuous learning, to build skills beyond curriculum.

To integrate training in engineering principles, critical thinking, hands-on projects, open-ended problem solving to build up creative abilities and research spirit.

To impart the essential skills of leadership, teamwork, communication and ethics so that they can interact and communicate effectively (written and/or oral) with others (e.g., supervisor, client and/or team).

To engage students with alumni, industry, Government, and community partners through outreach activities in order to inculcate global perception.

B.Tech Programs Offered

1. B. Tech (Honors / Research) in Electronics and Telecommunication Engineering
2. B. Tech (Honors / Research) in Electronics and Electrical Engineering
3. B. Tech (Honors / Research) in Electronics and Computer Science Engineering

B. Tech. Honors/ Research Degree in Electronics and Telecommunication Engineering

B. Tech in Electronics and Telecommunication Engineering Program Educational Objectives (PEOs):

1. Lead a successful career in industries or undertake entrepreneurial endeavors and provide solutions in the areas of electronic system design, communication & networking and allied areas of Electronics and Telecommunication engineering or pursue advanced studies.
2. Utilize their knowledge, skills and resources to design, invent and find creative and innovative solutions to engineering problems in a multidisciplinary work environment following appropriate ethical practices.
3. Develop attitude in lifelong learning, apply and adapt new ideas as the technology evolves.

Program Outcomes (POs):

The program outcomes are:

- a) **Engineering knowledge:** Ability to apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- b) **Problem analysis:** Ability to identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- c) **Design/Development of solutions:** Ability to design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- d) **Conduct investigations on complex problems:** Ability to use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- e) **Modern tool usage:** Ability to create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- f) **The engineer and society:** Ability to apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- g) **Environment and sustainability:** Ability to understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- h) **Ethics:** Ability to apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- i) **Individual and team:** Ability to function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

- j) **Communication:** Ability to communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- k) **Project management and finance:** Ability to demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- l) **Life-long learning:** Ability to recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

The program specific outcomes are:

- a) Ability to design, and comprehend electronics sub-systems using the knowledge of electronic circuits, signal processing, communication engineering, networking and embedded technology.
- b) Ability to carry out research in the fields of VLSI, advanced communication and related technologies.
- c) Ability to design and develop complex products using suitable tools for societal and engineering needs with skills to communicate effectively in groups.

CURRICULUM

The total minimum credits required for completing the B. Tech. programme in Electronics and Telecommunication Engineering is 162

PROFESSIONAL ELECTIVE COURSES

Professional elective-I, II, III are offered during semester five and six. Professional elective IV and V are offered during semester seven and eight. List of electives to be offered during an academic year is announced at the beginning of respective semesters. An elective will be offered only if ten or more students are interested in it. Not that all the electives will be offered in every academic year. Some electives may have seat limitations and will be offered in first cum first serve basis. In order to accommodate more aspiring students, electives having high demand may be offered twice, that is during autumn as elective-I or II and again as elective-III during spring semester.

Students can select electives based on their interest in a domain. Areas of specialization or domain are optional, however electives can be grouped to provide learning around a functional area. Students may qualify for a maximum of one area of Specialization. Completion of the specialization will not be reflecting on transcripts or degree certificate.

Electronics and Telecommunication Engineering

SEMESTER III

Theory							
Sl.No	Course Code	Course Title	L	T	P	Total	Credit
1.	MA21001	Probability and Statistics	3	1	0	4	4
2.	EC20001	Signals and Systems	3	0	0	3	3
3.	EC20003	Electromagnetic Theory and Antennas	3	0	0	3	3
4.	EC20007	Semiconductor Technology	3	0	0	3	3
5.	EC21001	Electronic Circuits	3	1	0	4	4
6.	EX20003	Scientific and Technical Writing	2	0	0	2	2
Total Credit (Theory Subjects)			17	2	0	19	19
Practical							
1.	EC29001	Electronic Circuits Lab	0	0	4	4	2
2.	EC29003	Signal Processing Lab	0	0	2	2	1
Sessional							
1.		Vocational Elective	0	0	2	2	1
Total Credit (Practical and Sessional Subjects)			0	0	8	8	4
Grand Total						27	23

SEMESTER IV

Theory							
Sl. No	Course Code	Course Title	L	T	P	Total	Credit
1.	MA21006	Vectors, Differential Equations and Complex Analysis	3	1	0	4	4
2.	EC20002	Microprocessors and Embedded Systems	3	0	0	3	3
3.	EC21002	Communication Systems and Techniques	3	1	0	4	4
4.	CS20001	Concepts of Data Structures and Algorithms	3	0	0	3	3
5.	EX20001	Industry 4.0 Technologies	2	0	0	2	2
6.		HASS Elective-II	3	0	0	3	3
Total Credit (Theory Subjects)			17	2	0	19	19
Practical							
1.	EC29002	Communication Engineering Lab	0	0	2	2	1
2.	EC29006	Microprocessors and Embedded System Lab	0	0	2	2	1
3.	CS29001	Data Structures Lab	0	0	2	2	1
Total Credit (Practical Subjects)			0	0	6	6	3
Grant Total						25	22

SEMESTER V

Theory							
Sl. No	Course Code	Course Title	L	T	P	Total	Credit
1.	EC30001	Microwave Engineering	3	0	0	3	3
2.	EC30003	Linear and Digital Control System	3	0	0	3	3
3.	HS30101	Engineering Economics	3	0	0	3	3
4.		HASS Elective-III	3	0	0	3	3
5.		Professional Elective-I	3	0	0	3	3
6.		Professional Elective-II	3	0	0	3	3
Total Credit (Theory Subjects)			18	0	0	18	18
Practical							
1.	EC39003	Microwave Engineering Lab	0	0	2	2	1
2.	EC39005	Control Systems Lab	0	0	2	2	1
Sessional							
1.	EC38001	Electronics Product Development	0	0	2	2	1
2.	SAXXXXX	K-Explore Open Elective-I	0	0	2	2	1
Total Credit (Practical and Sessional Subjects)			0	0	8	8	4
Total						26	22

SEMESTER VI

Theory							
Sl. No	Course Code	Course Title	L	T	P	Total	Credit
1.	EC30002	Wireless Mobile Communication	3	0	0	3	3
2.	EC30004	Data Communication and Networking	3	0	0	3	3
3.	EC30005	VLSI Circuits and Systems	3	0	0	3	3
4.	HS30401	Universal Human Values	3	0	0	3	3
5.		Professional Elective III	3	0	0	3	3
6.		Open Elective-II/ (MI – I)	3	0	0	3	3
Total Credit (Theory Subjects)			18	0	0	18	18
Practical							
1.	EC39006	VLSI Design Lab	0	0	2	2	1
2.	EC39002	Wireless Communication and Networking Lab	0	0	2	2	1
3.	EC39004	Electronics Design Lab	0	0	4	4	2
Sessional							
1.	EC37002	Minor Project	-	-	-	-	2
Total Credit (Practical and Sessional Subjects)							6
Total						26	24

SEMESTER VII (B. Tech. (Hons.))

Theory							
Sl. No	Course Code	Course Title	L	T	P	Total	Credit
1.	EX40003	Engineering Professional Practice	2	0	0	2	2
2.		Professional Elective-IV	3	0	0	3	3
3.		Open Elective – III / (MI – II)	3	0	0	3	3
4.		MI – III (optional)	3	0	0	3	3
5.		MI – IV (optional)	3	0	0	3	3
Total of Theory							8
Sessional							
1.	EC47001	Project- I	-	-	-	-	5
2.	EC48001	Practical Training/ Internship	-	-	-	-	2
Total							8
							15

SEMESTER VIII (B. Tech. (Hons.))

Theory							
Sl. No	Course Code	Course Title	L	T	P	Total	Credit
1.		Professional Elective-V	3	0	0	3	3
2.		Open Elective-IV /(MI V)	3	0	0	3	3
3.		MI - VI (optional)	3	0	0	3	3
Total of Theory							6
Sessional							
1.	EC47002	Project- II	-	-	-	-	9
Total							6
							15

SEMESTER VII (B.Tech. (Research))

Theory							
Sl. No	Course Code	Course Title	L	T	P	Total	Credit
1.	EX40001	Research Methods and Ethics	3	0	0	3	3
2.	EX40003	Engineering Professional Practice	2	0	0	2	2
3.		Research Elective-I	3	0	0	3	3
4.		MI – II (optional)	3	0	0	3	3
5.		MI – III (optional)	3	0	0	3	3
6.		MI – IV (optional)	3	0	0	3	3
Total of Theory							8
Sessional							
1.	EC47001	Project- I	-	-	-	-	5
2.	EC48001	Practical Training/ Internship	-	-	-	-	2
3		MI-Lab / MI Project (optional)	-	-	-	-	2
Total							8
							15

SEMESTER VIII (B.Tech.(Research))

Theory							
Sl. No	Course Code	Course Title	L	T	P	Total	Credit
1.		Research Elective-II	3	0	0	3	3
2.		MI-V (Optional)	3	0	0	3	3
3		MI – VI (optional)	3	0	0	3	3
Total of Theory							3
Sessional							
1.	EC47002	Project- II	-	-	-	-	12
Total							3
							15

PROFESSIONAL ELECTIVES – I/II/III

Sl. No	Course Code	Course Title	L	T	P	Total	Credits
1.	CS20002	Operating Systems	3	0	0	3	3
2.	CS20006	Database Management Systems	3	0	0	3	3
3.	CS30010	Cloud Computing	3	0	0	3	3
4.	CS30011	Computational Intelligence	3	0	0	3	3
5.	CS30019	Web Technology and Applications	3	0	0	3	3
6.	CS30029	Computer Vision and Pattern Recognition	3	0	0	3	3
7.	EC30006	Hardware Description Language for Digital Design	3	0	0	3	3
8.	EC30007	ARM and Advanced Processors	3	0	0	3	3
9.	EC30008	Wireless Sensor Networks	3	0	0	3	3
10..	EC30009	Compound Semiconductor Basics	3	0	0	3	3
11.	EC30010	Mobile Ad Hoc Network	3	0	0	3	3
12.	EC30011	Digital System Design with Verilog	3	0	0	3	3
13.	EC30012	Nanoelectronics	3	0	0	3	3
14.	EC30013	Optical and Satellite Communication	3	0	0	3	3
15.	EC30015	Hardware and Software Co-Design of Embedded System	3	0	0	3	3
16.	EC30017	Audio and Speech Processing	3	0	0	3	3
17.	EC30019	Information Theory and Coding	3	0	0	3	3
18.	EC30021	Industrial IoT	3	0	0	3	3
19.	EE30012	Sensors & Actuators	3	0	0	3	3
20.	EE30022	Special Machines & Control	3	0	0	3	3
21.	EE30038	Introduction to Electrical Machines	3	0	0	3	3
22.	EE30047	Power Electronics Circuits	3	0	0	3	3
23.	EL30001	Industrial Automation	3	0	0	3	3
24.	EM30007	Machine Learning based Signal Processing	3	0	0	3	3
25.	EM30008	Deep Learning: Algorithms and Implementation	3	0	0	3	3
26.	EM30009	Data Analytics	3	0	0	3	3
27.	EM30011	Data Mining	3	0	0	3	3

PROFESSIONAL ELECTIVE –IV/ V

1.	CS30023	Software Defined Networking	3	0	0	3	3
2.	CS40010	Augmented and Virtual Reality	3	0	0	3	3
3.	CS40015	Cryptography and Network Security	3	0	0	3	3
4.	EC40001	Optimization Techniques in Engineering	3	0	0	3	3
5.	EC40002	Millimetre Waves and Terahertz Technology	3	0	0	3	3
6.	EC40003	Cognitive Radio and Cooperative Communication	3	0	0	3	3
7.	EC40004	Quantum Communication	3	0	0	3	3
8.	EC40005	Analog and Mixed Signal IC Design	3	0	0	3	3
9.	EC40006	Advanced VLSI and SoC	3	0	0	3	3
10.	EC40007	Low Power VLSI Design	3	0	0	3	3
11.	EC40008	Advanced Computer Architecture and RISC-V Processor Design	3	0	0	3	3
12.	EC40009	Biomedical Signal Processing	3	0	0	3	3
13.	EE30024	Electric Drives and Control	3	0	0	3	3
14.	EE40010	Electric Vehicles Technology	3	0	0	3	3
15.	EL40001	Process Control & Robotics	3	0	0	3	3
16.	EL40003	Advanced Control System	3	0	0	3	3

17.	EM40001	ML for Language Processing	3	0	0	3	3
18.	EM40006	Cybersecurity	3	0	0	3	3
19.	EM40008	Bioinformatics	3	0	0	3	3
20.	EM40010	Optimization Methods in Machine Learning	3	0	0	3	3

Elective Baskets (Specialization)

PE I	PE II	PE III	PE IV	PE V	Specialization
CS20002	CS20006 / CS30019	EM30009 / EM30011 / CS30010	CS30023 / CS40015	EM40006 / CS40010	Computer Engineering
EC30019	EC30013	EC30010 / EC30008	EC40003 / CS40015	EC40004 / EC40002	Communication & Networking
EC30009 / EC30007	EC30011 / EC30006	EC30015	EC40005 / EC40007	EC40006 / EC40008	VLSI & Embedded Design
CS30011 / EM30007	CS30029 / EC30017	EM30008 / EM30009 / EM30011	EC40009 / EM40010	EM40001 / EM40008	Machine Learning and Applications
EE30038 / EC30021	EE30047 / EE30012	EE30022 / EL30001	EE30024 / EL40003	EL40001 / EE40010	Automation

B. Tech. Honors/ Research Degree in Electronics and Electrical Engineering

B. Tech in Electronics and Electrical Engineering Program Educational Objectives (PEOs):

The B. Tech Program in Electronics and Electrical Engineering aims to prepare the graduates with the following objectives:

1. Lead a successful career in industries or undertake entrepreneurial endeavors and provide solutions in the areas of electronic system design for power system, power electronic drives and allied areas of Electronics and Electrical engineering or pursue advanced studies.
2. Utilize their knowledge, skills and resources to design, invent and find creative and innovative solutions to engineering problems in a multidisciplinary work environment following appropriate ethical practices.
3. Develop attitude in lifelong learning, apply and adapt new ideas as the technology evolves.

Program Outcomes (POs)

The program outcomes are:

- a) **Engineering knowledge:** Ability to apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- b) **Problem analysis:** Ability to identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- c) **Design/Development of solutions:** Ability to design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- d) **Conduct investigations on complex problems:** Ability to use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- e) **Modern tool usage:** Ability to create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- f) **The engineer and society:** Ability to apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- g) **Environment and sustainability:** Ability to understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- h) **Ethics:** Ability to apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- i) **Individual and team:** Ability to function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

- j) **Communication:** Ability to communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- k) **Project management and finance:** Ability to demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- l) **Life-long learning:** Ability to recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

The program specific outcomes are:

- a) Ability to design, and implement electrical and electronic circuits, electrical drives and power system control for industrial applications.
- b) Ability to conduct research in automation & control, embedded system and related technologies.
- c) Ability to design and develop complex products using suitable tools for societal and engineering needs with skills to communicate effectively in groups.

CURRICULUM

The total minimum credits required for completing the B. Tech. programme in Electronics and Electrical Engineering is 162

PROFESSIONAL ELECTIVE COURSES

Professional elective-I, II, III are offered during semester five and six. Professional elective IV and V are offered during semester seven and eight. List of electives to be offered during an academic year is announced at the beginning of respective semesters. An elective will be offered only if ten or more students are interested in it. Note that all the electives will be offered in every academic year. Some electives may have seat limitations and will be offered in first cum first serve basis. In order to accommodate more aspiring students, electives having high demand may be offered twice, that is during autumn as elective-I or II and again as elective-III during spring semester.

Students can select electives based on their interest in a domain. Areas of specialization or domain are optional, however electives can be grouped to provide learning around a functional area. Students may qualify for a maximum of one area of Specialization. Completion of the specialization will not be reflecting on transcripts or degree certificate.

Electronics and Electrical Engineering

SEMESTER III

Theory							
Sl. No	Course Code	Course Title	L	T	P	Total	Credit
1.	MA21001	Probability and Statistics	3	1	0	4	4
2.	EC20001	Signals and Systems	3	0	0	3	3
3.	EC21001	Electronic Circuits	3	1	0	4	4
4.	EE20001	Network Theory	3	0	0	3	3
5.	CS20001	Concepts of Data Structures and Algorithms	3	0	0	3	3
6.	EX20003	Scientific and Technical Writing	2	0	0	2	2
Total of Theory							19
Practical							
1.	EC29001	Electronic Circuits Lab	0	0	4	4	2
2.	CS29001	Data Structures Lab	0	0	2	2	1
Sessional							
1.		Vocational Electives	0	0	2	2	1
Total Credit (Practical and Sessional Subjects)			0	0	8	8	4
Semester Total							27
							23

SEMESTER IV

Theory							
Sl. No	Course Code	Course Title	L	T	P	Total	Credit
1.	MA21006	Vectors, Differential Equations and Complex Analysis	3	1	0	4	4
2.	EC20003	Electromagnetic Theory and Antennas	3	0	0	3	3
3.	EE20010	Electrical Machines	3	0	0	3	3
4.	EL20002	Instrumentation and Control Systems	3	0	0	3	3
5.	EX20001	Industry 4.0 Technologies	2	0	0	2	2
6.		HASS Elective II	3	0	0	3	3
Total of Theory							18
Practical							
1.	EC29003	Signal Processing Lab	0	0	2	2	1
2.	EE29002	Electrical Machines Laboratory	0	0	2	2	1
3.	EL29002	Instrumentation and Control System Lab	0	0	2	2	1
Total of Practical							6
Semester Total							24
							21

SEMESTER V

Theory							
Sl. No	Course Code	Course Title	L	T	P	Total	Credit
1.	EC20002	Microprocessors and Embedded Systems	3	0	0	3	3
2	EE30007	Power Transmission and Distribution	3	0	0	3	3
3.	HS30101	Engineering Economics	3	0	0	3	3
4.		HASS Elective III	3	0	0	3	3
5.		Professional Elective – I	3	0	0	3	3
6.		Professional Elective – II	3	0	0	3	3
Total of Theory							18
Practical							
1.	EC29006	Microprocessors and Embedded System Lab	0	0	2	2	1
2.	EE39007	Programmable Logic Control Lab	0	0	2	2	1
Sessional							
1.	EC38001	Electronics Product Development	0	0	2	2	1
2	EE28002	Electrical System Modeling using MATLAB	0	0	2	2	1
3.	SAXXXXX	K-Explore Open Elective – I	0	0	2	2	1
Total Credit (Practical and Sessional Subjects)							10
Semester Total							28
							23

SEMESTER VI

Theory							
Sl. No	Course Code	Course Title	L	T	P	Total	Credit
1.	EC20008	Communication Engineering	3	0	0	3	3
2.	EE30005	Power Electronics and Drives	3	0	0	3	3
3.	EE30006	Power System Operation and Control	3	0	0	3	3
4.	HS30401	Universal Human Values	3	0	0	3	3
5.		Professional Elective III	3	0	0	3	3
6.		Open elective – II (MI – I)	3	0	0	3	3
Total of Theory							18
Practical							
1.	EC39004	Electronics Design Lab	0	0	4	4	2
2.	EE39001	Power Electronics Lab	0	0	2	2	1
3.	EE39002	Power Systems Lab	0	0	2	2	1
Sessional							
1.	EL37002	Minor Project	-	-	-	-	2
Total Credit (Practical and Sessional Subjects)							8
Semester Total							26
							24

SEMESTER VII (B.Tech (Hons))

Theory							
Sl. No		Course Title	L	T	P	Total	Credit
1	EX40003	Engineering Professional Practice	2	0	0	2	2
2.		Professional Elective-IV	3	0	0	3	3
3.		Open Elective – III (MI – II)	3	0	0	3	3
4.		MI – III (Optional)	3	0	0	3	3
5		MI IV (Optional)	3	0	0	3	3
Total of Theory							8
Practical							
1.	EL47001	Project – I	-	-	-	-	5
2.	EL48001	Practical Training/Internship	-	-	-	-	2
Total of Practical							7
Semester Total							8
							15

SEMESTER VIII (B.Tech (Hons))

Theory							
Sl. No	Course Code	Course Title	L	T	P	Total	Credit
1.		Professional Elective-V	3	0	0	3	3
2.		Open Elective-IV (MI - V)	3	0	0	3	3
3.		MI - VI (Optional)	3	0	0	3	3
Total of Theory							6
Sessional							
1.	EL47002	Project- II	-	-	-	-	9
Total of Sessional							9
Semester Total							6
							15

SEMESTER VII (B.Tech (Research))

Theory							
Sl. No	Course Code	Course Title	L	T	P	Total	Credit
1.	EX40001	Research Methods and Ethics	3	0	0	3	3
2.	EX40003	Engineering Professional Practice	2	0	0	2	2
3.		Research Elective-I	3	0	0	3	3
4.		MI-II (Optional)	3	0	0	3	3
5.		MI-III (Optional)	3	0	0	3	3
6.		MI-IV (Optional)	3	0	0	3	3
Total of Theory							8
Sessional							
1.	EL47001	Project- I	-	-	-	-	5
2.	EL48001	Practical Training	-	-	-	-	2
3.		MI-Lab/ MI-Project (Optional)	-	-	-	-	2
Total of Sessional							-
Total							8
							15

SEMESTER VIII (B.Tech (Research))

Theory							
Sl. No	Course Code	Course Title	L	T	P	Total	Credit
1.		Research Elective-II	3	0	0	3	3
2.		MI-V (Optional)	3	0	0	3	3
3.		MI-VI(Optional)	3	0	0	3	3
Total of Theory							3
Sessional							
1.	EL47002	Project- II	-	-	-	-	12
Total of Sessional							12
Total							3
							15

PROFESSIONAL ELECTIVES – I/II/III

Sl. No	Course Code	Course Title	L	T	P	Total	Credits
1.	CS20006	Database Management Systems	3	0	0	3	3
2.	CS30011	Computational Intelligence	3	0	0	3	3
3.	CS30029	Computer Vision and Pattern Recognition	3	0	0	3	3
4.	EC30004	Data Communication and Networking	3	0	0	3	3
5.	EC30007	ARM and Advanced Processor	3	0	0	3	3
6.	EC30011	Digital System Design with Verilog	3	0	0	3	3
7.	EC30013	Optical & Satellite Communication	3	0	0	3	3
8.	EC30015	Hardware and Software Co-Design of Embedded System	3	0	0	3	3
9.	EC30019	Information Theory & Coding	3	0	0	3	3
10.	EC30021	Industrial IoT	3	0	0	3	3
11.	EE30012	Sensors and Actuators	3	0	0	3	3
12.	EE30013	Industrial Applications of Electric Energy	3	0	0	3	3
13.	EE30014	Power Generation and Control	3	0	0	3	3
14.	EE30015	IoT for Electrical Engineering	3	0	0	3	3
15.	EE30016	Renewable Energy Resource	3	0	0	3	3
16.	EE30020	Energy Audit and Accounting	3	0	0	3	3
17.	EE30024	Electric Drives and Control	3	0	0	3	3
18.	EE30045	Switch Gear and Protecting Devices	3	0	0	3	3
19.	EE30047	Power Electronics Circuits	3	0	0	3	3
20.	EL30001	Industrial Automation	3	0	0	3	3
21.	EM30007	Machine Learning Based Signal Processing	3	0	0	3	3
22.	EM30008	Deep Learning: Algorithms & Implementation	3	0	0	3	3

PROFESSIONAL ELECTIVE IV/V

Sl. No	Course Code	Course Title	L	T	P	Total	Credits
1.	CS40015	Cryptography and Network Security	3	0	0	3	3
2.	EC30008	Wireless Sensor Network	3	0	0	3	3
3.	EC40001	Optimization Techniques in Engineering	3	0	0	3	3
4.	EC40004	Quantum Communication	3	0	0	3	3
5.	EC40005	Analog and Mixed Signal IC Design	3	0	0	3	3
6.	EC40006	Advanced VLSI and SoC	3	0	0	3	3
7.	EC40007	Low Power VLSI Design	3	0	0	3	3
8.	EC40008	Advanced Computer Architecture and RISC-V Processor Design	3	0	0	3	3
9.	EC40009	Biomedical Signal Processing	3	0	0	3	3
10.	EE40010	Electric Vehicles Technology	3	0	0	3	3
11.	EE40012	Smart Grid	3	0	0	3	3
12.	EE40013	Wind and Biomass Energy	3	0	0	3	3
13.	EE40014	Energy Management and SCADA	3	0	0	3	3
14.	EE40017	Tidal and Small Hydro Power	3	0	0	3	3
15.	EL40001	Process Control and Robotics	3	0	0	3	3
16.	EL40003	Advanced Control System	3	0	0	3	3
17.	EM40006	Cybersecurity	3	0	0	3	3
18.	EM40010	Optimization Methods in Machine Learning	3	0	0	3	3

Elective Baskets (Specialization)

PE I	PE II	PE III	PE IV	PE V	Specialization
EC30019	EC30013	EC30004	EC30008	EC40004	Communication & Networking
EC30007	EC30011	EC30015	EC40005 / EC40007	EC40006 EC40008	VLSI and Embedded system
CS20006/ CS30011	EM30007/ CS30029	EM30008	EC40009 / EM40010	CS40015/ EM40006	Computer Science &ML
EL30001	EE30047/ EE30024	EE30012/ EC30021	EC40001 / EL40003	EL40001 / EE40010	Automation
EE30013 / EE30015	EE30016 / EE30020	EE30014 EE30045	EE40013 / EE40017	EE40012 / EE40014	Energy

B. Tech. Honors/ Research Degree in Electronics and Computer Science Engineering

B. Tech in Electronics and Computer Science Engineering Program Educational Objectives (PEOs):

The B. Tech program in Electronics and Computer Science Engineering aims to prepare the graduates with the following objectives:

1. Lead a successful career in industries or undertake entrepreneurial endeavors and provide solutions in the areas of system design, analysis of algorithms & data, computer networking, and allied areas of Electronics and Computer Science Engineering or pursue advanced studies.
2. Utilize their knowledge, skills and resources to design, invent and find creative and innovative solutions to engineering problems in a multidisciplinary work environment following appropriate ethical practices.
3. Develop attitude in lifelong learning, apply and adapt new ideas as the technology evolves.

Program Outcomes (POs):

The program outcomes are:

- a) **Engineering knowledge:** Ability to apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- b) **Problem analysis:** Ability to identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- c) **Design/Development of solutions:** Ability to design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- d) **Conduct investigations on complex problems:** Ability to use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- e) **Modern tool usage:** Ability to create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- f) **The engineer and society:** Ability to apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- g) **Environment and sustainability:** Ability to understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- h) **Ethics:** Ability to apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- i) **Individual and team:** Ability to function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

- j) **Communication:** Ability to communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- k) **Project management and finance:** Ability to demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- l) **Life-long learning:** Ability to recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

The program specific outcomes are:

- a) Ability to design and develop systems using suitable hardware and software tools for industrial data management and information communication requirements.
- b) Ability to conduct research in networking, software engineering, embedded system, and related technologies.
- c) Ability to design and develop complex products using suitable tools for societal and engineering needs with skills to communicate effectively in groups.

CURRICULUM

The total minimum credits required for completing the B. Tech. programme in Electronics and Computer Science Engineering is 164.

PROFESSIONAL ELECTIVE

Professional elective-I, II, III are offered during semester five and six. Professional elective IV and V are offered during semester seven and eight. List of electives to be offered during an academic year is announced at the beginning of respective semesters. An elective will be offered only if ten or more students are interested in it. Not that all the electives will be offered in every academic year. Some electives may have seat limitations and will be offered in first cum first serve basis. In order to accommodate more aspiring students, electives having high demand may be offered twice, that is during autumn as elective-I or II and again as elective-III during spring semester.

Students can select electives based on their interest in a domain. Areas of specialization or domain are optional, however electives can be grouped to provide learning around a functional area. Students may qualify for a maximum of one area of Specialization. Completion of the specialization will not be reflecting on transcripts or degree certificate.

Electronics and Computer Science Engineering

SEMESTER III

Theory							
Sl. No	Course Code	Course Title	L	T	P	Total	Credit
1.	MA21001	Probability and Statistics	3	1	0	4	4
2.	EC20001	Signals and Systems	3	0	0	3	3
3.	EC21001	Electronic Circuits	3	1	0	4	4
4.	CS21001	Data Structures	3	1	0	4	4
5.	CS20005	Computer System and Architecture	3	0	0	3	3
6.	EX20003	Scientific and Technical Writing	2	0	0	2	2
Total Credit (Theory Subjects)							20
Total Credit (Practical and Sessional Subjects)							3
Total Credit (Semester)							23

SEMESTER IV

Theory							
Sl. No	Course Code	Course Title	L	T	P	Total	Credit
1.	MA21002	Discrete Mathematics	3	1	0	4	4
2.	CS20002	Operating Systems	3	0	0	3	3
3.	EC20008	Communication Engineering	3	0	0	3	3
4.	CS20006	Database Management Systems	3	0	0	3	3
5.	EX20001	Industry 4.0 Technologies	2	0	0	2	2
6.		HASS Elective II	3	0	0	3	3
Total Credit (Theory Subjects)							18
Practical							
1.	EC29001	Electronic Circuits Lab	0	0	4	4	2
2.	CS29006	Database Management Systems Lab	0	0	2	2	1
3.	CS29008	Programming With Python and Java	0	0	4	4	2
Total Credit (Practical Subjects)							5
Total Credit (Semester)							28

SEMESTER V

Theory							
Sl. No	Course Code	Course Title	L	T	P	Total	Credit
1.	CS30001	Design and Analysis of Algorithms	3	0	0	3	3
2.	EC20002	Microprocessors and Embedded Systems	3	0	0	3	3
3.	HS30101	Engineering Economics	3	0	0	3	3
4.		HASS Elective III	3	0	0	3	3
5.		Professional Elective-I	3	0	0	3	3
6.		Professional Elective-II	3	0	0	3	3
Total Credit (Theory Subjects)							18
Practical							18
1.	CS39001	Algorithms Lab	0	0	2	2	1
2.	EC29002	Communication Engineering Lab	0	0	2	2	1
3.	EC29006	Microprocessors and Embedded Systems Lab	0	0	2	2	1
Sessional							
1.	EC38001	Electronics Product Development	0	0	2	2	1
2.	SAXXXX	K-Explore Open Elective-I	0	0	2	2	1
Total Credit (Practical Subjects)							10
Total Credit (Semester)							28
							23

SEMESTER VI

Theory							
Sl. No	Course Code	Course Title	L	T	P	Total	Credit
1.	CS31001	Software Engineering	3	1	0	4	4
2.	EC30005	VLSI Circuits and Systems	3	0	0	3	3
3.	CS30003	Computer Networks	3	0	0	3	3
4.	HS30401	Universal Human Values	3	0	0	3	3
5.		Professional Elective III	3	0	0	3	3
6.		Open Elective-II/(MI – I)	3	0	0	3	3
Total Credit (Theory Subjects)							19
Practical							
1.	CS33002	Applications Development Lab	0	0	4	4	2
2.	EC39001	VLSI Design Lab	0	0	2	2	1
3.	CS39003	Computer Networks Lab	0	0	2	2	1
Sessional							
1	EM37002	Minor Project	0	0	2	2	1
Total Credit (Practical Subjects)							10
Total Credit (Semester)							29
							24

SEMESTER VII (for B. Tech. (Hons.))

Theory							
Sl. No	Course Code	Course Title	L	T	P	Total	Credit
1	EX40003	Engineering Professional Practice	3	0	0	3	3
2.		Professional Elective-IV	2	0	0	2	2
3.		Open Elective – III (MI – II)	3	0	0	3	3
4.		MI – III (Optional)	3	0	0	3	3
5.		MI – IV (Optional)	3	0	0	3	3
Total Credit (Theory Subjects)						8	8
Practical							
1.	EM47001	Project – I	-	-	-	-	5
2.	EM48001	Practical Training/ Internship	-	-	-	-	2
3.		MI- Lab/ MI project					2
Total Credit (Practical Subjects)							7
Total Credit (Semester)						8	15

SEMESTER VIII (B. Tech. (Hons.))

Theory							
Sl. No	Course Code	Course Title	L	T	P	Total	Credit
1.		Professional Elective-V	3	0	0	3	3
2.		Open Elective-IV (MI V)	3	0	0	3	3
3.		MI - VI (Optional)	3	0	0	3	3
Total Credit (Theory Subjects)						6	6
Sessional							
1.	EM47002	Project- II	-	-	-	-	9
Total Credit (Sessional)							9
Total Credit (Semester)						6	15

SEMESTER VII (B.Tech (Research))

Theory							
Sl. No	Course Code	Course Title	L	T	P	Total	Credit
1.	EX40001	Research Methods and Ethics	3	0	0	3	3
2.	EX40003	Engineering Professional Practice	2	0	0	2	2
3.		Research Elective-I	3	0	0	3	3
4.		MI-II (Optional)	3	0	0	3	3
5.		MI-III (Optional)	3	0	0	3	3
6.		MI-IV (Optional)	3	0	0	3	3
Total of Theory							8
Sessional							
1.	EM47001	Project- I	-	-	-	-	5
2.	EM48001	Practical Training	-	-	-	-	2
3.		MI-Lab/ MI-Project (Optional)	-	-	-	-	2
Total of Sessional							-
Total							8
							15

SEMESTER VIII (B.Tech (Research))

Theory							
Sl. No	Course Code	Course Title	L	T	P	Total	Credit
1.		Research Elective-II	3	0	0	3	3
2.		MI-V (Optional)	3	0	0	3	3
		MI-VI(Optional)	3	0	0	3	3
Total of Theory							3
Sessional							
1.	EM47002	Project- II	-	-	-	-	12
Total of Sessional							12
Total							3
							15

PROFESSIONAL ELECTIVE I/II/II

Sl. No	CourseCode	Course Title	L	T	P	Total	Credits
1.	CS30005	High Performance Computing	3	0	0	3	3
2.	CS30009	Distributed Operating System	3	0	0	3	3
3.	CS30010	Cloud Computing	3	0	0	3	3
4.	CS30011	Computational Intelligence	3	0	0	3	3
5.	CS30019	Web Technology and Applications	3	0	0	3	3
6.	CS30023	Software Defined Networking	3	0	0	3	3
7.	CS30029	Computer Vision and Pattern Recognition	3	0	0	3	3
8.	EC30006	Hardware Description Language for Digital Design	3	0	0	3	3
9.	EC30007	ARM and Advanced Processors	3	0	0	3	3
10.	EC30008	Wireless Sensor Networks	3	0	0	3	3
11.	EC30009	Compound Semiconductor Basics	3	0	0	3	3
12.	EC30010	Mobile Ad Hoc Network	3	0	0	3	3
13.	EC30011	Digital System Design with Verilog	3	0	0	3	3
14.	EC30012	Nanoelectronics	3	0	0	3	3
15.	EC30013	Optical and Satellite Communication	3	0	0	3	3
16.	EC30015	Hardware and Software Co-Design of Embedded System	3	0	0	3	3
17.	EC30017	Audio & Speech Processing	3	0	0	3	3
18.	EC30019	Information Theory and Coding	3	0	0	3	3
19.	EC30021	Industrial IoT	3	0	0	3	3
20.	EL30001	Industrial Automation	3	0	0	3	3
21.	EM30007	Machine Learning based Signal Processing	3	0	0	3	3
22.	EM30008	Deep Learning: Algorithms and Implementation	3	0	0	3	3
23.	EM30009	Data Analytics	3	0	0	3	3
24.	EM30011	Data Mining	3	0	0	3	3

PROFESSIONAL ELECTIVE –IV/ V

Sl. No	CourseCode	Course Title	L	T	P	Total	Credits
1.	CS40003	Software Testing and Automation	3	0	0	3	3
2.	CS40005	Human Computer Interaction	3	0	0	3	3
3.	CS40007	Computer Graphics and Multimedia Systems	3	0	0	3	3
4.	CS40010	Augmented and Virtual Reality	3	0	0	3	3
5.	CS40012	Blockchain	3	0	0	3	3
6.	CS40015	Cryptography and Network Security	3	0	0	3	3
7.	EC40001	Optimization Techniques in Engineering	3	0	0	3	3
8.	EC40002	Millimetre Waves and Terahertz Technology	3	0	0	3	3
9.	EC40003	Cognitive Radio and Cooperative	3	0	0	3	3
10.	EC40004	Quantum Communication	3	0	0	3	3
11.	EC40005	Analog and Mixed Signal IC Design	3	0	0	3	3
12.	EC40006	Advanced VLSI and SoC	3	0	0	3	3
13.	EC40007	Low Power VLSI Design	3	0	0	3	3
14.	EC40008	Advanced Computer Architecture and RISC-V	3	0	0	3	3
15.	EC40009	Biomedical Signal Processing	3	0	0	3	3
16.	EM40001	ML for Language Processing	3	0	0	3	3
17.	EM40006	Cybersecurity	3	0	0	3	3
18.	EM40008	Bioinformatics	3	0	0	3	3
19.	EM40010	Optimization Methods in Machine Learning	3	0	0	3	3

Suggested Bucket of Professional Electives

PE I	PE II	PE III	PE IV	PE V	Specialization
CS30005 / CS30009	CS30019 / EM30009 / EM30011	CS30023/ CS30010	CS40003/ CS40015/ CS40007	EM40006 / CS40010/ CS40012	Computer Science
EC30019	EC30013	EC30010/ EC30008	EC40003/ CS40015	EC40004 / EC40002	Communication & Networking
EC30009 / EC30007	EC30011 / EC30006	EC30015	EC40005 / EC40007	EC40006 / EC40008	VLSI & Embedded Design
CS30011 / EM30007	CS30029 / EC30017	EM30008 EM30009 / EM30011	EC40009 / EM40010 / CS40005	EM40001 / EM40008/ EC30021	ML and Applications

LIST OF HASS ELECTIVES

HASS Elective-II

Sl. No	Course Code	Subjects	L	T	P	Total	Credit
1.	HS20120	Economics of Development	3	0	0	3	3
2.	HS20122	International Economic Cooperation	3	0	0	3	3
3.	HS20220	Organizational Behaviour	3	0	0	3	3
4	HS20222	Human Resource Management	3	0	0	3	3

HASS Elective-III

Sl. No	Course Code	Subjects	L	T	P	Total	Credit
1.	HS30125	Market Structure and Pricing Policies	3	0	0	3	3
2.	HS30127	Pragmatic Inquiry	3	0	0	3	3
3.	HS30129	Economic Analysis of Decision Rules	3	0	0	3	3
4.	HS30131	Economics of Health and Education	3	0	0	3	3
5.	HS30223	Business Ethics and Corporate Governance	3	0	0	3	3
6.	HS30225	Leadership and Team Effectiveness	3	0	0	3	3
7.	HS30421	Gender Studies	3	0	0	3	3
8.	HS30423	Tribal Resource Management	3	0	0	3	3
9.	HS30425	Indian Knowledge System	3	0	0	3	3

RESEARCH ELECTIVE - I (OFFERED BY SCHOOL OF ELECTRONICS ENGINEERING)

Sl. No.	Course Code	Subjects	L	T	P	Total	Credit
1.	EC30009	Compound Semiconductor Basics	3	0	0	3	3
2.	EC40007	Low Power VLSI Design	3	0	0	3	3
3.	CS30023	Software Defined Networking	3	0	0	3	3
4.	EC40015	5G Supportive Technologies	3	0	0	3	3
5.	EC40017	Planner Antenna	3	0	0	3	3
6.	EC40019	Solar Cell Device and Material Technology	3	0	0	3	3

RESEARCH ELECTIVE – II (OFFERED BY SCHOOL OF ELECTRONICS ENGINEERING)

Sl. No.	Course Code	Subjects	L	T	P	Total	Credit
1.	EC40003	Cognitive Radio and Cooperative Communication	3	0	0	3	3
2.	EC40006	Advanced VLSI and SoC	3	0	0	3	3
3.	EC40010	Massive MIMO Technology	3	0	0	3	3
4.	EC40014	RF CMOS VLSI	3	0	0	3	3
5.	EC40016	VLSI Signal Processing	3	0	0	3	3
6.	EC40018	Smart Antennas	3	0	0	3	3

VOCATIONAL ELECTIVES

Vocational courses offered by School of Civil Engineering

Sl. No.	Course Code	Subjects	L	T	P	Total	Credit
1.	CE28001	Building Drawing, Estimation & Costing (for Civil Engineering Students)	0	0	2	1	1
2.	CE28003	GIS & GPS Applications (For other branch students)	0	0	2	1	1

Vocational courses offered by School of Computer Science Engineering

Sl. No.	Course Code	Subjects	L	T	P	Total	Credit
1.	CS28001	Web Design	0	0	2	1	1

Vocational courses offered by School of Electrical Engineering

Sl. No.	Course Code	Subjects	L	T	P	Total	Credit
1.	EE28011	Industrial wiring and control panel design	0	0	2	1	1
2.	EE28013	Installation, operation and maintenance of solar power system	0	0	2	1	1
3.	EE28015	Domestic wiring and home automation	0	0	2	1	1
4.	EE28017	Cyber physics application in industrial IOT	0	0	2	1	1
5.	EE28019	Industrial Control and Remote Monitoring	0	0	2	1	1

Vocational courses offered by School of Electronics Engineering

Sl. No.	Course Code	Subjects	L	T	P	Total	Credit
1.	EC28001	Computational Photography	0	0	2	1	1
2.	EC28003	Sound Engineering	0	0	2	1	1
3.	EC28005	Sensors for Automation	0	0	2	1	1
4.	EC28007	PCB Design	0	0	2	1	1

Vocational courses offered by School of Mechanical Engineering

Sl. No.	Course Code	Subjects	L	T	P	Total	Credit
1	ME28011	Additive Manufacturing(3-D Printing)	0	0	2	1	1
2	ME28013	Die development by CNC milling	0	0	2	1	1
3	ME28015	Concept Car Manufacturing	0	0	2	1	1
4	ME28017	Development of Autonomous Wheeled Robots	0	0	2	1	1
5	ME28019	Modelling of Micro-Wind turbine by 3D CAD	0	0	2	1	1

K-EXPLORE OPEN ELECTIVE - I

Sl. No.	Course Code	Subjects	L	T	P	Total	Credit
1.	SA38001	Robotics	0	0	2	2	1
2.	SA38003	Web Designing	0	0	2	2	1
3.	SA38005	Civil-Tech	0	0	2	2	1
4.	SA38007	Circuit Design & Control	0	0	2	2	1
5.	SA38009	Indian Classical, Folk & Bollywood Dance	0	0	2	2	1
6.	SA38011	Indian Classical & Western Music	0	0	2	2	1
7.	SA38013	Graphic Designing & Editing	0	0	2	2	1
8.	SA38015	Art & Craft	0	0	2	2	1
9.	SA38017	Theatre & Street Play	0	0	2	2	1
10.	SA38019	Film Making	0	0	2	2	1
11.	SA38021	Debating,Public Speaking& Anchoring	0	0	2	2	1
12.	SA38023	Creative Writing	0	0	2	2	1
13.	SA38025	Photography & Videography	0	0	2	2	1
14.	SA 38027	Fashion Styling	0	0	2	2	1
15.	SA 38029	Culinary Arts	0	0	2	2	1
16.	SA 38031	Quiz Activity	0	0	2	2	1
17.	SA 38033	Social Outreach	0	0	2	2	1
18.	SA 38035	Health & Emergency Care	0	0	2	2	1

SIGNALS AND SYSTEMS

Course Code: EC20001
Credit: 3
L-T-P: 3-0-0
Prerequisites: Nil

COURSE OBJECTIVE

This course will begin with an introduction to analog and digital signal processing, then elaborates on various transformation techniques to signals, and finally presents an idea about actual implementations of these methods in today's hardware and software systems. The course includes analog-time, discrete-time signals and, systems. The syllabus revisits the continuous time transform methods like Fourier and Laplace. This will be followed by discrete time transform methods like the Z transform, DFT, and its properties and system theoretic implications. Later, the concepts and foundations of digital filter design and its realization are built up for FIR and IIR filters.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Analyze continuous and discrete signals, apply sampling process, determine related characteristics.
- CO 2: Distinguish and classify various types of systems and analyze system characteristics in time domain.
- CO 3: Apply appropriate continuous time transformation technique for signal analysis.
- CO 4: Analyze the signal and its properties in its frequency domain using discrete time transformation techniques.
- CO 5: Apply Fourier transform techniques in real time applications.
- CO 6: Apply the knowledge of analog filters to digital filters, design and realization of digital filter.

COURSE DETAILS

Introduction to Signals and System

Representation of continuous and discrete time signals, Basic operations, Sampling Theorem, Linear convolution, Correlation.

Revision of Fourier and Laplace Analysis

Significance of Fourier series in LTI system, Continuous time Fourier series formula. Dirichlet conditions & properties, S-plane mapping, ROC properties and examples, Relationship between Fourier and Laplace Transform, Pole-zero Plot.

Discrete Time Fourier Transforms

Discrete Time Fourier Transform, Conditions and properties of DTFT, Discrete Fourier Transform, Properties of DFT, Inverse Discrete Fourier Transform, Circular Convolution, Properties of Circular Convolution, Sectioned convolution, Fast Fourier Transform.

Z-Transform

Z transform, ROC, Properties, Applications

Digital Filters

Introduction to Digital FIR Filter, Design of FIR Filter: Rectangular, Digital IIR filters: Introduction to Digital IIR Filter, Conversion to digital IIR Filter using impulse invariance technique, Bilinear Transformation, Realization of Digital Filters, Direct form – I realization Direct form – II.

Introduction to Adaptive Filter and applications.

Textbooks

1. Proakis J.G. and Manolakes D. G. *Digital Signal Processing* (4th Edition). Pearson.
2. Oppenheim A. V. and Willsky A. S. (2015). *Signals & Systems* (2nd Edition), Pearson.

Reference books

1. Lathi B. P. *Principle of Signal Processing and Linear System* (1st Edition). Oxford University Press.
2. Babu P. R. *Digital Signal Processing* (2nd Edition). Scitech.
3. Mitra S. K. *Digital Signal Processing - Computer Based Approach* (4th Edition). MGH.

MICROPROCESSORS AND EMBEDDED SYSTEMS

Course Code: EC20002

Credit: 3

L-T-P: 3-0-0

Prerequisite: EC21001

COURSE OBJECTIVE

To provide an overview of a 16-bit Microprocessor, and its interfacing to solve design-based problems. Also, to acquaint students with insight of embedded systems, design perspective and applications.

COURSE OUTCOMES

After successfully completing the course, students will be able to

- CO 1: Analyze the architecture of a 16-bit Microprocessor (like 8086), assess and demonstrate programming proficiency using the various addressing modes and instructions of 8086.
- CO 2: Design memory interfacing using memory chips with proper decoder circuits with a 16-bit processor and analyze the interrupt structure of 8086 Microprocessor.
- CO 3: Design circuits with interfacing chips to establish communication between 8086 and I/O to solve real-time applications.
- CO 4: Apply different design constraints and communication protocols for embedded systems.
- CO 5: Analyze 8-bit Microcontroller (like 8051), its instructions, timers & counters and serial operation, and also analyze ARM processor.
- CO 6: Develop skill for writing assembly and/or embedded C programs for interfacing various external devices with 8051 Microcontroller.

COURSE DETAILS

Introduction

Review of digital electronics, a basic Microprocessor based system, tristate concept, bus structure, evolution of Microprocessors, machine instructions & format, addressing modes

Intel 8086 Microprocessor

Architecture, pins, 8086 instructions, sample programs, interrupts

Memory and I/O Interfacing

Memory interfacing, Programmable Peripheral Interface (PPI 8255), Programmable Interrupt Controller (8259), USART (8251)

Fundamentals of Embedded Systems

Embedded processor in system, components of embedded system, brief introduction to embedded software in system, design process in embedded system, programming methods for embedded system case study, communication protocols - I2C, SPI/CAN

Microcontrollers & Interfacing

Overview of MCS-51 family of Microcontrollers, memory organization, pins, addressing modes, interrupts, timers & counters, serial communication, 8051 instruction set & interfacing with ADC, LCD, DC motor

Brief on RISC philosophy and ARM principles

Textbooks

1. A. K. Ray and K. M. Bhurchandi, Advanced Microprocessor and Peripherals, McGraw Hill Education, 3rd edition, 2017. ISBN-10: 978-1259006135
2. Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, The 8051 Microcontroller and Embedded Systems, 2nd edition, Pearson. ISBN-10: 9780131194021

Reference books

1. Douglas V. Hall and S. S. S. P. Rao, Microprocessors and Interfacing, Programming & Hardware, McGraw Hill Education, 3rd Edition, 2017. ISBN-10: 9781259006159
2. Muhammad Ali Mazidi, Sarmad Naimi, Sepher Naimi and Shujen Chen, ARM Assembly Language Programming & Architecture, Microdigitaled.com, 2nd edition, 2017. ISBN10: 9780997925906
3. Deshmukh, Microcontroller Theory & Applications, McGraw Hill Education, 2017. ISBN-10: 9780070585959.
4. Raj Kamal, Embedded Systems: Architecture, Programming & Design, McGraw Hill Education, 3rd Edition, 2017. ISBN: 9789332901490

ELECTROMAGNETIC THEORY AND ANTENNAS

Course Code: **EC20003**

Credits: **3**

L-T-P: **3-0-0**

Prerequisites: **Nil**

COURSE OBJECTIVE

Objective of this course is to acquaint students with the electromagnetic fundamentals underlying the operation of devices and components used in communication and transmission systems. The emphasis is on the physical concepts of fields, waves, and their applications in engineering problems.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Analyze time varying electromagnetic fields and Maxwell's equations.

CO 2: Evaluate the characteristics of wave propagation in different media, power flow.

CO 3: Analyze and Design transmission lines.

CO 4: Design transmission line components and two port networks.

CO 5: Assess the role of electromagnetism to antenna radiation and the related Network theorems for antennas.

CO 6: Design different types of antennas and antenna arrays.

COURSE DETAILS

Time varying Electromagnetic fields

Faraday's Law of electromagnetic induction, Maxwell's equations, Potential functions, Electromagnetic boundary conditions, Wave equations, Time harmonic fields.

Plane Electromagnetic Waves

Wave propagation in lossless media and in lossy media, Propagation constant, Intrinsic impedance, Loss tangent, Phase velocity and group velocity, Wave propagation in good conductors, Skin depth and surface resistance of conductors, Flow of electromagnetic power and Poynting vector, Normal incidences of electromagnetic waves (parallel and perpendicular polarized) at plane perfect conductors and dielectric boundaries, Brewster angle, Standing wave ratio.

Transmission Line Theory

General transmission line equations, Characteristic impedance, Transmission line parameters, Lossless and distortionless line, Wave characteristics of finite transmission lines, Input impedance, Reflection coefficient, VSWR.

Applications of Transmission Lines

Transmission lines as circuit elements, Transmission line resonator, Quarter wave transformer, Transients on transmission lines (qualitative), Smith chart (qualitative), Single stub matching, Strip line, Microstrip line, Impedance Parameters, Admittance parameters, Hybrid parameters, Transmission (ABCD) parameters, Equivalent circuit of two-port network.

Antenna Radiation and Network Theorems

Radiation from antennas, Near & Far fields, gain, efficiency, Directivity, Polarization, Thin linear antennas, Effective length, Half-wave dipole, Quarter-wave monopole, Friis transmission formula, Effective aperture area, Norton's theorem, Thevenin's theorem, Maximum power transfer theorem, Compensation theorem, Reciprocity theorem, and their applications to antennas.

Antennas

Uniform linear array of isotropic elements, Yagi-Uda antenna, Horn antenna, Parabolic disc antenna, Microstrip antenna.

Textbook

1. D. K. Cheng, Field and Wave Electromagnetics, Pearson Education, 2nd Ed.

Reference books

1. M. N.O. Sadiku, Elements of Electromagnetics, Oxford University Press, 4th Ed.
2. J. D. Kraus & R. J. Marhefka, Antennas for All Applications, Tata McGraw Hill, 3rd Ed.
3. E. C. Jordan and K. G. Balmain, Electromagnetic Waves and Radiating Systems, Prentice Hall of India.
4. D. M. Pozar, Microwave Engineering, Wiley-India, 3rd Ed.

SEMICONDUCTOR TECHNOLOGY

Course Code: EC20007

Credit: 3

L-T-P: 3-0-0

Prerequisites: Nil

COURSE OBJECTIVE

This course aims to make the students understand the fundamentals of electronic devices and familiarization with the fabrication of semiconductor devices, integrated circuits, and Micro-systems. In addition, students will gain knowledge of opto-electronic devices and quantum technology and appreciate the significance of these devices in various applications.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Analyze different types of semiconductor materials based on their band diagrams and estimate various electrical properties.
- CO 2: Evaluate various junction properties and illustrate PN junction fundamentals.
- CO 3: Analyze various MOS structures and their characteristics
- CO 4: Utilize the knowledge of MOS structures to appraise the high electron mobility MOSFET structures and their characteristics.
- CO 5: Explain and demonstrate the different fabrication processes of MOS devices.
- CO 6: Utilize the basic knowledge of semiconductors to analyze emerging devices and technologies .

COURSE DETAILS

Introduction to Semiconductor and P-N Junction theory

Energy band diagram and classification, Density states and Fermi level, Semiconductor under equilibrium Condition (n_0 , p_0 and intrinsic carrier concentration), Intrinsic and extrinsic semiconductor, Drift and diffusion current, Carrier generation and recombination, Excess carrier concentration, Continuity equation, Carrier lifetime, Qualitative description of charge flow in a p-n Junction, Junction Theory (concept of potential barrier, built in electric field, depletion layer width, and junction capacitance qualitative only), PN Junction operation under bias, and I-V relationship.

MOSFET

Basics of MOSFET, Two terminal MOS structure and its operation under external bias condition, Threshold voltage of MOS, Qualitative description of MOSFET operation, I-V characteristics of MOSFET, MOSFET as circuit element (CMOS Inverter operation and DC characteristics,

qualitative only), High voltage MOSFET and Gallium Nitride power HEMT (structure and operation), III-V high electron mobility transistors, and Multigate MOSFET.

Opto-Electronic Devices

Photo diode, Light emitting diodes, Semiconductor LASER, OLED, Solar cell, Tunnel diode, and Schottky diode.

Semiconductor Fabrication

Historical perspective, Processing overview, Crystal growth, Wafer fabrication and basic properties of Silicon wafers, Clean rooms, Wafer cleaning, Diffusion, Ion-Implantation, Thermal Oxidation of Silicon, Lithography, Etching (Wet and Dry), Thin film deposition, Epitaxy, Metallization, and Overview of CMOS N-well process.

Emerging Devices and Technologies

Quantum confinement in semiconductor devices, Quantum dot, quantum well devices, Spintronic, and QLED.

Textbook

1. Simon M. Sze, Ming-Kwei Lee, Semiconductor Devices: Physics and Technology, Wiley, 3rd Edition (2021).

Reference books

1. V K Dugaev and V I Litvinov, Modern Semiconductor Physics and Device Applications, CRC Press, 2022 (Foreign Publication).
2. Pallab Bhattacharya, Semiconductor Optoelectronic Devices, Pearson, 2nd Ed (2017). Robert F. Pierret, Semiconductor Device Fundamentals, Pearson, 1st Edition 9 (2006).

COMMUNICATION ENGINEERING

Course Code: **EC20008**
Credit: **3**
L-T-P: **3-0-0**
Prerequisite: **Nil**

COURSE OBJECTIVE

The objective of the course is to learn the concepts of various analog and digital communication systems. Students will also be able to analyze and develop the problem solving abilities related to communication Engineering.

COURSE OUTCOMES

- CO 1: Analyze signal attributes and apply the concept of Fourier transform and series to observe signal in frequency and time domain, and explore the concepts of stochastic processes.
- CO 2: Select appropriate analog modulation techniques for specified broadcasting requirements and design corresponding transmission and reception systems with their spectral representations.
- CO 3: Apply the concept of sampling theorem to develop and analyze different Pulse Modulation based communication systems including PCM and their integration with TDM system for signal transmission and reception.
- CO 4: Apply problem solving skills to recommend appropriate digital communication techniques considering the principle of operation of ASK,FSK,PSK,QPSK and QAM.
- CO 5: Analyze the significance of various terminologies associated with Wireless and Satellite Communication and evaluate the performance
- CO 6: Analyze the significance of signal communication with Optical Communication technology and various and various applications.

COURSE DETAILS

Introduction

Basic communication system , Signals in time and frequency domain, Fourier transform and Series, properties of FT and FS, Various Signal functions, Brief Idea of Probability, Cumulative Distributive Function, Probability Density Function, Gaussian and Rayleigh PDF. Concept of Signal to Noise Ratio.

Amplitude Modulation Techniques

Need of Modulation, Frequency Translation, Principle of AM, side bands, Power Relationship, Assignable Frequency spectrum, Side band Transmission, DSB, SSB, VSB, AM modulators and demodulators, AM Radio Receiver, Super hetero-dyne Principle.

Frequency Modulation Techniques

Principle of FM, Frequency Deviation, Spectrum of FM wave, Power in Modulated wave, Narrow band FM, Pre-emphasis and De-emphasis, Block Diagram of FM Transmitter, FM Detector, Block Diagram of FM Receiver,

Pulse Modulation Techniques

Analog vs Digital modulation, Sampling Process, Pulse Amplitude Modulation, Pulse Width Modulation, Pulse Position Modulation, Time Division Multiplexing, Frequency Division Multiplexing, The Quantization Process, Pulse Code Modulation, Bandwidth vs SNR trade-off in PCM.

Digital Modulation

Data Form, Principles involved in ASK, PSK (BPSK, QPSK, $\pi/4$ QPSK), FSK.

Different Communication Systems

Introduction to Modems, Brief concept of satellite communication, Fiber optic communication and Mobile communication.

Textbooks:

1. B.P. Lathi, Modern Digital and Analog Communications Systems, Oxford Univ Press, 4th Edition.
2. Simon Haykin, Introduction to Analog & Digital Communication System, Wiley Student edition 2011

Reference book:

1. H. Taub, and D.L. Schilling, Principles of Communication System, McGraw Hill, 3rd Edition

ELECTRONIC CIRCUITS

Course Code: EC21001

Credit: 4

L-T-P: 3-1-0

Prerequisites: Nil

COURSE OBJECTIVE:

This course is designed to enrich the basic knowledge of engineering students in the field of analog and digital electronics and to provide them with a support in their engineering investigative studies. The subject will prepare them to perform the analysis of any analog and digital electronics circuit, empower them to understand the design and working of transistor, operational amplifier, filters, oscillators, various combinational and sequential circuits etc. This course will also help students to explore various other domains of science and technology like communication systems, VLSI design, Internet of Things etc.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Comprehend the fundamentals of transistors, linear integrated circuits, combinational and sequential circuits,
- CO 2: Apply knowledge to solve different biasing circuits using BJT and FET amplifiers; analyze small signal model of transistor,
- CO 3: Simplify and realize Boolean expressions and design various combinational and sequential circuits,
- CO 4: Analyze different circuits using OPAMPs and its performance evaluation by frequency response & stability,
- CO 5: Design and analyze various circuits like instrumentation amplifier, filter, oscillator, differentiator, integrator, and multivibrators using linear ICs, and
- CO 6: Develop the ability to design practical electronic circuits that perform desired/industrial applications.

COURSE DETAILS

Transistor Amplifier

Requirement of biasing, Different types of biasing circuits for BJT & FET, Small signal model for BJT (simplified hybrid model), Low frequency small signal analysis of CE and CC configurations (without feedback), Small signal model for FET's (JFET and MOSFET), Low frequency small signal analysis of CS and CD configurations, frequency response of amplifier, Classification of amplifier, Class B Push Pull Amplifier.

Boolean Algebra and K-maps

Representation of Boolean Function, Minterms & Maxterms, K-map representation, simplification and realization with logic gates.

Analysis & design of Combinational Circuits

Introduction to combinational circuits, Adders (Full adders, parallel binary adders, 4-bit Adder/Subtractor), Decoders and Encoders and its application, Multiplexer.

Operational amplifiers

Block diagram representation, Op-amp parameters, feedback concept, General characteristics of negative feedback amplifier, Op-amp circuits using negative feedback (voltage series feedback & voltage shunt feedback), Differential amplifier, Op-amp applications: Instrumentation amplifier, Voltage to current converter and vice versa, Integrator, Differentiator, active filter, Op-amp with positive feedback.

Analysis & design of Sequential Circuits

Overview of various Flip-flops (inter-conversion of FFs), Concepts of level and edge triggering, Counter (synchronous and asynchronous) & application, Multi-vibrator using IC555

Textbooks

1. Boylestad, R. L.& Nashelsky, L. (2021). *Electronics Devices and Circuits* (11th Edition). Pearson Education. ISBN 13: 978-0-13-262226-4.
2. Mano, M. M. (2016). *Digital Logic and Computer Design* (1st Edition), Pearson Education. ISBN-13: 978-93-325-4252-5.

Reference Books

1. Millman, J., Halkias, C. & Parikh, C. D. (2017). *Integrated Electronics* (2nd Edition). McGraw-Hill Publications. ISBN 13: 978-0-07-015142-0.
2. Choudhury, D. R. & Jain, S. B. (2021). *Linear Integrated Circuits* (6th Edition). New Age International Publishers. ISBN: 978-812247212-7.
3. Gayakwad, R. A. (2017). *Op-Amps & Linear Integrated Circuits* (4th Edition). Pearson Education. ISBN: 978-93-325-4991-3.
4. Anand Kumar, A. (2016). *Fundamentals of Digital Circuits* (4th Edition). PHI. ISBN: 9788120352681

COMMUNICATION SYSTEMS AND TECHNIQUES

Course Code: EC21002

Credit: 4

L-T-P: 3-1-0

Prerequisite: Nil

COURSE OBJECTIVE

Objective of the course is to familiarize students with the fundamental principle of various analog and digital communication systems, techniques and applications. Students will be able to analyze, design and develop the problem solving abilities related to both Analog and Digital Communication Engineering.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Analyze signal attributes and apply the concept of Hilbert Transform, Pre-Envelope, Complex Envelope for bandpass signal representation and explore the concepts of stochastic processes.
- CO 2: Select appropriate analog modulation techniques for specified broadcasting requirements and design corresponding transmission and reception systems with their spectral representations.
- CO 3: Apply the concept of sampling theorem to develop and analyze different Pulse Modulation based communication systems including PCM and their integration with TDM system for signal transmission and reception.
- CO 4: Apply problem solving skills to recommend appropriate digital communication techniques considering the principle of operation of ASK,FSK,PSK,QPSK and QAM.
- CO 5: Comprehend and analyze ISI in communication systems, pulse shaping for zero ISI, raised cosine filtering, Gaussian filtering and matched filter.
- CO 6: Evaluate the performance of various analog and digital modulation systems in terms of SNR and probability of error to estimate the channel of an effective communication system.

COURSE DETAILS

Introduction to communication system

Concept of bandwidth, spectral efficiency, Hilbert Transform, Pre-envelope, base-band and band-pass signals, Brief Idea of Probability, Random Variable, Random Process, Cumulative Distribution Function, Probability Distribution function, Mean, Variance, Gaussian and Rayleigh PDFs.

Modulation

Need of Modulation, Frequency Translation, Principle of AM, side bands, Power Relationship, Assignable frequency spectrum, Side band transmission, DSB, SSB, VSB, Generation of AM signals, square law modulator, balanced modulator. Demodulation of AM signals, coherent and non-coherent detection, Envelope detection. AM Radio Receiver, Super hetero-dyne principle, Noise in AM systems.

Angle Modulation

Narrowband vs wide band FM, Bessel functions, Carson's rule, generation of FM, demodulation of FM, Pre-emphasis/De-emphasis, Applications of FM in commercial broadcasting and other applications. FM Super hetero-dyne radio receiver, Noise in FM systems

Pulse modulation techniques

Pulse modulation techniques: Pulse amplitude modulation, Pulse width modulation, Pulse position modulation, Time Division Multiplexing, Pulse code modulation: Quantization Process, Quantization Error, Bandwidth vs SNR trade-off in PCM.

Digital Modulation and Transmission

PSK and its types (QPSK, M-ary PSK), signal space and symbols, distance between symbols and its significance) PSK generation and reception, FSK, generation and reception, signal space representation, ASK and QAM, signal space representation, generation and reception.

ISI in communication systems, Pulse Shaping for zero ISI, raised cosine filtering, Gaussian filtering. Matched filter and its significance in digital signal reception, Correlator, calculation of probability of error for different modulation techniques.

Textbooks

1. Lathi, B. P. *Modern Digital and Analog Communications Systems* (4th Edition). Oxford University Press. ISBN-978-0-19-538493-2.
2. Haykins, S.(2011). *Introduction to Analog & Digital Communication System* (Student edition). Wiley. ISBN-9788126536535

Reference books

1. Taub, H. & Schilling, D. L. *Principles of Communication System* (4th Edition) MGH. ISBN-9781259029851
2. Couch, L. *Digital & Analog Communication Systems* (8th Edition). Pearson, ISBN-9780132915380

COMPUTATIONAL PHOTOGRAPHY

Course Code: EC28001

Credit: 1

L-T-P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

Computational photography (CP) is the fusion of computer graphics, computer vision, optics and imaging. The role of CP is to overcome the limitations of traditional cameras by combining imaging and computing to enable new and improved ways to capture, represent and interact with the physical world. The course provides an overview of elements of photography, which includes digital image capturing mechanisms, lighting controls, effect of focal length and aperture and various lossy and lossless image storage mechanisms. Objective is to briefly explain computational methods used to enhance photographs.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Appreciate concept of photography, and digital camera technology
- CO 2: Understand types of cameras and their mechanisms
- CO 3: Demonstrate computational image processing
- CO 4: Apply computational photography methods for photo composition and panoramic
- CO 5: Apply computational image processing for photography quality enhancement
- CO 6: Comprehend various image filtering techniques

COURSE DETAILS

Introduction to Computational Photography

History of Photography and Computational Photography, Digital Representation of Images, Cameras, Difference between Full frame, APSC and Medium format sensors, scaling, crop sensor advantages/disadvantages

Digital photography

Principle of Operation of DSLR camera, Aperture, ISO, Shutter speed and Angle Control, Camera Calibration and Tethering, Computational Cameras, Image Storage formats: Compressed vs uncompressed formats, Basics of Lenses: Wide angle, Telephoto, Prime lenses, Macro lenses. Difference in angle, Depth of field control

Computational Techniques

Concept of Color, color models , noise, its types, image histogram, Image Processing software: Licensed and Open Source

Training on Computational Photography

Shooting with wide angle lenses, Shooting with Telephoto lens, zooming, changes in angle , Shooting with Prime lenses and constant aperture lenses, Shooting with Macro lenses, microscopic photography

Training on Digital Imaging-I

Photography Genres, Scene Composition, Dynamic Range improvement, Portraits, Photographing scenes, crowd and people, Shooting Portraits, group photos and events

Training on Digital Imaging-II

Long exposure, Brenizer's Method, Sports High Shutter speed, Burst, fisheye, architecture photography, Macro, Basics of Long exposures, using polarizing filters Shooting panorama, Brenizer's method and other photographing techniques Shooting sports, high shutter speed

Training on Digital Imaging-III

Use of lights, soft box and flashes, guide number etc. , product photography, computational photography,E-commerce photography, Use of Lights, Flash, wireless flash, Basics of product photography, photography for e-commerce and computational photography

Training on Post Processing-I

RAW image processing, Basic adjustments and correction, Lens Distortion and color correction using Adobe Photoshop, Monochrome image processing, color image processing batch processing using Light-room

Training on Post Processing-II

Image enhancement operations, noise removal, Artistic filtering, cosmetic filtering, and other post processing methods. Post Processing III: Background removal, artificial coloring.

Training on Post Processing-III

Open Source and free software for image post processing and computational photography, their usage and capabilities.

Photography Ethics

Photography ethics: empathy, consent, integrity, ethical decision making, privacy

Textbook

1. Richard Szeliski, Computer Vision: Algorithms and Applications, 2nd ed

Reference books

1. Ayush Bansai, Achuta Kadambi, and Ramesh Raskar, Computational Imaging Book
2. Richard Hartley and Andrew Zisserman., Multiple View Geometry in Computer Vision
3. David Forsyth and Jean Ponce., Computer Vision: A Modern Approach
4. Steven Gortler., Foundations of 3D Computer Graphics
5. Rafael Gonzalez and Richard Woods., Digital Image Processing
6. Barbara London and John Upton, Photography

SOUND ENGINEERING

Course Code: EC28003

Credit: 1

L-T-P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

It elaborately covers in various aspects of sound(physical and mechanical behavior), equipment used for recording/ reproducing and basic idea for the preparation of final sound track in film or television production.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Recognize, define, and explain the principles of sound engineering related to signal flow, microphones, recording, mixing, production, and mastering.
- CO 2: Demonstrate practical, imaginative understanding and fluency on sound engineering technologies and procedures .
- CO 3: Solve problems independently, imaginatively, and creatively in the field of sound engineering will be demonstrated by students.
- CO 4: Learn how to conduct research and have a critical comprehension of sound engineering and its related fields.
- CO 5: Understand the basic techniques of sound recording.
- CO 6: Understand the working of different types microphone and louspeakers and their applications in industry.

COURSE DETAILS

- Introduction to technology of sound
- Analysis of prerecorded speech, music and effects
- Observation of the installation of PA System in a large auditorium
- Study and analysis of different microphones
- Study the feature of 2 channel digital sound recorder
- Study about the effect of loudness in relation with the distance from source to the listener
- Sound recording and reproduction practice by using recorder in PA system chain
- Study of sound in different environmental situation
- Study and analysis on Modulated Radio wave AM and FM in Live streaming radio stations
- Study the effect of Bass and Treble (Concept of Equalization)

Textbook

1. Glyn Alkin, Sound Recording and Reproduction

Reference book

1. Michael Talbot Smith, Sound Assistance

SENSORS FOR AUTOMATION

Course Code: EC28005

Credit: 1

L-T-P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

Sensors and automation are revolutionizing the technology in the areas like consumer electronics, automotive industry, healthcare, and in other settings. The course will provide an opportunity for students to learn different sensors and its application in real world problems. It will empower the students to develop their knowledge

regarding operation, application and integration of sensors to enable the design and realization a complete systems.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Learn about the microcontroller, its hardware interfacing and programming
- CO 2: Understand the working principle and characteristics of different types of sensor
- CO 3: Interface various sensor interfacing with microcontroller and display devices
- CO 4: Understand the basic principles of analog to digital conversion and its application with different sensors
- CO 5: Gain knowledge about various types of automation system
- CO 6: Develop and implement sensor for final products in real time applications

COURSE DETAILS

1. Introduction to microcontroller, platform of operations with basic programming techniques
2. Interfacing of serial and parallel device with microcontroller
3. Interfacing of microcontroller with display devices
4. Use of ADC to interface various analog sensors with microcontroller
5. Introduction to sensor, measurement of physical parameters like temperature and humidity
6. Application of ultrasonic and proximity sensor
7. Application of gas and pressure sensor
8. Application of IR sensor and RFID
9. Interfacing actuators to drive DC motor (application of touch switch as actuators)
10. Implement sensor in final products for real time solution

Textbook

1. T. Karvinen, and K. Karvinen, Getting started with sensors, Shroff Publishers, Kindle , Edition, 2014.

Reference books

1. J. S. Katre, Sensors in Automation, Tech Knowledge Publications, 1st Edition, 2023
2. D. Patranabis, Sensors and Transducers, PHI Learning, 2nd Edition, 2003.

PCB DESIGN

Course Code: EC28007

Credit: 1

L-T-P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

Over the years, printed circuit board manufacturing has continued to grow in order to keep up with the increasing demands of newer, faster, and more complex electronic circuitry. This course will familiarize students to design, simulate electronics circuit and fabricate PCB for prototyping using CAD tool. This program is designed to provide a balanced foundation of theoretical knowledge and practical skills in printed circuit board design.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Understand and evaluate different electronics components.
- CO 2: Create schematic and simulate the circuit using OrCAD or any other CAD tools.
- CO 3: Understand single- and double-layer PCB.
- CO 4: Create and fabricate PCB and analyze the PCB using screen printing method.
- CO 5: Understand assembly of electronics component by soldering.
- CO 6: Analyze and test the circuit for any error.

COURSE DETAILS

Description of different Electronics Component and their Identification

Passive and active components, component identification, Color code for resistor and disc capacitors, Inductor and their types, simple air core and iron core inductor design.

Circuit Design and Simulation using CAD tool (OrCAD)

Design of a simple electronics circuit using data sheet and circuit schematic and simulation.

Schematic to PCB transfer and routing

Schematic to PCB transfer (assigning foot prints to various components, transfer to PCB), routing, DRC, ERC, EMC

Screen Printing Procedure

Preparation of screen, mask transfer

PCB preparation and Checking of Routing

transfer of layout to PCB using screen printing methods, etching, cleaning, error checking of routing, component mounting, soldering

Testing and Verification

Testing the circuit with the help of multi-meter and CRO

Textbooks

1. Chris Robertson, Printed Circuit Board, PHI, 2003
2. Elaine Rhodes, Developing Printed Circuit Assemblies: From Specifications to Mass Production, 2008, ISBN: 978-1435718760.

Reference books

1. Douglas Brooks, Signal Integrity Issues and Printed Circuit Board Design, PHI, 2003.
2. Kraig Mitzner, Complete PCB Design Using OrCAD Capture and PCB Editor, Newnes, 2009
3. Open source EDA Tool KiCad Tutorial : <http://kicad-pcb.org/help/tutorials/>

ELECTRONIC CIRCUITS LAB

Course Code: EC29001

Credit: 2

L-T-P: 0-0-4

Prerequisites: Nil

COURSE OBJECTIVE

Students will be able to gain knowledge and implement as well as simulate basic analog and digital electronic circuits (amplifier, oscillator, voltage regulator, decoder, multiplexer, counter) using discrete components and ICs. Students will have the ability to analyse, and resolve engineering problems associated with component selection, assembly and testing and get familiarization to PCB designing

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Design and simulate amplifier circuit using BJT/FET and ICs .
- CO 2: Design and simulate oscillator circuit using BJT/FET and ICs .
- CO 3: Design and simulate filter circuit using discrete components/ICs .
- CO 4: Design and simulate voltage regulator circuit using discrete components/ICs .
- CO 5: Simulate and design combinational logic circuits like adders, decoders and multiplexers in Xilinx ISE and logic gate ICs.
- CO 6: Simulate and design sequential logic circuits like Synchronous type counters and Asynchronous type counters in Xilinx ISE and Flip-flop ICs.

COMMUNICATION ENGINEERING LAB

Course Code: EC29002

Credit: 1

L-T-P: 0-0-2

Prerequisites: Nil

COURSE OBJECTIVE

This lab aims to make students practice the fundamental theories of analog and digital communication systems. Students will use computer simulation tools such as P-SPICE or Matlab to carry out design experiments. Students will design, and build and examining trade-offs in different modulation systems. Perform experiments in converting analog information into digital data.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Investigate and analyze the signal's characteristics both in time and frequency domains (spectral analysis)
- CO 2: Design and analyze the circuit for analog modulations techniques (amplitude modulation and frequency modulation) and their applications in real world scenario.
- CO 3: Analyze pulse-based transmission (PAM, PWM, and PPM) and multiplexing technique.
- CO 4: Evaluate the operating principles of various digital modulation techniques (ASK, FSK, PSK).
- CO 5: Utilize software-based simulation tools to analyze communication system and propose innovative solutions for improving system performance.
- CO 6: To document their experimental procedures, observations, circuit designs, and test results in a clear and concise manner. They should be able to effectively communicate their work through lab reports, diagrams, and data analysis, demonstrating their understanding and proficiency in working with electronic devices and various softwares.

SIGNAL PROCESSING LAB

Course Code: EC29003

Credits: 1

L-T-P: 0-0-2

Prerequisites: Nil

COURSE OBJECTIVE

The objective of this laboratory is to make students familiar with various signals and systems used in real world application. Students will develop Signal Processing algorithms for convolution, correlation, DFT, FFT, filtering of various real world signals etc. Dedicated digital signal processing hardware or development board will be used for realization of various signal processing techniques.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Analyze linear and time invariant system responses for various real world signals.
- CO 2: Gain proficiency using software tools and programming for various signal processing techniques like Fourier analysis, DTFT, DFT and DCT etc.
- CO 3: Design, implement and compare digital filters for defined specifications.
- CO 4: Analyze and manipulate different types of signals like audio, images and videos etc.
- CO 5: Design and implementing digital signal processing systems using hardware platforms or development boards.
- CO 6: Prepare appropriate textual and graphical reports of laboratory data and computational results incorporating accepted data analysis and synthesis methods, mathematical software and processing tools.

MICROPROCESSORS & EMBEDDED SYSTEM LAB

Course Code: **EC29006**

Credit: **1**

L-T-P: **0-0-2**

Prerequisites: **Nil**

COURSE OBJECTIVE

This course aims to develop assembly level and high-level language programming skills on 8086 Microprocessor and 8051 Microcontroller. Also, to develop the skill of designing embedded systems using ARM for various general purpose and sensing applications.

COURSE OUTCOMES

After successfully completing the course, students will be able to

CO 1: Develop assembly language programming skills on 8086 Microprocessor.

CO 2: Develop assembly language programming skills on 8051 Microcontroller.

CO 3: Utilize software development tools to interface circuits and execute programs on 8086 Microprocessor.

CO 4: Design practical circuits to interface I/O devices with 8051 Microcontroller.

CO 5: Analyze the architectural features, develop programs using instructions of ARM and C language for different applications.

CO 6: Design and solve real life engineering problems using embedded systems.

MICROWAVE ENGINEERING

Course Code: **EC30001**

Credit: **3**

L-T-P: **3-0-0**

Prerequisite: **Nil**

COURSE OBJECTIVE

The course offers the students regarding the basic knowledge on rectangular waveguide, various types of waveguide microwave components and measurements. It also introduce vacuum tube and semiconductor based microwave sources and amplifiers. The course also included the applications of microwaves in communication systems and industries.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Apply propagation characteristics for the design of rectangular waveguide and cavity resonator for microwave communications.

CO 2: Construct various types of microwave components for the design of microwave communication systems and antennas and make use of microwave measurement equipments.

CO 3: Analyze Klystron amplifier, Reflex Klystron, Magnetron and slow-wave structures for the design of vacuum-type amplifiers and oscillators for high-frequency applications.

CO 4: Analyze the microwave solid state transferred electron devices for miniaturized low-power RF devices.

CO 5: Design microwave avalanche transit-time devices for oscillators and amplifiers at microwave frequencies.

CO 6: Explain and make use of microwaves systems for Satellite, RADAR, medical, and home appliances.

COURSE DETAILS

Waveguide and Cavity Resonator

Transverse electric and transverse magnetic wave propagation in rectangular waveguides, Waveguide parameters, Wave impedances, Rectangular cavity resonator (qualitative).

Microwave Components and Microwave Measurements

Scattering matrix representation, Variable attenuators, Linear phase shifter, E-plane, H-plane and magic Tees, Rat race power divider, Two-hole directional coupler, Slotted section, Matched terminations, Coupling probes, Crystal detector, Isolator, 3-port & 4-port circulators. Microwave power measurement, Bolometer, Frequency measurement, Impedance measurement by vector network analyzer.

Microwave Vacuum Type Amplifiers and Sources

Limitations of conventional vacuum tubes, Klystron amplifier, Bunching process, Beam coupling coefficient & bunching parameter. Reflex Klystron, Velocity modulation, Bunching parameter, Applegate diagram. Magnetron oscillator, Travelling wave tube (qualitative), Backward wave oscillator (qualitative).

Transferred Electron Devices

Differential mobility, Gunn effect, Gunn diode, RWH theory, Two-valley model theory, Modes of operation of Gunn diode (qualitative).

Avalanche Transit-time Devices

READ diode, PIN diode, IMPATT diode, BARITT diode.

Applications of Microwaves

Microwave RADAR system, RADAR equation, Pulsed RADAR, Microwave communication systems, Terrestrial system (Terminal systems, Repeaters), Satellite communication systems, Components of a satellite, LEO, MEO and HEO orbits, Industrial applications of microwaves, Microwave heating, Principle of microwave ovens. Medical applications of microwaves (qualitative).

Textbooks

1. Liao, S. Y. (2003). *Microwave Devices and Circuits* (3rd Edition). Pearson Education. ISBN: 9788177583533.
2. Pozar, D. M. (2009). *Microwave Engineering* (3rd Edition). Wiley-India Edition. ISBN: 8126510498, 9788126510498.

Reference books

1. Jordan, E. C. & Balmain, K. G. (2016). *Electromagnetic Waves and Radiating Systems* (2nd Edition). Pearson Education. ISBN: 9789332551770.
2. Das, A. & Das, S. K. (2000). *Microwave Engineering* (1st Edition). Tata McGraw-Hill. ISBN: 0071188843, 9780071188845.

WIRELESS MOBILE COMMUNICATION

Course Code: EC30002

Credits: 3

L-T-P: 3-0-0

Prerequisites: Nil

COURSE OBJECTIVE

The course intends to make the students learn the Cellular Concept, RF signal propagation through a wireless channel, Various fading scenarios, Equalization and diversity techniques, multiple access techniques, and various signal degradation factors associated with wireless communication and to study numerous wireless standards and current technological trends in this domain.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Analyze the significance of various terminologies associated with cellular architecture and evaluate the performance of Cell Splitting, Sectoring, and Microcell zone techniques in terms of SIR and capacity improvement.
- CO 2: Solve problems associated with basic propagation models like two ray reflection model, Knife edge propagation model etc and be able to analyze signal degradation in wireless outdoor propagation models.
- CO 3: Analyze the concepts and solve problems on various modulation schemes like QPSK, offset QPSK, $\pi/4$ QPSK, MSK, GMSK, QAM used in present day mobile communication.
- CO 4: Apply the concepts of channel equalization and various diversity techniques for improving the signal quality in wireless communication.
- CO 5: Design PN sequence generators using the concepts of spread spectrum technique and its applications to CDMA systems.
- CO 6: Appraise MC-CDMA and OFDMA modulation concepts and MIMO antenna systems used in higher generation wireless and mobile communication.

COURSE DETAILS

Channel Coding

Error correction codes – Introduction to Galois fields, polynomial arithmetic, linear block codes for error correction – Generator matrix, Encoding, Parity check matrix, Decoding – standard array decoding and Syndrome decoding. Cyclic codes – Generation of codes, encoding and syndrome decoding, Introduction to Convolutional codes

Cellular Communication System

Cellular concept, System architecture, Spectrum allocation, Frequency reuse, Channel assignment Strategies, Co-channel interference & System capacity. Hand off, Hand off structure, Practical Hand off consideration, Prioritizing Handoff, Power control, Near – far problem, System capacity, Improvement techniques : Cell splitting, Sectoring, Micro cell zone concept

RF Propagation and Fading

Free space propagation model, propagation mechanism

Large scale fading, Diffraction & Scattering by high – raise structures, shadowing and path loss. Small scale fading, Doppler and time-delay spread, Coherence bandwidth and Coherence-time, Types of Small scale Fading

Equalization and Diversity Principles

Fundamentals of Equalization, Adaptive equalizer. Concept of diversity, Types of diversity (space, time, frequency, polarization), Rake receiver

Different Multiple Access Techniques and Spread Spectrum Modulation

Multiplexing and multiple access, TDD and FDD techniques, Description of FDMA, TDMA, CDMA systems. Architecture and special features of GSM Spread Spectrum modulation and principle, PN sequence and its properties. Direct sequence Spread Spectrum, Frequency hopped Spread Spectrum and Time hopped Spread Spectrum.

OFDM and Multi-Carrier communication

Data transmission using multiple carriers, multi carrier modulation with overlapping sub channels, mitigation of sub-carrier fading. Discrete implementation of multi carrier modulation, DFT and its properties, OFDM principle, Cyclic Prefix. Matrix representation of OFDM, Multi-carrier communication with OFDM

Technological trends in Wireless and Mobile communication

Concept of Multi input multi output Antenna system, Narrow band MIMO model. MIMO channel capacity, MIMO Diversity gain, Space time Modulation & Coding, LTE and LTE Advanced support technologies, Cognitive radio, mobility management, IEEE 802.11, Bluetooth.

Textbooks

1. T.S.Rappaport ,Wireless Communication, Pearson, Second Edition
2. Andrea Goldsmith, Wireless Communication, Cambridge University Press, 2009

Reference books

1. C. Y. Lee, Wireless and Cellular Communication, MGH, 3rd Edition
2. Schillar , Mobile Communication, Pearson, 2nd Edition
3. Harri Holma, Antti Toskala , LTE for UMTS, Evolution to LTE Advanced, Wiley, 2018

LINEAR AND DIGITAL CONTROL SYSTEMS

Course Code: EC30003

Credits: 3

L-T-P: 3-0-0

Prerequisites: Nil

COURSE OBJECTIVE:

This course covers concepts of open- and closed-loop systems, mathematical modeling of a physical system, transfer functions, signal flow graphs, feedback theory, time domain analysis, design specifications & performance indices. This course also deals with the time response of 2nd order systems, stability analysis using Routh-Hurwitz criteria and root-locus methods, frequency responses, Proportional, PI, PID controllers, and Z-transform as applied to discrete-time systems with the transformation from the s-plane to the z-plane, Discrete state space modeling, state and output feedback designing.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Determine the transfer function and calculate the effect of feedback on gain, time constant, bandwidth, noise etc.
- CO 2: Understand and analyse the working and importance of control components in a control loop.
- CO 3: Apply the knowledge of performance characteristics and able to draw the response of system to different standard inputs.
- CO 4: Define type and order of systems. Calculate rise time, peak time, steady state error for standard test inputs.
- CO 5: Determine the stability from characteristic equation using Routh stability criterion and Root Locus analysis and frequency response with bode plot.
- CO 6: Apply the knowledge of discrete system to find the state space model and pulse transfer function and their stability.

COURSE DETAILS

Introduction

Open-loop Vs Closed-loop Control Systems, Mathematical Representation of Systems, Basic understanding of systems and transfer function using signal flow graph.

Time Domain Analysis and Performance Criteria

Stability Definitions and Conditions, Negative Feedback Analysis and Stability Testing, Transient Time Response: The Effect of Pole Locations, Second Order Time Response Characteristics, Steady State Response and System Type and PID controller design.

Concept of stability

Routh stability criterion, Root locus concept and checking stability, Frequency response bode plot and lead lag compensator.

Sampled data control system

Z-transform, pulse transfer function (z-transfer function), stability analysis of sampled data control systems, Discrete state space modelling with stability analysis.

Textbooks

1. I. J. Nagrath & M. Gopal , Control System Engg ,New Age 2ndEdn,
2. Benjamin C. Kuo, Automatic Control Systems, Wiley, 7th Ed.

Reference books

1. K. Ogata, Modern Control Engg, Pearson, 5th Ed
2. Norman Nise , Control Systems Engineering, Wiley, 2018

DATA COMMUNICATION & NETWORKING

Course Code: EC30004

Credit: 3

L-T-P: 3-0-0

Prerequisite: Nil

COURSE OBJECTIVE

To enable students to apply, analyze different techniques and protocols used for data communication networks with a bottom-up approach of OSI layer architecture. To design IP-based packet-switched networks. To select/Judge apt protocols and suitable communication techniques associated with different layers of TCP/IP for real-world Internet applications.

COURSE OUTCOMES

After successfully completing of the course, the students will be able to:

- CO 1: Analyze the functions of OSI layer architecture and physical layer attributes.
- CO 2: Analyze algorithms/ protocols in flow, error control, media-access control (MAC) functions and solve problems with some IEEE standards in the data-link layer.
- CO 3: Design IPv4 networks and solve real-world network routing problems using algorithms/ protocols of network layer and internetworking.
- CO 4: Investigate various protocols associated with networking: address-resolution, DHCP, NAT, DNS, ICMP.
- CO 5: Analyze connection-oriented (TCP) with handshaking and connectionless (UDP) transport layer protocols, Congestion Control mechanism in TCP and solve problems.
- CO 6: Investigate various application layer frameworks, protocols and analyze Quality-of-Service (QoS).

COURSE DETAILS

Introduction

Overview of telecommunication networks, Analog and digital data transmission, Protocol and their function, OSI model and layering, Concept of image and video transmission over Internet, Loss-less, Rate distortion and lossy coding, Image and video coding techniques.

Physical Layer

Transmission impairments, Transmission media: Twisted pair, Coaxial cable, Optical fiber and wireless transmission, Line coding formats their features and performance, Types of data and corresponding signal with examples: digital data-analog signal, analog data-digital signal, digital signal-digital data and analog data-analog signal, Asynchronous and synchronous transmission, transmission topology, Synchronous and statistical Time Division Multiplexing (TDM), Modem.

Link Layer

Circuit switching and packet switching. Framing, Error detection and correction, Flow-Control Mechanism and Re-transmission Mechanisms (ARQ), Sliding window Protocol, Go-Back-N, Selective Repeat.

Multiple Access Control

ALOHA protocol, Carrier Sensing (CSMA, CSMA/CD, CSMA/CA), MAC Addressing, Examples of Local area networks: Ethernet (IEEE 802.3), Wi-Fi (IEEE 802.11), IEEE 802.11ac.

Network Layer and Internetworking

Bridging, Global Internet, IPv4 protocol and addressing, Subnetting and supernetting, Classless Inter-domain Routing (CIDR), IPv6 protocol, Internet Control Message Protocol (ICMP), Address Resolution, ARP, RARP, DHCP, IP address lookup, Domain Name Systems (DNS), Network Address Translator (NAT), Unicasting, broadcasting and multicasting, Routing Algorithms, Distance Vector, Link-State, Routing protocols in Internet: RIP, OSPF.

Transport Layer

Transport layer functions Process-to-Process, Concept of Socket, Connectionless UDP and Connection-Oriented TCP, TCP connection-control and handshaking, TCP Congestion Control, Additive Increase/Multiplicative Decrease, Slow Start, Fast Retransmit/ Fast Recovery.

Application Layer

Introduction, Architectures: Client-Server and peer-to-peer, Hyper Text Transfer Protocol (HTTP), Non-persistent and Persistent, HTTP Messages, Concepts of Proxy, Cache, Cookie, E-mail Communication, Push-Pull Architecture, SMTP, POP3, IMAP4, Introduction to Quality of Services (QoS).

Textbooks

1. Forouzan, B. A. (2017). *Data Communications and Networking* (5th Edition). New Delhi: McGraw-Hill. ISBN-13: 978-1259064753.
2. Kurose, J. F. & Ross, K. W. (2017). *Computer Networking – A top-down Approach* (6th Edition). Pearson. ISBN-13: 978-9332585492.

Reference books

1. Comer, D. E. (2013). *Internetworking with TCP/IP Principles, Protocols and Architecture – Volume I* (6th Edition). PHI. ISBN-13: 978-9332550100.
2. Stallings, W. (2017). *Data and Computer Communications* (10th Edition). Pearson. ISBN-13: 978-9332586932.
3. Tanenbaum, A. S., Feamster, N. & Wetherall, D. J. (2022). *Computer Networks* (6th Edition). Pearson. ISBN-13: 978-9356063600.
4. Kumar, A., Manjunath, D. & Kuri, J. (2004). *Communication Networking – An analytical Approach* (1st Edition). Morgan Kaufmann Publishers. ISBN-13: 978-0124287518.
5. White, R. & Banks, E. (2018). *Computer Networking Problems and Solutions: An innovative approach to building resilient, modern networks* (1st Edition). Addison-Wesley. ISBN-13: 978-1587145049.

VLSI CIRCUITS & SYSTEMS

Course Code: **EC30005**

Credit: **3**

L-T-P: **3-0-0**

Prerequisites: **Nil**

COURSE OBJECTIVE

The VLSI design course aims for students to learn fundamental theories and techniques of digital VLSI Circuits & Systems using CMOS technology, and layout, about the digital integrated circuits domain. In addition, the course aims to enable students to analyze and design different VLSI architectures using the fundamental concepts of digital VLSI systems.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Apply knowledge to analyze different methods for VLSI chip design,
CO 2: Analyze the role of key parameters of MOS transistor and formulate threshold voltage and drain current model of the transistor,

- CO 3: Interpret different performance metrics of CMOS inverter circuit in terms of supply voltage and transistor size,
- CO 4: Implement and optimize CMOS Circuit performance to achieve desired circuit characteristics/ performance,
- CO 5: Construct CMOS sequential circuits using different design styles and compare performance such as area, speed and power consumption,
- CO 6: Create different VLSI subsystems intended for societal and or industrial needs.

COURSE DETAILS

Introduction to VLSI

VLSI Design Methodology, VLSI Design Flow, VLSI Design Hierarchy, VLSI Design Styles.

MOSFET and its Characteristics

Two terminal MOS Structure, MOS Structure under external Bias Condition, Derivation of Threshold Voltage and its components, MOSFET structure and its Qualitative Analysis, MOSFET Current-Voltage Relationship and its Characteristics, MOSFET Scaling and short geometry effects (only qualitative) .

Inverter DC and Switching Characteristics

Inverter Noise Margin, CMOS Inverter DC Characteristics and its analysis, Delay time definitions, estimation of propagation delay for CMOS Inverter, Super buffer, Power dissipation in CMOS, Interconnect Parameters - Resistance, Capacitance, Inductance, Lumped RC Model, Distributed RC Model.

CMOS Combinational Circuits

CMOS NAND and NOR Gate and their qualitative analysis with sizing, CMOS Complex Logic Circuit, logical efforts, NMOS and PMOS as Pass transistor, pass transistor and CMOS Transmission Gate based logic circuit, Stick Diagram and layout of Inverter and Complex logic Circuit.

High performance CMOS logic and Sequential logic Circuits

Dynamic Logic Concept, Synchronous Dynamic Logic Circuits (Domino and NOR logic Circuit), Bistable Circuit, SR Latch, Clocked Latch and Flip Flop Circuits.

VLSI Subsystem

Approach to digital system design, Adder (CMOS, transmission gate, pass transistor based), Multiplier, SRAM (6T).

Textbooks

1. Kang, Sung-Mo, 1945-. (1996). CMOS digital integrated circuits : analysis and design (4th edition). New York :McGraw-Hill.
2. Weste, N., & Harris, D. (2023). CMOS VLSI Design: A Circuits and Systems Perspective (4th ed.). USA: Pearson.

Reference books

1. Baker, R. J., & Harry, W. (2005). LI., David E. Boyee, "CMOS Circuit Design, Layout and Simulation". USA: IEEE Press
2. Rabaey, J. M. (1999). Digital integrated circuits a design perspective(2nd edition). PHI

HARDWARE DESCRIPTION LANGUAGE FOR DIGITAL DESIGN

Course Code: EC30006

Credit: 3

L-T-P: 3-0-0

Prerequisite(s): Nil

COURSE OBJECTIVE

This course describes the ASIC design flow and FPGA design flow. It also introduces different design methodology such as top-down and bottom-up approaches. Here, students will learn different coding styles that can be used in Verilog HDL to design and synthesize digital circuits. Also, it is necessary to verify the correctness of the design by applying different input patterns. Therefore, students will also learn test bench writing strategies to verify the correctness of the design. Several examples that include important arithmetic units of digital systems are covered in this course which demonstrate how to design and test the digital circuits using Verilog HDL. In addition, the course discusses the mapping of Verilog HDL to logic gates. It depicts with examples how Verilog HDL constructs are transformed into logic gates and their interconnections. Finally, a brief introduction on how logic-level circuits are converted into transistor-level circuits is illustrated in this course.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Analyze the ASIC-based and FPGA-based design flow and VLSI design methodology.
- CO 2: Design digital systems using Hardware Description Language (HDL).
- CO 3: Develop test cases to simulate and verify the correctness of the design.
- CO 4: Change Hardware Description Language to a gate-level netlist.
- CO 5: Implement optimized digital circuits using different HDL-based mechanisms.
- CO 6: Design circuits by using knowledge of translating logic circuits to transistor-level circuit.

COURSE DETAILS

Introduction

Overview of digital systems, digital design methodology using HDL-RTL design using, Verilog, FPGA architecture, Design flow for FPGA and ASIC using HDL.

Introduction to Verilog HDL

Basic Verilog structure, operators, different, modeling techniques (gate-level, dataflow, behavioral) with examples of combinational and sequential logic designs.

Floating-point circuit design using Verilog HDL

Floating-point number system (single and double precision), floating-point adder and multiplier (Verilog implementation).

Digital System Design

Analysis of combinational logic design (different adder architectures), carry save adder, pipelined adder design, analysis of sequential design (timing issues- set up and hold time)

Advanced combinational design using Verilog HDL

Array multiplier, Booth's multiplier (radix-2), matrix multiplication.

FSM Design using Verilog HDL

State assignment, state minimization, Mealy and Moore type design of sequence detector (regular and arbitrary), serial multiplier, traffic-light controller, vending machine, pacemaker.

Textbook

1. Samir Palnitkar, Verilog HDL: A Guide to Digital Design and Synthesis, Pearson Education, 2nd edition, 2011.

Reference books

1. J. Bhaskar, A System Verilog Primer, BS Publication, 2013.
2. Michael D. Ciletti, Advanced Digital Design with the Verilog HDL 1st edition, PHI, 2010.
3. T. R. Padmanabhan, B. Bala Tripura Sundari, Design Through Verilog HDL, Wiley Student Edition, 2012.

ARM AND ADVANCED PROCESSORS

Course Code: EC30007
Credit: 3
L-T-P: 3-0-0
Prerequisites: Nil

COURSE OBJECTIVE

The objective of this course is to teach the higher-level concepts of Advanced Microprocessors and ARM to the students. The students learn about Multitasking, Virtual memory, Memory management, Paging, TLB, RISC features, Pipelining and Branch Prediction like concepts. They develop skills for writing programs on ARM to solve simple problems as well as some real time applications.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Appraise the concepts implemented in higher level Processors like Multitasking, Virtual Memory, Memory Management etc.
- CO 2: Examine the mode of Operation of 80286, Concept of program invisible registers, Segment Descriptors etc.
- CO 3: Analyze Segment Descriptors, Privilege level and Protection, Virtual '86 Mode and Paging in 80386, enhanced features incorporated in 80486
- CO 4: Analyze the RISC features implemented in the design of Pentium Processors, Parallel processing through U & V Pipelines / Superscalar Execution and Branch Prediction Techniques
- CO 5: Acquire the knowledge of a 32-bit ARM Processor, its RISC features, Registers, Pipelining and Interrupts
- CO 6: Evaluate the 32-bit ARM instruction set, 16-bit Thumb instructions and Interfacing

COURSE DETAILS

Introduction

Overview of Intel higher level Processors, Concept of Multitasking, Virtual memory & Memory management.

Intel 80286 & 80386

Brief outline of Processor Architecture, Mode of operation, Segment descriptor, Privilege level & protection and Task switching in 80286, Virtual 86 mode, Paging and TLB in 80386

Pentium Processor

Features of RISC processors & Implementation of RISC features in Pentium, Pipelining, Superscalar execution & Branch prediction Technique

ARM & Interfacing

ARM design, ARM Processor fundamentals: Registers, CPSR, Memory map, Pipelines, Exceptions, Interrupt Vector Table, Introduction to ARM Instruction set and Thumb instructions, Interfacing – LCD, ADC, DAC, Stepper motor, UART

Textbooks

1. K. Ray and K. M. Bhurchandi - Advanced Microprocessor and Peripherals - Architecture, Programming and Interfacing, McGraw Hill Education Pvt Ltd - 3rd Edition
2. Muhammad Ali Mazidi, Sarmad Naimi, Sepehr Naimi, Shujen Chen - ARM Assembly Language Programming & Architecture - Micro Digital Ed, ISBN: 9780997925906 - 2nd Edition.

Reference books

1. B. B. Brey - The Intel Microprocessors 8086/8088, 80186/80188, 80386, 80486, Pentium and Pentium Pro - Processor - PHI - 8th Edition

2. D. V. Hall - Microprocessors & Interfacing, Programming & Hardware - TMH - 3rd Edition.
3. William Hohl, Christopher Hinds - ARM Assembly Language: Fundamentals and Techniques - Taylor & Francis - 2nd Edition.
4. M A Mazidi & others, ARM System Developers Guide Design & Optimizing System Software – Andrew N. Sloss & others - Elsevier.

WIRELESS SENSOR NETWORK

Course Code: EC30008

Credit: 3

L-T-P: 3-0-0

Prerequisites: Nil

COURSE OBJECTIVE

This course describes the functioning of a wireless sensor network, the layered architecture and auxiliary units viz., time synchronization and localization.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Identify the different elements of Wireless Sensor Network (WSN), network designing factors including the characteristics, and constraints.
- CO 2: Make use of different techniques in physical and MAC layer in WSN.
- CO 3: Apply different routing mechanisms in WSN.
- CO 4: Analyze Transport layer, Application layer protocols and cross layer effects and solutions for WSN.
- CO 5: Estimate the position of sensor nodes using different ranging techniques and ranging based protocols for WSN.
- CO 6: Elaborate the time synchronization challenges and discuss some approaches that have been designed to address these challenges.

COURSE DETAILS

Introduction

Basic concepts, Platforms, Standardization, Architecture and protocols, Applications in military, Environment, Healthcare, Industry and Energy, Factors influencing WSN Design.

Physical & MAC Layer

PHY layer standard (IEEE 802.15.4), MAC challenges, MAC protocols for Sensor Network, Contention based MAC (S-MAC, B-MAC, CC-MAC), Reservation based MAC (TRAMA) & Hybrid MAC (Zebra MAC).

Network & Transport layer

Routing challenges, Data centric and flat architecture protocol (SPIN), Hierarchical protocol (LEACH), Geographical routing protocol (MECN), QoS based Protocol (SAR), Challenges of Transport layer, Transport layer protocols (PSFQ & CODA).

Application Layer

Source Coding, Query Processing, Network Management

Cross Layer Solutions

Interlayer Effects, Cross layer Interactions (MAC-Network, MAC-Application, Network and PHY, Transport – PHY), Cross layer module.

Localization

Challenges in localization, Ranging techniques, Range based localization protocols, Range free localization protocol.

Time Synchronization

Challenges for time synchronization, Timing Sync Protocol for Sensor Network (TPSN), Time Diffusion Synchronization Protocol (TDP), Rate based Diffusion Protocol (RDP).

Textbook

1.Ian F. Akyildiz and Mehmet Can Vuran, Wireless Sensor Networks, John Wiley and Sons Ltd, Publication, 2010.

Reference books

1. Jun Zheny and Abbas Jamalipour, Wireless Sensor Network - a networking perspective, Wiley, 2009.
2. C. Raghavendram, K Sivalingam and T. Znati, Wireless Sensor Network, Springer, 2005.

COMPOUND SEMICONDUCTORS BASICS

Course Code: EC30009

Credit: 3

L-T-P: 3-0-0

Prerequisite: Nil

COURSE OBJECTIVE

This course is an introduction to properties of Compound Semiconductors highlighting the theoretical and practical aspects of their device physics and suitability for high speed devices. Beginning with an introduction to the basics of semiconductor devices and characteristics, it presents an overview compound semiconductor materials, as well as a detailed look at the electrical and optical properties of compound semiconductor hetero-structures.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Analyze the basic concepts of Semiconductor Devices and characteristics.
- CO 2: Assess the requirements of Compound Semiconductors.
- CO 3: Evaluate of the Performance measure of high speed devices
- CO 4: Analyze principle of operation and the unique features of HBT, HEMT, TFET.
- CO 5: Evaluate the issues and targeted performances of Compound Semiconductor Devices.
- CO 6: Develop critical thinking ability supported by the learned concepts of Compound Semiconductors: Device Properties & Applications.

COURSE DETAILS

Introduction

Fundamentals of Semiconductor Devices, P-N Junction Diode and MOSFET, Introduction of Compound Semiconductors, Crystal structure, Properties of Compound semiconductors, Merits of III –V binary and ternary compound semiconductors (GaAs, InP, InGaAs, AlGaAs, SiC, GaN etc.), different SiC structures, silicon-germanium alloys and silicon carbide for high speed devices, as compared to silicon based devices, Band Diagrams, Pinch off voltage and threshold voltage, D.C. Characteristics and Analysis of Drain Current. Sub threshold Characteristics, Short Channel Effects.

Important parameters governing for the high speed and high power device performance

Transit time of charge carriers, junction capacitances, ON-resistances, the device geometry and size, carrier mobility, doping concentration and temperature break down voltage.

Hetero junction Bipolar Transistors (HBTs)

Principle of operation and the benefits of hetero junction BJT for high speed applications. GaAs and InP based HBT device structure, SiGe HBTs and the concept of strained layer devices.

High Electron Mobility Transistors (HEMT)

Hetero-junction devices. The generic Modulation Doped FET(MODFET) structure for high electron mobility realization. Principle of operation and the unique features of HEMT, InGaAs/InP HEMT structures. Tunneling devices: Principle of operation and the unique features of TFET, Resonant-tunneling hot electron transistors

Textbooks

1. S.M. Sze, High Speed Semiconductor Devices, Wiley (1990) ISBN 0-471-62307-5
2. G.A. Armstrong, C.K. Maiti, TCAD for Si, SiGe and GaAs Integrated Circuits, The Institution of Engineering and Technology, London, United Kingdom, 2007, ISBN 978-0-86341-743-6.

Reference books

1. Ralph E. Williams, Modern GaAs Processing Methods, Artech (1990), ISBN 0-89006-343-5,
2. Sandip Tiwari, Compound Semiconductor Device Physics, Academic Press (1991), ISBN 0-12-691740-X.

MOBILE AD HOC NETWORKS

Course Code: EC30010

Credits: 3

L-T-P: 3-0-0

Prerequisites: Nil

COURSE OBJECTIVE

Wireless networks play an increasingly important role in the world of communications. This course provides an introduction to operation and developing standards for mobile networks, such as Vehicular Networks, Unmanned Air Vehicles, and Small Satellites, and students will learn to analyze the performance of these cutting-edge networks. Related protocols and their performance are studied using formal analytical tools and realistic simulations.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Analyze and evaluate characteristics, Architecture, features, factors and challenges related to Mobile Ad Hoc Networks (MANET).
- CO 2: Compare different Medium Access Control (MAC) protocols in the context of MANET and choose apt MAC protocol based on application requirements and network design specifications.
- CO 3: Compare different Routing protocols in the context of MANET and choose apt Routing protocol based on network scenario.
- CO 4: Assess issues and challenges for providing Quality of Service (QoS) in Ad Hoc wireless Networks and plan required QoS solutions in MAC and Network layers.
- CO 5: Evaluate various Energy Management schemes in Ad Hoc Wireless Networks and would be able to judge the best scheme based on network specifications.
- CO 6: Perceive various Ad Hoc Nomadic Mobile Applications to acquire skills required for designing and creating scenario specific Ad Hoc Mobile Applications.

COURSE DETAILS

Introduction

Origin Of Ad Hoc :Packet Radio Networks - Technical Challenges - Architecture of PRNETs - Components of Packet Radios - Introduction to Ad Hoc networks - Definition, characteristics features - Issues in Mobile Ad Hoc networks- Types of Ad Hoc Mobile Communications - Types of Mobile Host Movements - Ad Hoc wireless Internet. Characteristics of Wireless channel Mobility models - Indoor and Outdoor.

Medium Access Protocols

MAC protocols: design issues, goals and classification. Contention based protocols - With reservation, scheduling algorithms, protocols using direction antennas - Distributed packet reservation - Multiple access protocol, collision avoidance time allocation protocol. IEEE standards: 802.11 a, 802.11 b, 802.11g.

Routing Protocols and Multicast Routing in Ad Hoc Networks

Introduction - Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks - Classifications of Routing Protocols Table Driven routing protocols: Destination Sequenced Distance Vector Routing Protocol - Cluster head Gateway switched routing protocol. On Demand routing protocol: Dynamic source routing protocol, AODV routing protocol, temporarily ordered routing algorithm. Hybrid routing protocols: Zone routing protocol, Zone based Hierarchical link state routing protocol. Architecture Model for Multicast Routing Protocols - Classifications of Multicast Routing Protocols - Tree Based Multicast Routing Protocols - Mesh-Based Multicast Routing Protocols - Energy-Efficient Multicasting - Comparisons of Multicast Routing Protocols.

QoS and Energy Management

Issues and Challenges in Providing QoS in Ad Hoc Wireless Networks - Classifications of QoS Solutions - MAC Layer Solutions - Network Layer Solutions. Need for Energy Management in Ad Hoc Wireless Networks - Classification of Energy Management Schemes - Battery Management Schemes - Transmission Power Management Schemes - System Power Management Schemes.

Ad Hoc Nomadic Mobile Applications

In the Office, While Traveling, Arriving Home, In the Car, Shopping Malls, The Modern battlefield, Car-to-Car Mobile Communications, Mobile Collaborative Applications - Location/context based mobile services - Introduction to wireless mesh networks and vehicular Ad Hoc networks.

Textbook

1. C.Sivaram Murthy and B.S Manoj, Ad Hoc Wireless Networks, Pearson Education, Second Edition India, 2001.

Reference books

1. K Toh, Ad Hoc mobile wireless networks, Protocols and Systems, Pearson Education, 2nd Edition, 2009.
2. Stefano Basagni, Mobile Ad hoc Networking, Wiley Inter science, IEEE Press, 2004.
3. George Aggelou, Mobile Ad Hoc Networks, McGrawHill, 2004.
4. Thomas Krag and Sebastin Buetrich, Wireless Mesh Networking, O'Reilly Publishers, 2nd Edition, 2007.

DIGITAL SYSTEMS DESIGN WITH VERILOG

Course Code: EC30011

Credit: 3

L-T-P: 3-0-0

Prerequisites: Nil

COURSE OBJECTIVES

This course will make the student learn the design principles of digital computing systems and the Verilog modelling techniques. They will also be able to learn Boolean Algebra and understand various logic gates along with combinational circuits. Futher the students will be exposed to designing synchronous and asynchronous sequential circuits and CMOS level gate design.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Design and implement complicated digital systems using Verilog.
- CO 2: Design a VLSI circuit for an application.
- CO 3: Analyze the digital design logic
- CO 4: Design and Analysis of a given digital circuit – combinational and sequential
- CO 5: Apply Boolean simplification techniques to design a combinational hardware circuit
- CO 6: Apply advance concepts of digital systems to design high speed arithmetic circuits.

COURSE DETAILS

Basic VLSI System Design

Introduction to digital systems and VLSI design, Moore's Law, VLSI Design flow, Design hierarchy, Introduction to Verilog HDL, operators and Modelling techniques (gate-level, data-flow, and behavioral)

Binary Codes & Boolean Algebra

Signed Binary numbers and its arithmetic (1's and 2's complement form), Binary codes (Weighted and non-weighted codes, Gray codes, BCD codes), Boolean Algebra-Laws and Axioms, SOP and POS (Min-term and Max-term), K-Maps (2-,3-,4- variables with don't care condition)

Combinational Circuits

Adders (Half adder, Full adders, Binary Parallel Adders), Subtractor (Half Subtractor, Full Subtractor), Code conversion algorithms, Combined Adder-Subtractor Block, Design of code converters, Decoders and Encoders, Multiplexer and Demultiplexer. Implementation of Combinational Circuits using Gate-level and Data-flow level of modelling.

Sequential Circuits

Basic latch, Flip-flops (SR, D, JK, T, Master-Slave), Triggering of flip-flops, FF conversions, Shift Registers (SISO, SIPO, PISO, PIPO), Counter Design (Synchronous and Asynchronous) Implementation of sequential circuits using Behavioral level of modelling.

Advanced Concepts

Overview of CMOS, CMOS level gate design (Basic and Universal gates), Design of general Boolean circuits using CMOS gates, CMOS level design of latches and flip-flops. Verilog description of CMOS level design.

Textbooks

1. Morris Mano, and Michael D. Ciletti, "Digital Design", Fifth Edition, PHI, 2012.
2. Samir Palnitkar, "Verilog HDL", Second Edition, Pearson Education, 2003.

Reference books

1. Michael D. Ciletti, "Advanced Digital Design with the Verilog HDL", Second Edition, Pearson Education, 2010.
2. Stephen Brown, "Fundamentals of Digital Logic with Verilog", McGraw Hill, 2007.

NANO ELECTRONICS

Course Code: EC30012

Credit: 3

L-T-P: 3-0-0

Prerequisites: Nil

COURSE OBJECTIVE

In this course the students will be introduced to the basic concepts of Nanoelectronics, Nanodevices, Spintronic and also able to learn the quantum mechanics that governs the operation of Nanoelectronics devices.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Analyze the basic and advanced concepts of Nano electronics.

CO 2: Apply and evaluate the use of fundamental science of quantum mechanics in Nano electronics.

CO 3: Identify Nanoelectronics materials and will be able to distinguish from other materials.

CO 4: Analyze the different fabrication and characterization techniques of nanostructure materials.

CO 5: Apply the concepts of few Nano electronics devices.

CO 6: Analyze and evaluate the idea of single electron transistors and its further applications

COURSE DETAILS

Particles and Waves

Introduction to Particles and waves, Wave Particle duality, Schrodinger Wave equation, Wave Mechanics of particle with suitable examples, Atoms and atomic orbitals
Density of states, quantum transport and tunneling effect.

Tunnel Junction and Applications of Tunneling

Tunneling Through a Potential Barrier, Metal-Semiconductor, and Metal-Insulator-Metal Junctions, Tunnel Junctions, Tunnel Junction Excited by a Current Source. Spintronics and Foundations of nano-photonics.

Field Emission, Gate—Oxide Tunneling and Hot Electron Effects in nano MOSFETs, Growth, Fabrication, and Measurement Techniques for Nanostructures: Introduction, Bulk crystal and heterostructure growth, Nanolithography, etching, and other means for fabrication of nanostructures and nano-devices, Techniques for characterization of nanostructures (FESEM, STM).

Nanostructure Devices

Quantum dots and nanoparticles, Carbon nanotubes and nanowires, Nano pillars, Nano sensors and Nano medicines, MEMS, Single Electron Transistor, Carbon Nanotube Transistors (FETs and SETs), Semiconductor Nanowire FETs and SETs. Applications of Nano electronic devices,12

Textbooks

1. Vladimir V. Mitin , Viatcheslav A. Kochelap and Michael A. Stroscio, Introduction to Nano electronics (Science, Nanotechnology, Engineering, and Applications); Cambridge University Press, 2008
2. T Pradeep, NANO: The Essentials Understanding Nanoscience and Nanotechnology, McGraw Hill, 2018

Reference books

1. George W Hanson, Fundamentals of Nan electronics, Pearson 2008
2. WR Fahrner, Nanotechnology and Nano electronics – Materials, Devices and Measurement Techniques Springer, 2005
3. Stephen D. Senturia, Microsystem Design, Springer, 2001
4. Marc Madou, Fundamentals of Microfabrication & Nanofabrication, 3rd Edition, CRC Press, 2011.

OPTICAL & SATELLITE COMMUNICATION

Course Code: EC30013

Credits: 3

L-T-Pl: 3-0-0

Prerequisites: Nil

COURSE OBJECTIVE

The course intend to make the students to learn the Optical Communication and Networking Concept, primarily signal propagation through optical fiber, Modulation for optical Communication, Losses, Dispersion, Link Budget and Networking. The knowledge of Satellite Communication and Systems are also very important for a communication Engineering student. The aim of the course is to develop the industry identified competencies within the students like Maintenance of optical communication systems and Satellite communication systems through various teaching and learning processes.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Explain the significance of terminology associated with optical communication, analyze the principle of light propagation through optical fiber with concept of modes and solve problems on this concept.

- CO 2: Analyze various types of losses and dispersion in optical fiber and solve related problems associated with the concept.
- CO 3: Analyze the structure, principle of operation and the characteristics of optical sources and detectors.
- CO 4: Identify the optical communication system link elements, preparation of link budget and estimate basic entities of optical Networking.
- CO 5: Identify the Satellite communication elements and analyze the principles.
- CO 6: Analyse the Satellite Communication Systems and design the satellite Link budget.

COURSE DETAILS

Principles of Optical Communication and Wave Propagation in Optical Fiber

Optical frequencies used in optical fibers, Principle of light propagation in optical fibers, Advantages of optical fiber communication. Relation, Basic structure of optical fibers and ray diagram of optical path in an optical fiber, Acceptance angle, Numerical aperture. Concept of modes, Different types of modes in optical fibers, Relation between modes and rays, Cut-off condition for guided modes, Boundary conditions, single mode / multi-mode fibers, Concept of V number and its importance.

Losses in Fiber and Dispersion

Intrinsic / Extrinsic losses, Material or impurity losses, Rayleigh scattering loss, Absorption loss, Bending loss. Loss versus wavelength plot, Concept of dispersion, Intermodal dispersion, Intramodal dispersion, Wave guide and material dispersion, minimization of dispersion.

Optical Sources, Detectors, and Fiber Optic Links

Characteristics of optical sources, Principle of operation of LED and LASER diode, Intensity modulation circuits for LED and Laser diode. Principle of operation of PIN diode and APD, Basic structures, Current characteristics, SNR calculation and Noise equivalent power, Bit error rate, fiber optic links - power budget, rise-time budget.

Single-wavelength networks

SONET/SDH, FDDI, WDM networks - Broadcast- and-select WDM LAN, Wavelength-routed metro and wide-area networks, passive optical networks for access segment.

Principle and elements of Satellite Communication

Introduction, Frequency spectrum for satellite communication, Types of orbits, Kepler's Laws of planetary motion, Orbital perturbations, Geostationary orbit, Satellite launching, General satellite communication, Block diagram uplink, Downlink frequencies, Types of modulation techniques used

Losses, Attenuation and Satellite Link Budget

Signal loss on transmission through earth's atmosphere, Atmospheric losses, Ionosphere effects, Rain attenuation. Satellite link budget : Transmission losses, Interference, System noise temperature, Link power budget

Satellite sub-systems

Antenna sub-systems, Attitude and orbit control sub-system, Power sub-system, Communication sub-system, TTC&M sub-systems.

Textbooks

1. J. C. Palais, Optical Fiber Communication, Pearson Education, 2022 reprint
2. Pratt, Bostien, Allnut, Satellite Communication, John Wiley Publications, 2nd edition, 2013

Reference books

1. G. Kaiser, Optical Fiber Communication, McGraw Hill, - 5th edition, 2013
2. Denish Roddy, Satellite Communication, McGraw Hill, 3rd edition, 2001

CIRCUITS, SIGNALS AND COMMUNICATION

Course Code: **EC30014**

Credit: **3**

L-T-P: **3-0-0**

Prerequisite: **Nil**

COURSE OBJECTIVE

The aim of Circuits, Signals, and Communication is to help students from non-electronics specialization to become familiar to analog & digital circuits, fundamentals of systems & signal processing, and technologies used for information communication. This course will bring the students of other disciplines to a common learning level, while fulfilling the prerequisite knowledge required for many other open elective courses.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Determine the DC and AC parameters of OPAMP; analyze and comprehend the difference between circuits using Op Amps (Closed loop: negative and positive feedback or open loop),
- CO 2: Design and analyze instrumentation amplifier, V-I converter, active filters,
- CO 3: Analyze and plot continuous and discrete signals, determine various operations on signals, Classify various types of systems and analyze system characteristics in time domain,
- CO 4: Analyze the characteristics of signals and systems in frequency domain using Fourier analysis and its properties
- CO 5: Identify the need of communication and analyze different Amplitude and Angle Modulation based communication systems and their functions.
- CO 6: Analyze and compare different Pulse and Digital Modulation based communication systems and their functions.

COURSE DETAILS

Operational amplifier & its parameters

Introduction to operational amplifier, opamp parameters- Input offset voltage, Input Bias current, Input offset current, total output offset voltage, Thermal drift, PSRR, Common mode configuration and CMRR, Noise in Op-amp, Slew rate, Op-amp circuits using negative feedback (voltage series feedback & voltage shunt feedback), Differential amplifier.

Operational amplifier applications

Instrumentation amplifier, Voltage to current converter and vice versa, Active filters, Analog-to-digital converter, Digital-to-analog converter

Introduction to Signals & Systems

Classification of signals, Basic elementary operation on signals, Basic properties of Systems, Linear Convolution and Correlation

Continuous time Fourier analysis

Signals in time and frequency domain, Fourier Analysis of Periodic Signal, Dirichlet's condition, Convergence and properties of continuous time Fourier series, Approximation of Fourier series to Fourier transform for a periodic signal, Fourier transform of useful signals and properties, Frequency response of LTI system.

Amplitude Modulation Techniques

Introduction to communication system, Need of Modulation, Frequency Translation, Principle of AM, side bands, Power Relationship, Assignable Frequency spectrum, Side band Transmission, DSB, SSB, VSB, AM modulators and Demodulators, AM Radio Receiver, Super hetero-dyne Principle.

Frequency Modulation Techniques

Principle of FM, Frequency Deviation, Spectrum of FM wave, Power in Modulated wave, Narrow and wide band FM, Pre-emphasis and De-emphasis, Block Diagram of FM Transmitter, FM Detector, Block Diagram of FM Receiver. Application of analog modulation for broadcasting and point to point communication systems

Pulse Modulation Techniques:

Analog vs Digital modulation, Sampling Process, Pulse Amplitude Modulation, Pulse Width Modulation, Pulse Position Modulation, The Quantization Process, Pulse Code Modulation.

Digital Modulation Techniques, Principles involved in ASK, PSK (BPSK, QPSK, $\pi/4$ QPSK), FSK.

Application of Digital modulation for broadcasting and point to point communication systems

Textbooks

1. R. K. Gayakwad, Op-Amp & LIC, PHI, 4th Edition, 2015
2. A. V. Oppenheim A. S. Willsky and S. H. Nawab, "Signals and Systems", New Delhi: Prentice Hall of India
3. H. Taub & D.L. Schilling, Principles of Communication System, TMH, 3rd Edition

Reference books

1. D. Ray Choudhury & Shail Jain, Linear Integrated Circuits, New Age, 4th Edition
2. Tarun Kumar Rawat, Signals and Systems, Oxford University Press, 2010
3. Simon Haykin, Introduction to Analog & Digital Communication System, Wiley Student edition, 2011

HARDWARE AND SOFTWARE CO-DESIGN FOR EMBEDDED SYSTEM

Course Code: EC30015

Credit: 3

L-T-P: 3-0-0

Prerequisites: Nil

COURSE OBJECTIVE

This course will make the student understand the concept of an embedded system, to get the clarity of various design metrics for a system, and learn the concept of improving productivity by presenting a unified view of software & hardware. Further they will be exposed to general purpose processors, standard single purpose processors and to grasp the advanced techniques for embedded system modelling using the RTOS and task scheduling algorithms.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Interpret the HW /SW co design issues and challenges
- CO 2: Apply different embedded system modelling techniques.
- CO 3: Analyse different methods of software design for embedded system
- CO 4: Apply knowledge to create different architecture for es
- CO 5: Create prototyping of an embedded system
- CO 6: Apply knowledge to optimize the performance of embedded system

COURSE DETAILS

Introduction to Embedded System & Co-Design

Embedded System & Future trend, Problem description, goals of co-design, co-design steps, existing co-design approaches, and present challenges.

System Modelling and Specification

Models of computation (Signal flow graphs, Data flow model, Task graphs, Finite State Machines, hierarchical models), Petri net, UML.

Software Design

Embedded System Software, ES Software Consideration, Dealing with Data Que and Interrupt, Computation

and communication model of software, consideration ES with OS, Memory and shared memory issues.

Architectures for Embedded Systems & Synthesis

Single processor – coprocessor architecture, mixed-signal architectures, multiprocessor architectures, reconfigurable architectures, Systems on Chip, I/O System, Peripherals and buses, Partitioning and Architecture Selection, Software Synthesis, cost Estimation Hardware Synthesis.

Prototyping and Verification of ES

prototyping phases- simulation & emulation, prototyping with development boards, rapid prototyping, Testing- Goals and scope of testing, testing approaches, design for testability, Verification- functional, timing and formal verification, debugging.

Textbook

1. Bashir I. Morshed, Embedded Systems – A Hardware-Software Co-Design Approach Springer, 2021.

Reference books

1. Felice Balarin, Massimiliano Chiodo, Paolo Giusto, Harry Hsieh, Attila Jurecska, Luciano Lavagno, Claudio Passerone, Alberto Sangiovanni-Vincentelli, Ellen Sentovich, Kei Suzuki, Bassam Tabbara, Hardware-Software Co-Design of Embedded Systems, Springer, 1997
2. D. Gajski, F. Vahid, S. Narayan, and J. Gong, Specification and Design of Embedded Systems, Prentice Hall, 1994.
3. Wayne Wolf, Jorgen Staunstrup, “Hardware / Software Co- Design Principles and Practice”, , Springer.2009
4. Giovanni De Micheli, Mariagiovanna Sami, “Hardware / Software Co- Design”, Kluwer Academic Publishers, 2002.

INTRODUCTION TO SENSOR TECHNOLOGY

Course Code: EC30016

Credit: 3

L-T-P: 3-0-0

Prerequisite: Nil

COURSE OBJECTIVE

The course provides in depth knowledge in physical principles applied in sensing, measurement and a comprehensive understanding on how measurement systems are designed, calibrated, characterized, and analyzed. It further gives a fundamental knowledge on the basic laws and phenomena on which operation of sensor transformation of energy is based.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Analyze the basic measurement techniques and sensor fundamentals.

CO 2: Apply the concepts in common methods for converting a physical parameter into an electrical quantity.

CO 3: Choose an appropriate sensor comparing different standards and guidelines to make sensitive measurements of physical parameters like acceleration, shock, vibration, etc.

CO 4: Apply the appropriate Biosensors and Chemical sensors.

CO 5: Explain the functioning of microphones.

CO 6: Design the machinery vibration monitoring systems.

COURSE DETAILS

Basics of measurements and Sensor fundamentals and characteristics

Basics of measurements, Sensor Characteristics, System Characteristics, Instrument Selection, Data Acquisition and Readout

Sensor Signal Conditioning

Conditioning Bridge Circuits, Amplifiers for Signal Conditioning, Analog to Digital Converters for Signal Conditioning, Signal Conditioning High Impedance Sensors

Technology Fundamentals, Selecting and Specifying Accelerometer, Applicable Standards, Interfacing and Designs, Quartz Sensors, Strain Gage Sensors, Sensor Manufacturers

Biosensors and Chemical Sensors

What Is a Biosensor, Origin of Biosensors, Transduction Mechanisms in Biosensors, Application Range of Biosensors, Chemical Sensor Technology and Applications, Sensor Manufacturers

Test and Measurement Microphones

Electromagnetism and Inductance, Magnetic Field Sensors, Measurement Microphone Characteristics, Frequency Response, Effect of Environmental Conditions, Specialized Microphone Types, and Calibration, Sensor Manufacturers

Machinery Vibration Monitoring Sensors

Introduction, Technology Fundamentals, Accelerometer Types, Selecting Industrial Accelerometers, Applicable Standards, Sensor Manufacturers

Textbook

1. Jon S. Wilson, Editor-in-Chief, "Sensor Technology Handbook", Elsevier, 1st, 2005.

Reference books

1. Edited by Krzysztof Iniewski, Optical, Acoustic, Magnetic, and Mechanical Sensor Technologies, CRC Press, 1st, 2012.
2. Winncy Y Du, Resistive, Capacitive, Inductive, and Magnetic Sensor Technologies, CRC Press, 1st, 2015.

AUDIO AND SPEECH PROCESSING

Course Code: EC30017

Credits: 3

L-T-P: 3-0-0

Prerequisites: Nil

COURSE OBJECTIVE

This course will be able to provide the basic concepts and methodologies for the analysis, modeling, synthesis and coding of speech and music. Also the students will get a foundation for developing applications and for future study in this field. Further it introduces software tools for the analysis and manipulation of speech and music and to gain practical experience in the design and implementation of speech and music processing algorithms.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Explain the fundamental concepts of speech production, perception, and auditory psychoacoustics.
- CO 2: Analyse and extract features from speech signals using various digital models and linear prediction techniques.
- CO 3: Design and implement speech coding and synthesis algorithms for various applications.
- CO 4: Apply speech transformations, such as time scale modification and voice morphing.
- CO 5: Implement and evaluate automatic speech recognition systems using various models and techniques, including speaker recognition systems.
- CO 6: Apply speech enhancement techniques to real-world applications, such as digital hearing aids.

COURSE DETAILS

Introduction

Mechanism of speech production and perception, acoustic and articulatory phonetics,

Digital models for the sampled speech signal

Acoustic Theory, lossless tube models – digital models.

Linear prediction of speech

Time domain processing of speech signals: short-time energy, magnitude, zero-crossing rate, auto correlation - formulation of LPC equation - solution of LPC equations - Levinson Durbin algorithm - Levinson recursion - Schur algorithm - lattice formulations and solutions – PARCOR coefficients

Spectral analysis of speech

Short Time Fourier analysis - filter bank design.

Auditory Perception

Psychoacoustics- Frequency Analysis and Critical Bands - Masking properties of human ear.

Speech coding

Sub band coding of speech - transform coding - channel vocoder - formant vocoder - cepstral vocoder -vector quantizer coder- Linear predictive Coder.

Speech synthesis

Pitch extraction algorithms - Gold Rabiner pitch trackers - auto correlation pitch trackers - voice/unvoiced detection - homomorphic speech processing – homomorphic systems for convolution - short-time cepsturm and complex cepsturm - pitch extraction using homomorphic speech processing.

Speech Transformations

Time Scale Modification - Voice Morphing. Automatic speech recognition systems – isolated word recognition - connected word recognition -large vocabulary word recognition systems - pattern classification – Dynamic Time Warping – Hidden Markov Modeling - speaker recognition systems - speaker verification systems – speaker identification. Speech Enhancement Techniques — Approaches and Challenges in the design of Digital Hearing Aids.

Textbooks

1. L.R. Rabiner and R.W. Schafer, Digital Processing of Speech Signals Pearson Education, Delhi, India, 2004
2. D. O'Shaughnessy, Speech Communications: Human and Machine, Second Edition, University Press, 2005.

Reference books

1. Thomas F. Quatieri, Discrete-time Speech Signal Processing: Principles and Practice, Prentice Hall, Signal Processing Series, 2002
2. Philipos C. Loizou, Speech Enhancement – Theory and Practice, CRC Press, 2013
3. John N. Holmes, Wendy J. Holmes, Speech Synthesis and Recognition, Taylor and Francis, 2nd Edition, 2003.
4. J. R. Deller, Jr., J. H. L. Hansen and J. G. Proakis Discrete-Time Processing of Speech Signals, Wiley-IEEE Press, NY, USA, 1999.

EVOLUTION OF COMMUNICATION TECHNOLOGY

Course Code: EC30018

Credit: 3

L-T-P: 3-0-0

Prerequisite: Nil

COURSE OBJECTIVE

The is intended to make the students understand the Wireless communication system, Principle and working Cellular communication system, means and medium of wireless communication. They will able to analyze the Evolution of different wireless communication techniques and can differentiate between the feature and technology behind different generation wireless communication technology. Also they will able to comprehend the various standards for different generation wireless technology.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Explain the basic concept of 2G Wireless systems Like GSM, IS-95 and their architecture.
- CO 2: Analyze the concept of 2.5G wireless systems like GPRS and EDGE
- CO 3: Explain and analyze the concept of 3G systems
- CO 4: Discuss the concept of LTE based 4G wireless systems
- CO 5: Explain and analyze the concept of LTE Advance and 5G communication.
- CO 6: Analyze the supportive technologies like Massive MIMO, Evolution of IOT and the concept of 6G Communication.

COURSE DETAILS

GSM

Air-Interface Standards: GSM, IS-95, WiFi, GSM,GSM Architecture Description,GSM Bands Part 1,GSM Bands Part 2,GSM Channels,GSM Basic Call Flow,GSM Cells,GSM Identifiers Part 1,GSM Identifiers Part 2, IS-95, WiFi

GPRS

GPRS Introduction,GPRS Architecture,GPRS Channels,GPRS Questions

EDGE

EDGE Technology, EDGE Questions

3G

3G Identifiers, WCDMA Concept, 3G Codes, Handovers, 3G Questions

LTE and 4G

LTE Frequency Bands, 4G Network, LTE Resource Block, LTE Key Points, LTE Voice Solution, LTE Optimization, LTE Drive Test, LTE DT Parameters, LTE Coverage Factors, LTE Cell Planning, VoLTE & ViLTE, 4G LTE Questions

5G and Beyond

LTE Advance, 5G introduction, 5G Air Interface, Massive MIMO, 5G Small Cells, 5G Questions, Evolution of the Internet of Things, The Situation and Development of 5G and Future 6G, Futuristic Communication Technology.

Textbook

1. Ajaya R Mishra, Fundamentals of Network Planning and Optimization 2G/3G/4G: Evolution to 5G, Wiley, 2nd Edition

Reference books

1. C. Y. Lee, Wireless and Cellular Communication, McGraw Hill, 3rd Edition
2. J. Schiller, Mobile Communication, Pearson Education, 2nd Edition
3. T.S.Rappaport, Wireless Communication Principles and Practice, Pearson Education, 2nd Edition

INFORMATION THEORY & CODING

Course Code: EC30019

Credit: 3

L-T-P: 3-0-0

Prerequisites: Nil

COURSE OBJECTIVE

The course will help in forming a strong foundation for the broad areas of information theory, coding and

cryptography. It emphasizes on the basic concepts, lays stress on the fundamental principles and motivates their application to practical problems. This course starts with the basics of information theory and source coding. The theory of linear block codes (including cyclic codes, BCH codes, RS codes), convolution codes are explained. Basics of secure communications including cryptography and physical layer security are covered.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Explain the mathematical definitions of information, using conditional and unconditional probability theorem
- CO 2: Analyze and differentiate several sources of information and coding techniques
- CO 3: Explain and analyze channel coding schemes and Shannon's information theory
- CO 4: Distinguish between various error decoding schemes
- CO 5: Design and simplify different codes such as cyclic codes, CRC codes (cyclic Redundancy Codes) and BCH codes, generate Convolution codes
- CO 6: Discuss practical applications of coding for secure communication

COURSE DETAILS

Introduction

Introduction to Information Theory, Entropy, Mutual Information, Conditional and Joint Entropy, Measures for Continuous Random Variable, Relative Entropy

Source Coding

Variable Length Codes, Prefix Codes, Source Coding Theorem, Various source coding techniques: Huffman, Arithmetic, Lempel Ziv, Run Length, Rate Distortion Functions, Entropy rate of Stochastic Proces. Introduction to Image Compression, JPEG Standards.

Channel Capacity & Coding

Channel models, Channel Capacity, Shannon Limit, Channel capacity of MIMO systems,

Error control coding

Linear Block Codes, Hamming Codes, parity check coding, Cyclic code for burst error correction, BCH Codes and convolutional Codes, Trellies Coded Modulation

Coding for Secure Communication

Introduction to Cryptography, Overview of Encryption Techniques, Symmetric (Secret Key) Cryptography, Data Encryption Standard (DES), Hashing techniques, quantum cryptography, Biometric Cryptography

Textbooks

1. Ranjan Bose, Information Theory, Coding and Cryptography, McGraw Hill, 2nd edition, 2011
2. J. Das, P. K. Chatterjee & S. K. Mullick, Principle of Digital CommunicationNew age Internationals, 2008

Reference books

1. T. M. Cover & J. A. Thomas, Elements of Information Theory, Wiley-Interscience-2nd edition 2010.
2. J. G. Proakis, Digital Communication, McGraw Hill Education, 4th edition

ELECTRONICS AND PCB DESIGN

Course Code: EC30020

Credit: 3

L-T-P: 3-0-0

Prerequisite: Nil

COURSE OBJECTIVE

This is a basic course for designing of Electronic Circuits and implement on their own PCB (Printed Circuit Board).

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Explain and analyze Electronic Components towards Circuit.
- CO 2: Design a Electronics circuit.
- CO 3: Design PCB layout of their design.
- CO 4: Create PCB of their own circuit.
- CO 5: Debug and analyze the PCB design steps, starting from schematic, through layout.
- CO 6: Discuss the technologies used for PCB fabrication in electronic industry.

COURSE DETAILS

Introduction

Active and Passive components, Simple Analog and Digital Circuits Design, Rectifier, Amplifier, Oscillator, Counter, voltage regulator circuit, Analyze and construct basic circuits, Assemble and get them running.

Printed Circuit Board

Need for PCB, Types of PCBs, Single and Multilayer, Technology- Plated Through Hole, Surface Mount, PCB Material, Electronic Component packaging, PCB Designing, Fabrication, Production, Electronic Design Automation Tools- Proprietary tools like Eagle, Ultiboard, Orcad and Open source tools like KiCad,

PCB Designing: Schematic Entry, Net listing, PCB Layout Designing, Prototype Designing, Design Rule Check (DRC), Design for Manufacturing (DFM) PCB Making, Printing, Etching, Drilling, Assembly of components. Design Issues- Transmission line, Cross talk and Thermal management, PCB testing and debugging.

Textbooks

1. Jon Varteresian, Fabricating Printed Circuit Boards, Newness, 2002.
2. Marc J. Madou, Fundamentals of Microfabrication, CRC Press, 2nd edition.

Reference books

1. C. Coombs, Printed Circuits Handbook, McGraw Hill, 7th edition.
2. V. Shukla, Signal Integrity for PCB Designers, Reference Design 2009
3. D. Brooks, Signal Integrity Issues and Printed Circuit Board Design, Prentice Hall, 2003

INDUSTRIAL INTERNET OF THINGS

Course Code: EC30021

Credit: 3

L-T-P: 3-0-0

Prerequisites: Nil

COURSE OBJECTIVE

The course is intended to introduce the students, the basics of Industrial Internet of Things, its architecture, protocols, design requirements, and key technologies. The learner will be able to understand the key concepts of industrial data transmission and acquisition. Application of data analytics and machine learning methods provides insights into IIoT data science. Some case studies will help the reader to understand the application of IIoT in various industrial sectors.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Analyze the basic concepts of IIoT and Industry 4.0
- CO 2: Explain key technologies for IIoT and Industry 4.0

- CO 3: Apply the sensors and actuators in industrial applications
- CO 4: Develop industrial data transmission and acquisitions systems
- CO 5: Develop machine learning and data science methods for IIoTs.
- CO 6: Analyze case studies on IIoT use cases in Industries and develop allied methods and applications.

COURSE DETAILS

Introduction

Overview of IoT, architecture, application-based IOT protocols, cloud computing, Big Data IIoT and Industry 4.0, Industry 4.0 Basics, Design requirements, Sustainability, Cybersecurity and Impacts of Industry 4.0, IIoT Basics, Industrial Internet systems, Industrial Sensing, Processes. Business models of IIoT, Reference architecture of IIoT

Industrial Process and Devices: Technical requirements, The industrial process, The CIM pyramid, The I-IoT data flow

Industrial Data Flow and Devices

Technical requirements, The I-IoT data flow in the factory, Controllers. Sensors: Introduction, Characteristics, Categories. Actuators: Introduction, Thermal, Hydraulic, Pneumatic, and Electromechanical Actuators.

Industrial data transmission

Foundation Fieldbus, Profibus, HART, Interbus, Bitbus, CC-Link, Modubus, Batinbus, DigitalSTORM, CAN, DeviceNet, LonWorks, ISA 100.11, LoRa. Acquisition: Distributed control system, PLC, SCADA. Inventory management and quality control

Case Studies

Manufacturing, Automotive, and Mining Industry

Industrial IoT Security

Cyber security vs cyber physical IoT security, Divergence in IT and OT security fundamentals, Industrial threats, Vulnerabilities, and Risk factors. Evolution of cyber-physical attacks. Securing Connectivity and Communications, Distinguishing features of IIoT, Connectivity, Security Assessment of IIoT Connectivity and Protocols.

Textbooks

1. Sudip Misra, Chandana Roy, Anandrup Mukherjee, Introduction to Industrial Internet of Things and Industry 4.0 published , CRC Press, First Edition 2021
2. Giacomo Veneri and Antonio Capasso, Hands-On Industrial Internet of Things, Packet Publishing Ltd.

Reference books

1. Alasdair Gilchrist, Industry 4.0: The Industrial Internet of Things published, Apress 2016
2. Sravani Bhattacharjee, Practical Industrial Internet of Things Security: Packt Publishing 2018
3. D. Pyo, , J. Hwang, , and Y. Yoon, Tech Trends of the 4th Industrial Revolution, Mercury Learning & Information

MINOR PROJECT

Course Code: EC37002

Credit: 2

L-T-P: 0-0-4

Prerequisite: Nil

COURSE OBJECTIVE

Students are required to undertake a mini project either as an individual or in a group in consultation with the project supervisor which may be completed in one semester. The project work is aligned with the discipline of the student and its allied areas. It is preferably related to certain research objective or advanced technical domain. Students will demonstrate higher level learning outcomes and cognitive skills in the implementation of the project.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Perform a background study on certain technical aspect and formulate a project objective
- CO 2: Outline a pathway for the implementation of the project within the time line
- CO 3: Apply fundamental engineering concepts, advanced technical know-how, use modern engineering tools, perform experiments and critically analyze the data
- CO 4: Provide engineering solutions, design system components or processes with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
- CO 5: Function effectively as an individual, and as a member or leader in a team under multidisciplinary settings following ethical practices
- CO 6: Communicate effectively with a range of audiences and prepare technical reports

ELECTRONICS PRODUCT DEVELOPMENT

Course Code: EC38001

Credit: 1

L-T-P: 0-0-2

Prerequisites: Nil

COURSE OBJECTIVE

This course provides an overview of the process and considerations involved in the development of electronics products. It covers the key stages of product development planning, including ideation, concept design, prototyping, testing, manufacturing, and commercialization. Students will gain hands-on experience with tools, techniques, and methodologies used in electronics product development through practical projects and case studies.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Appreciate the product development lifecycle and the role of electronics in product design.
- CO 2: Gain knowledge of design principles, requirements, and constraints for electronics products.
- CO 3: Develop skills in prototyping, testing, and refining electronics product designs.
- CO 4: Learn about manufacturing processes, quality control, and regulatory compliance in electronics product development.
- CO 5: Explore strategies for commercialization, market analysis, and intellectual property protection.
- CO 6: Apply knowledge and skills acquired to successfully complete a product development project.

COURSE DETAILS

Overview of the product development lifecycle

Role of electronics in product design, Market analysis and identifying customer needs, Design Principles for Electronics Products

Product design considerations

form factor, user interface, power requirements, Component selection, sourcing, and supply chain management, Design for manufacturability and assembly, Circuit Design and Simulation

Circuit design techniques and best practices

Simulation tools for electronics design and analysis, PCB layout and routing considerations
Prototyping and Testing

Rapid prototyping techniques

Breadboarding, soldering, 3D printing, Test and measurement tools for electronics verification
Design verification and iteration process, Manufacturing and Quality Control

Manufacturing processes for electronics products

Assembly, soldering, and surface mount technology, Quality control, testing, and inspection methodologies,
Regulatory Compliance and Certification

Standards and regulations for electronics products (FCC, CE)

Product safety, electromagnetic compatibility (EMC), and environmental considerations
Certification processes and documentation requirements, Intellectual Property and Commercialization

Intellectual property rights and protection

Market analysis and competitive landscape, Business models, pricing strategies, and market entry
considerations, Project Development and Presentation

Team-based product development project

Project management techniques and tools, Final presentation and documentation of the product development
project.

Textbooks

1. R.G. Kaduskar, and V.B. Baru, Electronic Product Design, 2ed, Wiley India Pvt. Limited.
2. V.S.Bagad, Electronic Product Design - A Conceptual Approach, Technical Publication, ISBN: 9789350993620

Reference books

1. Kim R. Fowler , Electronic Instrument Design, Architecting for the Life Cycle, Oxford University Press, ISBN: 9780195083712
2. Karl T. Ulrich, Steven D. Eppinger, Maria C. Yang, Product Design and Development| 7th Edition ,Mc Graw Hill Education, ISBN13: 9781260043655
3. S D Mehta , Electronic Product Design, S.Chand Publication

VLSI DESIGN LAB

Course Code: EC39001

Credit: 1

L-T-P: 0-0-2

Prerequisites: Nil

COURSE OBJECTIVE

Student will learn about digital circuit modeling techniques (data flow, gate level, structural, behavioural) using Verilog. In addition, student will learn about digital circuit design using Tanner tool and verify different responses.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Comprehend XILINX VIVADO tool and HDL for digital logic design.
- CO 2: Implement combinational circuits using gate, structural, data flow and behavioural level modelling styles.
- CO 3: Design of sequential logic circuit such using Verilog HDL
- CO 4: Implement of RAM and ROM memory block using behavioural modelling technique
- CO 5: Model finite state machines (FSM) using HDL suitable for real time FPGA applications
- CO 6: Design of CMOS logic circuits and verify different responses using Tanner Tools.

WIRELESS COMMUNICATION & NETWORKING LAB

Course Code: EC39002

Credit: 2

L-T-P: 0-0-2

Prerequisites: Nil

COURSE OBJECTIVE

The laboratory course introduces readers to the various aspects of wireless & cellular communication and computer networks. The experiments are performed using open-source and industry-accepted simulators.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Demonstrate proficiency in using industry-standard wireless networking tools, simulation software, and test equipment for designing, analyzing, and troubleshooting wireless communication systems.
- CO 2: Design different wired and wireless network topologies and evaluate the various Quality of Service (QoS) parameters.
- CO 3: Design and simulate ad-hoc/infrastructure-based IEEE 802.11 wireless networks under static and mobility conditions and evaluate network performance.
- CO 4: Analyze and evaluate the effect of channel impairments on signal propagation.
- CO 5: Design and simulate wired/ wireless and heterogeneous networks using industry-standard routers, and switches by configuring networking parameters and observing the network operation.
- CO 6: Analyze the application and scenario-specific network requirements based on case-study/client requirements, and design and simulate networks using the learned utilities.

MICROWAVE ENGINEERING LAB

Course Code: EC39003

Credit: 1

L-T-P: 0-0-2

Prerequisites: Nil

COURSE OBJECTIVE

To introduce the students to various microwave sources, components, and equipment and measure multiple performance characteristics.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Apply knowledge of various microwave passive components and active devices to evaluate microwave subsystem performances.
- CO 2: Analyze various transmission line problems using Smith's chart.
- CO 3: Select materials based on attenuation and dielectric constant by using X-band rectangular waveguide bench.

- CO 4: Evaluate communication links developed by directional antenna(microwave Horn antenna), by calculating signal power reception, gain and determination of the shape of radiation pattern.
- CO 5: Apprais half wave dipole antenna, Yagi-Uda Array antenna commonly utilized in low frequency communication system.
- CO 6: Characterize microstrip based components for specific applications.

ELCTRONICS DESIGN LAB

Course Code: **EC39004**

Credit: **2**

L-T-P: **0-0-4**

Prerequisites: **Nil**

COURSE OBJECTIVE

Electronics Design Lab focuses on creating transformative and scalable technology that makes designing of end-to-end processes through innovations in data-acquisition, analytic and automation. Lab objectives are to train students on how to select appropriate sensors, instrumentation, and/or software tools to make measurements of physical quantities. Aim includes evaluating whether a theory adequately describes a physical event, identifying the strengths and limitations of theoretical models and establishing or validating a relationship between measured data and underlying physical principles

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Devise an experimental approach, specify appropriate equipment and procedures, implement these procedures, and interpret the resulting data to characterize an engineering material, component, or system.
- CO 2: Demonstrate the ability to collect, analyze, and interpret data, and to form and support conclusions. Make order of magnitude judgments, and know measurement unit systems and conversions.
- CO 3: Design, build, or assemble a part, product, or system, including using specific methodologies, equipment, or materials; meeting client requirements; developing system specifications from requirements; and testing and debugging a prototype, system, or process using appropriate tools to satisfy requirements.
- CO 4: Recognize unsuccessful outcomes due to faulty equipment, parts, code, construction, process, or design, and then re-engineer effective solutions.
- CO 5: Work effectively in teams, including structure individual and joint accountability; assign roles, responsibilities, and tasks; monitor progress; meet deadlines; and integrate individual contributions into a final deliverable.
- CO 6: Demonstrate appropriate levels of independent thought, creativity, and capability in real-world problem solving and demonstrate competence in selection, modification, and operation of appropriate engineering tools and resources.

CONTROL SYSTEMS LAB

Course Code: **EC39005**

Credits: **1**

L-T-P: **0-0-2**

Prerequisites: **Nil**

COURSE OBJECTIVE

To provide practical experiences on modeling, analysis and design of control systems using simulations and hardware trainer platforms, including hands-on practices in operating and handling of various instruments.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Build simulation models of control systems using simulators.
- CO 2: Analyze control systems using time domain specifications.
- CO 3: Analyze control systems using frequency domain specifications.
- CO 4: Examine the system performance and correlate significance of the PID controller parameters.
- CO 5: Recommend suitable compensation technique for speed and position control applications.
- CO 6: Implement and analyze state-space model of LTI systems

OPTIMIZATION TECHNIQUES IN ENGINEERING

Course Code: **EC40001**

Credit: **3**

L-T-P: **3-0-0**

Prerequisites: **Nil**

COURSE OBJECTIVE

Students will gain expertise in designing algorithms based on conventional techniques and be able to deal with intractable problems and implement algorithms given the description. At the end of this course, students will be able to comprehend and apply various optimization techniques for numerical analysis of different engineering and design related problems. Course modules include various methods to obtain the extremum (minimum or maximum) of a non-dynamic system and the use of these methods in various engineering applications.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Analyze the need for optimization, the concepts of design variables and constraints.
- CO 2: Apply various unconstrained optimization techniques and develop corresponding Python/MATLAB codes.
- CO 3: Apply various multi-variable optimization techniques and develop corresponding Python/MATLAB codes.
- CO 4: Analyze various constrained optimization techniques and utilize them for evaluating engineering problem statements.
- CO 5: Investigate various complex problems using dynamic programming algorithms.
- CO 6: Analyze various advanced metaheuristic techniques and develop Python/MATLAB codes for analysis.

COURSE DETAILS

Introduction

Design variables, constraints, variable bounds, local and global optimization, classification of optimization techniques.

Unconstrained Optimization Techniques

Single-variable optimization techniques - Concepts of Bracketing (Exhaustive Search) and Region Elimination (Interval Halving), Programming in Python/MATLAB.Gradient Based techniques - Newton-Raphson method and its application, Programming in Python/MATLAB.Multi-variable optimization techniques - Concepts of Direct Search (Hooke-Jeeves pattern search method) and Gradient based search (Cauchy's method, Newton's method).

Constrained Optimization Techniques

L1 and L2 norm based optimization, Kuhn-Tucker (KT) necessity and sufficiency theorems, Penalty function method, Method of multiplier.

Dynamic Programming

Dynamic programming algorithms, shortest path problems, time optimal control.

Metaheuristics

Genetic Algorithm, Particle Swarm Optimization, Simulated Annealing, Differential Evolution - Grey Wolf Optimization, Programming in Python/MATLAB.

Textbook

1. Deb, Kalyanmoy, Optimization for engineering design: Algorithms and examples. PHI Learning Pvt. Ltd., 2012.

Reference books

1. Stephen P. Boyd, and Lieven Vandenberghe. Convex optimization. Cambridge university press, 2004.
2. Deb, Kalyanmoy, Multi-objective optimization using evolutionary algorithms: an introduction. Springer London, 2011.
3. Rao, S. S.,Engineering optimization: theory and practice. John Wiley & Sons,2019.
4. Bellman, R. E. and Dreyfus, S. E., Applied dynamic programming (Vol. 2050). Princeton university press, 2015.

MILLIMETER-WAVES AND TERAHERTZ TECHNOLOGY

Course Code: EC40002

Credit: 3

L-T-P: 3-0-0

Prerequisites: Nil

COURSE OBJECTIVE

This course deals with the fundamental theory of millimeter wave multiple access techniques and the fundamentals of Terahertz technology. The course will comprehensively discuss the channel modelling for mm Waves and multiple access techniques.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Analyze the various communication technologies, difference between sub-6GHz 5G and mm-Wave 5G, characteristics of mm-Wave and standards
- CO 2: Apply the channel models for mm-Wave systems and design them.
- CO 3: Analyze the different modulation schemes and multiple access technologies for mm-Wave systems.
- CO 4: Analyze the beam forming concept and apply water filling algorithm for channel capacity improvement in mm-Waves.
- CO 5: Explain the sources of THz and the means of detecting it
- CO 6: Explain the application of THz for future wireless communication systems.

COURSE DETAILS

Introduction to Millimeter Wave (mm-Wave) Technology

Overview of communication technologies (1G to 5G), 5G requirements, sub-6GHz 5G, mm-Wave 5G, mm-Wave characteristics, mm-Wave standards, mm-Wave MIMO systems.

Channel Modelling for mm-Wave Technology

Channel modelling challenges, mm-Wave propagation loss due to atmospheric Oxygen, and water vapor (especially, at 60GHz), path loss models, Channel models for mm-Wave MIMO systems.

Modulation and Multiple-Access Techniques

Modulation techniques: Orthogonal frequency division multiplexing (OFDM), filter bank multi-carriers (FBMC), generalized frequency, division multiplexing (GFDM), and universal filtered multi-carrier (UFMC)

Orthogonal Frequency Division

Multiple accesses (OFDMA), generalized frequency division multiple accesses (GFDMA), non-orthogonal multiple accesses (NOMA).

MIMO and Beam Steering Technology

mm-Wave transmission and reception, antennas for mm-Wave beam-steering concept, MIMO requirements, noise in MIMO mm-Wave, spatial diversity.

Overview of Terahertz (THz) Technology

Introduction to THz radiation, Overview of THz generation and detection: THz pulses, and continuous THz wave generation, Overview of THz components (waveguides, filters, and modulations)

THz Communications

Ultra fast THz communication, Short distance THz communications, 6G communications with THz, Space communication with THz

Textbooks

1. Theodore S.Rappaport, Robert W. Heath Jr., Robert C. Daniels and James N. Murdock, Millimeter Wave Wireless Communication, Prentice Hall, 2014.
2. Yun-Shik Lee, Principles of Terahertz Science and Technology, Springer 2009

Reference books

1. Kao- Cheng Huang and Zhoacheng Wang, Millimeter Wave Communication Systems, Wiley IEEE Press, 2011.
2. Athanasios G.Kanatos, Konstantina S.Nikita, Panagiotis Mathiopoulos, New Directions in Wireless Communication Systems from Mobile to 5G, CRC Press,2017
3. Erik Bründermann, et al., Terahertz Techniques, Springer, 2012.
4. R. A. Lewis, Terahertz Physics, Cambridge University Press, 2012

COGNITIVE RADIO AND COOPERATIVE COMMUNICATIONS

Course Code: EC40003

Credit: 3

L-T-P: 3-0-0

Prerequisites: Nil

COURSE OBJECTIVE

Cognitive radio is an exciting emerging technology that has the potential of dealing with the stringent requirement and scarcity of the radio spectrum. Aim of this course is to familiarize students with the technology that allows the agile and efficient utilization of the radio spectrum by offering distributed terminals or radio cells the ability of radio sensing, self-adaptation, and dynamic spectrum sharing.

COURSE OUTCOMES

After successfully completing the course, the students will be able to:

- CO 1: Analyze Cooperative Communication Concepts and Cooperation protocols.
- CO 2: Differentiate between Distributed space-time coding (DSTC) - Distributed space-frequency coding (DSFC) and analyze Differential modulation for DF and AF cooperative communication.
- CO 3: Analyze the features of cooperative Networking like energy efficiency, distributed routing, source channel coding etc.
- CO 4: Analyze the concept of Software Defined Radio and Cognitive Radio.

CO 5: Model various cognitive Radio tasks.

CO 6: Explain the recent trends and challenges in Cognitive Radio.

COURSE DETAILS

Introduction

Cooperative Communication, Cooperation protocols - Hierarchical cooperation, Cooperative communications with single relay, Multi-node cooperative communications.

Distributed Space–Time Coding (Dstc) - Distributed Space–Frequency Coding (Dsfc)

Distributed space–time coding (DSTC) - Distributed space–frequency coding (DSFC); Relay selection-Differential modulations for DF cooperative communications - Differential modulation for AF cooperative communications.

Cooperative Networking

Energy efficiency in cooperative sensor networks, Cognitive multiple access via cooperation, Content-aware cooperative multiple access, Distributed cooperative routing, Source–channel coding with cooperation.

Introduction to Software Defined Radio and Cognitive Radio

Characteristics and Benefits of Software Radio; Dynamic Spectrum Access; Digital dividend; Types of Cognitive Radio; Spectrum policies and Regulations; Information theoretic perspective on Cognitive Radio networks.

Cognitive Radio Tasks

Spectrum sensing and its methods; Cooperative Spectrum sensing; Spectrum sharing; spectrum mobility; spectrum management; spectrum trading.

Recent Trends and Challenges in Cognitive Radio

OFDM based Cognitive Radio; Security issues in cognitive radio; Game theory in Cognitive radio; applications of cognitive radio; IEEE 802.22 WRAN standard.

Textbook

1. Rayliu K J, Sadek A K, Weifeng Su and Andres Kwasinski, Cooperative Communications and Networking, Cambridge University Press, 2009.

Reference books

1. Jeffrey H Reed, Software Radio: A Modern Approach to Radio Engineering, PEA Publication, 2002.
2. Bruce A Fette, Cognitive Radio Technology, Elsevier Publication, Burlington, 2009.
3. Joseph Mitola III, Cognitive Radio Architecture: The Engineering Foundations of Radio XML, Wiley Interscience Publication, NEW JERSEY, 2006.
4. Kwang-Cheng Chen and Ramjee Prasad, Cognitive Radio Networks, John Wiley & Sons, 2009.

QUANTUM COMMUNICATION

Course Code: EC40004

Credit: 3

L-T-P: 3-0-0

Prerequisites: Nil

COURSE OBJECTIVE

This course introduces students to basic laws of quantum mechanics and provides an introduction to the revolutionary quantum technologies. This course is about the potential for quantum technologies, a field that promises to revolutionize the way we compute by using the dynamics of quantum mechanics. The boundary between classical and quantum physics, quantization of EM field and its consequences, quantum electromagnetic and atomic physics and their applications in quantum communication, quantum computations and quantum sensing are discussed. The course aims to develop conceptual understanding of quantum

phenomena and identifies engineering challenges of various quantum technologies.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Identify fundamental differences between quantum and classical technologies
- CO 2: Analyze mathematically simple quantum phenomena
- CO 3: Explain quantum signatures in experimental data
- CO 4: Discuss quantum errors and error correction methods
- CO 5: Analyze engineering challenges of quantum technologies
- CO 6: Discuss methods of fault-tolerant quantum computation

COURSE DETAILS

Overview of Quantum Technologies

Quantum Engineering, Motivation: Quantum Computing, Quantum Communication, Motivation: Quantum sensing, Fundamentals of Quantum Mechanics

Essential Concepts in Quantum Mechanics

The Birth of quantum mechanics, Postulates of quantum mechanics, Hamiltonian and Schrodinger Equation, Dirac notation, Density operator

Quantum Resources

EM waves: Quantum EM fields, Polarization of optical fields, EM resonators, Single photon detection, E-field detection, Quantum light.

Atoms: Two-level atom, Introduction to light-atom interactions, Trapping and cooling atoms, Three-level atoms, Rydberg atoms, Trapped ions

Superconducting Devices: Fundamentals of superconductors, Superconducting two-level systems, Superconducting qubits, Superconducting qubits and challenges

Quantum Sensing and Communication

Light interferometry-LIGO, Particle interferometry- Ramsey measurement, Sensing via defects in diamond, Quantum cryptography, Quantum teleportation, Quantum Memory, Entanglement distribution

Quantum Computing

Introduction to classical computing, Introduction to quantum computing, Experimental implementation of quantum computation, Deterministic two-qubit logic gates, Single and two-qubit photonic gates, Superconducting gates, Quantum logic operation using trapped ions, Quantum logic operation using Rydberg atoms, Linear optics quantum computing, Engineering Quantum Systems

Textbook

1. Nielsen, M., & Chuang, I., Quantum Computation and Quantum Information: 10th Anniversary Edition. Cambridge: Cambridge University Press, 2010, doi:10.1017/CBO9780511976667;

Reference books

1. David A. B. Miller, Quantum Mechanics for Scientists and Engineers Illustrated Edition, Advanced Quantum Communications: An Engineering Approach Sandor Imre, Laszlo Gyongyosi, ISBN: 978-1-118-00236-0, December 2012 Wiley-IEEE Press
2. A.M. Zagoskin, Quantum Engineering: Theory and Design of Quantum Coherent Structures, Cambridge, Cambridge University Press, 2011, ISBN 978-0-521-11369-4.

ANALOG AND MIXED SIGNAL IC DESIGN

Course Code: EC40005
Credit: 3
L-T-P: 3-0-0
Prerequisite: Nil

COURSE OBJECTIVE

Student will be able to understand the design parameters of Analog and Mixed signal CMOS VLSI circuits. Students will be able to design and model Analog and Mixed signal MOS circuits with the given specifications.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Select the most appropriate design configuration for a specified single stage amplifier implementation.
- CO 2: Evaluate performance issues and trade-offs based on a knowledge of different current mirror circuits.
- CO 3: Choose the most appropriate differential amplifier configuration for a specified analog circuit implementation.
- CO 4: Choose the most appropriate operational amplifier configuration for a specified analog circuit implementation.
- CO 5: Select the most appropriate design configuration for a specified Nyquist rate DAC and ADC implementation.
- CO 6: Analyze different designs of PLLs best suited for a specific mixed signal circuit application

COURSE DETAILS

Single stage Amplifiers:

Small signal models of MOS transistors, Basic amplifier topologies and their characteristics, common-source stage amplifier, Cascode amplifiers,

Biasing circuits

Basic and Cascode current mirrors, Current and Voltage references; bandgap reference, Folded Cascode amplifier

Differential amplifiers

Basic differential pair, Differential amplifier with tail current source, Differential amplifier with active load.

Operational amplifier and applications

Analysis of different performance parameters, Miller effect, Design of CMOS op-amp, one-stage op-amp, cascode op-amp and analysis, two-stage op-amp, Gain boosting, Latch-based comparator, Ring oscillator, LC oscillator, Voltage control oscillator.

Nyquist rate ADC and DAC design

Block diagram of SAR ADC, Design of SAR ADC, Working principle and architecture of a folding-and-interpolation ADC, Design of sample and hold amplifier, Design of folding amplifier and interpolation network, Resistor ladder DAC, Binary weighted, R-2R ladder based DAC, switch capacitor based DAC..

Phase locked loop

Phase locked loop: Simple PLL, Building blocks in PLL, Locking characteristic of PLL and Design of PLL; non-ideal effects in PLLs, Charge-Pump. PLL based frequency synthesizer, Application and block diagram of a DLL, Design of a multiphase generator.

Textbooks

1. Behad Razavi, Design of Analog CMOS Integrated Circuits; MGH, 2nd edition, 20017.
2. David Johns and Ken Martin, Analog integrated circuit design, Wiley 2nd Edition, 2013,

Reference books

1. Allen and Holberg, CMOS Analog Circuit Design, Oxford , International 2nd edition,
2. R. Jacob Baker, CMOS mixed-signal circuit design , Wiley India, IEEE press, 1st edition, 2009.
3. Mikael Gustavsson, J.Jacob Wickner, Nianxiong nick Tan, CMOS Data Converters for communications, Kluwer, Academic Publishers New York, Boston, Dordrecht, London, Moscow,2002

ADVANCED VLSI AND SoC

Course Code: **EC40006**
Credit: **3**
L-T-P: **3-0-0**
Prerequisites: **Nil**

COURSE OBJECTIVE

This course focuses on data path interconnects aware design methodologies, SoC design flow, bus architecture, hardware security and IP protection.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Analyze the basic arithmetic building blocks used in VLSI Circuits.
- CO 2: Apply knowledge to implement arithmetic blocks for data path design
- CO 3: Analyze the partitioning technique for component placement.
- CO 4: Solve the VLSI interconnects and clock routing issues.
- CO 5: Discuss the SoC design method and soft- and hard-core processors.
- CO 6: Evaluate and analyze the method of SoC Verification and IP protection methods.

COURSE DETAILS

Design of arithmetic building blocks

Introduction to processor design and digital arithmetic, Carry select adder, Manchester carry-chain, Carry bypass adder, carry-save adder, Array multiplier, carry save multiplier, Wallace tree multiplier, Booth's multiplier, Delay optimization of adders and multipliers, Area-time trade-off, power consumption issues, Optimization for speed, Low-power design and high-speed logic.

Design automation tools and partitioning

Constructive and iterative partitioning, Kernighan-Lin algorithm, ratio-cut algorithm, Placement, floor planning and pin assignments
Global routing, Lee's algorithm, Channel routing, clock and power routing algorithms.

Clocking and interconnect issues

Clocking and Crosstalk, system noise, complexity management, Signal integrity issues, high speed interconnects, Clock, clock skew, clock distribution and routing, Clock buffering, gated clock and clock tree, Design of buffers and I/O pad and memory design interconnect issues.

Introduction to SoC

Soc Design Flow, Overview of SoC Design methodologies, SoC Components- Processor and Memory, On chip interconnect- AMBA Bus, soft and hard core development process.

SoC Verification & SoC Security

Overview of verification techniques, Verification flow, HW/SW Multi-Level Security, Overview of hardware security, IP protection, Encryption

Textbooks

1. Weste and Eshraghian "Principles of CMOS VLSI Design", Second Edition,Pearson Education, 2001
2. Farzad Nekoogar, Faranak Nekoogar, "From ASICs to SOCs: A Practical Approach", PHI, 2003

Reference books

1. Neil H.E. Weste, David F. Harris, "CMOS VLSI Design ", Pearson Education, 2010
2. Jan M. Rabaey, Anant Chandrakasan, and Borivoje Nikoli, "Digital Integrated Circuits", Prentice Hall (India), 2016

LOW POWER VLSI DESIGN

Course Code: EC40007

Credit: 3

L-T-P: 3-0-0

Prerequisite: Nil

COURSE OBJECTIVE

This course focuses on Optimization of VLSI design prototype in architecture, gate and in cell level of abstraction.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Explain various power dissipation mechanisms in a CMOS logic
- CO 2: Estimate and analyse the various components power dissipation in VLSI circuits.
- CO 3: Apply and analyse various low power optimization techniques in architecture level
- CO 4: Apply and analyse various low power optimization techniques in gate level
- CO 5: Analyse various low power optimization techniques in cell level
- CO 6: Analyse various low power optimization techniques in layout level

COURSE DETAILS**Basic MOS inverters, MOS combinational circuits**

Sources of power dissipation in CMOS circuits: static power dissipation - diode leakage power, subthreshold leakage power, gate and other tunnel currents; dynamic power dissipation - short circuit power, switching power, gliching power; degrees of freedom, energy delay product, power delay product.

Supply voltage scaling approaches

Technology Level - feature size scaling, threshold voltage scaling; logic level - gate sizing for voltage scaling; architecture level - parallelism and pipelining; algorithm level - transformations to exploit concurrency; dynamic voltage scaling. Switched capacitance minimization approaches: system level - power down, system partitioning;

Algorithm level

Concurrency, locality, regularity, data representation; architecture level - concurrency, signal correlation; logic level - gate sizing, logic styles; layout level - layout optimization; technology level - advanced packaging, SOI.

Leakage power minimization techniques:

Threshold voltage scaling: MT莫斯, VT莫斯 and Multiple-V_t CMOS circuits.

Textbook

1. Ajit Pal, Low-Power VLSI Circuits and Systems, Springer, 2015

Reference books

1. Anantha P. Chandrakasan and Robert W. Brodersen, Low Power Digital CMOS Design, Kluwer Academic Publishers,2002.
2. Kaushik Roy and Sharat C. Prasad, Low-Power CMOS VLSI Design, Wiley-India,2011.

ADVANCED COMPUTER ARCHITECTURE AND RISC-V PROCESSOR DESIGN

Course Code: EC40008
Credit: 3
L-T-P: 3-0-0
Prerequisite: Nil

COURSE OBJECTIVE

This course focuses on instruction pipeline and their hazards, branching, pipeline scheduling mechanisms, cache memory organization and mapping techniques and also teaches about RISC-V Architecture and instruction formats and Brief overview to ARM.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Interpret the performance of a processor based on metrics such as execution time, cycles per instruction (CPI), Instruction count etc
- CO 2: Explain instruction pipeline and pipeline hazards
- CO 3: Analyze pipeline scheduling and different scheduling mechanisms.
- CO 4: Apply the concept of memory hierarchy for efficient memory design
- CO 5: Discuss the RISC V instruction sets and addressing modes used in RISC -V processors.
- CO 6: Evaluate RISC -V processor instructions and their usage.

COURSE DETAILS

Introduction

Review of basic computer architecture, RISC vs CISC, Performance evaluation methods, Introduction RISC pipeline, Instruction pipeline and performance.

Instruction Pipeline Principles

Pipeline hazards, Pipeline hazard control and branching, MIPS pipeline for multi-cycle operation.

Pipeline scheduling mechanism

Compiler technique, dynamic scheduling, static and dynamic scheduling.

Cache memory and its organization

Cache memory basics, Cache memory mapping replacement algorithms, cache memory optimization.

RISC-V Processor

Introduction to RISC-V Processor, RISC -V instruction format and RIC-V Instruction sets, RISC-V Addressing Modes and Synchronization, Overview of a basic RISC Processor- ARM.

Textbooks

1. J.L.Hennessy, D.A.Patterson, Computer Architecture: a quantitative approach, Morgan Kaufmann, 5th edition, 2011, ISBN: 978-1558605961.
2. David A. Patterson & John L. Hennessy, Computer Organization and Design RISC-V Edition, Elsevier, 2nd Edition, 2020

Reference books

1. Bernard Goossens, Guide to Computer Processor Architecture, Springer, 1st edition, 2023
2. Sivarama P. Dandamudi, Guide to RISC Processors for Programmers and Engineers, 1st Edition, 2005
3. Sarah L. Harris & David Harris, Digital Design and Computer Architecture- RISC-V Edition, Morgan Kaufmann, 2012, ISBN: 9780123978165
3. Daniel Page, A Practical Introduction to Computer Architecture, Springer London, 1st edition 2009
4. William Stallings, Computer Organization and Architecture, Prentice Hall, 10th edition, 2015, ISBN-10: 013293633X, ISBN-13: 978-0132936330

BIOMEDICAL SIGNAL PROCESSING

Course Code: EC40009
Credit: 3
L-T-P: 3-0-0
Prerequisites: Nil

COURSE OBJECTIVE

Biomedical signals are acquired from a medical or biological source which can be at the cell level, molecular level, or organ level. Several biomedical signals are generally employed in the research laboratory, and hospitals. The aim this course covers the application of signal processing and stochastic methods to detect or diagnosis of disease or physiological states in the human body.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Appraise various techniques for acquiring bio-medical signals.
- CO 2: Investigate and interpret bio-medical signal characteristics.
- CO 3: Apply signal processing techniques for noise reduction and artefact removal.
- CO 4: Demonstrate skills in analyzing bio-medical signals using time-frequency analysis.
- CO 5: Implement appropriate signal processing algorithms for disease diagnosis.
- CO 6: Evaluate feature extraction and feature selection techniques to identify abnormal patterns.

COURSE DETAILS

Introduction to Biomedical Signals

Generation of Bio-signals, Sources of bio-signals, Bio electric potential/ action potential, Types of bio-signals (ECG, EEG, EMG, EOG), Study of diagnostically significant bio-signal parameters, Acquisition of bio-signals (signal conditioning).

Filtering Techniques

Classification of signals and noise, Digital filtering, Spectral analysis of deterministic, stationary random signals and non-stationary signals, Coherent treatment of various biomedical signal processing methods and applications. Biomedical signal processing by Fourier analysis, wavelet (time-frequency) analysis.

Analysis of Bio-signals

Cardiological signal processing: Basic Electrocardiography, ECG data acquisition, Power spectrum of the ECG, filtering techniques, Template matching, QRS detection algorithm, Estimation of R-R Interval, Real-time ECG processing.

Neurological signal processing: The brain and its potentials, origin of brain waves, EEG signal and its characteristics (EEG rhythms, waves, and transients), Detection of EEG rhythms, spike and wave detection. Analysis of EMG signal and PCG Signal. Deep learning for bio-signal analysis.

Applications of BSP

Analysis of chaotic signals Application areas of BSP: Multi-resolution analysis (MRA) and wavelets, Principal component analysis (PCA), Independent component analysis (ICA), Adaptive segmentation of ECG and PCG signals, Time varying analysis of heart rate variability, Detection of Coronary Artery Disease , Analysis of Ectopic ECG beats. Pattern classification on biomedical signal analysis.

Textbooks

1. Rangaraj M. Rangayyan, Biomedical Signal Analysis, IEEE Press, 2001.Charu C. Aggarwal. Neural Networks and Deep Learning: A Textbook. Springer. 2019.
2. W. J. Tompkins, Biomedical Digital Signal Processing, Prentice Hall, 1993.

Reference books

1. Eugene N Bruce, Biomedical Signal Processing and Signal Modeling, John Wiley & Son's publication, 2001.
2. Myer Kutz, Biomedical Engineering and Design Handbook, Volume I, McGraw Hill, 2009.
3. D C Reddy, Biomedical Signal Processing, McGraw Hill, 2005.
4. A V Oppenheim & R W Schafer, Discrete-time Digital Signal Processing, 2009, 3rd edition, Prentice-Hall

MASSIVE MIMO TECHNOLOGY

Course Code: **EC40010**

Credit: **3**

L-T-P: **3-0-0**

Prerequisites: **Nil**

COURSE OBJECTIVE

The course is intended to make the research students understand the massive MIMO system, Principle and working of massive MIMO system, means and modes of communication. They will able to analyze the Principle and working of different massive MIMO network scenarios and application to Millimeter wave communication. Also they will able to comprehend and analyze the power control in massive MIMO system and its applications for small cells and device to device communications.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Compare and contrast the concepts of MIMO and massive MIMO techniques.
- CO 2: Analyze and optimize the performance of massive MIMO for capacity and SNR improvement of various Network Scenarios.
- CO 3: Apply and analyze the Massive MIMO Aided millimeter communication Technology
- CO 4: Analalyze the power control in massive MIMO system.
- CO 5: Discuss case studies on massive MIMO applications.
- CO 6: Apply MIMO and Massive MIMO techniques for real world scenarios and applications.

Introduction

Evolution of cellular systems from 1G to 4G and the principles underlying different generations, Engineering requirements and application scenarios for 5G, Role of massive MIMO as a key 5G solution, Characteristics and benefits of massive MIMO systems, signal and channel models, Difference between traditional MIMO and Massive MIMO.

Massive MIMO Technology

Main Application Scenarios: Homogeneous Network Scenarios, Heterogeneous Network Scenarios,Physical Layer Technology, Recorders and detectors in multi cell environments, Networking Technology, Scheduling

Massive MIMO Aided millimeter communication Technology

Back ground, deployment of Millimeter Wave Communication, Physical Layer Challenges and solutions, CSI acquisition and beam forming schemes.MAC and Networking Design

Power control in massive MIMO systems

Single cell, multiple cells, max-min fairness; Propagation channels: Conditions for favorable propagation, independent Rayleigh fading, uniformly random line-of-sight channels;

Case studies

Examples of single and multiple cell deployment; Recent research results: Pilot Decontamination, Effects of hardware impairments, Massive MIMO with FDD operation, Cell-free Massive MIMO;

Other potential 5G technologies such as device to device communications and applicability of massive MIMO to small cells.

Textbooks

1. T. L. Marzetta, E. G. Larsson, H. Yang, and H. Q. Ngo, *Fundamentals of Massive MIMO*, Cambridge University Press, 2016
2. Long Zhao, Hui Zhao, Kan Zheng, Wei Xiang ,Massive MIMO in 5G Networks: Selected Applications, Springer,2018

References books

1. R. S. Kshetrimayum, *Fundamentals of MIMO Wireless Communications*, Cambridge University Press, 2017.
2. W. Xiang, K. Zheng, and X. Xuemin, *5G Mobile communications*, Springer, 2017
3. J. Rodriguez, *Fundamentals of 5G Mobile Networks*, John Wiley & Sons, 2015
4. H. Yang and T. S. Quek, *Massive MIMO meets Small Cell: Backhaul and Cooperation*, Springer, 2016.

RF CMOS VLSI

Course Code: EC40014

Credit: 3

L-T-P : 3-0-0

Prerequisite: Nil

COURSE OBJECTIVE

This course introduces the design parameters of integrated radio front-end circuits for given specifications. The course imparts knowledge on RF modulation,RF CMOS circuit design and testing.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Evaluate the performance parameters of RF and wireless systems
- CO 2: Analyze performance issues and trade-offs based on a knowledge of different passive and active devices.
- CO 3: Select appropriate modulation technique for a specified RF circuit implementation.
- CO 4: Investigate and select device topology for specified RF circuit implementation.
- CO 5: Examine the operation and parameters of basic functional blocks of RF systems.
- CO 6: Analyze different designs of PLLs for RF circuit applications.

COURSE DETAILS

Introduction to RF & Wireless Technology

Complexity, design and applications. Choice of Technology. Basic concepts in RF Design: Nonlinearity and Time Variance, intersymbol Interference, random processes and Noise. Definitions of sensitivity and dynamic range, conversion Gains and Distortion.

Passive and Active Devices

Passive devices: monolithic capacitors, resistors, inductors, RLC networks, transmission lines, lumped and distributed resonators, impedance matching networks, transformers, and baluns. Active devices: MOSFET operations (in both long channel and deep submicron regimes), practical limitations, and other various silicon transistors and technologies (Si/SiGe Bipolar, SOI, etc.).

Analog & Digital Modulation for RF Circuits

Comparison of various techniques for power efficiency. Coherent and Non coherent detection. Mobile RF Communication systems and basics of Multiple Access techniques. Receiver and Transmitter Architectures and Testing Heterodyne, Homodyne, Image-reject, Direct-IF and sub-sampled receivers. Direct Conversion and two steps transmitters

RF Device Modeling

BJT and MOSFET behavior at RF frequencies. Modeling of the transistors and SPICE models. Noise performance and limitation of devices. Integrated Parasitic elements at high frequencies and their monolithic implementation.

Basic Blocks in RF Systems

Low Noise Amplifiers design in various technologies, Design of Mixers at GHz frequency range. Various Mixers, their working and implementations, Oscillators: Basic topologies VCO and definition of phase noise. Noise-Power trade-off. Resonator less VCO design.

VLSI Implementations of RF Systems

Quadrature and single-sideband generators, Radio Frequency Synthesizers: PLLS, Various RF synthesizer architectures and frequency dividers, Power Amplifiers design. Linearisation techniques, Design issues in integrated RF filters.

Textbook

1. B.Razavi, RF Microelectronics, 2nd edition, Prentice-Hall PTR,
2. T.H.Lee, The Design of CMOS Radio-Frequency Integrated Circuits, Cambridge University Press, 2nd Edition, 2003

Reference books

1. Frank Gustrau, RF and Microwave Engineering: Fundamentals of Wireless Communications, Wiley
2. Reinhold Ludwig, RF Circuit Design Theory And Application, 2nd Edition, Pearson Education, 2000
3. Valeria Teppati, Andrea Ferrero, Mohamed Sayed, Modern RF and Microwave Measurement Techniques, Cambridge Univ. Press, 2013

5G SUPPORTIVE TECHNOLOGIES

Course Code: EC40015

Credit: 3

L-T-P : 3-0-0

Prerequisite: Nil

COURSE OBJECTIVES

This course provides the comprehensive overview of the 5G supportive Technologies. The key supportive technologies like D2D, mm-wave communications, massive MIMO, wireless network coding, interference management and spectrum utilization issues are emphasized. Various 5G application domains such as automotive, building, energy and manufacturing economic sectors are addressed. The relationship between IoT, machine type communications, and cyber-physical systems under 5G standard are included. Glimpses for future e6G communication is also provided with its base technologies.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Comprehend and Analyze the 5G Concept and Architecture.
- CO 2: Comprehend and analyze the concept behind Machine to Machine and Device to Device based Communication.
- CO 3: Comprehend and analyze various 5G radio access technologies for wireless communication.
- CO 4: Comprehend and analyze the concept of Massive MIMO technology in the context of 5G Communication.
- CO 5: Comprehend and analyze the concept of Interference Management, Mobility Management and Dynamic network reconfiguration in 5G systems.

CO 6: Comprehend and analyze concept of Spectrum ,standard and technologies for 5G and future 6G communication.

COURSE DETAILS

Introduction

Background History, Mobile Communication generations from 1G to 4G, IOT: relation to 5G,5G capacity and Volume, Global Initiatives, Standardization activities

5G System concept and Architecture

5G use cases and requirements, Basic concepts of 5G system, Basics of RAN architecture, High level requirements for 5G architecture, Functional architecture and 5G flexibility, Physical architecture and 5G deployments.

Machine Type Communications (MTC) and Device to Device(D2D) Communication

MTC categorization and requirements, Fundamental Technologies for MTC, Massive MTC, Ultra reliable and Low Latency MTC, Device to Device communication from 4G to 5G,4G LTE D2D, 5G D2D, Radio resource management for Mobile Broad band D2D.

5G Radio Access Technologies

Access design principles for Multi User Communications: Orthogonal Multiple Access Systems, Spread Spectrum Multiple access Systems,Capacity Limits for multiple access systems, Multi carrier with filtering:Filter bank based Multi carrier,Universal Filtered OFDM,Non-Orthogonal Schemes for efficient Multiple Access: Non-Orthogonal Multiple Access(NOMA), Sparse Code Multiple Access (SCMA)

Massive Multiple Input Multiple Output(MIMO) Systems

MIMO in LTE,Single user MIMO,Multi-User MIMO,Capacity of Massive MIMO, Resource allocation and Transceiver Algorithms for Massive MIMO, Fundamentals of base band and RF Implementations in Massive MIMO.

Interference Management and Mobility Management and Dynamic reconfiguration in 5G

Network Deployment Types, Interference Management in 5G, Mobility Management in 5G,Dynamic network reconfiguration in 5G.

Spectrum for 5G

Spectrum for 4G, Spectrum Challenges for 5G,Bandwidth requirements, Spectrum access nodes and sharing scenarios,5G spectrum Technologies, Spectrum ,standard and technologies for future 6G communication.

Textbook:

1. Afif Qsseiran, Jose F Monserrat, Patrick Marsch, 5G Mobile and Wireless Communications Technology, Cambridge University Press, 2016

Reference books

1. Jonathan Rodriguez,Fundamentals of 5G mobile networks, WILEY,2015
2. 5G NR the next generation Wireless Access Technology, Academic Press, Second Edition,2020

VLSI SIGNAL PROCESSING

Course Code: **EC40016**

Credit: **3**

L-T-P: **3-0-0**

Prerequisite: **Nil**

COURSE OBJECTIVE

This subject is designed to represent DSP systems and covers some of the important techniques for designing efficient VLSI architectures for its applications. The subject will also help students to develop high throughput system for real time applications, with an intention to reduce power consumption and chip area.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Interpret DSP Architectures and Algorithms.
- CO 2: Apply pipelining and parallel processing to FIR filters for Low Power application
- CO 3: Compare different technique of retiming, folding and unfolding of DSP architecture to reduce critical path delay.
- CO 4: Appraise systolic array design of DSP architecture.
- CO 5: Apply Fast convolution technique for Filtering Application.
- CO 6: Analyze different arithmetic architecture for addition, subtraction and multiplications technique applicable to DSP.

COURSE DETAILS

Introduction

Graphical representation of DSP algorithms, Block Diagram, signal flow graph (SFG), data flow graph (DFG) and dependence graph (DG), critical path, loop bound and iteration bound.

Pipelining and Parallel Processing

Introduction, Pipelining and parallel processing of FIR digital filters, Pipelining and Parallel Processing for Low Power.

Retiming, Unfolding and Folding

Retiming techniques; algorithm for unfolding, Folding transformation

Systolic architecture design

Systolic array design methodology, FIR Systolic Arrays, Selection of Scheduling Vectors, 2D Matrix Multiplication Systolic Array Design.

Fast Convolution

Cook-Toom algorithm, modified Cook-Toom algorithm, Winograd algorithm, iterated convolution

Bit level Arithmetic Architectures

Parallel Multipliers- Parallel Multiplication with sign extension (Parallel Carry Ripple Array and Parallel Carry Save Multipliers), Bit Serial Multipliers.

Textbook

1. Keshab K. Parhi, VLSI Digital Signal Processing Systems, Design and Implementation, John Wiley, Indian Reprint, 2007.

Reference books

1. Magdy A. Bayoumi, VLSI Design Methodologies for Digital Signal Processing Architectures , Springer/BSP Books, 2005.
2. S.Y. Kuang, H.J. White house, T. Kailath,VLSI and Modern Signal Processing, Prentice Hall, 1995.
3. U. Meyer, Baese, Digital Signal Processing with Field Programmable Gate Arrays, Springer, Second Edition, 2004.

PLANAR ANTENNAS

Course Code: EC40017

Credit: 3

L-T-P: 3-0-0

Prerequisite: Nil

COURSE OBJECTIVE

The objective of the course is to understand the theory and the design principles of planar antennas for the applications to small devices. The subject focuses to learn the design methods of microstrip antenna, planar monopole antenna, planar antenna arrays, slot antenna, millimeter wave and TeraHertz antennas for the applications to miniaturized devices.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Identify the antenna basics for the design of small planar antennas.
- CO 2: Analyze the characteristics and design principles of microstrip antennas for small and low gain antenna applications.
- CO 3: Construct the circularly polarized patch antennas and microstrip antenna arrays for small and high gain antenna applications.
- CO 4: Design planar slot antennas and planar monopole antennas for the applications to small and omnidirectional antennas.
- CO 5: Evaluate the characteristics and design aspects of electrically small antennas.
- CO 6: Make use of planar antennas for special applications to wireless access.

COURSE DETAILS

Introduction to Antennas and Planar Antennas

Radiation, Antenna parameters, Basics of antenna array, Different types of planar antennas, Brief description of fabrication process of planar antennas.

Microstrip Patch Antennas-I

Characteristics of microstrip patch antennas, radiation from microstrip antenna, field configurations, different types of feeding techniques. Design equations for rectangular and circular microstrip patches, analysis of microstrip antennas using transmission line model and cavity method. Broadband techniques using stacked patch antennas, proximity-coupled and aperture-coupled microstrip antennas, slot-loaded and slit-loaded microstrip antennas, microstrip antennas with shorted pin, effect of finite ground plane on the performance of microstrip antennas, principle of planar fractal antennas.

Microstrip Patch Antennas-II

Methods of generating circular polarization in microstrip antennas using single feed and double feed, methods of generating multiple frequencies using microstrip antennas, miniaturization techniques for microstrip antennas. Design techniques of microstrip antenna arrays with feed network, effect of mutual coupling, microstrip phased array antenna design.

Planar Slot Antennas

Geometry and design of microstrip slot antenna, radiation pattern, CPW-fed slot antennas, design of folded slot antenna, annular slot antenna.

Planar Monopole Antennas

Feeding methods and characteristics of planar triangle monopole, Sierpinski monopole, planar bi-conical monopole antenna and roll monopole antenna.

Electrically Small Antennas

Electrically small antennas and their limitations, planar inverted F antenna (PIFA), PIFA for wireless portable sets, ground-plane effects on PIFA performance, different types of PIFA, multi-frequency PIFA, Printed notch antennas, small fractal antennas, dielectric resonator antennas, small TeraHertz antennas.

Planar Antennas for Special Applications

Planar mobile handset antennas, planar laptop computer antennas, planar antennas for USB modem, planar antennas for WLAN and UWB communication.

Textbooks

1. R. Garg, P. Bhartia, I. Bahl and A. Ittipiboon, Microstrip Antenna Design Handbook, Artech House, 1st Ed., 2001.
2. Z. N. Chen & M. Y. W. Chia, Broadband Planar Antennas-Design & Applications, John Wiley & Sons, 1st Ed., 2006.

Reference book

1. K-L. Wong, Compact and Broadband Microstrip Antennas, John Wiley & Sons, 1st Ed., 2002.

SMART ANTENNAS

Course Code: EC40018

Credit: 3

L-T-P: 3-0-0

Prerequisite: Nil

COURSE OBJECTIVE

This course focuses on advanced topics in design of smart antennas systems, including antenna array principles and smart antenna algorithms such as angle of arrival estimation and antenna beam forming. The course provides the student with the basic principles of smart antenna systems, which is an adaptive antenna array consisting of multiple antennas. Objective is to use intelligent algorithms to calculate the optimal antenna combination to make optimal use of beam forming and antenna array technologies, thereby reaping better benefits.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Analyze linear and circular antenna arrays.

CO 2: Classify adaptive processing for smart antenna using different methods.

CO 3: Solve design problems on smart antenna in presence of mutual coupling between the antennas.

CO 4: Minimize mutual coupling in presence of jammers.

CO 5: Solve design problems on smart antenna by estimating direction of arrival (DOA) of signal.

CO 6. Investigate different types of DOA estimation methods..

COURSE DETAILS

Introduction

Analysis of linear and circular antenna arrays, phased array antenna, Array synthesis methods, Adaptive antennas and smart antennas, adaptive processing using minimum variance distortion less technique.

Direct Data Domain Least Square Approaches to Adaptive Processing

Direct data domain least square procedures, eigenvalue method, forward method, backward method, forward-backward method, main beam construction for prevention of signal cancellation.

Mutual Coupling in Adaptive Smart Antennas

Mutual coupling among an array of dipoles (qualitative), compensation using open-circuit voltages and minimum norm formulation, effect of mutual coupling for constant jammers and constant signals, compensation for mutual coupling for constant jammers and constant signals.

Direction of Arrival (DOA) Estimation and Adaptive Signal Processing for Smart Antennas

Problem formulation, transformation matrix to compensate undesired electromagnetic effects, DOA estimation for a semicircular array, adaptive processing using a single snapshot from a non-uniformly spaced array in presence of mutual coupling and near-field scatterers, DOA estimation using a phased array on a conformal hemispherical surface, DOA estimation using cyclostationarity, Optimization of base station location for indoor wireless communication.

Textbook

1. T. K. Sarkar, M. C. Wicks, M. Salazar-Palma and R. J. Bonneau, Smart Antennas, Wiley-Interscience, 1st Ed., 2003

Reference books

1. Ahmed El-Zooghby, Smart Antenna Engineering, Artech House, 1st Ed., 2005.
2. F. Gross, Smart Antennas for Wireless Communication: With MATLAB, McGraw Hill, 1st Ed., 2005.

SOLAR CELL DEVICE AND MATERIALS TECHNOLOGY

Course Code: **EC40019**

Credits: **3**

L-T-P: **3-0-0**

Pre-requisites: **Nil**

COURSE OBJECTIVE

This course is an introductory course on solar photovoltaic materials and devices covering fundamentals of operation of solar cells, physics of semiconducting materials, P-N junction device characteristics in dark and light. We will also discuss various solar photovoltaic technologies and their status with a brief discussion of the fabrication and characterization aspects of the devices. The course will also discuss the simulation aspects of designing and the PV module design basics.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Interpret the basics of Semiconductor Properties and working principle of solar cell.
- CO 2: Explain the basic operation of a photovoltaic cell; explain the optical and electrical mechanisms that limit efficiency and methods for improving these limits
- CO 3: Design, analyze and simulate basic homojunction and heterojunction photovoltaic cells.
- CO 4: Design and analyze different types of photovoltaic solar cells.
- CO 5: Apply different fabrication and characterization process involved in thin film solar cell.
- CO 6: Estimate the performance metrics of PV modules.

COURSE DETAILS

The Physics of Solar Cell

Review of Semiconductor Physics, Electrons and holes; density of states; drift and diffusion; conductivity; carrier generation and recombination; optical phenomena in solids; carrier generation by photon absorption.

Solar Spectrum and Air Mass Concepts, Semiconductors as basic solar cell material, materials and properties, P – N junction , I-V curves in dark and under illumination and solar cell. Sources of Losses and prevention.

Principles of solar energy conversions, open circuit voltage; short circuit current, maximum power, fill factor, conversion efficiency.

Photovoltaic Technology

a) Silicon Solar cell technologies

Mono- crystalline and poly – crystalline cells, wafer production, Si-wafers, commercial Si solar cells, process flow of commercial Si cell technology, Metal contacts. Monocrystalline materials and design issues;

b) Thin Film Solar Cells

Substrate and Super-state configuration, Thin film module manufacturing, Amorphous Si Solar cell technology.

Principles of homojunction and heterojunction solar cells. Cadmium Telluride Cell Technology, CIGS, CZTS based thin film solar cell. 2D materials for solar cell fabrication.
Strategies for improving solar cell efficiency, light trapping, bandgap engineering, multi-junction concepts.

New Generation Solar Cells

Dye-sensitized solar cells (DSSC), Perovskite solar cells (PSC), Organic photovoltaics (OPV), Nano Materials for Solar Cell

Fabrication and Simulation Methodology

Thin Film Solar Cells, Advantage of thin film, Thin film deposition techniques: Evaporation, Sputtering, Atomic Layer Deposition (ALD), Spin Coating, Doctor Blade, Spray pyrolysis.

Open source software for solar cell modeling: SCAPS-1D, TCAD, WXAMPS

Introduction To PV Module Design

PV Modules: Series Resistance and shunt resistances, optimization, module design basics, interconnection schemes, PV arrays, associated system electronics components.

Life cycle analysis, impact on air, water and soil pollution.

Textbook:

1. Chetan Singh Solanki, Solar Photovoltaics, Fundamentals, Technologies and Applications
Third Eds, PHI, 2015

Reference books

1. U. P. Singh and N. B. Chaure, Recent Advances in Thin Film PV Eds., Springer, 2022
2. A. Luque and S. Hegedus, eds., Handbook of Photovoltaic Science and Engineering, 2nd Edition, John Wiley & Sons, Inc., 2011, ISBN: 978-0-470-72169-8.
3. Gavin J. Conibeer and Arthur Willoughby, eds., Solar Cell Materials: Developing Technologies, John Wiley & Sons, Inc., 2014, ISBN: 978-0-470-06551-8
4. J. Poortmans and V. Arkhipov, eds., Thin Film Solar Cells: Fabrication, Characterization, and Applications, John Wiley & Sons, Ltd., 2006,

ESSENCE OF BIOMEDICAL SIGNAL PROCESSING

Course Code: EC40020

Credit: 3

L-T-P: 3-0-0

Pre-requisites: Nil

COURSE OBJECTIVE

A biomedical engineer must have a qualitative understanding of the importance of biomedical signal processing. Biomedical signals are essentials of human life and indicate the functionality of the body organs. The main goal is to provide the theoretical and practical knowledge required for processing biomedical signals in order to detect anomalies.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Identify the origin and characteristics of biomedical signals
- CO 2: Assess the artifact and its removal techniques from biomedical signals
- CO 3: Appraise the basic concepts and tools for real time processing of signals.
- CO 4: Analyze processing of physiological signals through digital signal processing techniques and to address biomedical problems.
- CO 5: Interpret the nature of physical processes and pathological conditions and to evaluate the usefulness of biomedical signal processing in a clinical context.
- CO 6: Apply DSP techniques to solve complex problems related to biomedical domain.

COURSE DETAILS

Introduction to Biomedical Signals

Generation of action potential, Origin and waveform characteristics of basic biomedical signals like Electrocardiogram (ECG), Electroencephalogram (EEG), Electromyogram (EMG), Phonocardiogram (PCG), Electroneurogram (ENG), Objectives of biomedical signal analysis, Artifacts, Difficulties in biomedical signal Analysis, Computer-Aided Diagnosis.

Signals & Systems

Data Acquisition: Sampling in time, aliasing, interpolation, and quantization, Fundamentals of Deterministic Signal, Linear Time-invariant systems, Convolution, Transform domain analysis of signals: Discrete Fourier Transform (DFT), discrete-time Fourier transform (DTFT), the fast Fourier transform (FFT), the spectrogram, correlation, Power spectral density, Noise figure of the systems.

Filter Design And Noise Removal

Sampling and aliasing, spectral analysis, Types of noises. Design parameters for a filter, Linear time-invariant filters: Time domain filters, Synchronized averaging, Moving average filters, Derivative based filters, the overlap-save algorithm, digital filtering of continuous-time signals, Butterworth filters, Notch and comb filters, Chebyshev and elliptic filters, Bilinear transform.

Cardiological Signal Processing

Pre-processing, Event detection, Morphological analysis, Envelope extraction, Feature extraction, Case studies, Removal of artifacts, QRS Detection and classification of ectopic beats in ECG signals, Adaptive filters like LMS adaptive filter, adaptive noise cancellation, Cancellation of 60 Hz interference in ECG, Cancellation of maternal ECG in fetal ECG, Arrhythmia detection.

Neurological Signal Processing

Modeling of EEG Signals. Detection of spikes and spindles, Detection of Alpha, Beta and Gamma Waves. Auto Regressive (A.R.) modeling of seizure EEG. Sleep Stage analysis. Inverse Filtering. Least squares and polynomial modeling.

Textbooks

1. R.M. Rangayyan, Biomedical Signal Analysis, IEEE Press, 2001.
2. A. Oppenheim, R. Schafer, Discrete-Time Signal Processing, Prentice Hall, 2009.

Reference books

1. E.N Bruce, Biomedical Signal Processing and Signal Modeling, John Wiley & Son's -publication, 2001.
2. M. Kutz, Biomedical Engineering and Design Handbook, Volume I, McGraw Hill, 2009.
3. D.C Reddy, Biomedical Signal Processing, McGraw Hill, 2005.

IMAGING TECHNIQUES

Course Code: EC40022

Credit: 3

L-T-P : 3-0-0

Prerequisite: Nil

COURSE OBJECTIVE

Imaging Techniques is a comprehensive course that introduces students to the principles and applications of various imaging modalities used in medical, scientific, and industrial settings. The course covers the fundamental concepts and techniques of imaging acquisition. Students will gain knowledge of the physical principles underlying different imaging modalities, their strengths and limitations, and their applications in diverse fields.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Appraise the basics of imaging techniques.

- CO 2: Apply the basic principles of medical imaging modalities, including X-ray, computed tomography (CT), magnetic resonance imaging (MRI), ultrasound.
- CO 3: Analyze the concepts of optical imaging and its applications.
- CO 4: Explain the principles of satellite imaging and its applications.
- CO 5: Investigate the knowledge of thermal imaging and its applications.
- CO 6: Discuss the applications of various imaging modalities.

COURSE DETAILS

Introduction to Imaging Techniques

Definition of imaging, Brief overview of different imaging modalities, Basic principles of image acquisition and image formation.

Medical Imaging

X-ray Imaging: Physics of X-ray production, X-ray image acquisition and processing, Applications and limitations of X-ray imaging. Computed Tomography (CT): Principles of CT imaging, CT image acquisition and reconstruction, Applications and limitations of CT imaging. Magnetic Resonance Imaging (MRI): Principles of MRI, MRI image acquisition and processing, Applications and limitations of MRI. Ultrasound Imaging: Physics of ultrasound. Ultrasound image acquisition and processing, Applications and limitations of ultrasound imaging. Applications of medical imaging.

Optical Imaging

Principles of optical imaging, Optical imaging techniques, including microscopy, endoscopy, and fluorescence imaging, Applications and limitations of optical imaging. Applications of optical imaging.

Satellite Imaging

Definition and importance of satellite imaging, Basic principles of electromagnetic radiation and its interaction with Earth's surface, Overview of satellite sensors and platforms. Different types of satellite sensors (optical, thermal, radar, etc.). Satellite orbits and their implications on image acquisition, Image resolution, spatial, spectral, and temporal. Applications of satellite imaging.

Thermal Imaging

Fundamentals of Infrared Thermal Imaging: Infrared radiation, Radiometry and thermal radiation, Emissivity, Optical material properties in IR. Applications of thermal imaging.

Textbooks

1. Paul Suetens, Fundamentals of Medical Imaging, Cambridge University Press; 2nd edition.
2. John R. Jensen, Remote Sensing of the Environment: An Earth Resource Perspective, Pearson Education, India, 2nd edition, 2013

Reference books

1. Michael Vollmer, Klaus-Peter Möllmann, Infrared Thermal Imaging: Fundamentals, Research and Applications, Wiley-VCH; 2nd edition.
2. Craig Scott, Introduction to Optics and Optical Imaging, John Wiley & Sons Inc; 1st edition.

CONSUMER ELECTRONICS

Course Code: EC40023
Credit: 3
L-T-P: 3-0-0
Prerequisite: EC30014

COURSE OBJECTIVE

This course discusses about current state of the art of digital consumer devices as per current leading-edge technology. This course broadly covers audio systems, video systems, telecommunication principles, office equipment and domestic appliances to make understand of current digital technology.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Apply DC and AC Technology used in consumer Electronics.
- CO 2: Categorize different electrical & electronics components.
- CO 3: Apply knowledge for the use of Sensors for acquiring Acoustic and Electromagnetic waveform and their Manipulation.
- CO 4: Apply knowledge of Audio and Video System for Consumer Electronics Circuit Design.
- CO 5: Analyze the concepts of electronics gadgets and home appliances and their applications.
- CO 6: Create desired Electronics Equipment based on requirement and specifications.

COURSE DETAILS

DC, AC Technology, Components and Circuits, Waveforms:

DC and AC Technology, Electrical and Electronics components(Passive, Active Components) and their Nomenclatures, Testing of Components and Circuits, Fundamental and Harmonic Waveforms, Acoustic and Electromagnetic Waveforms, Wave-shaping

Transducers and Sensors:

Different Transducers/Sensors, properties, application, CRT, Recording and Reproduction System (8)

Audio and Video System:

Audio Systems and standards, Monochrome and Color TV Systems, (13)

Electronics Gadgets and Home Appliances:

Telecommunications Systems, Mobile Radio Systems, Facsimiles, CAR Infotainment, Washing Machines, Microwave Ovens, Air conditioners and Refrigerators, Set-Top boxes(10)

Textbooks

1. S. P. Bali, Consumer Electronics, Pearson Education, 1st Edition, 2009

Reference books

1. Amit Dhir, The Digital Consumer Technology Handbook, Elsevier, 1st Edition, 2004
2. Gerald B. Halt, Jr., John C. Donch, Jr., Robert Fesnak, Amber R. Stiles, Intellectual Property in Consumer Electronics, Software and Technology Startups, Springer, 2014.
3. Ian Sinclair and John Dunton, Electronic and Electrical Servicing, Taylor & Francis, 2nd Edition, 2007

FUNDAMENTALS OF DATA ACQUISITION SYSTEMS

Course Code: EC40025

Credit: 3

L-T-P: 3-0-0

Prerequisite: NIL

COURSE OBJECTIVE

This course offers study of different aspects of data acquisition systems such as data acquisition system hardware, communication bus, design of data acquisition systems, software for data acquisition systems, smart data acquisition system.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Explain different components of data acquisition systems.
- CO 2: Compare different hardware of the data acquisition systems.
- CO 3: Examine the communication bus standards.
- CO 4: Design the data acquisition systems.

CO 5: Explain the software of the data acquisition systems.

CO6: Build smart data acquisition systems.

COURSE DETAILS

Introduction

Overview of Data Acquisition Systems, Sensors and Transducers, DAQ Hardware, DAQ Software, Communications Cabling, Parameters of a DAQ System.

Data Acquisition Systems Hardware

Plug-in DAQ Systems, Signal Conditioning, Converters A/D, Converters D/A, Digital Signal Processing, Microprocessor and Microcontrollers, Amplifier, Multiplexer/Demultiplexer, Power Management, Timing System, Filtering, Memory Board, Bus Interface.

Communication Bus

Bus USB and FireWire, Serial Communications, Wireless, Ethernet, and Bluetooth, GSM for Data Acquisition Systems, PCI and PCI Express, Standard VME.

Design of Data Acquisition Systems

Introduction to the Design, Functional Design of High Speed Computer-Based DAS, Portable DAS, Design Guidelines for High-Performance, Multichannel.

Software for Data Acquisition Systems

LabView, Android for DAQ, Design of Firmware, Example of Implementation of a Software for Data Acquisition System via VME Bus.

Smart Data Acquisition System

General Description of MAX1329, Complete DAQ.

Textbooks:

1. Maurizio Di Paolo Emilio, Data Acquisition Systems, Springer, 1st, 2013.

Reference books

1. John Park and Steve Macka, Practical Data Acquisition for Instrumentation and Control Systems, 2003, Newnes.
2. Psumathi, LabVIEW based advanced instrumentation system, 1st edition, 2007, Springer Science Elsevier

EMBEDDED SYSTEMS DESIGN AND APPLICATIONS

Course Code: EC40027

Credits: 3

L-T-P: 3-0-0

Prerequisite: Nil

COURSE OBJECTIVE

This course covers fundamentals of embedded system hardware and firmware design. Topics such as embedded processor selection, hardware/firmware partitioning, circuit design, circuit layout, circuit debugging, development tools, firmware architecture, firmware design, and firmware debugging will be discussed. The Intel 8051 and PIC18F series microcontroller with instructions will be studied. The course briefly covers ARM processor architecture, instruction set and programming. The course will culminate with a significant design examples using ARM processor.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Understand the architecture, programming, and interface requirements of ARM.

CO 2: Learn to use assemblers, compilers, simulators and emulators to help with design and verification for ARM processors.

- CO 3: Interface a microprocessor to displays, memories, different I/O ports
- CO 4: Apply ALP to solve real-time problems like timers, counters, A2D, Motors, etc. using ARM. CO5. understand RTOS and its functionality for real time application.
- CO 6: Develop closed and open embedded/Linux based systems for ARM processors

COURSE DETAILS

Overview of Embedded System

Embedded System, Embedded Processor in System, Components of Embedded System, Brief introduction to Embedded software in system, Design Process in Embedded System.

Embedded Hardware: Processor & Memory

Brief overview of 8051 Architecture and real world interfacing, Processor and Memory organization, Parallelism in instruction level, Processor and memory selection.

I/O Types

Serial and Parallel communication Ports, Timer and Counting devices, Watchdog timers, real time clock, Serial bus Communication Protocols- I2C, CAN, and Parallel Communication Protocol-ISA.

Interrupt Service Mechanism

Concept of ISR, different interrupt sources, Interrupt handling Mechanism, Multiple Interrupts, Interrupt Latency and deadline.

Embedded Software Development

Programming concept in ALP (assembly language programming) and High level language-C, Processor directives, functions and macros and other programming elements, Embedded C++ concept only.

Embedded System Design using ARM

PIC: Introduction to PIC Architecture, Memory Mapped programming using Embedded C, Interfacing Programming- ADC, UART, PWM, I2C, SPI

ARM Architectures

Register Organization, ARM Memory Map, CPSR, ARM Data Format and Directives, The Program Counter and Program ROM Space in the ARM, Addressing Modes, RISC Architecture in ARM, The ARM Instruction Set, ARM Organization and Implementation- 3-stage pipeline ARM, 5-stage pipeline in ARM.

ARM Instruction Set and ARM Assembly Language Programming

Data processing instructions, Data transfer instructions, Control flow instructions, Introduction to assembly language programs, Examples of ARM Assembly Language Programming, Interfacing with peripherals- ADC, Data EEPROM, Asynchronous serial port, SPI mode, I2C mode, Interfacing with LCD, ADC, sensors, stepper motor, key board, DAC.

RTOS(Real time operating System)

OS overview, Process, Interrupt and memory management, RTOS overview, Basic Design rule using RTOS, Task scheduling using Priority based scheduling, cyclic scheduling and round robin scheduling.

Case study of different types of Embedded System

Design of Automated Chocolate Vending Machine, Digital Camera.

Textbooks

1. Raj Kamal, Embedded Systems: Architecture, Programming & Design, TMH, 2011
2. ARM Assembly Language:Fundamentals and Techniques by William Hohl
3. Christopher Hinds, CRC Press, 2nd Edition, 2015.

Reference books

1. Rank Vahid, Embedded System Design : A unified Hardware/Software Introduction, Wiley Student Edition, Wiley, 2002
2. Muhammad Ali Mazidi, Sarmad Naimi, Sepehr Naimi, Arm Assembly Language Programming & Architecture: Volume 1, Microdigitaled.com, 2nd Edition, 2016

COMMUNICATION NETWORK FUNDAMENTALS

Course Code: EC40029
Credit: 3
L-T-P : 3-0-0
Prerequisite: Nil

COURSE OBJECTIVE:

The course is designed for non electronics engineers. It will give the student an overview of how internet and cellular communication work. The student can go for detailed study after completion of this course.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Comprehend the techniques of analog and digital communication.
- CO 2: Analyze the working of data network in different media.
- CO 3: Apply the routing protocols used for different configurations.
- CO 4: Choose relevant transport and application layer protocols.
- CO 5: Comprehend the basics of cellular communication.
- CO 6: Evaluate how the spectrum efficiency increased in different evolution stages of cellular communication.

COURSE DETAILS

Basics of Communication

Introduction to communication system, Amplitude Modulation and Demodulation, Angle Modulation and Demodulation, Noise in Communication Systems, Multiplexing, Digital Modulation and Demodulation Techniques

Data Communication Basics

Introduction, Media, Physical Layer, MAC Protocols, Link Layer Protocols

Data Communication Intermediate

Routing Protocols

Data Communication Advanced

Transport Layer Protocols, Application Layer Protocols

Mobile Communication Basics

Basics of Cellular Communication, Large Scale and Small Scale Fading

Mobile Communication Advanced

WCDMA Basics, LTE Basics, 5G Core and NR

Textbooks

1. B. A. Forouzan, Data Communications and Networking, McGraw-Hill, 4th Edition, 2011.
2. H. Taub, D. L. Schilling, & G. Saha, Principles of Communication Systems, McGraw-Hill, 4th Edition, 2013.

Reference books

1. Sassan Ahmadi, LTE Advanced, Elsevier, 2014.
2. Eric Dahlman, Stefan Parkvall, Johan Skold, 5G NR The Next Generation Wireless Access Technologies, Elsevier, 2018.

PRINCIPLES OF OPTO-ELECTRONICS

Course Code: EC40031
Credit: 3
L-T-P: 3-0-0
Prerequisite: EC30014

COURSE OBJECTIVE

This course aims at covering the physics and engineering issues that define the basic semiconductor optoelectronics devices. We start off with the concept of an energy band representation for the electrons and holes in semiconductors and relate the energy of the free electrons to the electrical and optical properties. The behavior of p-n junctions and other barrier potentials in semiconductor structures are analyzed. These junctions are presented as simple instruments that enable electrical injection of electrons with excess potential energy for radiative emission of photons. In reverse, these same junctions cause photo-generated electrons to drift rapidly across the field to generate a photocurrent. Semiconductor optoelectronic devices such as the LED, the laser diode, the photodetector are presented as mere converters of electrical energy to photon energy and vice-versa. Optical modulators are devices for controlling the intensity or phase of an optical beam using an electrical input. The course contains a good mix of the electrical properties and optical properties of semiconductors and the interplay between photons and the free electrons within.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Learn To know the basics of solid state physics and understand the nature and characteristics of light
- CO 2: Understand different methods of luminescence, display devices and laser types and their applications.
- CO 3: Apply the principle of optical detection mechanism in different detection devices.
- CO 4: Analyze the different light modulation techniques and the concepts and applications of optical switching.
- CO 5: Evaluate the integration process and application of optoelectronic integrated circuits in transmitters and receivers.
- CO 6: Develop critical thinking ability for analysis of Optoelectronic Channel Waveguide Components

COURSE DETAILS

Elements of Light and Solid State Physics

Wave nature of light, Polarization, Interference, Diffraction, Light Source, review of Quantum Mechanical concept, Review of Solid State Physics, Review of Semiconductor Physics and Semiconductor Junction Device.

Display Devices and Lasers

Introduction, Photo Luminescence, Cathode Luminescence, Electro Luminescence, Injection Luminescence, Injection Luminescence, LED, Plasma Display, Liquid Crystal Displays, Numeric Displays, Laser Emission, Absorption, Radiation, Population Inversion, Optical Feedback, Threshold condition, Laser Modes, Classes of Lasers, Mode Locking, laser applications.

Optical Detection Devices

Photo detector, Thermal detector, Photo Devices, Photo Conductors, Photo diodes, Detector Performance.

Optoelectronic modulators and switches

Introduction, Franz-Keldysh effect, Quantum confined Stark effect in quantum well semiconductors, Analog and Digital Modulation, Electro-optic modulators, Magneto Optic Devices, Acoustooptic devices, Optical, Switching and Logic Devices.

Optoelectronic Integrated Circuits

Introduction, hybrid and Monolithic Integration, Application of Opto-electronic Integrated Circuits, Integrated transmitters and Receivers, Guided wave devices.

Optoelectronic Channel Waveguide Components

Passive waveguide components: The power divider, Wavelength filters/ multiplexers, waveguide reflectors, resonators, the optical time delay line

Textbook

1 J. Wilson and J. Haukes, Optoelectronics, Third Edition, Pearson Education, 2018

Reference books

1. Pallab Bhattacharya, Semiconductor Optoelectronic Devices, Second Edition, Pearson Education 2017
2. Jasprit Singh, Opto Electronics: An Introduction to materials and devices, McGraw-Hill International Edition, 1998.
3. Emmanuel Rosencher, Borge Vinter and P. G. Piva, Optoelectronics, Cambridge University Press, 2010.
4. William S. C. Chang, Fundamentals of Guided-Wave Optoelectronic Devices, Cambridge University Press, 2010.
5. Kevin F Brennan, The physics of semiconductors-with applications to optoelectronic devices, Cambridge University Press, 1999

PRINCIPLE OF MODERN COMMUNICATION SYSTEMS

Course Code: EC40033

Credit: 3

L-T-P: 3-0-0

Prerequisite: EC30014

COURSE OBJECTIVE

This is intended to make the students understand the communication system, Principle and working communication system, means and medium of communication. They will able to analyze the Principle and working of different modulation techniques and can differentiate between analog and digital communication. Also they will able to comprehend the Principle and working of Cellular, Satellite and optical fiber communication.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Comprehend the basic concept of Communication, means and medium of Communication and Familiar with —AM|| and —FM —techniques.
- CO 2: Comprehend the basic concept of Pulse Modulation techniques
- CO 3: Comprehend and analyze the concept of various Carrier Modulation techniques for digital transmission Like ASK,FSK,PSK and QPSK.
- CO 4: Comprehend the basic concept of cellular and mobile Communication.
- CO 5: Comprehend the basic concept of Satellite Communication
- CO 6: Comprehend the basic concept of Optical Fibre Communication

COURSE DETAILS

Analog Modulation Techniques

Block diagram of electronic communication system. Modulation, need and types of modulation (AM, FM & PM).

Amplitude modulation – representation, modulation index, Various forms of Amplitude Modulation (DSB, SDB/SC/SSB/SC), frequency spectrum, power relations.AM Detectors, Limitations of AM.

Frequency Modulation- definition, modulation index, frequency spectrum, bandwidth requirements, frequency deviation and carrier swing. Block diagram of AM and FM transmitter and receivers. Comparison of AM and FM.

Introduction to pulse communication: types- PAM, PWM, PPM, PCM – quantization, advantages and applications

Digital Modulation Techniques

Data Form, Principles involved in ASK, PSK (BPSK, QPSK, $\pi/4$ QPSK), FSK.

Satellite Communication - Introduction, need, geosynchronous satellite orbits, geostationary satellite advantages of geostationary satellites. Satellite visibility, transponders (C - Band), path loss, ground station, simplified block diagram of earth station. Uplink and downlink.

Cellular Communication Principle

Cellular Concept System Architecture, Spectrum Allocation, Frequency Reuse, Channel Assignment Strategies, Co-channel Interference & System Capacity, Hand off, Hand off structure, Practical Hand off consideration, Prioritizing Hand off, Power Control, Near – Far Problem, System capacity, Improvement Techniques: Cell splitting, Sectoring, Micro cell Zone concept.

Optical Fiber Communication

Introduction – need for OFC. Block diagram of OFC system. Fiber optic cables, light propagation through fiber – step index fiber, graded index fiber, Snell's law, numerical aperture (derivation). Types of optical fiber cables, light sources – requirements, LEDs and semiconductor laser diodes. Photo detectors – PN, PIN and avalanche photodiodes. Losses and Dispersion in optical fibers – Rayleigh scattering, absorption, leaky modes, bending, joint junction losses. Advantages and disadvantages of OFC over metallic cables.

Textbook

1. Louis E. Frenzel Jr., Principles of electronic communication systems, Fourth edition, McGraw Hill Education

Reference books

1. B.P. Lathi, Modern Digital and Analog Communications Systems, Oxford University Press
2. H. Taub & D.L.Schilling, Principles of Communication System, TMH
3. Simon Haykins, Introduction to Analog & Digital Communication System, Edition 2011, John Wiley.

PROJECT - I

Course Code: EC47001

Credit: 5

L-T-P: 0-0-10

Prerequisite: Nil

COURSE OBJECTIVE

Students are required to undertake a final year major project either as an individual or in a group in consultation with the project guide which may be completed in one year. The project should be related to certain advanced technical domain. The work encompasses two semesters and to be carried out in two phases. In Project-I, students are expected to complete detailed literature review, identify their objective and start working on the same; perform experiments, carry out analyses and report their findings to their supervisors and the panel.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO1: Conduct a detailed research survey or background study and summarize the theory and findings
- CO2: Formulate a research question or a general objective of the project
- CO3: Propose and outline the solution to the research question or a pathway for the implementation of the project with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
- CO4: Conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
- CO5: Function effectively as an individual, and as a member or leader in a team under multidisciplinary settings following ethical practices
- CO6: Communicate effectively with a range of audiences and prepare technical reports

PROJECT - II

Course Code: EC47002

Credit: 9

L-T-P: 0-0-18

Prerequisite: Nil

COURSE OBJECTIVE

Project-II is a continuation of Project-I, the second phase of final year major project. Students should complete all related experiments, develop a final solution, product or system and validate the applicability of the same under real time scenario with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors. They produce a detailed technical report on their work as well as individual contribution reports. Throughout the implementation of the major final year project, students should demonstrate all cognitive skills and attainment of all program outcomes and student outcomes.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Readily apply fundamental concepts in their area of study for executing the projects
- CO 2: Demonstrate skill in using modern technical tools, apply advanced technical knowledge integrate information from different sources, perform complex experiments and critically analyze the findings to draw conclusions
- CO 3: Provide engineering solutions to predefined research question or project objective, design system components or processes with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
- CO 4: Function effectively as an individual, and as a member or leader in a team under multidisciplinary settings following ethical practices
- CO 5: Communicate effectively with a range of audiences and prepare detailed technical reports
- CO 6: Demonstrate knowledge and understanding of the management principles in executing their project as a member or leader of the team, and willingness to engage in life-long learning

PROJECT (MINOR DEGREE)

Course Code: EC47004

Credit: 2

L-T-P: 0-0-4

Prerequisite: Courses earmarked for the minor degree

COURSE OBJECTIVE

Students can opt for a mini project instead of lab work to complete the requirements of minor degrees. The project work is to be aligned with the specialization of minor degrees and allied areas. It can be carried out individually or in a group in consultation with the project supervisor and is to be completed in one semester. Students will demonstrate higher-level learning outcomes and cognitive skills in implementing the project.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Perform a background study on minor degree related technical aspect and formulate a project objective
- CO 2: Outline a pathway for the implementation of the project within the time line
- CO 3: Apply fundamental engineering concepts, knowledge of minor degree courses, use modern engineering tools, perform experiments and/or critically analyze the outcomes.
- CO 4: Provide engineering solutions, design system components or processes with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
- CO 5: Demonstrate self learning skill and innovation in critical thinking.
- CO 6: Communicate effectively with a range of audiences and prepare technical reports.

PRACTICAL TRAINING / INTERNSHIP

Course Code: EC48001
Credit: 2
L-T-P : 2-0-0
Prerequisite: Nil

COURSE OBJECTIVE

In this course, the students will get opportunity to explore career augmentation aspects prior to graduation, integrate theory and practice, assess interests and abilities in their field of study, learn to appreciate work and its function in the economy, develop work habits and attitudes necessary for job success, develop communication, interpersonal and other critical skills in the job interview process and build a record of work experience.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Apply engineering knowledge in solving real-life problems
- CO 2: Acquire new skills in the engineering disciplines of their own interest
- CO 3: Get exposure to real-life-working environment practices, and to attain the professionalisms
- CO 4: Work with multi-tasking professionals and multidisciplinary team
- CO 5: Prepare a technical report, to improve presentation and other soft skills
- CO 6: Learn to appreciate work and its function in the economy

ELECTRONICS ENGINEERING LAB (MINOR DEGREE)

Course Code: EC49001
Credit: 2
L-T-P: 0-0-4
Prerequisites: Nil

COURSE OBJECTIVE

This Lab caters hands-on experience to the students who opts for a minor degree in various specializations offered by the School of Electronics. A student can select this lab or a project to acquire 2 credits requirement of the minor degree. A student will work in at least two labs related to their minor degree by completing the required experiments. If both the labs are designed to include open experiments, a student may decide to work on a mini project in the domain of minor degree and complete the requirements. The quantity and quality of the work will be monitored and evaluated by the course faculty.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Devise an experimental approach,following the procedures, and interpret the result to validate the requirements of the experiment.
- CO 2: Demonstrate the ability to corelate the theoretical learning covered under the respective minor degree courses and the observed measurement.
- CO 3: Design, build, or assemble a part, product, or system, using specific methodologies, equipment, or materials; meeting system specifications or process using appropriate tools to satisfy the requirements.
- CO 4: Recognize unsuccessful outcomes due to faulty equipment, parts, code, construction, process, or design, and then re-engineer effective solutions.

- CO 5: Work effectively in teams, monitor progress; meet deadlines; and integrate individual contributions into a final deliverable.
- CO 6: Demonstrate appropriate levels of independent thought, creativity, and capability in real-world problem solving and demonstrate competence in selection, of appropriate engineering tools and resources.

INSTRUMENTATION AND CONTROL SYSTEMS

Course Code: EL20002

Credit: 3

Credits: 3-0-0

Prerequisites: Nil

COURSE OBJECTIVE

To introduce the fundamental concepts of instrumentation and control systems that provides an opportunity to learn system modeling, stability analysis, controller design including basics of modern control techniques and practice measurements of various electrical and non-electrical physical parameters using different instruments, sensors and transducers.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Define the static characteristics of instrumentation and control systems and their mathematical and graphical representation
- CO 2: Explain the dynamic characteristics of systems in time and frequency domain
- CO 3: Analyze system stability and design of control systems for achieving predefined specifications
- CO 4: Develop, analyze and implement LTI systems using modern control techniques
- CO 5: Recommend suitable instruments for measurement of various electrical parameters
- CO 6: Interpret working and applications of various sensors and transducers for non-electrical parameters.

COURSE DETAILS

Fundamentals of Instrumentation and Control Systems

Static characteristics: Resolution, Accuracy & Precision, Repeatability & Sensitivity, Measurement standards and Instrument calibration, Measurement errors and Statistical analysis, Mathematical modeling and representation of LTI systems: Differential equations, Transfer function, Block diagram, Signal flow graph.

Dynamic Characteristics of Systems

Transient response of first and second order systems, Time domain specifications, Steady state error, Error constant, Frequency response of control systems, Frequency domain specifications

Analysis and Design of Control Systems

Stability analysis of control systems using s-plane and Routh-Hurwitz criterion, Properties and construction of root locus, Lag, Lead and Lag-Lead Compensation, P, PI and PID controller tuning & design

Fundamentals of Modern Control Systems

Introduction to state variables, State space model of control systems, Solution of state space equations of LTI systems

Electrical & Electronic Measurements:

Potentiometer, DC bridges, AC bridges, Ammeters & Voltmeters, Energy and Power measurements, Digital voltmeters, Oscilloscopes

Sensors & Transducers:

Primary sensing elements and transducers: classification and characteristics, Strain gauge, RTD, Thermistors, Thermocouples, LVDT

Textbooks

1. A. K. Sawhney, A Course in Electrical and Electronic Measurements and Instrumentation, 19th Revised Edition, Dhanpat Rai & Co. Pvt. Ltd., 2011 (Reprint 2015)
2. M. Gopal, Control Systems: Principles and Design, 4th Edition. McGraw Hill Education (India) Pvt. Ltd., 2012

Reference books

1. William Bolton, Instrumentation and Control Systems, 3rd Edition, Newnes, Elsevier, 2021
2. Curtis D. Johnson, Process Control Instrumentation Technology, 8th Edition. Pearson Education, 2015
3. David A. Bell, Electronic Instrumentation and Measurements, 3rd Edition, Oxford University Press India, 2013
4. Benjamin C. Kuo, Farid Golnaraghi, Automatic Control Systems, 9th Edition, Wiley, 2014

INSTRUMENTATION AND CONTROL SYSTEMS LAB

Course Code: EL29002

Credits: 1

L-T-P: 0-0-2

Prerequisites: Nil

COURSE OBJECTIVE

To provide practical experiences on modeling, analysis and design of control systems using simulations and hardware trainer platforms, including hands-on practices in operating and handling of various instruments used for the measurement of various physical parameters.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Build simulation models of control systems using simulators.

CO 2: Analyze control systems using time domain specifications.

CO 3: Analyze control systems using frequency domain specifications.

CO 4: Examine the system performance and correlate significance of the PID controller parameters.

CO 5: Interpret working and applications of bridge circuits, potentiometer, wattmeter.

CO 6: Recommend suitable sensors and transducers for measurement of pressure/force, displacement, and temperature.

INDUSTRIAL AUTOMATION

COURSE CODE: EL30001

Credit: 3

L-T-P : 3-0-0

Prerequisites: Nil

COURSE OBJECTIVE

Understand automation technologies and identify advantages, limitations and applications of the same. Selection of proper sensor and its working. Design of controller using different controlling methods. Develop ability to recognize, articulate and solve industrial problems using automation technologies.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Understand the need of automation in real world and Industry 4.0 challenges

CO 2: Analyze the need of transducer and working of different transducers and actuators

CO 3: Determine the effects of different controllers and design of controllers using analog and digital platform

CO 4: Analyze the different advanced control schemes applied to different industrial processes.

CO 5: Analyze the Architecture of PLC, and design different process control applications through ladder logic.

CO 6: Understand DCS, SCADA hardware and software and its merits/demerits in industrial automation.

COURSE DETAILS

Introduction to Industry 4.0

History of industrial revolutions, Concept of IR4.0, Typical architecture of IR4.0, Design principles and major role players in IR4.0, Advantages and Challenges.

Sensors, Actuators and Signal conditioning

Displacement sensors, Force sensors, Ultrasonic sensors, Temperature sensors, Pressure sensors, Dc motors, Servo motors, Stepper motors, Piezo electric actuators, Pneumatic actuators etc. Estimation of errors and calibration, Filtering, Amplification, Isolation, ADC, DAC, Sensor protection circuits, Signal transmission and noise suppression,

Controller tuning

Need of controller, Effects P, I, D, PI, PD and PID controller, Design of controller parameters using Ziegler-Nichols tuning method, Cohen coon tuning method, Implementation of Analog and Digital PID controller.

Advanced control techniques

Feed forward control, Ratio control, Cascade control, Adaptive control, Duplex or split range control, Override control, Model predictive Control.

Programmable Logic Controller (PLC)

An overview of PLC, Introduction, definitions and history of PLC, Architecture of PLC system, input and output modules, Ladder logic, PLC Programming, Application Examples.

Introduction to Distributed Control System, SCADA

DCS architecture, Functional requirements of Distributed control systems, Communication Protocol, Introduction to SCADA, SCADA system components, architecture and communication, Application examples

Textbooks

1. Krishna Kant, Computer-Based Industrial Control, 2nd edition Prentice Hall of India Ltd.
2. John R. Hackworth, Fredrick D. Hackworth Jr., Programmable Logic Controllers: Programming Methods and Applications, Pearson.

Reference books

1. Surekha Bhanot, Process Control Principles & Applications, OXFORD, 1st Edition
2. Ogata, Modern Control Engineering, 4th edition, Prentice Hall of India
3. William C. Dunn, Fundamentals of Industrial Instrumentation and Process Control, McGrawHill, 2009

MINOR PROJECT

Course Code: EL37002

Credit: 2

L-T-P: 0-0-4

Prerequisite: Nil

COURSE OBJECTIVE

Students are required to undertake a mini project either as an individual or in a group in consultation with the project supervisor which may be completed in one semester. The project work is aligned with the discipline of the student and its allied areas. It is preferably related to certain research objective or advanced technical domain. Students will demonstrate higher level learning outcomes and cognitive skills in the implementation of the project.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Perform a background study on certain technical aspect and formulate a project objective
- CO 2: Outline a pathway for the implementation of the project within the time line
- CO 3: Apply fundamental engineering concepts, advanced technical know-how, use modern engineering tools, perform experiments and critically analyze the data
- CO 4: Provide engineering solutions, design system components or processes with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
- CO 5: Function effectively as an individual, and as a member or leader in a team under multidisciplinary settings following ethical practices
- CO 6: Communicate effectively with a range of audiences and prepare technical reports

PROCESS CONTROL AND ROBOTICS

Course Code: EL40001

Credits: 3

L-T-P: 3-0-0

Prerequisites : Nil

COURSE OBJECTIVE

To introduce the fundamental concepts of robotic system and its control that provides opportunity to learn mathematical modeling of kinematics and dynamics of robots and practice controller design for different robotic applications.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Learn and describe brief history, basic elements, different types and applications of robots
- CO 2: Understand and explain the kinematics and dynamics associated mathematics of robots
- CO 3: Employ and demonstrate basic techniques for computed torque control of robots
- CO 4: Analyze stability of control systems employed for robotic applications
- CO 5: Apply advanced and intelligent control techniques to formulate suitable control systems for robotics
- CO 6: Evaluate and interpret the performance robotics and and associated control systems

COURSE DETAIL

Fundamentals Concepts in Robotics

Basic Elements and Anatomy of Robots, Classification of Commercial Robots, History of Robotics, Design and Control Issues, Applications of Robotics

Kinematics of Robotic System

Basic manipulator Geometries, Robot Kinematics, Homogeneous Transformation, Forward Kinematics, Inverse Kinematics, Manipulator Jacobians

Dynamics of Robotic System

Lagrange-Euler Dynamics, Structure and Properties of the Robot Equation, State-Variable Representations and Feedback Linearization, Cartesian and Other Dynamics, Actuator Dynamics

Basic Control of Robotic System

Basic Control Theory: Linear and Nonlinear State-Variable Systems, Nonlinear Systems and Equilibrium Points, Stability Theory and Lyapunov Theorems, Linear Controller Design

Computed Torque Control, Digital Robot control, Optimal Outer-Loop Design, Cartesian Control

Advanced Control Techniques for Robots

Robust Control: Feedback - Linearization Controllers, Nonlinear Controller, Dynamics Redesigns

Adaptive Control: Adaptive Control by a Computed-Torque Approach, Adaptive Control by an Inertia-Related Approach, Composite Adaptive Controller

Intelligent Control for Robots

Fundamentals of Fuzzy Logic and Neural Networks, Fuzzy Logic Control, Tracking Control Using Static Neural Networks, Tuning Algorithms for Linear-in-the-Parameters NN, Tuning Algorithms for Nonlinear-in-the-Parameters NN

Textbooks

1. Lewis, Frank L., Darren M. Dawson, and Chaouki T. Abdallah, Robot Manipulator Control: Theory and Practice by 2nd Ed., CRC Press, 2003.
2. K. R. Guruprasad, Robotics: Mechanics and Control, PHI Learning Pvt. Ltd. 2019.

Reference books

1. John Craig, Introduction to Robotics: Mechanics and Control, 4th Ed. Pearson, 2017
2. R. K. Mittal and I. J. Nagrath, Robotics and Control, 1st Ed. McGraw Hill Education, 2003

ADVANCED CONTROL SYSTEM

Course Code: EL40003

Credits: 3

L-T-P: 3-0-0

Pre-requisites: Nil

COURSE OBJECTIVE

This course introduces students to developed and advanced techniques for solving complex control problems. The course presents theory and methodology for analysis and modelling of systems and signals, and methods for design and synthesis of feedback controllers. The emphasis of this course will be on robust control and optimal control of dynamical systems.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO1: Comprehend state variable representation of continuous and discrete time LTI systems.
- CO2: Analyze state models for linear continuous time and discrete time systems.
- CO3: Apply vector and matrix algebra to find the solution of state equations
- CO4: Evaluate controllability and observability conditions of a given system.
- CO5: Design control systems using state feedback and pole placement techniques.
- CO6: Develop Lyapunov function for the stability analysis of nonlinear systems.

COURSE DETAIL

State Variable Analysis and Design

Introduction, Concept of State, State Variables and State Model, State Models for Linear Continuous – Time Systems,

State Variable Analysis and Design

Diagonalization, Solution of State Equations, Concepts of Controllability and Observability.

Pole Placement Design and State Observers

Introduction, Stability Improvements by State Feedback, Necessary and Sufficient Conditions for Arbitrary Pole Placement, State Regulator Design, Design of State Observer.

Non-linear systems Analysis

Introduction, Common Nonlinear System Behaviours, Common Nonlinearities in Control Systems, Fundamentals, Describing Functions of Common Nonlinearities, , Concept of Phase Plane Analysis, Construction of Phase Portraits, System Analysis on the Phase Plane.

Non-linear systems Analysis

Simple Variable Structure Systems, Lyapunov Stability Definitions, Lyapunov Stability Theorems, Lyapunov Functions for Nonlinear Systems.

Textbooks

1. I.J. Nagarath and M.Gopal, Control Systems Engineering, New Age 5th Edition, 2007
2. M.Gopal, Digital Control and State Variable Methods: Conventional and Intelligent Control Systems, McGraw Hill 3rd Edition, 2008

Reference books

1. K. Ogata, Discrete Time Control System, 2nd Edition Pearson Education
2. Hasan Khalil, Non linear systems, 3rd Edition PHI

DSP WITH FPGA

Course Code: EL40004

Credit: 3

L-T-P: 3-0-0

Pre-requisites: Nil

COURSE OBJECTIVE

This course will give students an understanding scope of implementing digital signal processing (DSP) algorithms with Field Programmable Gate Arrays (FPGAs). This course covers: FPGA architecture and design tools, implementation of FIR and IIR filters, DFT and FFT algorithms.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Comprehend and explain DSP and VHDL Modelling
- CO 2: Explore requirement of fixed and floating-point techniques for FPGA implementations.
- CO 3: Create different VLSI Subsystems like adder, multipliers for DSP.
- CO 4: Analyse and implement FIR digital filters with FPGA.
- CO 5: Analyse and implement IIR digital filters with FPGA
- CO 6: Implement Fast Fourier Transform algorithms with FPGA.

COURSE DETAIL

Introduction

Overview of Digital Signal Processing, FPGA Technology, Design Implementation, VHDL Coding style, Verilog HDL Modelling style, Dataflow modelling, Behavioral modelling, Task & function

Computer Arithmetic

Introduction, Number Representation- Fixed-Point Numbers, Floating-Point Numbers, Binary Adders - Pipelined Adders, Modulo Adders, Binary Multipliers, Binary Dividers, Floating-Point Arithmetic Implementation, Multiply-Accumulator (MAC) and Sum of Product (SOP), Distributed Arithmetic Fundamentals- Signed DA Systems, Modified DA Solutions, Computation of Special Functions Using CORDIC

FPGA Architecture for Digital Filters

Digital Filters, FIR Theory, Transposed FIR Filter Structure, Symmetry in FIR Filters, Linear-phase FIR Filters, Designing FIR Filters, Constant Coefficient FIR Design, IIR Theory, IIR Coefficient Computation , IIR Filter Implementation, Fast IIR

FPGA Architecture for Fourier Transform

The Discrete Fourier Transform Algorithms, The Fast Fourier Transform (FFT) Algorithms , Fourier-Related Transforms -Computing the DCT Using the DFT, Fast Direct DCT Implementation

Textbook

1. Uwe Meyer-Baese, Digital Signal Processing with Field Programmable Gate Arrays, Springer, 2014

Reference book

1. Roger Woods, John McAllister, Gaye Lightbody, Ying Yi, FPGA-based Implementation of Signal Processing Systems, Wiley, 2017

PROJECT - I

Course Code: EL47001

Credit: 5

L-T-P: 0-0-10

Prerequisite: Nil

COURSE OBJECTIVE

Students are required to undertake a final year major project either as an individual or in a group in consultation with the project guide which may be completed in one year. The project should be related to certain advanced technical domain. The work encompasses two semesters and to be carried out in two phases. In Project-I, students are expected to complete detailed literature review, identify their objective and start working on the same; perform experiments, carry out analyses and report their findings to their supervisors and the panel.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Conduct a detailed research survey or background study and summarize the theory and findings
- CO 2: Formulate a research question or a general objective of the project
- CO 3: Propose and outline the solution to the research question or a pathway for the implementation of the project with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
- CO 4: Conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
- CO 5: Function effectively as an individual, and as a member or leader in a team under multidisciplinary settings following ethical practices
- CO 6: Communicate effectively with a range of audiences and prepare technical reports

PROJECT - II

Course Code: **EL47002**
Credit: **9**
L-T-P: **0-0-18**
Prerequisite: **Nil**

COURSE OBJECTIVE

Project-II is a continuation of Project-I, the second phase of final year major project. Students should complete all related experiments, develop a final solution, product or system and validate the applicability of the same under real time scenario with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors. They produce a detailed technical report on their work as well as individual contribution reports. Throughout the implementation of the major final year project, students should demonstrate all cognitive skills and attainment of all program outcomes and student outcomes.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Readily apply fundamental concepts in their area of study for executing the projects
- CO 2: Demonstrate skill in using modern technical tools, apply advanced technical knowledge integrate information from different sources, perform complex experiments and critically analyze the findings to draw conclusions
- CO 3: Provide engineering solutions to predefined research question or project objective, design system components or processes with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
- CO 4: Function effectively as an individual, and as a member or leader in a team under multidisciplinary settings following ethical practices
- CO 5: Communicate effectively with a range of audiences and prepare detailed technical reports
- CO 6: Demonstrate knowledge and understanding of the management principles in executing their project as a member or leader of the team, and willingness to engage in life-long learning

PRACTICAL TRAINING / INTERNSHIP

Course Code: **EL48001**
Credit: **2**
L-T-P : **2-0-0**
Prerequisite: **Nil**

COURSE OBJECTIVE

In this course, the students will get opportunity to explore career augmentation aspects prior to graduation, integrate theory and practice, assess interests and abilities in their field of study, learn to appreciate work and its function in the economy, develop work habits and attitudes necessary for job success, develop communication, interpersonal and other critical skills in the job interview process and build a record of work experience.

COURSE OUTCOMES

After successfully completing the course, the students will be able to:

- CO 1: Apply engineering knowledge in solving real-life problems
- CO 2: Acquire new skills in the engineering disciplines of their own interest
- CO 3: Get exposure to real-life-working environment practices, and to attain the professionalisms
- CO 4: Work with multi-tasking professionals and multidisciplinary team
- CO 5: Prepare a technical report, to improve presentation and other soft skills
- CO 6: Learn to appreciate work and its function in the economy

MACHINE LEARNING BASED SIGNAL PROCESSING

Course Code: EM30007

Credits: 3

L-T-P: 3-0-0

Prerequisite: Nil

COURSE OBJECTIVE

Traditionally, signal characterization is performed with mathematically driven transforms and statistical tools. On the other hand, machine learning aims to design algorithms that learn from data. This course discusses the use of machine learning techniques to process and understand signals. This course focuses on, firstly to acquaint students with the representation and characterization of speech, images, and other important signals. Thereafter, designing of ML models for classifying and retrieving information from signals is engrossed. Content delivery will be conceptual oriented and not cover mathematical or optimization methods in detail.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Conceptualize the difference between deterministic and stochastic processes
- CO 2: Appreciate various spectral analysis methods
- CO 3: Comprehend the methods and underlying challenges in extracting hidden information from various signals
- CO 4: Explain clustering methods, fuzzy set, rough set and neural network topology.
- CO 5: Explain Neural Network topology and learning algorithms.
- CO 6: Apply ML methods for speech, seismic, image analysis and other similar applications.

COURSE DETAILS

Introduction to Various Signals

Audio and Speech Signal, Image Acquisition and Storage, Radar, Sonar & Seismic signals, Signal decomposition using Fourier & Wavelet transforms,

Estimation and Detection

Introduction, Bayesian Hypothesis Testing, Maximum Likelihood Hypothesis, Maximum likelihood estimator, Least Square Estimator, Parametric estimation, Wiener Filter, Kalman Filter, Non-parametric estimation, Filter Bank Methods.

Spectral Analysis Stochastic Processes

Adaptive Spectral Analysis, Multivariate Signal Processing, Independent Component Analysis, Principal Component Analysis, Markov Process, Gaussian Mixture Model, Linear Prediction Analysis.

Machine Learning

Unsupervised Learning: Clustering Principles, K-Means, Expectation Maximization, GMM Clustering
Basics of Fuzzy Logic and Rough Sets, Fuzzy Clustering, Fuzzy Probabilities

Supervised Neural Network and Ensemble Methods: Perceptron, Multi Layer Perceptron, Stochastic Gradient Descent and Backpropagation algorithm, Deep learning, Linear sequential model using Keras, Transfer learning,

Applications

Selected applications of Machine Learning techniques for speech, image and manifold learning of radar and seismic signals.

Textbooks

1. Francesco Camastra, Alessandro Vinciarelli, Machine Learning for Audio, Image and Video Analysis Theory and Applications, 2nd Edition, 2015, Springer
2. Deepika Ghai, Suman Lata Tripathi, Sobhit Saxena, Manash Chanda, Mamoun Alazab, Machine Learning Algorithms for Signal and Image Processing, 2022, Wiley Online, ISBN:9781119861829.

Reference books

1. Max A. Little, Machine Learning for Signal Processing: Data Science, Algorithms, and Computational Statistics, Oxford University Press
2. Valliappa Lakshmanan, Martin Görner, Ryan Gillard, Practical Machine Learning for Computer Vision, Released July 2021, Publisher(s): O'Reilly Media, Inc., ISBN: 9781098102364

DEEP LEARNING: ALGORITHMS AND IMPLEMENTATION

Course Code: EM30008

Credit: 3

L-T-P: 3-0-0

Prerequisites: Nil

COURSE OBJECTIVE

In this course, students will learn the fundamental principles, underlying mathematics, and implementation details of deep learning. This includes the concepts and methods used to optimize these highly parameterized models (gradient descent and backpropagation, and more generally computation graphs), the modules that make them up (linear, convolution, and pooling layers, activation functions, etc.), and common neural network architectures (CNN, RNN, etc.). Applications ranging from computer vision to natural language processing and generative models will be demonstrated. Through in-depth programming assignments, students will learn how to implement these fundamental building blocks as well as how to put them together using popular deep learning libraries, Keras & PyTorch.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Describe the functional roles of DNN sequential blocks.
- CO 2: Demonstrate skills in selecting deep learning architecture for computer vision tasks.
- CO3: Develop critical thinking skills to evaluate and analyze generative models for computer vision applications
- CO 4: Appraise and apply transfer learning and the concepts of fine-tuning
- CO 5: Implement deep learning techniques on sequential data
- CO 6: Design deep learning techniques to perform efficient analysis for real-world applications

COURSE DETAILS

Foundations of Deep Learning

Overview of ANN, Feed forward, MLP, Gradient descent, back propagation algorithm, evolution of DL, Regularization

Convolution Neural Networks

CNN Architectures: Convolution, Pooling Layers, Transfer Learning, GAN, Popular CNN Model Architectures (Imagenet, LeNet architecture, AlexNet, VGGNet, GoogLeNet, ResNet architecture

Recurrent Neural Network

RNN architecture, LSTM, GRU, Encoder Decoder architecture

Applications of Deep Learning

Applications of Deep Learning to Computer Vision: Image segmentation, Object detection, Image Captioning, Medical imaging, Image Classification using Transfer Learning, Applications of Deep Learning to NLP.

Advance Models

Auto-encoders, Generative Adversarial Network

Implementation

Tensor Flow, PyTorch, Comparing TensorFlow & PyTorch, Configuring and Running Jupyter notebooks on an AWS EC2 GPU Instance.

Textbooks

1. Ian J. Goodfellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2017.
2. Charu C. Aggarwal. Neural Networks and Deep Learning: A Textbook. Springer. 2019.

Reference books

1. Phil Kim, Matlab Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence, Apress, 2017.
2. Ragav Venkatesan, Baoxin Li, Convolutional Neural Networks in Visual Computing, CRC Press, 2018.
3. Navin Kumar Manaswi, Deep Learning with Applications Using Python, Apress, 2018.
4. Francois Chollet, Deep Learning with Python, Manning Publications, 2018

DATA ANALYTICS

Course Code: EM30009

Credit: 3

L-T-P: 3-0-0

Prerequisites: Nil

COURSE OBJECTIVE

Objective of this course is to familiarize students with the concepts of data science, gain knowledge on Big data technologies and tools, become familiar with statistical concepts and apply data analytics techniques.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Make use of data science concepts to handle big data.
- CO 2: Examine the statistical concepts for finding relationships among variables and estimate data samplings.
- CO 3: Select the data analytics techniques&models for both data prediction and performance analysis.
- CO 4: Develop rules using frequent item sets and association mining.
- CO 5: Solve real-time problems using classification and clustering techniques.
- CO 6: Apply the mining techniques for data streams.

COURSE DETAILS

Introduction to Data Science

Introduction to data, Data science, Challenges of traditional systems, Evolution of analytic scalability, Types of computing (Distributed, Parallel, Grid), Data analytics life-cycle, Introduction to Big Data (Characteristics) and Hadoop (Hadoop Ecosystem, MapReduce, Hbase, Pig, Hive, Sqoop, NOSQL), Visualizations

Statistical Concepts

Data exploration: Distribution of a single variable, Basic concepts (populations and samples, Data sets, variables, and observations, types of data), Descriptive measures for categorical variables, Descriptive measures for numerical variables, Outliers and missing values. Finding relationships among variables: Categorical variables, Numerical variables, Sampling and distributions: Terminology, Estimation, Confidence interval

estimation, Sampling distributions, Confidence interval, Hypothesis testing, Chi-square test for independence

Data Analytic

Introduction, Types of data analytic, Importance of data analytics, Data analytics applications, Regression modelling techniques: Linear regression, Multi-variable regression, Non linear regression, Logistic regression, Time series analysis, Performance analysis (RMSE, MAPE).

Frequent Item-sets and Association

Introduction to frequent itemsets, Market-basket model, Algorithm for finding frequent, Itemsets, Association rule mining, Apriori algorithm and correlations.

Classification & Clustering

Introduction to classification and clustering, Distance-based algorithms: K-Nearest Neighbour (KNN), Decision Tree-based algorithms: Decision Tree (ID3 Algorithm), Linear Support Vector Machines, Naves Bayes. Overview of clustering techniques, Hierarchical clustering, Partitioning methods, K- means algorithm.

Data Streams

Introduction to mining data streams, Data stream management systems, Data stream mining, Examples of data stream applications, Stream queries, Issues in data stream query, Processing, Sampling in data streams, Filtering streams, Counting distinct elements in a stream, Estimating moments.

Textbook

1. Radha Shankarmani, M.Vijayalaxmi, Data Analytics, Wiley India Private Limited, ISBN: 9788126560639.

Reference books

1. S. Christian Albright and Wayne L. Winston, Business Analytics: Data Analysis & Decision Making . 6th Edition, Cengage Learning. (ISBN: 9781305947542)
2. Jiawei Han, Micheline Kamber, and Jian Pei, Data Mining: Concepts and Techniques 3rd Edition. Morgan Kaufmann. (ISBN: 9780123814791)
3. Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data by EMC Education Services (Editor), Wiley, 2014
4. DT Editorial Services, Big Data, Black Book, Dreamtech Press, 2015

DATA MINING

Course Code: EM30011

Credit: 3

L-T-P: 3-0-0

Prerequisites: NIL

COURSE OBJECTIVE

This course is an introductory course on data mining. It introduces the basic concepts, principles, methods, implementation techniques, and applications of data mining, with a focus on two major data mining functions: (1) pattern discovery and (2) cluster analysis.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Articulate the role of data mining in decision-making
- CO 2: Perform data processing and analysis.
- CO 3: Recall important pattern discovery concepts, methods, and applications, such as frequent pattern, and association rules
- CO 4: Recall basic concepts, methods, and applications of cluster analysis.
- CO 5: Evaluate the output of data mining for decisions and practical application
- CO 6: Demonstrate the benefits of data mining from business perspective.

COURSE DETAILS

Introduction

What is data mining? Why data mining? Data mining process, Introduction to data mining tasks (Classification, Clustering, Association Analysis, Anomaly Detection).

Data Pre-processing

Understanding of data, Types of attributes, Properties of attribute values, Types of data, Data quality, Sampling, Data normalization, Data cleaning, Similarity measures, Feature selection/Instance selection, Importance of feature selection/ instance selection in various big data scenarios

Classification

Decision-Tree based approach (e.g. C4.5), Rule-based approach (e.g. Ripper), Instance-based classifiers (e.g. k-Nearest Neighbor). Support Vector Machines (SVMs), Ensemble learning, Classification model Selection and evaluation, Applications: B2B customer buying stage prediction, Recommender systems

Clustering

Partition and hierarchical clustering methods, Graph-based method, Density-based methods, Cluster validation applications: Customer profiling, Market segmentation.

Association Analysis

Apriori algorithm and its extensions, Association pattern evaluation, Sequential patterns and frequent sub-graph mining, Applications: B2B customer buying path analysis, Medical informatics, Telecommunication alarm diagnosis.

Anomaly Detection

Statistical-based and density-based methods, Ethics of data mining, Privacy in data mining

Case Studies

Big data analytics in mobile environments, Fraud detection and prevention with data mining techniques, Big data analytics in business environments

Textbook

1. Han, J., Kamber, M., & Pei, J., Data mining: Concepts and techniques, 3rd ed., Waltham: Morgan Kaufmann

Reference books

1. Foster Provost and Tom Fawcett, O'REILLY, Data Science for Business, ISBN: 978-1-449-36132-7, 2013
2. Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Introduction to Data Mining, Addison Wesley, ISBN: 0-321-32136-7

MINOR PROJECT

Course Code: EM37002

Credit: 2

L-T-P: 0-0-4

Prerequisite: Nil

COURSE OBJECTIVE

Students are required to undertake a mini project either as an individual or in a group in consultation with the project supervisor which may be completed in one semester. The project work is aligned with the discipline of the student and its allied areas. It is preferably related to certain research objective or advanced technical domain. Students will demonstrate higher level learning outcomes and cognitive skills in the implementation of the project.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: perform a background study on certain technical aspect and formulate a project objective
- CO 2: outline a pathway for the implementation of the project within the time line
- CO 3: apply fundamental engineering concepts, advanced technical know-how, use modern engineering tools, perform experiments and critically analyze the data
- CO 4: provide engineering solutions, design system components or processes with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
- CO 5: function effectively as an individual, and as a member or leader in a team under multidisciplinary settings following ethical practices
- CO 6: communicate effectively with a range of audiences and prepare technical reports

ML FOR LANGUAGE PROCESSING

Course Code: EM40001

Credit : 3

L-T-P: 3-0-0

Prerequisites : EM30007

COURSE OBJECTIVE

- To understand the steps involved in Natural language processing
- To learn about the lexical, syntactic and semantic analysis of natural language processing
- To explore the various parsing techniques for natural languages
- To understand the statistical models for Natural language processing
- To learn about the various applications involved in Natural language processing

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Evaluate different computing architectures for natural language processing for various parameters
- CO 2: Justify the various steps necessary for processing natural language
- CO 3: Suggest appropriate lexical and parsing techniques for a given natural language
- CO 4: Apply appropriate statistical models for a given natural language application
- CO 5: Modify existing algorithms to suit any natural language for processing
- CO 6: Suggest appropriate pre-processing steps essential for the various applications involving natural language processing

COURSE DETAIL

Lexical Analysis

Lexical Analysis, Regular expression and Automata for string matching, Words and Word Forms, Morphology fundamentals, Morphological Diversity of Indian Languages, Morphology Paradigms, Finite State Machine, Transducers Based Morphology, Automatic Morphology Learning, Parts of Speech, N-gram Models, Hidden Markov Models.

Speech Processing

Biology of Speech Processing, Place and Manner of Articulation, Word Boundary Detection, Argmax based computations, HMM and Speech Recognition, Text to Speech Synthesis, Rule based, Concatenative based approach.

Parsing

Theories of Parsing, Parsing Algorithms, Earley Parser, CYK Parser, Probabilistic Parsing, CYK, Resolving attachment and structural ambiguity, Shallow Parsing, Dependency Parsing, Named Entity Recognition, Maximum Entropy Models, Conditional Random Fields.

Lexical Knowledge Networks

Meaning: Lexical Knowledge Networks, Wordnet Theory, Indian Language Wordnets and Multilingual Dictionaries, Semantic Roles, Word Sense Disambiguation, WSD and Multilinguality, Metaphors, Coreference and Anaphora Resolution.

Applications

Applications: Sentiment Analysis, Text Entailment, Machine Translation, Question Answering System, Information Retrieval, Information Extraction Cross Lingual Information Retrieval (CLIR).

Textbook

1. Christopher Manning, Schutze Heinrich, Foundations of Statistical Natural Language Processing, MITPress, 1999.

Reference book

1. Allen James, Natural Language Understanding, Second Edition, Benjamin Cumming, 1995.

CYBERSECURITY

Course Code: EM40006

Credit: 3

L-T-P: 3-0-0

Prerequisites: Nil

COURSE OBJECTIVE

This course aims to provide a comprehensive introduction and effective defence to distinct challenges like; securing the infrastructure, securing devices, and securing local networks.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Understand what cybercrime is and appreciate the importance of legal perspective on cybercrime and organizational implications
- CO 2: Explain types of cyberattacks, role of cybercafes and what is cyberstalking
- CO 3: Understand the security challenges in mobile devices, removable medias, and organizational measures needed to protect information systems.
- CO 4: Describe tools and methods used in cybercrime
- CO 5: Learn about phishing-pharming-pharming and different types of ID thefts
- CO 6: Understand global and Indian IT Act in cybercrime perspective

COURSE DETAILS

Introduction of Cybersecurity

Cybercrime, Classifications, Legal perspectives, Ethics of Hacking and Cracking

Cyber offenses

Active and Passive Attacks, Cyberstalking, Botnets, Benefits of Cloud Computing

Vulnerability

Authentication Security and Attacks on Mobile Devices, Email Attacks and Browser based vulnerabilities, Server Vulnerability, TCP/IP Vulnerability, Incident handling, Organizational Security Policy

Tools and Methods Used in Cybercrime

Proxy Servers, Phishing, Spoofing, Encryption & Password Cracking, Session Hijacking, Hacking Network Devices, Trojan Horses, Malware in Action

Prevention and Mitigation

Buffer overflow detection and Prevention, Organizational Security Policies, Digital Forensic tools, , Incident Handling

Social, Political, Ethical and Physiological Dimensions

Intellectual property in Cyberspace, Ethical Dimensions, Legal Perspective, Information Technology Act

Textbook

1. Nina Godbole, Sunit Belapure, Kamlesh Bajaj, Cyber Security: Understanding Cyber Crimes, Computer Forensics And Legal Perspectives Paperback – January 1, 2011, Wiley India
2. Alfred Basta, Cyber Security And Cyber Laws, Cengage Learning India Pvt Ltd

Reference books

1. Yuri Diogenes and Dr. Erdal Ozkaya, Cybersecurity – Attack and Defense Strategies: Counter modern threats and employ state-of-the-art tools and techniques to protect your organization against cybercriminals.
2. Ashish Mishra, Modern Cybersecurity Strategies for Enterprises: Protect and Secure Your Enterprise Networks, Digital Business Assets, and Endpoint Security with Tested and Proven Methods

BIOINFORMATICS

Course Code: EM40008

Credit: 3

L-T-P: 3-0-0

Prerequisite: Nil

COURSE OBJECTIVE

Bioinformatics is a rapidly evolving interdisciplinary field in which computational resources are necessary to investigate and interpret complex biological data. The students will gain the basic knowledge of sources of sequences and protein structure data, an understanding of the relevance and importance of this data, and some exposure to basic algorithms used for processing this data.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Understand fundamental concepts and application of Bioinformatics
- CO 2: Have an overview of the most important methods and tools that are used
- CO 3: Understand how some of the basic methods for biological sequence analysis works
- CO 4: Understand the need for methods to be accurate and efficient
- CO 5: Implement some of the algorithms
- CO 6: Using existing tools to perform simple sequence analyses

COURSE DETAILS

Introduction to Bioinformatics

Introduction to Bioinformatics; Biological databases: Nucleotide databases, Protein databases, Specialized databases; Laboratory data submission and data retrieval; Various file formats for biomolecular sequences: Genbank, EMBL, FASTA, GCG, msf, nbrf-pir etc.; Basic concepts of sequence similarity: identity and homology, definitions of homologues, orthologues, paralogues; Sequence patterns and profiles

Sequence Alignment and Database Searching

Introduction, Evolutionary Basis of Sequence Alignment, Optimal alignment method, Statistical Significance of Alignment. Database searching Artifacts; Database similarity searching: FASTA, BLAST, Various basic and advance version, Multiple sequence alignment: progressive method and Iterative method; Applications of pairwise and multiple sequence alignment; Tools for multiple sequence alignment: CLUSTALW and Pileup (Algorithmic concepts).

Introduction to Genes and Proteins

Genome Sequences, ORFs, Genes, Introns, Exons, Splice Variants, DNA/RNA Secondary Structure Triplet Coding, Protein Sequences, Protein Structure: Secondary, Tertiary, Quaternary, The notion of Homology. Scoring matrices: Basic concept of a scoring matrix, Similarity and distance matrix, Predictive Method using Nucleotide Sequence: Introduction, Marking repetitive DNA, Database search, Codon bias detection, detecting functional site in DNA.

Phylogenetics

Phylogeny and concepts in molecular evolution; nature of data used in taxonomy and phylogeny; definition and description of Phylogenetic trees and various types of trees; Different methods of Phylogenetic tree construction: UPGMA and Fitch-Margoliash Algorithm; case studies in phylogenetic sequence analysis.

Machine learning for Bioinformatics

Unsupervised learning, K-means clustering, Hierarchical clustering, Heatmap representations. Dimensionality reduction, Principal Component Analysis (PCA). Hands-on session with unsupervised learning analysis of cancer cells further highlighting practical considerations and best practices for the analysis and visualization of high dimensional datasets.

Textbooks

1. A. M. Lesk, Introduction to Bioinformatics, Oxford University Press, 2022

Reference books

1. T. K. Attwood & D. J. Parry-Smith, Introduction to Bioinformatics, Pearson Education Ltd, Low Price Edition, 2001.
2. D.W. Mount, Bioinformatics: Sequence and Genome Analysis, Cold Spring Harbor Laboratory Press, 2001.
3. D. Baxevanis and F. Ouellette, Bioinformatics : A practical guide to the analysis of genes and proteins, Wiley Indian Edition, 2002.
4. M.D.B. Bergeron, Bioinformatics Computing, Prentice Hall India (Economy Edition), 2003.

OPTIMIZATION METHODS IN MACHINE LEARNING

Course Code: EM40010

Credit: 3

L-T-P: 3-0-0

Prerequisite: Nil

COURSE OBJECTIVE

This course introduces students to the fundamental concepts, techniques, and algorithms in optimization for machine learning. Students will learn how optimization plays a crucial role in the design and analysis of machine learning models. The course will cover a broad range of optimization methods, with a focus on understanding their theoretical properties and practical implementation.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Understand the foundational concepts of optimization and their importance in the context of machine learning, including the role of loss functions, performance metrics, and optimization problems.

- CO 2: Analyze and implement a variety of optimization techniques, including gradient descent and its variants, adaptive learning rate methods, second-order optimization methods, and metaheuristic optimization algorithms.
- CO 3: Apply regularization techniques to prevent over fitting and improve the generalization performance of machine learning models.
- CO 4: Design and implement optimization algorithms for deep learning models, including proper initialization, back propagation, and fine-tuning strategies.
- CO 5: Employ model selection and hyperparameters optimization techniques to enhance the performance of machine learning models on real-world tasks.
- CO 6: Utilize distributed and parallel optimization algorithms to scale up optimization processes for large-scale machine learning applications.

COURSE DETAILS

Introduction to Optimization and Machine Learning/Deep Learning

Introduction to optimization, Machine learning basics, The role of optimization in machine learning, Loss functions and performance metrics, Deep learning basics, Back propagation algorithm, Initialization techniques, Transfer learning and fine-tuning

Convex and Non Convex Optimization Techniques

Convex sets and functions, Convex optimization problems, First-order and second-order optimality conditions, Introduction to gradient descent ,Batch gradient descent, Stochastic gradient descent (SGD), Mini-batch gradient descent, Momentum and Nesterov accelerated gradient (NAG) , Adagrad, RMSprop, Adam and its variants, Learning rate scheduling, Early stopping, Dropout, Cross-validation techniques, Grid search, Random search, Bayesian optimization

Second-Order Optimization Methods

Newton's method, Quasi-Newton methods (BFGS, L-BFGS), Conjugate gradient method,

Non -Convex Optimization Techniques

Local and global minima, Saddle points and plateaus, Strategies for escaping saddle points,

Constrained Optimization

L1 and L2 regularization, Elastic net regularization, Equality and inequality constraints, Lagrange multipliers, Karush-Kuhn-Tucker (KKT) conditions Sequential quadratic programming (SQP)

Metaheuristic Optimization Algorithms

Genetic algorithms, Simulated annealing, Particle swarm optimization, Ant colony optimization

Multi-objective Optimization

Pareto optimality, Scalarization methods, Evolutionary multi-objective optimization algorithms (NSGA-II, MOEA/D)

Distributed and Parallel Optimization

Data and model parallelism, Synchronous and asynchronous updates, Distributed optimization algorithms (ADMM, Federated Learning)

Textbooks

1. Goodfellow, I., Bengio, Y., & Courville, A. Deep Learning. MIT Press. (Link: <https://www.deeplearningbook.org/>)
2. Deb, Kalyanmoy. Optimization for engineering design: Algorithms and examples. PHI Learning Pvt. Ltd., 2012.

Reference books

1. Boyd, S., & Vandenberghe, L. Convex Optimization. Cambridge University Press. (Link: <https://web.stanford.edu/~boyd/cvxbook/>)
2. K. Deb.- Multi-Objective Optimization Using Evolutionary Algorithms— (Chichester, U.K.: Wiley, 2001

3. Ruder, S. , An Overview of Gradient Descent Optimization Algorithms. arXiv preprint arXiv:1609.04747. (Link: <https://arxiv.org/abs/1609.04747>)
4. Sra, S., Nowozin, S., & Wright, S. J. (Eds.). Optimization for Machine Learning. MIT Press.
5. Nocedal, J., & Wright, S., Numerical Optimization. Springer Science & Business Media.

PROJECT - I

Course Code: EM47001

Credit: 5

L-T-P: 0-0-10

Prerequisite: Nil

COURSE OBJECTIVE

Students are required to undertake a final year major project either as an individual or in a group in consultation with the project guide which may be completed in one year. The project should be related to certain advanced technical domain. The work encompasses two semesters and to be carried out in two phases. In Project-I, students are expected to complete detailed literature review, identify their objective and start working on the same; perform experiments, carry out analyses and report their findings to their supervisors and the panel.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Conduct a detailed research survey or background study and summarize the theory and findings
- CO 2: Formulate a research question or a general objective of the project
- CO 3: Propose and outline the solution to the research question or a pathway for the implementation of the project with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
- CO 4: Conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
- CO 5: Function effectively as an individual, and as a member or leader in a team under multidisciplinary settings following ethical practices
- CO 6: Communicate effectively with a range of audiences and prepare technical reports

PROJECT - II

Course Code: EM47002

Credit: 9

L-T-P: 0-0-18

Prerequisite: Nil

COURSE OBJECTIVE

Project-II is a continuation of Project-I, the second phase of final year major project. Students should complete all related experiments, develop a final solution, product or system and validate the applicability of the same under real time scenario with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors. They produce a detailed technical report on their work as well as individual contribution reports. Throughout the implementation of the major final year project, students should demonstrate all cognitive skills and attainment of all program outcomes and student outcomes.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Readily apply fundamental concepts in their area of study for executing the projects
- CO 2: Demonstrate skill in using modern technical tools, apply advanced technical knowledge integrate information from different sources, perform complex experiments and critically analyze the findings to draw conclusions

- CO 3: Provide engineering solutions to predefined research question or project objective, design system components or processes with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
- CO 4: Function effectively as an individual, and as a member or leader in a team under multidisciplinary settings following ethical practices
- CO 5: Communicate effectively with a range of audiences and prepare detailed technical reports
- CO 6: Demonstrate knowledge and understanding of the management principles in executing their project as a member or leader of the team, and willingness to engage in life-long learning

PRACTICAL TRAINING / INTERNSHIP

Course Code: **EM48001**

Credit: **2**

L-T-P: **2-0-0**

Prerequisite: **Nil**

COURSE OBJECTIVE

In this course, the students will get opportunity to explore career augmentation aspects prior to graduation, integrate theory and practice, assess interests and abilities in their field of study, learn to appreciate work and its function in the economy, develop work habits and attitudes necessary for job success, develop communication, interpersonal and other critical skills in the job interview process and build a record of work experience.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Apply engineering knowledge in solving real-life problems
- CO 2: Acquire new skills in the engineering disciplines of their own interest
- CO 3: Get exposure to real-life-working environment practices, and to attain the professionalisms
- CO 4: Work with multi-tasking professionals and multidisciplinary team
- CO 5: Prepare a technical report, to improve presentation and other soft skills
- CO 6: Learn to appreciate work and its function in the economy

NETWORK THEORY

Subject Code: **EE20001**

Credit: **3**

L-T-P: **3-0-0**

Prerequisites: **Nil**

COURSE OBJECTIVE

To familiarize the concepts of network theorems, explain the concept of coupling in electric circuits and analyze the transient response of circuits with dc and ac inputs. Understand the concept of two port network, network topology and able to design filters.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Analyze different electrical circuits using network theorems.
- CO 2: Understand the magnetic couple circuits.
- CO 3: Apply the transients in DC/AC circuits.
- CO 4: Evaluate different parameters and functions of one port and two port networks
- CO 5: Know the concept of network topology
- CO 6: Design different passive filters

COURSE DETAILS

Network Theorems (for DC and AC Circuit)

Superposition theorem, Thevenin's Theorem, Norton's Theorem, Maximum Power Transfer Theorem, Reciprocity Theorem.

Magnetic coupled circuits

Self and Mutual Inductance, Dot convention for coupled circuits and coefficient of coupling.

Transient Response

Duality of circuits, Transient response for R-L, R-C and R-L-C circuits with both DC and AC excitation in time domain and Laplace transformation method.

Two-Port Networks

Network Configurations, Open Circuit, Short circuit, transmission and hybrid parameters, Condition of symmetry and reciprocity in two port network, Interconnection of two port networks (Series, Parallel & Cascade).Inter-relationship between parameters of two port network.

Network Function

Concept of complex frequency, driving point and transfer functions of one port and two port network.

Network Topology

Concepts of Network graph, Tree, Co-Tree, Links and Twigs, Formation of incidence matrix [A] and loop matrix [B] Formation of Fundamental Cut-Set Matrix [QF], Tie-Set Matrix. Relation between branch voltage and current, loop current network topology analysis.

Filter Design

Passive filters, Design of low pass, high pass, band pass, and band elimination filter.

Textbooks

1. M. E. Van Valkenburg - Network Analysis by, Pearson Education, 3rd Edition, 2006.
2. Charles K. Alexander, Matthew N.O. Sadiku- Fundamentals of Electric Circuits, , McGraw Hill Education; 5th edition.

Reference books

1. A Sudhakar Shyam Mohan S Palli - Circuits and Networks Analysis and Synthesis (Second Edition), Tata McGraw-Hill, 2011.
2. Basic Circuit Analysis, John O'Malley, Schaum's Outlines, Tata McGraw-Hill, 2nd edn., 2010 (Reprint).
3. Ravish R Singh- Network Theory Analysis and Synthesis- S. Chand Publication 1st edition 2023.
4. William Hart Hayt Jack E Kemmerly Steven M Durbin- Engineering circuit analysis
5. D.Roy Choudhury - Networks and systems- New Age Publication, 2nd Edition, June 2013.

ELECTRICAL MACHINES

Course Code: EE20010

Credits: 3

L-T-P: 3-0 -0

Pre-requisites: Nil

COURSE OBJECTIVES

To understand construction, working principles, testing and control of different electrical machines and their industrial and domestic applications.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Know the Construction, principle, efficiency and control of DC machines.
- CO 2: Understand the principle, Phasor diagram, losses, efficiency and regulation of transformers.
- CO 3: Analyze the three phase transformers through vector grouping.
- CO 4: Comprehend the operation and characteristics of Synchronous machines.
- CO 5: Investigate the operation and characteristics of Induction Motor.
- CO 6: Study the construction, principle of operation and application of single phase induction motors.

COURSE DETAIL

DC Machine

Principle of Operation, emf equation of DC machine, Types and its characteristics. Concepts of back emf, armature and shaft torque, Speed control of DC shunt motor, efficiency, Necessity of starter, 3-point starter.

Transformer

Single phase transformer, Construction , Principle of operation, emf equation, equivalent circuit and phasor diagram, open circuit and short circuit test, regulation, losses and efficiency. Three phase transformer with different vector group.

Three-phase Synchronous Machine

Construction, Principle of operation, Pitch factor, distribution factor, winding Factor, winding diagram, EMF equation, armature reaction, equivalent circuit V-curves, method of starting and application, voltage regulation of three phase alternator (synchronous impedance and mmf method), power stage and efficiency.

Three-Phase Induction Motor

Construction, squirrel cage and slip ring type, principle of operation, equivalent circuit and phasor diagram, Torque slip characteristics, starting torque and maximum torque, losses and efficiency, method of starting, speed control and application.

Single-phase Induction Motor

Construction, Staring method and application

Textbooks

1. P. S Bimbhra, Electrical Machinery, 7th Edition, Khanna Publishers, 2008.
2. B. L. Theraja, Electrical Technology, Volume -II. S .Chand Publications. 2010.
3. Ashfaq Hussain, Electrical Machines, Dhanpat Rai, Delhi, 2nd Edition, 2008.

Reference books

1. C. I. Hubert, Electric Machines, Pearson Education, 2003.
2. Kothari. D P and I J Nagrath, Electric Machines, 3rd edn, Tata McGraw-Hill, New Delhi. 2004

ELECTRICAL SYSTEM MODELING USING MATLAB

Course Code: EE28002

Credit: 1

L-T-P: 0-0-2

Prerequisite(s):Nil

COURSE OBJECTIVE

This course is proposed as a Sessional to UG students with the aim of imparting basic understanding of Modeling and Simulation so that the students will find it easy to use this knowledge in profession for applying to various engineering systems and design.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Know the characteristic of half wave and full wave uncontrolled rectifier .
- CO 2: Understand the characteristic of half wave and full wave controlled rectifier .
- CO 3: Apply modeling techniques to Simulate the R-L and R-C circuit.
- CO 4: Analyse the methods of plotting of single phase and 3 phase sine wave.
- CO 5: Evaluate the simulated design of the PID controller.
- CO 6: Design a circuit to Plot I-V & P-V Characteristic of a PV cell.

INDUSTRIAL WIRING AND CONTROL PANEL DESIGN

Course Code: EE28011

Credit: 1

L-T-P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

This vocational course will provide an overview of electrical occupations, including the training and the employment options available in electrical industry. It is also designed to provide related training in the electrical trade that will give students the proper coursework in installation and designing of control panel.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Realise the purpose and general principles of control components and circuits, CO 2: Install Industrial wiring circuits according to given specification and plan,
- CO 3: Analyze circuit operations on basic motors (3ø induction Motor),
- CO 4: Interpret and install circuits according to rules and regulations of the National Electrical Codebook,
- CO 5: Connect motor controllers for specific applications with emphasis on safety practices and in accordance with National Electrical Code (NEC) requirements, and
- CO 6: Select and size contactors, relays and timing relays and overload relays both physically and schematically and describe their operating principles.

COURSE DETAILS

- Design multiwire circuit for a direct motor starter (DoL) with one operating (forward) direction using QElectrotech software.
- Design multiwire circuit for a direct motor starter (DoL) with two operating (forward & reverse) direction using QElectrotech software.
- Design multiwire circuit for a Star – Delta motor stator with one operating (forward) direction using QElectrotech software.
- Design multiwire circuit for a Star – Delta motor stator with two operating (forward & reverse) direction using QElectrotech software.
- Design & connect for a direct motor starter (DoL) with one operating (forward) direction in modular set up.
- Design & connect for a direct motor starter (DoL) with two operating (forward & reverse) direction in modular setup.
- Design & connect for a Star – Delta motor stator with one operating (forward) direction in modular set up.
- Design & connect for a Star – Delta motor stator with two operating (forward& reverse) direction in modular set up.
- Install & wire for a direct motor starter (DoL) with one operating (forward) direction in Industrial Control Panel.
- Install & wire for a direct motor starter (DoL) with two operating (forward & reverse) direction in Industrial Control Panel.
- Install & wire for a Star – Delta motor stator with one operating (forward) direction in Industrial Control

Panel.

- Install & wire for a Star – Delta motor stator with two operating (forward & reverse) direction in Industrial Control Panel.

Reference Books

1. Tarlok Singh, Installation, commissioning and maintenance of electrical equipment.
2. B.P. Patel and M.A. Chaudhari, Industrial Electrical Systems.

INSTALLATION, OPERATION AND MAINTENANCE OF SOLAR POWER SYSTEM

Course Code: EE28013

Credit: 1

L-T-P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

To impart job-oriented training to students and make them well convergent on Installation, operation & maintenance of solar PV system. This vocational course is based on study of solar photovoltaic (PV) cells, modules, and system components; electrical circuits; PV system design and sizing for use on homes, commercial building etc., understanding energy conversion from sunlight to electricity, and working with solar conversion equipment. This Course will give students the book knowledge and hands on experience needed to become entrepreneur / self-employed.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Demonstrate and apply the knowledge of solar electric systems terms and concepts,
- CO 2: Size and design a photo voltaic system,
- CO 3: Mount, ground, position, install, wire and connect a photo voltaic system,
- CO 4: Test voltage generated by photo voltaic system,
- CO 5: Learn different types of solar PV modules and batteries used in solar PV plant, and
- CO 6: Design of solar PV plant based on estimated loads.

COURSE DETAILS

- To demonstrate the I-V and P-V Characteristics of PV module with varying radiation and temperature level.
- To demonstrate the I-V and P-V characteristics of series and parallel combination of PV modules.
- To show the effect of variation in tilt angle on PV module power.
- To demonstrate the effect of shading on module output power.
- To demonstrate the working of diode as bypass diode and blocking diode.
- To draw the charging and discharging characteristics of battery.
- Observe the output waveform of the inverter in auto mode.
- Workout power flow calculations of standalone PV system of AC load with battery.
- Workout power flow calculations of standalone PV system of DC load with battery.
- Find the MPP manually by varying the resistive load across the PV panel.

Reference Books

1. Chetan Singh Solanki, Solar Photo Voltaic Technology and Systems.
2. B.H. Khan, Non-Conventional Energy Resources.
3. P. Sukhatme, Solar Energy - Principles of Thermal Collection and Storage.
4. G.N. Tiwari, Solar Energy: Fundamentals, Design, Modelling and Applications.

DOMESTIC WIRING AND HOME AUTOMATION

Course Code: EE28015

Credit: 1

L-T-P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

This vocational course will provide an overview of electrical occupations, including the training and the employment options available in electrical consultancy. It is also designed to provide related training in the electrical wing that will give students the proper coursework in installation and designing of domestic wiring and home automation. To develop electrical wiring skills in students through systematic training that would enable the students to construct and test various electrical circuits using appropriate electrician tools, wires, protective devices and wiring accessories as per IS standards.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Use appropriate electrician tools, wires, protective devices and wiring accessories,
- CO 2: Rig up wiring diagrams using conduit system of wiring,
- CO 3: Apply IS standards for electrical wiring,
- CO 4: Prepare different types of wiring joints,
- CO 5: Well convergent in drawing electrical wiring circuit, and
- CO 6: Enhancement of knowledge regarding specification and application of different electrical devices.

COURSE DETAILS

- Perform the assembly, wiring and implementation of a single switch (SPST Switch) in circuit.
- Perform the assembly, wiring and implementation of a Double switch (SPST Switch) in circuit.
- Perform the assembly, wiring and implementation of a power socket in circuit.
- Perform the assembly, wiring and implementation of a controlled power socket circuit in housing.
- Perform the assembly, wiring and implementation of a two ways switches (SPDT Switch) in circuit.
- Perform the assembly, wiring and implementation of a impulse relay in circuit.
- Perform the assembly, wiring and implementation of a time switch in circuit
- Perform the assembly, the wiring and the implementation of a timer lighting in circuit.
- Perform the assembly, the wiring and the implementation of a twilight switch in circuit in house or in a shop.
- Perform the assembly, wiring and implementation of a controlled lighting in circuit (time switch, timer, twilight switch).
- Perform the assembly, the wiring and the implementation of a water heater in circuit.
- Perform the assembly, wiring and implementation of a central impulse relay in circuit.
- Study and implementation of Light sensitive switch.
- Perform the assembly, wiring and implementation of a fan in circuit.
- Perform the assembly, wiring and implementation of a distribution panel.
- Home automation using KNX technology.
- Application of Load shedding contactor and programmable time switch.

Reference Books

1. Frederic Marsh, Home Automation - A Smart Home Guide: The Beginner's Manual Including Google Home, Echo Dot and Amazon Alexa. Easy Instructions, Directions and Commands ... and Home Automation Guide Series Book 1, Kindle Edition.
2. James Gerhart, Home Automation and Wiring.

CYBER PHYSICS APPLICATION IN INDUSTRIAL IOT

Course Code: EE28017

Credit: 1

L-T-P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

The students will utilize the principles of Cyber-Physical Systems (CPS) and Internet of Things (IoT) to develop applications, implement IoT applications by selecting appropriate hardware and software platform and also Develop IoT applications using open-source platforms.

COURSE OUTCOMES

After successfully completing the course, the students will be able to CO 1: Basics of cyber physics components,

CO 2: Understanding of sensors and actuators,

CO 3: Layout diagram of open source microcontroller board,

CO 4: Understanding of analog and digital I/O for cyber-physics, CO 5: Understanding of different protocols for IoT connectivity, and CO 6: Basic architecture for IoT enabled Cyber Physics.

COURSE DETAILS

1. CYBER PHYSICAL SYSTEM (THEORY)

- CPS Realworld.
- Design and Validation of CPS.
- Smart city application CPS.
- CPS Hardware Platforms (Process, Sensors and Actuators).

2. Industry 4.0

- IOT Fundamentals and protocols including layers.
- Sensor and Interfacing.

Hands on Practice

- Architecture and pin diagram of Arduino UNO/MEGA and ESP8266
- IDE installation for open source C++ or Python
- Analog and Digital voltage sensing and processing through Firmware.
- Analog and Digital voltage based actuator through Firmware
- Display OLED/Seven segment integration through IDE
- PCB Design Concept and implementation with uC.
- Implementation of UI/UX through RestAPI based Thing speak
- DATA logging and Generating CSV through Rest API
- Writing a Firmware for ESP-8266 or NODEMCU (programming based knowledge)
- IoT based transformer / condition monitoring system

Reference Books

1. Adrian McEwen, Hakim Cassimally, Designing the Internet of Things.
2. Asoke K Talukder and Roopa R Yavagal, Mobile Computing, Tata McGraw Hill, 2010.
3. Tanenbaum, Andrew S, Computer Networks, Pearson Education Pte. Ltd., Delhi, 4th Edition
4. Stallings, William, Data and Computer Communications, Pearson Education Pte. Ltd., Delhi, 6th Edition.
5. F. Adelstein and S.K.S. Gupta, "Fundamentals of Mobile and Pervasive Computing," McGraw Hill, 2009.

INDUSTRIAL CONTROL AND REMOTE MONITORING

Course Code: EE28019

Credit: 1

L-T-P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

To provide hands on experience in developing Industrial Control and remote monitoring by using PLC (Programmable logic Controller), thus by utilizing it in Process control applications.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Know about typical components of a Programmable Logic Controller,

CO 2: Know the concept of Electrical ladder logic and its relationship to PLC instructions, CO 3: Understand the concept of digital electronics and data acquisition,

CO 4: Program PLC logical switching circuits for industrial applications,

CO 5: Choose and utilize Timer, Counter, and other intermediate programming functions, and CO 6: Design and program automated industrial production line.

COURSE DETAILS

1. Programmable logic Controller SYSTEM. (THEORY)

- Introduction to Industrial Automation.
- Introduction to PLC programmable logic controller
- PLCs & related software and its major Components
- Relay logic Hardware Platforms (Switches, Sensors and Actuators).
- Study of Contactors, Timers, Counter and Comparator

2. Human Machine interface

- Introduction to HMI Communication with PLC
- HMI tags and Assignments
- Project on Industrial load sequential feedback control Using PLC HMI

Hands on Practice

- Introduction of PLC SOFTWARE as TIA Portal
- Ladder Programming for Basic gates logics by using SPST Contacts
- Ladder Programming on SPDT
- Latching Concept and related Latching program
- Study of program memory and Programming on Memory Bits
- Study of TIMER BLOCKs and its Programming
- Introduction to COMPARATOR BLOCK and its Programming
- Introduction to COUNTER BLOCK and its Types with Programming
- Project on Industrial Load OFF/ON control Using PLC and HMI
- Introduction to analog Logic in PLC and its Programming

Reference Books

1. Vijay R. Jadhav, Programmable logic Controller, KHANNA PUBLISHERS, 2nd Edition, 2012.
2. R.G Jamkar, Industrial Automation Using PLC, SCADA and DCS, Laxmi Publications Private Limited.
3. PLC and SCADA by Prof Rajesh Mehra and Er. Vikrant Vij Published by University Science Press.
4. John R Hackworth and Frederick D. Hackworth Jr., Programmable logic Controller: Programming methods and Applications, PEARSON Edition: 1st Edition, 2006.

ELECTRICAL MACHINES LABORATORY

Course Code: EE29002

Credit: 1

L-T-P: 0-0-2

Prerequisite(s): Nil

COURSE OBJECTIVE

The main objective of the Electrical machines laboratory is to provide the practical exposure to the student regarding operation of various electrical machines like DC generators, DC Motors, Alternators, Synchronous motors, Induction Motors, Special Motors and Transformers. Students are allowed to conduct various experiments for the validation of performance characteristics of all the machines. From this laboratory courses student will gain the skill to select correct machine for a specific application.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Memorize the working principle and applications of different electrical machines.

CO 2: Understand the challenges in industrial applications of electric motors.

CO 3: Utilize different electrical machines.

CO 4: Analyse different electrical machine according to the requirement in the industrial applications.

CO 5: Assess the safety precautions to be taken while using electrical equipment.

CO 6: Design the equivalent circuit of the transformer and construct the circle diagram of an induction motor.

POWER ELECTRONICS AND DRIVES

Subject Code: EE30005

Credits: 3

L-T-P: 3-0-0

Pre-requisites: Nil

COURSE OBJECTIVES

It aims to familiarize readers with switching devices, power converters, and their uses in different power control systems.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Understand the working principles of different power electronics devices.

CO 2: Analyze the concepts of single phase and three phase controlled rectifiers.

CO 3: Compare different topologies of DC to DC converters.

CO 4: Understand the control of single phase and three phase Inverters

CO 5: Know the operation of power factor correction circuit and MLI

CO 6: Analyze the different industrial drive system.

COURSE DETAIL

Introduction to Power Electronics

Comparison of power devices operating in the switch mode to those operating in the active region.

Power Electronic Devices

Thyristor characteristics, Turn ON methods, Dynamic Characteristics of thyristors, Two Transistor Model of thyristor, Characteristics and construction of Power MOSFETS, Characteristics and construction of IGBT, SiC based power devices and applications.

AC to DC Converters

Single Phase Converters – Half Wave with R, RL, RLE load and effect of free Wheeling diode, Single Phase half and full controlled full Wave converters with R and RLE Load, 3 Phase half and fully controlled rectifiers, Power factor correction circuit.

DC to DC Converters

Step up and Step Down choppers, basic concepts of bi-directional converter. Forward and Flyback converters.

Inverters

Single Phase Half Bridge and Full Bridge Inverters, 3 Phase Inverters, 180° and 120° conduction, Voltage Control of inverters, Sinusoidal Pulse Width Modulation, Concept of multi level inverters.

Electric Drives

Different loading and operating points of speed torque characteristics, Selection of motors, Steady state stability, load Equalization, D.C. Motor Speed control, 4 quadrant choppers for control of DC motor, A.C. Drives: variable frequency drives.

Textbooks

1. M. H. Rashid, Power Electronics, Devices, Circuits & Applications, Pearson Education, 4th Edition, 2017.
2. P S Bhimbra, Power Electronics, Khanna Publishers, 7th Edition, 2022.
3. G K Dubey, Electrical Drives, Narosa Publishing House Pvt Ltd; 2nd Edition 2010.

Reference books

1. M. D. Singh and K. B. Khanchandani, Power Electronics, Tata McGraw-Hill, Second Edition, 2007.
2. N. Mohan, Tore M. Undeland, and William P. Robbins, Power Electronics, Converters, Applications and Design , John Wiley and Sons, 3rd Edition, 2009.
3. R Krishnan, Electric Motor Drives: Modeling, Analysis and Control, Pearson Education India, 1st Edition, 2015.

POWER SYSTEM OPERATION AND CONTROL

Course Code: EE30006

Credits: 3

L-T-P: 3-0-0

Pre-requisites: Nil

COURSE OBJECTIVE

This subject provides the basic knowledge of analyzing a power system by different studies and suggests appropriate control action for smooth operation of a power system.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Compute the bus admittance matrices

CO 2: Solve the load flow problems.

CO 3: Find economic operation of power generation.

- CO 4: Classify different Power system faults.
 CO 5: Apply the stability concept to power system.
 CO 6: Analyze the concepts of generation control

COURSE DETAIL

Load Flow Studies

Bus classification, Nodal Admittance matrix, Formulation of load flow problem, Approximate load flow solution by Gauss-Siedel Method with and without PV bus, acceleration of convergence, Newton-Raphson Method, Decoupled and Fast decoupled method.

Economic Operation of Power System

Introduction, Optimal operation of generators, Distribution of load on various generating units, Penalty factor and Transmission loss as a function of plant generation.

Symmetrical and Unsymmetrical Fault Analysis

Introduction, Transients in transmission line, Symmetrical components, Sequence analysis of power system, Symmetrical Fault analysis, Unsymmetrical Fault analysis.

Stability Analysis

Introduction to stability, Dynamics of synchronous machines, Swing equation, Power angle curve and its equation, Steady state stability, Equal area criterion, Effect of clearing time on stability.

Automatic Generation and Voltage Control

Introduction, Load frequency control, Turbine speed governing system, Modeling of speed governing system, Turbine model, Generator load model, Integrated representation of various models, Proportional plus integral control, Automatic voltage regulator .

Textbooks

1. I. J. Nagrath, D. P. Kothari- Modern Power System Analysis, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 3rd Edition, 2003.
2. John. J. Grainger & W. D. Stevenson- Jr Power System Analysis- TMH, 2003 Edition, (15th Reprint).

Reference books

1. T K Nagarkar and M S Sukhija- Power System Analysis - 1st Edition, Eighth impression 2012, Oxford University Press.
2. Abhijit Chakrabarti, Sunita Halder- Power System Analysis Operation and Control, Third Edition, 2010, PHI Learning Private Limited.

POWER TRANSMISSION AND DISTRIBUTION

Course Code: EE30007

Credit: 3

L-T-P: 3-0-0

Prerequisite: EE20001

COURSE OBJECTIVE

To give the students requisite basic knowledge about the key parameters of transmission and distribution of modern power supply system, analyze the performance of transmission lines, cables, distribution systems and mechanically design the components of a power system.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Describe different powers in power system.
- CO 2: Evaluate the line constants in different configuration of overhead lines.
- CO 3: Analyze the performance of transmission lines and underground cables.
- CO 4: Describe different phenomenon of transmission line.
- CO 5: Calculate the corona loss in transmission lines.
- CO 6: Determine the current and voltage distribution in different distribution modules.

COURSE DETAIL

Introduction

Single and 3-phase transmission, Concept of complex power, Per Unit system, Power System layout. Supply System: Comparison of AC and DC transmission, Advantage of high voltage transmission, Advantages and Disadvantages of EHV (AC) and HVDC Transmission.

Line constants

Resistance, Inductance of Single phase and three phase line with symmetrical and unsymmetrical spacing, GMD and GMR calculation, Transposition of power line, Capacitance of Single-phase line, Effect of earth on line capacitance, Charging current due to capacitance effect, Bundle conductors, Skin and Proximity effect.

Performance of Transmission line

Analysis of short, medium and long Transmission Line, ABCD constants and its calculation for Short, Medium and Long Transmission Line, Ferranti effect, Surge Impedance and Surge Impedance Loading, Line compensators.

Corona: Critical disruptive voltage, Visual critical voltage, Corona Power losses, Factors affecting corona, Advantages and Disadvantages of Corona, Problem Discussion, Radio Interference between power and communication line.

Mechanical Design of overhead transmission lines:

Types of conductors and insulator, Insulating materials, Potential distribution over a string of suspension Insulators, String Efficiency, Methods of equalization of the potentials, Sag and Stress calculation, Effect of ice and wind loading, Vibration dampers.

Underground Cable:

Overhead line verses underground cables, Type and construction, Grading of cables, Insulation resistance of cable, Capacitance of three core cable, dielectric losses.

Distribution Systems:

Classification of distribution system, Types of AC and DC distributors, Feeder, Voltage drop and load calculation for concentrated and distributed loads, Radial and ring main system, Economic choice of conductor, Kelvin's law.

Textbooks

1. C.L. Wadhwa- Electrical Power System, , New Age International (P) Limited, Publishers, 2009.
2. A. Chakrabarti, M.L. Soni, P.V. Gupta and U.S. Bhatnagar, Dhanpat Rai and Co -A Text Book on Power System Engineering, Reprint 2012.

Reference books

1. J. B. Gupta, S K Kataria- A Course in Power System- Sons Publishers and Distributors, 2011.
2. B. R. Gupta- Power System Analysis and Design- S. Chand Publications, 3rd Edition, Reprint, 2003.
3. V.K.Mehta- Principle of Power System- S.Chand Publishers, 2012.

SENSORS AND ACTUATORS

Course Code: EE30012

Credit: 3

L-T-P: 3-0-0

Prerequisite: EE20001

COURSE OBJECTIVE

This course helps the students to have an exposure to sensors and its importance in the real world. Student will be able to understand basics of sensors, actuators and their operating principle and also have knowledge about simulation and characterization of different sensors.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Understand components of sensor and selection criteria.
- CO 2: select suitable sensor for measuring displacement and velocity.
- CO 3: Select suitable sensor for force, weight and pressure measurement.
- CO 4: Select suitable sensor to measure temperature, level and flow.
- CO 5: Know about different actuators and Electrical actuating systems.
- CO 6: Use micro sensor and micro actuators in different applications.

COURSE DETAILS

Introduction

Definition of sensor and transducer, classification, characteristics. Selection criteria of transducers. Smart sensor: Block diagram, features.

Displacement and velocity Measurement

Linear and rotary displacement sensors: Potentiometer, capacitive, inductive, Position measurement: Optical Encoder, proximity sensors.

Velocity measurement: Tachometer types, Stroboscope, Encoder.

Measurement of Force, Weight and Pressure

Force and weight measurement: Strain gauge, load cell. Pressure measurement: Manometer types, Strain gauge, diaphragm gauge, capsule, bellows, bourdon tube, piezoelectric sensor.

Temperature measurement

Temperature scales, Mechanical thermometers: Filled in systems, Metallic expansion, Electrical thermometers: RTD, Thermo-couple, Semiconductor temperature sensors.

Level & Flow measurement

Mechanical methods: float and displacer. Electrical methods: Resistance, inductive, capacitance type. Ultrasonic level gauging. Basic principles of flow measurement. Differential pressure devices: orifice, venturi, flow nozzle, pitot tube, annubar.

Actuators

Definition, types and selection of Actuators; linear; rotary; Logical and Continuous Actuators, Pneumatic actuator- Electro-Pneumatic actuator; cylinder, rotary actuators, Mechanical actuating system: Hydraulic actuator - Control valves; Construction, Characteristics and Types, Selection criteria.

Electrical actuating systems

Solid-state switches, Solenoids, Electric Motors- Principle of operation and its application: D.C motors - AC motors - Single phase & 3 Phase Induction Motor; Synchronous Motor; Stepper motors - Piezoelectric Actuator.

Micro Sensors

Principles and examples, Force and pressure micro sensors, position and speed micro sensors, acceleration micro sensors, chemical sensors, biosensors, temperature micro sensors and flow micro sensors. Simulation and characterization of various sensors using COMSOL Multiphysics.

Micro actuators

Actuation principle, shape memory effects-one way, two way and pseudo elasticity. Types of microactuators: Electrostatic, magnetic, fluidic, inverse piezoeffect.

Textbook

1. S.K.Singh- Industrial instrumentation and control, 3rdEdition,TMH

Reference books

1. Murthy.D.V.S- Transducers and Instrumentation, ,2001,Prentice Hall of India.
2. Patranabis. D- Sensors and transducers, , 2003, PHI.
3. Sergej Fatikow and Ulrich Rembold- Microsystem Technology and Microrobotics, ,1st edition, Springer-Verlag Berlin Heidelberg.
4. Manfred Kohl- Shape memory actuators, first edition, Springer.

INDUSTRIAL APPLICATIONS OF ELECTRIC ENERGY

Course Code: EE30013

Credit: 3

L-T-P: 3-0-0

Prerequisite: EE20001

COURSE OBJECTIVE

This subject gives a comprehensive idea in utilization of electrical power such as drives, electric heating, electric welding and illumination, electric traction, electrolysis process.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Describe in applications of different motors.
- CO 2: Demonstrate on electric tariff.
- CO 3: Examine the characteristics and intensity of lightning systems for different types of lamps.
- CO 4: Analyze various electrolytic processes.
- CO 5: Know the Process of different kinds of electric heating and electric welding.
- CO 6: Know the application of different lamps.

COURSE DETAILS

Motor power rating and selection

General considerations in selecting motor power rating, Selection of motor capacity for continuous duty, Equivalent current, torque and power methods, Selection of capacity for short term and intermittent periodic duty.

Electric Tariff

Classification of costs, Formulation of Electric Tariff, Various kinds of Tariff, Economics of Generation, Load duration curve, Base load and peak load plants, Effect of Load Factor, diversity Factor and power factor on tariff.

Electric Heating and Welding

Advantages of electrical heating, Design of heating elements, Heating methods, Resistance Heating, Induction Heating, Dielectric Heating, Resistance furnace, Causes of failure of heating elements, Temperature control of resistance furnace, Arc furnace, Advantages of electric welding, Welding methods: Resistance welding, Electric arc welding, Atomic hydrogen welding, Modern welding techniques: Ultrasonic and Laser welding.

Illumination

Introduction, terminology in illumination: luminous flux, luminous intensity, lumen candela power, illumination lux, lamp efficiency, Brightness glare, Space height ratio, Polar curve, Laws of illumination, Co-efficient of utilization, Maintenance factor, Depreciation factor, Solid Angle, Types of Lamps: Arc Lamp, Incandescent lamp, Sodium vapor lamp, Mercury Vapor Lamp, Fluorescent Lamp, Neon Lamp, Types of Lighting Scheme, Flood Lightning, Street lightning, Compact Lighting Characteristics.

Electrolytic Processes

Fundamental principles, Faradays law of electrolysis, Extraction and refining of metals, Electro deposition.

Textbooks

1. C.L. Wadhwa- Generation, Distribution and Utilization of Electrical Power- Wiley Eastern Ltd, New Delhi, 2006.
2. J B Gupta, S K Kataria and Sons- Utilization of Electrical Power and Electric Traction, Delhi, 2011.

Reference books

1. H. Pratab- Art & Science of Utilization of Electrical Energy - Dhanpat Rai & Co.(P) Ltd. 2013.
2. Er. R K Rajput- Utilization of Electric power - Lakshmi publications Pvt. Ltd, 1st Edition 2006.
3. L Thereja, A.K Thereja- Electrical Technology volume – III, S Chand Publisher – 2013.

POWER GENERATION AND CONTROL

Course Code EE30014

Credit: 3

L-T-P: 3-0-0

Prerequisite: EE20001

COURSE OBJECTIVE

This subject provides the basic knowledge of various types of power generating stations. Students will be able to know the know the philosophy of components of generating power stations, generation control, substations, tariff, and power factor improvement.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Understand various energy sources and their applications to power stations.

CO 2: Discuss the requirement and description of various components used in different power generation station

CO 3: Compare various sources of power generation and evaluate their power output.

CO 4: Analyze the performance of the speed governing system

CO 5: Elaborate on the process of testing and commissioning for different substation components.

CO 6: Measure power factor and tariffin electrical power system.

COURSE DETAILS

Introduction

Introduction to different sources of Energy. Discussion on application of energy sources to power station.

Thermal Power Plant

Layout of thermal power plant, Main Equipment, Coal Handling plant, Boiler, Super heater, Reheater, Economizer,Air Preheater steam turbine,condenser, Ash handling plant, Cooling tower and ponds, Feed water heater, E.S.P, Power supply to auxiliaries. Governor, specific speed, Plant auxiliaries. Load frequency control,Turbine speed governing system,Modelling of speed governing system, Turbine model, generator model,load model, Integrated representation of various model,Excitation System: DC exciter, AC exciter, static exciter, AVR.

Hydro Power Plant

Classification according to (i) Water Flow (ii) Load (iii) Head, surge tank, Penstock, spillway, Tail Race, Types of turbine (i) Pelton turbine, (ii) Francis turbine, (iii) Kaplan turbine, Governor, specific speed, Plant auxiliaries.

Nuclear Power Plant

Location, Layout of nuclear power plant, Fission, Fusion, controlled chain reaction, Classification of Nuclear reactors –Advanced Gas cooled Reactor, Pressurized Water Reactor, Boiling Water Reactor, Fast Breeder Reactor, Reactor Control & Cooling.

Diesel Electric Power plant and Gas Turbine Power plant

Introduction, Selection of site, Layout and Main components, Application.

Electrical System

Testing and commissioning of generators and power transformers. HT, EHT, and LV Substation arrangements. Station batteries and battery chargers. Tariffs-Types, power factor improvement.

Textbook

1. B.R. Gupta- Generation of Electrical Energy- S.Chand Publication, 2009.
2. J.B.Gupta, S.K.Kataria- A course in power system- Sons Publication,2013.

Reference books

- 1.B.G.A. Skrotzki and W.A. Vopat, Power Station Engineering and Economy, McGraw Hill, Digitized on Dec 2007.
2. Sudipta De- Nag's Power Plant Engineering, 5th Edition- McGraWHill, 2021

IOT FOR ELECTRICAL ENGINEERING

Course Code: EE30015

Credit: 3

L-T-P: 3-0-0

Prerequisite: Nil

COURSE OBJECTIVE

This course enhance both device-to-device interactions, as well as device-to-human interactions via the Internet. IoT systems facilitate controlling and monitoring devices from anywhere by integrating sensors, actuators, local processing and storage devices, wireless networks, Internet, and cloud computing and their applications in electrical engineering.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Identify the components of IoT.
- CO 2: Analyze various protocols of IoT.
- CO 3: Apply internet of things in power sector.
- CO 4: Examine schemes for the applications of IoT in home automation.
- CO 5: Demonstrate embedded development platform.
- CO 6: Create building blocks of Internet of Things and characteristics.

COURSE DETAILS

Introduction

Definition, Components in internet of things, Sensing and Actuation Anywhere, Anytime, Genesis of the Internet of Things, Power Sources, Internet Principles, Internet Communications: An Overview (IP, TCP, The IP Protocol Suite (TCP/IP), UDP), IP Addresses (DNS, Static IP Address Assignment, Dynamic IP Address Assignment, IPv6), MAC Addresses, TCP and UDP Ports.

IoT in the power sector

Asset Performance Management, Operational Optimization, Comprehensive Customer Services and Experiences

Advanced Embedded Development Platforms

System on Chip (SoC), ARM®, Raspberry Pi, Evolution of Pi and technical specification comparative study, GPIO Interfacing Cloud, Analytics & UI, Client Server Model, HTTP, Thingspeak, AWS, Cloud MQTT.

Home Automation

Sensor based automated technologies, PIR Sensor, GSM module, Node MCU Module, Bluetooth module, Humidity sensor.

Textbooks

1. Adrian McEwen, Hakim Cassimally- “Designing the Internet of Things”, Wiley publication, 1st Edition, November 2013.
2. Ramamurthy, A. and Jain, P- The Internet of Things in the Power Sector Opportunities in Asia and the Pacific, 2017.

Reference books:

1. Luigi Atzori, Antonio Lera, Giacomo Morabito- “The Internet of Things: A Survey”, Journal on Networks, , Elsevier Publications, October, 2010.
2. Honbo Zhou- "The Internet of Things in the Cloud: A Middleware Perspective", , CRC Press-2012.
3. Dieter Uckelmann, Mark Harrison- “Architecting the Internet of Things- Springer, 2011.

RENEWABLE ENERGY RESOURCES

Course Code: **EE30016**

Credit: **3**

L-T-P: **3-0-0**

Prerequisite: **Nil**

COURSE OBJECTIVE

To facilitate the students to achieve a clear conceptual understanding of technical aspects of Renewable Sources of Energy.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Understand the need of renewable energy sources for future requirements globally.
- CO 2: Demonstrate on various solar thermal system applications
- CO 3: Apply the concept of solar PV for maximizing the energy efficiency.
- CO 4: Describe the process of extraction of power from wind energy and biomass energy.
- CO 5: Analyze the scope of Geothermal and Ocean energy.
- CO 6: Reflect the concept of principle of operation of fuel cell and its applications.

COURSE DETAILS

Fundamentals of Energy

Energy Consumption and standard of living, Classification of Energy Resources, Importance of Non-Conventional Energy Sources, Common Forms of Energy, Advantages and Disadvantages of Conventional energy Sources, Environmental aspects of energy, Environment-economy-energy and sustainable development, Energy densities of fuels, Energy scenario in world and India

Basics of Solar Energy

Extraterrestrial and Terrestrial Radiations, Depletion of Solar Radiation, Solar Time, Solar Radiations Measurement.

Solar Thermal Systems

Solar Collectors: Classification, Performance indices, Working of Flat plate collector and Evacuated Tube collector, various other types of Collectors, Solar Passive Space – Heating and Cooling Systems, Solar thermal energy applications in Water Heater, Cookers, Furnaces, Green House, Dryer and Distillation.

Solar Photovoltaic Systems

Solar Cell Fundamentals, P-N Junction, Generation of electron hole pair, Photoconduction, Solar Cell Characteristics, Effect of variation of isolation and temperature, Energy payback period, Solar Cell Classification, Solar Cell, Module, Panel and Array Construction, Cell mismatch and Effect of shadowing. Maximizing the Solar PV Output and Load Matching, Maximum Power Point Tracker (Perturb and Observance method and Incremental conductance method).

Wind and Biomass energy

Wind Energy: Origin of Winds, Nature of Winds, Wind Turbine Siting, Major Application of Wind Power, Power extraction from wind, Wind Turbine Types and Their Construction, Speed control strategies for wind turbine, Power versus wind speed Characteristics, Wind Energy Conversion Systems (WECS), Environmental aspects of wind energy, Wind energy programme in India.

Biomass Energy: Usable Forms of Biomass, their Composition and Fuel Properties, Biomass Resources, Energy Farming, Biomass Conversion Technologies, Urban Waste to Energy Conversion, Biomass Gasification, Biomass Liquefaction, Biomass to Ethanol Production.

Geothermal Energy

Applications, Origin, and Distribution of Geothermal Energy, Types of Geothermal Resources, Environmental aspects of Geothermal energy, Geothermal Energy in India

Ocean Energy

Ocean Thermal Electric Conversion (OTEC) systems like open cycle, closed cycle, Environmental impact, Tidal Energy: Energy from tides, Tidal energy conversion scheme: single basin and double basin tidal power plants, advantages, limitation and scope of tidal energy.

Wave energy

Power from wave, wave energy conversion devices, advantages and disadvantages of wave energy, Environmental impact

Fuel cells

Principle of working of various types of fuel cells and their working, performance and limitations, MHD (Magneto hydro dynamics) generation principles, advantages and disadvantages.

Textbook

1. B. H. Khan, "Non – Conventional Energy Resources" Tata Mc Graw Hill, 2nd edition 2009.
2. N. K. Bansal, Manfred Kleemann, Michael Meliss, "Renewable energy sources and conversion technology", Tata Mc Graw Hill, 1990.

Reference books

1. Kothari D.P., "Renewable energy resources and emerging technologies", Prentice Hall of India Pvt. Ltd, 2006.
2. Rai G.D, "Non-Conventional Energy Sources", Khanna Publishers, 4th Edition 2000.
3. Ashok V. Desai, "Nonconventional Energy", New Age International Publishers Ltd, Reprint 2003.

ENERGY AUDIT AND ACCOUNTING

Course Code: EE 30020

Credit: 3

L-T-P: 3-0-0

Prerequisite: EE20001

COURSE OBJECTIVE

The objective of Energy Audit is to determine ways to reduce energy consumption per unit of product output or to lower operating costs and accounting the cost of energy.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Learn the need of energy audit.

CO 2: Understand the concept of energy conservation and audit.

CO 3: Apply the concept of accounting in energy audit.

CO 4: Design the capacitor rating for power factor improvement.

CO 5: Evaluate the energy efficiency of furnace & CHP System.

CO 6: Create a report for an Economic Evaluation.

COURSE DETAILS

General Aspects

Indian Energy scenario, definition of energy conservation, management and audit,, Energy audit-need, Types of energy audit, Energy Audit Reporting Format ,Energy audit instruments, Energy Conservation schemes, Energy index, Cost Index, Representation of energy consumption.Economic and ecological implications on management & auditing systems, auditing on emission, pollution, safety and reliability.

Energy Utilization and Conversion System

Furnace: Classification of furnace, controlled atmosphere in furnace, furnace fuels, efficiency of energy in furnace, thermal efficiency, heat losses, reducing heat losses.

Combined heat and power systems: Characteristic of prime movers, heat and power requirement, economics of C.H.P. system

Industrial Heating: Resistance heating, Induction heating, arc Heating, dielectric and microwave atmosphere generators, radiant heating

Lighting: Lamp lifetime, efficient lighting

Motive power and power factor improvement

Cost of electrical Energy, Power factor improvement, Capacitor rating, sitting the capacitor, effect of power factor improvement. Hydraulic power system, Electrical Measurement, Temperature measurement and optimal start control.

Economic Analysis

Introduction, Basic Concepts, Interest Rate, Inflation Rate, Tax Rate ,Cash Flows, break even charts, Compounding Factors, Single Payment, Uniform-Series Payment, Economic Evaluation Methods Net, Present Worth, Rate of Return Benefit–Cost Ratio, Payback Period, Summary of Economic Analysis Methods, Life-Cycle Cost Analysis Method, General Procedure for an Economic Evaluation.Financing Options, Direct Purchasing, Leasing, Performance Contracting

Textbooks

1. W.R. Murphy and G. McKay, “Energy management”, Butterworth & Co Publishers, Oxford, UK, 2001.
2. Moncefkrarti- Energy Audit of Building systems: An Engineering approach, CRC PRESS, Second Edition, 2009.

Reference books

1. Tarik Al, Shemmeri- A Workbook for Energy Management in building- Wiley-Blackwell.
2. Y. Pabbi- Energy audit: Thermal power, combined cycle, and co-generation plants, TERI, 2011.
3. WC Turner- Energy Management Handbook, Seventh Edition, (Fairmont Press Inc., 2007).
4. Bureau of Energy Efficiency (BEE) (2016); Study material for Energy managers and Auditors Examination: Paper I.

SPECIAL MACHINES AND ITS CONTROL

Course Code: EE30022

Credit: 3

L-T-P: 3-0-0

Prerequisite: Nil

COURSE OBJECTIVE

To understand the working of special machines like stepper motor, switched reluctance motor, BLDC motor & PMSM and Linear induction motor with proper design of controller for smart inverter used to control the above special machine.

COURSE OUTCOMES

After successfully completing the course, the students will be able to:

- CO 1: Understand the operation of different special machines.
- CO 2: Select different special machines as part of control system components.
- CO 3: Analysis of Linear induction motor and its control.
- CO 4: Design digital controllers for different machines.
- CO 5: Apply the knowledge of axial and radial flux motor into a way of thinking to solve in real time applications.
- CO 6: Design Smart Inverters and Sizing for Grid Connection and Off Grid.

COURSE DETAILS

Stepper Motors

Introduction, Hybrid stepping motor, Construction, Principles of operation, Energization with two phase at a time, essential conditions for the satisfactory operation of a 2-phase hybrid step motor, very slow speed synchronous motor for servo control-different configurations for switching the phase windings-control circuits for stepping motors, an open-loop controller for a 2-phase stepping motor.

Linear Induction Motor

Development of a double-sided LIM from rotary type IM- A schematic of LIM drive for electric traction development of one-sided LIM with back iron-field analysis of a DSLIM fundamental assumptions.

Synchronous Motors

Construction- Principle of operation of Permanent Magnet Synchronous Motors – EMF and torque equations – Starting – Rotor configurations –Dynamic model, Synchronous Reluctance Motors: Constructional features– axial and radial flux motors – operating principle – characteristics.

Control of PMSM, BLDC and Switched Reluctance Motor

Bipolar optical sensor based control of Trapezoidal BLDC Motor, Sensorless control of BLDC motor, Torque ripple control of BLDC motor, Unipolar control for SRM, Torque ripple control of SRM.

Smart Inverters

Selection of power conditioning unit (PCU), Sizing of solar inverter for roof top and grid connected projects, Passive and active protection, IEC/IEEE /Grid Compliance of inverters, Grid-Connected Inverters vs. Stand-Alone Inverters.

Textbooks

1. Miller, T. J. E., Brushless Permanent Magnet and Reluctance Motor Drives, Oxford Science Publications, 1989.
2. Kenjo, T., and Sugawara, A., Stepping Motors and their Microprocessor Controls, Oxford Science Publications, 1984.

Reference books

1. Krishnan, R., Electric Motor Drives: Modeling, Analysis, and Control. Prentice Hall, (2001).
2. Krishnan, R., "Permanent Magnet and BLDC Motor Drives", CRC Press, 2009.
3. Chang-liang, X., "Permanent Magnet

ELECTRIC DRIVES AND CONTROL

Course Code: EE30024

Credit: 3

L-T-P: 3-0-0

Prerequisite: Nil

COURSE OBJECTIVE

It aims to familiarize readers with steady-state performance, starting, dynamic and regenerative braking, plugging and reverse direction operation, speed control, sudden and temporary overloads, ambient conditions and mechanical coupling of machines.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1. Learn the need of Electric Drives in the industry.
- CO 2. Understand the various braking methods of electrical drives.
- CO 3. Know the applications of different electric motors.
- CO 4. Analyze the open loop and closed loop control techniques of different drives.
- CO 5. Understand different speed control techniques for various industrial drives.
- CO 6. Analyze the performance of Permanent Magnet Synchronous and Brushless DC motor drives.

COURSE DETAILS**Introduction**

Basic elements of an electric drive, Four quadrant operation of an electric drive, Dynamics of motor load combination, Types of loads, Stable operating condition of various motor load combinations, Fundamental load torque equation, Speed and current limit control, Load curve, load equalization, motor selection and rating calculations.

DC Motor Drives

Review of characteristics of DC motors, Modification of characteristics of DC shunt and series motors, Concept of Electric Braking, Regenerative, Dynamic and Counter current braking of DC motors.

Control of DC motor drives

Open loop speed control, Closed loop Speed control, Closed loop speed and current control, Closed loop Torque control, Hysteresis controller, PI controller.

Solid State Control of DC drive

Chopper and rectifier based DC Separately excited motor and series motor drive control, four quadrant drive using dual converter.

Induction Motor Drives

Review of characteristics of three phase Induction motors, Modification of speed torque characteristics due to variation of stator voltage, Stator frequency and rotor resistance, Electric Braking of Induction Motors: Regenerative Braking, DC Dynamic braking and Plugging, Slip Power recovery.

Speed Control of Induction Motors

Control of IM by three phase AC-AC Voltage controller, PWM Voltage Source Inverter fed induction motor drives, Current source inverter fed induction motor drives, Comparison of VSI and CSI fed drives, slip compensation schemes, closed loop control (V/f control).

Synchronous and Brushless DC Motor Drives

Synchronous motors, cylindrical rotor, salient pole synchronous motor, permanent magnet synchronous motor, synchronous reluctance motor, Transients due to load disturbances, Braking, Permanent magnet AC motor drives, Sinusoidal PMAC motor drives, Brushless DC motor Drives.

Textbooks

1. G.K. Dubey, Fundamentals of Electric Drives, Second Edition, Narosa Publishers, 2007.
2. S. K. Pillai, A First Course On Electrical Drives, New Age International Publishers, 2nd Edition, 2007.

Reference books

1. Bimal K. Bose, Power Electronics and Motor Drives: Advances and Trends, Academic Press, Har/Cdr edition (13 September 2006).
2. N. K. De, P. K. Sen: Electric Drives, PHI Learning Pvt. Ltd., 7th Edition, 2004.
3. Bimal. K. Bose, Modern Power Electronics and AC Drives, PHI Publisher, 1st Edition, 2013.
4. S.A. Nasar, Boldea , Electrical Drives, CRC Press, Second Edition, 2006
5. M. A. El-Sharkawi , Fundamentals of Electrical Drives , Thomson Learning, 1st Edition, 2000.
6. R. Krishnan, Electrical Motor Drives, PHI, 2003

DISTRIBUTION SYSTEM PLANNING AND AUTOMATION

Course Code: EE30026

Credit: 3

L-T-P: 3-0-0

Prerequisite: Nil

COURSE OBJECTIVE

This course gives the complete knowledge of electrical distribution systems, the design of feeders, substations. It also gives conceptual knowledge on how to determine the performance of a distribution system through its important parameters i.e. voltage drops and power losses and the very important thing that protection of the system by means of protective devices and their co-ordination during the several fault conditions. it also specifies how to improve the voltage profiles and power factors of the system to better value using various voltage control and compensation techniques.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Know the concept of distribution planning.

CO 2: Understand load forecasting techniques.

CO 3: Identify appropriate substation location.

CO 4: Evaluate a distribution system for a given geographical service area.

CO 5: Determine the location and optimum size of capacitor for distribution system.

CO 6: Understand the concept of distribution system automation.

COURSE DETAILS

Planning and forecasting techniques

Methods of load forecasting: regression analysis, correlation analysis and time series analysis, Load management, tariffs and metering of energy.

Distribution Transformers: Types – Three phase and single phase transformers – connections Dry type and self-protected type transformers – regulation and efficiency. Sub Transmission Lines,

Distribution Sub-Stations: Distribution substationsBus schemes –description and comparison of switching schemes, Substation location and rating

Primary Systems

Types of feeders – voltage levels – radial type feeders.

Voltage Drop and Power Loss Calculations

Three phase primary lines – Copper loss – Distribution feeder costs – Loss reduction and Voltage improvement in rural networks.

Distribution Systems

Effects of series and shunt capacitors – justification for capacitors – Procedure to determine optimum capacitor size and location.

Distribution System Protection

Basic definitions – types of over current protection devices. Objective of distribution system protection.

Distribution System Automation

Reforms in power sector, Methods of improvement, Reconfiguration, Reinforcement, Automation, Communication systems, Sensors, Automation systems, Basic architecture of Distribution automation system, software and open architecture, RTU and Data communication , SCADA requirement and application functions, GIS/GPS based mapping of Distribution networks, Communication protocols for Distribution systems , Integrated sub, station metering system , Revenue improvement , issues in multi–year tariff and availability based tariff.

Textbooks

1. Turan Gonen : Electric Power Distribution Engg., Mc-Graw Hill,1986.
2. A. S. Pabla : Electric Power Distribution, TMH, 2000.

Reference books

1. Shahnia, Farhad, Arefi, Ali, Ledwich, "Electric Distribution Network Planning",2018, Springer Nature Singapore Pte Ltd.
2. James Northcote-Green , Robert G. Wilson, ``Control and Automation of Electrical Power Distribution Systems'', 1st Edition, September 22,2006 , Taylor and Francis Publisher.

HVDC AND FACTS

Course Code: EE30028

Credit: **3**

L-T-P: **3-0-0**

Prerequisite: Nil

COURSE OBJECTIVE

To understand the configuration and working of HVDC & AC systems. To impart knowledge on application of shunt and series compensators to improve AC power transmission using FACTS devices.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Know the basic of HVDC transmission systems.

CO 2: Analyze converter configurations used in HVDC and list the performance metrics.

CO 3: Apply the control techniques to HVDC transmission systems.

CO 4: Analyze the reactive power requirement and harmonics with its elimination in HVDC system.

CO 5: Realize the application of FACTS devices in power system.

CO 6: Analyze and design shunt and series compensation in a transmission system.

COURSE DETAILS

HVDC Transmission

DC Power Transmission: Introduction, Need for power system interconnections, Types of DC links, Relative merits, Components of a HVDC system, Modern trends in DC Transmission systems.

Analysis of HVDC Converters

Pulse number, Choice of converter configurations, Analysis of Graetz circuit with and without overlap, Voltage waveforms, Analysis of two and three valve conduction mode, Converter Bridge characteristics, Inverter mode of operation, voltage waveforms.

Converter and HVDC Control

Principles of DC link control, Converter Control characteristics, Control hierarchy Constant current (CC) control, CIA control, CEA Control, firing angle control of valves, starting and stopping of a dc link, Power control.

Reactive Power and Harmonics in HVDC

Reactive power requirements in steady state, Conventional control strategies, Alternate control strategies, Sources of Reactive Power, Harmonics and filters, Generation of harmonics, Types of ac filters, DC filters for HVDC system.

Flexible AC Transmission Systems (FACTS)

FACTS concepts and general system conditions: Power flow in AC systems, Basic types of FACTS controllers, Shunt and series controllers, Current source and Voltage source converters

Static Shunt Compensators

Objectives of shunt compensation, Methods of controllable VAR generation, Static Var Compensator, Its characteristics, TCR, TSC, FC-TCR configurations, STATCOM, basic operating principle

Static Series Compensators

Objectives of series compensator, Variable impedance type of series compensators, TCSC, TSSC and

Combined Compensators

Introduction to Unified Power Flow Controller, Basic operating principles

Textbooks

1. Prabha Kundur, Power System stability and Control, McGraw Hill, Inc
2. K.R.Padiyar, HVDC Power Transmission Systems –Technology and System Interactions, New Age International Publishers
3. Narain G.Hingorani, Laszlo Gyugyi Understanding FACTS –Concepts and Technology of Flexible AC Transmission Systems,

Reference book

1. Sang, Y.H. and John, A.T., Flexible AC Transmission Systems, IEEE Press (2006).
2. S. Rao., EHVAC and HVDC Transmission Engineering and Practice
3. J. Arrillaga, High Voltage Direct Current Transmission, Peter Pregrinu
4. R. Mohan Mathur, Rajiv K. Varma Wiley- Thyristor Based FACTS Controllers for Electrical

SOLAR ENERGY UTILIZATION

Course Code: EE30030

Credit: 3

L-T-P: 3-0-0

Prerequisite: Nil

COURSE OBJECTIVE

To provide a deep introduction about solar energy basics, principles, materials, theories and derivations about solar radiation, devices and its applications.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Analyze the mathematical modelling of the solar radiation pattern

CO 2: Estimate of solar radiations and its measurement methods

CO 3: Design the construction of various solar collectors

CO 4: Analyze the performance parameters of various solar collectors

CO 5: Explore the various applications of solar energy

CO 6: Categorize the different forms of the energy storage units

COURSE DETAILS

Solar Radiation

History of solar energy utilization - Solar radiation and modelling - Empirical equations for predicting the availability of solar radiation – Measurement of global, direct and diffuse radiation – Radiation computations on inclined surfaces – Angstrom's turbidity - Solar chart - Standard radiation scale.

Solar Radiation Measurement and Estimating

Measurement of solar radiation - Solar energy measuring instruments – Pyranometer – Pyrheliometer – Sunshine recorder - Estimation of average solar radiation - Ratio of beam and total radiation on tilted surface of that on horizontal surface.

Solar Collectors

Flat plate collector - Materials for flat plate collector and their properties - Thermal Analysis of Flat- plate Collector and Useful Heat Gained by the fluid - fin efficiency, Collector efficiency, Heat Removal Factor, Focusing collectors, Types and applications of focusing collectors

Solar Energy Applications

Introduction and principle of operation of solar cooker, Solar air heater, Solar water heater, Solar distillation, Solar pond, Solar thermal power generation, Greenhouse effect, Solar PV application

Storage of Solar Energy

Types of Energy Storage, Thermal Storage, Electrical Storage, Chemical Storage, hydro-storage

Textbooks

1. Rai, G.D., Solar Energy Utilization, Khanna Publishers, N. Delhi, 2010.
2. Sukhatme S.P., Solar Energy, Tata McGraw Hills P Co.,3rd Edition, 2008

Reference books

1. Jean Smith Jensen, Applied solar energy research: a directory of world activities and bibliography of significant literature, Volume2, Association for Applied Solar Energy, Stanford Research Institute, 2009.
2. Duffie, J.A., and Beckman, W.A. Solar Energy Thermal Process, John Wiley and Sons, NewYork, 2006. Jui Sheng Hsieh, Solar Energy Engineering, Prentice- Hall, 2007.

INTRODUCTION TO ELECTRICAL MACHINES

Course Code: EE30038

Credit: 3

L-T-P: 3-0-0

Prerequisite: Nil

COURSE OBJECTIVE

The objective of this course to enable the efficient and effective conversion of one form of energy into another form by using various DC and AC machine.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO1: Know the principle of electromechanical Energy conversion system.

CO2: Understand the principle of operation and characteristics of DC generator.

CO3: Analyze the performance of DC motor through its characteristics

CO4: Analyze the performance of transformer by equivalent circuit

CO5: Know the operation principle, torques and starting of 3 phase induction motor.

CO6: Understand the construction, operating principle and application of Synchronous Machine

COURSE CONTENT

Electromechanical Energy Conversion

Principle, Singly Excited Magnetic System and Doubly Excited Magnetic system, Physical concept of torque production, Electromagnetic torque and Reluctance torque.

DC Machines

DC Generator: EMF equation of dc generator, methods of excitation, armature reaction, interpoles and compensating winding, commutation, characteristics of separately excited and self excited dc generator, losses, condition for maximum efficiency. DC Motor: Working principle, voltage equation, condition for maximum power, characteristics, operating characteristics of dc motor, torque developed, speed control methods.

Transformers

Single Phase Transformer: Working principle, types, EMF equation, Transformer on no load and full load, vector diagram, exact and approximate equivalent circuit, O.C and S.C.test on transformer, Voltage regulation of transformer, losses and efficiency, condition for maximum efficiency, Auto transformer, 3 Phase transformers: connections (Y-Y, Y-Δ, Δ- Δ, Δ-Y).

3 Phase Induction Motor

Types, rotating magnetic field, principle of operation, slip, frequency of rotor current, rotor emf, rotor current, vector diagram and equivalent circuit, expression for torque, conditions for maximum torque, torque slip characteristics, starting torque in squirrel cage and slip ring motors, effect of change in supply voltage on torque, slip and speed , relation between full load torque and maximum torque, Power stages in induction motor, starting methods for 3 phase induction motor.

Synchronous Machine

Alternator: Basic principle, pitch factor, distribution factor, emf equation, alternator on load, voltage regulation: Synchronous impedance method. Synchronous motor: Basic principle.

Textbooks

1. Electrical Machines, Ashfaq Hussain, Dhanpat Rai, Delhi, 2nd Edition, 2008.
2. Electrical Machinery, P. S Bimbhra, 7th Edition, Khanna Publishers, 2008.

Reference Books:

1. Principles of Electrical power systems by J. B. Gupta
2. Text book of Electrical Machine by K R Sidhapura and D B Raval, Vikash, 1st edition, 2013.

SWITCH GEAR AND PROTECTION DEVICES

Course Code: EE30045

Credit: 3

L-T-P: 3-0-0

Prerequisite: Nil

COURSE OBJECTIVE

To know the construction and working principles of Circuit breakers and relays for protection of Generators, Transformers and feeder bus bar and understand the need of protection of electric equipment and their protection schemes.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Describe the need of protective devices in power system.
- CO 2: Distinguish in different types of Circuit Breakers.
- CO 3: Demonstrate the principle of operation of different relays.
- CO 4: Realize the different scheme of protection for alternator, transformer.
- CO 5: Understand the protection schemes of bus bar, feeder and transmission line.
- CO 6: Know the protection against surges.

COURSE DETAILS

Introduction

Protection system and its attributes, Philosophy of protection, Requirement of ideal protective scheme, Different terms in protective systems, Basic elements in protective scheme, Requirement of circuit breakers, Characteristics of an electric arc, Principle of AC and DC arc interruption, Recovery voltage, Re-striking voltage, Current chopping, Resistance switching.

Circuit Breakers

Types of AC and DC circuit breakers, Arc extinction methods, oil circuit breaker, Air blast circuit breaker, Vacuum and SF₆ circuit breaker, Principle of miniature circuit breaker and Moulded case circuit breaker, determination of circuit breaker capacity, Circuit breaker ratings.

Protective Elements

Concept of Fuse, need, construction, principle, characteristics of H.R.C fuse.

Earthing

Introduction, Methods of neutral grounding (Solid earthing, Resistance earthing and Peterson coil earthing and its effects on fault conditions), Construction, Principle of operations of Electromagnetic type, induction type: Over current, Directional, Distance relays, Differential relay.

Alternator Protection

Different types of faults, Differential protection with biasing, Restricted earth fault protection, Negative sequence protection, Automatic field suppression and Neutral circuit breakers.

Transformer Protection

Buchholz relay, Biased differential protection, Restricted earth fault protection, Harmonic restraint, Protection of combined alternator and Transformer.

Bus Bar Protection

Differential scheme for both phase and line faults, Introduction to digital protective relay and Microprocessor based relays.

Feeder protection

Time graded protection: Radial, Parallel and Ring feeders; Over current and Earth fault protection, Calculation of graded time setting, Split core protection of feeders, Carrier current protection.

Pilot Wire Protection

Circulating current differential protection (Merz-Price protection), Biased or percentage differential protection scheme, Opposed (balanced) voltage differential protection system, Translay scheme; static relays.

Protection against Surges

Ground wire, Surge diverters: Rod gap, Horn gap lightning arresters, Surge absorbers.

Textbooks

1. Y. G. Paithankar, S. R. Bhide, Fundamentals of Power System Protection”, 2nd edition, Prentice Hall of India Private Limited, New Delhi, 2011.
2. B Rabindranath and M Chander, Power System Protection and Switchgear, Wiley Eastern 2017, 2nd Edition.

Reference books

1. J. B. Gupta, S. K. Kataria, A Course in Power Systems, Sons Publishers and Distributors, 2009.
2. Y. G. Paithankar, Van Warrington, Principles of Relaying”, TMH, 2009.
3. N.Veerappan and S R Krishnamurthy, Power system Switchgear and Protection S Chand Publication, Revised edition 2013.
4. Badri Ram and D N Vishwakarma, Power system Protection and Switchgear, Tata McGraw Hill, 2nd reprint 2012
5. C.L. Wadhwa, Electrical Power System, New Age International (P) Limited, Publishers, 2009.

POWER ELECTRONIC CIRCUITS

Course Code: EE30047

Credits: 3

L-TP: 3-0-0

Prerequisites: Nil

COURSE OBJECTIVE

It aims to familiarize the switching devices, Power converters and Its applications in various systems for power control.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Understand the working principles of different power electronics devices.
- CO 2: Analyze the concepts of single phase and three phase controlled rectifiers.
- CO 3: Compare different topologies of DC to DC converters.
- CO 4: Realize the control of single phase and three phase Inverters
- CO 5: Know the operation of power factor correction circuit and MLI
- CO 6: Comprehend the concepts of AC to AC converters

COURSE DETAILS

Introduction to Power Electronics

Comparison of power devices operating in the switch mode to those operating in the active region.

Power Electronic Devices

Thyristor characteristics, Turn ON methods, Dynamic Characteristics of thyristors, Two Transistor Model of thyristor, Characteristics and construction of Power MOSFETS, Characteristics and construction of IGBT, SiC based power devices and applications.

AC to DC Converters

Single Phase Converters – Half Wave with R, RL, RLE load and effect of free Wheeling diode, Single Phase half and full controlled full Wave converters with R and RLE Load, 3 Phase half and fully controlled rectifiers, Power factor correction circuit.

DC to DC Converters:

Step up and Step Down choppers, 4 quadrant choppers for control of DC motor, Basic concepts of bi-directional converter, Forward and Flyback converters.

Inverters

Single Phase Half Bridge and Full Bridge Inverters, 3 Phase Inverters, 180° and 120° conduction, Voltage Control of inverters, Concept of multi level inverters, modulation techniques.

AC to AC Converters:

Single phase AC Voltage regulator with R and RL load, Single phase mid-point type cyclo-converter with R-L Load.

Textbooks

1. M. H. Rashid, Power Electronics, Devices, Circuits & Applications Pearson Education, 4th Edition, 2017.
2. Philip T. Krein, Elements of Power Electronics, Oxford University Press, 2nd Edition, 2017.
3. P S Bhimbra, Power Electronics, Khanna Publishers, 7th Edition, 2022.

Reference books

1. N. Mohan, Undeland and Robbins, Power Electronics, Converters, Applications and Design, John Wiley and Sons , 3rd Edition ,2009.
2. P. C Sen, Modern Power Electronics S Chand Publisher, 2013.
3. K.R.Varma and Chikku Abraham, Power Electronics, Cengage Publications, 2014.
4. M. D. Singh and K.B. Khanchandani, Power Electronics, McGraw - Hill, 2nd edition, 2017.

POWER ELECTRONICS LABORATORY

Course Code: EE39001

Credit: 1

L-T-P: 0-0-2

Prerequisite(s): Nil

COURSE OBJECTIVE

Utilities of Power Electronic Converters are introduced. The AC-DC converters are examined in details with R and RL loads. Analysis of DC-DC converters are done so that experimental verification can be facilitated. The principle of chopper is applied in the Fly-Back Converters for SMPS. The waveforms and the output voltage equation of SMPS are experimentally verified.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Choose an appropriate converter for variety of needs..

CO 2: Comprehend the principles of operation of various converters.

CO 3: Apply AC-DC converters for rectification..

CO 4: Analyze the parameters and the waveforms of the output of the converters.

CO 5: Assess the efficacy of a converter.

CO 6: Discuss about the merits and demerits of the converters.

POWER SYSTEMS LABORATORY

Course Code: EE39002

Credit: 1

L-T-P: 0-0-2

Prerequisites: Nil

COURSE OBJECTIVE

The main objective of the Power Systems laboratory is primarily used for teaching power system basic and advance modelling of transformers, transmission lines, fault analysis, protective relays characteristics and its schematics. The Power Systems Laboratory is equipped with different Protection Scheme of Alternator, over Current Relay, over voltage relay, Percentage biased Differential Relay, Microcontroller based negative sequence relay, Transmission line simulator kit. From this laboratory courses student will gain the skill to analyse the performance of power system networks, study different power system protective relays & develop computer software programs for analysis of power systems.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Spell the characteristics of a transmission line.

CO 2: Comprehend the uses of different relays in power systems.

CO 3: Apply suitable techniques to locate the fault of an underground cable.

CO 4: Analyze the results of short circuit analysis for symmetrical and unsymmetrical faults.

CO 5: Assess the characteristics of a solar PV module.

CO 6: Discuss the procedural steps needed to implement for interpreting the results of the power system software.

PROGRAMMABLE LOGIC CONTROL LABORATORY

Course Code: EE39007

Credit: 1

L-T-P: 0-0-2

Prerequisite(s): Nil

COURSE OBJECTIVE

PLC Laboratory is to aware the students about the Industrial Automation Techniques. The students will be familiar with different switches, sensors, actuators and measuring instruments which are most frequently used in process control industries. The students will be enabling with the upgraded relevant advanced software based controller utilized in modern industry. PLC laboratory gives the effort for making them efficient to design and construct the hardware part related to desired process control. Students can be able to know the technique and logical programme behind the Industrial process Control.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Spell typical components of a Programmable Logic Controller.

CO 2: Explain the concept of electrical ladder logic and its relationship to programmed PLC instruction.

- CO 3: Apply the concept of basic digital electronics and data manipulation.
 CO 4: Analyse the timers and counters using intermediate programming functions.
 CO 5: Evaluate the PLC circuits for entry-level PLC applications.
 CO 6: Design and program automated industrial production line.

ELECTRIC VEHICLE TECHNOLOGY

Subject Code: EE40010

Credits: 3

L-T-P: 3-0-0

Pre-requisites: Nil

COURSE OBJECTIVE

To understand and develop a vehicle model with a focus on the analysis of power train components and selection of battery systems for the Design of electric vehicles.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Understand the history and renaissance of EVs.
- CO 2: Study the power train configuration of EV systems.
- CO 3: Analyze the control of various traction motors for EVs.
- CO 4: Demonstrate the basics of energy storage systems.
- CO 5: Describe Types of Battery systems for EVs.
- CO 6: Design of Electric Vehicle system.

COURSE DETAIL

Introduction

A brief history of Electric vehicles, The Renaissance of EVs, social and environmental importance of electric vehicles.

EVs and HEVs

The basic concept of electric traction, introduction to various electric drive-train topologies, Power flow control in electric drive-train topologies, Fuel efficiency analysis, Challenges, and key technologies of EVs.

Electric Propulsion System

Introduction to electric components used in electric vehicles, Configuration, and control of Induction Motor drives, Permanent Magnet Motor drives, and Switch Reluctance Motor drives, and trends in electric motors for EVs.

Energy Storage

Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Hybridization of different energy storage devices. Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, and selecting the energy storage technology, Communications, and supporting subsystems.

Battery systems and Design of EVs

Introduction to battery management systems used in electric vehicles, exploration of different battery management strategies, Comparison of different battery management strategies. Trends and developments in battery systems for EVs and Concept of tariff systems used in charging stations.

Case Studies

Design of a Battery Electric Vehicle (BEV)

Textbooks

1. Husain, I. (2021). Electric and hybrid vehicles: design fundamentals. CRC press.
2. Emadi, A., Ehsani, M., & Miller, J. M. (Eds.). (2003). Vehicular electric power systems: land, sea, air, and space vehicles. CRC press.

Reference books

1. Ehsani, M., Gao, Y., Longo, S., & Ebrahimi, K. M. (2018). Modern electric, hybrid electric, and fuel cell vehicles. CRC press.
2. Larminie, J., & Lowry, J. (2012). Electric vehicle technology explained. John Wiley & Sons.
3. Brenna, M., Foiadelli, F., & Zaninelli, D. (2018). Electrical railway transportation systems. John Wiley & Sons.
4. Chan, C. C., & Chau, K. T. (2001). Modern electric vehicle technology (Vol. 47). Oxford University Press on Demand.

SMART GRID

Course Code: EE40012

Credit: 3

L-T-P: 3-0-0

Prerequisite: Nil

COURSE OBJECTIVE

To provide students with a working knowledge of fundamentals and development of Smart Grid, from the basic concepts of power systems.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO1: Know the different elements of smart grid.
- CO2: Demonstrate on Smart Grid Architecture.
- CO3: Describe in Synchro Phasor Measurement Unit.
- CO4: Understand the wide area monitoring system of smart grid.
- CO5: Solve the load flow analysis in micro grid.
- CO6: Control of the voltage and reactive power in smart grid.

COURSE DETAILS

Introduction to Smart Grid

Definition of smart grid, Components and Architecture of smart grid design, Review of the proposed architectures for smart grid, The fundamental components of smart grid designs, Transmission automation, Distribution automation, Renewable integration.

Tools and Techniques for Smart Grid

Synchro Phasor Measurement Units (PMUs), Computational intelligence techniques, Distribution Generation Technologies

Communication Technologies and Smart Grid

Computational techniques, Static and Dynamic optimization techniques, Introduction to communication technology, Evolutionary algorithms, Artificial intelligence techniques.

Control of Smart Power Grid System

Load Frequency Control (LFC) in micro grid system, Voltage control in micro grid system, Reactive power control in smart grid, Case studies and test beds for the smart grids.

Textbooks

1. James Momoh, "SMART GRID, Fundamentals of Design and Analysis" IEEE press, 2013.
2. A. G. Phadke and J. S. Thorp, "Synchronized Phasor Measurements and their Applications", Springer Edition, 2010

Reference books

1. Gil Masters, "Renewable and Efficient Electric Power System", Wiley–IEEE Press, 2004.
2. T. Ackermann, "Wind Power in Power Systems", Hoboken, NJ, USA, John Wiley, 2005.
3. Clark W Gellings P.E. "The Smart Grid enabling energy efficiency and demand response", CRC Press, 2013.
4. Stuart Borlase, "Smart Grids, Infrastructure, Technology and Solutions", CRC Press, 2013.

WIND AND BIOMASS ENERGY

Course Code: EE40013

Credit: 3

L-T-P: 3-0-0

Prerequisite: EE30016

COURSE OBJECTIVE

To provide a deep introduction about wind energy basics, wind energy conversion Technologies, Various types of Biomass energy sources and Biomass to energy conversion technologies.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Understand the basics of wind energy conversion and their operating characteristics
- CO 2: Understand the aerodynamics of wind rotor and design the wind turbine system
- CO 3: Understand the use of different power electronics converters and electrical machines used in standalone wind energy conversion systems.
- CO 4: Analyze the nature and principles of bioenergy systems.
- CO 5: Prioritize the concept of waste management to produce energy
- CO 6: Analyze the mechanism of different Biomass energy conversion technologies.

COURSE DETAILS

Wind Energy: Basics &Types of Turbines

Sources of Energy: Renewable energy sources and features. Introduction to wind energy. Wind Turbine Sitting, General theories of wind machines: Basic laws and concept of aerodynamics, efficiency limit for wind energy conversion. Description and performances of horizontal axis wind turbine: Design of the blades and determination of forces acting on the wind power plant, power ~ speed and torque ~ speed characteristics of wind turbines, wind turbine control systems. Description and performances of vertical axis wind turbine

Wind Energy: Power Conversion Technologies and applications

Conversion to electrical power: Induction and synchronous generators, Grid connected and Self-excited induction generator operation, Generation schemes with variable speed turbines, Constant voltage and Constant frequency generation with power electronic control, Optimized control of induction generators and Synchronous generators. Reactive power compensation, Types of converters, Type of wind energy conversion system, MPPT techniques for wind electrical systems.

Biomass energy source

Biomass energy sources, Energy content of various Bio – fuels, Energy plantation, Origin of Biomass photo synthesis process, Biomass Characteristics, Briquetting, Pelletization, Agrochemical, sustainability of Biomass.

Biomass energy conversion technologies

Biomass Conversion Technologies, Urban Waste to Energy Conversion, Biomass Gasification: Types of gasifiers. Fixed bed gasifiers, Fluidized bed gasifiers. Biomass Liquefaction: Biomass to Ethanol Production, Bio Diesel from edible & non-edible oils, Production of Bio diesel from Honge & Jatropha seeds, Blending of Bio diesel, Performance analysis of diesel engines using bio diesel, Biogas production from waste Biomass, classification of Biogas digester, floating gasholder & fixed dome type.(Working Principle with diagram), Calculations for sizing the Biogas plant.

Textbooks

1. S. N. Bhadra, D. Kastha, S. Banerjee, Wind Electrical Systems, Oxford Univ. Press , 2005
2. B. H. Khan, "Non – Conventional Energy Resources" Tata Mc Graw Hill, 2nd edition 2009.

Reference books

1. Kothari D.P., "Renewable energy resources and emerging technologies", Prentice Hall of India Pvt. Ltd, 2006.
2. Rai G.D, "Non-Conventional Energy Sources", Khanna Publishers, 4th Edition 2000.
3. T. Ackermann, "Wind Power in Power Systems", John Wiley and Sons Ltd., 2005.

ENERGY MANAGEMENT AND SCADA

Course Code: EE40014

Credit: 3

L-T-P: 3-0-0

Prerequisite: Nil

COURSE OBJECTIVE

Energy management system provides the information about optimizing the performance of the generation including the economic aspects and monitoring and control the power system through computerized tools.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Know recent developments in Energy management System.
- CO 2: Understand economic load dispatch and unit commitment.
- CO 3: Analyze the economic aspect of energy production.
- CO 4: Demonstrate the knowledge of energy management to existing system.
- CO 5: Understand optimization and control of power systems.
- CO 6: Describe SCADA system.

COURSE DETAILS

Introduction to Energy Management

Energy Management Centers and Their Functions, Architectures, Characteristics of Power Generating Units and Economic Dispatch, Unit Commitment (Spinning Reserve, Thermal, Hydro and Fuel Constraints), Solution techniques of Unit Commitment, Generation Scheduling with Limited Energy, Energy management system.

Economic Aspect

Energy Production Cost – Cost Models, Budgeting and Planning, Practical Considerations, Interchange Evaluation for Regional Operations, Types of Interchanges.

SCADA System

Introduction to Supervisory Control and Data Acquisition, SCADA Functional requirements and Components, General features, Functions and Applications, Benefits, Configurations of SCADA, RTU (Remote Terminal Units) Connections, Power Systems SCADA and SCADA in Power System Automation.

Textbooks

1. Wood, A. J and Wollenberg, B. F, & sheble B.G.“Power Generation Operation and Control”, 2nd Edition John Wiley and Sons, 2003.
2. Handschin, Edmund, Petroianu& Alexandar. “Energy Management Systems”, Springer Verlag, 1990

Reference books

1. Green, J. N, Wilson, R, “Control and Automation of Electric Power Distribution Systems”, Taylor and Francis, 2007.

COMPUTER AIDED POWER SYSTEMS

Course Code: EE40015

Credit: 3

L-T-P: 3-0-0

Prerequisite: Nil

COURSE OBJECTIVE

This course is designed to give students the required knowledge to calculate the Y_{bus} including transformer and model the network using graph theory. It also give the information how to compute Z_{bus} and short circuit analysis using Z_{bus} and the transient stability analysis of a power system

COURSE OUTCOMES

After successfully completing the course, the students will be able to:

- CO 1: Formulate Bus admittance matrix during load flow study .
- CO 2: Model power system components using graph theory.
- CO 3: Formulate incidence and network matrix of 3-phase networks.
- CO 4: Calculate the Bus impedance (Z_{bus}) using algorithm.
- CO 5: Analyze the different fault study of 3-phase network using Z_{bus} .
- CO 6: Know the transient stability analysis.

COURSE DETAILS

Load Flow Study using Computer Techniques

Formation of Y_{bus} when regulating transformer present, Network matrices, Reference frame, Network graph, Tree, branch, Basic loop and Cut sets, Basic Incidence matrices, Augmented matrices, Primitive networks, Network matrices by Singular and Non-singular transformation with Bus frame of reference, Branch frame of reference, Loop frame of reference.

Three Phase Networks

Elements in impedance and admittance form, Balance excitation, Un-balance excitation, Transformation matrices for symmetrical components, Incidence and network matrix for 3-phase elements, Formation of Z_{bus} , Addition of branch, Addition of link problems.

Representation of Three Phase Elements in Short Circuit Study

Short circuit study of balanced network by Z_{bus} , LG fault, L-L fault, 3-ph fault with and without fault impedance, Problems.

Transient stability Analysis

Load representation, Network performance equation, Swing equation, Machine equation, Solution techniques in transient stability study, RK 4th order method, Problems.

Textbooks

1. Glenn W. Stagg, Ahmed H. El-Abiad, Computer Methods in Power System Analysis, McGraw-Hill Book Company, International Editions, 2009.
2. L. P. Singh, Advanced Power System Analysis and Dynamics, New Age International (P) Limited, Publishers, Revised 4th Edition, 2011.

Reference books

1. N.V.Ramana, Power System Analysis, Pearson Publication,2011
2. M.A.Pai, Computer application techniques in Power System, TMH, 2006.

TIDAL AND SMALL HYDRO POWER

Course Code: EE40017

Credit: 3

L-T-P: 3-0-0

Prerequisite: EE30016

COURSE OBJECTIVE

The objective of this course is to provide an understanding of the principles and technology involved in the design, operation, and maintenance of small hydro and tidal power plants

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Understand the functioning of Hydro, Tidal, and Geothermal Energy systems.
- CO 2: Apply the knowledge in selecting the turbine according to site conditions.
- CO 3: Classify various Hydro power plant.
- CO 4: Estimate energy for various Tidal power plants.
- CO 5: Analyze the performance of different Tidal power plants.
- CO 6: Discuss the possible locations of SHP and Tidal energy around the globe.

COURSE DETAILS

Basic working principle of Hydro and Tidal power plant

Classification of Hydroelectric power plants: Large, small, Mini, Micro - Energy equation, Numerical problems. Tidal power, Mean extractable power, Numerical problems, Introduction to geothermal energy, Selection of Sites.

Hydro power Energy System

Turbine Size, Types of Hydraulic turbines, Pelton Wheel, Francis Turbine, Propeller and Kaplan Turbines, Bulb Turbine, Specific Speed, Selection of turbines, Spillways, Surge Tanks, Water Hammer, Draft Tube, Schemes of Hydro Plants, Run-of-River Plants, Valley Dam Plants, High Head Diversion Plants, Pumped Storage Plants.

Tidal Power System

Introduction to tidal energy, Tidal characteristics, Tidal range, Components of tidal Power plant, Types of tidal power plants- single basin single effect plant, Single basin double effect plant, Double basin double effect plants, and tidal energy estimation.

Scope of Hydro and Tidal Power Energy System

Possible locations of SHP and Tidal energy around the globe, Limitations, Some case Studies.

Textbooks

1. Nag P.K., "Power Plant Engineering" Tata McGraw Hill, 2nd Edition, 4th Fourth Reprint,2003.
2. R.H. Charlier, Ocean Energy: Tidal and Tidal power-, Springer, 2009.

Reference books

1. Bryan Leyland, Small hydroelectric engineering practice- CRC Press,2014.
2. Harvey, A., Brown, A. and Hettiarachi, P., "Micro Hydro Design Manual", Intermediate Technologym,1993.
3. GD Rai, "Non-Conventional Energy" Khanna publication, 2011.

POWER CONVERTER ANALYSIS AND DESIGN

Course Code: EE40019

Credits: 3

L-T-P: 3-0-0

Pre-requisites: Nil

COURSE OBJECTIVE

This course is intended to teach the fundamentals of power conversion and will cover the design and analysis of all types of power converters – such as, dc-dc converters, dc-ac inverters.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Learn the design of power electronics converters for different applications.

CO 2: Design high frequency transformers and Inductors.

CO 3: Analyze the operation and application of inverters.

CO 4: Describe resonant converter and SMPS in various industrial applications.

CO 5: Know the power quality improvement strategies using power electronic converters.

CO 6: Design the gate driver circuit for different semiconductor devices.

COURSE DETAIL

AC – DC Converters

Single phase Rectifier Circuit: L-C filter design, Performance parameter calculation, Heat Sink calculation.

DC to DC Converters

Non-isolated dc-dc converters: Design and operation of buck-boost, Cuk, SEPIC, Zeta in DCM and CCM.

Switch Mode Power

Isolated dc-dc converters: Operation of Flyback Converter, Forward Converter and push-pull Converters in CCM, Current Mode Control; Design of Magnetic Materials suitable for high frequency transformers.

Resonant Converters

Introduction to Soft switching, Difference between hard and Soft switching, Basic resonant circuit concept; ZCS and ZVS resonant converters; Electronic Ballasts.

Inverters

Modulation Strategies of inverter: Bipolar and Unipolar switching scheme; Performance parameters of 3 phase Sinusoidal PWM Inverters; Harmonic reduction techniques, Multi-level inverters-configurations: Diode clamped, Flying capacitor, Cascaded multi-level inverters and Applications.

Gate drive Circuits

Gate drive circuits for MOSFET, IGBT.

Textbooks

1. M.H. Rashid, Power Electronics, Pearson Education, 3rd Edition, 2009.
2. N. Mohan, Under land and Robbins, Power Electronics, Converters, Applications and Design, John Wiely and Sons, 3rd Edition, 2011.

Reference books

1. M.D. Singh and K.B. Khanchandani, Power Electronics, Tata McGraw - Hill publishers, 2nd edition, 2008.
2. P.C Sen, Modern Power Electronics, Wheeler publishing Co, First Edition, 2009.
- . Philip T. Krein, Elements of Power Electronics, Oxford University Press, 25 Sept 1997.

ENERGY STORAGE TECHNOLOGY

Course Code: EE40035

Credits: 3

L-T-P: 3-0-0

Pre-requisites: Nil

COURSE OBJECTIVE

This course introduces the procedure for energy storage and provides a broad understanding and scientific principles of operations and the importance of the Fuel cell for recent needs.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Describe application of different energy storage systems.
- CO 2: Understand the performance of different types of energy storage device.
- CO 3: Analyze the principle of different types of fuel cell.
- CO 4: Understand different types of battery technology.
- CO 5: Solve the state of charge of batteries using different techniques.
- CO 6: Know super capacitor, green house heating.

COURSE DETAIL

Introduction

Energy availability, Demand and Storage, Need for energy storage, Different types of energy storage; Mechanical, Chemical, Electrical, Electrochemical, Biological, Magnetic, Electromagnetic, Thermal, Comparison of energy storage technologies.

Mechanical, Thermal Energy Storage

Flywheel storage, Hydro storage, Capacitor, Principles and Applications, Thermal energy storage, Principles and applications, Phase change materials; Energy analysis of thermal energy storage, Solar energy and Thermal energy storage.

Electrochemical Energy Storage

Electrochemical energy storage: Battery fundamentals and technologies, Characteristics and Performance comparison of Lead-acid, Nickel-Metal hydride, Lithium Ion; Battery system model, Emerging trends in batteries, Voltages and Capacities of Electro-chemical Cells, Equivalent Circuit of an Electrochemical Cell, Charging and Discharging operation of batteries, State-of-charge (SOC) of batteries, Battery management systems.

Fuel Cells

Hydrogen as energy carrier and Storage; Hydrogen resources and Production; Basic principles; Fuel cell types: AFC, PEMFC, MCFC, SOFC, Microbial Fuel cell; Fuel cell performance; Fuel cell applications for power and transportation.

Application of Energy Storage: Food preservation, Waste heat recovery, Solar energy storage: Greenhouse heating; Drying and heating for process industries.

Textbooks

1. Huggins R. A., Energy Storage: Fundamentals, Materials and Applications, second edition, Springer International Publishing, 2015.
2. Dincer I., and Rosen M. A., Thermal Energy Storage: Systems and Applications, second edition, Wiley, 2011.

Reference books

1. O'Hayre R., Cha S., Colella W., and Prinz F. B., Fuel Cell Fundamentals, Wiley, Second Edition, 2009.
2. Narayan R. and Viswanathan B., Chemical and Electrochemical Energy System, Universities Press, (1998).
3. Rahn C. D. and Wang C., Battery Systems Engineering, First Edition, Wiley, 2013.
4. Moseley P. T., and Garche J., Electrochemical Energy Storage for Renewable Sources and Grid Balancing, Elsevier Science, 2014.
5. Miller F. P., Vandome A. F., and John M. B., Compressed Air Energy Storage, VDM Publishing, 2010.

GIS & GPS APPLICATIONS

Course Code: CE28003

Credit: 1

L-T-P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

The objective of the course is to understand the GIS principles, applications, preparation of study maps, creation of interpolation maps, delineation of watershed, explain the functions of GPS and operation of GPS.

COURSE OUTCOMES

After successfully completing the course, the students will be able to CO 1: Explain the fundamentals of GIS, CO 2: Comprehend the operations of ArcGIS tools and prepare the layout of study area, CO 3: Create interpolation maps,

CO 4: Delineate watershed using ArcGIS,

CO 5: Describe the principles and functions of GPS, and CO 6: Operate GPS in the field for navigation.

COURSE DETAILS

- Overview of Geographic Information System (GIS)
- Familiarization to ArcGIS Interface
- Layout of study area
- Preparation of interpolation map
- Watershed delineation
- Remote sensing satellites
- Basics of Global position system
- Basic operations of GPS Handset
- GPS field surveying and data processing

Reference Books

1. Principles of geographical information systems by P.A. Burrough and R. A. McDonnell, Oxford University Press, UK.
2. Geographic information systems and science by M.F. Goodchild, P.A. Longley, D.J. Maguire and D.W. Rhind, John Wiley & Sons Ltd., England.
3. Global Positioning system: Principles and Applications by Satheesh Gopi, McGraw Hill Education.

CONCEPTS OF DATA STRUCTURES AND ALGORITHMS

Course Code: CS20001

Credit: 3

L-T-P: 3-0-0

Prerequisites: Nil

COURSE OBJECTIVE

The objective is to familiarize students with the Time Complexity and Space Complexity of algorithms. In addition, students will be acquainted with various techniques of sorting and searching, and implementing arrays, stacks, queues, and linked lists. This course also includes complex data structures like tree sand graphs related to real-life problems

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Apply the concepts of data structure and abstract data type (ADT).

CO 2: Synthesize the algorithm for real-life problems with time and space complexity analysis.

CO 3: Implement a linked data structure to solve various problems.

CO 4: Comprehend and apply stacks and Queues for applications such as expression evaluation, etc.

CO 5: Develop and implement Trees data structure.

CO 6: Implement and apply standard algorithms for searching and Sorting.

COURSE DETAILS

Introduction

Notations, Abstract Data Type, Algorithms and Types, Time complexity and Space complexity.

Arrays

Arrays, Sparse matrices, Polynomials.

Linked List

Linked Lists, Doubly linked lists, Circularly linked lists, Applications

Stacks and Queues

Stacks, Queues, Circular Queues, Double ended Queues, Applications in evaluation of expressions.

Trees

Tree representation, Binary Trees, Binary search trees, Tree traversal, Height balanced trees, AVLtrees.

Sorting and Searching

Sorting Techniques: Selection, Bubble, Insertion, Merge, Heap, Quick, Radix sort, Linear search, Binary search, Hash table methods.

Textbooks

1. M.Tenenbaum, Augestien, Data Structures using C, 3rd Edition, Pearson Education, 2007.
2. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, 2nd Edition, Addison-Wesley Educational Publishers, 2006.

Reference book

1. Sahni Horowitz,Fundamentals of Data Structure in C, Universities Press, 2nd Ed
2. J.P.Tremblay,P.G.Sorenson, An Introduction to Data Structures with Applications, 2nd Edition,Tata McGrawHill,1981.

OPERATING SYSTEMS

Course Code: CS20002

Credit: 3

L-T-P: 3 0-0

Pre-requisites: Nil

Course Objectives

- To provide knowledge about the services rendered by operating systems
- To explore the various scheduling policies and to provide solutions for critical section and deadlock problems
- To provide a detailed discussion of the various memory management techniques
- To discuss the various file-system design and implementation issues
- To discuss how the protection domains, help to achieve security in a system
- To explore the design and implementation issues of Distributed OS

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Distinguish between different types of modern operating systems, virtual machines
CO 2: Comprehend the techniques used to implement the process manager
CO 3: Comprehend virtual memory abstractions in operating systems
CO 4: Design and develop file system and I/O system
CO 5: Apply various mechanisms in storage management
CO 6: Design and develop OS modules for Distributed Environment

COURSE DETAIL

Introduction

Need for Operating Systems, Computer Systems, OS Operations, Abstract view of OS, Virtualization, Computing Environments, OS Services, OS Structures, System Calls, Building and Booting OS, Process, Threads, Multithreading.

Process Management

Process Scheduling, Process Co-ordination, Synchronization, Semaphores, Monitors, Hardware Synchronization, Deadlocks, Methods for Handling Deadlocks.

Memory Management

Memory Management Strategies, Contiguous and Non-Contiguous allocation, Virtual memory Management, Demand Paging, Page Placement and Replacement Policies.

File Management

File System, Basic concepts, File System design and Implementation, Case Study: Linux File Systems, Mass Storage Structure, Disk Scheduling, Disk Management, I/O Systems, System Protection and Security.

Distributed Systems

Distributed Systems, Distributed operating systems, Distributed file systems, Distributed Synchronization, OS architecture, Case study on LINUX and Windows OS.

Textbook

1. Silberschatz, Galvin, Gagne, "Operating System Concepts", John Wiley and Sons, Tenth Edition, 2018.

Reference books

1. William Stallings, "Operating Systems – Internals and Design Principles", Pearson Publications, Eighth Edition, 2014.
2. Andrew S. Tanenbaum, "Modern Operating Systems", Pearson Publications, Fourth Edition, 2014.
3. Dhananjay M. Dhamdhere, "Operating Systems, A Concept-Based Approach", McGraw Hill Education, Third Edition, 2012.

COMPUTER SYSTEM AND ARCHITECTURE

Course Code: CS20005

Credit: 3

L-T-P: 3 0-0

Pre-requisites: Nil

COURSE OBJECTIVES

- To understand the basic hardware and software issues of computer organization
- To understand how computations are performed at machine level
- To understand how data storage is happening at machine level
- To understand the memory hierarchies, cache memories and virtual memories
- To learn the different ways of communication with I/O devices

Course Outcome

After successfully completing the course, the students will be able to

- CO 1: Perceive the functions of hardware components of computer and its requirements for the execution of instructions.
CO 2: Choose Instruction Set Architecture (ISA): Instruction format, types, and various addressing modes.
CO 3: Apply the basic components to design the CPU: the ALU and control unit.
CO 4: Assess the different levels of memory organization: SRAM, DRAM, Cache memory, Virtual Memory.
CO 5: Design the ALU and it's operations: Addition, Subtraction, Multiplication, and Division.
CO 6: Classify and compare the I/O Organization and types of I/O Transfer.

COURSE DETAILS

Basic Structure of Computers

Computer Types, Functional Units, Basic Operational Concepts, Bus Structures, Machine Instructions and Programs: Memory Locations and Addresses, Memory Operations, Encoding of Machine Instructions, Addressing Modes, Instruction Types, Instruction Format, Instruction Length, Assembly Language, Subroutines, Additional Instructions, RISC vs CISC.

Basic Processing Unit

Fundamental Concepts, Execution of a Complete Instruction, Single and Multiple Bus CPU Organization, Hard-wired Control, Micro programmed Control unit.

Memory System

Basic Concepts, Semiconductor RAM Memories, Read Only Memories, Speed, Size, and Cost, Memory module design, Memory Hierarchy, Cache Memories, Mapping Functions, Replacement Algorithms, Memory Performance Considerations, Memory interleaving, Virtual Memories.

Input/ Output Organization

Accessing I/O Devices, Modes of I/O Transfer, Program Controlled I/O, Interrupts – Interrupt Hardware, Enabling and Disabling Interrupts, Handling Multiple Devices, Controlling Device Requests, Exceptions, Direct Memory Access.

Case Study

IA-32 Register Structure, IA-32 Addressing Modes, IA-32 Instructions, Machine Instruction Format, IA-32 Assembly Language, Program Flow Control, Logic and Shift/Rotate Instructions, Subroutines for IA-32, Programming examples.

Textbooks

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Computer Organization and Embedded Systems, 6th Edition, MGH, 2022.

Reference books

1. M. Morris Mano, Computer System Architecture, Pearson Education India, 3rd Edition
2. William Stallings, Computer Organization & Architecture, 11th Edition, Pearson Education, 2006.

DATABASE MANAGEMENT SYSTEMS

Course Code: CS20006

Credit: 3

L-T-P: 3-0-0

Prerequisites: Nil

COURSE OBJECTIVE

- To learn data models, conceptualize and depict a database system using ER diagram
- To understand the internal storage structures in a physical DB design
- To know the fundamental concepts of transaction processing techniques
- To understand the concept of Database Design in Normalization techniques
- To know the manipulation of SQL Queries

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Install, configure, and interact with a relational database management system

CO 2: Conceptualize and depict a database system using ER diagram.

CO 3: Master the basics of SQL and construct queries using SQL

CO 4: Design and develop a large database with optimal query processing

CO 5: Develop efficient storage scheme of saving and retrieving Records and Files

CO 6: Design the database with normalization techniques

COURSE DETAILS

Introduction

Purpose of Database System, Views of data, Data Models, Database Languages, Database System Architecture, Components of DBMS, Entity, Relationship model (E-R model), E-R Diagram notation, EER notations, Examples.

Relational Model

Relational Data Model, Concept of relations, Schema-instance distinction, keys, integrity rules, Relational algebra operators, SQL: Data definition, Data manipulation, Aggregate function, Null Values, Nested sub queries, Joined relations.

Database Design

Dependencies and Normal forms, Dependency theory, Functional dependencies, Armstrong's axioms for FD's, Closure of a set of FD's, minimal covers, Definitions of 1NF, 2NF, 3NF and BCNF, 4NF, 5NF, Decomposition and desirable properties of them.

Transaction Management

ACID properties, Serializability and concurrency control, Lock based concurrency control (2PL), Timestamp ordering protocol, Database recovery management.

Implementation Techniques

Overview of Physical Storage Media, Magnetic Disks, RAID, Tertiary storage, Organization of Records in Files, Indexing and Hashing, Ordered Indices, primary, Secondary index structures.

Textbooks

1. Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", Fifth Edition, Tata McGraw Hill, 2006.
2. C. J. Date, A. Kannan, S. Swamynathan, "An Introduction to Database Systems", Eighth Edition, Pearson Education, 2006.

Reference books

1. Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", Fourth Edition, Pearson/Addision Wesley, 2007.
2. Raghu Ramakrishnan, "Database Management Systems", Third Edition, McGraw Hill, 2003.
3. S. K. Singh, "Database Systems Concepts, Design and Applications", First Edition, Pearson Education, 2006.

DATA STRUCTURES

Course Code: CS21001

Credit: 4

L-T-P : 3-1-0

Prerequisites: Nil

COURSE OBJECTIVE

The basic course objective is to familiarize students with Time Complexity and Space Complexity for algorithm, various techniques of sorting and searching, design and implement arrays, stacks, queues, and linked lists, complex data structures such as trees and graphs, and use above knowledge to solve real life problems

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Use the concepts of data structure, data type and abstract data type to develop solutions for engineering problems.
- CO 2: Develop programs to implement linear data structures such as stacks, queues, linked lists, etc.
- CO 3: Apply the concept of trees and graph data structures in real world scenarios
- CO 4: Comprehend the implementation of sorting and searching algorithms
- CO 5: Compare Time Complexity and Space Complexity for algorithm
- CO 6: Effectively choose the data structure that efficiently models the information in a problem.

COURSE DETAILS

Introduction

Development of Algorithms, Notations and analysis, Storage structures for arrays, Sparse matrices, Stacks and Queues: Representations and applications.

Linked List, Stacks, and Queues

Linked Lists, Linked stacks and queues, Operations on polynomials, Doubly linked lists, Circularly linked lists, Dynamic storage management, Garbage collection and compaction.

Trees

Tree representation, Binary Trees, Binary search trees, Tree traversal, Expression manipulation, Symbol table construction, Height balanced trees, AVL trees.

Graphs

Graphs, Representation of graphs, BFS, DFS, Topological sort, String representation and Manipulations, Pattern matching.

Sorting and Searching

Sorting Techniques: Selection, Bubble, Insertion, Merge, Heap, Quick, Radix sort, Linear search, Binary search, Hash table methods.

Textbook

1. S. Sahani and S. Anderson-Freed, Fundamentals of Data Structures in C by E. Horowitz, Universities Press.

Reference book

1. Sartaj Sahni, "Data Structures, Algorithms and Applications in C++", Universities Press Pvt. Ltd., 2008.

WEB DESIGN

Course Code: CS28001

Credit: 1

L-T-P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

Web design and programming is a large field, with different types of technologies implemented by different tools. HTML, CSS, and JavaScript are known to be the three pillars of client-side web programming. After finishing this course, a student should be prepared to write nicely formatted, interactive web pages, with no dependencies on server-side technologies.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO1: Understand the basics of web page design,

CO2: Use formatting instructions of HTML,

CO3: Apply the style formats using CSS,

CO4: Write basic scripts using JavaScript,

CO5: Apply DOM in web pages, and

CO6: Create dynamic web pages using HTML and JavaScript.

COURSE DETAILS

HTML Fundamentals

HTML: Structure of a program, various tags and their roles in HTML programs, Lists: ordered, unordered, definition, Table.

More with HTML

Form design, Frames, link and its types, Images.

CSS Essentials

Style sheets: Inline, Internal, External.

JavaScript Basics

Introduction, characteristics, Variables, Data types, Type casting and conversion Functions. Primitives, operators, Control statements, Array, Function, Function – Parameter Passing and dynamic argument and return statement

More with JavaScript

DOM - browser, window, document, image and form object, Properties and Methods of different objects, Predefined Java Script Object - Array, String and Date Object and their methods, Event handling – Link, Body, Image and events associated with different HTML tags

Textbook

- MASTERING HTML, CSS & Java Script Web Publishing, Laura Lemay, Rafe Colburn and Jennifer Kyrnin, BPB Publications.

Reference Books

- HTML, CSS and JavaScript All in One, Sams Teach Yourself, Julie C. Meloni and Jennifer Kyrnin, Pearson Education.
- HTML 5 Black Book, DT Editorial Services, Dreamtech Press.

DATA STRUCTURES LAB

Course Code: CS29001

Credit: 1

L-T-P 0-0-2

Pre-requisites: Nil

COURSE OBJECTIVE

The fundamental objective of this course is to develop linear and non-linear data structures algorithms for practical application and analyze the algorithm in their time and space complexity.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Apply and implement the learned algorithm for problem-solving.
- CO 2: Develop the program for real-time application of the algorithm.
- CO 3: Design, develop, and implement optimal algorithms using appropriate data structures.
- CO 4: Implementation of priority queue for optimal algorithms.
- CO 5: Implement Binary Tree, Binary Search Tree, and AVL Trees for problem-solving
- CO 6: Analyze the different sorting and searching algorithm for real-time applications.

DATABASE MANAGEMENT SYSTEMS LAB

Course Code: CS29006

Credit: 1

L-T-P: 0-0-2

Pre-requisites: Nil

COURSE OBJECTIVE

- To explore the features of a Database Management Systems
- To interface a database with front end tools
- To understand the internals of a database system
- To identify Structure Query Language statements used in creation and manipulation of Database
- To identify the methodology of conceptual modeling through Entity Relationship model.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Identify Structure Query Language statements used in creation and manipulation of Database

CO 2: Use databases for building client server applications

CO 3: Comprehend the internal working of a database system

CO 4: Design and develop a database using SQL and the mechanism in connecting with a Web based GUI

CO 5: Analyze and design a real database application

CO 6: Evaluate the efficiency of the database design for real time applications.

PROGRAMMING WITH PYTHON AND JAVA

Course Code: CS29008

Credit: 2

L-T-P: 0-0-4

Pre-requisites: NIL

COURSE OBJECTIVE

This lab course starts with basic concepts in Python and ramps up to more complex subjects such as object-oriented programming and data structures in Java. The objective is to impart programming skills and make students competent to decide between JAVA and Python while working on various interfacing and writing fully-functional programs using the two most well-known and frequently used programming languages. Python deliverables include conditional programming, file I/O, data analysis, and visualization using Jupyter Notebook. Java programs include a text file parser that reads, writes, and analyzes text files using Eclipse; students will appraise object-oriented principles, data structures, file I/O, unit testing, and debugging process.

COURSE OUTCOMES

After successful completion of this course, the students will be able to:

- CO 1: Gain skills on Python programming concepts, including how to configure tools for Python code and write fully functional programs using data structures.
- CO 2: Examine core data science techniques by applying learned skills in data aggregation and summarization, including using data analysis libraries and developing data visualization skills.
- CO 3: Write fully-functional Python programs using commonly used data structures, custom functions, reading and writing to files for specified applications
- CO 4: Apply core principles of object-oriented programming and Java to write fully functional programs using classes and methods.
- CO 5: Gain competency to use Java inheritance and apply techniques for parsing text in files, using advanced data structures to store information, and debugging code
- CO 6: Write programs using abstract classes interfaces and packages, multi threading, exception handling and design Java application using String and I/O classes

DESIGN AND ANALYSIS OF ALGORITHMS

Course Code: CS30001
Credit: 3
L-T-P: 3-0-0
Pre-requisites: CS21001

COURSE OBJECTIVES

- To understand the importance of algorithm
- To analyze the complexity of an algorithm in terms of time and space complexities
- To understand various problem solving techniques
- To learn about amortized analysis of algorithms
- To design and implement various programming paradigms and its complexity

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO1: Analyze the time and space complexity for any algorithm

CO2: Compare and contrast different algorithm techniques

CO3: Apply the design techniques of algorithm in solving real world problems

CO4: Perform amortize analysis for any algorithm

CO5: Modify existing algorithms to apply in common engineering design situations

CO6: Use NP class of problems to propose approximation algorithms

COURSE DETAILS

Introduction

Concepts in algorithm analysis & design motivation, Space and Time Complexity of algorithm, Asymptotic Notations (Big Oh, Omega, Theta), Analysis of time complexity of Insertion Sort by step count method, Solving recurrences using Iterative, Substitution, Recurrence Tree, Master theorem

Divide & Conquer and Greedy Approaches

Divide and Conquer method, Greedy method, Huffman code, Minimum spanning trees, Dijkstra algorithm, Knapsack problem, Job sequencing with deadlines.

Dynamic Programming Approaches

Dynamic Programming, Knapsack problem, Matrix Chain Multiplication, longest common subsequence Multistage graphs, All pair's shortest paths, Optimal binary search trees, Travelling salesman problem.

Amortization

Randomized Algorithms and Amortized Analysis, Las Vegas and Monte Carlo types, Randomized quick sort andits analysis, Min-Cut algorithm.

NP Problems

NP-Hard and NP-complete problems, Basic concepts, Reducibility, Vertex cover, 3CNF_SAT, clique, Hamiltoniancycle, TSP, Approximation algorithms, Vertex cover, TSP.

Textbook

1. T. Cormen, C. Lieserson, R. Rivest, C. Stein, "Introductions to Algorithms", MIT Press , Third Edition, 2009.

Reference books

1. M. Tenenbaum, Augestien, "Data Structures using C", Pearson Education, Third Edition, 2007.
2. E. Harwitz, S. Sahani, S. Rajsekharan, Galgotia "Fundamentals of Computer Algorithms", Galgotia Publication.

COMPUTER NETWORKS

Course Code: CS30003

Credit: 3

L-T-P: 3-0-0

Pre-requisite: Nil

COURSE OBJECTIVES

- To provide insight about fundamental concepts and reference models (OSI and TCP/IP) and its functionalists
- To gain comprehensive knowledge about the principles, protocols, and significance of Layers in OSI and TCP/IP
- To know the implementation of various protocols and cryptography techniques
- Learn the flow control and congestion control algorithms

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO1: Use of different models for study of computer networks
- CO2: Identify the components required to build different types of networks
- CO3: Choose the required functionality at each layer for given application
- CO4: Identify solution for each functionality at each layer
- CO5: Trace the flow of information from one node to another node in the network
- CO6: Build networking solutions using the concepts of world wide web and electronic mail technologies

COURSE DETAILS

Data Communications

Data Transmission, Multiplexing, Data Encoding Techniques, Introduction to computer networks, Network, Topologies, Reference Models: ISO/OSI Model and TCP/IP Model.

Physical Layer

Transmission Media, Analog signals, Digital Signals, Data Link Layer, Error Detection and Correction, Parity, LRC, CRC, Hamming Code, Flow Control and Error Control, Stop and wait, ARQ, Sliding window – IEEE, Ethernet.

Network Layer

Packet Switching and Circuit Switching, IP addressing methods, Subnetting, Supernetting, Routing Protocols: IP, ARP, RARP, DHCP, Routing Algorithms: Distance Vector Routing, Link State Routing.

Transport Layer

Transport Services, UDP, TCP, Congestion Control, Quality of Services (QOS).

Application Layer

Domain Name Space (DNS), Electronic Mail, HTTP, WWW.

Textbooks

1. Andrew S. Tanenbaum, David J. Wetherall, "Computer Networks", Pearson, Fifth Edition,
2. Behrouz A. Foruzan, "Data Communication and Networking", Science Engineering & Math Publications, Fifth Edition, 2013.

Reference books

1. W. Stallings, "Data and Computer Communication", Pearson Education, Tenth Edition, 2014.
2. Larry L. Peterson, Bruce S. Davie, "Computer Networks: A Systems Approach", Morgan Kaufmann Publishers, Fifth Edition, 2011.
3. Nader F. Mir, "Computer and Communication Networks", Pearson, 2010.

HIGH PERFORMANCE COMPUTING

Course Code: CS30005

Credit: 3

L-T-P: 3-0-0

Pre-requisite: CS20005

COURSE OBJECTIVES

- To understand the concept of advanced pipelining techniques
- To understand the current state of art in memory system design
- To know the working principle of I/O devices
- To understand the memory management techniques

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO1 : Choose performance metrics to find the performance of systems

CO2 : Identify the program block that requires parallelism for any program

CO3: Comprehend the concept of different types of hazards along with the structural implementation and applications.

CO4: Elaborate the criteria to enhance the performance of the pipelined processors.

CO5: Design algorithms for memory management techniques for multiprocessor system

CO6: Identify various parallel architecture like centralized and distributed memory architecture required for real life application

COURSE DETAILS:

Introduction, Classes of computers, Defining Computer Architecture, Trends in Technology, Trends in Power and Energy in Integrated Circuits, Trends in Cost, Dependability, Measuring, Reporting and Summarizing Performance, Quantitative Principles of Computer Design

Basic and Intermediate pipelining Concepts, The Major Hurdle of Pipelining, Pipeline Hazards, Pipelining Implementation, Implementation issues that make Pipelining hard, Extending the MIPS Pipeline to Handle Multicycle Operations, The MIPS R4000 Pipeline.

Instruction Level Parallelism: Concepts and Challenges, Basic Compiler Techniques for Exposing ILP, Reducing Branch Costs with Prediction, Overcoming Data Hazards with Dynamic Scheduling, Dynamic Scheduling, Hardware Based Speculation, Exploiting ILP Using Multiple Issue and Static Scheduling, Exploiting ILP, Advanced Techniques for Instruction Delivery and Speculation, Studies of the Limitations of ILP.

Vector Architecture, SIMD Instruction Set Extensions for Multimedia, Graphics Processing Units, Detecting and Enhancing Loop-Level Parallelism, Centralized Shared-Memory Architectures, Performance of Shared-Memory Multiprocessors, Distributed Shared Memory, Models of Memory Consistency, Multicore Processors and their Performance.

Review of Memory Hierarchy Design, Cache Performance, Basic Cache Optimizations, Virtual Memory, Protection and Examples of Virtual Memory, Advanced Optimizations of Cache Performance, Memory Technology and Optimizations, Protection: Virtual Memory and Virtual Machines, Crosscutting Issues: The Design of Memory Hierarchies, Case Studies / Lab Exercises.

Textbooks

1. David. A. Patterson, John L. Hennessy, “Computer Architecture: A Quantitative approach”, Sixth Edition,Morgan Kaufmann, 2012.

Reference books

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Naraig Manjikian, “Computer Organization and Embedded Systems”, Sixth Edition, McGraw Hill Inc, 2022.
2. William Stallings “Computer Organization and Architecture”, Eleventh Edition, Pearson Education, 2006.

DISTRIBUTED OPERATING SYSTEMS

Course Code: CS30009

Credit: 3

L-T-P: 3-0-0

Pre-requisite: CS20002

COURSE OBJECTIVES

- To understand the fundamentals of distributed system
- To be able to know the basic concepts of shared memory architecture
- To be able to understand various implementation difficulties of distributed operating systems
- To be able to understand transparency in distributed operating systems

COURSE OUTCOMES:

After successfully completing the course, the students will be able to

CO1: Assess the concept of Distributed Operating Systems

CO2: Enlist the communication techniques in Distributed Operating Systems

CO3: Determine the clock synchronous concepts and algorithms

CO4: Examine the distributed system that fulfills requirements with regards to key distributed systems properties

CO5: Discuss distributed shared memory architectures and algorithms

CO6: Analyze the distributed files systems

COURSE DETAILS:

Fundamentals of Distributed Systems:

Introduction to distributed systems, Goals of Distributed Systems, Hardware Concepts, Software Concepts, Design Issues, Network Operating Systems, True Distributed System and Time sharing Multiprocessor Operating System, System Architectures.

Communication in Distributed Systems:

Basics of Communication Systems, Layered Protocols, ATM Models, Client Server Model, Blocking Primitives and Non Blocking Primitives, Buffered Primitives and Unbuffered Primitives, Reliable and Unreliable primitives, Message Passing, Remote Procedure Call.

Synchronization and Processes:

Clock Synchronization, Mutual Exclusion, Election Algorithm, Atomic Transactions, Deadlock in Distributed Systems, Process and Threads, System Models, Processor Allocation, Process Scheduling.

Consistency, Replication and Fault Tolerance:

Data Centric Consistency Models, Client-Centric Consistency Models, Replica Management, Consistency protocols, Fault Tolerance, Process Resilience, Distributed Commit, Reliable Client Server Communication, Reliable Client Server Communication.

Overview of shared memory:

Architecture, Algorithm, Protocols, Design Issues, consistency model, Page based Distributed Shared Memory, Shared variable Distributed shared Memory, and Object based Distributed Shared Memory.

Textbooks:

1. Andrew S. Tanenbaum, "Distributed Operating Systems", Pearson Education, 1995.

Reference Books:

1. G. Coulouris, J. Dollimore, and T. Kindberg, "Distributed Systems: Concepts & Design", Pearson Publication, 4th Edition, 2005.
2. Pradeep K. Sinha, "Distributed Operating Systems Concepts and Design", PHI, 1998.

CLOUD COMPUTING

Course Code: CS30010

Credit: 3

L-T-P: 3-0-0

Prerequisites: CS20002

COURSE OBJECTIVE

- To provide an in-depth and comprehensive knowledge of the deployment models in Cloud Computing
- To understand the enabling technologies needed for establishing cloud environment
- To motivate students to do programming and experiment with the various cloud computing environments
- To shed light on the cloud providers and software platforms
- To introduce about different programming models in cloud computing

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Articulate the main concepts, key technologies, strengths, and limitations of cloud computing and the possible applications for state-of-the-art cloud computing
- CO 2: Compare the various cloud services and cloud platforms
- CO 3: Identify the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, Public cloud, Private cloud, Hybrid cloud
- CO 4: Adopt suitable computing mechanisms for establishing a cloud environment
- CO 5: Examine various cloud applications and issues.
- CO 6: Provide the appropriate cloud computing solutions and recommendations according to the applications used

COURSE DETAILS

Introduction

Evolution: Clustering, Grid computing, Virtualization, Basic concepts, Benefits and Risks, Roles and Boundaries, Characteristics, XaaS based service offerings, Basic Deployment models.

Enabling Technologies

Networks: ISPs, Connection less Packet Switching, Router-based Inter-connectivity, Technical and Business Considerations, Data Center: Standardization and Modularity, Automation, Remote Operation, High Availability, Hardware Virtualization: Hardware Independence, Server Consolidation, Resource Replication, OS and hardware based Virtualization, Web Technology, Multitenant Technology, Service Technology.

Computing Mechanisms

Infrastructure: Logical Network Perimeter, Virtual Server, Storage Device, Usage Monitor, Resource Replication, Specialized: Automated Scaling Listener, Load Balancer, Monitors, Failover System, Hypervisor, Resource Cluster, Multi-Device Broker, State Management Database, Management: Resource, SLA, Billing, Remote Administration, Security.

Cloud Providers & Software Platforms

Globally available public clouds (Microsoft Azure, Amazon Web Services, Google Cloud Platform): Overview and Comparison, Instances, Images, Networking and Security, Storage, Monitoring and Automation, Introduction to Open-source softwares: Eucalyptus, Open Nebula, Open Stack, Apache Cloud Stack.

Programming Models & Advances

Introduction to Map Reduce, Apache Spark, Tensor Flow, Inter cloud: Architecture, Resource Provisioning, Billing, Security, Mobile Cloud Computing: Resource Allocation, Security, Business Aspects, Application, Future Scope, Introduction to Edge and Fog Computing.

Textbook

1. Kai Hwang, Geoffrey C. Fox, and Jack J. Dongarra, “Distributed and Cloud Computing from Parallel Processing to the Internet of Things”, Morgan Kaufmann, Elsevier, 2012.

Reference books

1. Barrie Sosinsky, “Cloud Computing Bible”, John Wiley & Sons, 2010.
2. Tim Mather, Subra Kumaraswamy, Shahed Latif, “Cloud Security and Privacy: An Enterprise Perspectiveon Risks and Compliance”, O'Reilly, 2009.
3. James Turnbull, “The Docker Book: Containerization is the New Virtualization”, E-Book, 2015.

COMPUTATIONAL INTELLIGENCE

Course Code: CS30011

Credit: 3

L-T-P: 3-0-0

Prerequisites: Nil

COURSE OBJECTIVE

- To understand the basic concepts and characteristics of soft computing
- To understand and analyse fuzzy rules, fuzzy reasoning and various fuzzy inference systems
- To be able to know derivative free optimization and apply genetic algorithms to optimization problems
- To apply neural networks to various classification problems.
- To know some hybrid models such as adaptive Neuro-fuzzy inference systems

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO1: Identify the basic concepts and characteristics of soft computing and also its associated methodologies.

CO2: Apply various set theoretic operations in fuzzy sets.

CO3: Analyze fuzzy rules, fuzzy reasoning and various fuzzy inference systems.

CO4: Choose derivative free optimization and apply genetic algorithms to optimization problems.

CO5: Assess concepts of artificial neural networks and apply neural networks to various classification problems.

CO6: Analyze some hybrid models such as adaptive neuro-fuzzy inference systems.

COURSE DETAILS

Introduction

Introduction, Soft Computing constituents and Conventional AI, Neuro-Fuzzy and Soft Computing characteristics

Artificial Neural Networks

Introduction to ANN, Perceptrons and MLP, Adaline and Madaline, Back-propagation Multilayer Perceptrons (BPMLP), Radial Basis Function Networks (RBF), Kohonen Self-Organizing Networks, Learning Vector Quantization, Hebbian Learning, Hopfield networks.

Fuzzy Set Theory

Fuzzy sets, Basic Definition and Terminology, Set-theoretic Operations, Member Function Formulation and Parameterization, More on Union, Intersection and Complement, Extension Principle and Fuzzy Relations, Fuzzy If-Then Rules, Fuzzy Reasoning, Fuzzy Inference Systems, Mamdani Fuzzy Models, Sugeno Fuzzy Models, Tsukamoto Fuzzy Models, Adaptive Neuro-Fuzzy Inference Systems(ANFIS), ANFIS Architecture, Hybrid Learning Algorithm

Particle Swarm Optimization

PSO Model, Global Best, Local Best, Velocity Update Equations, Position Update Equations, Velocity Clamping, Inertia Weight, Constriction Coefficients, Synchronous and Asynchronous Updates, Binary PSO.

Differential Evolution

DE as modified GA, generation of population, operators and their implementation.

Ant Colony Optimization

Basic Concepts, Ant System, Application.

Artificial Bee Colony

Historical Development, Types of Bees and Their Role in the Optimization Process.

Textbooks:

1. Jang, Sun, Mizutani, Neuro-Fuzzy and Soft Computing, Pearson Education

Reference Books:

1. Adam Slowik, Swarm Intelligence Algorithms: A Tutorial, Ed: CRC Press, 2020
2. Simon Haykin, Neural Networks: A Comprehensive Foundation, Pearson Education
3. David E. Goldberg, Genetic Algorithms, Pearson Publication, 2003

WEB TECHNOLOGY AND APPLICATIONS

Course Code: CS30019

Credits: 3

L-T-P: 3-0-0

Pre-requisites: Nil

COURSE OBJECTIVES

- To understand the basics of Web Designing using HTML, DHTML, and CSS
- To learn the basics about Client side scripts and Server side scripts

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO1: Describe and interpret standard web technologies

CO2: Apply the basics of Web Designing using HTML, DHTML, and CSS

CO3: Build real world applications using client side and server side scripting languages

CO4: Design and develop applications using web technologies

CO5: Create the database connectivities

CO6: Suggest appropriate web technologies for any application

COURSE DETAILS

HTML, Introduction, HTML Formatting, Hyper-Links, Lists, Tables, Images, Forms, Frames, Cascading Style sheets, Types, XML, Document type definition, XML Schemas, Document Object model.*

Introduction to Client Side scripting, JavaScript, Control statements, Functions, Arrays, Objects, Events, Dynamic HTML with Java Script, AJAX: Ajax Client Server Architecture, XML Http Request Object, Call BackMethods.

NodeJS and Express, Introduction to AngularJS and Fundamentals of ReactJS, Web servers, IIS (XAMPP, LAMPP) and Tomcat Servers, Server Side Scripting, Java Servlets, Java Server Pages, Java Server Faces, JSFComponents, Session Tracking, Cookies.

PHP, Basic Syntax, Defining variable and constant, PHP Data types, Operator and Expression, Operator Precedence, Decisions and Loop, Functions & Recursion, String Processing and Regular Expressions, Form Processing, Working with file and Directories, Cookies

Database Connectivity with MySQL, Servlets, JSP, PHP, MongoDB, NOSQL Database*, Fundamentals of JQuery and Bootstrap

Textbooks:

1. Paul J. Deitel, Harvey M. Deitel, Abbey Deitel, “Internet & World Wide Web How to Program”, Fifth Edition, Deitel Series, 2012.
2. Jason Gilmore, “Beginning PHP and MySQL from Novice to Professional”, Fourth Edition, Apress Publications, 2010.(Foreign books with available in the publisher site)
3. Brown, Ethan, “Web Development with Node and Express: Leveraging the JavaScript Stack”, Second Edition O'ReillyMedia,.
4. Anthony, Accomazzo, Murray Nathaniel, Lerner Ari, “Fullstack React: The Complete Guide to React JS and Friends”, Fullstack.io, 2017.(Not available in the publisher site)

Reference books:

1. Robert W. Sebesta, “Programming with World Wide Web”, Fourth Edition, Pearson, 2008.

2. David William Barron, "The World of Scripting Languages", Wiley Publications, 2000.
3. Dayley B., "Node.js, MongoDB, and AngularJS Web Development", Addison-Wesley Professional, 2014.
4. Vainikka J., "Full-Stack Web Development using Django REST Framework and React", 2018.

SOFTWARE DEFINED NETWORKING

Course Code: CS30023
Credit: 3
L-T-P: 3-0-0
Prerequisite: CS30003/EC30004

COURSE OBJECTIVES

- Analyze reduced Complexity of Network Operation
- Describe and understand the concepts of minimize Layer and maximize Network Resources
- Evaluate and understand the Faster Time to Revenue for New Applications
- Memorize Data center and its usage
- Illustrate about Big data

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Comprehend Software Defined Networks

CO 2: Analyze reduced Complexity of Network Operation

CO 3: Compare and analyze the advantages of SDN over traditional network

CO 4: Design and implement software defined network

CO 5: Design algorithm for virtualization

CO 6: Design algorithm for big data analytics

COURSE DETAILS

Introduction

Introduction, Control Plane, Data Plane, Distributed Control Planes, IP and MPLS, Creating the IP Underlay, Convergence Time, Load Balancing High Availability, Creating the MPLS Overlay, Replication, Centralized Control Planes, Logical Versus Litera, ATM/LANE, Route Servers, Wire Protocol, FAWG, Config and Extensibility, Architecture, Hybrid Approaches, Ships in the Night, Dual Function Switches.*

Interface

VMWare, Nicira, Mininet, NOX/POX, Trema, Ryu, Big Switch Networks/Floodlight, Layer 3 Centric, L3VPN, Path Computation Element Server, Plexxi Affinity, Cisco OnePK, Management Interface, Network Divide, Modern Programmatic Interfaces, Modern Orchestration.*

Data Center

Multitenant Data Center, Virtualized Multitenant Data Center, SDN Solutions for Data Center Network, VLANs, EVPN, VxLan, NVGRE, Virtualization and Data Plane I/O, Services Engineered Path, Service Locations and Chaining, NEV at ETSI, Non-ETSI NEV Work.*

Topology

Network Topology, Traditional Methods, LLDP, BGP-TE/LS, ALTO, I2RS, Build Code First, The Juniper SDN Framework(s), Open Daylight Controller/Framework, Policy.*

Technology:

Bandwidth Scheduling, Manipulation, Calendaring, Bandwidth Calendaring, Big Data and Application Hyper, Virtualization for Instant CSPF, Expanding Technology, Use Cases for Data Center Overlays, Big Data,

Network Function Virtualization, Data Center Orchestration, Puppet, Network Function Virtualization, Optimized Big Data, Firewall as Service, Network Access Control Replacement, Virtual Firewall, Feed Back and Optimization, Intrusion Detection/Threat Mitigation.*

*Programming Assignments are mandatory

Textbooks

1. Thomas D. Nadeau, Ken Gray, "Software Defined Networks", First Edition, O' Reilly Media Inc., 2013.
2. FEI HU, "Network Innovation through Open Flow and SDN: Principles and Design", CRC Press, 2014.

Reference Books

1. Azodolmolky, Siamak, "Software Defined Networking with OpenFlow", Packt Publishing Ltd., 2013.
2. Nadeau, Thomas D., Ken Gray, "SDN: Software Defined Networks: An Authoritative Review of Network Programmability Technologies", O'Reilly Media Inc., 2013.
3. Dillinger, Markus, Kambiz Madani, Nancy Alonistioti, "Software Defined Radio: Architectures, Systems and Functions", John Wiley & Sons, 2005.
4. Goransson, Paul, Chuck Black, Timothy Culver, "Software Defined Networks: A Comprehensive Approach", Morgan Kaufmann, 2016.

COMPUTER VISION AND PATTERN RECOGNITION

Course Code: CS30029

Credit: 3

L-T-P: 3-0-0

Prerequisites: Nil

COURSE OBJECTIVE

The challenge of computer vision is to develop a computer based system with the capabilities of the human eye-brain system. It is therefore primarily concerned with the problem of capturing and making sense of digital images. The field draws heavily on many subjects including digital image processing, artificial intelligence, computer graphics and psychology. The objectives are to develop students' understanding of the basic principles and techniques of image processing, image understanding, and to develop skillsets in the design and implementation of computer vision techniques.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO1: Explain the image formation and camera technologies
- CO2: Perform feature extraction using different image processing techniques.
- CO3: Differentiate between image formats
- CO4: Perform image transformation based on different types of transformation techniques.
- CO5: Design filters to perform image analysis using spatial and frequency domain methods.
- CO6: Design systems to detect and track various objects.

COURSE DETAILS

Digital Image Fundamentals

Elements of visual perception, A simple image model, Sampling and Quantization, Relationship between pixels, image geometry: Translation, Rotation.

Image Analysis

Introduction spatial domain methods, Frequency domain method, Enhancement by point processing : Histogram equalization, Spatial filtering : Mean & Median filter, Sharpening filter, High boost filters, Derivative filters, Enhancement in frequency domain, Homomorphic filtering.

Image Transform Review of mathematical preliminaries

Toepplitz and Circulant matrices, Orthogonal and Unitary matrices, Block matrices and Kronecker products, Separable operators, Introduction to image transforms, Two dimensional orthogonal and Unitary transforms, Properties of unitary transforms, 2-D DFT, Walsh Transforms, Hadamard transform, Discrete Cosine Transform (DCT), Karhunen-Lauve (K-L) Transform, SVD Transform.

Feature Extraction

Edges Canny, Sobel, Line detectors (Hough Transform), Corners -Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, Feature analysis, Feature vectors, Distance/similarity measures.

Object Representation and Tracking

Object detection, Face detection, Pedestrian detection, Face recognition: Eigenfaces, Active appearance and 3D shape models. Object representation, Motion detection and Tracking, Background Subtraction and Modelling, Optical Flow. Point tracking, Kernel tracking, Introduction to Yolo.

Machine Learning for Computer Vision

Neural Architecture, deep learning use cases, Datasets for Machine perception, Training Pipeline, Building sequential model using Keras and CV2, Transfer learning.

Textbooks

1. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited 2011.
2. Valliappa Lakshmanan, Martin Görner, Ryan Gillard, Practical Machine Learning for Computer Vision, Released July 2021, Publisher(s): O'Reilly Media, Inc., ISBN: 9781098102364
3. D. A. Forsyth, J. Ponce, Computer Vision: A Modern Approach, Pearson Education, 2003.

Reference Books

1. E.R Davis, Computer and Machine Vision Theory, Algorithms, Practicalities, Academic Press,4th Edition
2. R.C. Gonzalez and R.E. Woods, Digital Image Processing, Addison- Wesley, 1992.
3. Bradski, G., & Kaehler, A. (2008). Learning Open CV: Computer vision with the OpenCV library. " O'Reilly Media, Inc."
4. Hartley, R., & Zisserman, A. (2003). Multiple view geometry in computer vision. Cambridge university press.

SOFTWARE ENGINEERING

Course Code: CS31001

Credit: 4

L-T-P: 3-1-0

Pre-requisites: Nil

COURSE OBJECTIVE

- To understand the Software Engineering Practice
- To understand the Software Engineering Process Models
- To understand Design Engineering, Web applications
- To gain knowledge of the software testing

- To understand Software Project Management

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO1: Identify appropriate software process models for developing real life projects
- CO2: Assess each module given the overall Software engineering practice
- CO3: Enhance the software project management skills
- CO4: Comprehend the systematic methodologies involved in SE
- CO5: Work ethically in a team as well as independently on software projects and adapt to the ever changing dynamic real world situations.
- CO6: Design and develop a software product in accordance with SE principles

COURSE DETAILS

Introduction

Role of Software Engineer, Software Components, Software Characteristics, Software Crisis, Software Engineering Processes, Similarity and Differences from Conventional Engineering Processes, Quality Attributes.

Assessment

How Software Engineering Changes? Software Development Life Cycle (SDLC) Models: Water Fall Model, Prototype Model, Spiral Model, Evolutionary Development Models, Iterative Enhancement Models, Choosing a social relevant problem, Summary Team Report.

Requirement Engineering Process

Elicitation, Analysis, Documentation, Review and Management of User Needs, Feasibility Study, Information Modeling, Data Flow Diagrams, Entity Relationship Diagrams, Designing the architecture.

Assessment

Impact of Requirement Engineering in their problem, Decision Tables, SRS Document, IEEE Standards for SRS, Architectural design, component level design, User interface design, WebApp Design, Submission of SRS Document for Team Project.

Quality concepts, Review Techniques, Software Quality Assurance (SQA)

Verification and Validation, SQA Plans, Software Quality Frameworks.

Assessment

Framing SQA Plan, ISO 9000 Models, SEI-CMM Model and Their relevance to project Management, Other emerging models like People CMM.

Testing Objectives, Unit Testing, Integration Testing, Acceptance Testing, Regression Testing, Testing for Functionality and Testing for Performance, Top-Down and Bottom-Up Testing, Software Testing Strategies, Strategies: Test Drivers and Test Stubs, Structural Testing (White Box Testing), Functional Testing (Black Box Testing), Testing conventional applications, Object oriented applications, Web applications, Formal modeling and Verification, Software configuration management, Product metrics. Assessment: Team Analysis in Metrics Calculation.

Project Management Concepts, Process and Project Metrics, Estimation for Software projects, Project Scheduling, Risk Management, Maintenance and Re-engineering. Assessment: Preparation of Risk mitigation plan.

Text books:

1. R. S. Pressman, "Software Engineering: A Practitioners Approach", Seventh Edition, McGraw Hill, 2010.
2. Rajib Mall, "Fundamentals of Software Engineering", PHI, Third Edition, 2009.
3. Pankaj Jalote, "Software Project Management in Practice", Pearson Education, New Delhi, 2002.

APPLICATIONS DEVELOPMENT LAB**Course Code: CS33002****Credit: 2****L-T-P: 0-0-4****Pre-requisites: Nil****COURSE OBJECTIVE**

- To be familiar with Web page design using HTML/XML and style sheets
- To learn to write Client Server applications
- To be familiar with the PHP programming
- To be exposed to creating applications with AJAX
- Know the components and structure of mobile application development frameworks for Android and windows OS based mobiles
- Learn the basic and important design concepts and issues of development of mobile applications

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO1: Construct Web pages using HTML/XML and style sheets
CO2: Build dynamic web pages with validation using Java Script objects and by applying different event handling mechanisms
CO3: Develop Web application which makes use of PHP programming
CO4: Construct web applications using AJAX
CO5: Design and Implement various mobile applications using emulators
CO6: Deploy applications to hand-held devices

ALGORITHMS LAB**Course Code: CS39001****Credit: 1****L-T-P: 0-0-1****Pre-requisites: CS21001****COURSE OBJECTIVE:**

- To learn how to analyze the complexity of algorithms
- To compare and evaluate algorithms in terms of time and space complexity
- To program brute force, divide and conquer, decrease and conquer, transform and conquer, greedy, and dynamic techniques

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO1: Solve and analyze general algorithms based on space and time complexity
CO2: Implement and empirically compare fundamental algorithms and data structures to real-world problems

- CO3: Design, develop, and optimize algorithms in different paradigms
- CO4: Implement problems in string manipulation
- CO5: Develop solutions using graph theory
- CO6: Evaluate optimization techniques for real-world problems

COMPUTER NETWORKS LAB

Course Code: CS39003

Credit: 1

L-T-P: 0-0-2

Pre-requisites: Nil

COURSE OBJECTIVE

- To create client and server applications using the "Sockets" API and the implementation of Data link layer protocol and TCP layer
- To conduct computer communication network simulations
- To have a hands on experience of computer network simulation and modelling techniques using NS-3 simulation software

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO1: Invoke analytical studies of Computer Networks through network simulation
- CO2: Design a network using NS-3 toolkit and its importance in designing a real network
- CO3: Measure and analyze the network parameters for a high throughput network
- CO4: Practice experiments on Network Equipments
- CO5: Evaluate Network Performance Evaluation using NS-3
- CO6: Build experiments on Network equipments

SOFTWARE TESTING AND AUTOMATION

Course Code: CS40003

Credit: 3

L-T-P: 3-0-0

Pre-requisites: Nil

COURSE OBJECTIVES

- To understand the criteria for test cases
- To Develop and design test cases
- To Analyse test management and test automation techniques
- To Assess test metrics and measurements
- To Design and validate website testing

COURSE OUTCOMES:

After successfully completing the course, the students will be able to

- CO1: Identify suitable tests to be carried out
- CO2: Design test cases suitable for a software development for different domains
- CO3: Prepare test planning based on the document
- CO4: Document test plans and test cases designed

- CO5: Apply automatic testing tools
- CO6: Develop and validate a test plan

COURSE DETAILS

Introduction:

Testing as an Engineering Activity, Testing as a Process, Testing Maturity Model, Testing axioms, Basic definitions, Software Testing Principles, The Tester's Role in a Software Development Organization, Origins of Defects, Cost of defects, Defect Classes, The Defect Repository and Test Design, Defect Examples, Developer/Tester Support of Developing a Defect Repository.

Test Case Design Strategies:

Test case Design Strategies, Using Black Box Approach to Test Case Design, Boundary Value Analysis, Equivalence Class Partitioning, State based testing, Cause-effect graphing, Compatibility testing, User documentation testing, Domain testing, Random Testing, Requirements based testing, Using White Box Approach to Test design, Test Adequacy Criteria, Static testing vs. Structural testing, Code functional testing, Coverage and Control Flow Graphs, Covering Code Logic, Paths, Code complexity testing, Additional White box testing approaches, Evaluating Test Adequacy Criteria.

Levels of Testing:

The need for Levels of Testing, Unit Test, Unit Test Planning, Designing the Unit Tests, The Test Harness, Running the Unit tests and Recording results, Integration tests, Designing Integration Tests, Integration Test Planning, Scenario testing, Defect bash elimination System Testing, Acceptance testing, Performance testing, Regression Testing, Internationalization testing, Ad-hoc testing, Alpha Beta Tests, Testing OO systems, Usability and Accessibility testing, Configuration testing, Compatibility testing, Testing the documentation, Website testing.

Test Management:

People and organizational issues in testing, Organization structures for testing teams, Testing services, Test Planning, Test Plan Components, Test Plan Attachments, Locating Test Items, Test management, Test process, Reporting Test Results, Introducing the test specialist, Skills needed by a test specialist, Building a Testing Group, The Structure of Testing Group, The Technical Training Program.

Test Automation:

Software test automation, Skills needed for automation, Scope of automation, Design and architecture for automation, Requirements for a test tool, Challenges in automation, Test metrics and measurements – project- progress and productivity metrics.

Textbooks:

1. Srinivasan Desikan, Gopalaswamy Ramesh, "Software Testing: Principles and Practices", Pearson Education, 2006.
2. Ron Patton, "Software Testing", Second Edition, Second Edition, Sams Publishing, 2007.

Reference Books:

1. Ilene Burnstein, "Practical Software Testing", Springer International Edition, 2003.
2. Edward Kit, "Software Testing in the Real World – Improving the Process", O'Reilly(Sams), 1995.
3. Boris Beizer, "Software Testing Techniques", Second Edition, Wiley, 1990.
4. Aditya P. Mathur, "Foundations of Software Testing Fundamental Algorithms and Techniques", Dorling Kindersley (India) Pvt. Ltd., Pearson Education, 2008

HUMAN COMPUTER INTERACTION

Course Code: CS40005

Credit: 3

L-T-P: 3-0-0

Pre-requisites: Nil

COURSE OBJECTIVES

- To provide an overview of the concepts of human-computer interfaces
- To understand the theoretical dimensions of human factors involved in the acceptance of computer interfaces
- To understand the implementation of human-computer interfaces
- To identify the various tools and techniques for interface analysis, design and evaluation

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO1: Describe the Human Computer Interaction and its fundamentals.

CO2: Design and Develop processes and life cycle of Human Computer Interaction

CO3: Analyze product usability evaluations and testing methods

CO4: Apply the interface design standards/guidelines for cross cultural and disabled users

CO5: Categorize, Design and Develop Human Computer Interaction in proper architectural structures

CO6: Build the application oriented human computer interface for solving real life problems.

COURSE DETAILS

HCI Foundations: Input-output channels, Human memory, Thinking: Reasoning and Problem solving, Emotion, Individual differences, Psychology and The design of interactive systems, Text entry devices, Positioning, pointing and Drawing, Display devices, Devices for virtual reality and 3D interaction, Physical controls, Sensors and Special devices, Paper: Printing and Scanning.

Designing, Programming Interactive systems, Models of interaction, Frameworks and HCI, Ergonomics, Interaction styles, Elements of the WIMP interface, The context of the interaction, Experience, Engagement and Fun, Paradigms for interaction. Centered Design and Testing, Interaction design basics, The process of design, User focus, Scenarios, Navigation design, Screen design and Layout, Iteration and Prototyping.

HCI in the software process, Iterative design and Prototyping, Design rules, Principles to support usability, Standards and Guidelines, Golden rules and Heuristics, HCI patterns. Implementation support, Elements of windowing systems, Programming the application, Using toolkits, User interface management systems.

Evaluation techniques, Evaluation through expert analysis, Evaluation through user participation, Universal design, User support. Models and Theories, Cognitive models, Goal and task hierarchies, Linguistic models, The challenge of display-based systems, Physical and device models, Cognitive architectures.

Collaboration and Communication, Face-to-face communication, Conversation, Text-based communication, Group working, Dialog design notations, Diagrammatic notations, Textual dialog notations, Dialog semantics, Dialog analysis and Design Human factors and Security, Groupware, Meeting and Decision support systems, Shared applications and Artifacts, Frameworks for groupware, Implementing synchronous groupware, Mixed, Augmented and Virtual Reality.

Textbooks:

1. Alan Dix, Janet Finlay, G D Abowd, R Beale, "Human, Computer Interaction", Third Edition, Pearson Publishers, 2008.
2. Shneiderman, Plaisant, Cohen, Jacobs, "Designing the User Interface: Strategies for Effective Human Computer Interaction", Fifth Edition, Pearson Publishers, 2010.

COMPUTER GRAPHICS AND MULTIMEDIA SYSTEM

Course Code: **CS40007**

Credits: **3**

L-T-P: **3-0-0 3**

Pre-requisites: **Nil**

COURSE OBJECTIVES

- To understand the basics of various inputs and output computer graphics hardware devices
- Exploration of fundamental concepts in 2D and 3D computer graphics
- To know 2D raster graphics techniques, 3D modeling, geometric transformations, 3D viewing and rendering
- Exploration of fundamental concepts in multimedia systems, file handling, hypermedia

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO1: Make use of various computer graphics hardware and display technologies
- CO2: Analyze and implement various algorithms to scan, convert the basic geometrical primitives, transformations, Area filling
- CO3: Identify the use of three dimensional graphics, 3D geometric transformations, projections to detect visible surfaces
- CO4: Apply 2D and 3D viewing technologies into the real world applications
- CO5: Implement multimedia components efficiently
- CO6: Design and develop of modeling, rendering, shading and animation.

COURSE DETAILS

Basic of Computer Graphics

Applications of computer graphics, Display devices, Random and Raster scan systems, Color models, Graphics Primitives: Points, Lines, Circles and Ellipses as primitives, Scan conversion algorithms for primitives.*

Two-Dimensional Graphics

Two dimensional geometric transformations, Matrix representations and Homogeneous coordinates, Composite transformations, Two dimensional viewing, Viewing pipeline, Viewing coordinate reference frame, Window to viewport coordinate transformation, Two dimensional viewing functions, Clipping operations, Point, Line, Polygon clipping algorithms.*

Three-Dimensional Graphics

Three dimensional concepts, Three dimensional object representations, Polygon surfaces, Polygon tables, Plane equations, Polygon meshes, Curved Lines and Surfaces, Quadratic surfaces, Blobby objects, Spline representations, Bezier curves and Surfaces, B-Spline curves and Surfaces, Transformation and Viewing: Three dimensional geometric and Modeling transformations, Translation, Rotation, Scaling, Composite transformations, Three dimensional viewing, Viewing pipeline, Viewing coordinates, Projections, Clipping.*

Multimedia System Design & Multimedia File Handling

Data and File Formats, Multimedia basics, Multimedia applications, Multimedia system architecture, Evolving technologies for multimedia, Defining objects for multimedia systems, Multimedia data interface standards, Multimedia databases, Compression and Decompression, Data and File format standards, Multimedia I/O

technologies, Digital voice and Audio, Video image and Animation, Full motion video, Storage and Retrieval technologies.*

Hypermedia

Multimedia authoring and User interface, Hypermedia messaging, Mobile messaging, Hypermedia message component, Creating hypermedia message, Integrated multimedia message standards, Integrated document management, Distributed multimedia systems.*

*Programming assignments are mandatory.

Textbooks:

1. J. D. Foley, A. Van Dam, S. K. Feiner, J. F. Hughes, "Computer Graphics: Principles and practice", Second Edition in C, Addison Wesley, 1997.
2. Donald Hearn, Pauline Baker M, "Computer Graphics", Prentice Hall, New Delhi, 2007.
3. Andleigh, P. K, Kiran Thakrar, "Multimedia Systems and Design", PHI, 2003.

Reference Books:

1. D. F. Rogers, J. A. Adams, "Mathematical Elements for Computer Graphics", Second Edition, McGraw Hill International Edition, 1990.
2. F. S. Hill Jr., "Computer Graphics using OpenGL", Second Edition, Pearson Education, 2003.
3. "The OpenGL Reference Manual, The Bluebook", Version 1.4, Fourth Edition, Addison-Wesley.
4. Judith Jeffcoate, "Multimedia in Practice: Technology and Applications", PHI, 1998.
5. "The OpenGL Programming Guide, The Redbook", Version 2, Fifth Edition, Addison-Wesley.

AUGMENTED AND VIRTUAL REALITY

Course Code: CS40010

Credits : 3

L-T-P 3-0-0

Prerequisites: CS30015/CS30029

COURSE OBJECTIVE:

- To know basic concepts of virtual reality
- To understand visual computation in computer graphics
- To understand interaction between system and computer
- To know application of VR in Digital Entertainment
- To know basic concepts of augmented reality

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Discuss the fundamentals and I/O components of the augmented and virtual reality system

CO 2: Evaluate different computing architectures for virtual reality

CO 3: Provide opportunity to explore the research issues in Augmented Reality and Virtual Reality (AR & VR)

CO 4: Apply the different modeling concepts to visual virtualization

CO 5: Explore the role of virtual reality in traditional & emerging applications

CO 6: Develop prototypes using the concepts for virtual reality

COURSE DETAILS

Introduction of Virtual Reality

Fundamental Concept and Components of Virtual Reality, Primary Features and Present Development on Virtual Reality, Multiple Models of Input and Output Interface in Virtual Reality: Input, Tracker, Sensor, Digital

Glove, Movement Capture, Video-based Input, 3D Menus & 3DScanner, Output, Visual /Auditory / Haptic Devices.

Visual Computation in Virtual Reality

Fundamentals of Computer Graphics, Software and Hardware Technology on Stereoscopic Display, Advanced Techniques in CG: Management of Large Scale Environments & Real Time Rendering.

Interactive Techniques in Virtual Reality

Body Track, Hand Gesture, 3D Manus, Object Grasp.

Development Tools and Frameworks in Virtual Reality: Frameworks of Software Development Tools in VR. X3DStandard; Vega, MultiGen, Virtools.

Application of VR in Digital Entertainment

VR Technology in Film & TV Production, VR Technology in Physical Exercises and Games, Demonstration of Digital Entertainment by VR.

Augmented and Mixed Reality

Taxonomy, Technology and Features of augmented reality, Difference between AR and VR, Challenges with AR, AR systems and Functionality, Augmented reality methods, Visualization techniques for augmented reality, Wireless displays in educational augmented reality applications, Mobile projection interfaces, Marker-less tracking for augmented reality, Enhancing interactivity in AR environments, Evaluating AR systems.

Textbooks

1. Burdea, G. C., P.Coffet., "Virtual Reality Technology", Second Edition, Wiley-IEEE Press, 2003/2006.
2. Alan B. Craig, "Understanding Augmented Reality, Concepts and Applications", Morgan Kaufmann, 2013.

Reference book

1. Alan Craig, William Sherman, Jeffrey Will, "Developing Virtual Reality Applications, Foundations of Effective Design", Morgan Kaufmann, 2009.

BLOCKCHAIN

Course Code: CS40012

Credits: 3

L-T-P: 3-0-0

Prerequisites: Nil

COURSE OBJECTIVES

- To understand the design principles Block Chain
- To describe differences between proof-of-work and proof-of-stake consensus
- To understand building a distributed application
- To understand Bitcoin's consensus mechanism

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO1: Explain the design principles of Bitcoin and Ethereum.

CO2: List and describe differences between proof-of-work and proof-of-stake consensus.

CO3: Interact with a blockchain system by sending and reading transactions

CO4: Design, build and deploy a distributed application.

CO5: Apply the concept of Bitcoin's consensus mechanism and the interaction between Bitcoin and Altcoins

CO6: Familiarize with Ethereum, smart contracts and related technologies, and solidity language

COURSE DETAILS

Blockchain Fundamentals

Fundamental of Blockchain Technology and Its importance, Electronic Systems and Trust, Distributed Versus Centralized Versus Decentralized, Bitcoin Predecessors, DigiCash, E-Gold, Cryptographic hash functions, Properties of a hash function-Hash pointer and Merkle tree, digital signatures, B-Money, Evolution of the Blockchain Technology, Storing Data in a Chain of Blocks, Compelling Components, Achieving Consensus

Cryptocurrency Fundamentals

Basic cryptocurrency system, Public and Private Keys in Cryptocurrency Systems, The UTXO Model, Transactions, Signing and Validating Transactions, Bitcoin Transaction Security, Wallet Types: Custodial Versus Noncustodial, Lightweight wallets, Hierarchical deterministic wallets, Permissioned and Permissionless Consensus, Proof-of-Work, Proof-of-Stake, Proof of Burn, Proof of Elapsed Time, Bitcoin Miner, Mining Difficulty

Distributed Consensus

Permissioned Blockchain: Design issues for Permissioned blockchains, Execute contracts, State machine replication, Overview of Consensus models for permissioned blockchain- Distributed consensus in closed environment, Paxos, RAFT Consensus Algorithm, Practical Byzantine Fault Tolerance (PBFT), Lamport-Shostak-Pease BFT Algorithm.

Forks and Altchains

Understanding Forks, Contentious Hard Forks, The Bitcoin Cash Fork, Altcoins, Litecoin, Privacy-Focused Cryptocurrencies, Segregated witness, Validation and Analysis of Smart Contracts, Evolution of Ethereum, The Ethereum Classic Fork, Comparison among Bitcoin, Ethereum, Stellar, Monero, ZCash, Quorum and Hyperledger fabric. Enterprise, Healthcare and transportation application of Blockchain

Textbooks

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder. Bitcoin and cryptocurrency technologies: a comprehensive introduction. Princeton University Press, 2016.
2. Lorne Lantz & Daniel Cawrey, Mastering Blockchain Unlocking the Power of Cryptocurrencies, Smart Contracts, and Decentralized Applications, O'REILLY Publications

Reference Books

1. Bina Ramamurthy, Blockchain in Action, MANNING Publication.
2. Bikramaditya Singhal, Gautam Dhameja, and PriyansuSekhra Panda, Beginning Blockchain, Apress Publication.
3. Draft version of “S. Shukla, M. Dhawan, S. Sharma, S. Venkatesan, “Blockchain Technology: Cryptocurrency and Applications”, World scientific, 2020.
4. Josh Thompson, “Blockchain: The Blockchain for Beginnings, Guid to Blockchain Technology and Blockchain Programming’, Create Space Independent Publishing Platform, 2017.

CRYPTOGRAPHY AND NETWORK SECURITY

Course Code: CS40015

Credit: 3

L-T-P 3-0-0

Prerequisites: EC30004/CS30003

COURSE OBJECTIVE

The main objective of this course is to cover the cryptography algorithms for network security in communication and to introduce students to the areas of cryptography and crypt-analysis attacks and security goals. This course develops the understanding of the algorithms Symmetric and Asymmetric Algorithms and used to protect users online and to understand some of the design choices behind these algorithms.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Analyze different security threats and attacks with reference to ISO/OSI model security.
- CO 2: Differentiate between various cryptography, watermarking, steganography methods.
- CO 3: Analyze different Symmetric and Asymmetric cryptographic algorithms
- CO 4: Differentiate various key distribution and Digital Signature.
- CO 5: Analyze the working of various communication security protocols with respect to OSI layer.
- CO 6: Analyze different network security systems implementation in Wireless systems.

COURSE DETAILS

Introduction

Cryptography, Watermarking, Steganography, Escrow and Crypt Analysis, ISO/OSI reference model and Security, Security Goals, Security threatening attacks, Security Services, Security Mechanisms.

Symmetric Key Mono-Alphabetic Cryptography

Symmetric key cipher, Traditional Ciphers, Substitution Cipher, Mono-Alphabetic Ciphers, Additive Cipher/ Shift Cipher/ Caesar Cipher, Multiplicative Cipher,, Affine Cipher (combination of Additive Multiplicative Cipher).

Symmetric Key Poly-Alphabetic Cryptography

Poly-Alphabetic, Auto-key, Play-fair, Vigenere, Hill Cipher, Rotor Cipher- Enigma Machine

Symmetric Key Transposition Cryptography

Introduction to Traditional Transposition, Key-less Transposition, Keyed Transposition, Combined Two Approach, Double Transposition, Stream/ Block.

Asymmetric Key Cryptography

Introduction to asymmetric key cryptography, Keys, General Idea, Plain- text, Cipher-text, Encryption, Decryption.

RSA Cryptosystem

Rivest-Shamir-Adleman (RSA), RSA Procedure, RSA key generation, RSA Encryption and Decryption, Attacks on RAS, Cryptography key distribution system (KDS).

Network Security

Network Security at Application Layer (PGP and S/MIME), Network Security at Transport Layer (SSL and TSL), Security at Network Layer (IPSec).

Textbooks

1. B A Forouzan and D Mukhopadhyay, Cryptography & Network Security Mc-Graw Hill, India, 2ndEdition, 2010.
2. S V. Kartalopoulos, Security of Information and Communication Network Wiley-IEEE Press., 2009.

Reference books

1. Stavroulakis, Peter, Handbook of Information and Communication Security ; Springer, 2010.
2. Adrian Perrig& Doug Tygar, Secure Broadcast communication in Wired and Wireless Communication.

- Kluwer Publication, 2002.
3. W Mao, Modern Cryptography: Theory and Practice, Pearson, 1st Edition, 2003.

INDUSTRY 4.0 TECHNOLOGIES

Course Code: EX20001

Credits: 2

L-T-P: 2-0-0

Pre-requisites: Nil

COURSE OBJECTIVES

The current manufacturing industries and businesses are moving from the third industrial revolution of the computers and automation to the fourth where the automation becomes even smarter fueled by data analytic and artificial intelligence. This course is designed to offer learners an introduction to use of Internet and Digital technology for better manufacturing and business. Learners will gain deep insights into how smartness is being harnessed from data and appreciate what needs to be done in order to overcome some of the challenges.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Understand the key components and enablers of Industry 4.0 Technology
- CO 2: Appreciate the smartness in Smart Factories, smart products and smart Services.
- CO 3: Outline Smart Factory technologies and their role in an Industry 4.0 world
- CO 4: Outline IoT technology and scope of implementing IoT in Industries and businesses.
- CO 5: Comprehend distributed cyber-physical and digital manufacturing system
- CO 6: Demonstrate the opportunities, challenges brought about by Industry 4.0 and how organizations and individuals should prepare to reap the benefits

COURSE DETAILS

Introduction

The Fourth Industrial Revolution, Difference between conventional automation and Industry 4.0, Case Studies: Health, Agriculture, Manufacturing

Industry 4.0 and its components

Internet of Things (IoT) & Industrial Internet of Things (IIoT), Internet of Services, Value chains in manufacturing companies, Digital Twins

Digital Manufacturing and Design

Cyber Physical Systems and Next Generation sensors, Collaborative Platform and Product Life-cycle Management, Robotics and Automation

Industrial IoT

Cloud Computing, Big Data Analytic, AI & ML, Virtual and Augmented Reality, Block-chain

Challenges & Opportunities in Industry 4.0

A Digital Strategy alongside Resource Scarcity, Standards and Data security, Financing conditions, availability of skilled workers, Comprehensive broadband infra- structure, Legal framework, Protection of corporate data, liability, Handling personal data.

Textbooks

1. D. Pyo, J. Hwang, and Y. Yoon, *Tech Trends of the 4th Industrial Revolution*, Mercury Learning & Information publisher, 2021.
2. Bruno S. Sergi, Elena G. Popkova, Aleksei V. Bogoviz, and Tatiana N. Litvinova *Understanding*

Reference books

1. S. Misra, A. Mukherjee, and A. Roy *Introduction to IoT*. Cambridge University Press, 1st edn. 2021
2. Dac-Nhuong Le, Chung Van Le, Jolanda G. Tromp , Gia Nhu Nguyen, *Emerging Technologies for Health and Medicine: Virtual Reality, Augmented Reality, Artificial Intelligence, Internet of Things, Robotics, Industry 4.0*, John Wiley publisher, 2018
3. Alasdair Gilchrist, *Industry 4.0: The Industrial Internet of Things*, Apress Berkeley publisher, CA 1st ed 2016.

SCIENTIFIC AND TECHNICAL WRITING

Course Code: EX20003

Credit: 3

L-T-P: 3-0-0

Prerequisite: NIL

COURSE OBJECTIVE

Technical documents take many forms depending on their purpose and the audience. A technical document can be a project proposal, minutes of a meeting, an advertisement in a newspaper, or even a research paper. A scientific document is a form of technical document where both the author and the audience are experts. The writing styles and the document density of technical documents depend on the nature of the document. The objective of this subject is to train the students in the art and science of writing a range of scientific and technical documents.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Realize the need to articulate the purpose of the document, identify its audience, and decide the density of information to be included in scientific and technical documents;
- CO 2: Internalize the art and science of scientific and technical writing;
- CO 3: Make appropriate use of crisp language, illustrations, and symbols.
- CO 4: Distinguish between bad and good writing. (Analyze and Evaluate)
- CO 5: Prepare a variety of scientific and technical documents, including laboratory and project reports; and
- CO 6: Write these documents in an accurate, clear, concise, coherent, appropriate, and readable manner.

COURSE DETAILS

Introduction

Forms and features of creative, technical, scientific, and science writing; Audience types (general and specific experts, technicians, managers, laypersons, and mixed audience); Examples of documents for technical, professional, and scientific communications; Characteristics of effective technical writing: Accuracy, clarity, conciseness, coherence, appropriateness, and readability.

Language Issues

Revisiting English grammar; Punctuation (period, comma, colon, semicolon, question mark, exclamatory mark, apostrophe, quotation marks, hyphen, dash, parentheses, and brackets); Mechanics (capitalization, italics, abbreviations, acronyms); Latin terms used popularly in English texts; Informal and colloquial English; Dangling modifiers, Faulty parallelism, Judicious use of common words and phrases; Active and passive voice; Nominalization; Common English errors; Pitfalls in writing; Adapting texts to issues of gender, race, and ethnicity; and Guarding against Plagiarism.

Paragraphing: Unity of idea, topic sentence, logical and verbal bridges through use of signposts, transitions, and link words; Patterns of development of an idea; and Lists.

Structure of Scientific Documents

Prefatory Materials

Title, Copyright Notice, Declaration and Certificates, Abstract, Keywords, Acknowledgements and Conflict of Interest Statement, Symbols and Abbreviations, and Table of Contents.

Body of Scientific Documents

Introductory Materials—Context, Problem and Current response, Research questions, Hypotheses, and Objectives and Scope; Literature Review—Presentation styles, Citations and Referencing systems, Quoting, paraphrasing, and summarizing; Materials and Methods—Mathematical Materials: Methodology, methods, tools, and techniques; Quantitative, Qualitative, Experimental and Mixed methods; Numbers and Numerals, Engineering and Scientific notations of numbers, Mathematical operators, Equations, Flowcharts, Algorithms, SI units, Significant digits and Order of magnitude, Figures, Tables, and Photographs; Experimental apparatus, Materials, Specifications, Measuring instruments, Procedure, Data analysis; Concluding Materials—Conclusions, Implications, Generalization, Limitations, Scope for further work and Contributions of the work.

End Matters

References, Appendixes, and Supplementary materials.

Structure of Selected Technical Documents

PowerPoint presentation, Abstract of a paper, Laboratory reports, Progress report, Project proposal, Minutes of a meeting, Brochure, and News items.

Textbooks

1. Lecture notes on Scientific and Technical Writing
2. Alred, G. J., C. T. Brusaw, and W. E. Oliu (2008), *Handbook of Technical Writing*, St. Martin's Press, New York, Ninth Edition.
3. Angelika H. Hofmann (2014), Scientific Writing and Communication, Papers, Proposals, and Presentations, Oxford: Oxford University Press.
4. Duke Graduate School Scientific Writing Resource (<https://sites.duke.edu/scientificwriting/>).
5. Gerald. J. Alred, Charles. T. Brusaw, and Walter. E. Oliu (2008), *Handbook of Technical Writing*, St. Martin's Press, New York, Ninth Edition.
6. OWL, The Purdue Online Writing Laboratory, <https://owl.english.purdue.edu/owl/>.
7. Perelman, L. C., J. Paradis, and E. Barrett (1998), The Mayfield Handbook of Technical and Scientific Writing, Mayfield Publishing (ed.), Available free at <http://www.mhhe.com/mayfieldpub/tsw/toc.htm>, Mayfield Publishing Company, Inc., 1280 Villa Street, Mountain View, CA 94041, 415.960.3222, <http://www.mayfieldpub.com>, <mailto:hypertext@mayfieldpub.com>
8. Rubens, P. (2001), Science and Technical Writing: A Manual of Style, 2nd Edition, Routledge, New York.

RESEARCH METHODS AND ETHICS

Course Code: EX40001

Credit: 3

L-T-P: 3-0-0

Prerequisite: NIL

COURSE OBJECTIVE

The objective of this course is to introduce to the undergraduate students the various elements and methods of ethically conducting a piece of scientific research.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Select research topics and formulate research questions,

CO 2: Conduct a literature search and make a review of literature,

CO 3: Get acquainted with a range of qualitative, quantitative, experimental, and theoretical methods of Research,

- CO 4: Become familiar with the techniques of data collection, analysis, and interpretation,
CO 5: Understand the importance of research ethics and the implications of the broader impact of
research, and
CO 6: Conduct research with honesty and integrity.

COURSE DETAILS

Introduction to research

Structure of research: Scientific method and Engineering design cycle, Defining and Scoping Research problems, Formulating research objectives and Research questions.

Literature Review

Searching for literature; Narrative and Systematic literature review; Summarizing, paraphrasing, and quoting; and Referencing styles.

Design of Experiments

Basic Principles of randomization, Replication, and Blocking; Factors and Responses; Analysis of variance, Experiments with blocking factors, and Factorial designs.

Data Analytics

Data pre-processing; Data visualization; Tests of hypothesis; Decision trees; and Artificial neural networks.

Theoretical Models

Typology of models; Optimization models, Forecasting models, and Control models; Monte Carlo simulation; Genetic Algorithm; Model verification and validation; and Measurement and uncertainty analysis.

Drawing Inferences

Drawing inferences, Generalizing, Finding potential applications, Imagining future scope and Highlighting novelty of research.

Research Ethics

Ethics and morality; Utilitarian and deontological theories of ethics; Fabrication, falsification, plagiarism, and questionable research practices; Issues related to privacy and confidentiality; and Ethical issues related to publications

Textbooks

1. Dunn, P. K. (2021), Scientific Research and Methodology: Tutorials, An Introduction to Quantitative Research and Statistics in Science, Engineering, and Health: Tutorials, Available free at <https://bookdown.org/pkaldunn/SRM-tutorials/>.
2. Dunn, P. K. (2021), Scientific Research and Methodology: Software, An Introduction to Quantitative Research and Statistics in Science, Engineering, and Health: Using Software, Available free at <https://bookdown.org/pkaldunn/SRM-software/>. (Uses Jamovi and SPSS Software, Jamovi is a freely downloadable software)
3. Lectures note on Research Methods and Ethics provide by Concerned faculty members.

ENGINEERING PROFESSIONAL PRACTICE

Subject Code: EX40003

Credit: **2**

L-T-P: **2-0-0**

Prerequisite: **Nil**

COURSE OBJECTIVE

Engineers are expected to perform their tasks responsibly and ethically, following professional standards and guidelines. This subject allows the students to understand the roles and responsibilities of engineers in society, learn professional standards, codes of ethics, issues concerning employment contracts and other legal matters, and skills of working in teams, and to effectively communicate. The subject will be offered jointly by the faculty members of various schools of technology and will be coordinated by the School of Mechanical Engineering.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO1: Know (a) the features of engineering as a profession, (b) the roles and responsibilities of engineers in society, and (c) the skills for working in teams,
- CO2: Realize the use of professional standards, codes of ethics, legal provisions surrounding engineering functions,
- CO3: Apply the above-stated standards, codes, legal provisions, and group communication skills in their decision-making situations,
- CO4: Break down a complex problem into smaller manageable tasks,
- CO5: Compare among alternatives in situations of uncertainty, risk, and ambiguity, and
- CO6: Design engineering solutions to industrial environmental and social problems.

COURSE DETAILS

Engineering and Engineer

Engineering as a discipline and a profession; Attributes and functions of a practicing engineer and Engineer as a problem solver, designer, and change agent.

Selected Functions of Engineering

Designing for safety and reliability; Quality and Productivity management; Dealing with problem complexity, Uncertainty, Risk and Ambiguity; Project management and Managerial functions such as planning, Organizing, Motivating and Controlling; Costing and Accounting.

Professional Aspects of Engineering

Accreditation, Certification and Licensing; Ethical issues: Ethics and morality, Ethical dilemmas, Codes of ethics, Professional conduct, Nature and Role of professional societies, Engineering standards; Legal issues—Legal forms of business organizations, Employment contracts, Trademarks, Patents, Copyrights, Trade secrets, Professional liability, Contractual agreements, Environment and Information technology laws and International legal framework such as WTO.

Group Dynamics

Individual cognition; Dynamics of working in teams/groups; Interacting with stakeholders; Dealing with multicultural environments; Team and group communication; and Negotiation and conflict resolution.

Text Book

1. Shrestha, R. K. and Shrestha, S. K. (2020), Text Book of Engineering Professional Practice, 3rd Edition, Heritage Publishers and Distributors Pvt. Ltd.

Reference Books

1. Habash, R. (2019), Professional Practice in Engineering and Computing: Preparing for Future Careers, 1st Edition, Boca Raton: CRC Press.
2. Welsh, S. G. (2012), Engineering Your Future: The Professional Practice of Engineering, 3rd Edition, Wiley.
3. Subramaniam, R. (2017), Professional Ethics, 2nd Edition, Oxford University Press
4. Lectures note on Engineering Professional Practice provide by Concerned faculty members.

ECONOMICS OF DEVELOPMENT

Course Code: HS20120

Credit: **3**

L-T-P: **3-0-0**

Prerequisite: Nil

COURSE OBJECTIVE

The objective of this course is to provide students with the essential tools and concepts of development economics, to prepare them to understand what makes underdevelopment persist and what helps development succeed. Students will explore diverse dimension and measures of development, as well as the application of microeconomic analysis to issues of development in poor countries, including the study of household decisions and the analysis of institutions and norms influencing development. And To enhance students understanding of the SDGs to create a better-informed citizenry, which will lead to a more sustainable action by all and for all.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Understand key factors and issues in the process of economic development,
- CO 2: Enhance their ability in applying economic models to study development Problems,
- CO 3: Learning the role of the three basic components of ecosystems and environment and underlying causes of their degradation,
- CO 4: Understand the policy scenario and the existing environmental conventions/ regulations/ laws,
- CO 5: Development of sustainable planning for sustainable development of environment, economy and firms,
- CO 6: Select and apply appropriate economic techniques to solve environmental problems and measure the value of environmental goods.

COURSE DETAILS

Economic Growth and Development

Meaning of development and Economic growth, Characteristics of less developed countries. Factors in Economic development, Measuring development and development gap — per capita income, inequality of income and wealth, Gini coefficient, Human Development Index , Physical Quality of Life Index, and other indices of development.

Theories of Economic Growth and Development

Theories of Economic Development: Classical (Smith, Ricardo, Malthus), Marxian – Theory of Social change, immutable laws, Crisis in capitalism, Schumpeter and capitalist development, Rostow's stages of growth. Partial theories of growth and development: Vicious circle of Poverty, Big push, balanced growth, unbalanced growth,

International aspects of Economic Development

International trade as an engine of growth; Static and dynamic gains from trade; Prebisch, Singer and Myrdal theses vs. free trade; Export-led growth; Tariffs and effective protection; WTO and developing countries. External resources; FDI; Aid vs. trade;

Development and Environment

Economy linkage; Environment as a necessity and luxury; Population environment linkage. Allocation problem; Market failure for environmental goods; environment as a public good.

Sustainable Development

Concept and indicators of sustainable development. Common Property Resources, Property right approach to environmental problem-property rights approach, property rights and environmental problems, Externalities and Pigovian tax, Coase theorem, Coase theorem and transaction cost. Prevention, control and abatement of pollution.

Textbooks

1. S.Ghatak, An Introduction to Development Economics, Allen and Unwin, London,2003
2. Kindleberger, C. P. Economic Development, McGraw Hill, New York, 1958
3. Todaro, M. P. Economic Development, Longman, London.

References books

1. Thirwal, A. P. Growth and Development, Macmillan, U. K,2017.
2. Adelman, I. Theories of Economic Growth and Development. Stanford University Press, Stanford, 1966.
2. Chenery, H. and T.N. Srinivasan (Eds) Handbook of Development Economics, Vols 1 & 2 Elsevier, Amsterdam, 2002.
3. Myint, H. Economic Theory and Underdeveloped Countries, Oxford University Press, New York,1971.

INTERNATIONAL ECONOMIC COOPERATION

Course Code: HS20122

Credit: 3

L-T-P: 3-0-0

Prerequisite: Nil

COURSE OBJECTIVE

This course's overarching objective is to equip students with knowledge of both the theoretical concepts and the actual procedures involved in international trade. The specific purpose is to increase the knowledge of importing and exporting essentials and to offer the skills for understanding the international trading process.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Learn theories of international trade,
- CO 2: Understand free trade, protection, and BOP,
- CO 3: Analyse the role of international organisations,
- CO 4: Understand the working of foreign exchange,
- CO 5: Study the EXIM policies, and
- CO 6: Analyse secondary data relating to international trade.

COURSE DETAILS

Theories of International Trade

Classical Theories of International Trade- Mercantilism, Absolute Advantage, Comparative advantage Theory, Gains from international trade; Terms of trade; Theory of Reciprocal Demand; Modern Theories of International Trade-Heckscher-Ohlin theory

Free Trade, Protection and Balance of Payment

Free trade and Protection in developing countries; Forms, Methods and Effects of protection; Introduction of BoP; Structure of BoP; Disequilibrium in BoP; Measures to overcome disequilibrium in BoP., Tariff; Trade creation vs Trade diversion.

International Organizations

International Monetary Fund; World Trade Organasation; Regional Trade Agreements; Trade Blocs.

Foreign Exchange

Foreign Exchange Market; Theories of foreign exchange; Factors affecting exchange rate; Fixed and flexible exchange rate; FERA and FEMA.

EXIM Policies

Recent budgetary policies and Programs relating to inequality; Analysis of Economic Survey data.

Textbooks

1. R. R Paul, *Money Banking and International Trade*, Kalyani Publishers; 12th edition,2015, ISBN-10 : 932725774X ISBN-13 : 978-9327257748
2. Bo Södersten and Geoffrey Reed, Palgrave Macmillan, International Economics. 1994, ISBN-10 : 0333612167 ISBN-13 : 978-0333612163

Reference books

1. Dominick Salvatore, International Economics: Trade and Finance, Wiley; Eleventh edition,2017, ISBN-10 : ISBN-13 8126552344 978-8126552344
2. Paul R. Krugman, Maurice Obstfeld, Marc Melitz, *International Trade: Theory and Policy*, 2017, ISBN-10 : 9789332585768 ISBN-13 : 978-9332585768

ORGANIZATIONAL BEHAVIOUR

Course Code: HS20220

Credit: 3

L-T-P: 3-0-0

Prerequisite: NIL

COURSE OBJECTIVE

This course shall guide the students to learn the basic concepts of Organizational Behaviour and its applications in contemporary organizations. Further, it help them to describe how people behave under different conditions and understand why people behave as they do. The students would be in a position to synthesize related information and evaluate options for the most logical and optimal solution such that they would be able to predict and control human behaviour and improve results. Lastly, this course would help the students to understand how individual, groups and structure have impacts on the organizational effectiveness and efficiency.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Know about organization, organizational behaviour, its nature, scope and significance,
- CO 2: Develop their personality as per industry requirement,
- CO 3: Apply motivational techniques to make the employees work with confidence and satisfaction,
- CO 4: Develop different leadership styles to adjust themselves in different organizational situations,
- CO 5: Improve the knowledge of group behaviour and techniques of group decision making, and
- CO 6: Apply the concepts for managing changes in organization as well as the development of an organization's human resources.

COURSE DETAILS

Introduction to Organizational Behaviour

Organizational Behaviour- nature and scope; Need for studying OB; contributing disciplines to OB; evolution of OB; OB approaches and models; OB opportunities and disruptions

Individual Perspective

Introduction to Individual behaviour; Personality- concept, determinants, types and theories/models; Personality and OB; Perception- meaning, perceptual process, factors affecting perception; perception and Its application in OB; Attitude- nature, Components, Formation and Types; Values- concepts, Types and Formation; Attitude, Values and Behaviour

Individual Perspective

Learning- meaning, Determinants, Theories and Principles; Learning and Behaviour; Motivation- nature, importance, process and theories; managerial implication of motivation- job design, quality of work life and employee engagement; organizational citizenship behaviour- meaning, theoretical perspective, determinants and predictors

Group Perspective

Foundation of group behaviour; meaning and characteristics of group; why do people form and join groups; types and groups; stages of group development; group decision making; Team building- meaning and types of team; team building process; Meaning, sources and types of conflict; conflict management and negotiation strategies; Leadership- meaning and importance; differentiating between leader and manager; leadership styles; leadership theories

Organizational Perspective

Organizational structure- meaning and elements; Organizational culture- meaning, types and functions of culture; creating, sustaining and changing a culture; Organizational change- meaning and need; ; managing resistance to change; Organizational development- meaning, objectives, models and interventions

Textbooks

1. Dr. S..S. Khanka, Organizational behaviour texts and cases Sultan Chand, OB text and cases S.S. Khanka, S chand, 2022
2. Stephen P. Robbins, Timothy A. Judg, Neharika Vohra Organizational Behaviour, Pearson, 18th edition, 2018

Reference books

1. Fiona M. Wilson,Organizational Behaviour and Work Oxford University Press,2014
2. K. Aswathappa ,Organizational Behaviour, , Himalaya Publishing House, 2013

HUMAN RESOURCE MANAGEMENT

Course Code: HS20222

Credit: 3

L-T-P: 3-0-0

Prerequisite: NIL

COURSE OBJECTIVE

This course aims at providing conceptual knowledge on human resource management that will be useful for a manager of an organization. It also understands employer and employee relationship in order to achieve organizational objectives effectively. It starts with hiring and continues till retention. It also focuses on enabling the students to integrate the understanding of various HR concepts along with the domain concept in order to take correct business decisions.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Learn the various functions of management, personal and professional qualities of a manager in order to manage human resource of an organization effectively,
- CO 2: Understand the process of acquiring human resource through effective planning, recruitment and selection process,
- CO 3: Apply different training and development methods for organizational effectiveness,
- CO 4: Analyse the importance of performance appraisal and equitable pay for the growth of both individual and organization,
- CO 5: Inculcate the sense of inter personal relation required in professional front in handling employer-employee relation effectively for achievement of organizational objectives and
- CO 6: Know the technique of managing and being managed by the organization.

COURSE DETAILS

Introduction to HRM

Introduction, scope, Objectives; Managerial and Operational functions of Management; HRM as a source of competitive advantage; Qualities and role of HR managers

Planning and Acquiring Manpower

Human resource planning- Introduction, objectives, need, importance; Factors, Process and barriers of HRP; Job analysis- concept, objective and Process; Meaning, process and sources of recruitment; Factors of effective recruitment; Meaning and process of selection; Competency mapping for selection decision; Induction and socialization; recent trends in recruitment and selection

Developing Manpower

Training- nature, need, objectives, importance; areas of training; training process- identifying training need, designing a training program; methods and techniques of training; evaluating training effectiveness; Role specific and competency based training; career planning and development- meaning, objective and process

Managing Performance and Compensation

Performance appraisal- concept, objectives and importance of performance appraisal; Process of performance appraisal; Methods of performance appraisal; Problems in performance appraisal; Potential Appraisal; Components of compensation; objectives and factors affective Wage and salary administration; methods of wage payment; process of wage determination; Pay band compensation system

Maintaining and Retaining Human Resources

Industrial Relation- concept, objective and approaches: Reasons for poor industrial relation; Measures for improving industrial relation; Industrial Dispute- nature, causes, prevention and settlement; meaning, objectives, importance and conditions for successful collective bargaining; Workers Participation in management- concept, objectives, forms and measures; Discipline and Grievance- Statutory provisions concerning discipline; causes and machinery for redressal of grievances

Textbooks

1. P. Jyoti & D. N. Venkatesh ,Human Resource Management, Oxford Publication.
2. Gary Dessler and Biju Varkkey ,Human Resource Management, , Pearson Education, 2020

Reference books

1. S S Khanka Human Resource Management Text and Cases by, S.Chand and company Limited, 2022
2. K. Aswathappa,Human Resource Management. Mc Graw Hill Education, 2013
3. P. Subba Rao Personnel and Human Resource Management., Himalaya Publishing House, 2022

ENGINEERING ECONOMICS

Course Code: HS30101

Credit: 3

L-T-P: 3-0-0

Prerequisite: Nil

COURSE OBJECTIVE

The objective of Engineering Economics is to aid in decision-making by focusing on the economic implications of technical analysis. It is committed to making operational level decisions and solving problems.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Comprehend the significance of different components of Engineering Economics,

CO 2: Analyze the basic economic concepts required for engineers and managers,

CO 3: Develop the problem solving aptitude in the students through practical and case problems,

CO 4: Decide the feasibility of a particular project by the application of different project evaluation Techniques,

CO 5: Use the economic tools in the decision making process, and

CO 6: Survey the current macroeconomic situations in the economy.

COURSE DETAILS

Introduction to Economics and Engineering Economics

Basic concepts of Engineering Economics: Demand Analysis, Supply Analysis, Market Equilibrium. Revenue Analysis. Demand Forecasting- Quantitative Methods, Consumer's Equilibrium.

Production and Cost Analysis

Short Run and Long Run Production Functions, Producer's Equilibrium condition. Cobb-Douglas Production Function.

Cost Concepts: Short Run and Long Run Cost analyses. Break-Even Analysis.

Market: Concepts and Types;Perfect Competition, Monopoly

Time Value of Money

Interest Formulae and their applications with cash flow diagram. Evaluation of Investment Proposals - Present

Worth, Future worth and Annual Equivalent Method of comparison

Economic Appraisal Techniques

Net Present Value (NPV), Internal Rate of Return(IRR) ,Cost Benefit analysis.Depreciation calculation; Meaning and Definition, Methods.

Macroeconomic policies

Functions of commercial banks and central bank, Fundamentals of Business cycle, Macroeconomic policies for stabilization.

Textbooks

1. Dominick Salvatore, Siddartha K. Rastogi, Managerial Economics: Principles and Worldwide Applications, Oxford University Press, ISBN 9780199467068, 9th Edition,2020
2. D N Dwivedi, H L Bhatia, & S N Maheswari,Engineering Economics:, Vikas Publishing House, Noida, ISBN:978-93-5674-625-1, 2nd Edition 2023.
3. James Riggs, David D.Bedworth and Sabah U.Randhawa ,Engineering Economics–, 4th Edition, McGraw Hill Education (India) Private Limited, New Delhi, 2016.

Reference book

1. William A. McEachern and Simrit Kaur Micro ECON-A South-Asian Perspective-, Cengage Learning, 2013.
2. Yogesh Maheshwari, Managerial Economics- 3rdEdition, PHI Learning Private Limited,2014.
3. A. Khan, Arshad Noor Siddiquee, Brajesh Kumar,Engineering Economy-Zahid Pearson Publication, 2012.
4. R.Panneer Selvam Engineering Economics –, Pub: PHI Learning Private Limited, New Delhi, 9thEdition, 2008.
5. G.S Gupta Managerial Economics, , Tata McGraw Hill Education Private Limited, 2nd Edition, 2011.
6. D.M.Mithani, Managerial Economics – Theory and Applications –Himalaya Publication, New Delhi, 6th Edition, 2009.
7. S.B.Gupta, R7. Monetary Economics-Institutions, Theory and Policy- Publication: S.Chand, 1995.
8. R.D. Gupta R8. Macro – Economics –, Publication: Kalyani Publication, 1994.

MARKET STRUCTURE AND PRICING POLICIES

Course Code: HS30125

Credit: 3

L-T-P: 3-0-0

Prerequisite: Nil

COURSE OBJECTIVE

Develop the ability for getting conceptual clarity about the various types of markets along with their functions and understand the pricing policy operations in the different markets.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Comprehend the significance of different components of market,
- CO 2: Analyze the basic economic concepts required for various types of market and their policies,
- CO 3: Develop the problem solving aptitude through practical and case study problems faced by the economy,
- CO 4: Able to use the economic tools in the decision making process of fixing prices and quantities in different Market,
- CO 5: Differentiate between different markets and the policy measures to regulate it, and
- CO 6: Survey and map the impact of the current micro and macro-economic situations in the economy.

COURSE DETAILS

Cost and Revenue Analysis

Concepts of cost (economic cost, production cost, real cost, opportunity cost, private & social cost), Cost function, Output maximisation and Cost minimisation, Derivation of cost function, Traditional and Modern theories of costs.

Concepts of revenue (total, average, marginal revenue), Relationship between TR, AR and MR.

Market Structures and Perfect Competition

Meaning of market, Characteristics of market, and Types of market.

Perfectly competitive market and Features, Equilibrium of the firm and industry under perfect competition (short run and long run).

Monopoly Market

Meaning, concepts and characteristics of monopoly market. Equilibrium price and output determination under monopoly market in short and long run. Monopoly price discrimination. Degree of monopoly power and its measure. Control and regulation of monopoly power.

Duopoly and Oligopoly Market

Non-collusive oligopoly: Cournot's duopoly and Kinked-Demand Model. Collusive oligopoly: Cartel; Cartels aiming at joint profit maximization and market sharing cartels. Price leadership; low-cost price leadership, dominant firm price leadership and barometric price leadership.

Monopolistic Competition

Meaning, price determination of a firm under monopolistic competition; Chamberlin's group equilibrium; theory of excess capacity; selling costs; difference between perfect competition and monopolistic competition; difference between monopoly and monopolistic competition.

Textbooks:

1. Koutsoyiannis, Modern Microeconomics, St. Martin's Press, New York, 2nd Edition 1979, ISBN 978-0-333-25349-6
2. G. S. Maddala , Ellen M. Miller ,Microeconomics: Theory and Applications, , McGraw-Hill Inc.,US-Publisher, 1989, 0070394156-ISBN
3. H L Ahuja, Modern Microeconomics: Theory & Applications, S Chand Publishing, 2022, ISBN : 9789355011015,

Reference books:

1. Robert Pindyck, Daniel Rubinfeld, Microeconomics, Eighth Edition, 2017, 9789332585096-ISBN, Pearson Education Publication
2. G. Fransico Stigler, Theory of Price, Prentice Hall of India, New Delhi, 4th Edition 1996.
3. H. Gravelle and R. Rees, Microeconomics, Person Education U.K. 3rd Edition 2007, 2007ISBN: 9788131716557, 8131716554
4. H. R. Varian , Micro Economic Analysis, W W Norton & Company; New York, 3rd edition 2019, ISBN-13 : 978-8130908632

PRAGMATIC INQUIRY

Course Code: HS30127

Credit: 3

L-T-P: 3-0-0

Prerequisite: Nil

COURSE OBJECTIVE

As a foundation for lifelong inquiry, this course introduces students to research techniques and how they are used in both liberal arts, technical and professional courses.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Understand the meaning and importance of research in behavioral science,
- CO 2: Describe in detail different types of research methodologies,
- CO 3: Identify the strengths and weaknesses of the different study designs,
- CO 4: Assess whether research studies are using the most appropriate study design,
- CO 5: Discuss why various approaches may be appropriate/ inappropriate for their work-based research Question, and
- CO 6: Apply the concepts in research related activity.

COURSE DETAILS

Pragmatic Inquiry

Meaning, Characteristics, Need, Type and Approaches.

Research Problem

Meaning, definition, Selection and Framing of problem statement.

Research Design

Meaning, Characteristics, Need, Type, Approaches and Problems of research design.

Sampling Design

Meaning, Characteristics, Need, Type, Approaches and Problems.

Data Collection Method and Analysis

Types of data, Source of data, Methods of data collection, data analysis.

Textbook

1. Deepak Chawla & Neena Sodhi, Research Methodology: Concepts and Cases, Vikas Publishing House,2018, ISBN-10: ISBN-13: ,9325982390 978-9325982390.

Referencebooks

1. C R Kothari and Gaurav Garg, Research Methodology, New Age International Publishers,2019,ISBN-10 9386649225, ISBN-13- 978-9386649225
2. S.K. Mangal, Research Methodology in Behavioural Sciences, Prentice Hall India Learning Private Limited, 2013, ISBN-10 : : 9788120348080, ISBN-138120348080-978
3. Sameer S. Phanse, Research Methodology-Logic, Methods, and Cases,OUP, Sameer S. Phanse,2016 ISBN: 9780199453788

ECONOMIC ANALYSIS OF DECISION RULES

Course Code: HS30129

Credit: 3

L-T-P: 3-0-0

Prerequisite: Nil

COURSE OBJECTIVE

Analyze and understand investment decisions under the conditions of risk and uncertainty. Particular economic models are not the ends, but the means for illustrating the method of applying mathematical techniques to economic theory in general.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Analyze and understand investment decisions under the conditions of risk and uncertainty,
- CO 2: Explain how game theory brings out the strategy used by the oligopoly firms to determine the best possible action to maximize profit-maximizing objective,
- CO 3: Understand functional formulation of the problem and application of linear programming,
- CO 4: Describes different concepts used in analysing the national income and the different methods applied to measure the national income,
- CO 5: Describe and explain the main channels of the monetary transmission mechanism through monetary and fiscal policy, and
- CO 6: Describe managerial decisions through the application of some economic concepts, theories and principles.

COURSE DETAILS

Investment Decisions under Risk and Uncertainty

Concepts of Risk and Uncertainty; Investment Decisions under Risk: The Pay-Off Matrix Method, Risk-Adjusted Discount Rate Method, Certainty-Equivalent Approach, Probability Theory Approach, Decision Tree Method, Simulation, Sensitivity Analysis.

Game Theory and Strategic behaviour of Firms

Basics of Game Theory, Prisoners' Dilemma: The Problem of Oligopoly Firms; Application of Game Theory to Oligopolistic Strategy; Nash Equilibrium: Pure and Mixed Strategy

Optimization: Constrained & Extrema

Free and constrained optimization, Extrema of a function of two variables: graphical analysis, Lagrange method. Utility maximization & Cost minimization.

Linear and Non-Linear Programming for Business Decisions

Conditions for Application of Linear Programming; Concept of Feasible Solution; Assumptions of Linear Programming Application of Linear Programming Technique: Profit Maximization Problem, Formulation of Profit Maximization Problem in Linear Programming Mode; Graphical Method of Solving Linear Programming Problems; Simplex Method: Algebraic Solution, Simplex Tableau Method. Introduction to Non-Linear Programming

Input-Output Analysis

Input-output model, its structure and its derivation. The use of input output model in Economics.

Textbook

1. D. N. Dwivedi, H L Bhatia, S N Maheshwari, VIKAS® PUBLISHING HOUSE PRIVATE LIMITED, 2022

Reference books

1. C. Chiang and K. Wainwright, *Fundamental Methods of Mathematical Economics*, McGraw Hill International Edition, 2017
2. K. Sydsaeter and P. J. Hammond:, *Mathematics for Economic Analysis*, Pearson Educational Asia, 2002

ECONOMICS OF HEALTH AND EDUCATION

Course Code: HS 30131

Credit: 3

L-T-P: 3-0-0

Prerequisite: Nil

COURSE OBJECTIVE

The United Nations member states' adoption of the Millennium Development Goals, which include among other objectives achieving universal primary education, reducing child mortality, enhancing maternal health, and combating diseases, reflects the significance of education and health in enhancing wellbeing. This course offers a microeconomic framework to examine, among other things, individual preference in the demand for health and education, governmental involvement, and elements of inequality and discrimination in both sectors. An outline of India's health and education system is also provided.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Understanding role of health and education in human development,

CO 2: Analysing microeconomic foundations of health economics,

CO 3: Assessing the growth of health sector in India,

CO 4: Appraising the benefits of investment in human capital,

CO 5: Assessing the growth of education health sector in India, and

CO 6: Examining the underling discrepancies in both sectors.

COURSE DETAILS

Role of Health and Education in Human Development

Importance of health and education outcomes and their relationship with macroeconomic performance.

Health Economics Market

Demand for health; Uncertainty and health insurance market; Alternative insurance mechanisms; market failure and rationale for public intervention; equity and inequality.

Education: Investment in Human Capital

Rate of return to education: Private and Social; Quality of education; Signaling or human capital; Theories of discrimination; Gender and Caste discrimination in India.

Health and Education Sectors in India: An Overview

Health outcomes; health systems; health financing. Cost effectiveness and cost-benefit analysis; burden of disease. Literacy rates, school participation, school quality measures.

Trend in Health and Education Sector in India

Secondary data analysis pertaining to health and education sector. Trend analysis and forecasting using time series data. Simple growth rate calculations.

Textbook

1. S. K. Mishra, and V. K. Puri, *Indian Economy*, Himalaya Publishing House,2022, ISBN: 978-93-5596-423-6

Reference books

1. William, Jack, *Principles of Health Economics for Developing Countries*, World Bank Institute Development Studies, 1999.
2. World Development Report, *Investing in Health*, The World Bank, 1993.
3. G.Ronald, Ehrenberg and S.Robert, Smith, *Modern Labor Economics: Theory and Public Policy*, Addison Wesley, 2005.

BUSINESS ETHICS AND CORPORATE GOVERNANCE

Course Code: HS30223

Credit: **3**

L-T-P: **3-0-0**

Prerequisite: **NIL**

COURSE OBJECTIVE

This course focuses upon the fundamental principles and standards that should govern the business organizations. The objective of this paper is to make the students aware about the importance of ethics, corporate governance and role of CSR & sustainable development goals in the business to encourage moral practices and sensitivity towards the ethical dimension of managerial problems.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Familiarize the learners with the concept and relevance of Business Ethics in the modern era,
- CO 2: Understand the value of business ethics which will guide them in maintaining firm moral values while taking managerial decision,
- CO 3: Apply the ability to make moral judgments in dilemmatic situations across the work domains,
- CO 4: Analyse the application of management practices by adhering to corporate law and ethics,
- CO 5: Evaluate the scope, opportunity and complexity of Corporate Social responsibility in the global and Indian context, and
- CO 6: Create an opportunity to understand the sustainable development goals in maintaining a balance between the economic, environmental and social needs.

COURSE DETAILS

Business Ethics: Concept, Principles & Theories

Meaning, objective and types of Ethics; Business ethics- concept, need, scope, objectives and importance; factors influencing business ethics; Principles of Business ethics; Relationship between ethics and business ethics; theories of business ethics; Ethical dilemma and ethical decision making

Ethics in Practice across the domain

Ethics in marketing- introduction, ethical dilemma in marketing, unethical marketing practices, measures to stop unethical practices in marketing; Ethics in Finance- introduction, code of ethics in finance, unethical practices in finance or frauds, measures to stop unethical practices in finance; Ethics in HRM- introduction, ethical issues in HRM (job discrimination, sexual harassment, employee privacy, whistle blowing, affirmative action); importance of workplace ethics and employee code of conduct

Corporate Governance

Corporate Governance- concept, objective and need. Role of law in corporate governance; important issues in corporate governance; Corporate governance in India-past, present and Future; Importance and principles of Corporate Governance

Introduction to Corporate Social Responsibility

CSR- Concept, evolution and development; Why CSR; Apprehensions against CSR; Forms and dimensions of CSR; making business corporations socially responsible; CSR in India

Sustainable Development

Introduction, meaning, history, features, objectives of sustainable development; The pillars and principles of sustainable development; SDG and its relevance in business

Textbooks

1. Dr. K. Nirmala, Dr. B.A. Karunakara Reddy & N. Aruna Rani, Business Ethics and Corporate Governance, Himalaya Publication House
2. C.S.V. Murthy, Business Ethics and Corporate Governance, Himalaya Publishing, 2022

Reference books

1. Prabhakaran Paleri, Corporate Social Responsibility (concept, cases and trends) Cengage Learning India Pvt. Limited, 2020
2. Dr. S.S. Khanka, Business Ethics and Corporate Governance, Sultan Chand, 2019
3. C.U. Saraf, Corporate Social Responsibility (CSR), Corporate Governance, Sustainable Development and Corporate Ethics/Business Ethics Himalaya Publishing House 2017

LEADERSHIP AND TEAM EFFECTIVENESS

Course Code: HS30225

Credit: 3

L-T-P: 3-0-0

Prerequisite: NIL

COURSE OBJECTIVE

An effective leader understands the team dynamics, stimulates the morale of the followers and always aims at creating a participative workforce by enhancing team work. This course mainly focuses on individual, group and organization factors associated with leadership. There is a strong connection between emotional intelligence and leadership because the technical skills and knowledge will definitely help the students to fulfil the entry level requirements. Similarly, understanding employee empowerment would assist the students in acquiring the desirable professional skills.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Learn the characteristics and need of an effective leader,
- CO 2: Understand the effectiveness of different leadership styles in different contexts from an instrumental, political and ethical perspective,
- CO 3: Apply leadership theories to the real business scenario,
- CO 4: Analyse group dynamics and importance of team work,
- CO 5: Evaluate the ways to handle emotions and stress and manage work-life flexibility, and
- CO 6: Create organizational environment that is psychologically safe and make the employees feel empowered.

COURSE DETAILS

Leadership: concepts and practices

Meaning, Definition and understanding of leadership; the role and functions of a leader; Differentiation between leadership and management; ; what makes a leader effective; characteristics of an effective leader; leadership in Indian organization

Leadership Perspectives

Trait perspective of leadership (Great man theory and trait theory); Behavioural perspective of leadership (mangerial grid and likert system - four management); Studies on leadership (Hawthorne, IOWA, Michigan and Ohio); Contingency perspective of leadership (fiedler's contency theory, path goal, hersey blanchard situational theory); contemporary perspective to leadership (transformational, transactional, charasmatic, servant and Nurturant-task leadership style)

Team effectiveness and Leadership

Characteristics and types of teams; types and functions of group; Group vs team; understanding an effective team; who is a team leader; tuckman's team development stages; team development and team building; team meetings and leadership; team effectiveness leadership model; high-performance teams and leadership;team cohesiveness; common threats to groups

Emotional Intelligence and Leadership

What are emotions; Meaning, type and source of emotions; Concept and competencies of emotional intelligence; Elements of emotional intelligence; importance of EI; EI at workplace; Emotional intelligence and leadership; Significance of EI for leaders; strategies to enhance EQ in our jobs; EQ vs. IQ; developing EQ; obstacles to the development of EQ

Leadership and empowerment

Employee empowerment- concept, need and importance; approaches to empowerment; advantages and disadvantages of empowerment; empowerment skills of a leader; empowering vs. Dis-empowering; leader as a coach (coaching skill); delegation (advantages and levels of delegation, steps and principles of effective delegation); empowering interpersonal skills

Textbook

1. Ranjana Mittal,Leadership Personal effectiveness and Team Building, Vikas Publishing House Pvt Ltd, 2015

Reference book

1. S. Bhargava and Gourav Bhargava,Team Building and Leadership Neelam Himalaya Publishing House, 2015.

UNIVERSAL HUMAN VALUES

Course Code: HS30401

Credits: 3

L-T-P: 3-0-0

Pre-requisites: Nil

COURSE OBJECTIVE

The objective of the course is to develop a holistic perspective based on self-exploration, understand the harmony in the human being, strengthen self-reflection, and develop commitment and courage to act.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Understand the concept of value education and its need,
- CO 2: Apply their knowledge on value education for apt self-assessment,
- CO 3: Comprehend human-human relationship,
- CO 4: Build holistic perception of harmony at all levels of existence,
- CO 5: Develop the sense of natural acceptance of human values, and
- CO 6: Create people friendly and eco-friendly environment.

COURSE DETAILS

Need, Basic Guidelines, Content and Process for Value Education

Purpose and motivation for the course, recapitulation from Universal Human Values-I. Self-Exploration—what is it? - Its content and process; ‘Natural Acceptance’ and Experiential Validation- as the process for self-exploration. Continuous Happiness and Prosperity- A look at basic Human Aspirations. Right understanding, Relationship and Physical Facility- the basic requirements for fulfillment of aspirations of every human being with their correct priority. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario. Method to fulfil the above human aspirations: understanding and living in harmony at various levels. Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking

Understanding Harmony in the Human Being - Harmony in Myself!

Understanding human being as a co-existence of the sentient ‘I’ and the material ‘Body’. Understanding the needs of Self (‘I’) and ‘Body’ - happiness and physical facility. Understanding the Body as an instrument of ‘I’ (I being the doer, seer and enjoyer). Understanding the characteristics and activities of ‘I’ and harmony in ‘I’. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail. Programs to ensure Sanyam and Health. Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one’s own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease

Understanding Harmony in the Family and Society- Harmony in HumanHuman Relationship

Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfillment to ensure mutual happiness; Trust and Respect as the foundational values of relationship . Understanding the meaning of Trust; Difference between intention and competence . Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family. Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students’ lives

Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

Understanding the harmony in the Nature. Interconnectedness and mutual fulfilment among the four orders of naturerecyclability and selfregulation in nature. Understanding Existence as Co-existence of mutually interacting units in allpervasive space. Holistic perception of harmony at all levels of existence. Include practice sessions to discuss human being as cause of imbalance in nature (film “Home” can be used), pollution, depletion of resources and role of technology etc.

Implications of the above Holistic Understanding of Harmony on Professional Ethics

Natural acceptance of human values. Definitiveness of Ethical Human Conduct. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order. Competence in professional ethics: a) Ability to utilize the professional competence for augmenting universal human order b) Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c) Ability to identify and develop appropriate technologies and management patterns for above production systems. Case studies of typical holistic technologies, management models and production systems. Strategy for transition from the present state to Universal Human Order: a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers b) At the level of society: as mutually enriching institutions and organizations . Sum up. Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. To discuss the conduct as an engineer or scientist etc.

Textbook

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010

Reference books

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. A.N. Tripathi, Human Values New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. Mohandas Karamchand Gandhi ,The Story of My Experiments with Truth -
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj - Pandit Sunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

GENDER STUDIES

Course Code: HS30421

Credit: 3

L-T-P: 3-0-0

Prerequisite: Nil

COURSE OBJECTIVE

The objective of this course is to make student understand the concepts of masculinity and femininity as analytical categories via analysing the role of communalism, patriarchy, violence as major hurdles to women's rights globally. Further, this course will enhance their understanding over the current health and education status of women to analyze impact of government health policy on women. Additionally, it will bring greater understanding over the integration of gender concerns and perspectives in policies and programmes for sustenance of environment at international, national, regional levels.

COURSE OUTCOME

After successfully completing the course, the students will be able to

- CO 1: Familiarise the students with the concepts of sex, gender and sexuality commonly used in gender studies,
- CO 2: Identifying major human rights violations faced by women worldwide,
- CO 3: Learn about women's health movements and government health policies,
- CO 4: Develop an insight into policy perspective issues, and concerns of girl's education in India,
- CO 5: Delineate the characteristics and the issues of environment and the involvement of women in balancing ecosystem, and
- CO 6: Understand on sustainable development, millennium development goal, and other global level development initiatives taken for uplifting women status in society.

COURSE DETAILS

Understanding Basic Concepts in Gender Studies

Concepts: Sex, Gender, Sexuality, Femininities, Masculinities and other sexualities, Patriarchy; WID: Women in Development; WAD: Women and Development; GAD: Gender and Development

Gender and Human Rights Discourse

Women's Rights as Human Rights (FGM, FF, Rape, Honour Killing, IVP, Witch Hunting, Virginity Test, Communalism, Trafficking, Immigration); National Commission for Women and other State Commissions, Ministry and Department of Women and Child.

Gender and Health

Sexual and reproductive health (ICPD, B.P.A. Family planning and Abortion); Impact of violence on women's health; Women's health movement: National and International; National health and population policy; National Family Health Survey (NFHS)

Gender and Education

Women's Education in Free India: Gender Disparity in Enrolment; Constraints of Women's Education: Social, Economic, Cultural, Geographical, other Factors; Important Committees and Commissions on Women's Education: Radhakrishnan Commission (1948), Mudaliar commission (1952), Kothari Commission (1964-1966), Ramamurthy Commission (1991).

Gender and Environment

Role of women in environment conservation; Role of Women in Waste Management; Women's Resistance to Environmental Destruction: Joint Forest Management – CHIPKO Movement – Narmada Bachao Aandolan

Reading Materials

1. Gerda Lerner, Creation of Patriarchy, Oxford University Press, 1985
2. Menon, Nivedita. ed. 2007. Sexualities. Women Unlimited. New Delhi.
3. Gnew, Sneja, A Reader in Feminist Knowledge, Routledge, New York, 1991
4. Marjorie Agosin (ed.), Women, Gender and Human Rights: A Global Perspective, Rawat Publications, 2000
5. Monica Chawla, Gender Justice: women and law in India, Deep and Deep pub., New Delhi, 2006, 2013
6. P D Kaushik, Women's rights; access to justice, Bookwell Publications, New Delhi, 2007
7. Paola Monzini, Sex Traffic, Prostitution, Crime and Exploitation, Zed Pub., 2005
8. Chloe E. Bird, Patricia P. Rieker, Gender and Health, Cambridge University Press, 2008.
9. Jasmine Gideon, Ed., Handbook on Gender and Health (International Handbooks on Gender series), Development Studies, Birkbeck, University of London, UK, 2016.
10. Nelson E, Zimmerman C. Household survey on domestic violence in Cambodia. Ministry of Women's Affairs, Project Against Domestic Violence, Cambodia, 1996.
11. Parker B, McFarlane J, Soeken K. Abuse during pregnancy: effects on maternal complications and birth weight in adult and teenage women. *Obstetrics and gynaecology*, 1994, 84(3):323-328.
12. Madeleine Arnot and Mairtin Mac, An Ghail, (2006) "Gender and Education" Routledge, New York
13. Aruna Goel, (2004) "Education and Socio-Economic Perspective of Women Development and Empowerment" Deep and Deep Publications, New Delhi
14. Eileen M. Byrne, (1978) "Women and Education" Tevi Stock Publications, Michigan
15. Payal Mago and Isha Gunwal, (2019). Role of Women in Environment Conservation.
16. M.S Swaminathan. (1998). "Gender Dimensions in Biodiversity management". Konark Publisher's Pvt. Ltd, New Delhi.
17. P.K.Rao. (2000). "Sustainable Development – Economics and Policy". Blackwell, New Delhi.
18. Swarup, Hemlata and Rajput, Pam. (2000). "Gender Dimensions of Environmental and Development Debate: The Indian Experience" in Stuart S. Nagel, (ed.) "India's Development and Public Policy". Ashgate, Burlington.

TRIBAL RESOURCE MANAGEMENT

Course Code: HS30423

Credit: **3**

L-T-P: **3-0-0**

Prerequisite: Nil

COURSE OBJECTIVE

The course intends to impart a comprehensive knowledge about the reality, pertaining to economic alleviation of the poor and downtrodden. It is inter-disciplinary and based on utilization of natural resources employing traditional means of approach, conducive for societal growth and development. This shall hone socioeconomic environmental development for uplifting the condition of tribal population for igniting new ideas in the new economy.

COURSE OUTCOME

After successfully completing the course, the students will be able to

- CO 1: Identify the concept of sustainable natural resource management,
- CO 2: Recognize agribusiness management, its opportunities and risks,
- CO 3: Discuss adequate skills to prepare and implement integrated development plan & projects for the optimal use of tribal renewable resources for the sustainable development of the environment,
- CO 4: Illustrate the nuances of environmental policies and Laws in India and understand the core competencies required for resource mobilization and policy formulation based on the research insight,
- CO 5: Prioritize the role of health and education for the development of tribal community, considering tribal people as resources, and
- CO 6: Develop trainees or volunteers as competent change agent in the field of tribal resource management.

COURSE DETAILS

Natural Resource Management

Introduction to Natural Resources and their management: Natural Resource Management (NRM): Concept, Issue and Approaches; Need for developing extension strategies for NRM; Issues in management of NRM; Problems encountered while advocating strategies for NRM; Monitoring and auditing in Natural Resource Management (NRM); Triple Bottom Line (TBL) and concept of Sustainable Natural Resource Management; NRM of Water, land and forests: Water resources and their management, Overview of irrigation management, Integrated Watershed management and rainwater harvesting, River Basin management; Scope of market mechanism in NRM

Agribusiness Management

Agricultural value chains and their relevance; Managerial Insights: Identifying agribusiness opportunities; Assessing feasibility – technical, commercial and financial and thereby identify feasible opportunities for projects; Analyzing influences of external environment factors and associated risks; Discussions on illustrative agribusiness projects; select models and opportunities of agribusiness opportunities and ventures.

Environmental Resource Management of Tribals

Environment and Development-Theories of optimal use of exhaustible and renewable resources; Sustainable Development - The concept of sustainable development; strong and weak sustainability; Mechanism for environment regulation in India; environmental laws and their implementation; Environmental Policy in India-Policy instruments for controlling water and air pollution and forestry policy; Institution for forest Management-The institutions of joint forest management , social forestry-rationale and benefits

Tribal Health and Education Management

Role of Health and Education in Tribal Development: Importance in poverty alleviation; health and education outcomes and their relationship with macroeconomic performance; Tribal Health in India: An Overview Health outcomes; health systems; health; Evaluation of Health Programs for tribals: Costing, cost-effectiveness and cost benefit analysis; burden of disease; Tribal Education in India: An Overview Literacy rates, school participation, school quality measures

Agro forestry Management

Multiplicity of Agroforestry products and services- ecological and economic and cultural considerations- gender equality- preservation of indigenous knowledge. Socioeconomic benefits of agroforestry; Smallholder livelihood and the role of agroforestry- Food and nutritional security Fulfillment of food, fodder, fuelwood and shelter based needs- income generation vs. subsistence production; Adoption of AF- Determinants of adoption: feasibility, profitability, and acceptability; . Self-efficacy in farmer decision-making - policy aspects.

Text Books

1. Madhusudan Bandi ,Tribals and Community Forest Management , Rawat Publication, 2013
2. Jumyir Basar, Indigenous Knowledge and Resource Management Shipra Publications, 2014
3. Laishram Herojit, Rethinking Resource Management: Sustainability and Indigenous Peoples, A.K. Publications, 2012.

Reference Book

1. G.K. Bera, Tribal India's Traditional Wisdom and Indigenous Resource Management by, Abhjeet Publishers.

INDIAN KNOWLEDGE SYSTEM

Course Code: HS30425

Credit: 3

L-T-P: 3-0-0

Prerequisite: Nil

COURSE OBJECTIVE

The objective of the course is to promote interdisciplinary study on all aspects of the Indian Knowledge System (IKS), preserve and disseminate IKS for further study and societal applications. It will actively help students to engage in spreading the rich heritage of our country and traditional knowledge in the field of Liberal Arts, Literature, Basic Sciences, Engineering and Technology, Economics, mental and physical well being etc.

COURSE OUTCOME

At successfully completing the course, the student will be able to

- CO 1: Understand the concept of Indian traditional knowledge and its importance,
- CO 2: Know the need and importance of protecting traditional knowledge,
- CO 3: Develop an appreciation among the students for ancient scriptures,
- CO 4: Contrast and compare characteristics and important kinds of traditional knowledge,
- CO 5: Evaluate social change on traditional knowledge and
- CO 6: Create innovative ways of bringing forward ancient knowledge to the forefront.

COURSE DETAILS

Meaning of Traditional Knowledge System

Overview of the Vedas, the Upanishads, the Puranas, and the Itihasas. Main Schools of Darshana/ Philosophy: Astika (Vedanta, Nyaya, Vaisheshika, Sankhya, Mimamsa, Yoga) and Nastika (Buddhist, Jainist, Lokayata). Types of Shastra (Vyakarana, Kavya, Alamkara, Shilpa, Vastu, Natya and Sangita). Types of Kavya (Drishya, Shravya, Chitra). Theory of Rasa: Natyashastra by Bharata (Chapter 6). Applied Traditional Knowledge: Myths, Rituals, Taboos and Superstitions, Folktales, Proverbs. Fundamental Concept of Dharma and Its Role in Various Streams of Indian Knowledge System

Yoga and Spiritualism

Definition and Origin of Yoga. Significance of spirituality in Yoga, Historical development of Yoga; Yogic philosophy: The eight limbs of yoga according to Patanjali, Mind, body & spirit connection in yoga; Relevance of Asana, Pranayama & Dhyana in Yoga: Physical posture for physical, mental and spiritual development, Breathing techniques for energy restoration & consciousness, Meditation for inner stillness and mindfulness, Meditation for spiritual growth & self-discovery; Ethics & Moral Values in Yoga: Exploring the ethical principles Yama and Niyama, Application of yogic principles to daily life for spiritual growth; Yoga & Spirituality in modern life.

Fun with mathematics without calculator

Arithmetic- Quick calculation with 11 and 12, Multiplication with 99999 in seconds, multiplication with numbers near the bases, vertical and cross multiplication, Magic squares and square roots, cubes, fractions, divisions, HCF and LCM in ancient style. **Algebra-** Factorising quadratic expressions, One variable linear equation, Simultaneous linear equations. Implementation of Vedic mathematics tools during competitive examinations.

Ancient Indian Science and Technology

Technological development in India: Agriculture (Origin and development, ancient crops, Traditional practices), Water management (Overview, Harappan water management, other case studies, Medieval Water structures), Pottery (Overview, Technical aspects), Silpasastra (Architecture and Construction- An introduction to Silpasastra, Construction Technology), Metallurgy (Copper/Bronze/Zinc, Iron and Steel Technology in India).

Trade and Commerce in Ancient India

Internal, External, Trade routes Indo-Roman contacts and Maritime Trade of South India; Silk and Cotton Textiles, the Principal Maritime Trade Commodities of Ancient India; Trade routes in Ancient India: Silk Route and Spice Route.

Reading Materials

1. Dasgupta, Surendranath. A History of Sanskrit Literature, Motilal Banarsidass
2. Banerji, Suresh Chandra. A Companion to Sanskrit Literature, Motilal Banrasidass
3. Chatterjee, Satischandra. An Introduction to Indian Philosophy, Motilal Banarsidass
4. Sharma, Chandradhar. A Critical Survey of Indian Philosophy, Motilal Banarsidass
5. A Text Book on Yoga and Health by Dr. Sajib Kumar Bhowmik, Sports Publication, 2020.
6. Light on the Yoga Sutras of Patanjali, B.K.S Iyengar, Element, 2005.
7. The Complete Book of Yoga: Karma Yoga, Bhakti Yoga, Raja Yoga, Jnana Yoga by Swami Vivekananda, Fingerprint Publishing, 2019.
8. Singhal, Aditi. How to Become A Human Calculator. ISBN : 9789352836543. S Chand Publishing
9. M. Tyra and K Kundan. Magical Book on Quicker Maths . ASIN : B07X93W2FC. BSC Publishing Co Pvt Ltd.
10. Singh, Balram. Science and Technology in Ancient texts. DK Print World ltd, 2012. ISSN 9788124606322.
11. Chandra Moti, Trade and Trade Routes in Ancient India. New Delhi: Abhinav Publications, 1977
12. Textiles in Ancient India: From Indus Valley Civilization to Maurya Period. Vishwavidyalaya Prakashan, 1994.
13. Duraiswamy, D. Silk and Cotton Textiles, the Principal Maritime Trade Commodities of Ancient India. ACTA VIA SERICA, Vol. 6, No. 2, Dec. 2021: 91-116, 6(2), 91–116.

PROBABILITY AND STATISTICS

Subject Code: MA21001

Credit: 4

L-T-P: 3-1-0

Prerequisite: Intermediate mathematics

COURSE OBJECTIVE

The objective of this course is to familiarize the students with the foundation of probability and statistics and to use it in solving the problems arises in engineering and real life applications.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Understand basic probability and its applications
- CO 2: Study probability distributions and can use it in real life data analysis
- CO 3: Have a knowledge on univariate and bivariate distributions and their properties
- CO 4: Measure the central tendency and dispersion of a data set to draw conclusion from the data and interpret the data with the appropriate pictorial representation.
- CO 5: Have good understanding of the Central Limit Theorem and its applications
- CO6: analyze the statistical inference

COURSE DETAILS

Probability and random variables

Basic concepts of sample space, events (with example), Axiom of Probability, Conditional Probability, Bayes' Theorem and its applications. Discrete random variable, probability mass function, cumulative distribution function and Moment Generating function for discrete random variable, some special distributions like Uniform distribution, Geometric distribution, Binomial distribution, Negative Binomial distribution, Poisson distribution, Hypergeometric distribution, mean and variance. Continuous random variable, density function, cumulative distribution function and Moment Generating function. Uniform distribution, normal distribution, mean, variance, percentile and critical value of normal distribution, normal approximation of the binomial distribution and exponential distribution.

Joint probability and distributions

Joint probability mass function and marginal probability mass function, joint probability density function and marginal probability density function, concept of independent random variable (joint probability), conditional probability mass function and conditional probability density function. Expected value, covariance and correlation for jointly distributed random variable (both continuous and discrete).

Descriptive Statistics

Frequency distribution, pictorial and tabular representation of data, stem and leaf display, dot plots, histogram, box plots and comparative box plots. Basic concepts on mean, median and mode, Skewness, Kurtosis, Correlation, Coefficient of Correlation, rank correlation, Regression Analysis: Least square method.

Inferential statistics

Population, sample, random sample, sampling distribution, distribution of sample mean, central limit theorem, point estimator, point estimation of parameter using method of maximum likelihood estimation, confidence interval, confidence interval for the mean of a normal population with known and unknown variance, confidence interval for the variance of a normal population, hypothesis testing, one sided and two sided alternatives, Tests for mean of the normal distribution with known variance, Tests for mean of the normal distribution with unknown variance, tests for variance of the normal distribution.

Textbooks

1. J. L. Devore, Probability and Statistics for Engineers and Sciences, CENGAGE Learning, 9th Edition.
2. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley, INC, 10th Edition.

Reference Books:

1. S.M. Ross, Introduction to Probability and Statistics for Engineers and Scientists, Elsevier/AP, 6th Edition.
2. J.S. Milton & J.C. Arnold, Introduction to Probability and Statistics, Mc Graw Hill, 4th Edition.
3. H.J. Larson, Introduction to Probability Theory and Statistical Inference, John Wiley & Sons Inc, 3rd Edition.
4. S.C. Gupta & V. K. Kapoor, Fundamental of Mathematical Statistics, S. Chand, 12th Edition.

DISCRETE MATHEMATICS

Subject Code: MA21002

Credit: 4

L-T-P: 3-1-0

Prerequisite: Nil

COURSE OBJECTIVE

The main objective of this course is to provide mathematical concepts and build up strong mathematical fundamentals to support many subjects of computer science engineering such as design and analysis of algorithms, computability theory, software engineering, computer systems, syntactical analysis, information organization and retrieval, switching theory, computer representation of discrete structures and programming languages etc.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1. Convert sentences in natural language into mathematical statements and understand predicate and quantifiers, rules of inference and prove results by principle of mathematical induction.
- CO 2. Understand the principles of inclusion and exclusion of sets, concept of relations and functions and solve related problems.
- CO 3. Know the concepts of partition of sets, partial ordering relation, Hasse diagram and Lattice.
- CO 4. Solve problems on recurrence relations by substitution and method of generating functions and know a powerful method of counting
- CO 5. Understand the concept of algebraic structures, groups, semi group, subgroups and Lagrange theorem. Gets the idea of homomorphism and isomorphism of groups, definition and examples of ring, integral domain and field.
- CO 6. Apply Graph theory in related areas like Syntactic analysis, Fault detection and diagnosis in computers, Scheduling problems and Minimal-path problems, network flow problems.

COURSE DETAILS

Logic

Proposition,

Truth values, Connectives, Logical equivalence of composite statement (using truth table & without truth table), Predicates and Quantifiers, Rules of Inference, Methods of Induction.

Set, Relation & Function

Set, Operations on set, Principles of Inclusion and Exclusion, Relation, Types of relations, Properties on Binary Relation, Equivalence relation, partial ordering relation, Hasse diagram, Lattice, Definition of function, Injection, Bijection, Surjection, Permutation function.

Recurrence Relation and their solutions

Principles of counting, Discrete numeric function and their manipulation, Generating Function, Concept of Recurrence Relation with constant coefficients, Solution of Recurrence Relations (Substitution and generating function methods).

Groups and Rings

Concept of binary operations, Algebraic structures, Semigroup, monoid, Group, Abelian group with examples. Properties of groups, Cyclic groups and its generator, Sub group, cosets, Normal subgroup, Lagrange's Theorem, Homomorphism and Isomorphism, ring, field, Integral domain (Definition with examples)

Graph Theory

Basic Terminology, Adjacency & Incident Matrix, graph Isomorphic Test, Paths, Circuit, Eulerian path and Eulerian Circuit, Hamiltonian path and circuit, shortest path Algorithms (Dijkstra), Tree, Rooted Tree, Binary Tree, spanning tree, Minimal Spanning Tree (MST) Algorithms (Prim's & Kruskal's Algorithms), Planar and Nonplanar Graphs.

Textbook

1. Discrete Mathematics and its Applications by Kenneth H Rosen (Mc Graw Hill 7th Edition)

Reference books

1. Elements of Discrete Mathematics. A Computer oriented approach by C.L Liu, D.P. Mohapatra (Tata Mc Graw Hill 4th Edition-2013)
2. Discrete Mathematics by Sudarsan Nanda, Allied Publisher Pvt. Ltd., 2022
3. Introduction to Graph Theory by Douglas B. West, Pearson, 2nd Edition, 2002
4. Discrete Mathematics by Iyenger et al., Vikas Publishing House Pvt.Ltd., 2020

VECTORS, DIFFERENTIAL EQUATIONS AND COMPLEX ANALYSIS

Subject Code: MA21006

Credit: 4

L-T-P: 3-1-0

Prerequisite: MA11001, MA11002

COURSE OBJECTIVE

The objective of this course is to empower the students to design and solve branch prospective problems by the use of Vector calculus, partial differential equations, Complex variables.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Understand the physical significance of the concepts like divergence, curl and gradient.
- CO 2: Apply vector integration theorems like Gauss divergence, Stokes and Greens theorem in different engineering applications like work done by force, evaluation of flux etc.
- CO 3: Know the basic analytical techniques for solving the classical wave, heat and Laplace equation
- CO 4: Know the concepts of analytic functions, its differentiation and its series representation
- CO 5: Understand the fundamental concepts of contour integration to evaluate complicated real integrals via residue calculus
- CO 6: Apply multi steps numerical methods to solve initial and boundary value problems

COURSE DETAILS

Vector Calculus

Brief concepts of vectors, gradient of a scalar field, directional derivatives, divergence and curl of a vector field. Vector line integral, surface integral, Green's theorem, Gauss divergence theorem, Stoke's theorem, engineering applications of above integral theorems like work done by force, flux integration, independence of path etc.

Partial Differential Equations (PDE)

Basic concepts of PDE like order, degree, linear, nonlinear, homogeneous and non-homogeneous PDE. Solution of PDE by Variable Separable method. Classification of PDE and their reduction to normal form. One dimensional Wave equation, D'Alembert and Fourier series solution of 1-D wave equation. Solution of 1-D heat

equation by Fourier series method. Solution of 2-D Laplace equation and 2-D heat equations. (steady state) with different types of boundary conditions using Fourier series. Laplace equation in polar co-ordinate and its application to find the electrostatic potential/steady state temperature in a disk with appropriate boundary conditions. Solution of PDE by Laplace Transform.

Complex Analysis

Basic concepts of complex number. Complex functions, derivatives, analytic function, Cauchy Riemann equations, harmonic functions, harmonic conjugate, elementary functions like exponential, trigonometric, hyperbolic, logarithmic functions and general powers. Curves in complex plane and their parametric representation. Line integrals, Cauchy integral theorem, Cauchy integral formula, Derivatives of analytic function. Power series, Taylor's series, Maclaurin's series, Laurent's series, singularities, Residues, Residue Integration, Real Integrals and Cauchy's Principal Value integrals.

Numerical Solution of ODEs

Solution of Linear Difference Equations; IVP (Multi Steps Method): (Predictor-Corrector method) Adams-Bashforth Method, Adam-Moulton Method; BVP: Shooting methods.

Textbooks:

1. Erwin Kreyszig, Advanced Engineering Mathematics by Wiley, INC, 10th Edition.
2. Jain, Iyenger and Jain, Numerical Methods for Scientific and Engineering Computation
New age International (P) Ltd.,6th Edition.

Reference books:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers,36th Edition.
2. B.V. Ramana, Higher Engineering Mathematics TMH, 2017 Edition.
3. H. K. Dass, Advanced Engineering Mathematics S. Chand, 2007 Edition

ADDITIVE MANUFACTURING (3D PRINTING)

Course Code: ME28011

Credit: **1**

L-T-P: **0-0-2**

Prerequisite: Nil

COURSE OBJECTIVE

Additive Manufacturing (AM) is a modern manufacturing technology also known as 3D printing process, will provide a clear understanding about the process, acceptability and usability in various field. AM technologies classified on the basis material types will be focused with its real-life applications with advantages and disadvantages. Different types of errors associated with AM and CAD technology will be discussed with suitable error minimization processes. Various reverse engineering process will be discussed and practically implemented with its real-life applications.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Understand the concept of additive manufacturing, its benefits and applications in various fields,
- CO 2: Know the various liquid, powder and solid material based technologies in Rapid Prototyping and Rapid Tooling process,
- CO 3: Know the application of AM process in the field of Bioedical,
- CO 4: Design solid models and converting it to 3D printing readable file format required for part fabrication, CO 5: Focus on the various types of errors in the RP parts and errors during CAD file conversion, and
- CO 6: Apply reverse engineering process to generate data for fabrication of RP part.

COURSE DETAILS

Introduction to Additive Manufacturing Technologies

Need & Development of AM systems, AM process chain, Impact of AM and Tooling on Product Development, Benefits, Applications, Digital prototyping, Virtual prototyping.
Model Preparation using Solid Modelling Software.

Classification of Additive Manufacturing Technologies

Classification of AM technologies on the basis of Materials types. Discussion on various AM processes based solid, liquid and semi solid type of materials along with its application, advantages and disadvantages.
Hands on practice for model creation and saving on particular file format.

Data Processing for AM Technologies

Process planning for AM, CAD model preparation, data requirements & geometric modelling techniques: Wire frame, surface and solid modelling data formats.
Hands on practice for the fabrication of Single components and Assembly components.

Rapid Tooling

Classification: Soft tooling, Production tooling, Bridge tooling; direct and indirect, Fabrication processes, Applications, Rapid tooling techniques such as laminated metallic tooling, direct metal laser sintering, vacuum casting.

Hands on practice for the fabrication of pattern and mould preparation.

Reverse Engineering Processes

Introduction to reverse engineering, Integration of reverse engineering with AM technology.
Hands on practice to generate model data in reverse engineering process integrated with AM process

Reference Books

1. Rafiq I Noorani, Rapid Prototyping: Principle and Applications, Wiley & Sons, 2006.
2. Chua C.K., Leong K.F., and Lim C.S., Rapid prototyping: Principles and applications, Yes Dee Publishing Pvt. Ltd, Third Edition, 2010.
3. Frank W. Liou, Rapid Prototyping and Engineering Applications, CRC Press, Special Indian Edition, 2007.
4. R.B. Choudhary, Additive manufacturing, Khanna Publication, 2022.

DIE DEVELOPMENT BY CNC MILLING

Course Code: ME28013

Credit: 1

L-T-P: 0-0-2

Prerequisite: Workshop (ME18001)

COURSE OBJECTIVE

The objective of the course is to provide basic knowledge on various tools and precision instruments used during CNC milling operation. It helps in understanding the usage of various machining cycles to reduce the manufacturing lead time. Moreover, it explains the usage of various standards and programming methods to be followed during CNC machining operation. Finally, the students can develop/generate the programs used to produce the geometries with complex contours using CNC milling machine.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Understand the usage of different tools and precautions to be followed during machining,
- CO 2: Know the principle and operation of precision instruments,
- CO 3: Understand the technological advancements in NC and aimed to achieve JH pillar,
- CO 4: Understanding the programming methods and programming in simulators,
- CO 5: Planning for optimized CNC programming by estimating suitable process parameters, and
- CO 6: Programming of die contours and executing on CNC milling machine.

COURSE DETAILS

Tools and Safety

List of tools used on Milling Machine to perform various operations. Safety: Introduction to safety equipment and their uses.

Measuring instruments

Vernier caliper, Micrometer, Bevel protractor, Coordinate measuring machine (CMM): Construction, principle graduation and reading, least count.

Introduction to CNC

Introduction to CNC technology, Conventional Vs. CNC machine tool, CNC clamping system. Implementation of JH for CNC.

CNC programming

Introduction to CNC programming, Introduction and demonstration of line programs milling machine using ISO codes into the CNC simulator. Part programming methods, Cutting process parameter selection, Process planning issues and path planning, G & M Codes, Interpolations, Tool compensations.

CNC Programming-Milling

Calculations of parameters like speed feed, depth of cut etc. and set a references for the various operations. Prepare & set CNC Milling operations and dry run on the machine. Execute program and inspect simple geometrical forms / standard parts.

Reference Books

1. Yoram Koren, Computer Control of Manufacturing Systems, Mc Graw Hill Publication.
2. Mikell P. Groover, CAD/CAM.
3. P.C. Sharma, A textbook of Manufacturing Technology-II.
4. R.K. Jain, Engineering Metrology, Khanna Publishers.

CONCEPT CAR MANUFACTURING

Course Code: ME28015

Credit: 1

L-T-P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

Objective of the course is to give the students hands on experience on building a racing car. Students find it very interesting to develop important parts of a racing car and then assemble and take part in various national and international events. In this process they meet the requirement set by the authorities. Therefore the students learn here how to propose a new car body and prove the feasibility by computational analysis of the body and other important parts.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Remember the fundamentals of concept car characteristics,
- CO 2: Understand the aerodynamic requirements in racing vehicles,
- CO 3: Use the concepts of chassis behaviour of concept car,
- CO 4: Illustrate the suspension characteristics of the concept car,
- CO 5: Understand the problems faced in drives and braking systems in motor sports, and
- CO 6: Build a concept car body.

COURSE DETAILS

Car Development

Constraints And Specifications – Performance, Handling, Structure; Driver Accommodation and Safety.

Tyres

Adjustable Features, Preliminary Design and Analysis; Driver-Vehicle Relationship. Desirable Vehicle Characteristics, Fundamentals of Track and Lap.

Racing Car Aerodynamics

Aerodynamic Force and Moment, Race Car Drag; Spoilers, Dams, Wings - Effectiveness Of Wings In Steady State Cornering.

Chassis Design

Conditions For Traversing a 90° Corner, Effects Of High Speed Braking, Cornering, Combined Braking Cornering; Steady State Cornering, Throttle Behaviour, Steering Wheel Force And Kick Back; Moving CG Position, Roll Centre Position Changing.

Suspension System

Front Suspension- General Design Issues, Camber Effects; SLA Suspension, McPherson Struts; Independent Rear Suspension- Trailing Arm Types, Instant Axis Concept; Suspension Springs- Torsion Springs, Coil Springs.

Textbook

1. Advanced Race Car Chassis Technology HP1562: Winning Chassis Design and Setup for Circle Track and Road Race Cars Bob Bolles, HP Books; Revised, Updated Edition, 2010.

Reference Books

1. William F. Milliken and Douglas L. Milliken, Race car vehicle dynamics, 11th Edition, SAE, 1995.
2. Peter Wright, Formula 1Technology, Sae Intl; 1st Edition, 2001.

DEVELOPMENT OF AUTONOMOUS WHEELED ROBOTS

Course Code: ME28017

Credit: **1**

L-T-P: **0-0-2**

Prerequisite: Basic Electronics (EC10001)

COURSE OBJECTIVE

Nowadays, robotics is playing a vital role in industry 4.0, and autonomous wheeled robots are being applied to minimize human efforts and to improve the production rate. This course gives fundamental knowledge about wheeled robotics and its different hardware and software components. Moreover, the course discusses kinematics equations, which will be implemented to control the motion of wheeled robots through the actuators. Further, the present course also describes the integration of various sensors and their programming, which will be used to make an autonomous control system for a robot.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Understand the fundamentals of wheeled robotics and its different components,
- CO 2: Apply locomotion constraint features to travel the wheeled robots in different surface conditions,
- CO 3: Apply various sensors integration on wheeled robots for autonomous navigation,
- CO 4: Analyze the kinematics of wheeled robots,
- CO 5: Create a robot programming to make an autonomous sensor-actuator control system, and
- CO 6: Design of automation solutions using wheeled robots.

COURSE DETAILS

About Locomotion for Wheeled Robot

Key issues for locomotion, wheeled mobile robot's locomotion, Legged wheeled robots.

Wheeled Robots Kinematics

Kinematic models and constraints, Representing robot position, Forward kinematic models, Wheel kinematic constraints, Degree of freedom.

Sensors for Autonomous Wheeled Robots

Various sensors for wheeled robots, Sensor classification, Ultrasonic sensor, Infrared sensor, Vision sensor, Inertial measurement unit (IMU).

Actuators for Autonomous Wheeled Robots

Various actuators for wheeled robots, DC motor, Servo motor, Stepper motor, Motor controller.

Wheeled Robots Programming

Robot programming language features, Computer control and robot software (monitor mode, run mode and editor mode), Arduino microcontroller programming, Raspberry Pi programming, Complete design of an autonomous wheeled robot.

Reference Books

1. R. Siegwart, I.R. Nourbakhsh, D. Scaramuzza, *Introduction to Autonomous Mobile Robots*, MIT Press, 2011
2. S.G. Tzafestas, *Introduction to Mobile Robot Control*, Elsevier Science, 2013.
3. G. Dudek, M. Jenkin, *Computational Principles of Mobile Robotics*, Cambridge University Press, 2010.
4. T. Bräunl, *Embedded Robotics Mobile Robot Design and Applications with Embedded Systems*, Springer Berlin Heidelberg, 2013.
5. U. Nehmzow, *Mobile Robotics: A Practical Introduction*, Springer, London, 2012.

MODELLING OF MICRO-WIND TURBINE BY 3D CAD DESIGN

Course Code: ME28019

Credit: 1

L-T-P: 0-0-2

Prerequisite: Differential Equations and Linear Algebra (MA11001)

COURSE OBJECTIVE

Introduce computer-based solid, parametric, and assembly modeling as a tool for engineering design; enhance critical thinking and design skills. This course introduces the technology and economics of converting wind energy to electricity and other kinds of energy. Both utility scale horizontal axis wind turbines and small-scale horizontal are addressed, as well as the economical and environmental issues associated with wind energy.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

- CO 1: Learn about the basic concepts of wind energy conversion system,
- CO 2: Understand the engineering design process and the implementation of different design phases,
- CO 3: Create a 3D solid model with high degree of confidence,
- CO 4: Develop the ability to extract 2D orthographic views from the 3D model for fabrication,
- CO 5: Learn the basics of assembly and associative constraints, and
- CO 6: Understand the importance of standalone, grid-connected, and hybrid operation in renewable energy systems.

COURSE DETAILS

Introduction to Wind Energy, Wind Power, State of the art technology

Introduction to renewable sources, Wind energy, Types of wind turbines, State of the art technology in wind energy.

Design and development of small wind turbines

Small wind technology, blade element momentum theory, design of tail fin, Wind turbine tower structure design stiffness and strength consideration, Aerodynamics of wind turbine rotor blade design, angle of attack, profile.

3D modelling of wind turbine using CAD tools (SOLIDWORKS)

Introduction to 3D modeling, Parametric modeling, feature-based modeling, Design Intent; Solid modeling commands: Sketching, Extrusion, Revolve, fillet, pattern.; Solid Modeling: reference geometry, Sweeps and Lofts;

Assembling of the 3D model of the Wind turbine

Assembly modeling; Top-down and bottom-up, Mates in assembly, exploded view,

Creation of 2D drawings for production/manufacturing processes

Extract 2D orthographic views from the 3D model for fabrication by specifying the proper dimensions, according to industry standards, for parts to be fabricated and to extract section and auxiliary views, Dimensioning standards and conventions. 3D assembly drawing of the wind turbine, exploded view of the tower, 3D drawings of all 3D printed parts.

Simulation of wind turbine using SOLIDWORKS using CAD tools (SOLIDWORKS and ANSYS)

Engineering analysis with SolidWorks, Stress and deflection of the wind turbine tower, Simulation of wind turbine using SolidWorks

Reference Books

1. James F. Manwell, Jon G. McGowan, and Anthony L. Rogers, Wind Energy Explained: Theory, Design, and Application, Wiley, 2010.
2. Gasch, Robert, Twele, Jochen (Eds.), Wind Power Plants: Fundamentals, Design, Construction and Operation, Springer-Verlag Berlin Heidelberg; 2nd Edition, 2012.
3. Open source SOLIDWORKS Tutorial: <https://my.solidworks.com/training/video/40d7a678-3293-4d7b-ba18-2113ff114b2a>.

K-Xplore **(Practice Oriented Open Elective – I)**

The B. Tech. curriculum provides for a 1-Credit practice-oriented Open Elective K-Xplore in Semester V to make our undergraduate engineering programme holistic, multidisciplinary, skill-based, and balanced. This course allows the students to explore the opportunity that the KIIT University offers to them to sharpen their skills in areas which excite them the most.

Offered in a self-learning mode, this subject allows the students to hone their skills in areas they are passionate about which they select from a wide spectrum of subjects in art, literature, technology, community engagement and service, health, and environment and sustainability. In addition, the students develop soft skills that are important for them in their professional life. This course, thus, allows students to explore and grow in areas outside of core academics and provides a channel for complementing the lessons learned in the classroom, offering them the opportunity to apply academic skills in a real-world context and providing a truly well-rounded education.

This course is designed on the basis of the guiding philosophy of student-centered learning where the students define problems, evaluate alternatives, design solutions, and self-learn by performing certain assigned activities with limited guidance from faculty facilitators.

Each student selects an area of his (or her) choice from a specified list of areas. All the students with choice in a particular area are assigned to one or more faculty facilitators. Faculty facilitators assign the activities and tasks necessary for the course to the students and decide the desired mode of skills training. They may decide to

make small groups of students of varying group sizes to carry out the assigned activities and tasks. They also make the required facilities available to the students to enable them to carry out the assigned activities and tasks.

The timetable will earmark specific hours for the subject. But the students are expected to use their spare time (including holidays and after-lecture hours on working days) to learn the required skills and use these skills to accomplish the assigned activities and tasks. The students, however, have to meet the faculty supervisors on the specified hours every week to appraise them of their progress, clear their doubts, if any, and chart their future plan.

The Head of KIIT Student Activity Centre (KSAC) will coordinate offering of the course.

COURSE OUTCOMES

At successfully completing the course, the student will be able to

- CO 1 : Develop the needed technical skills in their chosen fields of interest,
- CO 2 : Develop higher levels of self-confidence and soft skills such as communication, writing, discussion and debate, time-management, and leadership skills,
- CO 3 : Apply the learned skills to give shape to their passionate ideas,
- CO 4 : Develop Innovation and entrepreneurial mindset,
- CO 5 : Analyze and judge a problem situation for deploying the learnt knowledge and skills and develop problem solving strategies and
- CO 6 : Build new products and services using the learned knowledge and skills.

ROBOTICS

Subject Code: SA38001

Credit: 1

L_T_P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

To assist students develop the knowledge of robotics and circuitry, build circuits, bots and robots, and participate in different Robotics events such as Robo Wars.

WEB DESIGNING

Subject Code: SA38003

Credit: 1

L_T_P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

To help a student learn and develop front-end and back-end web development skills and create websites.

CIVIL-TECH

Subject Code: SA38005

Credit: 1

L_T_P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

To make a student ready to plan and design selected aspects of real life construction projects with relation to environment, transport & connectivity, water resource engineering & soil exploration and gain pre-, present-, and post- construction experience.

CIRCUIT DESIGN & CONTROL

Subject Code: SA38007

Credit: 1

L_T_P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

To let the students learn the required skills to design and develop electrical circuits and implement controllers for use in robotics, automation, voice recognition, gesture recognition, etc.

INDIAN CLASSICAL, FOLK & BOLLYWOOD DANCE

Subject Code: SA38009

Credit: 1

L_T_P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

To encourage and boost the confidence of the students to choreograph and perform in classical, semi classical / folk and bollywood dance forms.

INDIAN CLASSICAL & WESTERN MUSIC

Subject Code: SA38011

Credit: 1

L_T_P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

To give confidence to the students to participate and perform as a vocalist and/or instrumentalist in different forms of Indian classical and western music.

GRAPHIC DESIGNING & EDITING

Subject Code: SA38013

Credit: 1

L_T_P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

To nurture the students' skills in creative designing, photo and video editing activities, and digital sketching and painting, using Designing & Editing software such as Photoshop, Illustrator and video editing software.

ART & CRAFT

Subject Code: SA38015

Credit: 1

L_T_P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

To endow the students with the skills to do various types of painting such as portrait painting, landscape painting, abstract painting, pencil sketching, and doodling and craft, using various Painting and Sketching tools.

THEATRE & STREET PLAY

Subject Code: SA38017

Credit: 1

L_T_P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

To give students the confidence to perform in Theatres, Nukkad, Mono Acts and skits based on written scripts.

FILM MAKING

Subject Code: SA38019

Credit: 1

L_T_P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

To impart skills for film making in areas such as cinematography, script writing, audio recording, and editing.

DEBATING, PUBLIC SPEAKING & ANCHORING

Subject Code: SA38021

Credit: 1

L_T_P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

To develop the students' skills for performing oratory activities such as extempore speech, debate, poetry reading, open topic speech, public speaking, interviewing, open dialogue, anchoring, and presentation.

CREATIVE WRITING

Subject Code: SA38023

Credit: 1

L_T_P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

To develop the students' skills in creative writing, content writing, article writing, and poem composition.

PHOTOGRAPHY & VIDEOGRAPHY

Subject Code: SA38025

Credit: 1

L_T_P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

To provide the technical knowledge required to create photos and videos that tell a story or capture a real-world occurrence.

FASHION STYLING

Subject Code: SA38027

Credit: 1

L_T_P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

To impart the basic skills of costume design, styling, grooming, and presentation relevant to a specified theme.

CULINARY ARTS

Subject Code: SA38029

Credit: 1

L_T_P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

To help the students learn the skills of cooking, knowing ingredients, and preparing cuisines of Pan India and 65 countries

QUIZ ACTIVITY

Subject Code: SA38031

Credit: 1

L_T_P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

To give the students the confidence to participate in, and conduct, various forms of quiz, such as Technical Quiz and Business Quiz.

SOCIAL OUTREACH

Subject Code: SA38033

Credit: 1

L_T_P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

To sensitize the students on the social issues and giving them an opportunity to connect with the community and the environment through outreach activities, community projects, and volunteering.

HEALTH & EMERGENCY CARE

Subject Code: SA38035

Credit: 1

L_T_P: 0-0-2

Prerequisite: Nil

COURSE OBJECTIVE

To let the students learn about health issues, basic Life-saving skills and participate in health awareness and sensitization programs.



KALINGA INSTITUTE OF INDUSTRIAL TECHNOLOGY

— Deemed to be University U/S 3 of UGC Act, 1956 —

 | www.kiit.ac.in

Continuous Learning...

Information Brochure

KIITEE-2024

Accredited by
NAAC in 'A++ Grade'

'Tier1' Accreditation
(Washington Accord) by NBA for
Engineering Streams

Accredited by
ABET, USA (B.Tech. Programme)

Accredited by
IET, U.K. (B.Tech. Programme)

ADMISSION POLICY

Admission to all the courses(except MBBS,BDS,PG Medical & PG Dental) will be ONLY through KIITEE – 2024

1.0 KIITEE – 2024

1.1 APPLICATION PROCEDURE

Application Form and Prospectus will be available online only. It will not be available in hard copy. Candidates have to apply online at <http://www.kiitee.ac.in> or <http://www.kiit.ac.in> or they can download it from the website.

The ‘Online Application Form’ will be accepted after the following steps are completed:-

- Browse KIIT web site <http://www.kiitee.ac.in> or <http://www.kiit.ac.in>
- Select ‘Online Application’
- Go through the Instructions to fill up the form.
- Fill up ‘Online Application Form’ and click on the submit button.
- Upload Photographs, Signature & 10th Mark sheet/Certificate to complete the application process.

1.2 ADMIT CARD

Admit Card will be hosted in the website and also send through mail. **Admit Cards will not be dispatched in Hard Copy. Candidates must preserve the Admit Card till the admission process is over.**

1.3 CALENDAR OF EVENTS

Apply Online : **10-11-2023**

Last date to Apply online (1st Phase) : **19-03-2024**

Date of Entrance Examination(1st Phase)*: **27-03-2024**
TO
: **31-03-2024**

Last date to Apply online (2ndPhase) *: **30-05-2024**

Date of Entrance Examination (2nd Phase) *:**07-06-2024**
TO
*: **11-06-2024**

Last date to Apply online (3rdPhase) *: **30-06-2024**

Date of Entrance Examination (3rd Phase) *:**03-07-2024**
TO
*: **05-07-2024**

***These are the tentative dates and subject to change.**

2.0 ENTRANCE EXAMINATION PROCEDURE

2.1 Rules and Regulation

You are going to take a computer based online Test at a workstation.

You are required to be present in the Test Centre 45 minutes before the starting time of the Test as specified in the admit card.

The Proctor will announce commencement and completion of the Examination. Candidates should leave their seat on hearing announcement of completion.

The candidate must show, on demand, the valid Admit Card for admission into the Examination Hall. A candidate, without a valid Admit Card, will not be permitted to enter the Examination Hall under any circumstances.

A seat indicating application number will be allotted to each candidate. Candidates should find out and occupy their allotted seats only. The candidature of a candidate, found to have changed Hall or seat on his/her own, shall be cancelled and no plea would be accepted.

Candidates are not allowed to carry any Textual, Material, Calculator, Slide Rule, Log Table, Electronics Watch, Printed or Written Material, Papers, Mobile Phone, Pager or any other device except the Admit Card and Pen/Pencil inside the Examination Hall.

No candidate, without the permission of the Centre Superintendent/ proctor can leave his/her seat or Examination Hall till the completion of the Examination.

Smoking in the Examination Hall is strictly prohibited.

Tea coffee, cold drinks or snacks are not allowed inside the Examination Hall.

Registration of candidates

Candidates cleared by security person immediately report to Registration desk:

- (a) Candidate produces the hall ticket.
- (b) Individual's identification verified with the photograph/identity proof.
- (c) On verification of identity, admit card scanned, photograph of the candidate and finger prints of left & right thumb captured, a Computer Number is allotted and directed to the computer lab.
- (d) Candidate proceeds to the allotted computer to take the examination.

Computer Based Test

Candidate enters the Computer lab:

1. Proctor guides the candidate to the allotted computer.
2. The computer will be showing a welcome screen.
3. Candidate will be provided with a sheet of paper for rough work.
4. The candidate waits for Start of Test.
5. Candidates are briefed about the examination process.
6. Candidate logs in by entering the password given in the admit card, goes through the instructions and waits for the administrator to start the test.
7. Technical in charge initiates the 'Start of Test', which refreshes the screen and enables candidates to start the test.
8. The candidate starts answering the questions and the timer starts. The individual cannot take any break before completion of the test.
9. The candidate takes the Test, and in case of any doubt with regard to the test raises hand to draw the attention of proctor for help.
10. In case the candidate finishes the test before allotted time, he/she gets a confirmation page which will give two options; either to go back to the test or to complete the test.
11. In case candidate wants to review the answers in the remaining time he/she can do so else he/she may complete the test and submit.
12. Once the candidate completes the on-line test, he/she should be able to see the screen indicating completion of test with a thank you note.

INFORMATION ON THE TEST

- In each of these sections, every question is followed by 4 answer options. Choose the option that is most appropriate. Indicate your answer by clicking on the circle adjacent to the option you think is right.
- You can go to any question directly by clicking on the question number, which will appear at the bottom of the screen. The answered question number will be marked Green and the unanswered/ skipped question number will remain in blue.
- If you are doubtful of the answer, you can mark a question for review using the ‘Mark for review’ button’. This will be unmarked once you come back to the same question at a later time and change the answer.
- If you want to change the answer of any question, you may select the question and change the answer by clicking on the appropriate answer.
- **Each correct answer fetches 4 marks.**
- **There is negative marking. 1 mark will be deducted for every wrong answer.**
- If you have completed answering all the questions in the sequence of a particular section, you will be automatically directed to the first question of the next section.
- You can move between sections at your will.
- The test closes automatically once the allotted time of 150 Minutes are over.
- In case you finish your test before allotted time, you will get a confirmation page which will give you two options. Either to go back to the test or to complete the test.
- In case you want to review the answers in the remaining time you can do so, else you may complete the test and submit. **Ensure that you click on submit as a sign of completion.**

2.2 UNFAIR MEANS

Candidates shall maintain perfect silence and attend to their Question only. Any conversation or gesticulation or disturbance in the Examination Hall shall be deemed as misbehavior. If a candidate is found using unfair means or impersonating, his/her candidature shall be cancelled and will be debarred from the Examination.

2.3 Non Attendance

For those unable to appear in Entrance Examination on scheduled date of Examination for any reason, no **re-examination** shall be held under any circumstance. The schedule will remain unchanged even if the date is declared as a public holiday.

2.4 Language of the Question Paper

Language of the questions will be in English. The questions will not be in any other language.

3.0 Eligibility Criteria

UNDERGRADUATE COURSES

3.1 For B.Tech. (4 Years) & B.Tech & M.Tech-Biotechnology (5years):-

Candidates applying for B.Tech.(4years), B.Tech – Biotechnology (4Years) Course should fulfill the following criteria.

I. Candidates who have passed 10+2 examination in **2022, 2023** or appearing in 10+2 examination in **2024** are only eligible to apply for B.Tech (4 years), B.Tech -Biotechnology course of the University.

II. Should have studied in regular full time formal education in their schooling / college.

III. Pass in 10 +2 or its equivalent with at least 60% marks in Physics, Chemistry and Mathematics taken together.

IV. B.Tech& M.Tech .-Biotechnology. Pass in 10+2 or equivalent with at least 60% marks in Physics, Chemistry and Mathematics/Biology/Biotechnology taken together.

V. Should have born on or after 01.07.2003.



3.2 For B.Tech. -L.E (3 years) :- Pass in three years diploma course in Engineering with at least 60% marks in aggregate from State Council of Technical Education of any state or equivalent.

Course wise Eligibility Criteria B.TECH (L.E)	
For Admission Into Following Branches	Eligible Diploma Holders
Civil Engg.	Civil Engg
Mechanical Engg./Automobile Engg./Mechatronics/Aerospace Engg.	Mechanical Engg /Automobile Engg/Production Engg./Mechatronics/ Aerospace
Electrical Engg.	Electrical Engg./ Electronics & Electrical Engg
Electronics & Electrical Engg/ Electronics & Telecomm. Engg./ Electronics & Computer science Engg. /Electronics & Instrumentation Engg./	Electrical Engg./Electronics & Electrical Engg./ Electronics &Telecomm./ Electronics & Instrumentation Engg./Electronics/
Computer Science & Engg./ Information Technology	Computer Science/Information Technology/Electronics & Telecommunication Engg. Electronics Engg./ Electronics & Instrumentation Engg/
Chemical Engg	Chemical Engg

3.3 For B.Arch (5 years):-

Pass in 10+2 examination with 50% marks in Physics, Chemistry and Mathematics and also 50% marks in aggregate of the 10+2 examination.

Pass in the National Aptitude Test in Architecture (NATA) conducted by the Council of Architecture (COA), New Delhi 2024.

3.4 For B.Sc. Nursing (4 years): Candidate with Science who have passed the qualifying 12 th Standard examination (10+2) and must have obtained a minimum of 45% marks in Physics, Chemistry and Biology taken together and passed in English individually

Age: Lower age should be 17 years as on 31.12.24 & upper age limit should be maximum 35 years as on 31.12.24

3.5 For B.Pharma (4years): Pass in 10+2 or equivalent examination with Physics, Chemistry & Biology and English (PCBE) with at least 45% marks in aggregate.

3.6 For D.Pharma (2years): Pass in 10+2 or equivalent examination with Physics, Chemistry & Biology and English (PCBE) with at least 45% marks in aggregate.

3.7 For B.A. LL.B/BBA LL.B/B.Sc LL.B (5 years)-
10+2 pass or equivalent in any stream with at least 45% marks. For B.Sc. LL.B candidates should have passed 10+2 or equivalent in the science stream with at least 45% marks

3.8 BBA (3 years) : Pass in 10+2 in any stream with at least 50% marks and having Mathematics / Business Mathematics / Economics / Statistics as one of the subjects in 10+2 level.

3.9 BCA (3 years) : Pass in 10+2 in any stream with at least 50% marks and having Mathematics as one of the subjects in 10+2 level.

3.10 Bachelor of Design (Fashion/Textile) (4 years): Pass in 10+2 in any stream with 50% marks in aggregate.

3.11 Bachelor of Film & Television Production (3years) : Pass in 10+2 in any stream with 50% marks in aggregate

3.12. Bachelor of Communication & Journalism (3Years): Pass in 10+2 in any stream with 50% marks in aggregate.

3.13 B.Sc. Computer science (4years): : Pass in 10+2 Science or equivalent having mathematics as one of the subject with at least 50% marks.

3.14 B.A Economics(Hons))(4years): Pass in 10+2 or equivalent with at least 50% marks.

3.15 B.A English(Hons))(4years): Pass in 10+2 or equivalent with at least 50% marks.

3.16. B.A Sociology(Hons))(4years): Pass in 10+2 or equivalent with at least 50% marks.

3.17. B.A Psychology (Hons))(4 years): Pass in 10+2 or equivalent with at least 50% marks.

Electronics, Electronics & Tele-Comm., Electronics & Instrumentation & Electronics & Communication.

3.18. B.Com (4years): Pass in 10+2 in any stream with at least 50% marks and having Mathematics / Business Mathematics & Statistics as one of the subjects in 10+2 level.

3.19. B.Design (Automobile/Graphics/Product)(4years): Pass in 10+2 or equivalent with at least 50% marks.

3.20. BBA Hospitality and Tourism.(4years): Pass in 10+2 or equivalent with at least 50% marks & having English one of the subjects .

3.21. Bachelor in Performing Arts(Acting)(3Years): Pass in 10+2 or equivalent with at least 40% marks.

3.22. A candidates who has passed IB Diploma from International Baccalaureate Organization, Geneva, Switzerland are eligible to take admission in all the courses where 10+2 is the eligibility qualification. Other criteria of the eligibility remain as applicable.

POST GRADUATE COURSES

3.23. For MCA(2 years) :- Any Graduate with minimum 50% marks in graduation or equivalent having mathematics either in 10+2 or graduation level as one of the subject.

Computer Science & Engineering/ Int.M.Tech & Ph.D(5Years)

Specialization in Computer Science Engineering/Computer Science & Information Security/Data Analytics/Software Engineering:

First Class B.E. / B.Tech. or equivalent in Computer Science, Information Technology, Electronics & Electrical, Electrical & Electronics, Electronics & Tele-Comm., Electronics & Instrumentation or First Class in MCA or First Class in M.Sc. Comp.Sc./ Information Technology.

Electronics & Tele- Communication Engineering / Int. M.Tech & Ph.D (5Years):

Specialization in Communication Engineering/ VLSI Design & Embedded System/RF & Microwave/ 5G & NextGen Wireless technology/Automotive Electronics and Software.-

First Class B.E./ B.Tech., or equivalent in Electronics & Tele-Comm., Electronics & Instrumentation, Electrical & Electronics, Electronics & Electrical or First Class in M.Sc. (Electronics).

Mechanical Engineering/ Int.M.Tech & Ph.D(5Years):- Specialization in Manufacturing Process& Systems/Thermal Engineering/Machine Design:

First Class B.E. /B. Tech. or equivalent in Mechanical / Production Engineering.

Civil Engineering Int.M.Tech & Ph.D(5Years) :- Specialization in Construction Engineering &Management/Structural Engineering/ Geotechnical Engineering/Water Resources Engineering/ Transportation Engineering/ Environmental Engineering:

First Class B.E./ B.Tech. or equivalent in Civil Engineering.

M.Tech in Civil Engg Specialization in Environmental Engineering: B.E. or B.Tech. or equivalent degree in Civil Engineering / Chemical Engineering / Chemical Technology / Biochemical Engineering / Biotechnology / Environmental Engineering / Mechanical Engineering with 60% marks or equivalent CGPA and have qualified KIITEE in Environmental Engineering or GATE in Environmental Science & Engineering

3.24. For M.Tech. (2 years)/ Int.M.Tech & Ph.D(5Years):- B.E. or B.Tech. or equivalent Degree (e.g. AMIE, GRADE-IETE etc) in respective branches of Engineering and Technology with a First Class or equivalent CGPA or First Class MCA / First Class M.Sc. in (Comp/IT/ETC)

GATE qualified candidates shall be accorded preference in the process of selection. GATE qualified candidates having Score 400 or above need not sit in the entrance Examination.

Course wise Eligibility Criteria(M.Tech.(2Years)/ Int.M.Tech & Ph.D(5Years)

Electrical:-

Specialization in Power Electronics & Drives/Power Energy & System/Power System Engineering :- First class B.E./ B.Tech. or equivalent in Electrical, Electronics & Electrical , Electrical &

3.25. M.Sc. (Biotechnology/Applied Microbiology)

(2years):- Bachelor's degree in any branch of Science/ Agriculture/ Pharmacy/ Veterinary / Engineering / Technology / Medicine (MBBS/BDS) with at least 55% marks.

3.26. M.Sc. Nursing (2Years): The candidate should be a Registered Nurse and Registered midwife or equivalent With any State Nursing Registration Council. The minimum education requirements shall be the passing of .B.Sc. Nursing / B.Sc. Hons. Nursing / Post Basic B.Sc. Nursing with minimum of 55% aggregate marks. The candidate should have undergone in B.Sc. Nursing / B.Sc. Hons. Nursing /Post Basic B.Sc. Nursing in an institution which is recognized by Indian Nursing Council. Minimum one year of work experience after Basic B.Sc. Nursing. Minimum one year of work experience prior or after Post Basic B.Sc. Nursing. Candidate shall be medically fit.7. 5% relaxation of marks for SC/ST candidates may be given.

3.27. LLM- (1Year) Candidate should have passed B.A.LLB/BBA LLB/B.Sc.LLB/LLB, degree or an equivalent degree from recognized university and must have secured at least 55% of marks in aggregate

3.28. For Master of Public Health (2Years)

Candidate must have passed Bachelors' degree in Medicine, AYUSH, Dentistry, Nursing, Pharmacy, Veterinary Sciences, Physiotherapy, or Allied Health Sciences from a recognized Institute / University with minimum 50% marks in aggregate, (or) Bachelor's degree in Technology (BTech), Public Health (BPH), Business Administration (BBA) or Law (LLB) from a recognized Institute / University with minimum 50% marks in aggregate, (or) Bachelor's degree in Science / Life science / Statistics / Economics / Nutrition / Demography from a recognized Institute / University with minimum 50% marks in aggregate..

3.29. For Master of Hospital Administration: (2Years) Candidate must have passed Bachelors'

degree in Medicine, AYUSH, Dentistry, Nursing, Pharmacy, Veterinary Sciences, Physiotherapy, or Allied Health Sciences from a recognized university with minimum 50% marks in aggregate, (or) Bachelor's degree in Technology (BTech), Commuter Application (BCA), Hospital Administration (BHA/BHM), Public Health (BPH/BSc-PH), Business Administration (BBA), Law (LLB) or equivalent degree from a recognized Institute or university with minimum 50% marks in aggregate, (or) Bachelors' degree in

Science/Arts/Commerce from a recognized Institute or university with minimum 50% marks in aggregate, (or) Bachelor's degree or equivalent in any other discipline from a recognized Institute or university with minimum 50% marks in aggregate

3.30. Msc.in Physics/Chemistry/Mathematics with Data Sciences)(2 years):

B.Sc./B.E./B.Tech. or an equivalent degree with at least 60% marks, Students possessing Bachelor's Degree with Physics / Chemistry / Mathematics as one of the main subjects or Engineering graduates with a strong aptitude for the above areas are eligible to apply. Students who are in the final year of graduation may also apply.

3.31. For M.A in Yoga & Naturopathy (2Years):

Graduate in any discipline are eligible.

3.32. M.Sc.Computer Science(2Years): Candidates must have B.Sc degree in Computer Science / IT /Mathematics /Electronics /Physics /Chemistry /BCA with minimum 50% aggregate marks.

3.33. M.Arch(2Years):-Candidates must have B.Arch degree with minimum 50% aggregate mark.

3.34. MA in Economics: (2Years):The candidate must have passed in Graduation or equivalent with one subject as Economics / Mathematics / Statistics with at least 60% mark.

3.35. MA in English(2Years): The candidate must have passed in Graduation or equivalent with one subject as English with at least 60% mark.

3.36. MA in Sociology(2Years): The candidate must have passed in Graduation or equivalent with at least 60% mark.

3.37. M.Com(2Years): The candidate must have a bachelor's degree in Management or Commerce from a recognized university with a minimum of 60% marks in aggregate.

3.38. M.A in Psychology (2years): The candidate must have passed in Graduation or equivalent with one subject as English with at least 60% mark.

3.39.Master of Communication & Journalism(2Years): The candidate must have passed in Graduation or equivalent with at least 50% mark.

3.40.MA/M.Sc in Public Policy (2Years): Any Graduate with minimum 60% marks in graduation or

equivalent having mathematics/statistics/Business mathematics either in 10+2 or graduation level as one of the subjects.

3.41.M.Design(Interior Design) (2Years):

The candidate must have passed in Graduation or equivalent with at least 50% mark.

3.42.Master of Library & Information Science (M.Lib.I.Sc) (2Years):

Any Graduate including BBA, BCA, B-Tech
(Candidates appearing the final examination are also eligible to apply)

Candidates who have secured a minimum of 50% marks in Graduation.

3.43.Master of Physical Education and Sports (MPES) (2Years):

Pass in Bachelor in Physical Education (B.PED) or Bachelor of Physical Education & Sports (BPES), B.A. in Physical Education or B.Sc. in Physical Education .

Candidates who have secured a minimum of 50% marks in Graduation.

RESEARCH PROGRAMME

4.0. For Ph.D-Candidate having M.Tech /ME/ MCA/MBA//M.Com/M.Sc or equivalent Degree with minimum 60% marks or an equivalent CGPA. MA /LLM or an equivalent degree with minimum of 60% marks or an equivalent CGPA.

For all the courses, candidates appearing in the qualifying examination can also apply. But, they have to produce the pass certificate of the qualifying examination on the day of counseling failing which their rank/position secured in the entrance Examination will stand cancelled automatically and they will have no claim for the admissions as per the rank

4.1 EVALUATION AND DECLARATION OF RESULTS

Results of KIITEE-2024 will be declared on the basis of marks secured by the candidate in Entrance Examination, separate Merit lists will be prepared for B.Tech(4 years) /B.Design/ B.Arch. / B.Tech. (LE), / BSc. Nursing /BPH/ BBA / BBA Hospitality and Tourism. / BCA / B.ALL.B / BBA.LLB / B.Sc.LL.B, Bachelor of Design (Fashion / Textile), Bachelor of Film & Television Production/ years/Bachelor of Communication & Journalism, Biotechnology-(B.Tech / M.Tech) , M.Tech, LLM, MCA/B.Pharma/ D.Pharma/ M.Design /MPH/MHA/M.Sc.(Biotechnology)/BAPsychology/BS c.ComputerScience/B.AEconomics(Hons)/B.AEnglis

h(Hons)/B.A Sociology(Hons)/B.Com./M.Sc.Applied Microbiology)/M.Com/M.A in Economics/M.A in English/M.A in Sociology/M.A Psychology /M.Sc in Computer Science/ Master of Communication & Journalism /MPES/M.Lib.I.Sc Ph.D. A cut-off qualifying mark will be fixed by the University, at the time of declaration of Entrance Result. Result will be published through University Websites. The candidates can see their result by giving their application number. Candidates can also download the rank card from the website.

As per the availability of seats in different courses, cut-off Rank for counseling will be notified. Candidates, having rank above cut-off rank, shall be called for counseling.

In case of two or more candidates obtaining equal marks, inter-se merit of such candidates shall be determined as follows:-

B.Tech./B.Design (4 Years):- On the basis of marks obtained in Mathematics, then in Physics and then by age (preference to older candidates).

B .Design (Automobile/Graphics/Product(4 year):- Preference to old candidate .

B.Arch.:-On the basis of marks obtained in NATA.

BHMCT- Preference to old candidate

B.Tech. (LE):- On the basis of marks obtained in Mathematics then in Basic Electrical Engineering and then by age. (Preference to older candidates).

B.Sc. Nursing:- On the basis of marks obtained in Biology, then in Chemistry and then by age (Preference to older candidates).

BBA/BCA/Bachelor in Design(Fashion/Textile)/ B.Design/Bachelor in Film & Television Production /BA.LLB/BBA LLB/B.Sc.LLB / Bachelor of Mass Communication& journalism):- On the basis of Marks obtained in Mathematical Ability, then in Analytical Ability, then in English and then by age. (Preference to older candidate)

Biotechnology- (B.Tech/M.Tech) (5Years):- On the basis of marks obtained in Biology, then in Chemistry and then by age (preference to older candidates)

B.Sc in Computer Science/ B.A Economics (Hons)/B.A English (Hons)/B.A Sociology (Hons)/ B.A Psychology (Hons B.Com.:
(Preference to Older Candidates)

MPES- Preference to Older Candidates

MCA:- On the basis of the marks obtained in Computer Awareness, then Mathematics and then by age (Preference to older candidate)

M.Tech:- Preference to Older Candidates

M.Lib.I.Sc- Preference to Older Candidates

M.Sc. (Applied Microbiology/Biotechnology):- On the basis of marks obtained in Biology, then Chemistry, then Mathematics and then by age. (Preference to Older Candidates)

LLM:- (Preference to Older Candidates)

M.Com/M.A in Economics/M.A in English/M.A in Sociology/M.Sc in Computer Science/Master of Mass communication/MA/M.Sc/Public Policy/MA Psychology :(Preference to Older Candidates)

M.Sc (2years)(Physics/Chemistry/Mathematics and Data Sciences): - Preference to Older Candidates

5.0 COUNSELING, SEAT ALLOCATION, DOCUMENT VERIFICATION AND ADMISSION

Counseling and seat allocation will be purely on merit basis i.e. based on the performance in the Entrance Examination.

Counseling Schedule will be published in the KIIT Website after the declaration of result. Candidates have to attend the counseling as per the schedule. Counseling will be stopped as soon as all the seats reserved for the KIITEE-2024 are filled up.

Verification of documents would be done at the time of counseling / admission. So as to verify records on identification, age, qualifying examination and category of candidates. On failing to establish correctness in any of the documents, the candidates will not be considered for admission.

Candidates, called for Counseling must bring Original Documents (listed below) and token Fees to the Counseling Centre.

1. Admit Card
2. Rank Card
3. 10th Pass Certificate
4. 12th Mark sheet and Pass Certificate
5. Graduation Mark sheet and Pass Certificate only for MCA, MCA(LE),M.Sc. (Biotechnology/ Applied Microbiology)
6. Diploma Pass Certificate and three years Mark Sheet (for Lateral Entry Candidates)
7. B.Tech./B.E./ MCA/ M.Sc. or Equivalent Degree Certificate (For M.Tech./LLM/Ph.D Candidates)
8. Relevant Certificate issued by the Competent Authority, clearly indicating the Reservation Criteria claimed by the candidate.
9. GATE Score Card (for M.Tech. GATE Qualified only)

10. Demand Draft of Rs. **75,000/-** which includes the **Counseling Registration fees** of Rs.10,000 (*Non Refundable*) in favor of **KIIT, payable at Bhubaneswar**. Balance fee as per the fee structure is to be paid on the day of reporting.

6.0 RESERVATION OF SEATS

The KIITEE-2024 Quota Seats are distributed among different categories of candidates as follows. Separate Merit list will be prepared for each Category.

Physically Challenged: Candidates will be considered eligible for admission under PC Category, who are having 40% disabilities in consonance with Section-39 of the Persons with Disabilities (Equal Participation) Act, 1995. As the institution is not having adequate facilities, the candidates having locomotory disabilities are only eligible to apply KIITEE- 2024.

Categories of Candidates

General	: -	GE
Scheduled Caste	: -	SC
Scheduled Tribe	: -	ST
Physically Challenged:	-	PC

15% & 7.5% seats of KIITEE-2024 quota seats will be reserved for Schedule Caste & Scheduled Tribe (by birth) respectively. (Not by adoption or marriage)

3% seats of KIITEE-2024 will be reserved for PC candidates. (Only locomotory disabilities).

Physically Challenged Candidates and capable of undergoing Engineering/MCA course at KIIT University as per the facilities available.

30% seats of each category will be reserved for women candidate (only applicable for B.Tech/ B.Tech & M.Tech. Biotechnology)

All the unfilled reserved seats will be converted to General Category.

Reservation Category	% of seats
Scheduled Caste (SC)	15%
Scheduled Tribe (ST)	7.5%
Physically Challenged (PC)	3%

7.0 Legal Jurisdiction

All disputes pertaining to the conduct of KIITEE-2024 shall fall within the jurisdiction of Bhubaneswar only. If any person or officer engages himself/herself in act(s) that would in this Examination, he/she shall be liable to prosecution under the Indian Penal Code. result in the leakage of the question paper(s) or attempt to use or help in the use of unfair means

ENTRANCE EXAMINATION SUBJECTS & SYLLABUS				
Course	Subjects		No. of Questions	Syllabus
B.Tech./ B.Arch/B.Sc.Nursing/Biotechnology –B.Tech & M.Tech/B.Sc.ComputerScience/B.Pharma/D.Pharma	(10+2 standard)	Physics	40	The detail Syllabus is given in the Appendix-I
		Chemistry	40	
B.Tech.(4years)/B.Arch./B.Sc. Computer Science/Biotechnology- B.Tech &M.Tech	(10+2 Standard)	Mathematics	40	The detail Syllabus is given in the Appendix-II
B.Sc Nursing/B.Pharma /D.Pharma/ Biotechnology-B.Tech & M.Tech	(10+2 standard)	Biology	40	The detail Syllabus is given in the Appendix-III
B.Tech.(Lateral Entry)	Mathematics		40	The detail Syllabus is given in the Appendix-IV
	Basic Electrical Engineering		40	
	Engineering Mechanics		40	
BBA/BCA//BA.LLB/ BBA.LLB/BSc.LLB/ /B.A Economics(Hons)/B.Com(Hons)/B.A English (Hons)/B.A Sociology(Hons)/B.A Psychology(Hons) /BBA Hospitality and Tourism.	Mathematical Ability		30	
	Analytical & Logical Ability		30	
	Verbal Ability		40	
	General Knowledge		20	
Bachelor of Design (Fashion/Textile)/ Bachelor of Film & Television Production// Bachelor of Communication & Journalism/B.Design (Automobile/Product/ Graphics)/Bachelor in Performing Arts (Acting)	English		30	
	General Knowledge & Current Affairs		30	
	Analytical Reasoning		20	
	Aptitude		40	
MCA/ M.Sc. Computer Science.	Mathematics(10+2 Standard)		60	The detail Syllabus is
	Analytical & Logical Ability		30	
	Computer Awareness		30	
M.Tech./Int.M.Tech & Ph.D	Branch Specific		120	The questions will be pertaining to the B.E/B.Tech. Syllabus of concerned discipline
LLM	Multiple Choice questions		120	The questions will be pertaining to LLB Syllabus

M.Sc.(Biotechnology) & M.Sc.(Applied Microbiology)(2 years)	Biology(10+2+3 Standard)	50	The detail Syllabus is given in the Appendix-VI
	Chemistry(10+2 Standard)	30	
	Mathematics(10+2 Standard)	20	
	Physics(10+2 Standard)	20	
Master of Public Health /Master of Hospital Administration /MA in Public Policy/M. Design (Interior Design)/Master in Yoga & Naturopathy /MBA/MBA-RM/MBA –Business Analytics/MBA –Operation and Supply chain Management/MBA-Agribusiness Management/Master of Library & Information Science (M.Lib.I.Sc.)	Quantitative aptitude	30	
	Logical Reasoning & Data Interpretation	30	
	English	40	
	General Awareness	20	
MSc Nursing	B.Sc Nursing	120	The questions will be pertaining to the B.Sc Nursing Syllabus.
M.Sc- Programme Physics/ Chemistry/ Mathematics and Data Sciences	B.Sc	120	The questions will be pertaining to the B.Sc Syllabus
Ph.D.	Teaching and Research Aptitude	60	
	Subject Specific	60	
MA in Economics	BA (Economics)	120	The questions will be pertaining to the BA (Economics)Syllabus
MA in English	BA (English)	120	The questions will be pertaining to the BA (English)Syllabus
MA in Sociology	BA (Sociology)	120	The questions will be pertaining to the BA (Sociology)Syllabus
MA in Psychology	BA (Psychology)	120	The questions will be pertaining to the BA (Psychology)Syllabus
M.Com.	B.Com	120	The questions will be pertaining to the B.Com Syllabus.
Master of Communication & Journalism	English	40	
	Analytical Reasoning	20	
	Current Affairs	30	
	Basic Knowledge of Mass Media	30	
M. Arch	B. Arch	120	The questions will be pertaining to the B .Arch Syllabus.
Master in Physical education & Sports (MPES)	BPED /BPES	120	The questions will be pertaining to the BPED /BPES Syllabus

(APPENDIX-I)

SYLLABUS FOR B.TECH./ B.DESIGN/BIO TECHNOLOGY- B.TECH / M.TECH & B.SC.NURSING/B.PHARMA/D.PHARMA/B.SC. COMPUTER SCIENCE

PHYSICS

Unit 1: Units and Measurement

Units for measurement, system of units-S.I., fundamental and derived units. Dimensions and their applications.

Unit 2: Description of Motion in One Dimension

Motion in a straight line, uniform and non-uniform motion, their graphical representation. Uniformly accelerated motion, and its application.

Unit 3: Description of Motion in Two and Three Dimensions

Scalars and vectors, vector addition, a real number, zero vector and its properties. Resolution of vectors. Scalar and vector products, uniform circular motion and its applications projectile motion.

Unit 4: Laws of Motion

Force and inertia-Newton's Laws of Motion. Conservation of linear momentum and its applications, rocket propulsion, friction-laws of friction.

Unit 5: Work, Energy and Power

Concept of work, energy and power. Energy-Kinetic and potential. Conservation of energy and its applications, Elastic collisions in one and two dimensions. Different forms of energy.

Unit 6: Rotational Motion and Moment of Inertia

Centre of mass of a two-particle system. Centre of mass of a rigid body, general motion of a rigid body, nature of rotational motion, torque, angular momentum, its conservation and applications. Moment of inertia, parallel and perpendicular axes theorem, expression of moment of inertia for ring, disc and sphere.

Unit 7:- Gravitation

Acceleration due to gravity, one and two-dimensional motion under gravity. Universal law of gravitation, variation in the acceleration due to gravity of the earth. Planetary motion, Kepler's laws, artificial satellite-geostationary satellite, gravitational potential energy near the surface of earth, gravitational potential and escape velocity.

Unit 8: Solids and Fluids

Inter-atomic and Inter-molecular forces, states of matter.

(A) Solids: Elastic properties, Hook's law, Young's modulus, bulk modulus, modulus of rigidity.

(B) Liquids : Cohesion and adhesion. Surface energy and surface tension. Flow of fluids, Bernoulli's theorem and its applications. Viscosity, Stoke's Law, terminal velocity.

Unit 9: Oscillations

Periodic motion, simple harmonic motion and its equation of motion, energy in S.H.M., Oscillations of a spring and simple pendulum.

Unit 10: Waves

Wave motion, speed of a wave, longitudinal and transverse waves, superposition of waves, progressive and standing waves, free and forced Oscillations, resonance, vibration of strings and air-columns, beats, Doppler effects.

Unit 11: Heat and Thermodynamics

Thermal expansion of solids, liquids and gases and their specific heats, Relationship between Cp and Cv for gases, first law of thermodynamics, thermodynamic processes. Second law of thermodynamics, Carnot cycle efficiency of heat engines.

Unit 12: Transference of Heat

Modes of transference of heat. Thermal conductivity. Black body radiations, Kirchoff's Law, Wien's law, Stefan's law of radiation and Newton's law of cooling.

Unit 13: Electrostatics

Electric charge-its unit and conservation, Coulomb's law, dielectric constant, electric field, lines of force, field due to dipole and its behaviour in a uniform electric field, electric flux, Gauss's theorem and its applications. Electric potential, potential due to a point charge. Conductors and insulators, distribution of charge on conductors. Capacitance, parallel plate capacitor, combination of capacitors, energy of capacitor.

Unit 14: Current Electricity

Electric current and its unit, sources of energy, cells-primary and secondary, grouping of cells resistance of different materials, temperature dependence, specific resistivity, Ohm's law, Kirchoff's law, series and parallel circuits. Wheatstone Bridge with their applications and potentiometer with their applications.

Unit 15 : Thermal and Chemical Effects of Currents

Heating effects of current, electric power, simple concept of thermo-electricity-Seebek effect and thermocouple, Chemical effect of current-Faraday's laws of electrolysis.

Unit 16: Magnetic Effects of Currents

Oersted's experiment, Bio-Savert's law, magnetic field due to straight wire, circular loop and solenoid, force on a moving charge in a uniform magnetic field (Lorentz force), force and torques on currents in a magnetic field, force between two current carrying wires, moving coil galvanometer and conversion to ammeter and voltmeter.

Unit 17: Magneto statics

Bar magnet, magnetic field, lines of force, torque on a bar magnet in a magnetic field, earth's magnetic field, para, dia and ferro

magnetism, magnetic induction, magnetic susceptibility.

Unit 18: Electromagnetic Induction and Alternating Currents

Induced e.m.f., Faraday's Law, Lenz's Law, Self and Mutual Inductance, alternating currents, impedance and reactance, power in a.c. Circuits with L.C. And R Series Combination, resonant circuits. Transformer and A.C. generator.

Unit 19: Ray Optics

Reflection and refraction of light at plane and curved surfaces, total internal reflection, optical fibre; deviation and dispersion of light by a prism; Lens formula, magnification and resolving power, microscope and telescope.

Unit 20: Wave Optics

Wave nature of light; Interference- Young's double slit experiment. Diffraction-diffraction due to a single slit. Elementary idea of polarization.

Unit 21: Electromagnetic Waves

Electromagnetic waves and their characteristics, Electromagnetic wave spectrum from gamma to radio waves-propagation of EM waves in atmosphere.

Unit 22: Electron and Photons

Charge on an electron, e/m for an electron, photoelectric effect and Einstein's equation of photoelectric effect.

Unit 23: Atoms, Molecules and Nuclei

Alpha particles scattering experiment, Atomic masses, size of the nucleus; radioactivity; Alpha, beta and gamma particles/rays and their properties, radioactive decay law, half life and mean life of radio-active nuclei, binding energy, mass energy relationship, nuclear fission and nuclear fusion.

Unit 24: Solids and Semi-Conductors Devices

Energy bands in solids, conductors, insulators and semi-conductors, pn junction, diodes, diode as rectifier, transistor action, transistor as an amplifier.

CHEMISTRY

Unit 1: Some Basic Concepts:

Measurement in chemistry (Precision, significant figures, S.I. units, Dimensional analysis). Laws of chemical combination. Atomic Mass, Molecular Mass, mole concept, Molar Mass, determination of Molecular formula. Chemical equation, stoichiometry of Chemical reactions.

Unit 2 : States of Matter

Gaseous state, measurable properties of gases, Boyle's Law, Charle's Law and absolute scale of temperature, Avogadro's hypothesis, ideal gas equation, Dalton's law of partial pressures.

Kinetic molecular theory of gases (the microscopic model of gas), deviation from ideal behaviour.

The solid state (classification of solids, X-ray studies of crystal lattices and unit cells, packing of constituent particles in crystals). Imperfection in solids, electrical, magnetic and dielectric properties of solids. Liquid state (Properties of liquids, Vapour pressure, Surface tension, Viscosity).

Unit 3: Atomic Structure

Constituents of the atom (discovery of electron, rutherford model of the atom).

Electronics structure of atoms-nature of light and electromagnetic waves, atomic spectra, bohr's model of hydrogen, shortcomings of the bohr model.

Dual nature of matter and radiation. de-Broglie relation. The uncertainty principle, Quantum Mechanical Model of the atom, Orbitals and Quantum numbers. Shapes of orbitals. Aufbau principle, Pauli Exclusion principle, Hund's Rule, Electronics Configuration of atoms.

Unit 4: Solutions

Types of solutions, Units of concentration, Vapour-pressure of solutions and Raoult's law. Colligative properties. Determination of molecular mass. Non-ideal solutions and

abnormal molecular masses. Volumetric analysis-concentration unit.

Unit 5: Chemical Energetics and Thermodynamics

Energy changes during a chemical reaction, Internal energy and Enthalpy, Internal energy and Enthalpy changes, Origin of Enthalpy change in a reaction, Hess's Law of constant heat summation, numericals based on these concepts. Enthalpies of reactions (Enthalpy of neutralization, Enthalpy of combustion, Enthalpy of fusion and vaporization).

Sources of energy(conservation of energy sources and identification of alternative sources, pollution associated with consumption of fuels. The sun as the primary source).

First law of thermodynamics; Relation between Internal energy and Enthalpy, application of first law of thermodynamics.

Second law of thermodynamics: Entropy, Gibbs energy, Spontaneity of a chemical reaction, Gibbs energy change and chemical equilibrium, Gibbs energy available for useful work.

Unit 6: Chemical Equilibrium

Equilibria involving physical changes (solid-liquid, liquid-gas equilibrium involving dissolution of solids in liquids, gases in liquids, general characteristics of equilibrium involving physical processes)

Equilibria involving chemical systems (the law of chemical equilibrium, the magnitude of the equilibrium constant, numerical problems).

Effect of changing conditions of systems at equilibrium (change of concentration, change of temperature, effect of catalyst-Le Chatelier's principle).

Equilibria involving ions- ionization of electrolytes, weak and strong electrolytes, acid-base equilibrium, various concepts of acids and bases, ionization of water, pH scale, solubility product, numericals based on these concepts.

Unit 7: Redox Reactions and Electrochemistry

Oxidation and reduction as an electron transfer concept. Redox reactions in aqueous solutions-electrochemical cells. e.m.f. of a galvanic cell.

Dependence of e.m.f. on concentration and temperature (NERNST). equation and numerical problems based on it .Electrolysis, Oxidation number (rules for assigning oxidation number, redox reactions in terms of oxidation number, nomenclature). Balancing of oxidation-reduction equations.

Electrolytic conduction. Molar conductivity, Kohlrausch's Law and its applications, Voltaic cell, Electrode potential and Electromotive force, Gibb's energy change and cell potential. Electrode potential and products of electrolysis, Fuel cells, corrosion and its prevention.

Unit 8: Rates of Chemical Reactions and Chemical Kinetics

Rate of reaction, Instantaneous rate of reaction and order of reaction. Factors affecting rates of reactions- factors affecting rate of collisions encountered between the reactant molecules, effect of temperature on the reaction rate, concept of activation energy catalyst. Effect of light of rates of reactions. Elementary reactions as steps to more complex reactions. How fast are chemical reactions?

Rate law expression. Order of a reaction (with suitable examples). Units of rates and specific rate constant. Order of reaction and effect of concentration (study will be confined to first order only). Temperature dependence of rate constant – Fast reactions (only elementary idea). Mechanism of reaction (only elementary idea). Photochemical reactions.

Unit 9: Surface Chemistry

Surface : Adsorption – physical and chemical adsorption, adsorption isotherms.

Colloids-Preparation and general properties, Emulsions, Micelles.

Catalysis : Homogeneous and heterogeneous, structure of catalyst, Enzymes, Zeolites.

Unit 10: Chemical Families Periodic Properties

Modern periodic law, Types of elements – Representatives elements (s & p block, Transition elements – d-block elements, inner

transition elements-f-block elements. Periodic trends in properties-ionization enthalpy, electron gain enthalpy, atomic radii, valence, periodicity in properties of compounds).

Unit 11: Chemical Bonding and Molecular Structure

Chemical bonds and Lewis structure, shapes of molecules (VSEPR theory), Quantum theory of the covalent bond, hydrogen and some other simple molecules, carbon compounds, hybridization, Boron and Beryllium compounds.

Coordinate covalent bond, ionic bond as an extreme case of polar covalent bond, ionic character of molecules and polar molecules. Bonding in solid state ionic, molecular and covalent solids, metals. Hydrogen bond, Resonance.

Molecules : Molecular orbital. Theory-bond order and magnetic properties of H_2, O_2, N_2, F_2 on the basis of MOT. Hybridisation involving s, p and d orbitals (including shapes of simple organic molecules), Dipole moment and structure of molecules.

Unit 12: Chemistry of Non-Metals - 1

Hydrogen (unique position in periodic table, occurrence, isotopes, properties, reactions and uses), Hydrides-molecular, soline and interstitial

Oxygen (occurrence, preparation, properties and reactions, uses),simple oxides; ozone

Water and hydrogen peroxide, structure of water molecule and its aggregates, physical and chemical properties of water, hard and soft water, water softening, hydrogen peroxide-preparation, properties, structure and uses.

Nitrogen- Preparation, properties, uses, compounds of Nitrogen-Ammonia, Oxides of Nitrogen, Nitric Acid-preparation, properties and uses.

Unit 13: Chemistry of Non-metals-II

Boron-occurrence, isolation, physical and chemical properties, borax and boric acid, uses of boron and its compounds.

Carbon, inorganic compounds of carbon-oxides, halides, carbides, elemental carbon.

Silicon- occurrence, preparation and properties, oxides and oxyacids of phosphorus, chemical fertilizers.

Sulphur – occurrence and extraction, properties and reactions, oxides, Sulphuric acid – preparation, properties and uses, sodium thiosulphate.

Halogens- occurrence, preparation, properties, hydrogen halides, uses of halogens.

Noble gases- discovery, occurrence and isolation, physical properties, chemistry of noble gases and their uses.

Unit 14: Chemistry of Lighter Metals

Sodium and Potassium- occurrence and extraction, properties and uses. Important compounds-NaCl, Na_2CO_3 , NaHCO_3 , NaOH, KCl, KOH.

Magnesium and calcium-occurrence and extraction, properties and uses. Important compounds MgCl_2 , MgSO_4 , CaO, $\text{Ca}(\text{OH})_2$, CaCO_3 , CaSO_4 , Plaster of paris, Bleaching Powder.

Aluminium –occurrence, extraction properties and uses, compounds- AlCl_3 , alums.

Cement.

Biological role of Sodium, Potassium, Magnesium and Calcium.

Unit 15:- Heavy Metals

Iron – Occurrence and extraction, compounds of iron, oxides, halides, sulphides, sulphate, alloy and steel.

Copper and Silver- occurrence and extraction, properties and uses, compounds-sulphides, halides and sulphates, photography.

Zinc and Mercury- occurrence and extraction, properties and uses, compounds-oxides, halides; sulphides and sulphates.

Tin and Lead- occurrence and extraction, properties and uses, compounds-oxides, sulphides, halides.

Unit 16: Chemistry of Representative Elements

Periodic properties- Trends in groups and periods (a) Oxides-nature (b) Halides-melting points (c) Carbonates and sulphates-solubility.

The chemistry of s and p block elements, electronics configuration, general characteristic properties and oxidation states of the following:-

Group 1 elements	- Alkali metals
Group 2 elements	- Alkaline earth metals
Group 13 elements	- Boron family
Group 14 elements	- Carbon family
Group 15 elements	- Nitrogen family
Group 16 elements	- Oxygen family
Group 17 elements	- Halogen family
Group 18 elements	- Noble gases & Hydrogen

Unit 17: Transition Metals Including Lanthanides

Electronic configuration : General characteristic properties, oxidation states of transition metals. First row transition metals and general properties of their compounds-oxides, halides and sulphides.

General properties of a second and third row transition elements (Groupwise discussion).

Preparation and reactions, properties and uses of Potassium dichromate Potassium permanganate.

Inner Transition Elements: General discussion with special reference to oxidation states and lanthanide contraction.

Unit 18: Coordination Chemistry and Organo Metallics

Coordination compounds, Nomenclature: Isomerism in coordination compounds; Bonding in coordination compounds, Werner's coordination theory. Applications of coordination compounds.

Unit 19: Nuclear Chemistry

Nature of radiation from radioactive substances. Nuclear reactions; Radio-active disintegration series; Artificial transmutation of elements; Nuclear fission and Nuclear fusion: Isotopes and their applications: Radio carbon-dating.

Unit 20: Purification and Characterisation of Organic Compounds

Purification (crystallization, sublimation, distillation, differential extraction, chromatography).

Qualitative analysis, detection of nitrogen, sulphur, phosphorus and halogens.

Quantitative analysis- estimation of carbon, hydrogen, nitrogen, halogens, sulphur, phosphorus (basic principles only)

Determination of molecular mass-Silver salt method, choloroplatinate salt method

Calculation of empirical formula and molecular formula.

Numerical problems in organic quantitative analysis, modern methods of structure elucidation.

Unit 21: Some Basic Principles

Classification of Organic Compounds.

Tetravalency of Carbon, Homologous series. Functional groups- - C=C-, -C C-, and groups containing halogen, oxygen, nitrogen and sulphur. General introduction to naming organic compounds-Common names and IUPAC nomenclature of aliphatic, aromatic and Cyclic Compounds. Illustration with examples of Compounds having not more than three same of different functional groups/ atoms. Isomerism- Structural and stereoisomerism (geometrical and optical). Chirality-Isomerism in Compounds having one and two chiral Centres. Enantiomers, diastereoisomers, recemic forms, recemisation & resolution.

Covalent bond fission-Homolytic and Heterolytic: free radicals carbocations and carbanions. Stability of Carbocations and free-radicals. Electrophiles and Nucleophiles.

Electron displacement in a covalent bond-inductive effect, electromeric effect, resonance Common types of organic reactions- Substitution, addition, elimination and rearrangement reactions. Illustration with examples.

Unit 22: Hydrocarbons

Classification. Sources of hydrocarbons: Alkanes- General methods of preparation (from unsaturated hydrocarbons, alkylhalides, aldehydes, ketones and carburoxylic acids). Physical properties and reactions (Substitution), Oxidation and miscellaneous). Conformations of alkanes(ethane, propane butane) and cyclohexane, sawhorse and Newman projections)-mechanism of halogaration of alkanes.

Alkanes and Alkynes- General methods of preparation physical properties, Chemical reactions-Mechanism of electrophilic addition reactions in alkenes-Markownikoff's Rule, peroxide effect. Acidic character of alkynes. Polymerisation of alkenes.

Aromatic hydrocarbons- Benzene and its homologues, Isomerism, Chemical reactions of benzene. Structure of benzene, resonance. Directive influence of substituents.

Petroleum – Hydro Carbons from Petroleum, Cracking and reforming, quality of gasoline-Octane number, gasoline additives.

Unit 23: Organic Compound Containing Halogens

(Haloalkanes and Haloarenes)

Methods of preparation, physical properties and reactions. Preparation, properties and uses of Chloroform and Iodoform.

Unit 24 : Organic Compounds Containing Oxygen

General methods of preparation, correlation of physical properties with their structures, chemical properties and uses of Alcohols, polyhydric alcohols, Ethers, aldehydes, ketones, carboxylic acids and their derivatives, Phenol, Benzaldehyde and Benzoic acid -their important methods of preparation and reactions. Acidity of carboxylic acids and phenol effect of substituents on the acidity of carboxylic acids.

Unit 25: Organic Compounds Containing Nitrogen

(Cyanides, isocyanides, nitrocompounds and amines)

Nomenclature and classification of amines, cyanides, isocyanides, nitrocompounds and their methods of preparation; correlation of their physical properties with structure, chemical reactions and uses- Basicity of amines.

Unit 26: Synthetic and Natural Polymers

Classification on Polymers, natural and synthetic polymers (with stress on their general methods of preparation) and important uses of the following.

Teflon, PVC, Polystyrene, Nylon-66, terylene, Bakelite)

Unit 27: Bio Molecules and Biological Processes

The Cell and Energy Cycle

Carbohydrates: Monosaccharides, Disaccharides, Polysaccharides

Amino acids and Peptides- Structure and classification.

Proteins and Enzymes-Structure of Proteins, Role of enzymes.

Nucleic Acids-DNA and RNA

Biological functions of Nucleic acids-Protein synthesis and replication.

Lipids – Structure, membranes and their functions.

Unit 28: Chemistry In Action

Dyes, Chemicals in medicines (antipyretic, analgesic, antibiotics & tranquillisers),

Rocket propellants.

(Structural formulae non-evaluative)

Unit 29: Environmental Chemistry

Environmental pollutants; soil, water and air pollution; major atmospheric pollutants; acid rain, Ozone and its reactions causing ozone layer depletion, effects of the depletion of ozone layer, industrial air pollution.

(APPENDIX-II)

SYLLABUS FOR B.TECH./B.DESIGN/ BIOTECHNOLOGY - (B.TECH / M.TECH)

MATHEMATICS

Unit 1:- Sets, Relations and Functions

Sets and their Representations, Union, intersection and complements of sets, and their algebraic properties, Relations, equivalence relations, mappings, one-one, into and onto mappings, composition of mappings.

Unit 2: Complex Numbers

Complex numbers in the form $a+ib$ and their representation in a plane. Argand diagram. Algebra of complex numbers, Modulus and Argument (or amplitude) of a complex number, square root of a complex number. Cube roots of unity, triangle inequality.

Unit 3: Matrices and Determinants

Determinants and matrices of order two and three, properties of determinants, Evaluation of determinants. Area of triangles using determinants; Addition and multiplication of matrices, adjoint and inverse of matrix. Test of consistency and solution of simultaneous linear equations using determinants and matrices.

Unit 4: Quadratic Equations

Quadratic equations in real and complex number system and their solutions. Relation between roots and co-efficients, nature of roots, formation of quadratic equations with given roots; Symmetric functions of roots, equations reducible to quadratic equations-application to practical problems.

Unit 5 : Permutations and Combinations

Fundamental principle of counting; Permutation as an arrangement and combination as selection, Meaning of $P(n,r)$ and $C(n,r)$. Simple applications.

Unit 6: Binomial Theorem and Its Applications

Binomial Theorem for a positive integral index; general term and middle term; Binomial

Theorem for any index. Properties of Binomial Co-efficients. Simple applications for approximations.

Unit 7: Sequences and Series

Arithmetic, Geometric and Harmonic progressions. Insertion of Arithmetic Geometric and Harmonic means between two given numbers. Relation Between A.M., G.M. and H.M. Special series: S_n, S_n^2, S_n^3 . Arithmetico-Geometric Series, Exponential and Logarithmic series.

Unit 8: Differential Calculus

Polynomials, rational, trigonometric, logarithmic and exponential functions, Inverse functions. Graphs of simple functions. Limits, Continuity; differentiation of the sum, difference, product and quotient of two functions: differentiation of trigonometric, inverse trigonometric, logarithmic, exponential, composite and implicit functions; derivatives of order upto two. Applications of derivatives: Rate of change of quantities, monotonic-increasing and decreasing functions, Maxima and minima of functions of one variable, tangents and normals, Rolle's and Lagrange's Mean Value Theorems.

Unit 9:- Integral Calculus

Integral as an anti-derivative. Fundamental integrals involving algebraic, trigonometric, exponential and logarithmic functions. Integration by substitution, by parts and partial fractions. Integration using trigonometric identities. Integral as limit of a sum. Properties of definite integrals. Evaluation of definite integrals; Determining areas of the regions bounded by simple curves.

Unit 10:- Differential Equations

Ordinary differential equations, their order and degree. Formation of differential equations. Solution of differential equations by the method of separation of variables. Solution of homogeneous and linear differential equations, and those of the type

$$\frac{d^2y}{dx^2} = f(x)$$

Unit 11:- Two Dimensional Geometry

Recall of Cartesian system of rectangular co-ordinates in a plane, distance formula, area of a triangle, condition of the collinearity of three points and section formula, centroid and incentre of a triangle, locus and its equation, translation of axes, slope of a line, parallel and perpendicular lines, intercepts of a line on the coordinate axes.

The straight line and pair of straight lines

Various forms of equations of a line, intersection of line, angles between two lines, conditions for concurrence of three lines, distance of a point from a line Equations of internal and external bisectors of angles between two lines, coordinates of centroid, orthocenter and circumcentre of a triangle, equation of family of lines passing through the point of intersection of two lines, homogeneous equation of second degree in x and y, angle between pair of lines through the origin, combined equation of the bisectors of the angles between a pair of lines, condition for the general second degree equation to represent a pair of lines, point of intersection and angle between two lines.

Circles and Family of Circles

Standard form of equation of a circle, general form of the equation of a circle, its radius and centre, equation of a circle in the parametric form, equation of a circle when the end points of a diameter are given, points of intersection of a line and a circle with the centre at the origin and conditions for a line to be tangent to the circle, length of the tangent, equation of the tangent, equation of a family of circles through the intersection of two circles, condition for two intersecting circles to be orthogonal.

(APPENDIX-III)

Conic Sections

Sections of cones, equations of conic sections (parabola, ellipse and hyperbola) in standard forms, condition for $y = mx+c$ to be a tangent and point (s) of tangency.

Unit 12: Three Dimensional Geometry

Coordinates of a point in space, distance between two points; Section formula, direction ratios and direction cosines, angle between two intersecting lines. Skew lines, the shortest distance between them and its equation. Equations of a line and a plane in different forms; intersection of a line and a plane, coplanar lines, equation of a sphere, its centre and radius. Diameter form of the equation of a sphere.

Unit 13: Vector Algebra

Vectors and Scalars, addition of vectors, components of a vector in two dimensions and three dimensional space, scalar and vector products, scalar and vector triple product. Application of vectors to plane geometry.

Unit 14: Probability

Probability of an event, addition and multiplication theorems of probability and their application; Conditional probability, Total probability theorem . Bayes' Theorem, independence of events.

Unit 15: Trigonometry

Trigonometrically identities and equations. Inverse trigonometric functions and their properties. Properties of triangles, including centroid, incentre, circum-centre and orthocenter, solution of triangles. Heights and Distances.

BIOTECHNOLOGY - B.TECH / M.TECH & B.SC.NURSING.B.PHARMA/D.PHARMA

BIOLOGY (BOTANY AND ZOOLOGY)

Unit : 1 Diversity in Living World

Biology – its meaning and relevance to mankind

What is living; Taxonomic categories and aids (Botanical gardens, herbaria, museums, zoological parks); Systematics and Binomial system of nomenclature.

Introductory classification of living organisms (Two-kingdom system, Five-kingdom system); Major groups of each kingdom alongwith their salient features (Monera, including Archaebacteria and Cyanobacteria, Protista, Fungi, Plantae, Animalia); Viruses; Lichens

Plant kingdom – Salient features of major groups (Algae to Angiosperms);

Animal kingdom – Salient features of Nonchordates up to phylum, and Chordates up to class level.

Unit : 2 Cell : The Unit of Life ; Structure and Function

Cell wall; Cell membrane; Endomembrane system (ER, Golgi apparatus/Dictyosome, Lysosomes, Vacuoles); Mitochondria; Plastids; Ribosomes; Cytoskeleton; Cilia and Flagella; Centrosome and Centriole; Nucleus; Microbodies. Structural differences between prokaryotic and eukaryotic, and between plant and animal cells. Cell cycle (various phases); Mitosis; Meiosis.

Biomolecules – Structure and function of Carbohydrates, Proteins, Lipids, and Nucleic acids.

Enzymes – Chemical nature, types, properties and mechanism of action.

Unit : 3 Genetics and Evolution

Mendelian inheritance; Chromosome theory of inheritance; Gene interaction; Incomplete dominance; Co-dominance; Complementary genes; Multiple alleles; Linkage and Crossing over; Inheritance patterns of hemophilia and blood groups in humans. DNA –its organization and replication; Transcription and Translation; Gene expression and regulation; DNA fingerprinting. Theories and evidences of evolution, including modern Darwinism.

Unit : 4 Structure and Function – Plants

Morphology of a flowering plant; Tissues and tissue systems in plants; Anatomy and function of root, stem(including modifications), leaf, inflorescence, flower (including position and arrangement of different whorls, placentation), fruit and seed; Types of fruit; Secondary growth; Absorption and movement of water (including diffusion, osmosis and water relations of cell) and of nutrients; Translocation of food; Transpiration and gaseous exchange; Mechanism of stomatal movement.

Mineral nutrition – Macro- and micro-nutrients in plants including deficiency disorders; Biological nitrogen fixation mechanism.

Photosynthesis – Light reaction, cyclic and non-cyclic photophosphorylation; Various pathways of carbon dioxide fixation; Photorespiration; Limiting factors.

Respiration – Anaerobic, Fermentation, Aerobic; Glycolysis, TCA cycle; Electron transport system; Energy relations.

Unit : 5 Structure and Function - Animals
 Tissues; Elementary knowledge of morphology, anatomy and functions of different systems of earthworm, cockroach and frog.

Human Physiology – Digestive system - organs, digestion and absorption; Respiratory system – organs, breathing and exchange and transport of gases. Body fluids and circulation – Blood, lymph, double circulation, regulation of cardiac activity; Hypertension, Coronary artery diseases. Excretion system – Urine formation, regulation of kidney function
 Locomotion and movement – Skeletal system, joints, muscles, types of movement. Control and co-ordination – Central and peripheral nervous systems, structure and function of neuron, reflex action and sensory reception; Role of various types of endocrine glands; Mechanism of hormone action.

Unit : 6 Reproduction, Growth and Movement in Plants

Asexual methods of reproduction; Sexual Reproduction - Development of male and female gametophytes; Pollination (Types and agents); Fertilization; Development of embryo, endosperm, seed and fruit (including parthenocarpy and apomixis). Growth and Movement – Growth phases; Types of growth regulators and their role in seed dormancy, germination and movement; Apical dominance; Senescence; Abscission; Photo-periodism; Vernalisation; Various types of movements.

Unit : 7 Reproduction and Development in Humans

Male and female reproductive systems; Menstrual cycle; Gamete production; Fertilisation; Implantation; Embryo development; Pregnancy and parturition; Birth control and contraception.

Unit : 8 Ecology and Environment

Meaning of ecology, environment, habitat and niche. Ecological levels of organization (organism to biosphere); Characteristics of Species, Population, Biotic Community and Ecosystem; Succession and Climax.

Ecosystem – Biotic and abiotic components; Ecological pyramids; Food chain and Food web; Energy flow; Major types of ecosystems including agroecosystem.

Ecological adaptations – Structural and physiological features in plants and animals of aquatic and desert habitats.

Biodiversity – Meaning, types and conservation strategies (Biosphere reserves, National parks and Sanctuaries)

Environmental Issues – Air and Water Pollution (sources and major pollutants); Global warming and Climate change; Ozonedepletion; Noise pollution; Radioactive pollution; Methods of pollution control (including an idea of bioremediation); Deforestation; Extinction of species (Hot Spots).

concepts of immunology. Plant Breeding and Tissue Culture in crop improvement.

Biofertilisers (green manure, symbiotic and free-living nitrogen-fixing microbes, mycorrhizae); Biopesticides (micro-organisms as biocontrol agents for pests and pathogens); Bioherbicides; Microorganisms as pathogens of plant diseases with special reference to rust and smut of wheat, bacterial leaf blight of rice, late blight of potato, bean mosaic, and root - knot of vegetables.

Bioenergy – Hydrocarbon - rich plants as substitute of fossil fuels.

Unit:10 Biotechnology and its Applications

Microbes as ideal system for biotechnology; Microbial technology in food processing, industrial production (alcohol, acids, enzymes, antibiotics), sewage treatment and energy generation.

Steps in recombinant DNA technology – restriction enzymes, DNA insertion by vectors and other methods, regeneration of recombinants.

Applications of R-DNA technology. In human health –Production of Insulin, Vaccines and Growth hormones, Organ transplant, Gene therapy. In Industry – Production of expensive enzymes, strain improvement to scale up bioprocesses. In Agriculture – GM crops by transfer of genes for nitrogen fixation, herbicide-resistance and pest-resistance including Bt crops

Unit : 9 Biology and Human Welfare

Animal husbandry – Livestock, Poultry, Fisheries; Major animal diseases and their control. Pathogens of major communicable diseases of humans caused by fungi, bacteria, viruses, protozoans and helminths, and their control. Cancer; AIDS. Adolescence and drug/alcohol abuse; Basic

(APPENDIX-IV)
SYLLABUS FOR B.TECH. (LATERAL ENTRY)

MATHEMATICS

Unit 1: Ordinary Differential Equation

Differential equation of first order. Linear differential equation of second order (homogeneous and nonhomogeneous case). Cauchy, Euler's equation, Application of first order differential equations (mixture problem, Newton's law of cooling, orthogonal trajectory). Application to LCR circuits, Application to free and forced vibration of Mass spring system.

Unit 2: Series Method

Properties of power series, Radius of convergence of power series, Legendre's equation and Legendre's polynomial, properties of Legendre's polynomial, Gamma function, ordinary and singular point Frobenious method, Bessel's equation and properties of Bessel's function.

Unit 3: Laplace Transform

Laplace transforms of standard function, periodic functions, Unit step function, Transforms of derivatives and integrals. Differentiation and integration of transforms, Linearity property, Inverse Laplace transform, Shifting theorems, Convolution. Application to solve differential and integral equations (initial value problem).

Unit 4: Fourier Series

Periodic function, Fourier series, Euler's formula, Even and odd functions, Fourier series expansions of even and odd function, half range expansion of functions, Expansion of functions with finite discontinuities.

Unit 5: Matrix

Types of matrices, algebra of matrices, rank, solution of non-homogenous system of equations, consistency of the system of equations, Linear dependence and independance, solution of homogeneous system of equation. Eigen values and eigen

vectors. Norm and inner product. Orthogonal and projection matrix.

Application of eigen values and vectors to solve the system of homogeneous linear differential equation.

Unit 6 : Vectors:

Vector algebra, product of vectors, vector differentiation, vector differential operator, gradient, directional derivatives, divergence, curl, line integral, double integral, green's theorem.

ENGINEERING MECHANICS

Unit 1:- Statics

Conditions of equilibrium, concept of free body diagram, methods of moments and solution to engineering problems.

Friction : Static friction, ladder friction, problems with friction, Belt friction and screw jack, force analysis of plane trusses (method of joint, method of sections, plane frames, methods of members), Parallel forces in a plane, Centre of parallel forces, Pappus Guldinus theorems, MI of plane figures, parallel axis theorem, perpendicular axis theorem, Polar MI, Principle of virtual work for a single particle, rigid bodies, ideal systems and constrained bodies.

Unit 2: Dynamics

Force proportional to displacement, free vibration, D' Alembert's principle, momentum and impulse. Application to principle of linear momentum to a single particle, rigid bodies and ideal systems. Application to principle of angular momentum to a single particle and rotating rigid bodies. Principle of conservation of momentum.\

Unit 3: Work and Energy

Principle of work and energy for ideal system, Conservation of energy.

BASIC ELECTRICAL ENGINEERING

Unit 1: Electrostatics

Coulomb's law, Electric charge, Potential, Field & Capacitance, Potential gradient due to spherical cylindrical and plane charges, Electric force, Flux density and permittivity. Calculation of Capacitance of spherical, coaxial, cylindrical and parallel plate condenser. Energy stored in a electric field.

Unit 2: Electromagnetism

Magnetic field due to current in conductor. Magnetic field intensity and Flux density. Permeability, B-H curves, Magnetisation, Concept in hysteresis. Magnetomotive force and Magnetic reluctance.

Electrodynamic force:- Faraday's law of electromagnetic induction, Eddy current, emf induced in a conductor moving in a magnetic field. Energy stored in a magnetic field.

Unit 3: D.C. Circuit

Current distribution in series and parallel circuit. Power and energy in electric circuit. Star-Delta conversion. Kirchoff;s law & its

application and solve electric circuit by branch & loop current method & nodal method. Superposition theorem.

Unit 4: A.C. Circuit

Production of alternating current – Instantaneous, average & rms value of current and voltage. Peak factor, Form factor, Amplitude, Frequency, Phase difference, Addition and subtraction of alternating quantity. Phasor diagram, Resistance, Inductance, Capacitance, impedance and admittance- power and power factor-series and parallel circuits. Q factor-Three phase circuit. Star-Delta connection-Active and reactive power. Power measurement with one and two wattmeter methods-Calculation in RLC circuit, in series circuit.

Unit 5: Instrument

Construction and principle of operation-PMMC, MI and dynamometer type ammeter, voltmeter and dynamometer type wattmeter. Power factor meter.

Unit 6: Illumination

Law of illumination- Solid angle, Luminous flux, Luminous intensity, illumination brightness and luminous efficiency.

Unit 7: Production Light

Filament lamp, Arc lamp, Electric discharge lamps, Sodium vapour lamp, Mercury vapour lamp-Theory of electrical energy radiation. Comparison between filament lamp and fluorescent lamp.

(APPENDIX-V)
SYLLABUS FOR MCA & M.SC. COMPUTER SCIENCE

MATHEMATICS

Unit 1:- Algebra of Sets : Set operations, Union, Intersection, Difference, Symmetric Difference, Complement, Venn Diagram, Cartesian products of sets, Relation and Function, Composite Function, Inverse of a Function, Equivalence Relation, Kinds of Function.

Unit 2:- Number Systems : Real numbers (algebraic and other properties), rational and irrational numbers, Complex numbers, Algebra of complex numbers, Conjugate and square root of a complex number, cube roots of unity, De-moivre's Theorem with simple applications. Permutation and combinations and their simple applications, Mathematical induction, Binomial Theorem. Determinants up to third order, Minors and Cofactors, Properties of determinants. Matrices up to third order, Types of Matrices. Algebra of matrices, Adjoint and inverse of a matrix. Application of determinants and matrices to the solution of linear equation (in three unknowns)

Unit 3:-Trigonometry : Compound angles, Multiple and Sub-multiple angles, solution of trigonometric equations, Properties of triangles, Inverse circular function.

Unit 4:- Co-ordinate Geometry of Two Dimensions : Straight lines, pairs of straight lines, Circles, Equations of tangents and normals to a circle. Equations of Parabola, Ellipse and Hyperbola, Ellipse and hyperbola in simple forms and their tangents (Focus, directix, eccentricity and latus rectum in all cases)

Unit 5:-Co-ordinate Geometry of Three Dimensions: Distance and division formulae, Direction cosines and direction ratios. Projections, Angles between two planes, Angle between a line and plane. Equations of a sphere-general equation.

Unit 6: -Vector Fundamentals, Dot and Cross product of two vectors, Scalar triple product,

Simple Applications (to geometry, work and moment).

Unit 7:-Differential Calculus : Concept of limit, continuity, Derivation of standard functions, successive differentiation, simple cases, Leibnitz Theorem, Partial differentiation, Simple cases, derivatives as rate measure, Maxima and minima, indeterminate forms, Geometrical applications such as tangents and normals to plane curves.

Unit 8:-Integral Calculus:- Standard methods of integration (substitution, by pars, by partial fractions etc.) Definite integrals and properties of Definite Integrals, Areas under plane curves, Differential Equations only simple cases such as

- (i) $dy/dx = f(x)$
- (ii) $dy/dx=f(x) g(y)$
- (iii) $d^2y/dx^2 = f(x)$ and application to motions in a straight line.

Unit 9:-Probability and Statistics : Averages (Mean, Median and Mode), Dispersion (standard deviation and variance). Definition of probability, Mutually exclusive events, Independent events, Addition theorem.

COMPUTER AWARENESS

Computer Basics: Organization of a Computer, Central Processing Unit (CPU), Structure of instructions in CPU, input/output devices, computer memory, back-up devices.

DATA REPRESENTATION

Representation of characters, integers and fractions, binary and hexadecimal representations, Binary Arithmetic : Addition, subtraction, multiplication, division, simple arithmetic and two's complement arithmetic, floating point representation of numbers, Boolean algebra, truth tables, venn diagram.

ANALYTICAL ABILITY AND LOGICAL REASONING

Questions in this section will test logical reasoning and quantitative reasoning.

(APPENDIX-VI)
SYLLBUS FOR M.SC. (BIOTECHNOLOGY / APPLIED MICROBIOLOGY)

BIOLOGY (10+2+3 Standard)

Unit 1:- General Biology

Taxonomy; Heredity; Genetic variation; Conservation; Principles of ecology; Evolution; Techniques in modern biology.

Unit 2 :-Biochemistry and Physiology

Carbohydrates; Proteins; Lipids; Nucleic acids; Enzymes; Vitamins; Hormones; Metabolism; Photosynthesis. Nitrogen Fixation, Fertilization and Osmoregulation; Nervous system; Endocrine system; Vascular system; Immune system; Digestive system, Reproductive System.

Unit 3 :-Basic Biotechnology

Tissue culture; Application of enzymes; Antigen-antibody interaction; Antibody production; Diagnostic aids.

Unit 4 :-Molecular Biology

DNA; RNA; Replication; Transcription; Translation; Proteins; Lipids; Membranes; Gene transfer.

Unit 5:-Cell Biology

Cell cycle; Cytoskeletal elements; Mitochondria; Endoplasmic reticulum; chloroplast; Golgi apparatus; Signaling.

Unit 6:-Microbiology

Isolation; Cultivation; Characterization and enumeration of virus; Bacteria; Fungi; Protozoa; Pathogenic micro-organisms.

CHEMISTRY (10+2+3 Standard)

Unit 1 :-Atomic Structure

Bohr's theory and Schrodinger wave equation; Periodicity in properties; Chemical bonding; Properties of s, p, d and f block elements; Complex formation; Coordination compounds; Chemical equilibria; Chemical thermodynamics (first and second law); Chemical kinetics (zero, first, second and third order reactions); Photochemistry; Electrochemistry; Acid-base concepts; Stereochemistry of carbon compounds; Inductive, Electromeric, conjugative effects and resonance.

Unit 2 :-Chemistry of Functional Groups

Hydrocarbons, alkyl halides, alcohols, aldehydes, ketones, carboxylic acids, amines and their derivatives; Aromatic hydrocarbons, halides, nitro and amino compounds, phenols, diazonium salts, carboxylic and sulphonic acids; Mechanism of organic reaction; Soaps and detergents; Synthetic polymers; Biomolecules-aminoacids, proteins, nucleic acids, lipids and carbohydrates (polysaccharides); Instrumental techniques – chromatography (TLC, HPLC), electrophoresis, UV-Vis-IR and NMR spectroscopy, mass spectrometry, etc.

MATHEMATICS (10+2 Standard)

Sets, Relations and Functions, Mathematical Induction, Logarithms, Complex numbers, Linear and Quadratic equations, Sequences and Series, Trigonometry, Cartesian System of Rectangular Coordinates, Straight lines and Family, Circles, Conic Sections, Permutations and Combinations, Binomial Theorem, Exponential and Logarithmic Series, Mathematical Logic, Statistics, Three Dimensional Geometry, Vectors, Stocks, Shares and Debentures, Average and Partition Values, Index numbers, Matrices and Determinants, Boolean Algebra, Probability, Functions, limits and Continuity, Differentiation, Application of Derivatives, Definite and Indefinite Integrals, Differential Equations, Elementary Statics and Dynamics, Partnership, Bill of Exchange, Linear Programming, Annuities, Application of Calculus in Commerce and Economics.

PHYSICS (10+2 Standard)

Physical World and Measurement, Kinematics, Laws of Motion, Work, Energy and Power, Electrostatics, Current electricity, Magnetic Effects of Current and Magnetism, Electromagnetic Induction and Alternating Current, Electromagnetics waves, Optics, Dual Nature of Matter and Radiations, Atomic Nucleus, Solids and Semiconductor Devices, Principles of Communication, Motion of System of Particles and Rigid Body, Gravitation, Mechanics of Solids and Fluids, Heat and Thermodynamics, Oscillations, Waves.

(APPENDIX –VII) STATE CODE

State/ Union Territory	Code
Andaman & Nicobar Islands	01
Andhra Pradesh	02
Arunachal Pradesh	03
Assam	04
Bihar	05
Chandigarh	06
Chhattisgarh	07
Dadra & Nagar Haveli (UT)	08
Daman & Diu (UT)	09
Delhi (NCT)	10
Goa	11
Gujarat	12
Haryana	13
Himachal Pradesh	14
Jammu & Kashmir	15
Jharkhand	16
Karnataka	17
Kerala	18
Lakshadweep (UT)	19
Madhya Pradesh	20
Maharashtra	21
Manipur	22
Meghalaya	23
Mizoram	24
Nagaland	25
Odisha	26
Puducherry (UT)	27
Punjab	28
Rajasthan	29
Sikkim	30
Tamil Nadu	31
Telangana	32
Tripura	33
Uttar Pradesh	34
Uttarakhand	35
West Bengal	36

EXAMINATION CENTRE FOR KIITEE-2024

Name of the State / City	Exam. Centre	Centre Code
Andaman Nicobar	Port Blair	01
Andhra Pradesh	Vijaywada	02
	Vishakhapatnam	03
Assam	Guwahati	04
	Silchar	05
	Dibrugarh	06
Bihar	Bhagalpur	07
	Gaya	08
	Patna	09
	Muzaffarpur	10
	Purnea	11
Chhattisgarh	Bilaspur	12
	Raipur	13
	Bhilai	14
Delhi	New Delhi	15
Gujarat	Ahmedabad	16
	Surat	17
Goa	Panjim	18
Haryana	Gurugram(Gurgaon)	19
Jharkhand	Bokaro	20
	Dhanbad	21
	Jamshedpur	22
	Ranchi	23
Jammu Kashmir	Jammu	24
Kerala	Thiruvananthapuram	25
	Kochi	26
Karnataka	Bangalore	27
Madhya Pradesh	Bhopal	28
	Gwalior	29
	Indore	30
	Jabalpur	31
Maharashtra	Mumbai	32
	Nagpur	33
	Pune	34
	Thane	35
Manipur	Imphal	36
Meghalaya	Shillong	37
Nagaland	Dimapur	38
Odisha	Angul	39
	Balasore	40
	Baripada	41



	Bhawanipatna	42
	Berhampur	43
	Bhubaneswar	44
	Bolangir	45
	Keonjhar	46
	Koraput	47
	Rourkela	48
	Sambalpur	49
Punjab	Chandigarh	50
Rajasthan	Jaipur	51
	Kota	52
Tamil Nadu	Chennai	53
Telangana	Hyderabad	54
Tripura	Agartala	55
Uttar Pradesh	Prayagraj(Allahabad)	56
	Banaras	57
	Bareilly	58
	Gorakhpur	59
	Kanpur	60
	Lucknow	61
	Noida	62
Uttarakhand	Dehradun	63
	Pant Nagar	64
West Bengal	Durgapur	65
	Kharagpur	66
	Kolkata	67
	Siliguri	68
	Howrah	69



KALINGA INSTITUTE OF INDUSTRIAL TECHNOLOGY (KIIT)

Deemed to be University
(Established U/S 3 of UGC Act, 1956)
Bhubaneswar, Odisha, India

Phone: 8080735735
Email: admission@kiit.ac.in, kiit@kiit.ac.in,
Website: www.kiit.ac.in, www.kiitee.ac.in

Proposal for Short Term Training
On
Rapid Prototyping for IoT: An Immersive Workshop with single board computers.

Date of commencement: 20th June 2024

This course delves into the methodology of Internet of Things (IoT) device development. You'll gain a strong foundation in single-board computers, their interaction with various sensors and actuators, and programming for cloud-based data transmission. Hands-on practical training sessions will solidify your understanding of these concepts.

Training Outcome:

Students learn IoT device development and prototyping

Duration: 4 weeks(40hr) + Project

Course Fee: Rs. 5000/- (inclusive all taxes)

Eligibility: B. TECH. 2nd Year or 3rd year

Mode: Hybrid Mode (Theory will be in online mode and hands-on in offline mode in university campus)

Week 1: Internet of Things

- ◆ IoT & IoE, its applications
- ◆ Sensors
- ◆ Actuators
- ◆ Networks
- ◆ Development boards

Week 2: IoT Platform Design methodology

- ◆ IoT design templates
- ◆ IoT Platform design I
- ◆ IoT Platform design II
- ◆ Case Studies/Use Cases
- ◆ Raspberry Pi Fundamentals

Week 3: Rapid Prototyping using Raspberry Pi

- ◆ Installing OS on Raspberry Pi 4

- ◆ SSH fundamentals and access to Rpi/Linux commands/configuration
- ◆ Interfacing sensors
- ◆ Interfacing actuators
- ◆ Sending and receiving data to cloud

Week 4: Rapid Prototyping using using Rugged Board

- ◆ Microchip SOM
- ◆ Rugged Board fundamentals
- ◆ MRAA and UPM
- ◆ Interfacing sensors and actuators
- ◆ Evaluation/Submission

Evaluation:

Online class participation will be evaluated through Zoom polling responses during lecture delivery. Hands-on activities in the Microchip Center of Excellence Lab will be assessed through project submissions.

Certificates will be issued to students achieving a score of more than 60%.

Instructor:

Dr. Deepak Kr. Rout

Assistant Professor,
School of Electronics Engineering,
Kalinga Institute of Industrial Technology (KIIT)-DU.



**KALINGA INSTITUTE
OF INDUSTRIAL TECHNOLOGY**

Deemed to be University U/S 3 of the UGC Act, 1956



Educational Excellence Transcending Borders

international.kiit.ac.in





UNITY-THE STRENGTH OF KIIT

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Sports and Facilities

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KISS: Humane face of KIIT

Uniqueness of KIIT

Visits of Dignitaries to KIIT/KISS

Global Footprint

International Relations Office

How to Apply?

FOUNDER'S MESSAGE

KIIT University is one of the most sought after Universities in the world, a university with human touch.

You will be one essential and integral part of Kalinga Institute of Industrial Technology because the university believes in being the most student friendly campus. This university supports and contributes to a human face that is the largest tribal education institution in the world- Kalinga Institute of Social Sciences, a protege. KISS is a home for 80,000 indigenous children (30,000 in KISS Bhubaneswar, 40,000 Alumni and 10,000 in satellite centers of KISS in 10 districts of Odisha) who are provided with quality education, free boarding, health care facilities, vocational training and life skills empowerment, all absolutely free.



Achyuta Samanta
Founder KIIT & KISS

This is the highest integration of elite and deprived in a seamless manner which fosters holistic development of all. KIIT provides comprehensive education that instills within its students a philosophy that values not only learning and professionalism, but also contribution and commitment to the advancement of community. KIIT University has grown to be one of the most prominent universities in India and globe for professional Education with 40,000 students from all over India and 65 countries across the globe. It's truly international character supporting cross cultural exchanges and values makes one feels at home. It's a melting pot of cultures, legacies and traditions from many countries across the globe. The customised education with hands on learning experience makes the students equip with knowledge and skills required to work in a global economy and place students as global citizens. Its infrastructure is world class and next to none.

The University has got many international and national accolades standing tall in the International rankings. More than 22 Nobel laureates and 100 ambassadors besides dignitaries, luminaries, academicians, policymakers have visited and hailed the best practices at KIIT. The University has a strong relation with over 130 countries of the world and makes Odisha feature in the global map of academics and innovation which was once in the oblivion. KIIT has made its name and carved a niche for itself in a small span of 25 years in the field of sports and extra curricular activities.

Housed in Bhubaneswar, Odisha, KIIT is perfectly located in the most vibrant part of the city. It will not be wrong to say that KIIT has made that part of city thriving. The city is well connected by air, rail and road and has a smart system of public transport. Its amalgamation of tradition and modernity makes it one of the most comfortable and welcoming places to be at and study. The boarding facilities and the campus life at KIIT adds to the perfection.

KIIT is not about classroom teaching and learning alone, it is about creating lifelong relation with the institution, friends, learning and life.



WHY STUDY AT KIIT ?

KIIT is one of the first institutions in the State of Odisha, India to attract foreign students into its various academic programmes. KIIT has students from over 65 countries, proving its reputation as a quality institution of professional education that transcends borders.

KIIT, though a very young institution has performed incredibly well in the rankings conducted by various national and international associations. Founded in 1992 and opened five years later as a centre for higher learning, its commitment to teaching excellence led to the grant of university status under Section 3 of UGC Act, 1956 by the Ministry of Human Resource Development, Government of India in 2004, within seven years of its inception.

KIIT comprises 25 constituent Schools imparting cutting-edge skill and knowledge to its students pursuing globally recognised Bachelor's, Master's and Doctoral degree programmes in 200+ plus disciplines, spanning Engineering, Medicine, Management, Biotechnology, Law and more. Each School functions from an independent campus having its own dedicated laboratories, library, conference halls, recreational and sports facilities.

Though very young, it is moving up the ladder of ranking and recognition with an increased acceleration with its focus on academics.



ABOUT KIIT

KIIT Overview

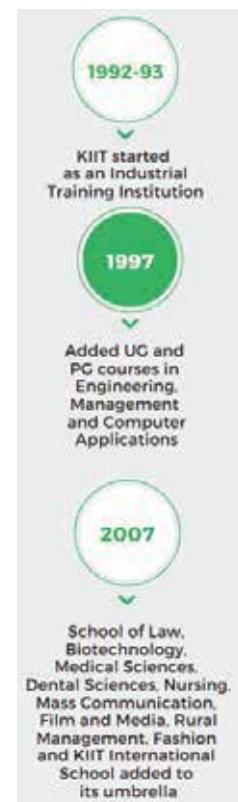
Kalinga Institute of Industrial Technology (KIIT), a household name in the education sector has become a sought-after destination in India for professional studies. It is admired all over for the quality of its academic courses, its community outreach work and as a university of compassion and humanitarianism. It has become a case study because no other educational institution in India has grown in its scope and scale as much as KIIT has in a short span of 25 years. Its incredible transformation is truly a journey from Soil to Silver.

Today, KIIT offers professional education to around 40,000 students from across India. This includes 2000 international students from 65 countries. The alumni of KIIT, over a lakh of them, have made their mark in their respective careers in academics, corporate organisations, civil services and enterprise.

One would find it difficult to imagine that such a celebrated institution with a global reputation was established by an unassuming humble being, Dr Achyuta Samanta, the Founder of KIIT and KISS, who started the institute with all of Rs 5000 as the initial investment.

He had big dreams and a passion to make a difference. Dr Samanta started KIIT in two rented rooms with 12 students and 2 staff. The modest institution has now grown to incomprehensible propositions and is spread over a vast 25-square-kilometre academic township. It has been accredited by and affiliated to prestigious national and international bodies.

Timeline



Ranking and Affiliations



Membership of National and International Organisations

Association of Commonwealth Universities (ACU)
Association of Indian Universities (AIU)
Association of University of Asia Pacific (AUAP)
European Association of International Education (EAIE)
Eurasian Silk Road Universities Consortium (ESRUC), Turkey
International Association of Universities (IAU)
International Association of University Presidents (IAUP)
Institute of International Education (IIE), New York
University Mobility in Asia and the Pacific (UMAP)
United Nations Academic Impact (UNAI)

CULTURAL DIVERSITY AT KIIT

KIIT boasts of a vibrant and diverse community. With students coming from all states of India and over 65 countries, the campus is a melting pot of cultures, traditions, and values.

At KIIT, every country and state has its unique flavor, and every student is encouraged to celebrate their diversity. The campus sees a plethora of cultural events and festivals throughout the year, with students showcasing their culture through music, dance, food, and art.



The institution prides itself on promoting a culture of inclusivity and respect for diversity. Students are encouraged to learn from each other's experiences, and their cultural differences are celebrated. The campus is a safe and welcoming space where students from different backgrounds come together to learn, grow, and prosper.

KIIT stands united in its mission to provide world-class education to students from all over the world while respecting their cultural heritage. The institution continues to strive towards creating a harmonious environment where diversity is celebrated, and every student feels valued and respected.

UNIQUENESS OF KIIT



**Student, Parent &
Staff-Friendly Campus**



**University of
Compassion & Humanity**



**Focus on Academics,
Research and Innovation**



**Consistent
High-Quality Placements**



**Great Promoter of Sports
and Sportspersons**

SENIOR FUNCTIONARIES

**Mr. Ashok Kumar Parija
Chancellor**



**Prof. (Dr.) Subrata Kumar Acharya
Pro-Chancellor**



**Prof. Saranjit Singh
Vice Chancellor**



**Prof. (Dr.) C.B.K. Mohanty
Pro-Vice Chancellor, School
of Medicine (KIMS, KIDS
and KINS)**



**Dr. Jnyana Ranjan Mohanty
Registrar**



COURSES OFFERED

Schools & Courses

SCHOOL OF CIVIL ENGINEERING

Bachelor of Technology (B.Tech) in Civil Engineering	4 Years
Master of Technology (M. Tech) in Civil Engineering (Construction Engineering & Management)	2 Years
Master of Technology in Civil Engineering (Structural Engineering)	2 Years
Dual Degree (B.Tech & M.Tech)	5 Years
Dual Degree (B.Tech & MBA)	6 Years
Ph. D & PDF	

SCHOOL OF MECHANICAL ENGINEERING

Bachelor of Technology (B.Tech) in Mechanical Engineering	4 Years
B.Tech in Mechanical Engg. (Automobile)	4 Years
B.Tech in Aerospace Engineering	4 Years
B.Tech in Mechatronics Engineering	4 Years
B.Tech in Production Engineering	4 Years
Master of Technology (M. Tech) in Mechanical Engineering (Manufacturing Process & System)	2 Years
Master of Technology (M. Tech) in Mechanical Engineering (Thermal Engineering)	2 Years
Master of Technology (M. Tech) in Mechanical Engineering (Machine Design)	2 Years
Dual Degree (B.Tech & M.Tech)	5 Years
Dual Degree (B.Tech & MBA)	6 Years
Ph. D & PDF	

SCHOOL OF ELECTRONICS ENGINEERING

Bachelor of Technology (B. Tech)	
Electronics and Telecommunication Engg	4 Years
Electronics and Electrical Engg.	4 Years
Electronics and Instrumentation Engg.	4 Years
Electronics & Computer Science Engg.	4 Years
Electronics & Control System Engg	4 Years
Communication Engg.	4 Years
Medical Electronics Engg.	
Master of Technology (M. Tech)	
Electronics and Telecommunications Engineering (Spl-Communication Engineering)	2 Years
Electronics & Telecommunications Engineering (Spl -VLSI Design & Embedded System)	2 Years
Electronics & Telecommunications Engineering (RF & Microwave)	2 Years
Dual Degree (B.Tech & M.Tech)	5 Years
Dual Degree (B.Tech & MBA)	6 Years
Ph. D & PDF	

SCHOOL OF ELECTRICAL ENGINEERING

Bachelor of Technology (B. Tech) in Electrical Engineering	4 Years
Master of Technology (M. Tech)	
Electrical Engineering (Power Electronics & Drives)	2 Years
Electrical Engineering (Power Energy System)	2 Years
Electrical Engineering (Power System Engineering)	2 Years
Dual Degree (B.Tech & M.Tech)	5 Years
Dual Degree (B.Tech & MBA)	6 Years
Ph. D & PDF	

SCHOOL OF COMPUTER ENGINEERING

Bachelor of Technology (B. Tech)	
Computer Science Engineering	4 Years
Computer Science & Communication Engg.	4 Years
Computer Science & Systems Engineering	4 Years
Information Technology	4 Years
M. Tech in Computer Science & Engineering (SPL: Computer Engineering)	2 Years
M. Tech in Computer Science & Information Security (SPL:Information Securities)	2 Years
M. Tech in Computer Science & Engineering (SPL: Data Analytics)	2 Years
M. Tech in Computer Science & Engineering (SPL: Software Engineering)	2 Years
Dual Degree (B.Tech & M.Tech)	5 Years
Dual Degree (B.Tech & MBA)	6 Years
Ph. D & PDF	



SCHOOL OF COMPUTER APPLICATION

M.C.A.	3 Years
MCA (Lateral Entry)	2 Years
B.C.A.	3 Years

SCHOOL OF ARCHITECTURE & PLANNING

Bachelor of Architecture (B. Arch)	5 Years
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KALINGA INSTITUTE OF MEDICAL SCIENCES (KIMS)

M.B.B.S	4.5 Years
PG Medical (M.D.)	3 Years
Master of Hospital Administration	2 Years

KALINGA INSTITUTE OF DENTAL SCIENCES (KIDS)

B.D.S.	5 Years
Master of Dental Surgery (MDS)	3 Years

KALINGA INSTITUTE OF NURSING SCIENCES

Basic B.Sc. in Nursing	4 Years
M.Sc. in Nursing	2 Years
General Nursing & Midwifery (GNM)	3 Years

SCHOOL OF BIOTECHNOLOGY

M.Sc. Biotechnology	2 Years
M.Sc. Applied Microbiology	2 Years
Biotechnology-Dual Degree	5 Years
Ph. D & PDF	

SCHOOL OF CHEMICAL TECHNOLOGY

B. Tech in Chemical Technology	4 Years
Dual Degree (B.Tech & M.Tech)	5 Years
Ph. D in Process Engineering & Materials	
Technology	

SCHOOL OF FILM AND MEDIA SCIENCES

Bachelor in Film & Television production (BFTP)	3 Years
Master of Mass Communication (Integrated)	5 Years

SCHOOL OF MANAGEMENT

Bachelor of Business Administration (BBA)	3 Years
Master of Business Administration (MBA)	2 Years
Ph. D & PDF	

SCHOOL OF RURAL MANAGEMENT

MBA in Rural Management	2 Years
MBA In Agribusiness Management	2 Years
Ph.D.	

SCHOOL OF FASHION TECHNOLOGY

Bachelor of Fashion Design	4 Years
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SCHOOL OF LAW

B.A.LL.B.	5 Years
B.Sc.LL.B.	5 Years
BBA.LL.B.	5 Years
LL.M	1 Year
Ph. D & PDF	

SCHOOL OF HUMANITIES

B.A. Economics/Sociology/English (Hons)	3 Years
Bachelor of Commerce (B.Com)	3 Years
M.A. Economics/Sociology/English (Hons)	3 Years
Master in commerce (M.Com)	2 Years

SCHOOL OF LANGUAGES

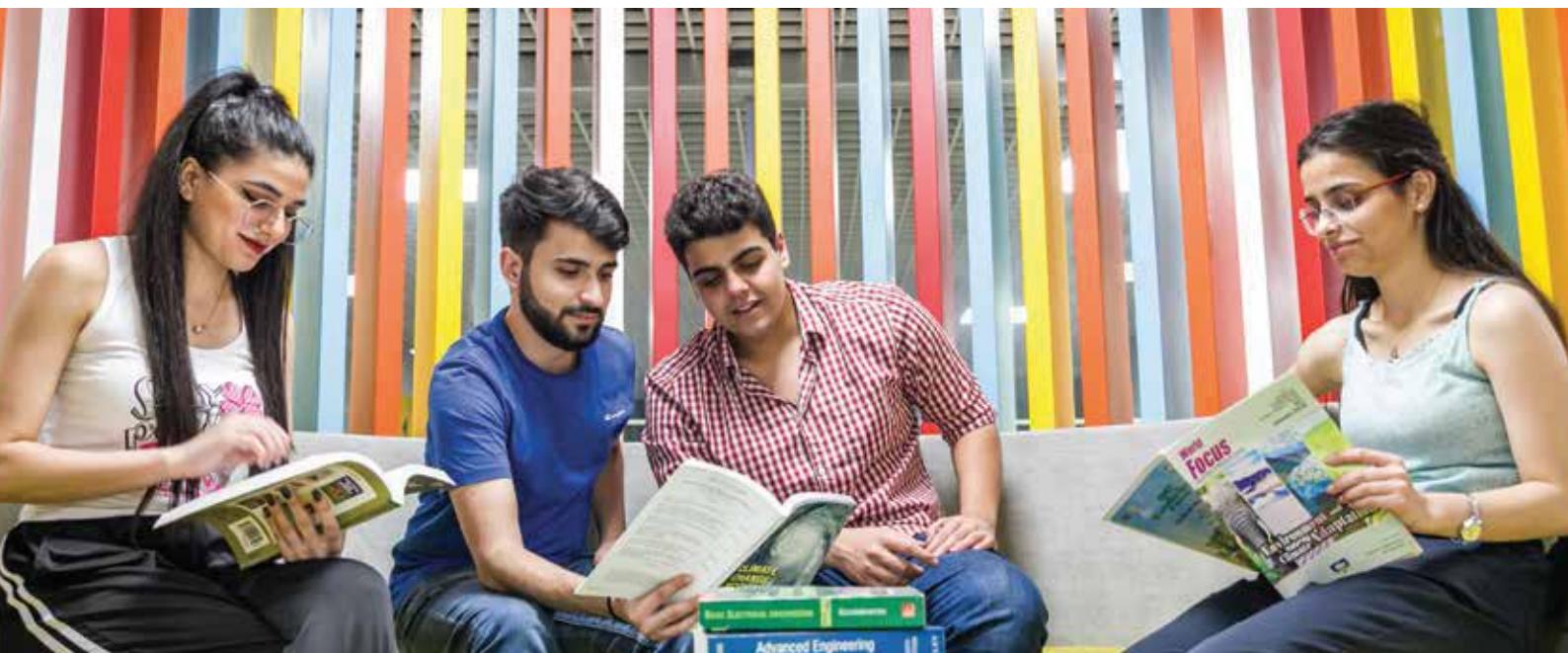
B. A. English (Honours)	2 Years
M. A. English	2 Years
M.Sc (by Research - Scientific	
Ph.D & PDF	

SCHOOL OF YOGA

M.A in Yoga Therapy	2 Years
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SCHOOL OF PUBLIC HEALTH

Master of Public Health (MPH)	2 Years
Master of Hospital Administration (MHA)	2 Years
Ph. D & PDF	



RESEARCH AND INNOVATION

Research and innovation are important hallmarks of a world-class university. KIIT has established 19 Centers of Excellence with industry to promote collaborative research. KIIT Faculty are actively involved in research and consultancy works attracting financial support to the tune of a few million dollars every year. Currently nearly 100 research and consultancy projects funded by various national and international funding agencies like UBS Promedica Foundation, Switzerland; Karolinska Institute, Sweden; DST, DBT, MNRE, Govt. of India, Board of Research in Nuclear Sciences, etc. are ongoing with substantial budget outlay.

Faculty members and research scholars of the University actively publish research papers in various national and international journals of repute. Over 14,700 research papers have been indexed in international databases like Scopus and Web of Science. The research papers have received a high citation, pushing up the 'h' index to 83. The University has 331 filed patents; 87 patents have been published and 198 have been granted so far.

To promote innovation and startup entrepreneurship among students as well as in wider society, KIIT opened KIIT Technology Business Incubator (KIIT-TBI) in 2008. One of its kind initiative in Odisha and among only 60- odd in the country, KIIT-TBI is supported by the Department of Science & Technology (DST), National Science & Technology Entrepreneurship Development Board (NSTEDB), and scores of other agencies. It was recognised as a Centre of Excellence in 2018. KIIT-TBI is presently supporting 235+ budding technology driven entrepreneurs, including 60+ women start-ups. As many as 65 start-ups have received national and international awards, while more than 50 have received follow on funding.

KIIT is among only seven institutions in India selected by Boeing India for its Boeing University Innovation Leadership Development (BUILD) programme to



Centres of Excellence

KIIT has established 18 Centres of Excellence with industry to promote collaborative research.

- SAP Centre of Excellence
- IBM Centre of Excellence
- Siemens Lab
- Innovation and Entrepreneurship Cell
- Centre for Industry Institutional Interface
- American Study Centre
- MSME Centre for Entrepreneurship development
- Interdisciplinary Centre of Energy with special reference to Renewable Energy
- Interdisciplinary research Centre in Materials and Nano Sciences
- Centre for Translational Research
- Centre for Industrial Technology IPR and Patent Cell
- ISRO KIIT Satellite Centre
- NI Centre of Excellence
- IOT Centre of Excellence
- Tech Mahindra Design Lab
- Intel Design Lab
- IOT Centre of Excellence

TUTOR- MENTOR SYSTEM



Faculty advisors or Tutor Mentors help, advise and guide the students with respect to academics and related issues. It helps the students to solve their academic and personal problems and respond to all correspondence concerning them. The major task undertaken by the tutor-mentor is to make sure that the new entrants feel comfortable in the new ambience. While the faculty advisors/tutor mentors monitor the student activities and identify the students who need a special counselling, counsellors provide those students who are academically deficient or emotionally distressed for academic or non-academic reasons. Services of professional psychiatrists are also available as required.

Student Counselling and Grievance redressal forum

The Counselling Section provides professional counselling and psychological boosting which include evaluation and therapy for a wide variety of personal situations. These range from adjusting to new environment, significant depression, anxiety, anger trauma, Interpersonal problems and other difficulties. Counselling service is rendered by a staff counsellor and a professional psychiatrist.



All the academic activities of the international students are planned by the Dean Academics - International Students. The primary responsibility of the Dean Academics is to collaborate with the heads of different Schools and address all academic grievances of the foreign students. The Dean Academics actively supports the International Relations Office (IRO) with academic inputs. The selection and counselling of the students going abroad for exchange programme/ semester abroad programme are also facilitated by the Dean. He/She is assisted by the Academic Coordinator (Foreign Students) along with the Faculty-in-charge (International Students) from every School and follow the objective of keeping a close connect with all foreign students studying in KIIT to indirectly facilitate and promote the Institute's strategic international agenda.





SPORTS & FACILITIES

At KIIT and KISS, Educational Excellence and sporting brilliance go hand in hand. Holistic development is the cornerstone of KIIT and KISS. Besides academics, effort is made to scout talent among the students, provide all necessary support and bring out the best in each one of them.

KIIT and KISS are proud to have rich sporting culture. They have created world class sports infrastructure and engaged international coaches in several disciplines to hone talents. Students have been bringing glory for the state and country for the last 15 years.

At present, KIIT and KISS have about 5000 active sportspersons. Over 100 students have represented in Olympics, ASIAD, South Asian Federation Games and various National and International meets. Both the Educational Institutions have produced over 2000 state level sports person and 2000 sportspersons who have participated and won in University and School games. More than 900 students are trained in 26 disciplines.

KIIT and KISS, in its journey, are determined to build upon this beginning and hope to bring more glory for the country and the state in the years to come.

Facilities

KIIT is well-known for its world-class infrastructure. Not only does each stream of education have a self-contained independent campus, but KIIT also has placed ultra-modern facilities, like Wi-Fi multimedia, air conditioned classrooms, virtual classrooms, video conferencing, state-of-the-art laboratories, close circuit cameras, gym & health club, seminar halls, auditoriums and open air theatres, etc., for students' all round growth.

Conferences & Seminars:

KIIT provides excellent ambience for national and international level conferences and seminars. Its Central Convention Centre Complex houses a world-class Auditorium having a seating capacity of 1600, besides a Guest House with 5-star facilities (42 suites), Conference Halls (18), Exhibition Ground (5 acre) and Banquet Hall. It is the largest of its type in the state of Odisha and one of the best in Eastern India. In addition, there are well-equipped auditoriums and conference halls in each campus. There are 20 Open Air Theatres (OATs) in different campuses with capacities ranging from 500 to 50,000.



Central Indoor Stadium:

Biju Patnaik Indoor Stadium is a hub for indoor sports activities.

Food Court:

In addition to canteens attached to each hostel, there are 15 Food Courts specializing in cuisines from different parts of the world.

Other Amenities:

Buses and shuttle cars are available to meet the transportation need of the students and staffs. An in-house computerised post office is functioning from the Campus. Other facilities like banks, police station, computerised railway ticket counter and ATMs of various banks are available in and around the campus.





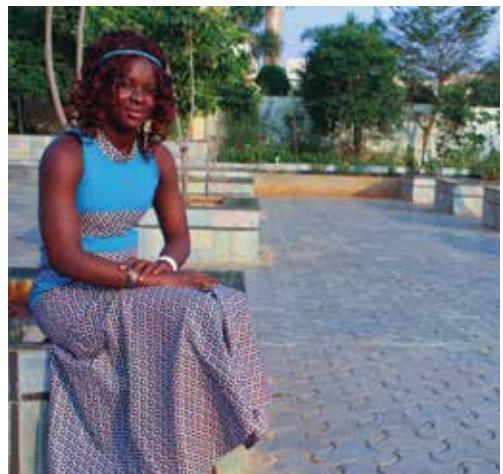
LIFE AT KIIT

Life at KIIT is more than just lectures and study sessions. Students get a plenty of opportunities to take a well-earned break from books. Our packed calendar of events and activities means a new friend is never far away.

At KIIT, students have a meaningful learning experience while enjoying all that university life has to offer. University is important, but it should also be a time to make friends and have great experiences outside the classroom. That's why along with libraries, lecture theaters and Wi-Fi hotspots – all of our campuses offer places to socialise, get a coffee and hang out during leisure. Soaking up the university atmosphere, meeting friends and reflecting on your classes are valuable take-aways of the student experience.



It's our priority to ensure that all students make a smooth transition to university and don't feel alone. KIIT's orientation programme includes workshops, social events, study groups and opportunities to get you involved in campus life. Participating in these activities ensure you make a successful start to studying at KIIT.



KISS : THE HUMANE FACE OF KIIT



KALINGA INSTITUTE OF SOCIAL SCIENCES (KISS)

KISS is the largest Residential Tribal institution in the world, providing free Education from Kindergarten to Post Graduation, a home for 80000 tribal children (30000 students in KISS Bhubaneswar, 40000 Alumni, 10000 in 10 satellite centres in 10 districts of Odisha). It is the recipient of UNESCO International Literacy Prize 2022. Its higher education wing, KISS Deemed to be University is the first and only university in India exclusively for tribals.



Uniqueness

1. World's Largest Indigenous Residential Educational Institution
2. First and only University exclusively for Indigenous Scholars
3. Sustainable Institution based on Unique Financial Model
4. Recipient of UNESCO International Literacy Prize 2022
5. Global Recognition and Collaboration with various UN organs, agencies and international NGOs
6. Chronicled in the Limca Book of Records & Guinness Book of Records on 4 counts each
7. Catering to 62 Tribal Groups and 13 PVTGs
8. Focus on Sports and Vocational Empowerment
9. Adopted over 200 orphans during Covid- 19 and providing them subsistence, education and job
10. Preserving the Tribal Way of Life

www.kiss.ac.in



VISIT OF INTERNATIONAL DIGNITARIES TO KIIT & KISS



JUSTICE DALVEER BHANDARI
INDIAN MEMBER - INTERNATIONAL
COURT OF JUSTICE



LYONCHHEN JIGMI Y. THINLEY
EX-PRIME MINISTER
OF BHUTAN



YURI AFANASIEV
UNDP RESIDENT
REPRESENTATIVE IN INDIA



MR. DIEGO PALACIOS
UNFPA REPRESENTATIVE
TO INDIA



PROF. ERWIN NEHER
NOBLE PEACE LAUREATE
GERMANY



PROF. ADA ETIL YONATH
NOBLE PEACE LAUREATE
ISRAEL



PROF. J. GEORG BEDNORZ
NOBLE PEACE LAUREATE
ZURICH



PROF. SIR JOHN E. WALKER
NOBLE PEACE LAUREATE
ENGLAND



PROF. RICHARD R ERNST
NOBLE PEACE LAUREATE
SWITZERLAND



PROF. ROLF ZINKERNAGEL
NOBLE PEACE LAUREATE
SWITZERLAND



PROF. HIROSHI AMANO
NOBLE PEACE LAUREATE
JAPAN



PROF. MUHAMMAD YUNUS
NOBLE PEACE LAUREATE
BANGLADESH



MS. ERTHARIN COUSIN
EXECUTIVE DIRECTOR,
WORLD FOOD PROGRAMME



PROF. MARTIN HUNTER
INTERNATIONAL COMMERCIAL
ARBITRATION



ASHLEY JUDD
AMBASSADOR
UN-POPULATION FUND



MR. ALAN GEMMEL, OBE
DIRECTOR,
BRITISH COUNCIL

KIIT GLOBAL FOOTPRINT



📍 ACADEMIC PARTNERSHIPS

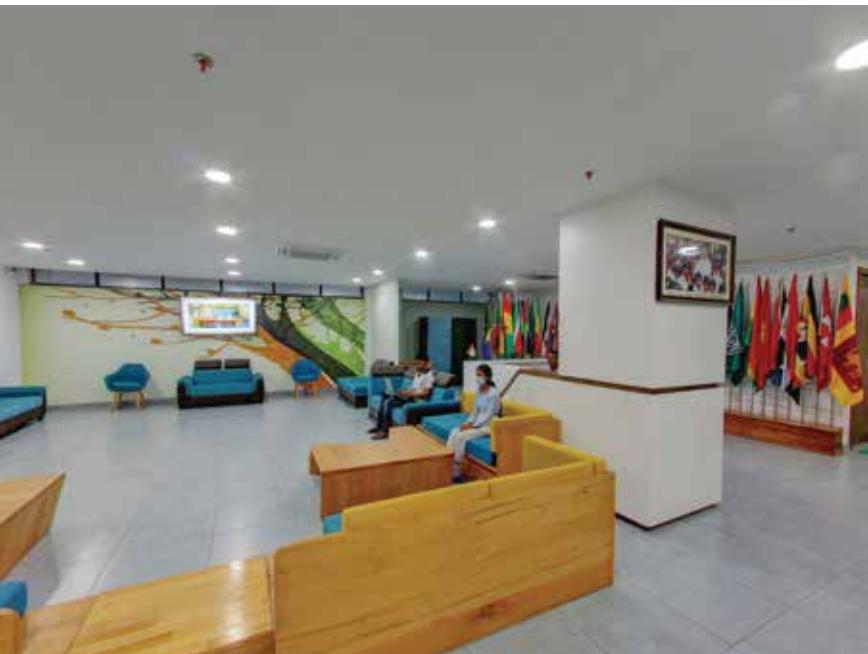
📍 INTERNATIONAL STUDENTS

FOREIGN PARTNER UNIVERSITIES

- Anglia Ruskin University, U.K
- CY Tech University, France
- MASSEY University, New Zealand
- Asian Institute of Technology (AIT), Thailand
- Ataturk University, Turkey
- Chiang Mai Rajbhat University, Thailand
- Cracow University of Technology, Poland
- Czech University of Life Sciences, Prague
- Deakin University, Australia
- Dumlupınar University, Turkey
- Edinburgh's Telford College, U.K.
- Hanbat National University, South Korea
- Hanseo University, S. Korea
- Institute of Asian and Oriental Studies (AOI), Eberhard, Karls Universität Tübingen, Germany
- Minghsin University of Science and Technology, Taiwan
- Modul University of Vienna
- Nano Bio Research Centre, Myongji University, S.Korea

- National Central University of Taiwan
- National Pingtung University of Science and Technology, Taiwan
- National Taipei University (NTPU), Taiwan
- Nano Bio Research Centre, Myongji University, S.Korea
- North Seattle Community College, Washington
- North-West University, South Africa
- Pokhara University, Nepal
- Reykjavik University, Iceland
- The National Formosa University of Taiwan
- Tomas Bata University in Zlin, Czech Republic
- University of Cambodia, Cambodia
- University of Miskolc, Hungary
- VSB Technical University of Ostrava, Czech Republic
- Yildiz Technical University (YTU), Turkey

ROLE OF INTERNATIONAL RELATIONS OFFICE



IRO has a dedicated team committed to the needs of international students. The team serves as the first point of contact for international students to make their arrival and stay comfortable, particularly with assistance in student visa, FRRO Registration and other requisite documentation. By advising personally and/or referring to specialist services, the IRO strives to contribute to the success of the international students at KIIT and elsewhere.

The goal of this Office is to enhance internationalisation at KIIT. It is the central contact point for international students and researchers – before, during and after their study at KIIT. It supports domestic students and researchers from KIIT with all questions concerning international mobility. It coordinates MOUs and international collaborations and develops programmes with partner universities for strengthening in higher education, innovation and

Strategy:

- Planning and developing international marketing strategies

Mobility:

- Advising and counselling aspiring international students and guest researchers who plan to conduct their studies or research in KIIT
- Guiding domestic students who would like to take up a part of their studies abroad
- Planning and executing semester abroad programme, faculty exchange programme, summer schools, short-term mobility programme, international volunteering programme, international seminars and workshops
- Planning and execution of international guest visits

Partnerships:

- Supporting and fostering international academic partnerships
- Maintaining partnerships with Embassies, Ministries of higher education, governmental and non-governmental organisations

Support services:

- First point of contact and offers welcome and orientation support to all international students.
- Services range from academic (in coordination with Dean Academics and Faculty In-Charge) to non-academic issues such as immigration support, local registration, visa extension, opening a bank account, authentication of certificates,etc.



List of the Faculty Incharge, International Relations

NAME	DESIGNATION	SCHOOL	CONTACT
Dr. Bijan Kumar Patel	Assistant Professor	School of Applied Sciences	8763155737/ bijan.patelfma@kiit.ac.in
Dr. Pallavi Kiran	Assistant Professor	School of Humanities	7992329188/ pallavi.kiranfhu@kiit.ac.in
Dr. Rajat Kumar Behera	Associate Professor	School of Computer Engineering	9886072882/ rajatkumar.beherafcs@kiit.ac.in
Mr. Kumar Devadutta,	Assistant Professor	School of Computer Engineering	9437072128/ kdevduttafcs@kiit.ac.in
Dr. Mainak Bandyopadhyay	Assistant Professor	School of Computer Engineering	8009387402/ mainak.bandyopadhyayfcs@kiit.ac.in
Prof. Kirti Kanta Sahoo	Assistant Professor	School of Civil Engineering	9937195845/ kirtikanta.sahoofce@kiit.ac.in
Prof. Jitendra kumar Patel	Associate Professor	School of Mechanical Engineering	9085884327/ jitendra.patelfme@kiit.ac.in
Mr. Swagat Das	Assistant Professor	School of Electrical Engineering	9938213035/ swagat.dasfel@kiit.ac.in
Prof. R. K. Khanna	Assistant Professor	School of Electronics Engineering	7873207177/ rishi.khannafet@kiit.ac.in
Mrs. Purnima Bhoi	Assistant Professor	School of Public Health	8368191025/ purnima.bhoifph@kiit.ac.in
Prof. Partha Sarathi Pattnayak	Assistant Professor	School of Computer Applications	9439165399/ parthafca@kiit.ac.in
Dr. Mrunmay Giri	Assistant Professor	School of Biotechnology	6372567877, 7008814316/ mrunmay.giri@kiitbiotech.ac.in
Dr. Sankha Chakrabortty	Assistant Professor	School of Chemical Technology	9614633977/ sankha.chakrabortty@kiitbiotech.ac.ir
Prof Bama dev Mahapatra	Assistant Professor	School of Commerce and Economics	8093995515/ bama dev.mahapatrafcm@kiit.ac.in
Dr. Gourab Chatterjee	Assistant Professor	School of Languages	9830422375/ gourab.chatterjeesol@kiit.ac.in
Prof V Venkatakrishnan	Professor & Dean	School of Rural Management	8280716964/ venkat@ksrm.ac.in
Prof. Ipsita Nayak	Assistant Professor	School of Management	9777810330/ ipsita.nayak@ksom.ac.in
Ms. Zeenat Taher	Assistant Professor	School of Law	9938362310/ zeenat.taher@kls.ac.in
Mr. Bauri Raula	Associate Professor	School of Fashion Technology	8763382535/ braula@kiit.ac.in
Dr. Bidu Bhushan Dash	Assistant Professor	School of Mass Communication	7830666700/ bidu.dashfmc@kiit.ac.in
Mr. Susanta Bahinipati	Lecturer	School of Film & Media Sciences	9437020613/ 7852910395 susanta.bahinipatiffm@kiit.ac.in
Mrs. Minati Das	Assistant Professor	School of Nursing	9438526249/minati.das@kins.ac.in
Dr. Nirmal Mahakud	Associate Professor	Department of Pediatrics, KIMS	9437365233/nirmal.mahakud@kims.ac.in
Dr. Dhirendra Kumar Singh	Reader	School of Dental Sciences	8895910320/dhirendra.singh@kids.ac.in
Dr. Khushboo Kuddus	Assistant Professor	School of Humanities (PhD)	9955303606/ khushboo.kuddusfhu@kiit.ac.in
Dr. Sri Kumar Acharya	Associate Professor	School of Applied Sciences (PhD)	8763215721/ sacharyafma@kiit.ac.in

ADMISSIONS & SCHOLARSHIPS

International students enrolled in KIIT University can be categorized in one of these categories:

Self-Financed Students – Students or Legal Guardian pay the fees for the student.

Govt. Sponsored Students – Students are sponsored either by Indian government scholarships or Scholarships given by their home country.

Sponsored Students – Students are sponsored by private entities or non-profit organizations. The scholarship providing bodies seek admission for the candidates as per their applications.

However, the admission decision rests with the Institute/University as per the eligibility criteria. Students sponsored by following Scholarships:

Government Scholarship: EdCIL: Compex Nepal Scholarship -

COMPEX is a scholarship scheme by Embassy of India in Nepal that provides admission with 100% scholarships to top Indian Universities in following undergraduate courses:

Engineering (BE)
Pharmacy (B. Pharmacy)
Agriculture (B.Sc-Agri)
Food Technology (B.Sc. – FT)
Nursing (B.Sc. Nursing)

Dr. Homi J. Bhabha Scholarship Scheme (HJBSS) –

HJBSS is a scholarship scheme by Embassy of India in Nepal that provides admission with 100% scholarships to top Indian Universities for pursuing Masters in Engineering.

Silver Jubilee Scholarship Scheme (SJSS)

Under SJSS, admission is provided to Nepalese candidates for MBA, MCA, MA, M.Sc & Ph.D in all streams except Engineering, Agriculture, Medicine and Para-medical courses in Indian Universities and Institutions.

Scholarship for Syrian students by Ministry of External Affairs (MEA):

MEA, Govt. of India extended financial support to 1,000 Syrian students for studying in India. MEA sponsored fees, accommodation, food, flight tickets etc. for the Syrian students i.e; under Syria 1000 Scholarship.

Royal Government of Bhutan Scholarship

Bhutan Government gives scholarship to the meritorious candidates to study in top universities in India in various courses. The candidates are provided with full institutional and other compulsory fees.

Asia Foundation

The Asia Foundation is a nonprofit international development organization committed to improving lives across a dynamic and developing Asia. Through Promote Women's Scholarship program Asia foundation provided scholarships and assistance to 147 Afghan women to pursue master's degrees in India.

Study in India Scholarship(SII)

Study in India, with the help of the following Indian ministries - the Ministry of Education and the Ministry of Commerce and Industry, is offering 2000 scholarships up-to USD 3500 each.

Every meritorious student that has been offered this scholarship by the Study in India team shall receive it for a maximum period:

of 5 years for undergraduate integrated courses;
of 3 or 4 years for undergraduate courses, according to the course duration;

of 2 years for postgraduate courses;

Or, till the completion of the course, whichever is lesser. The scholarship covers tuition fees, hostel and food charges. Each student under this scholarship must attain a minimum of 70% attendance and 60% or above average CGPA each year for its validity.

The scholarship does not cover travel tickets, visa charges, personal expenses and medical insurance.

KIIT University Inter, national Scholarship (KUISP)

With an aim to provide quality education to international student community, KIIT University every year offers KUISP scholarship to students from 70+ countries.

KIIT is committed to attracting the very best students, regardless of financial circumstances, thus under KUISP scholarship KIIT offers both 100% and 50% scholarships on the total fee for international students which would cover their Tuition, books, A.C. accommodation, multi cuisine mess facility, 24/7 library and internet access. Scholarship would also cover laptop, registration and examination fees as well. The scholarships are offered based on merit & university eligibility criteria.

Since 2010, students from 70+ countries have been getting the benefit of this scholarship.

Under the KUISP scholarship, applicants are eligible to apply for

- 1.Under graduate courses (3-5 years),
- 2.Post graduate courses(1-2 years) (except MBBS, Dental, Nursing and Architecture courses)
- 3.Ph.D courses

KIIT University promotes KUISP scholarships in international countries with the support of Foreign Missions in India and partner institutes in international countries.

International Application portal-

KIIT International applications is available for free to all foreign nationals and NRI candidates. The application for every academic year commences as below-

Start Date- 1 st March
End Date-30 th September

Admission Portal link - <https://international.kiit.ac.in/>
Email ID – internationaloffice@kiit.ac.in
Phone - (+91-9354030108)



“

I was a summer school student at KIIT. Bhubaneswar is a lively and friendly city and I felt very safe living here. It was an eye opening experience for me which expanded my horizons and helped me grow as a person.

**JAN BORAK, CZECH REPUBLIC,
EUROPE**

“

I was involved in a project called Mevlana Exchange Program in which I studied one semester in KIIT. It was one of the best semesters of my life. I really enjoyed the city, people, teachers and hostel that I stayed in. I highly recommend everyone to come to India and study in KIIT.

**SELENAY KUCUK
TURKEY**





“

I'm smiling because I feel fulfilled at KIIT. I am blessed to be surrounded by amazing students and faculty, as well as a vibrant community of international students.

At KIIT, I achieved my dream of becoming an AI researcher, thanks to a world-class academic programme, supportive teachers, and state-of-the-art academic facilities.

My 2 years here have been a blast and I pass it unto you !

WISDOM D'ALMEIDA TOGO

“

I am pursuing my M.Tech degree in Civil Engineering. It's my pleasure to be a student at KIIT where one can find high quality of education, co-curricular activities , friendly students from different countries and peace all at one place.

BASEL NASSOR SYRIA



How to Apply

Online Application:

international.kiit.ac.in

Contact us for queries:

International Relations Office,
KIIT University
At/Po- KIIT, Bhubaneswar,
Odisha, India, 751024
Email: internationaloffice@kiit.ac.in
Phone: +91 9873666072
Whatsapp: +919354030108
Fax: +91 674 2743271

www.kiit.ac.in

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- [!\[\]\(21fe28bba71e51bc0de8cb29f3b93b31_img.jpg\) /KIITUniversity](#)
- [!\[\]\(80e878e6a2b812374321aeb1fafdade4_img.jpg\) /KIITUniversity](#)





KALINGA INSTITUTE OF INDUSTRIAL TECHNOLOGY

— Deemed to be University U/S 3 of the UGC Act, 1956 —

Bhubaneswar, Odisha, India

www.kiit.ac.in



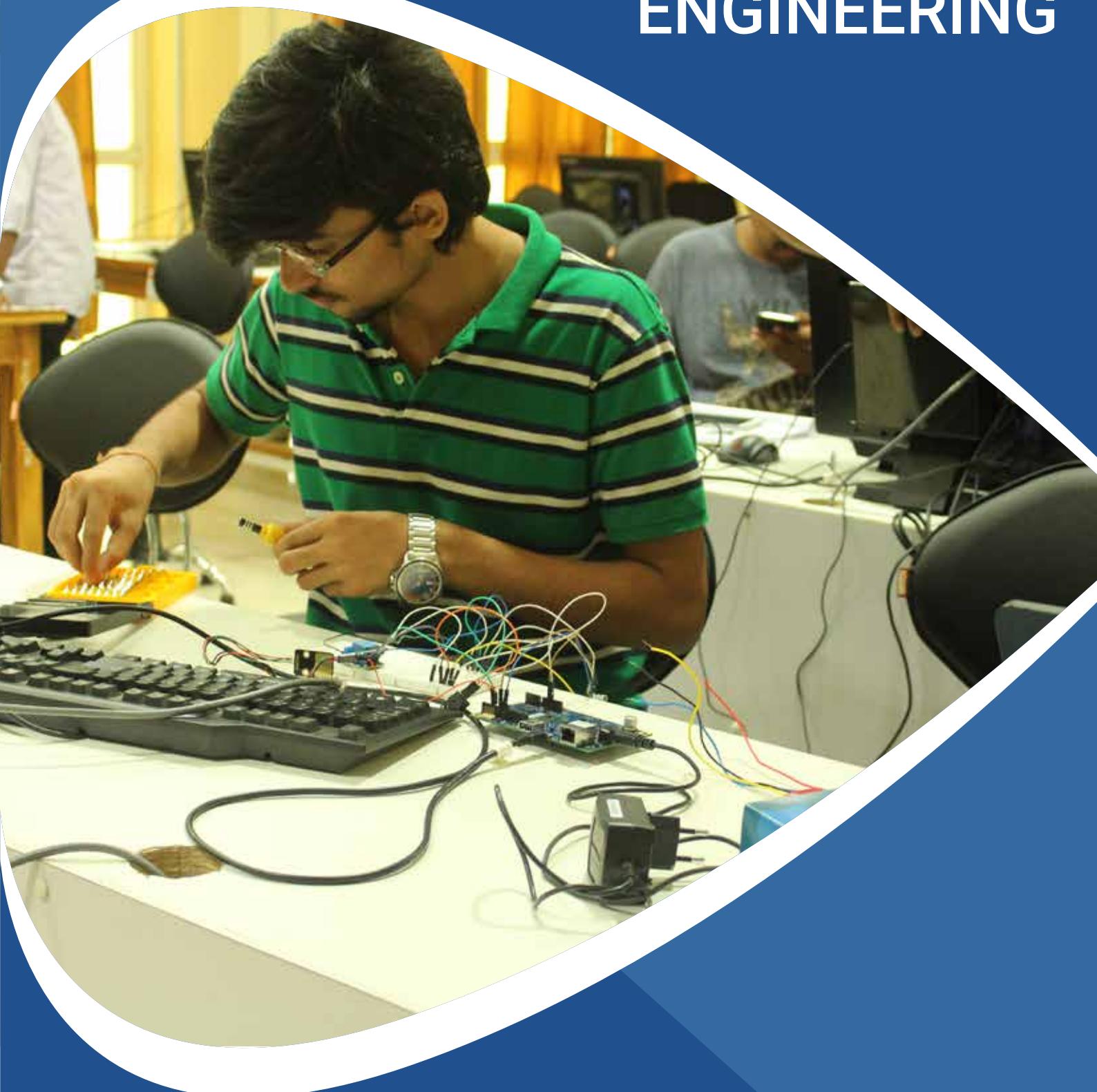
This brochure is issued for general guidance of students considering entry to KIIT DEEMED TO BE UNIVERSITY



KALINGA INSTITUTE OF INDUSTRIAL TECHNOLOGY (KIIT)

Deemed to be University U/S 3 of UGC Act, 1956

SCHOOL OF ELECTRONICS ENGINEERING





SCHOOL OF ELECTRONICS ENGINEERING

About KIIT

Established in 1992 and opened five years later as a centre for higher learning, KIIT University is today one of the most prestigious universities in India. Its commitment to teaching excellence led to the grant of university status under Section 3 of UGC Act, 1956 by the Ministry of Human Resources Development, Govt. of India in 2004, within only seven years of its inception. It serves more than 27,000 students through its 19 Schools imparting globally recognised bachelor's, master's and doctoral degree programmes in 100 plus disciplines, spanning engineering, medicine, management, biotechnology, law and more. Recognising the University's high standards, the Govt. of India in the Ministry of Human Resource Development has conferred 'A' Category status to it. It has been reaccredited by NAAC with grade 'A', placing it among the top ranking universities of the country. High national standing of the University is bolstered by the NBA accreditation under Washington Accord to its five B.Tech programmes.

About Founder

Achyuta Samanta, after obtaining Master's Degree in Chemistry in 1987 from Utkal University, started his career at 22 years of age. He has 30 years of teaching experience to his credit so far.

Prof. Samanta went on to serve KIIT as its first Chancellor and has had the distinction of being the youngest Chancellor of any Indian University. He served University Grants Commission (UGC) as Member for two consecutive terms (2008-11 & 2011-2014) and was a Member of the Executive Committee of All Indian Council for Technical Education (AICTE). He was also member of several other Government of India bodies like, NCTE, ISTE, ISCA, COIR BOARD, CAPART and many more. He has been a Member on the Academic Council of Central University, Silchar, Assam and the Central University, Odisha. He was the first Indian to be Member of both UGC and AICTE simultaneously and the first Odia to become Member of UGC and many other statutory bodies. Presently, he is the General President of Indian Science Congress Association (ISCA). He has delivered nearly 100 motivational speeches, including convocation addresses and foundation day lectures, in different institutions and organizations across the country and the globe.

About The School

School of Electronics Engineering aims to produce electronics engineering professionals to lead a successful career in industry, to pursue higher studies and/or entrepreneurial endeavors. Graduates of the School are versatile, adaptable and possess analytical capability to offer techno-commercially feasible and socially acceptable solutions to real life engineering problems in the field of Electronics & Telecommunication, Electronics & Electrical and Electronics & Instrumentation. The School has been involved in teaching and research activities in diverse aspects of Telecommunication, Microelectronics and VLSI, Signal Processing, RF and Microwave, Instrumentation Engineering. The classroom studies reinforced by well equipped laboratories for the students to nurture their ability to handle real life problems. The Programs in the School are supported by updated curriculum to keep pace with rapidly changing technology. The School, which has a qualified and experienced team of faculty members, conducts regular workshops, conferences, seminars and invited talks.

The School is actively engaged in R&D activities and in course of time, projects have been sponsored by Dept. of Atomic Energy, Defence, DST, AICTE, Etc. Some of the recent sponsored projects undertaken by the School are in the area of solar energy

Vision

To deliver world-class education and research in Electronics Engineering, with particular regard to their application in industry, healthcare and commerce in a diverse society.

Mission

- To prepare students for professional career, higher studies or entrepreneurship.
- To facilitate students to utilize fundamental technical knowledge and skills in Electronics engineering, to analyze and solve problems, and apply these abilities to generate new knowledge, ideas or products in academia, industry or government.
- To encourage and facilitate students, to involve themselves in high end research work through continuous learning, to build skills beyond curriculum.
- To integrate training in engineering principles, critical thinking, hands-on projects, open-ended problem solving to build up creative abilities and research spirit.
- To impart the essential skills of leadership, teamwork, communication and ethics so that they can interact and communicate effectively (written and/or oral) with others (e.g., supervisor, client and/or team).
- To engage students with alumni, industry, government, and community partners through outreach activities in order to inculcate global perception.

Administration And Operation

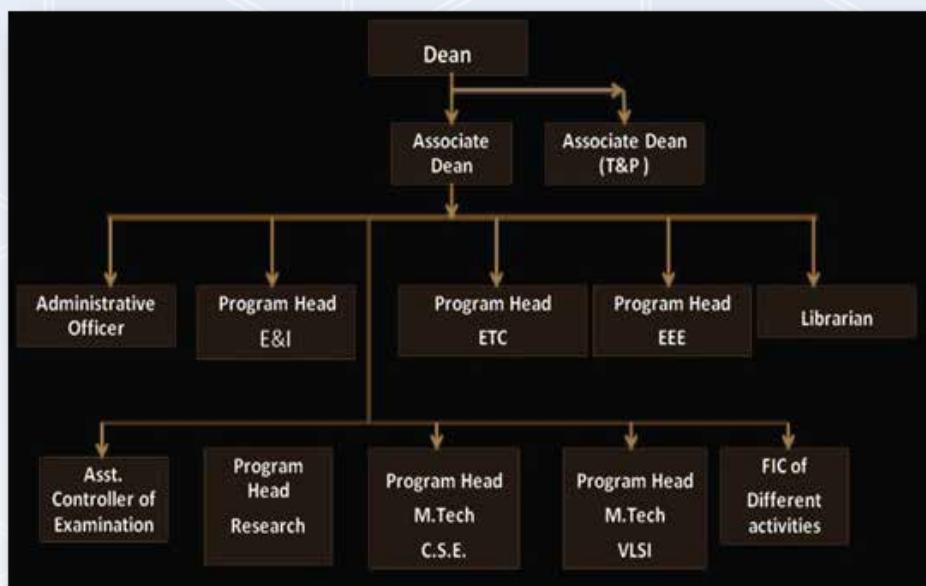
The School is governed by a Board of Management with its Chancellor, Vice Chancellor and Registrar of KIIT University.

Dean is the executive head of the School. He chairs the committee, and he is an authority on all academic matters, and is also a Member of the Academic Council.

The Associate Dean (Academic) for Academic Programmers, Students Affairs, Faculty Affairs; Associate Dean (Training & Placement) for Alumni & Corporate Relations; Administrative Officer (Administrative Affairs, Infrastructural Planning & Support Affairs, Finance & External Affairs) assist the Dean in his executive roles.

The Academic Council comprises all the professors of the School and a few nominated members. It is responsible for controlling the maintenance of standards of instruction, education and examinations and other allied academic matters.

The Board of Studies comprising eminent personalities from business, industry and academia, which reviews and makes suggestions on long-term policies and short-term goals.



(Organogram School of Electronics Engineering)

Academic Programmes

The programmes and courses offered at the School have the flexibility to evolve and change in response to new requirements. They serve the dual purpose of building a solid foundation of knowledge and of enhancing confidence, creativity and innovation in its students.

A unique attribute of School's academic structure is the autonomy enjoyed by faculty in designing and structuring courses and curriculum. All courses, however, need to be

approved by the Academic Council. A favourable student-teacher ratio ensures productive, personal contact between the student and the teacher.

Finally, choice based credit system offers flexibility to students to progress at their own pace. This system ensures an academic programme which is dynamic, constantly evolving and which reflects the School's commitment to stay in tune with the expanding frontiers of knowledge worldwide. The School offers B.Tech, M.Tech and Doctoral Programmes.

At present, undergraduate, postgraduate and doctoral programmes are offered as follows;

- + **B.Tech in Electronics and Telecommunication Engineering**
- + **B.Tech in Electronics and Electrical Engineering**
- + **B.Tech in Electronics and Instrumentation Engineering**
- + **M.Tech in Electronics and Telecommunication Engineering**
 - Specialization in Communication System Engineering**
 - Specialization in VLSI Design & Embedded Systems**
- + **Doctorate in Philosophy (PhD).**

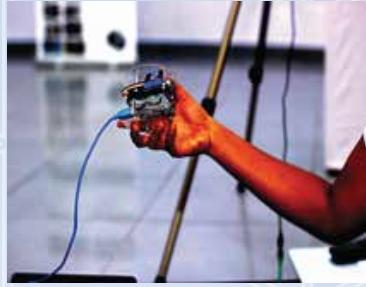
Faculty And Research

School believes in delivering quality education through a dedicated and committed team of faculties. At this point of time the School have a strong and dedicated team of faculty members drawn from premier institutes such as IITs, NITs and other institutes of repute. Apart from classroom teaching faculties are involved in publication and interacting with outside world on a frequent basis. The School places special value on the diversity of knowledge among scholars who increasingly apply a depth of expertise

in their fields to interdisciplinary challenges that cross traditional academic boundaries. Faculties encourage and participate in various extracurricular activities such as NSS, NCC, various techno managerial societies. The faculties as well as students are pro actively involved in research and development in various fields. One of the key goals of the school is to provide an ambience in which higher studies and research thrives among the students and faculty.

The Centre for Innovation & Research is responsible for fostering the overall R&D growth of the school, by facilitating interactions with external agencies, and promoting and managing interactions between the school and the industry.





The school undertakes R&D projects in various areas of specialization. Presently the research focus of the School is mainly focused on the following thrust areas:

Signal and Image Processing
Signal Detection and Estimation.
Mixed signal Analysis
Solar Energy Photovoltaic
VLSI & Embedded systems
Electronics Devices
VLSI design
Wireless and Mobile Communication
RF and Microwave engineering
Optical communication

RECENT HOT RESEARCH TRENDS

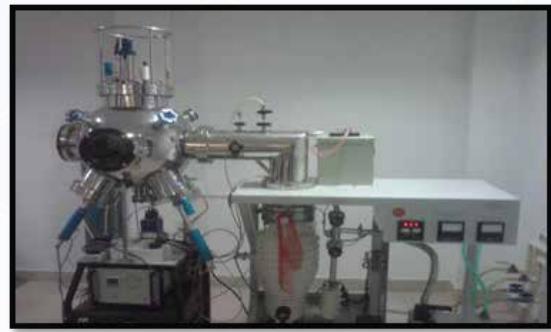
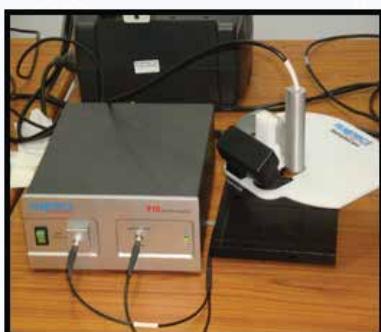
Internet of Things
Social, Mobile, Analytics & Cloud.
Media & Applications

Research Laboratories and Facilities:

Thin Film Photovoltaic Lab:

Research Facilities available in this lab are

DC/RF Sputtering System, Vacuum Coating Unit, High Speed Ball Mill ,Keithley Source Measure ,Unit, Solar Simulator-SS 150, UV-VIS Spectrophotometer , X-ray diffraction-6100 , LCR Meter 4908A (Agilent), Hall measurement System , RTP furnace (MTI,USA), Co-evaporation system.



Design & Thinking Lab

Since the very conception of Design & thinking Lab of School of Electronics Engineering in 2015 the Lab has witnessed many milestones achieved in the field of Internet of Things (IoT). The lab is functioning in collaboration with two industry giants namely Texas Instruments: Innovation Lab and Intel. The Lab is currently equipped with numerous Intel® Galileo Development Boards, Sensor Kits and Communication Modules like Intel centurion, ESP8266 WLAN Modules and GSM Modules. Students guided by faculty members of schools are working on various prototyping projects inspired by the latest trends in the Fields of Internet of Things (IoT).

Two Training programs have been successfully conducted for students in IoT in the month of Feb and May 2017 in collaboration with Intel®. The training program has been appreciated by students of our school even outside school.

Apart from training program, students are working on various embedded platform like Raspberry Pi, Arduino and various sensors and Networking devices to develop prototypes in the era of Internet of Things (IoT).

A team of young energetic faculty members are taking the front seat to motivate and guide students in the field of Internet of Things (IoT).



NI Centre of Excellence (NI Innovation Centre):

Research Facilities available in this lab are

National Instruments (NI) Lab View software, Instrumentation, signal processing, Communication, VLSI, PXIe system for Image & Video Processing ,C RIO, USRP for Communication and Signal processing, My Rio and DAQ cards for control system design and IoT Applications.

Microwave Simulation Lab: IE3D Simulation Tool

High Frequency Simulation & Fabrication Lab: Ansoft HFSS 14.0,

Wet Etching Micro strip Fabrication

Laboratory Details:

Apart from specific labs like NI Innovation Centre and Thin Film Photovoltaic Lab, all the labs are dedicated to provide adequate platform for research for both students and scholars. The Laboratories of our school are as follows;

Basic Electronics Lab

Analog Electronics Lab

Digital Electronics Lab

Digital Signal Processing Lab

Microprocessor and Microcontroller Lab

VLSI Lab

Embedded Lab

Control and Instrumentation Lab

Process Control Lab

Communication Engineering Lab

Advance Communication Lab

Wireless and Networking Lab

Microwave and Antenna Lab

Design and Thinking Lab



School Library

The Library of School of Electronics Engineering offers library and information services to both B. Tech and M. Tech students, research scholars and faculty members of the school. The library has a huge collection of text books, reference books and Journals. The Library operates in 24x7 mode access to all the students and faculties.

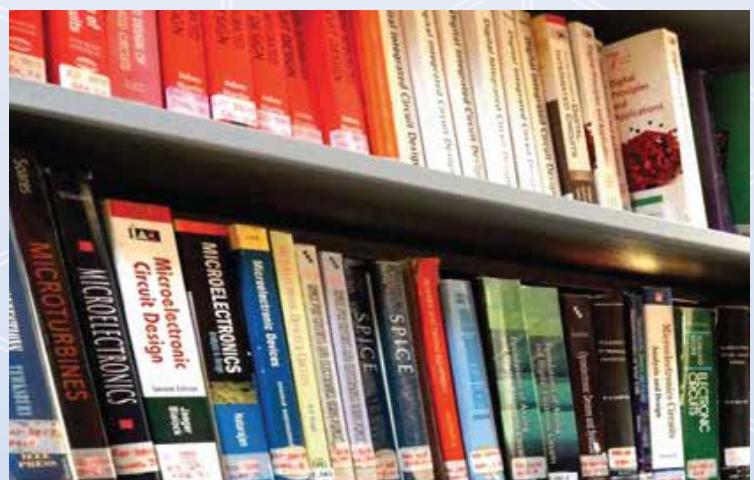
The library in the School is one of the best technical libraries. It hosts an impressive collection of academic resources in the form of books, journals, research papers and electronic journals on a variety of subjects including science, technology, humanities, social sciences and management sciences. It houses a large number of full-text electronic journals, online databases and Electronic Theses and Dissertations (ETD). The web-based library catalogue is accessible from anywhere on the campus' Local Area Network. The library has an online catalogue equipped with a global catalogue search. The library also offers video-viewing facilities.

The Library has the following facilities available which provides best ambience for innovation and improvement:

- o Area of the library :5790 Sq ft. (538 sqm).
- o Reading Room area: 3600Sq ft
- o Seating Capacity: 240
- o Total Collection of Books: 12950
- o Books in Reading Section: 3031
- o Books in Circulation Section : 9919
- o Total Titles: 4123
- o Periodicals: 32

Besides, the library facilitates online access to all of the E-Journals subscribed by KIIT university namely,

- IEL online
- Science Direct
- IEEE
- J-Gate
- Pro-Quest
- JSTOR
 - o Scopus (Indexing database),
 - o E-Brary (containing e-books)
 - o Turnitin(Anti-plagiarism tool)



Innovation And Best Practices

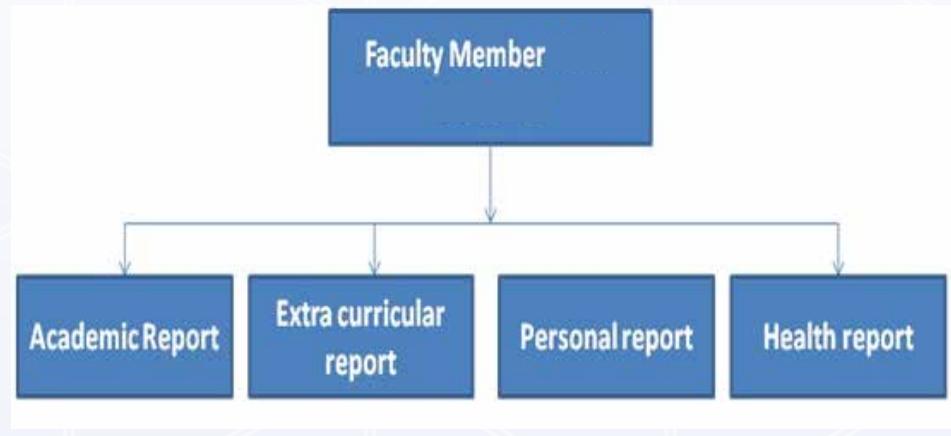
- o Medical and Life Insurance to all the students during admission.
- o Enriching students for National and International level competitive exams like GATE, GRE, GMAT, UPSC (IES,IAS) and many more in collaboration of CAAS(Career Advisory and Augmentation Services) and School of Leadership.
- o Empowering staff members by frequent skill up gradation and training programs. Choice based credit system and industry oriented courses offers flexibility to students to progress at their own pace.
- o Extended support for students outreach activities, such as there are 24 Student Societies and active participation for NCC, NSS camps.
- o Active participation of students in Governance mechanism of the School through memberships in various committees.
- o Promoting e-Governance though implementation of SAP.
- o Active participation of students in community development by creating awareness of "Swacch Bharat" campaign, etc and also giving lectures to the students of KISS, a school for indigenous children.
- o Active participation of students in TBI (Technology Business Incubator) which helps to realize their dreams as an entrepreneur.
- o Hands on experience of the students in conducting live projects.
- o Completely barrier free and eco-friendly campus.

The Student Prospective

**SCHOOL OF ELECTRONICS'S
VIBRANT CAMPUS COMMUNITY
COMES NOT ONLY FROM
THE DAILY ENGAGEMENT OF
ACCOMPLISHED STUDENTS
AND RENOWNED FACULTY,BUT
ALSO FROM THE EXTRAORDI-
NARY ENERGY, TALENT, AND
CULTURAL DIVERSITY THAT
DEFINES KIIT UNIVERSITY**

The School of Electronics Engineering provides a very vibrant and unique environment to all its students for all round development. Our students excel in all co-curricular and extra-curricular activities in India and abroad. This reflected in our campus placement records, which keep on setting a higher bar for itself every year. School of Electronics Engineering is also having a brilliant track record of sending students for higher studies in top notch institutes from India and across the globe. The vast alumni strengthen the School reputation in Industry and academia.

This herculean task is achieved due the unique initiative taken by university i.e. "Tutor-Mentor Program" which provides a distinctive platform to the students to share their problems to the faculties and solve them with the help of the experience of the faculties. The program is very well structured in which Each faculty is associated with a group of 30-35 students. The faculty acts as single point of contact for these students. Each faculty maintains reports of the student and these reports are sent to the parents of the ward on a regular basis. The problems of students are addressed by the respective tutor mentors every now and then.



(Tutor-Mentor Program Structure)

The Student Experience

The School of Electronics , KIIT University has a number of student organizations that are as diverse as its student body. Whether you are looking to explore a new activity or want to find students who share your current passion, you have a wide range of clubs from which to choose. Here are just a few:

Dramatic Society
National Service Scheme(NSS).
Classical Music Club
Rock Bands
Robotics Club
Aeronautical Society



Training And Placement Activities



The School has an active Training and Placement Cell headed by an Associate Dean (T&P) who reports to the Dean, School of Electronics Engineering and Dean, Central Training and Placement cell. The School of Electronics has a proven track record of over 95% successful placements of the students in different renowned National & International companies. This cell has been organizing various seminars and symposiums in association with Industry primarily for graduates and post graduates of School, like National Instruments, Texas Instruments, Oracle, CISCO to name a few. We are also trying to forge ties ups with various active societies like IET, ISTE, INCOSE, HAM Radio Club and Small Scale Satellite program in association with Dhruva Space to name a few. Moreover students are encouraged to take up various global certificates from companies like Microsoft, Oracle, CISCO, RED HAT, NOKIA, COMPTIA, EC Council, IBM and PMI to name few.

Global Outreach Programmes

The School strives to reach out beyond its student community to the larger society that exists beyond its walls. This reflects the institute's inherent philosophy – to teach what we know and share what we have, for mutual benefit. As such, the school engages in several activities to reach out to the academic communities at national and international levels. In this regard, its major activities are the student and the faculty exchange programs with universities across the globe.

Continuing education and quality improvement programme

Under the Quality Improvement Programme, training is imparted to teachers from other institutions to facilitate them in obtaining their Master's and Ph.D degrees. About 20 teachers take the benefit of this service every year. Short, intensive courses are conducted under the Continuing Education Programme for the enhancement of expertise of working professionals in industry and government. 'Open' courses cater to a wide variety of professional interests, and are open to professionals from any industry. 'In-house' courses are conducted for providing specific, customized training and for extended learning, to meet the needs of a particular group from an industry.

List of major recruiters who have visited are as follows:

RECRUITER'S	AREA (CORE/IT)
L&T ECC	CORE
TATA STEEL	IT
TCS	IT
WIPRO	IT
ACCENTURE	IT
PATNI	IT
CAPGEMINI	IT
HCL TECHNOLOGIES	IT
MAHINDRA_SATYAM	IT
SYNTEL	IT
ADANI	CORE
WIPRO-VLSI	IT
DELOITTE U.S. INDIA	Core
ACCENTURE	IT
SIEMENS	CORE
MU-SIGMA	IT
HCL INFOSYSTEM	IT
GENPACT	IT
SAP LABS INDIA	IT
HP	IT
TCS	IT
GYANSYS	IT
UST GLOBAL	IT
TRIDENT GROUP	IT
TATA POWER	CORE
iNautix Technology	IT

Facilities in and Around Campus :

Computer and Internet

The computer centre provides computational facilities to users in the School. Accounts are given on the high-end computational server to all faculty members, students and staff. The centre also administers the computer network and internet links. The campus-wide fibre optic network provides a high-speed backbone. Connections are provided to all faculty blocks and individual rooms in the hostels.

Conference Hall, Auditorium and Open Air Theatre

Well-equipped, air-conditioned conference hall, auditorium and lecture theatres facilitate the organization of workshops, lectures, conferences, which are regular events on the campus.

Hospital

KIIT University has an in-house 1500 bedded super specialty hospital i.e. "Pradyumna Bal Memorial Hospital" with facilities to take care of all general health issues of residents. Apart from the resident doctors, it also has specialists including ENT, surgeons, orthopaedics, neurologists, etc. It has well-equipped diagnostic laboratories to conduct all types of medical tests.

Guest House

Set in the University's scenic view is the guest house. People visiting the school – academic guests of the school, parents of students and alumni reside here during their stay. The only requirement is to book well in advance.

Students Activity Centre (K-SAC)

Souvenir items like t-shirts, mugs, tea coasters, bags, etc are available at the Alumni Association souvenir shop located within the K-SAC which is adjacent to the school

Life On Campus

One of the most distinctive characteristics of the school is its close-knit and integrated residential community. Housing is guaranteed for all students, allowing for a blending of academic and residential life. This residential experience offers its students a supportive and enriching environment, full of opportunities for personal growth.

A vast range of cultural, educational, athletic and social activities is available to KIIT students, faculty and staff. The quickest way to get involved in campus life is to become a part of the institute community, and to create one's own experience.

Sports, culture and leisure

Students here do much more than only study. There is ample opportunity to nurture all kinds of talent in students. There are excellent recreational facilities for sports, including gyms, a swimming pool, courts for tennis, basketball, volleyball, hockey, football and cricket, athletics tracks and much more. There is an annual University-level cricket gala "KPL" (KIIT Premiere League), an extremely popular event organized by the University.

Facilities for sports are matched by those for cultural activities, which include film clubs, classical music societies, a debating club, a literary society, the drama club, the fine arts club, the dance club, as well as the music club.

Students are also enthusiastic participants at the Science club, bringing the fun back into science and scientific hobbies. There is an Aero modelling club, an electronics club and Krittika organized by a group of students that coordinates all technical activities on campus. There are amateur astronomers, radio operators, designers and builders of model aeroplanes, race cars and satellites.

The students also produce Kritansh, a magazine that keeps students up-to-date on campus happenings.

Intra and Inter-hostel activities

The co-curricular activities for students are organized by the student's and are held at the Students Activity Centre (SAC). These activities can broadly be classified into cultural and sports. There are inter-hostel athletics, football, basketball, badminton, tennis, table-tennis, volley ball, kho-kho, chess, and carom. Competitions in music, drama, literature, debating, photography, fine arts, etc. are also held.

KIIT-fest

Come March, KIIT University, Bhubaneswar turns into the Mecca for all technology enthusiasts in the country. It is the season for Tech-fest, the annual technology festival of KIIT. 30,000 students from over 1,000 colleges spread across India and countries throng the campus to experience the extravaganza . Held in March for three days, it has grown into a mega-event which draws thousands to the campus. KIIT-fest provides a platform for a confluence of the industry, academia and students. Events in KIIT-fest include a combination of lectures, competitions, exhibitions and demos of the latest innovations in technology. It draws participants from across the globe.

Alumni

The School recognizes its alumni, who have distinguished themselves through their work and done the institute proud. The Distinguished Alumnus Awards have been instituted for this purpose by University. The School also involves the alumni in its educational and research activities whenever possible, by inviting them to participate on its advisory boards as visiting faculty or as guest speakers. The office of the KIIT Alumni Association is housed on the first floor of the K-SAC Building, Campus-13. Details about alumni achievements and initiatives are available at <http://kiitalumni.com/>.







**School of Electronics Engineering
Kalinga Institute of Industrial Technology (KIIT)
Deemed to be University
Campus 12, Bhubaneswar - 751024**

Proposal for Short Term Training On **Machine Learning & DevOps (MLOps)**

Date of commencement: 20th June 2024

Machine Learning Operations (MLOps) is often likened to DevOps for machine learning, amalgamating techniques and tools from data engineering, machine learning, software development, and operational practices. This training program aims to equip participants with the skills necessary to automate the lifecycle of machine learning algorithms, which is often desired in production environments, spanning from data curation, initial model training to deployment and retraining against new data.

Duration: 4 weeks(40hr) + Project

Course Fee: Rs. 5000/- (inclusive all taxes)

Eligibility: B. TECH. 2nd Year or 3rd year

Mode: Hybrid Mode (Theory will be in online mode and hands-on in offline mode in university campus)

The training will be structured into four comprehensive sections:

1. Data Curation and visualization
2. Understanding of Popular ML Algorithms
3. Software Development and Cloud integration
4. Projects



Pre-requisite:

Basic knowledge of Python and a strong interest in learning and applying new concepts.

Training Outcome:

Upon successful completion, participants will be able to

1. Translate business objectives into machine learning problems and develop ML operations to address them effectively.
2. Design and develop end-to-end software solutions, establishing contracts and APIs to deliver robust applications.
3. Gain a comprehensive understanding of MLOps principles, tools, and techniques necessary for deploying, managing, and scaling machine learning models in production environments.

Evaluation:

Online class participation will be evaluated through Zoom polling responses during lecture delivery. Hands-on activities in the ML Lab will be assessed through project submissions.

Certificates will be issued to students achieving a score of more than 60%

This training program offers a unique opportunity for participants to enhance their skills in machine learning, software development, cloud integration, and preparing them for the challenges of modern data-driven CI-CD environments.

Instructor:

Dr. Suprava Patnaik

Professor, School of Electronics Engineering, Kalinga Institute of Industrial Technology (KIIT)-DU.

Proposal for Short Term Training
On
FPGA based Digital System Design
Date of commencement: 20th June 2024

The School of Electronics Engineering going to organise a 4 weeks summer training program on FPGA based Digital System Design using Verilog HDL. A Hardware Description Language (HDL) called Verilog is used to simulate and create digital systems. Verilog is used in electronic design for test analysis, timing analysis, logic synthesis, and simulation-based verification. The focus of this course is on developing a thorough understanding of Verilog concepts. The course blends informative lectures with hands-on activities to help students remember fundamental ideas.

Duration: 4 weeks(40hr) + Project

Course Fee: Rs. 5000/- (inclusive all taxes)

Eligibility: B. TECH. 2nd Year or 3rd year

Mode: Hybrid Mode (Theory will be in online mode and hands-on in offline mode in university campus)

Course objectives:

- To learn IEEE standard Verilog HDL and its different modeling styles to model digital circuits.
- To apprehend the concept of delays, test benches and timing checks in digital circuits.
- To understand the fundamentals of FPGAs.
- To perceive the essentials of FPGA based implementation of digital circuits.

Course Outcomes:

The students will be able to:

- Design, simulate and synthesize the digital circuits with Verilog.
- Design combinational and sequential logic circuits.
- Synthesize logic and state machines using automatic logic synthesis program.
- Run a timing and Power calculations
- Use enhanced Verilog file I/O capability.

Week-1:

Introduction to VLSI Design and Verilog HDL:

- VLSI and ASIC Design Flow,
- Basic Concepts of Verilog HDL,
- Modelling: - data flow modelling, Gate level Modelling, Structural Modelling, Behavioural Modelling.
- Test bench and writing a testbench to verify a design

Week-2

- Combination circuit and sequential circuit design using Verilog and their verification.
- Multiplexed seven segment display implementations in FPGA and verify it.
- Interfacing Temperature sensor and displaying its value using FPGA.

Week-3

- Design and implementation of 8-bit signed multiplier using Radix-4 Booth algorithm.
- Implementation of 5-tap FIR filter with ADC and DAC in FPGA.
- Implementation of PWM based stepper motor controller in FPGA.

Week-4:

- Timing verification of a Logic in FPGA.
- FPGA Debugging using Integrated Logic Analyser.
- RTL to layout using Opensource tools.
- A small project
- Feedback collection

Note:

- The seats are limited and students are allowed to participate on first come first serve basis.
- Minimum attendance of 75% is required to get soft copy of certificate.

Instructor:

Dr. J. K. Das

Associate Professor, School of Electronics Engineering, Kalinga Institute of Industrial Technology (KIIT)-DU.