FACULTY OF ENGINEERING AND TECHNOLOGY

VISION

Providing world class quality education with strong ethical values to nurture and develop outstanding professionals fit for globally competitive environment.

MISSION

- Provide quality technical education with a sound footing on basic engineering principles, technical and managerial skills, and innovative research capabilities.
- Transform the students into outstanding professionals and technocrats with strong ethical values capable of creating, developing and managing global engineering enterprises.
- Develop a Global Knowledge Hub, striving continuously in pursuit of excellence in Education, Research, Entrepreneurship and Technological services to the Industry and Society.
- Inculcate the importance and methodology of life-long learning to move forward with updated knowledge to face the challenges of tomorrow.

DETAILS OF COURSE CODE

S. No	Code (3rd and 4th Digits)	Details	Code (5th and 6th Digits)	Details
1	ET	Common Course for the faculty	HS	Humanities Theory
2	CE	Civil Engg. Course	HP	Humanities Practical
3	CZ	Civil and Structural Engg. course	BS	Basic Science Theory
4	ME	Mechanical Engg. Course	BP	Basic Science Practical
5	MM	Mechanical Engg (Manufacturing). Course	ES	Engineering Science Theory
6	EE	Electrical and Electronics Engg. Course	SP	Engineering Science Practical
7	EI	Electronics and Instrumentation Engg. Course	PC	Professional Core Theory
8	CH	Chemical Engg. Course	CP	Professional Core Practical
9	CS	Computer Science and Engg. course	PE	Professional Elective Theory
10	IT	Information Technology course	EP	Professional Elective Practical
11	EC	Electronics and Communication Engg. Course	ST	Seminar / Industrial Training
12	AI	Computer Science and Engineering (Artificial Intelligence and Machine Learning)	OE	Open Elective Theory
13	DS	Computer Science and Engineering (Data Science)	PV	Project and Viva-voce
14	YY	Code of the Program concerned (S. No 02 to S.No.13)		

The first two digits relate to the year from which the Regulations commence 7th digit represents the semester and 8th and 9th digits represent the serial number of courses.

ANNAMALAI UNIVERSITY

FACULTY OF ENGINEERING AND TECHNOLOGY

B.E (Four Year) Degree Program (FULL-TIME)

Choice Based Credit System (CBCS)

COURSES OF STUDY AND SCHEME OF EXAMINATIONS (REGULATIONS 2022)

Curriculum for B.E 2022-23 onwards

SEMESTER I

Course Code	Category	Course	L	T	P/D	CA	FE	Total	Credits
22ETBS101	**BS-I**	Mathematics-I	3	1	-	25	75	100	4
22ETBS102	**BS-II**	Physics	3	1	-	25	75	100	4
22ETBS103	**BS-III**	Chemistry	3	1	-	25	75	100	4
22ETES104	**ES-I**	Programming for Problem Solving	2	1	-	25	75	100	3
22ETHS105	**HS-I**	Heritage of Tamils தமிழர் மரபு	1	-	-	25	75	100	1
22ETHP106	**HSP-I**	Communication Skills and Language Laboratory	-	-	3	40	60	100	1.5
22ETSP107	**ESP-I**	Engineering Workshop Practices	-	-	3	40	60	100	1.5
22ETSP108	**ESP-II**	Electrical Wiring and Earthing Practice Laboratory	-	-	3	40	60	100	1.5
								Total Credits	**20.5**

SEMESTER II

Course Code	Category	Course	L	T	P/D	CA	FE	Total	Credits
22ETHS201	**HS-II**	English	3	1	-	25	75	100	4
22ETBS202	**BS-IV**	Mathematics-II	3	1	-	25	75	100	4
22ETES203	**ES-II**	Basic Engineering*	4	-	-	25	75	100	4
22ETHS204	**HS-III**	Tamils and Technology தமிழரும் தொழில்நுட்பமும்	1	-	-	25	75	100	1
22ETBP205	**BSP-I**	Physics Laboratory	-	-	3	40	60	100	1.5
22ETBP206	**BSP-II**	Chemistry Laboratory	-	-	3	40	60	100	1.5
22ETSP207	**ESP-III**	Computer Programming Laboratory	-	-	3	40	60	100	1.5
22ETSP208	**ESP-IV**	Engineering Graphics	2	-	3	40	60	100	3
								Total Credits	**20.5**

*** Basic Civil Engineering (3 Units) & Basic Mechanical Engineering (2 Units) for Circuit Branches**
*** Basic Mechanical Engineering (2 Units) & Basic Electrical and Electronics Engineering (3 Units) for Civil, C&S and Chemical Engineering Branches**
*** Basic Civil Engineering (2 Units) & Basic Electrical and Electronics Engineering (3 Units) for Mechanical & Mechanical (Manufacturing) Engineering Branches**

DEPARTMENT OF ELECTRICAL ENGINEERING
B.E (Four Year) Degree Program (FULL-TIME)
Choice Based Credit System (CBCS)
COURSES OF STUDY AND SCHEME OF EXAMINATIONS (REGULATIONS 2022)
Curriculum for B.E 2022-23 onwards

SEMESTER III									
Course Code	**Category**	**Course**	**L**	**T**	**P/D**	**CA**	**FE**	**Total**	**Credits**
22ETBS301	**BS-V**	Mathematics - III	3	1	-	25	75	100	4
22ETES302	**ES-III**	Environmental Studies	3	-	-	25	75	100	3
22ETES303	**ES-IV**	Engineering Mechanics	3	-	-	25	75	100	3
22EEPC304	**PC-I**	Electric Circuits	3	-	-	25	75	100	3
22EEPC305	**PC-II**	Analog Electronic Circuits	3	-	-	25	75	100	3
22EEPC306	**PC-III**	Electrical Machines - I	3	-	-	25	75	100	3
22EEES307/ 22EESP307	**ES-V/ ESP-V**	Fluid Mechanics and Hydraulic Machinery/ Hydraulics Lab	2	-	2	40	60	100	3
22EECP308	**PCP-I**	Circuits and Devices Lab	-	-	3	40	60	100	1.5
22EECP309	**PCP-II**	Analog Electronics Lab	-	-	3	40	60	100	1.5
								Total Credits	**25**

SEMESTER IV									
Course Code	**Category**	**Course**	**L**	**T**	**P/D**	**CA**	**FE**	**Total**	**Credits**
22ETBS401	**BS-VI**	Probability, Random Process and Numerical Methods	3	-	-	25	75	100	3
22ETES402	**ES-VI**	Data Structure and Algorithms	2	-	-	25	75	100	2
22EEPC403	**PC-IV**	Electrical Machines - II	3	-	-	25	75	100	3
22EEPC404	**PC-V**	Digital Circuits	3	-	-	25	75	100	3
22EEPC405	**PC-VI**	Electrical Measurements and Instruments	3	-	-	25	75	100	3
22EEPC406	**PC-VII**	Electromagnetic Fields	3	-	-	25	75	100	3
22ETHS407	**HS-IV**	Universal Human Values	2	1	-	25	75	100	3
22EECP408	**PCP-III**	Electrical Machines Lab	-	-	4 (2*2)	40	60	100	2
22EECP409	**PCP-IV**	Analog and Digital Integrated Circuits Lab	-	-	3	40	60	100	1.5
22EECP410	**PCP-V**	Electrical Measurements Lab	-	-	3	40	60	100	1.5
								Total Credits	**25**
Students must undergo Internship for 4 weeks during summer vacation which will be assessed in the forthcoming V Semester									

SEMESTER V

Course Code	Category	Course	L	T	P/D	CA	FE	Total	Credits
22EEPC501	**PC-VIII**	Microcontroller and its Interfacing Techniques	3	-	-	25	75	100	3
22EEPC502	**PC-IX**	Power Electronics	3	-	-	25	75	100	3
22EEPC503	**PC-X**	Control Systems	3	-	-	25	75	100	3
22EEPC504	**PC-XI**	Power Systems	3	-	-	25	75	100	3
22EEPE505	**PE-I**	Professional Elective I	3	-	-	25	75	100	3
22EEPE506	**PE-II**	Professional Elective II	3	-	-	25	75	100	3
22YYOE507	**OE-I**	Open Elective - I	3	-	-	25	75	100	3
22EECP508	**PCP-VI**	Microcontroller Lab	-	-	3	40	60	100	1.5
22EECP509	**PCP-VII**	Power Electronics and Drives Lab	-	-	3	40	60	100	1.5
22EECP510	**PCP-VIII**	Control Systems Lab	-	-	3	40	60	100	1.5
22ETIT511	**IT-I**	Internship /Industrial Training	Four weeks during the summer vacation at the end of IV Semester				100	100	4.0
								Total Credits	**29.5**

SEMESTER VI

Course Code	Category	Course	L	T	P/D	CA	FE	Total	Credits
22EEPC601	**PC-XII**	Power System Analysis	3	-	-	25	75	100	3
22EEPC602	**PC-XIII**	Electrical Machine Design	3	-	-	25	75	100	3
22EEPE603	**PE-III**	Professional Elective - III	3	-	-	25	75	100	3
22EEPE604	**PE-IV**	Professional Elective - IV	3	-	-	25	75	100	3
22EEPE605	**PE-V**	Professional Elective - V	3	-	-	25	75	100	3
22YYOE606	**OE-II**	Open Elective - II	3	-	-	25	75	100	3
22EECP607	**PCP-IX**	Electrical Estimation and CADD Lab	-	-	3	40	60	100	1.5
22EECP608	**PCP-X**	Renewable Energy Lab	-	-	3	40	60	100	1.5
								Total Credits	**21**

Students must undergo Internship for 4 weeks during summer vacation which will be assessed in the forthcoming VII Semester.

SEMESTER VII

Course Code	Category	Course	L	T	P/D	CA	FE	Total	Credits
22ETHS701	**HS-III**	Engineering Ethics	2	-	-	25	75	100	2
22EEPC702	**PC-XIV**	Protection, Switchgear and Utilization	3	-	-	25	75	100	3
22EEPE703	**PE-VI**	Professional Elective - VI	3	-	-	25	75	100	3
22EEPE704	**PE-VII**	Professional Elective -VII	3	-	-	25	75	100	3
22YYOE705	**OE-III**	Open Elective - III	3	-	-	25	75	100	3
22EECP706	**PCP-XI**	Power System Analysis Lab	-	-	3	40	60	100	1.5
22ETIT707	**IT-II**	Internship /Industrial Training	Four weeks during the summer vacation at the end of VI Semester				100	100	4.0
22EEPV708	**PV-I**	Project Work and Viva-Voce	-	-	S 2	-	-	-	-
								Total Credits	**19.5**

SEMESTER VIII

Course Code	Category	Course	L	T	P/D	CA	FE	Total	Credits
22YYOE801	**OE-IV**	Open Elective - IV	3	-	-	25	75	100	3
22YYOE802	**OE-V**	Open Elective - V	3	-	-	25	75	100	3
22EEPV803	**PV-I**	Project Work and Viva-Voce	-	PR 10	S 2	40	60	100	6
								Total Credits	**12**

L	No. of Lecture	**TR**	No. of Discussion on Industrial Training
T	No. of Tutorial	**S**	No. of Seminar on Industrial Training / Project
P	No. of Practical	**PR**	No. of Discussion on Project work
CA	Continuous Assessment Marks	**FE**	Final Examination Marks
Credits	Credit points allotted to that course	**Total**	Total Marks

PROFESSIONAL ELECTIVE COURSES		
SEMESTER V		
1	22EEPESCN	NETWORK ANALYSIS AND SYNTHESIS
2	22EEPESCN	WIND AND SOLAR ENERGY SYSTEMS
3	22EEPESCN	SIGNALS AND SYSTEMS
4	22EEPESCN	DIGITAL SYSTEM DESIGN
5	22EEPESCN	TRANSDUCER SYSTEMS
6	22EEPESCN	MEASUREMENT DATA ANALYSIS
SEMESTER VI		
1	22EEPESCN	HIGH VOLTAGE TRANSMISSION SYSTEMS
2	22EEPESCN	ELECTRIC AND HYBRID VEHICLES
3	22EEPESCN	INDUSTRIAL AUTOMATION AND CONTROL
4	22EEPESCN	DIGITAL SIGNAL PROCESSING
5	22EEPESCN	DIGITAL CONTROL SYSTEMS
6	22EEPESCN	POWER PLANT INSTRUMENTATION
SEMESTER VII		
1	22EEPESCN	EMBEDDED SYSTEMS
2	22EEPESCN	VLSI DESIGN
3	22EEPESCN	INDUSTRIAL ELECTRICAL SYSTEMS
4	22EEPESCN	VIRTUAL INSTRUMENTATION AND SMART SENSORS
5	22EEPESCN	ROBOTICS AND AUTOMATION
6	22EEPESCN	FIBRE OPTICS AND LASER INSTRUMENTATION
7	22EEPESCN	IoT FOR ELECTRICAL ENGINEERING
8	22EEEPSCN	EMBEDDED SYSTEM LAB
OPEN ELECTIVE COURSES		
1	22YYOESCN	AUTOMOTIVE ELECTRICAL AND ELECTRONICS SYSTEM
2	22YYOESCN	QUANTITATIVE MANAGEMENT TECHNIQUES
3	22YYOESCN	SOFT COMPUTING TECHNIQUES
4	22YYOESCN	PRINCIPLES OF MANAGEMENT
5	22YYOESCN	TOTAL QUALITY MANAGEMENT
6	22YYOESCN	OPERATIONS RESEARCH
7	22YYOESCN	BIOMEDICAL ENGINEERING
8	22YYOESCN	MICRO ELECTRO MECHANICAL SYSTEMS
9	22YYOESCN	COMMUNICATION ENGINEERING
10	22YYOESCN	WIRELESS COMMUNICATION
11	22YYOESCN	COMPUTER NETWORKS
12	22YYOESCN	CLOUD COMPUTING
13	22YYOESCN	DATA SCIENCE
14	22YYOESCN	BIG DATA ANALYTICS
15	22YYOESCN	ENTERPRISE RESOURCE PLANNING
16	22YYOESCN	MACHINE LEARNING WITH APPLICATION TO OBJECT

		RECOGNITION **(Naan Mudhalvan Portal - VI Sem)**
17	22YYOESCN	POWERING IOT USING RASPBERRY PI or ARDUINO **(Naan Mudhalvan Portal - V Sem)**
18	22YYOESCN	BLOCK CHAIN **(Naan Mudhalvan Portal - VIII Sem)**
19	22YYOESCN	SMART ENERGY GRID **(Naan Mudhalvan Portal - VII Sem)**
20	22YYOESCN	INTELLECTUAL PROPERTY RIGHTS (IPR)
21	22YYOESCN	CYBER SECURITY
22	22YYOESCN	NCC STUDIES (ARMY WING) -I
HONOURS DEGREE COURSES		
1	22EEHESCN	SPECIAL ELECTRICAL MACHINES
2	22EEHESCN	HIGH VOLTAGE ENGINEERING
3	22EEHESCN	COMPUTER AIDED POWER SYSTEM ANALYSIS
4	22EEHESCN	POWER QUALITY STUDIES
5	22EEHESCN	SEMICONDUCTOR DEVICES AND MODELING
6	22EEHESCN	HIGH SPEED ELECTRONICS
7	22EEHESCN	NON LINEAR CONTROL SYSTEMS
8	22EEHESCN	INTRODUCTION TO NANO ELECTRONICS
9	22EEHESCN	ADAPTIVE SIGNAL PROCESSING
10	22EEHESCN	SOLAR CELL DESIGN AND FABRICATION
MINOR ENGINEERING COURSES		
1	22EEMISCN	ELECTRICAL TECHNOLOGY
2	22EEMISCN	ELECTRICAL MEASUREMENTS
3	22EEMISCN	FUNDAMENTALS OF ELECTRONIC DEVICES AND CIRCUITS
4	22EEMISCN	ANALOG INTEGRATED CIRCUITS
5	22EEMISCN	ELECTRIC MACHINES AND DRIVES
6	22EEMISCN	DIGITAL ELECTRONICS
7	22EEMISCN	BASICS OF CONTROL SYSTEMS
ONE CREDIT COURSES		
1	22EEOCSCN	PCB DESIGNING LAB
2	22EEOCSCN	MAT LAB PROGRAMMING
3	22EEOCSCN	ELECTRONIC HARDWARE TROUBLE SHOOTING
VALUE ADDED COURSES		
1	22EEEEVAC01	TESTING OF ELECTRICAL APPARATUS
2	22EEEEVAC02	ALTERNATIVE SOURCES OF ENERGY
3	22EEEEVAC03	ELECTRICAL SAFETY
4	22EEEEVAC04	SOLAR PV SYSTEM DESIGN

SEMESTER I

22ETBS101	MATHEMATICS -I	L	T	P/D	C
		3	1	0	4

COURSE OBJECTIVES

- To familiarize definite integrals and its application in finding area and volume.
- To introduce the fundamentals of functions of several variables.
- To make the student to learn infinite series and its nature.
- To impart knowledge about Vector calculus.
- To provide the concept of eigen values and eigen vectors of a real matrix and its properties of great utility in many branches of engineering.

UNIT I: INTEGRAL CALCULUS

Evaluation of definite integrals and their properties - Applications of definite integrals to evaluate surface areas and volumes of revolutions. Improper integral - Beta and Gamma functions and their properties.

UNIT II: FUNCTIONS OF SEVERAL VARIABLES

Rolle's theorem-Mean value theorem. Indeterminate forms - L'Hospital's rule, Functions of two variables: Taylor's and Maclaurin's series expansions - Maxima and minima for functions of two variables.

UNIT III: SEQUENCES AND SERIES

Convergence of sequence and series - Tests for convergence: Comparison test (only for series with positive terms) - D'Alembert's ratio test-Cauchy's root test-Integral test - Leibnitz's test (Alternating series).

UNIT IV: VECTOR CALCULUS (DIFFERENTIATION)

Gradient, divergence and curl - Directional derivative - Unit normal vector - Irrotational and solenoidal vectors - Expansion formulae for operators involving.

UNIT V: MATRICES

Rank of a matrix - Symmetric, skew - Symmetric and orthogonal matrices - Characteristic equation - Eigen values and Eigen vectors - Cayley-Hamilton Theorem - Diagonalization of symmetric matrices by Orthogonal transformation.

TEXT BOOKS

1. Veerarajan T., "Engineering Mathematics for First Year", Tata McGraw-Hill, New Delhi, 2008.
2. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 36th Edition, 2010

REFERENCE BOOKS

1. G.B. Thomas and R.L. Finney, "Calculus and Analytic geometry", 9th publishers, Reprint, 2002.
2. Erwin kreyszig, "Advanced Engineering Mathematics", 9th Edition, JohnWiley &Sons, 2006.
3. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill New Delhi, 11th Reprint, 2010.
4. N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, Reprint,2008.

COURSE OUTCOMES

At the end of this course, Students will able to

1. Solve improper integrals using Beta and Gamma functions.
2. Evaluate the extreme values for functions of two variables.
3. Analyze the convergence of infinite series.
4. Understand vector differentiation and Recognize solenoidal and irrotational fields.
5. Solve eigen values and eigen vectors of a real matrix and Orthogonal transformation of a matrix.

Mapping of Course Outcomes with Program Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**3**	**2**									
CO2	**3**	**3**	**2**	**2**								
CO3	**3**	**3**	**2**									
CO4	**3**	**3**										
CO5	**3**	**3**	**3**	**2**	**2**							

22ETBS102	PHYSICS	L	T	P/D	C
		3	1	0	4

COURSE OBJECTIVES

- To understand the ray of light to undergo the phenomenon of interference diffraction and polarization.
- To understand the principle and various application of laser.
- To develop knowledge in crystal structure and its properties.
- To understand the energy quantization of subatomic particles like electron.
- Rationalize the law of conservation of energy in solar water heater and solar cells.

UNIT I: WAVE OPTICS

Huygens' Principle, superposition of waves and interference of light by wave front splitting and amplitude splitting; Young's double slit experiment, Newton's rings, Michelson interferometer and Mach-Zehnder interferometer. Fraunhofer diffraction from a single slit and a circular aperture, the Rayleigh criterion for limit of resolution and its application to vision; diffraction gratings and their resolving power.

UNIT II: LASERS

Introduction - Principles of Laser - Stimulated emission, Properties of laser beams: mono- chromaticity, coherence, directionality and brightness Einstein's theory of, stimulated emission A and B coefficients; amplification of light by population inversion, different types of lasers: gas lasers (He-Ne, CO2), solid - State lasers (ruby, Neodymium), dye lasers, laser speckles, applications of lasers in science, engineering and medicine.

UNIT III: CRYSTAL PHYSICS

Introduction to solid Materials - Crystal structure - Geometry of lattice unit cell - Bravais' lattice - Crystal systems, Crystal structures of Materials - (Cordination number, Atomic radius, packing factor and packing density) - Types of crystal Lattice (Simple Cubic, Body Centered Cubic, Face Centered Cubic and Hexagonal Closed Packed) Miller Indices and their calculations - Finding Miller indices of crystal planes.

UNIT IV: QUANTUM MECHANICS

Heisenberg uncertainty Principle - CDual nature of Matter and radiation - De Broglie's Wave length - Wave Velocity and group velocity. The wave Equation, Schrödinger's time dependent and independent wave equations - The Wave function and its physical significance - The particle in a box Problem (one dimensional box) - Energy quantization - Eigen values and Eigen functions.

UNIT V: ENERGY PHYSICS

Introduction to energy sources - Energy sources and their availability (Conventional and Non-conventional energy sources) solar energy - Methods of Harvesting solar energy - Solar heat collector, solar water heater and solar cells. Wind energy - Basic principle and components of wind energy

Conversion system (WECS) - Application of wind energy. Biomass - Biogas Generation - Classification of Biogas plants - Properties and application of Biogas**.**

TEXT BOOKS

1. Arumugam.M. "Engineering Physics", Anuradha agencies, 2nd Edition, 1997.
2. John Twidell& Tony Weir, "Renewable Energy Resources", Taylor & Francis, 2005.
3. Avadhanulu. M.N. and Kshirsagar P.G., "A Text Book of Engineering Physics", S. Chand & Company Ltd., 7th Enlarged Revised Ed., 2005
4. Gaur R.K. and Gupta S.L., "Engineering Physics", Dhanpat Rai Publishers, New Delhi, 2003.
5. Rai.G.D, "Solar Energy Utilization" Volume-1 & 2 by - Khanna Publishers, New Delhi
6. Pajput. R. K. Non -Conventional energy sources and Utilization - S. Chand Publication -2013.

REFERENCE BOOKS

1. Rajendran.V , "Engineering Physics", Tata McGraw Hill publishers, 2009.
2. Rai G.D., "Non-conventional Energy sources", Khauna Publications, 1993.
3. Mani. P. "Engineering Physics", Dhanam Publication, Chennai, 2011.
4. Agarwal.M.P, "Solar Energy", S.Chand& Co., I Edn, New Delhi, 1983.

COURSE OUTCOMES

At the end of this course, student will be able to

1. Gain knowledge on the construction of different types of interferometer.
2. Description on different types of laser and its application.
3. Analyze the importance of packing factor in different crystal system.
4. Evaluate the quantum mechanical concept of wave velocity and group velocity.
5. Compared the different energy resource and their availability.

Mapping of Course Outcomes with Program Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**2**	**2**	**2**		**3**	**2**						**1**
CO2	**3**	**2**			**2**	**1**	**1**					
CO3	**3**	**1**	**1**			**1**						
CO4	**2**	**1**	**2**	**2**	**1**	**1**						
CO5	**3**	**2**			**1**	**2**	**1**			**1**		**1**

22ETBS103	CHEMISTRY	L	T	P/D	C
		3	1	0	4

COURSE OBJECTIVES

- To understand water treatment techniques and basic knowledge on surface chemistry.
- To provide knowledge on electrochemical cells and chemistry involved in corrosion.
- To learn various processes involved in fuel refining and mechanism involved in energy storage devices.
- To develop knowledge about synthesis of various types of polymers and nano materials.
- To get basic knowledge on refractories, lubricants and spectroscopical techniques.

UNIT I: WATER CHEMISTRY AND SURFACE CHEMISTRY

Hardness of water - Softening of hard water by ion exchange method - Boiler feed water - Boiler troubles - Internal treatment methods - Estimation of hardness by EDTA method - Desalination of brackish water - Reverse Osmosis. Disinfection of water - Break point chlorination -Adsorption - Types of Adsorption - Freundlich and Langmuir adsorption isotherms - Applications of adsorption.

UNIT II: ELECTROCHEMISTRY AND CORROSION

Electrode potential - Electrochemical cell - Measurement of EMF - Nernst equation for cell EMF - Concentration cells - Electrochemical series - Conductometry - Conductance, Cell constant - Types of conductometric titrations. Potentiometry - Principle of acid base titration. Corrosion - Dry and wet corrosion - Galvanic, concentration cell and pitting corrosion - Control of corrosion by Cathodic protection method.

UNIT III: FUELS AND STORAGE DEVICES

Fuels - Classification - Calorific values - HCV and LCV - Analysis of coal - Proximate and ultimate analysis - Refining of petroleum. Cracking - Fixed bed - Synthetic petrol - Fischer -Tropsch process - Flue gas analysis by Orsat apparatus. Batteries - Primary and secondary - Dry cell - Lead acid storage battery - Ni-Cd battery - Lithium battery - H2-O2 fuel cell.

UNIT IV: POLYMERS AND NANO MATERIALS

Polymers -Types of polymerization - Addition, condensation and copolymerisation - Mechanism of addition polymerization (Free radical). Plastics - Thermoplastics and thermosetting plastics -Preparation, properties and uses of polyethylene, polyvinyl chloride, polystyrene, Nylon and bakelite. Nano chemistry -Introduction to nano materials. Synthesis - Precipitation, sol- Gel process, electro deposition and chemical vapour deposition methods. Carbon nano tubes, fullerenes, nano wires and nano rods.

UNIT V: ENGINEERING MATERIALS AND SPECTROSCOPIC TECHNIQUES

Refractories - Classification, characteristics (Refractoriness, RUL, Thermal spalling, porosity) and uses, Lubricants - Classification, properties (cloud and pour point, flash and fire point, viscosity index) and

applications. Principles of spectroscopy - Beer - Lambert's Law - UV -Visible and IR spectroscopy -Basic principles and instrumentation (block diagram) -Fluorescence and its applications in medicine.

TEXT BOOKS

1. Jain, P.C. and Monica Jain (2010) "Engineering Chemistry" Dhanpat Rai & Sons, New Delhi.
2. Dara, S.S. and Umare, S.S. (2014) "Text Book of Engineering Chemistry" S. Chand & Co. Ltd., New Delhi.
3. Gopalan, R., Venkappaya, D. and Nagarajan, S. (2008) "Engineering Chemistry" Tata McGraw Publications Ltd., New Delhi.
4. Puri, B.R., Sharma, L.R. and Pathania, M.S. (2013) "Principles of Physical Chemistry" Vishal Publication Company, New Delhi.
5. Sharma, Y.R. (2010) "Elementary Organic Spectroscopy, Principle and Chemical Applications", S. Chand Publishers, New Delhi.
6. Asim K Das and Mahua Das (2017) "An Introduction to Nanomaterials and Nanoscience" CBS Publishers & Distributors Pvt. Ltd., New Delhi.

COURSE OUTCOMES

At the end of this course work,student will be able to

1. Develop innovative methods in soft water production for industrial uses and about adsorption analysis.
2. Describe the concept of electrochemistry and its applications; corrosion and its controlling methods.
3. Understand the properties of fuels and applications of energy storage devices.
4. Synthesis various polymers and understand about nanomaterials.
5. Gain knowledge on refractories, lubricants and understand the concepts of certain spectroscopical techniques

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**2**	**3**	**2**					**2**			
CO2				**2**	**1**							
CO3	**3**		**3**									
CO4	**3**				**1**							
CO5		**2**	**3**	**2**					**2**			

22ETES104	PROGRAMMING FOR PROBLEM SOLVING	L	T	P/D	C
		2	1	0	3

COURSE OBJECTIVES

- To understand the fundamentals of C programming
- To provide students with understanding of code organization and functional hierarchical decomposition using complex data types.
- To understand how to break a large problem into smaller parts, writing each part as a module or function
- To effectively utilize structures and pointers in problem solving
- To enable students to take up Systems programming or Advanced C programming course.

UNIT I: FUNDAMENTALS OF PROGRAMMING

Introduction to Programming, Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.), Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudocode with examples. From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code.

UNIT II: EXPRESSIONS AND CONTROL STRUCTURES

Arithmetic Expressions and Precedence, Conditional Branching and Loops, Writing and evaluation of Conditionals and consequent Branching, Iteration and Loops.

UNIT III: ARRAYS

Arrays: Arrays (1-D, 2-D), Character arrays and Strings, Basic Algorithms: Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example programs (no formal definition required).

UNIT IV: FUNCTIONS

Function: Functions (including using built in libraries), Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference, Recursion: Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort.

UNIT V: FILES AND STRUCTURES

Structure: Structures, Defining structures and Array of Structures, Pointers: Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation). File handling (only if time is available, otherwise should be done as part of the lab).

TEXT BOOKS

1. Byron Gottfried, “Schaum's Outline of Programming with C”, McGraw-Hill.

2. E. Balaguruswamy, “Programming in ANSI C”, Tata McGraw-Hill.

REFERENCE BOOKS

1. Brian W. Kernighan and Dennis M. Ritchie, “The C Programming Language”, Prentice Hall ofIndia.

COURSE OUTCOMES

At the end of this course, the students will be able to

1. Formulate algorithms, draw flowcharts and write pseudocode for solving arithmetic and logical problems.
2. Develop C programs using branching and looping statements.
3. Implement searching and sorting algorithms and analyze the order of complexities.
4. Define and call simple functions by value and by reference and also to write recursive functions.
5. Utilize structures, pointers and files in C programming.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**1**	**2**										
CO2	**2**	**2**	**3**	**2**								
CO3	**2**	**2**	**3**	**2**								
CO4	**1**	**1**										
CO5	**2**	**1**	**1**									

22ETHS105	HERITAGE OF TAMILS தமிழர் மரபு	L	T	P/D	C
		1	0	0	1

அலகு மொழி மற்றும் இலக்கியம்:
இந்திய மொழிக் குடும்பங்கள் – திராவிட மொழிகள் தமிழ் ஒரு செம்மொழி தமிழ் செவ்விலக்கியங்கள் –சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை – சங்க இலக்கியத்தில் பகிர்தல் அறம் – திருக்குறளில் மேலாண்மைக் கருத்துக்கள் – தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் – பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் – சிற்றிலக்கியங்கள் – தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி – தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

அலகு மரபு – பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை சிற்பக் கலை:
நடுகல் முதல் நவீன சிற்பங்கள் வரை – ஐம்பொன் சிலைகள்– பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் – தேர் செய்யும் கலை – சுடுமண் சிற்பங்கள் – நாட்டுப்புறத் தெய்வங்கள் – குமரிமுனையில் திருவள்ளுவர் சிலை – இசைக் கருவிகள் – மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் – தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

அலகு நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்:
தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

அலகு IV: தமிழர்களின் திணைக் கோட்பாடுகள்:
தமிழகத்தின் தாவரங்களும், விலங்குகளும் – தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் – தமிழர்கள் போற்றிய அறக்கோட்பாடு – சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் – சங்ககால நகரங்களும் துறை முகங்களும் – சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி – கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி. 3

அலகு V: இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு 3
இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு – இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் – சுயமரியாதை இயக்கம் – இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு – கல்வெட்டுகள், கையெழுத்துப்படிகள் – தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

1. Language and Literature: Language Families in India - Dravidian Languages -Tamil as a Classical Language - Classical Literature in Tamil -Secular Nature of Sangam Literature – Distributive Justicein Sangam Literature –Management Principlesin Thirukural –Tamil Epics and Impact of Buddhism & Jainismin Tamil Land – Bakthi Literature Azhwars and Nayanmars.- Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.

2. Heritage - Rock art paintings to modern art - Sculpture: Hero stone to modern sculpture – Bronzeicons –Tribes and the irhandi crafts-Art of temple car making –Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical

Instruments – Mridhangam, Parai, Veenai, Yazh and Nadhaswaram – Role of Temples in Social and Economic Life of Tamils.

3. Folk and Martial arts - Therukoothu, Karagattam, VilluPattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

4. Thinai concept of Tamils -Flora and Fauna of Tamils &Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.

5. Contribution of Tamils to Indian National Movement and Indian Culture: Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India -Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine -Inscriptions & Manuscripts -Print History of Tamil Books.

TEXT-CUM-REFERENCE BOOKS

[1] தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).

[2] கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).

[3] கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)

[4] Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL -(in print)

[5] Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.

[6] Historical Heritage of the Tamils (Dr. S.V.Subatamanian, Dr. K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).

[7] The Contributions of the Tamils to Indian Culture (Dr. M.Valarmathi) (Published by: International Institute of Tamil Studies.)

[8] Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

[9] Studies in the History of India with Special Reference to Tamil Nadu (Dr. K.K.Pillay) (Published by: The Author)

[10] Porunai Civilization (Jointly Published by Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

[11] Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) -Reference Book.

22ETHP106	COMMUNICATION SKILLS AND LANGUAGE LABORATORY	L	T	P/D	C
		0	0	3	1.5

COURSE OBJECTIVES

- To facilitate computer assisted multimedia instruction enabling individualized and independent language learning.
- To sensitize the students to the nuances of English speech sounds, word accent, intonation and rhythm.
- To bring about a consistent accent and intelligibility in student pronunciation of English by providing an opportunity for practice in speaking.
- To improve the fluency of students in spoken English
- To train students to use Language appropriately for public speaking, group discussion and interviews.

LIST OF TOPICS

1. Listening Comprehension
2. Pronunciation, Intonation, Stress and Rhythm
3. Common Everyday Situations: Conversations and Dialogues
4. Communication at Workplace
5. Interviews
6. Formal Presentations

Suggested Software Package: Globarena Package for communicative English The Globarena Package consists of the following exercises

1. Reading comprehension
2. Listening comprehension
3. Vocabulary exercises
4. Phonetics
5. Role Play in dialogues
6. Auto Speak

TEXT BOOKS

1. Daniel Jones Current," English Pronouncing Dictionary", Edition with CD.
2. R. K. Bansal and J. B. Harrison, "Spoken English ",Orient Longman 2006 Edn.
3. J. Sethi, Kamlesh Sadanand & D.V. Jindal, "A Practical course in English Pronunciation, (with two Audio cassettes)", Prentice-Hall of India Pvt. Ltd., New Delhi.
4. T.Balasubramanian, "A text book of English Phonetics for Indian Students", (Macmillan).
5. "English Skills for Technical Students", WBSCTE with British Council, OL.

COURSE OUTCOMES

At the end of this course work, Students will be able to

1. Student will heighten their awareness of correct usage of English Grammar in writing and speaking.
2. Acquire speaking ability in English both in terms of fluency and comprehensibility.
3. Enhance competence in the four modes of literacy; Writing, Speaking, Reading and Listening.
4. Ensure student to improve their accuracy and fluency in producing and understanding spoken and written English
5. Exposure of the grammatical forms of English and the use of these forms in specific communicative contexts.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1		**3**								**3**		**3**
CO2		**3**								**3**		**3**
CO3			**2**							**3**		**3**
CO4		**2**								**3**		**3**
CO5			**3**							**3**		**3**

22ETSP107	ENGINEERING WORKSHOP PRACTICE	L	T	P/D	C
		0	0	3	1.5

COURSE OBJECTIVES

- To provide the students simple hands-on-experience in the basic aspects of production engineering in fitting, carpentry and sheet metal.
- To familiarize the students in the various hand forging operations

CARPENTRY: Use of hand tools - exercises in planning and making joints namely, Lap joint, Lengthening joint, half lap joint, dovetail joint, mortising and tenoning etc.

FITTING: Use of bench tools, vice, hammers, chisels, files, hacksaw, centre punch, twist drill, taps and dies - Simple exercises in making T, V joint and dovetail joints.

SHEET METAL WORK: Use of hand tools - Simple exercises in making objects like cone, funnel, tray, cylinder.

SMITHY: Demonstration of hand forging and drop forging.

COURSE OUTCOMES

At end of this course work, students will be able to

1. Use basic tools of fitting, carpentry and sheet metal fabrication.
2. Fabricate simple carpentry joints.
3. Develop skill to make simple fitting joints.
4. Create simple shapes of sheet material.
5. Distinguish hand forging and drop forging operation.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		2		2		3					3
CO2	3		2		2		3					3
CO3	3		2		2		3					3
CO4	3		2		2		3					3
CO5	3		2		2		3					3

22ETSP108	ELECTRICAL WIRING AND EARTHING PRACTICE LABORATORY	L	T	P/D	C
		0	0	3	1.5

COURSE OBJECTIVES

- To create an awareness on the electrical safety in industrial and commercial environment.
- To enable the understanding on the principles of different types of electrical wiring.
- To offer exposure on the need for earthing and earthing practices.
- To provide practical knowledge on the various types of lighting circuits.
- To introduce methods for measuring the variables in electric circuits.

LIST OF EXPERIMENTS

1. Residential Wiring
2. Fluorescent lamp wiring
3. Stair case Wiring
4. Godown Wiring
5. Ceiling fan wiring
6. Industrial Wiring
7. Series and Parallel Lamp Circuits
8. Measurement of Earth Resistance
9. Measurement of Parameters in a Single-Phase AC Circuit
10. Measurement of Voltage, Current, Power and Power factor in a Resistive Circuit
11. Soldering Practice -Components devices and circuits -using general purpose PCB
12. Corridor Wiring
13. Test the operation and control circuit for LED Fluorescent Lamp (18W)
14. Study of various categories of Fuses and Insulators
15. Study and test the operation of Automatic Iron Box
16. Testing the buck/boost functions of the domestic stabilizer

COURSE OUTCOMES

At the end of this course work, Students will be able to

1. Familiarize with the electrical safety measures.
2. Identify the different types of electrical wiring.
3. Know the necessity of Earthing.
4. Gain knowledge on the different types of lighting circuits.
5. Understand the methods for measuring electrical variables.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**			**2**			**2**					**3**
CO2	**3**			**2**			**2**		**2**			**3**
CO3	**3**			**2**			**2**		**2**			**3**
CO4	**3**			**2**			**2**		**2**			**3**
CO5	**3**			**2**			**2**		**2**			**3**

SEMESTER II

22ETHS201	ENGLISH	L	T	P/D	C
		3	1	0	4

COURSE OBJECTIVES

- To ensure the students with good vocabulary
- To make the students participate actively in writing activities
- To practice the unique qualities of professional writing style
- To develop the students the proficiency in communicative skills
- To ensure the students to face the demand of their profession

UNIT I: VOCABULARY BUILDING

The concept of Word Formation
Root words from foreign languages and their use in English
Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives,
Count and uncount nouns.
Synonyms, antonyms, and standard abbreviations.
Language development - Wh questions asking and answering yes or no questions.

UNIT II: BASIC WRITING SKILLS

Sentence Structures
Use of phrases and clauses in sentences
Importance of proper punctuation
Creating coherence and Techniques for writing precisely
Organizing principles of paragraphs in writing

UNIT III: NATURE AND STYLE OF SENSIBLE WRITING

Describing and Defining
Classifying and Providing examples or evidence
Writing introduction and conclusion
Comprehension
Precise Writing

UNIT IV: WRITING PRACTICES & ORAL COMMUNICATION

Listening to lectures and making notes
Mechanics of presentation, asking and giving instruction
Essay Writing -Writing analytical essays and issue based essays
Dialogue writing and conversation
Letter writing -Formal and informal

UNIT V: GROUP DISCUSSION AND JOB APPLICATION

Characteristics and practices of group discussion
Job application
Resume preparation

Writing reports -minutes of a meeting, accident, survey E-mail -etiquette

TEXT / REFERENCE BOOKS

1. Michael Swan, "Practical English Usage", OUP, 1995.
2. F.T. Wood, "Remedial English Grammar", Macmillan, 2007.
3. William Zinsser, "On Writing Well", Harper Resource Book, 2001,
4. Liz Hamp - Lyons and Ben Heasly, "Study Writing", Cambridge University Press, 2006.
5. Sanjay Kumar and PushpLata, "Communication Skills" Oxford University Press, 2011.
6. "Exercises in Spoken English. Parts. I-III", CIEFL, Hyderabad, Oxford University Press.
7. Raman, Meenakshi and Shama, Sangeetha, "Technical Communication Principles and Practice", Oxford University Press, New Delhi, 2014.

COURSE OUTCOMES

At the end of this course work, students will able to

1. Comprehension, writing and speaking skills. Get an exposure of vocabulary and gain a good glossary.
2. Get knowledge regarding use of Grammar in speech and writing.
3. Acquire knowledge of remembering, understanding, applying, analyzing, evaluating & creating.
4. Determine how to articulate their ideas effectively to a variety of listeners.
5. Acquire ability to speak and write effectively in English.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1		**2**		**2**						**3**		**3**
CO2		**2**		**2**						**3**		**3**
CO3			**3**							**3**		**3**
CO4			**2**	**3**						**3**		**3**
CO5			**3**	**2**						**3**		**3**

22ETBS202	MATHEMATICS -II	L	T	P/D	C
		3	1	0	4

COURSE OBJECTIVES

- To familiarize multiple integrals and its application in finding area and volume.
- To make the student to learn line, surface and volume integrals.
- To solve Second order linear differential equations with constant coefficients.
- To acquaint the student with the techniques in the theory of analytic functions.
- To introduce the fundamentals of complex integrations.

UNIT I: MULTIVARIABLE CALCULUS (INTEGRATION)

Double integrals (Cartesian) - change of order of integration in double integrals - Change of variables (Cartesian to polar) - Applications: Area as a double integral. Triple integrals (Cartesian) - Applications: Volume as a triple integral.

UNIT II: VECTOR CALCULUS (INTEGRATION)

Line, Surface and Volume integrals - Gauss divergence theorem (without proof) - Green's theorem in the plane (without proof) -Stokes theorem (without proof).Verification of the above theorems and evaluation of integrals using them.

UNIT III: ORDINARY DIFFERENTIAL EQUATIONS

First order ordinary differential equations (Linear and Bernoulli's differential equations, exact differential equations). Solution of Second order ordinary linear differential equations with constant co-efficient (method of variation of parameters only).Solution of Second order ordinary linear differential equations with variable co-efficient (Euler and Legendre's linear equations)

UNIT IV: COMPLEX VARIABLE (DIFFERENTIATION)

Analytic functions and their properties - Cauchy-Riemann equations - Harmonic functions -harmonic conjugate of elementary analytic functions-Construction of an analytic function. Mobius transformations.

UNIT V: COMPLEX VARIABLE (INTEGRATION)

Cauchy theorem (without proof) - Cauchy Integral formula (without proof) - Cauchy Integral formula for higher derivatives (without proof) -zeros and poles of an analytic functions -singularities. Residues - Cauchy Residue theorem (without proof) - Evaluation of definite integral using them. Taylor's series and Laurent's series.

TEXT BOOKS

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 36th Edition, 2010.
2. Erwin kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley &Sons, 2006.

REFERENCE BOOKS

1. G.B. Thomas and R.L. Finney, "Calculus and Analytic geometry", 9th Edition, Pearson, Reprint, 2002.
2. W. E. Boyce and R. C. DiPrima, "Elementary Differential Equations and Boundary Value Problems", 9th Edn. Wiley India, 2009.
3. S. L. Ross, "Differential Equations", 3rd Ed., Wiley India, 1984.
4. J. W. Brown and R. V. Churchill, "Complex Variables and Applications", 7th Ed., Mc- Graw Hill, 2004.
5. N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, Reprint, 2008.

COURSE OUTCOMES

At the end of this course, students will be able to

1. Solve double and triple integrals in finding area and volumes.
2. Apply line, surface and volume integrals in Gauss, Greens and Stoke's theorems.
3. Solve Second order linear differential equations with constant coefficients.
4. Construct analytic function and analyze conformal mappings.
5. Evaluate the complex integrals and contour integration.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**3**	**3**	**2**								
CO2	**3**	**3**	**2**									
CO3	**3**	**3**	**3**	**3**	**3**							
CO4	**3**	**3**	**2**									
CO5	**3**	**3**	**3**	**2**								

22ETES203	BASIC ENGINEERING {Civil (2 Units), Civil (3 Units), Mechanical (2 Units), Electrical and Electronics (3 Units)}	L	T	P/D	C
		4	0	0	4

BASIC CIVIL ENGINEERING (2 Units)

COURSE OBJECTIVES

- To inculcate a knowledge on essentials of Civil Engineering and to expose on the role of significance and contributions
- To satisfying societal needs and illustrate the concepts of various construction techniques

UNIT I

Introduction to Civil Engineering - Various disciplines of Civil Engineering - Introduction to various building materials Stone, Bricks, Steel, Cement, Concrete – its characteristics, types and uses. Surveying - Principles and objectives of surveying; Types, Classifications of surveying, measurement of areas and distances – chain – compass: Introduction to Leveling, Total station, Remote sensing.

UNIT II

Building construction – foundations; Bearing capacity of soil, functions of foundations, Types - Shallow and Deep. Brick masonry – Header, Stretcher, Flemish and English Bond. Columns, Lintels, Roofs – functions, types, roofing materials. Bridges – necessity - selection of site – components of a bridge: Dams – types – selection site - forces acting on a dam – Roads – uses - classification of roads – components of a road.

TEXT BOOKS

1. Ramesh babu. V, A text book of Basic Civil Engineering, Anuradha Agencies, Kumbakonam, 1995.
2. Palanichamy M.S., Basic Civil Engineering, Tata McGraw Hill Publishing Company ltd, 2000.

REFERENCE BOOKS

1. Ramamrutham V, Basic Civil Engineering, Dhanpat Rai Publishing Co. (P) Ltd., 1999.
2. Natarajan K V, Basic Civil Engineering, Dhanalakshmi Publications, Chennai, 2005.
3. Satheesh Gopi, Basic Civil Engineering, Pearson Publications, 2010.

COURSE OUTCOMES

1. Understand the basic knowledge on civil engineering materials
2. Develops the skill to satisfy the social needs and suitable method of construction technique

Mapping of Course Outcomes with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2									2	3	2	2
CO2	3	2	2									2	2	3	2
CO3															
CO4															
CO5															

BASIC CIVIL ENGINEERING (3 Units)

COURSE OBJECTIVES

- To inculcate a knowledge on essentials of Civil Engineering
- To expose the students on the role, significance and contributions of Civil Engineering in satisfying societal needs
- To illustrate the concepts of various construction techniques

UNIT I

Introduction to Civil Engineering - Relevance of Civil Engineering in the overall infrastructural development of the country. Introduction to various building materials -Stone, Bricks, Steel, Cement, Concrete, Timber -its characteristics, types and uses. Various types of buildings as per NBC; Selection of suitable site for buildings, Components of a residential building -its functions, Orientation of a building, simple definitions - Plinth area / built up area, floor area / carpet area -floor space index.

UNIT II

Surveying - Principles and objectives of surveying; Types, Classifications of surveying, measurement of areas and distances - Chain - Compass: Introduction to Leveling, Total station, Remote sensing - Fundamental principles and applications.

Building construction - Foundations; Bearing capacity of soil, functions of foundations, Types - Shallow and Deep. Brick masonry - Header, Stretcher, Flemish and English Bond. Columns, Lintels, Roofs - Functions, types, roofing materials, Floors -functions, types, flooring materials. Decorative finishes - Plastering, interior design.

UNIT III

Bridges - Necessity - Selection of site - Components of a bridge: Dams -Types - Selection of site - Forces acting on a dam - Roads - Uses - Classification of roads - Components of a road; Railways - Basic components of permanent way -Water supply - Per capita requirement - Sources - Need for conservation of water - Rain water harvesting - Basic water treatment - Sewage and its disposal - Basic definitions - Septic tank - Components and functions.

TEXT BOOKS

1. Ramesh babu. V, A text book of Basic Civil Engineering, Anuradha Agencies, Kumbakonam, 1995.
2. Palanichamy M.S., Basic Civil Engineering, Tata McGraw Hill Publishing Company ltd, 2000.

REFERENCE BOOKS

1. Ramamrutham V, Basic Civil Engineering, DhanpatRai Publishing Co. (P) Ltd., 1999.
2. Natarajan K V, Basic Civil Engineering, Dhanalakshmi Publications, Chennai, 2005.
3. SatheeshGopi, Basic Civil Engineering, Pearson Publications, 2010.

COURSE OUTCOMES

1. Understand the basic knowledge on Civil engineering materials
2. Develops the skill to satisfy the social needs
3. Describe the suitable method of construction technique

Mapping of Course Outcomes with Programme Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**2**	**2**									**2**	**3**	**2**	**2**
CO2	**3**	**2**	**2**									**2**	**2**	**3**	**2**
CO3	**3**	**2**	**2**			**2**						**2**	**2**	**2**	**3**
CO4															
CO5															

BASIC MECHANICAL ENGINEERING (2 Units)

COURSE OBJECTIVES

- To familiarize the students the functioning of boilers, turbines and internal combustion engines.
- To provide knowledge about the use of various machine tools and manufacturing processes

UNIT I

Energy Conversion Devices: Boilers - Classification - Description and working of Cochran boiler - Babcock and Wilcox boiler. Steam turbines: Principles and working of Impulse and Reaction turbines. Gas turbines: Principles and working of Open cycle and Closed cycle gas turbines. Internal Combustion Engines: Classification - Principal parts - Two stroke and four stroke cycle engines - Working principle of petrol and diesel engines - Concept of CRDI and MPFI fuel injection systems - Hybrid engines. Battery electric vehicles (BEV) - key components

UNIT II

Formative Manufacturing Processes: Forging - Principle and operations; Rolling - Principle, rolling mill configurations; Extrusion - Direct versus indirect extrusion**.** Metal Casting: Principle - Green sand moulding - Injection moulding. Subtractive Manufacturing: Description of parts and operations performed: Lathe, Shaper, Universal Drilling machine, Universal Milling Machine - CNC Machining Centers. Additive Manufacturing Processes: 3 D Printing: Classification - Steps - Advantages - Disadvantages - Stereo lithography process - Gas welding -principle, Oxy-acetylene welding - Equipment, Arc welding - Principle - Equipment - Brazing: Types - Soldering - Comparison of brazing and soldering.

TEXT BOOKS

1. Prabhu T J, Jaiganesh V and Jebaraj S, Basic Mechanical Engineering, Scitech Publications Pvt. Ltd., Chennai, 2016.
2. Venugopal and Prabhuraj T J, Basic Mechanical Engineering, ARS publishers, Sirkali, 1996.

REFERENCE BOOKS

1. Hajra Choudhury S. K., Nirjhar Roy, Hajra Choudhury A. K., Elements of Workshop Technology,(Vol 1 and Vol II,) , Media Promoters, Pvt Ltd. (2008)
2. Rao P. N., Manufacturing Technology : Foundry, Forming and Welding - Vol 1,Mc Graw Hill Education, (2013)
3. Steven R. Schmid, Serope Kalpakjian, Manufacturing Processes for Engineering Materials (English) 5th Edition, Pearson India, (2009)

COURSE OUTCOMES

At end of this course work, Students will be able to

1. Demonstrate the working of various energy conversion devices such as boilers, turbines and internal combustion engines
2. Appraise the fundamental concepts of manufacturing processes which are commonly employed in the industry, to fabricate components using different materials.

BASIC ELECTRICAL AND ELECTRONICS ENGINEERING (3 Units)

COURSE OBJECTIVES

- To understand the basics of Electrical circuit laws and fundamentals of AC circuits
- To understand the working of DC Machines, transformers and AC machines
- To learn the basics of electronic devices and Communication Systems

UNIT-I BASIC CIRCUITS

Definition of current and voltage - Electrical circuit elements (R, L and C) - Ohm's Law- Kirchhoff's laws - solution for currents and voltages - AC circuits - RMS -Average values - Introduction to 3 phase systems - Advantages

UNIT-II ELECTRICAL MACHINES

Laws of Electromagnetism - Construction of DC Machines - DC Generator - EMF Equation - DC Motor - Principle of operation - Types – Characteristics

Single-phase Transformer: Construction and Working principle - EMF equation - Three-phase transformer - Working principle.

Three-phase induction motor – Construction and working principle - Single-phase induction motor - Alternators - Working principle

UNIT-III BASIC ELECTRONICS

P-N junction - VI Characteristics of PN junction diode, Zener diode - Rectifier circuits- Voltage Regulator using Zener diode - Elements of Communication Systems - Microwave, Satellite and Optical Fibre (Block Diagram Approach only).

TEXTBOOKS

1. Kothari DP and I.J Nagrath, "Basic Electrical and Electronics Engineering", McGraw Hill Education, 2014.
2. A K Theraja &B L Theraja, A Textbook of Electrical Technology, Vol.2, S. Chand Publishing, 2014.

REFERENCE BOOKS

1. Del Toro, "Electrical Engineering Fundamentals", Second edition, Pearson Education, New Delhi, 1989.
2. V.K. Mehta, Rohit Mehta, "Basic Electrical Engineering", S.Chand Publications, 2012.

COURSE OUTCOMES

At the end of the course, the students will be able to

- Understand the concepts related with electrical circuits and AC fundamentals.
- Acquire knowledge on the concepts of DC machines, Transformers and AC machines
- Enhance the knowledge about the basic electronic devices and their applications.
  Gain insight on the various elements of Communication systems.

Mapping of Course Outcomes with Programme Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**2**	**1**									**2**			
CO2	**3**	**2**	**1**									**2**			
CO3	**3**	**2**	**1**									**2**			
CO4															
CO5															

22ETHS204	TAMILS AND TECHNOLOGY தமிழரும் தொழில்நுட்பமும்	L	T	P/D	C
		1	0	0	1

அலகு I: நெசவு மற்றும் பானைத் தொழில்நுட்பம்: – கருப்பு சிவப்பு பாண்டங்கள் 3–
சங்க காலத்தில் நெசவுத் தொழில் – பானைத் தொழில்நுட்பம் பாண்டங்களில் கீறல் குறியீடுகள்.

3

அலகு II: வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்:
சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு– சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் – சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் – மாமல்லபுரச் சிற்பங்களும், கோவில்களும் – சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் – நாயக்கர் காலக் கோயில்கள் – மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் – செட்டிநாட்டு வீடுகள் – பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ–சாரோசெனிக் கட்டிடக் கலை.

அலகு III: உற்பத்தித் தொழில் நுட்பம்: 3
கப்பல் கட்டும் கலை – உலோகவியல் – இரும்புத் தொழிற்சாலை – இரும்பை உருக்குதல், எஃகு – வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் – நாணயங்கள் அச்சடித்தல் – மணி உருவாக்கும் தொழிற்சாலைகள் – கல்மணிகள், கண்ணாடி மணிகள் – சுடுமண் மணிகள் – சங்கு மணிகள் – எலும்புத்துண்டுகள் – தொல்லியல் சான்றுகள் – சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

அலகு IV: வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம்: 3
அணை, ஏரி, குளங்கள், மதகு – சோழர்காலக் குமுழித் தூம்பின் முக்கியத்துவம் – கால்நடை பராமரிப்பு – கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் – வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் – கடல்சார் அறிவு – மீன்வளம் – முத்து மற்றும் முத்துக்குளித்தல் – பெருங்கடல் குறித்த பண்டைய அறிவு – அறிவுசார் சமூகம்.

3
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அலகு V: அறிவியல் தமிழ் மற்றும் கணித்தமிழ்:
அறிவியல் தமிழின் வளர்ச்சி –கணித்தமிழ் வளர்ச்சி – தமிழ் நூல்களை மின்பதிப்பு செய்தல் தமிழ் மென்பொருட்கள் உருவாக்கம் – தமிழ் இணையக் கல்விக்கழகம் – தமிழ் மின் நூலகம் – இணையத்தில் தமிழ் அகராதிகள் – சொற்குவைத் திட்டம்.

TOTAL : 15 PERIODS

1. **Weaving and Ceramic Technology**:Weaving Industry during Sangam Age -Ceramic technology -Black and Red Ware Potteries (BRW) -Graffiti on Potteries.

2. **Design and Construction Technology:**Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age -Details of Stage Constructions in Silappathikaram - Sculptures

and Temples of Mamallapuram-Great Temples of Chola sandother worship places - Temples of Nayaka Period- Type study (Madurai Meenakshi Temple)-Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.

3. **ManufacturingTechnology**: Art of Ship Building -Metallurgical studies -Iron industry-Iron smelting,steel - Copper and gold-Coins as source of history-Minting of Coins–Beads making-industries Stone beads-Glass beads-Terracotta beads-Shell beads/bone beats-Archeological evidences - Gem stone types described in Silappathikaram.

4. **AgricultureandIrrigationTechnology:** Dam, Tank, ponds, Sluice, Significance of KumizhiThoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing-Knowledge of Sea-Fisheries–Pearl-Conchediving-Ancient Knowledge of Ocean - Knowledge Specific Society.

5. **Scientific Tamil& Tamil Computing**: Development of Scientific Tamil -Tamil computing –Digitalization of Tamil Books–Development of Tamil Software–Tamil Virtual Academy–Tamil Digital Library -Online Tamil Dictionaries - Sorkuvai Project.

TEXT-CUM-REFERENCEBOOKS

1 தமிழக வரலாறு மக்களும் பண்பாடும் கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2 கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3 கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4 பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL -(in print)
6. Social Life of the Tamils -The Classical Period (Dr. S.Singaravelu) (Publishedby: International Institute of Tamil Studies).
7. Historical Heritage of the Tamils (Dr. S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr. M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi ‘Sangam City Civilization on the bank so friver Vaigai’(Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Service Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu(Dr.K.K.Pillay) Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & TamilNadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) –Reference Book.

22ETBP205	PHYSICS LABORATORY	L	T	P/D	C
		0	0	3	1.5

COURSE OBJECTIVES

- To access the Rigidity modulus of wire.
- To assess the various properties of light.
- To assess the characterization of Metals.
- To analyses the thickness of microsized objects**.**

LIST OF EXPERIMENTS

1. Air Wedge
2. Newtons's Rings
3. Simple Pendulum
4. Dispersive power of the Prism
5. Diffraction Grating
6. Acoustic diffraction Grating
7. Compound Pendulum
8. Kunt's tube experiment
9. Young's double slit experiment
10. Laser Grating
11. Torsional Pendulum
12. Young's Modulus -Non-uniform Bending
13. Young's Modulus –Uniform Bending.

COURSE OUTCOMES

At the end of this course work, Students will be able to

1. Acquired the knowledge of torsional properties of metals wire
2. Determine the radius of curvature of the plano-convex lens.
3. Determine the dispersion power of the prism.
4. Evaluate the important characteristics of simple and compound pendulum
5. Determine the Young's Modulus of uniform and non-uniform bending.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3						2		2	3		3
CO2	3						2		2	3		3
CO3	3						2		2	3		3
CO4	3						2		2	3		3
CO5	3						2		2	3		3

22ETBP206	CHEMISTRY LABORATORY	L	T	P/D	C
		0	0	3	1.5

COURSE OBJECTIVES

- To list the water quality standards.
- To assess the composition of an alloy.
- To appreciate the practical significance of acidimetry, alkalimetry, permananganometry, conductometry and potentiometry.
- To analyse quantitatively the amount of a substance present in a given sample.

LIST OF EXPERIMENTS

1. Determination of surface tension and viscosity
2. Thin layer chromatography
3. Ion exchange column for removal of hardness of water
4. Determination of chloride content of water
5. Determination of the rate constant of a reaction
6. Determination of cell constant and conductance of solutions
7. Potentiometry - determination of redox potentials and emfs
8. Saponification / acid value of an oil
9. Determination of the partition coefficient of a substance between two immiscible liquids
10. Adsorption of acetic acid by charcoal
11. Volumetric analysis

COURSE OUTCOMES

At the end of this course work, Students will be able to

1. Determine the physical properties like surface tension and viscosity.
2. Determine rate of reactions and soapnification of oil.
3. Calculate the quantity of adsorbate adsorbed by charcoal.
4. Determine the impurity from Pharmacheutical products and hardness of water.
5. Determine exact concentration of acid and bases present in the industrial wastes.

Mapping of Course Outcomes with Program Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1		1			1					
CO2	2	1				1						
CO3	3	2		1			2					
CO4	3		1									
CO5	2	2										

22ETSP207	COMPUTER PROGRAMMING LABORATORY	L	T	P/D	C
		0	0	3	1.5

COURSE OBJECTIVES

- To enable students to code, compile and test C programs.
- To enable students to design algorithms using appropriate programming constructs for problem solving.
- Identify tasks in which the numerical techniques learned are applicable and apply them to write programs.
- To enable students to segregate large problems into functions using modular programming concepts.
- To enable students to apply pointer and structures in programs effectively.

[The laboratory should be preceded or followed by a tutorial to explain the approach or algorithm to be implemented for the problem given]

Tutorial 1: Problem solving using computers:
Lab1: Familiarization with programming environment
Tutorial 2: Variable types and type conversions:
Lab 2: Simple computational problems using arithmetic expressions
Tutorial 3: Branching and logical expressions:
Lab 3: Problems involving if-then-else structures
Tutorial 4: Loops, while and for loops:
Lab 4: Iterative problems e.g., sum of series
Tutorial 5: 1D Arrays: searching, sorting:
Lab 5: 1D Array manipulation
Tutorial 6: 2D arrays and Strings
Lab 6: Matrix problems, String operations
Tutorial 7: Functions, call by value:
Lab 7: Simple functions
Tutorial 8 & 9: Numerical methods (Root finding, numerical differentiation, numerical integration):
Lab 8 and 9: Programming for solving Numerical methods problems
Tutorial 10: Recursion, structure of recursive calls
Lab 10: Recursive functions
Tutorial 11: Pointers, structures and dynamic memory allocation
Lab 11: Pointers and structures
Tutorial 12: File handling:
Lab 12: File operations

COURSE OUTCOMES

At the end of this course work, Students will be able to

1. Analyze program requirements and develop programs using conditional and looping statements.

2. Write programs for handling arrays and strings.
3. Create C programs with user defined functions and recursive function calls.
4. Utilize pointers and structures for dynamic memory allocation in C programming.
5. Develop C programs for handling files.

Mapping of Course Outcomes with Programme Outcomes												
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**2**	**1**	**1**		**2**							
CO2	**2**	**1**	**1**		**2**							
CO3	**2**	**1**	**1**		**2**							
CO4	**1**	**1**	**1**		**2**							
CO5	**1**	**1**	**1**		**2**							

22ETSP208	ENGINEERING GRAPHICS	L	T	P/D	C
		2	0	3	3

TRADITIONAL ENGINEERING GRAPHICS

Principles of Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Reading a Drawing; Sectional Views; Dimensioning, True Length, Angle.

COMPUTER GRAPHICS

Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modeling; Solid Modeling; Introduction to Building Information Modeling (BIM). (Except the basic essential concepts, most of the teaching part can happen concurrently in the laboratory)

COURSE OBJECTIVES

- To develop the ability to produce simple engineering drawing and sketches based on current practice
- To develop the means for communication of ideas, thoughts and design of objects, related to engineering applications, to others though drawing
- To develop the skills to read manufacturing and construction drawings used in industry
- To develop a working knowledge of the layout of plant and equipment
- To develop skills in abstracting information from calculation sheets and schematic diagrams to produce working drawings for manufacturers, installers and fabricators

UNIT I: INTRODUCTION TO ENGINEERING DRAWING

Introduction to Engineering Drawing: Lettering, Dimensioning and use of drawing instruments. Conic sections: Eccentricity method of/for drawing ellipse, parabola and hyperbola- Tangent and Normal from a point on the curve.

UNIT II: ORTHOGRAPHIC PROJECTIONS

Orthographic projections: Introduction -Projections of points Projections of Straight lines: Determination of true length and true angle of inclinations using half cone and trapezoidal methods -drawing the projections of straight lines using half cone method from true length and true angle of inclinations.

UNIT III: PROJECTIONS OF REGULAR SOLIDS

Projections of solids in simple position: Projections of cube, Tetrahedron, prisms, Pyramids, cone and cylinder. Projections of solids: Auxiliary projections -projections of prisms, pyramids, cylinder and cone when the axis is inclined to only one plane.

UNIT IV: SECTIONS AND SECTIONAL VIEWS OF RIGHT ANGULAR SOLIDS,

Sections of solids: Sections of prisms, pyramids, cylinder and cones -true shape of section. Developments of solids: Developments of lateral surfaces of solids using parallel and radial line methods.

UNIT V: ISOMETRIC PROJECTIONS

Isometric projections: Projections of simple solids. Conversion of pictorial view of simple objects into orthographic projections (only elevation and plan)

OVERVIEW OF COMPUTER GRAPHICS COVERING

Introduction to CAD software: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars). The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.

CUSTOMIZATION & CAD DRAWING

Consisting of setup of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines and other basic geometric entities.

ANNOTATIONS, LAYERING & OTHER FUNCTIONS

Applying dimensions to objects and annotations to drawings; Setting up and use of Layers, Printing document stop a per using the print command; orthographic projection techniques Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation;

TEXT/REFERENCE BOOKS

1. BhattN.D.,Panchal V.M.& Ingle P.R.,(2014), Engineering Drawing, Charotar Publishing House.
2. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education.
3. Agrawal B. &Agrawal C. M. (2012), Engineering Graphics, TMH Publication.
4. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers.
5. (Corresponding set of) CAD Software Theory and User Manuals.

COURSE OUTCOMES

At the end of this course work, Students will be able to

1. Utilize drawing instruments effectively and able to present engineering drawings and sketches.
2. Describe the concept of orthographic, isometric projections of points, lines and regular solids.
3. Visualize the images and drawings in engineering perspective.
4. Practice sectioning of bodies like machines and equipment's.
5. Develop their technical communication skills and promote life-long learning.

Mapping of Course Outcomes with Programme Outcomes												
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1			**2**		**2**					**2**		**2**
CO2	**3**	**3**	**3**	**2**	**2**				**2**	**2**		**2**
CO3	**2**		**2**									
CO4	**3**	**2**	**2**	**2**								
CO5										**3**		**3**

DEPARTMENT OF ELECTRICAL ENGINEERING

VISION

To develop the Department into a "Centre of Excellence" with a perspective to provide quality education and skill-based training with state-of-the-art technologies to the students, thereby enabling them to become achievers and contributors to the industry, society and nation together with a sense of commitment to the profession

MISSION

M1: To impart quality education in tune with emerging technological developments in the field of Electrical and Electronics Engineering.

M2: To provide practical hands-on-training with a view to understand the theoretical concepts and latest technological developments.

M3: To produce employable and self-employable graduates.

M4: To nurture the personality traits among the students in different dimensions emphasizing the ethical values and to address the diversified societal needs of the Nation

M5: To create futuristic ambience with the state-of-the-art facilities for pursuing research.

PROGRAM EDUCATIONAL OBJECTIVES

PEO1: Envisage a solid foundation in Basic Sciences, Electrical and Electronics engineering for a successful career and Life-long Learning in the fields of having Societal Implications.

PEO2: Design and implement effective solutions for complex Electrical and Electronics Engineering problems using modern tools and techniques.

PEO3: Establish Professionalism, Good Communication skills and ethical attitude in multi-disciplinary team work.

PEO4: Apply creative thinking and critical reasoning skills in collaborative research

PEO5: Contribute to the economic growth of the country by creating job opportunities through entrepreneurship.

PROGRAM OUTCOMES (POs)

After the successful completion of ***B.E (Electrical and Electronics Engineering)*** *Program the students will be able to:*

PO1: Engineering Knowledge

Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem Analysis

Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/Development of Solutions

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.

PO4: Conduct Investigations of Complex Problems

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.

PO5: Modern Tool Usage

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.

PO6: The Engineer and Society

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.

PO7: Environment and Sustainability

Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics

Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and Team Work

Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication

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.

PO11: Project Management and Finance

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.

PO12: Life-Long Learning

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)

At the time of graduation, the students will be able to:

PSO 1: Identify, formulate and investigate various problems of electrical and electronic circuits, power electronics and power systems by applying the fundamental knowledge of mathematics, science and engineering.

PSO 2: Design, develop and implement multidisciplinary projects in the field of electrical power and energy using state-of-the-art technologies and modern software tools.

PSO 3: Develop effective communication skills and leadership qualities with professional and ethical responsibilities to meet the global technological challenges of the society and electrical industry.

Mapping PO with PEO															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
PEO1	**3**											**3**	**3**		
PEO2	**3**	**2**	**3**		**3**	**1**	**1**						**2**		**3**
PEO3						**3**		**3**	**2**	**3**	**1**			**3**	**3**
PEO4	**2**	**2**		**2**		**3**					**3**		**1**	**3**	
PEO5	**1**		**2**			**2**	**2**	**2**			**3**	**1**			**2**

SEMESTER III

22ETBS301	MATHEMATICS - III	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES

- To understand the basic concepts of partial differential equations which is helpful in solving real world problems
- Introduce Fourier series which is very useful in the study of electrostatics, acoustics and computing.
- Introduce boundary value problems which is helpful in investigation of the important features of electromagnetic theory.
- The study of Fourier transformer is useful in solving problem in frequency response of a filter and signal analysis.
- Provide a study of Z-transform which can played important role in the development of communication engineering.

UNIT I: PARTIAL DIFFERENTIAL EQUATIONS

Formation of partial differential equations by eliminating arbitrary constants and arbitrary functions - Solution of standard type of first order partial differential equations - Lagrange's linear equation - Linear partial differential equations of second order with constant coefficients.

UNIT II: FOURIER SERIES

Dirichlet's conditions - General Fourier series - Odd and Even functions - Half range sine series - Half range cosine series - Complex form of Fourier series - Parseval's identity.

UNIT III: BOUNDARY VALUE PROBLEMS

Solutions of one dimensional wave equation - One dimensional heat equation (without derivation) - Fourier series solutions in Cartesian co-ordinates.

UNIT IV: FOURIER TRANSFORM

Fourier integral theorem (without proof) - Fourier transform pair - Sine and Cosine transforms - Properties - Transforms of simple functions - Convolution theorem - Parseval's identity.

UNIT V: Z -TRANSFORM AND DIFFERENCE EQUATIONS

Z - Transform - Elementary properties - Inverse Z - transform - Convolution theorem -Solution of difference equations using Z - transform.

TEXT BOOKS

1. Kandasamy, P., Thilagavathy, K. and Gunavathy, K., "Engineering Mathematics", 6thed., (Vol - I and II) S. Chand and Co Ltd. 2006, New Delhi.
2. Ventakataraman, M.K., 2003. "Engineering Mathematics". The National Publishing Co.,Chennai.

REFERENCES

1. Ramana B v., "higher engineering mathematics".,2007, Tata McGraw Hill Pub.
2. Veerarajan, T., "Engineering Mathematics", 3rd edition, 2005, Tata McGraw Hill Pub.
3. Vairamanickam.K., Nirmala.P., Tamilselvan.S., "Transform and Partial Differential Equations"., 2014,Scitech Publications(India) Pvt. Ltd
4. Singaravelu, A., "Engineering Mathematics", Meenakshi Publications, Chennai, 2004.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Acquire basic understanding of the most common partial differential equations.
2. Understand the concept of Fourier series.
3. Ability to solve boundary value problems.
4. Able to investigate signals problems using Fourier transform.
5. Familiarize Z-transform that play important roles in many discrete engineering problems

Mapping with Programme Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**3**	**3**	**2**									**2**		
CO2	**3**	**3**	**3**	**2**									**2**		
CO3	**3**	**3**	**3**	**2**									**2**		
CO4	**3**	**3**	**3**	**2**									**2**		
CO5	**3**	**3**	**3**	**2**									**2**		

22ETES302	ENVIRONMENTAL STUDIES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To realize the importance of environment for engineering students.
- To understand the basics of ecosystems.
- To discuss various aspects of bio diversity and its conservation.
- To make aware the student about global environmental pollution problems and natural disasters.
- To give the ideas about advance technologies of engineering that will be useful to protect environment.

UNIT I: MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES

Definition, scope and importance - Need for public awareness. Natural resources and associated problems - Forest resources: use and over - Exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people. Water resources: use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Mineral resources: use and exploitation, environmental effects of extracting and using mineral resources, case studies. Food resources: world food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer - Pesticide problems, water logging, salinity, case studies. Energy resources: growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies - Land resources: land as a resource, land degradation, man induced landslides, soil erosion and desertification -Rrole of an individual in conservation of natural resources.- Equitable use of resources for sustainable lifestyles.

UNIT II: ECOSYSTEMS

Concept of an ecosystem - Structure and function of an ecosystem - Producers, consumers and decomposers - Energy flow in the ecosystem -Ecological succession - Food chains, food webs and ecological - pyramids - Introduction, types, characteristic features, structure and function of the following ecosystem - Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

UNIT III: BIODIVERSITY AND ITS CONSERVATION

Introduction - Definition: genetic, species and ecosystem diversity - Bio geographical classification of India - Value of biodiversity : consumptive use, productive use, social, ethical, aesthetic and option values - Biodiversity at global, National and local levels - India as a mega-diversity nation - Hot-spots of biodiversity - Threats to biodiversity: habitat loss, poaching of

wildlife, man-wildlife conflicts - Endangered and endemic species of India - Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

UNIT IV: ENVIRONMENTAL POLLUTION

Definition - Cause, effects and control measures of Air pollution - Water pollution - Soil pollution - Marine pollution- Noise pollution - Thermal pollution - Nuclear hazards- Solid waste Management: Causes, effects and control measures of urban and industrial wastes - Role of an individual in prevention of pollution - Disaster management: floods, earthquake, cyclone and landslides. Sustainable development - Urban problems related to energy - Water conservation, rain water harvesting, and watershed management - Resettlement and rehabilitation of people; its problems and concerns. - Environmental ethics: Issues and possible solutions - Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust.

Wasteland reclamation - Consumerism and waste products - Environment Protection Act - Air (Prevention and Control of Pollution) Act - Water (Prevention and control of Pollution) Act - Wildlife Protection Act - Forest Conservation Act - Issues involved in enforcement of environmental legislation.

UNIT V: HUMAN POPULATION AND THE ENVIRONMENT

Population growth, variation among nations - Population explosion - Family Welfare Programme - Environment and human health - Human Rights - Value Education - HIV/AIDS - Women and Child Welfare - Role of Information Technology in Environment and human health - Case Studies.

FIELD WORK

Visit to a local area to document environmental assets - River / Forest / Grassland / Hill / Mountain - Visit to a local polluted site - Urban/Rural/Industrial/Agricultural - Study of common plants, Insects, Birds - Study of simple ecosystems - Pond, River, Hill Slopes, etc. **(Field work equal to 5 lecture)**

TEXT BOOKS

1. Agarwal, K.C., 2001. “Environmental Biology”, Nidi Publ. Ltd. Bikaner.
2. Bharucha Erach, “The Biodiversity of India”, Mapin Publishing Pvt. Ltd., Ahmedabad - 380 013, India, Email:mapin@icenet.net (R).

REFERENCES

1. Brunner, R.C., 1989. “Hazardous Waste Incineration”, McGraw Hill Inc. 480p.
2. Clark, R.S., “Marine Pollution”, Clanderson Press Oxford (TB).

3. Cunningham, W.P. Cooper, T.H. Gorhani, E and Hepworth, M.T., 2001. "Environmental Encyclopedia", Jaico Publ. House, Mumbai, 1196p.
4. De A.K., "Environmental Chemistry", Wiley Eastern Ltd.
5. Down to Earth, Centre for Science and Environment (R).
6. Gleick, H.P. 1993. Water in crisis, Pacific Institute for Studies in Dev., "Environment and Security" Stockholm Env. Institute Oxford Univ. Press. 473p.
7. Hawkins, R.E., "Encyclopedia of Indian Natural History", Bombay Natural History Society, Bombay (R).
8. Heywood, V.H. and Waston, R.T., 1995. "Global Biodiversity Assessment". Cambridge Univ. Press 1140p.
9. Jadhav, H. and Bhosale, V.M. 1995. "Environmental Protection and Laws". Himalaya Pub. House, Delhi 284 p.
10. Mckinney, M.L. and School, R.M., 1996. "Environmental Science systems and Solutions", Web enhanced edition. 639p.
11. Mhaskar A.K., "Matter Hazardous", Techno-Science Publication (TB).
12. Miller, T.G. Jr., "Environmental Science", Wadsworth Publishing Co. (TB).
13. Odum, E.P., 1971. "Fundamentals of Ecology". W.B. Saunders Co. USA, 574p.
14. Rao M N. andDatta, A.K., 1987. "Waste Water treatment". Oxford and IBH Publ. Co. Pvt. Ltd. 345p.
15. Sharma B.K., 2001. "Environmental Chemistry". Geol Publ. House, Meerut.
16. Survey of the Environment, The Hindu (M).
17. Townsend, C., Harper J., and Michael Begon, "Essentials of Ecology", Blackwell Science (TB).
18. Trivedi, R.K., "Handbook of Environmental Laws, Rules Guidelines, Compliances and Stadards", Vol I and II, Enviro Media (R).
19. Trivedi, R. K. and P.K. Goel, "Introduction to air pollution", Techno-Science Publication (TB).
20. Wanger, K.D., 1998. "Environnemental Management'. W.B. Saunders Co. Philadelphia, USA 499p.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Understand the importance of environment.
2. Analyze the importance of environment in engineering.
3. Apply their own ideas and demonstrate advanced technologies that will be useful to protect environment.
4. Employ awareness among the society about environmental problems and natural disasters.
5. Practice according to the present and future environmental issues.

Mapping with Programme Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**2**	**1**					**2**				**2**		**2**		
CO2		**2**	**2**										**1**		
CO3					**1**		**2**		**2**						1
CO4						**2**			**2**				**1**		
CO5						**2**			**2**				**2**		

22ETES303	ENGINEERING MECHANICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce the fundamentals of forces and their effects with their governing laws.
- To understand the definitions of particle, body forces and their equilibrium conditions.
- To discuss about geo material properties of different types of surfaces of solids.
- To analyze the dynamics of particles and Newton's law of motion.
- To understand and predict the forces and its related motions.

UNIT I: STATICS OF PARTICLES

Introduction - Units and dimensions - Laws of mechanics - Lami's theorem - Parallelogram, triangular and polygon law of forces - Classification of forces - Vectorial representation of forces - Coplanar forces - Resolution of forces. Equilibrium of particle - Vector representation of space force - Equilibrium of particle in space - Equivalent system of forces - Principle of transmissibility.

UNIT II: EQUILIBRIUM OF RIGID BODIES

Free body diagram - Types of supports - Types of loads - Types of beams - Action and reaction of forces - Moments and couples - Moment of a force - Vectorial representation of moments and couples. Varignon's theorem - Stable equilibrium - Single equivalent force - Equilibrium of rigid bodies in two dimensions and three dimensions.

UNIT III: GEOMETRICAL PROPERTIES OF SURFACES AND SOLIDS

Centroid and centre of gravity - Determination of centroid of sections of different geometry - Centre of gravity of a body - Area moment of inertia - Parallel axis theorem - Perpendicular axis theorem - Determination of moment of inertias of rectangular, triangular, circular and semi - Circular - Moment of inertias of structural steel sections of standard and composite sections. Polar moment of inertia - Radius of gyration - Principal moment of inertia - Mass moment of inertia - Determination of mass moment of inertia of a thin rectangular plate, thin circular disc, solid cylinder, prism, sphere and cone from first principles.

UNIT IV: DYNAMICS OF PARTICLES

Introduction - Kinematics and kinetics - Displacements, velocity and acceleration - Equations of motion - Types of motion - Rectilinear motion - Relative motion - Curvilinear motion - Projectiles. Newton's laws of motion - Linear momentum - Impulse and momentum - d'alembert's principle - Dynamic equilibrium - Work energy equations - Law of conservation of energy -Principle of work and energy.

UNIT V: FRICTION AND ELEMENTS OF RIGID BODY DYNAMICS

Friction force - Laws of sliding friction - Equilibrium analysis of simple systems with sliding friction - Wedge friction. Rolling resistance - Translation and rotation of rigid bodies - Velocity and acceleration - General plane motion of simple rigid bodies such as cylinder, disc/wheel and sphere.

TEXT BOOKS

1. Beer, F.P., and Johnson, R., (2004).“Vector Mechanics for Engineers (Statics)”, McGraw Hill Book Company, New Delhi.
2. Palanichamy, M.S. and Nagan, S., (2010). “Engineering Mechanics (Statics and Dynamics)” Tata McGraw Hill Publishing Company, Ltd., New Delhi.

REFERENCES

1. Natesan, S.C., (2002). “Engineering Mechanics (Statics and Dynamics)”, First Edition, Umesh Publications, New Delhi.
2. S.S.Bhavikatti and K.G. Rajasekarappa,(1999). “Engineering Mechanics”, New Age International (P) Ltd.
3. Sadhu Sing, (2000). “Engineering Mechanics”, Oxford and IBH Publishing Co., NewDelhi.
4. Irving H. Shames, (2006). “Engineering Mechanics”, Prentice Hall of India Ltd., NewDelhi.
5. Hibbeller, R.C. and Ashok Gupta, (2010). “Engineering Mechanics: Statics and Dynamics”, Edition, Pearson Education.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Understand the forces and its related laws of mechanics in static and dynamic conditions.
2. Analyze the forces and its motions on particles, rigid bodies and structures.
3. Solve the moment of inertia of any section and masses for the structural members.
4. Study about Dynamics of particles.
5. Understand the elements of rigid body dynamics.

Mapping with Programme Outcomes															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1			1							1		
CO2	3	3	2			2									2
CO3	3	3	1			1		2			1		2		
CO4	3	3				1			1		2		1		
CO5	3	3				1			1						1

22EEPC304	ELECTRIC CIRCUITS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To study different types of networks and apply mesh and nodal analysis along with graph of a network.
- To understand the concepts of different network theorems and duality
- To introduce the analysis of single and three phase AC circuits.
- To analyze the magnetic circuits and the transient response of circuits.
- To impart knowledge on Two Port Network for the calculation of various network parameters.

UNIT I: DC CIRCUITS

Review of ideal and practical sources - Independent and dependent sources - Types of networks elements - Active, passive, linear, nonlinear, unilateral, bilateral, lumped and distributed- Linear relation between voltage and current in network elements - Kirchhoff's Laws - Mesh, Super mesh and Node, Super node analysis of DC circuits. Introduction to the graph of a network - Oriented graph - Tree - Link - Tie set and cut set schedule.

UNIT II: NETWORK THEOREMS

Network theorems and transformations - Star-delta transformation - Superposition theorem - Thevenin's theorem - Norton's theorem - Maximum power transfer theorem - Reciprocity theorem Compensation theorem - Millman's theorem - Tellegen's theorem - Power division theorem - Concept of duality and dual networks.

UNIT III: SINUSOIDAL STEADY STATE ANALYSIS

AC circuit analysis - average power and complex power - Application of basic theorems in the analysis of ac circuits - Resonance in series and parallel circuits - Q factor - bandwidth of resonant circuits - Three phase circuits: three phase sources - Analysis of three phase 3 wire and 4 wire circuits with balanced and unbalanced loads - power relations.

UNIT IV: MAGNETIC CIRCUITS AND TIME DOMAIN ANALYSIS

Magnetic circuit concepts and laws - Series and Parallel circuits - Statically and dynamically induced emf - Coupled circuits - Self and mutual inductances - Coefficient of coupling - Dot Convention in coupled circuits - Analysis of magnetically coupled circuits - Single and double tuned coupled circuits.

Time domain analysis: step, ramp, sinusoidal and impulse functions - Review of Laplace transform - Solution of circuit problems using Laplace transform - Transient response of R, L, C circuits with different types of forcing functions.

UNIT V: TWO PORT NETWORK AND NETWORK FUNCTIONS

Two Port Networks, terminal pairs, relationship of two port variables and governing equations, impedance parameters, admittance parameters, transmission parameters and hybrid parameters - Interconnections of two port networks.

TEXT BOOKS

1. Sudhakar, A. and Shyam Mohan, S.P., "Circuits and Network Analysis and Synthesis" Tata McGraw Hill Publishing Company Limited, New Delhi, Fourth Edition, 2010.

REFERENCES

1. M. E. Van Valkenburg, "Network Analysis", Prentice Hall, 2006.
2. D. Roy Choudhury, "Networks and Systems", New Age International Publications, 1998.
3. W. H. Hayt and J. E. Kemmerly, "Engineering Circuit Analysis", McGraw Hill Education, 2013.
4. C. K. Alexander and M. N. O. Sadiku, "Electric Circuits", McGraw Hill Education, 2004.
5. K. V. V. Murthy and M. S. Kamath, "Basic Circuit Analysis", Jaico Publishers,1999
6. S. Salivahanan and S. Pravin Kumar, "Circuit Theory", Vikas Publishing, 2014.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Understand the basics concepts of electric circuits.
2. Apply network theorems for analyzing electrical circuits
3. Obtain the steady-state response and investigate the resonance nature of electrical circuits.
4. Analyze the sinusoidal source driven electric circuits in transient-state and their magnetic state variables.
5. Acquire an insight of two port networks and parameters.

Mapping with Programme Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**2**	**3**	**2**		**2**						**3**	**3**	**2**	
CO2	**3**	**3**	**3**	**2**		**2**						**2**	**3**	**3**	
CO3	**3**	**2**	**2**	**3**		**2**						**3**	**2**	**3**	
CO4	**3**	**3**	**2**	**2**		**1**						**2**	**2**	**2**	
CO5	**3**	**2**	**2**	**3**		**1**						**2**	**3**	**2**	

22EEPC305	ANALOG ELECTRONIC CIRCUITS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To provide sound knowledge of the fundamentals of electronic circuits
- To analyze the BJT circuits and its characteristics
- To introduce a MOSFET and small signal models
- To understand the concepts of feedback amplifier and
- To study the op-amp circuits and its applications

UNIT I: PN JUNCTION DEVICES AND ITS APPLICATIONS

Review of Semiconductor theory - N-type and P-type semiconductors - Formation of PN junction - Biasing of PN junction - Diffusion and transition capacitance - Diode - Structure, operation and V-I characteristic- Temperature effects - Diode current equation - Power diodes - Zener diode - Structure, operation and V-I characteristics - Zener diode as voltage regulator. Diode clampers and clippers - Rectifiers: HWR, FWR, BR,- Filters .

Principle of operation and characteristics of SCR, UJT, opto electronic devices - Photodiode- PIN photodiode - LED.

UNIT II: BJT CIRCUITS

Structure, operation and I-V characteristics of a BJT: BJT as a switch. BJT as an amplifier, biasing circuits, common - Emitter, common - Base and common - Collector amplifiers; Difference Amplifier - Class A,B,C and Push - Pull Amplifier - Transformer coupled amplifier - Tuned amplifiers - Single tuned, double tuned and stagger tuned amplifiers.

UNIT III: MOSFET CIRCUITS

MOSFET structure, operation and I-V characteristics - MOSFET as a switch - MOSFET as an amplifier: Biasing circuits, common - Source, common - Gate and common - Drain amplifiers gain, input and output impedances, Trans conductance.

UNIT IV: FEEDBACK AMPLIFIERS AND OSCILLATORS

Concept of feedback - Types - Derivation of gain - Merits and demerits of negative feedback and positive feedback - Negative feedback types (voltage / current, series / shunt feedback) - Input and output impedance - Classification of oscillators - Equation for the oscillation - Condition for oscillations - Phase shift, crystal oscillators.

UNIT V: OPERATIONAL AMPLIFIERS

Internal structure of an operational amplifier, ideal op-amp, non - Idealities in an op-amp (Output offset voltage, input bias current, input offset current, slew rate, gain band width product) - Idealized analysis of op-amp circuits. Inverting and non-inverting amplifier,

differential amplifier, instrumentation amplifier, integrator, active filter, voltage regulator, Oscillators.

TEXT BOOKS

1. Jacob Milman, Christos. C. Halkias and Satyabratajit, "Electronic Devices and Circuits" Tata McGraw Hill Education Pvt. Ltd., Third Edition (Special Indian Edition), 2010.
2. A. S. Sedra and K. C. Smith, "Microelectronic Circuits", New York, Oxford University Press, 1998.
3. J. V. Wait, L. P. Huelsman and G. A. Korn, "Introduction to Operational Amplifier theory and Applications", McGraw Hill U. S., 1992.

REFERENCES

1. J. Millman and A. Grabel, "Microelectronics", McGraw Hill Education, 1988.
2. S. Salivahanan and N. Suresh Kumar, "Electronic Devices and Circuits" Tata McGraw Hill Education, Third Edition, 2012.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Provide exposure to basic electronic devices.
2. Understand the characteristics of transistors.
3. Acquire knowledge about MOSFET.
4. Design and analyze feedback amplifier and oscillator circuits.
5. Able to design OP-AMP based circuits.

Mapping with Programme Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**3**	**3**	**2**		**2**						**3**	**3**	**2**	
CO2	**3**	**2**	**3**	**2**		**2**						**2**	**3**	**2**	
CO3	**3**	**2**	**3**	**2**		**1**						**1**	**3**	**2**	
CO4	**3**	**2**	**2**	**3**		**2**						**3**	**3**	**2**	
CO5	**3**	**2**	**2**	**2**		**2**						**3**	**3**	**2**	

22EEPC306	ELECTRICAL MACHINES - I	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To gain knowledge about magnetic materials and the concepts of magnetic circuits
- To understand the fundamental related to construction, working principle and types of DC generator.
- To gain knowledge about the construction, working principle and types of DC motor.
- To understand the construction, working principle of transformer and the importance of different connections in the winding of three phase transformers
- To study the various testing methodologies of transformers and testing methods.

UNIT I: MAGNETIC CIRCUITS AND MAGNETIC MATERIALS

Magnetic circuits - Laws governing magnetic circuits - Flux linkage, Inductance and energy - Statically and dynamically induced EMF - Torque - Properties of magnetic materials, Hysteresis and Eddy Current losses - AC excitation, introduction to permanent magnets - Transformer as a magnetically coupled circuit.

UNIT II: DC GENERATORS

Construction and components of DC Machine - Principle of operation - Lap and wave windings- EMF equations - Circuit model - Armature reaction - Methods of excitation commutation - Inter poles compensating winding - Performance characteristics of separately excited, shunt and cumulatively compounded generators.

UNIT III: DC MOTORS

Principle and operations - Types of DC Motors - Torque equation - Performance Characteristics of DC Motors - Types of starters and speed control of DC motors - Plugging, dynamic and regenerative braking testing and efficiency - Retardation test- Swinburne's test and Hopkinson's test - Permanent Magnet DC (PMDC)motors-Applications

UNIT IV: TRANSFORMERS

Construction - Principle of operation - EMF Equation - Equivalent circuit parameters - Phasor diagrams, losses - Inrush current - Three phase transformers - Connections - Scott Connection- Phasing of transformer - Parallel operation of three phase transformers - Auto transformer - Tap changing transformers - Tertiary winding.

UNIT V: TESTING OF TRANSFORMERS

O.C and S.C tests - Voltage regulation and efficiency calculation on the basis of equivalent circuit - All day efficiency - Sumpner's test - Pseudo load test on three phase transformer - Separation of core losses - Scott connection - Open delta connection, vector groups, regulating transformers and phase shifters, use of tertiary winding in three phase transformers.

TEXT BOOKS

1. Say M.G. and Taylor E.O. "Direct Current Machines" ELBS edition; 1985.
2. Nagrath I.J. and Kothari D.P. "Electrical Machines" Tata McGraw Hill Publishing Company Limited, New Delhi; II Edition;1998.

REFERENCE BOOKS

1. Clayton. A.E and Hancock "Performance and Design of Direct Current Machines" Oxford and IBH publishing Co; 1988.
2. Hughes. E "Electrical Technology" ELBS and Longman edition; 1975.
3. Theraja B.L. and Theraja A.K. "A Text Book of Electrical Technology-Vol II", S.Chand and Company Ltd; 2000
4. Bimbhra P.S. "Electrical Machinery" Khanna Publishers; 1998.
5. Murugesh Kumar K "D.C. Machines and Transformers" Vikas Publishing House1999
6. Bhattacharya S.K. "Electrical Machines" Tata McGraw Hill Publishing Company Limited, New Delhi; 1998.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Learn about the magnetic circuit, flux linkages and properties of magnetic materials.
2. Understand the construction, working principle of dc generator and predict the performance characteristics of various types of dc generator.
3. Explain the working principle of dc motor, its types, characteristics and methods of controlling the speed.
4. Demonstrate the construction, working principle of transformer and the different connections in the winding of three phase transformers.
5. Study the different testing methods available to access the performance of three phase transformer.

Mapping with Programme Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**2**	**3**	**2**		**1**						**2**	**3**	**2**	
CO2	**3**	**2**	**3**	**2**		**2**	**1**					**2**	**3**	**3**	
CO3	**3**	**2**	**3**	**2**		**2**	**2**				**1**	**2**	**2**	**3**	
CO4	**3**	**2**	**2**	**2**		**1**	**2**				**1**	**2**	**2**	**2**	
CO5	**3**	**2**	**2**	**2**		**2**	**1**					**2**	**3**	**2**	

22EEES307/ 22EESP307	FLUID MECHANICS AND HYDRAULIC MACHINERY/ HYDRAULICS LAB	L	T	P	C
		2	0	2	3

FLUID MECHANICS AND HYDRAULIC MACHINERY

COURSE OBJECTIVES

- To understand the physical properties of fluids, fluid pressure and its measurement.
- To derive the equation of conservation of mass and its application.
- To solve problems of fluid kinematics and dynamics specifically flow through pipes and open channel flow.
- To use important concepts of continuity equation, bernoulli's equation and apply the same to problems.
- To study the performance of turbines, radial flow, reaction turbines and governing of turbines.
- To study the characteristics of centrifugal pumps and reciprocating pumps.

UNIT I: PROPERTIES OF FLUIDS, FLUID PRESSURE AND ITS MEASUREMENT

Mass Density, Specific Weight, Specific Volume, Specific Gravity, Viscosity - Newton's Law of Viscosity - Compressibility - Surface Tension and Capillarity - Real and Ideal Fluids - Pressure - Atmospheric and Vacuum Pressures - Measurement of Pressure by Manometers and Pressure Gauges - Total Pressure and Centre of Pressure - Buoyancy - Metacentre

UNIT II: DYNAMICS OF FLUID FLOW

Kinematics of Flow - Types of Fluid Flow - Continuity Equation - Euler's Equation of Motion - Bernoulli's Equation - Practical Applications - Venturi Meter, Orifice Meter and Pitot Tube.

UNIT III: FLOW THROUGH PIPES

Loss of Energy Due to Friction - Minor Energy Losses - Hydraulic Gradient and Total Energy Line - Flow Through Pipes in Series - Flow Through Parallel Pipes - Power Transmission Through Pipes.

UNIT IV: TURBINES

General Layout of a Hydroelectric Power Plant - Classification of Turbines - Velocity Triangles for Turbines - Work Done and Efficiency, Specific Speed - Impulse Turbine- Pelton Wheel - Reaction Turbine - Francis Turbine - Simple Problems - Selection of Turbines.

UNIT V: PUMPS

Centrifugal Pumps - Main Parts - Work Done - Definitions of Heads and Efficiencies - Multistage Pumps - Specific Speed - Priming - Cavitation - Reciprocating Pumps - Main Parts

- Working Principle - Slip - Indicator Diagrams - Maximum Speed of a Reciprocating Pump - Study of Air Vessels

TEXT BOOKS

1. P.N. Modi & Dr. S.M. Seth, "Hydraulics and Fluid Mechanics Including Hydraulics Machines", 20th Edition, Standard Book House, New Delhi; 2015.
2. R.K. Bansal, "A Text Book Of Fluid Mechanics and Hydraulic Machines" Laxmi Publications (P) Ltd, Madras; 2011.
3. Jagdish Al, "Fluid Mechanics and Hydraulics with Computer Applications", Metropolitan Book Company, 9th Edition, New Delhi; 2014.

REFERENCES

1. K.L. Kumar, "Engineering Fluid Mechanics", Eurasia Publishing House (P) Ltd. 8th Edition, New Delhi, 2014.
2. V.P. Vandana, "Theory and Design of Hydraulic Machines Including Basic Fluid Mechanics", Khanna Publishers, 11th Edition, New Delhi, 2016.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Apply the basic knowledge of fluid mechanics in finding fluid properties, performance Parameters of hydraulic turbines and pumps.
2. Understand various dynamics of fluid flow.
3. Use fluid dynamics for study of flow through pipes.
4. Present hydraulic design for the construction of efficient hydraulic turbines and pumps.
5. Get through knowledge of different kinds of pumps.

Mapping with Programme Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**3**			**1**		**1**						**1**		
CO2	**3**	**3**									**1**				**1**
CO3	**3**	**3**	**1**		**1**		**1**						**1**		
CO4	**3**	**3**	**1**	**2**	**1**								**1**		**1**
CO5	**3**	**3**					**1**				**1**				**1**

HYDRAULICS LAB

COURSE OBJECTIVES

- To understand the properties of fluids and fluid statics, methods for determination of co-efficient of discharge are to be explained and computed practically.
- To study of the characteristic features of pumps and turbines using experiments.
- To understand the significance and role of such utilities in their further course of study.

LIST OF EXPERIMENTS

1. Determination of Co-efficient of discharge of Mouth Piece
2. Determination of Co-efficient of discharge of Venturi meter
3. Determination of Co-efficient of Head loss due to Sudden Change in Section
4. Determination of Co-efficient of Head loss due to Friction in Pipe
5. Determination of Co-efficient of discharge of Rectangular Notch
6. Study of Performance characteristics of Elmo Pump (Centrifugal Pump)
7. Study of Performance characteristics of Sump Pump (Centrifugal Pump)
8. Study of Performance characteristics of Submersible Pump (Centrifugal Pump)
9. Study of Performance characteristics of Gould's Pump (Reciprocating Pump)
10. Study of Performance characteristics of Pelton Turbine (Constant Speed method)
11. Study of Performance characteristics of Francis Turbine (Constant Head method)

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Determine the properties of fluids, pressure and their measurements.
2. Measure flow in pipes and determine frictional losses.
3. Apply continuity equation and energy equation in solving problems on flow through conduits.
4. Determine the performance characteristics of pumps.
5. Determine the performance characteristics of turbines.

Mapping with Programme Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**2**	**1**		**2**		**2**							**2**	**2**	**1**
CO2	**1**	**2**				**2**							**1**	**1**	**2**
CO3	**1**	**2**				**2**							**1**	**1**	**2**
CO4	**1**	**1**				**1**								**1**	**1**
CO5	**1**	**1**				**1**							**1**	**1**	**1**

22EECP308	CIRCUITS AND DEVICES LAB	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES

- To understand and learn the relative theory.
- To build up appropriate methodology for articulation of circuit / algorithm implementation.
- To set-up the relevant connections for executing the experiment / code the methodology evolved.
- To carry out / employ the methodology.
- To surmise / arrive at inferences from the results.

LIST OF EXPERIMENTS

1. Verification of Thevenin's and Norton's theorem.
2. Verification of super position theorem.
3. Verification of maximum power transfer theorem.
4. Measurement of frequency and phase angle of AC circuits
5. Performance characteristics of series and parallel resonance circuits.
6. Performance characteristics half wave and full wave rectifier
7. Performance characteristics of Zener diode and Zener diode as voltage regulator
8. Performance characteristics of BJT
9. Performance characteristics of UJT
10. Performance characteristics of MOSFET
11. Performance characteristics of SCR
12. Performance characteristics of light dependent resistor
13. Simulation of AC circuit Analysis
14. Simulation of DC transients' analysis for RL and RC circuits
15. Simulation of half wave and full wave rectifiers with capacitor filter
16. Simulation of wave shaping circuits

COURSE OUTCOMES

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

1. Learn the relative theory.
2. Develop the appropriate methodology for articulation of circuit / algorithm implementation.
3. Contrivance the relevant connections for executing the experiment / code the methodology evolved.
4. Execute / implement the methodology.
5. Infer / arrive at inferences from the results.

Mapping with Programme Outcomes															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												2		
CO2	3	2												2	
CO3			2											2	
CO4		2											2		
CO5	2												2		

22EECP309	ANALOG ELECTRONICS LAB	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES

- To understand and learn the relative theory.
- To build up appropriate methodology for articulation of circuit / algorithm implementation.
- To set-up the relevant connections for executing the experiment / code the methodology evolved.
- To carry out / employ the methodology.
- To surmise / arrive at inferences from the results.

LIST OF EXPERIMENTS

1. Transistor biasing circuits
2. Characteristics of power amplifiers
3. Frequency response characteristics of amplifiers
4. Characteristics of tuned amplifiers
5. Astable and bistable multivibrator using BJT
6. Schmitt trigger using BJT
7. Feedback amplifiers
8. RC phase shift oscillator
9. Wein bridge oscillator
10. Hartley and colpitts oscillators using BJT
11. Characteristics of MOSFET based amplifiers
12. Inverting and non-inverting amplifiers
13. Simulation of monostable multivibrator using BJT
14. Simulation of mathematical operations using op-amp
15. Simulation of zero crossing detector using op-amp
16. Simulation of sine wave, square wave and saw tooth wave generator using op-amp

COURSE OUTCOMES

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

1. Learn the relative theory.
2. Develop the appropriate methodology for articulation of circuit / algorithm implementation.
3. Contrivance the relevant connections for executing the experiment / code the methodology evolved.
4. Execute / implement the methodology.
5. Infer / arrive at inferences from the results.

Mapping with Programme Outcomes															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3						2					2	2	
CO2	3	3			2								2	2	
CO3	3	3		2				2					2	2	
CO4	3	3	3	2				2					2		
CO5	3	3	3	2	2			2					2		

SEMESTER IV

22ETBS401	PROBABILITY, RANDOM PROCESS AND NUMERICAL METHODS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- Introduce probability theory which is helpful in investigating the important features of the random experiment.
- To understand the basic concepts of random processes which are widely used in electric field
- The aim of theory of sampling is to get as much information as possible of the population to the process of making scientific judgments in the face of uncertainty and variation.
- To develop the skills of the students in finding numerical solution of interpolation, differentiation and integration problems.
- Provide the study of numerical solution of algebraic and transcendental equations, the numerical solution of ordinary and partial differential equations.

UNIT I: PROBABILITY AND RANDOM VARIABLES

Definition - Types of random variables - Probability distribution function - Probability density function - Expectation and moments - Moment generating functions - Joint probability distribution - Marginal probability distribution function - Joint probability density function - Marginal probability density function - Conditional probability density function.

UNIT II: RANDOM PROCESSES

Classification of random processes - Methods of description of a random process - Special classes of random processes - Average values of random process - Stationary - Auto correlation function and its properties - Cross correlation function and its properties.

UNIT III: TEST OF SIGNIFICANCE

Hypothesis, testing - Large sampling tests - Small sampling test based on t, F and chi - Square distributions - Interval estimates of mean, standard deviation and proportion.

UNIT IV: INTERPOLATION, NUMERICAL DIFFERENTIATION AND INTEGRATION

Interpolation: Gregory Newton forward and backward interpolation formula; Stirling's central difference formula; Lagrange's interpolation formula for unequal interval. Numerical differentiation: Using Newton's forward and backward interpolation formula. Numerical integration: Trapezoidal rule, Simpson's one-third and three-eight rules.

UNIT V: SOLUTION OF ALGEBRAIC, TRANSCENDENTAL AND ORDINARY DIFFERENTIAL EQUATIONS

Solution of algebraic and transcendental equations: Bolzano's bisection method, Regula-falsi method, Newton - Raphson method. Solution of simultaneous algebraic equation: Gauss elimination method, Crout's method, Gauss - Seidel iteration method. Solution of ordinary differential equations: Taylor series method, Runge - Kutta fourth order method, Milne's - Predictor corrector method.

TEXT BOOKS

1. Kandasamy, P., Thilagavathy, K., and Gunavathy, K., "Probability and Random Processes", S.Chand and Co. Ltd. 2006, New Delhi.
2. Veerarajan, T., "Probability theory and Random Process", Tata McGraw Hill Co., Ltd., New Delhi, 2005.
3. Venkataraman, M.K., "Numerical methods in Science and Engineering", National Publishing Co., Chennai, 2003.

REFERENCES

1. Lipschutz, S., and Schiller, J., Schaums's "Outlines - Introduction to Probability and Statistics", McGraw Hill, New Delhi, 1998.
2. Kandasamy, P., Thilagavathy, K. and Gunavathy, K., "Numerical Methods", S.Chand and Co. Ltd., New Delhi, 2004.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Acquire skills in handling situations involving random variables, random processes.
2. Ability to solve problems for engineers in using numerical methods.
3. Acquire skills in solving algebraic transcendental equations.
4. Able to obtain solution of ordinary and partial differential equations.
5. Acquire knowledge on different numerical methods.

Mapping with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2									2		
CO2	3	3	2	2									2		
CO3	3	3	2	2									2		
CO4	3	3	3	2									2		
CO5	3	3	3	2									2		

22ETES402	DATA STRUCTURE AND ALGORITHMS	L	T	P	C
		2	0	0	2

COURSE OBJECTIVES

- To impart the basic concepts of data structures and algorithms.
- To understand basic concepts about stacks and queues.
- To explain the theory of linked lists, its types and its use in algorithmic analysis
- To enable a framework for trees and bring out its applications on algorithms.
- To enumerate the importance of sorting and hashing.

UNIT I: INTRODUCTION

Basic Terminologies: Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off. **Searching:** Linear Search and Binary Search Techniques and their complexity analysis

UNIT II: STACKS AND QUEUES

DT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation - Corresponding algorithms and complexity analysis. ADT queue, Types of Queue: Simple Queue, Circular Queue, Priority Queue; Operations on each types of Queues: Algorithms and their analysis.

UNIT III: LINKED LISTS

Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion in to, Deletion from linked list; Linked representation of Stack and Queue, Header nodes, doubly linked list: operations on it and algorithmic analysis; Circular Linked Lists: all operations their algorithms and the complexity analysis.

UNIT IV: TREES

Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees. B Tree, B+ Tree: definitions, algorithms and analysis.

UNIT V: SORTING AND HASHING

Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods, Hashing.

Graph: Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis.

TEXT BOOKS

1. Horowitz, Sartaj Sahni, "Fundamentals of Data Structures", Illustrated Edition, Ellis Computer Science Press.
2. E.Balagurusamy, "Data structures using C", McGraw Hill, 2013.

REFERENCES

1. Mark Allen Weiss, "Algorithms, Data Structures, and Problem Solving with C++", Illustrated Edition Addison-Wesley Publishing Company.
2. R.G.Dromey, "How to Solve it by Computer", 2ndImpression by Pearson Education.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Describe an algorithm for computation complexity and justify the correctness.
2. Compare the various queue techniques.
3. Use appropriate data structures like linked lists, Stacks and queue to solve real world problem efficiently.
4. Manipulate data using nonlinear data structures like tree to design an algorithm for various applications.
5. Illustrate the various hashing techniques.

Mapping with Programme Outcomes														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1		**2**				**3**	**3**					**3**			**2**
CO2						**3**	**3**					**2**			**2**
CO3						**3**	**3**					**3**			
CO4						**3**	**3**					**2**			**2**
CO5		**2**				**3**	**3**					**2**			**3**

22EEPC403	ELECTRICAL MACHINES - II	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To teach the constructions, operating principle and the measures for evaluating the performance of three phase induction motors.
- To explain the methods for starting and types of speed control
- To gain knowledge about the construction and operation of synchronous generator
- To acquire knowledge on various aspects of synchronous machines
- To provide basic knowledge about the single phase induction motors and special machines

UNIT I: THREE PHASE INDUCTION MOTOR

Constructional details - Types of rotors - Principle of operation - Slip - Cogging and crawling - Equivalent circuit - Torque-Slip characteristics - Condition for maximum torque - Losses and efficiency - Load test - No load and blocked rotor tests - Circle diagram - Separation of losses - Double cage induction motors - Induction generators - Introduction to magnetic levitation systems - Plain and linear induction motor -Synchronous induction motor.

UNIT II: STARTING AND SPEED CONTROL OF THREE PHASE INDUCTION MOTOR

Need for starting - Types of starters - DOL, Rotor resistance, Autotransformer and Star delta starters - Speed control - Voltage control, Frequency control and pole changing - Cascaded connection - V/f control - Slip power recovery scheme - Braking of three phase induction motor: Plugging, dynamic braking and regenerative braking.

UNIT III: SYNCHRONOUS GENERATOR

Constructional details - Types of rotors - winding factors- Emf equation - Synchronous reactance - Armature reaction - Phasor diagrams of non-salient pole synchronous generator connected to infinite bus-Synchronizing and parallel operation - Synchronizing torque - Change of excitation and mechanical input - Voltage regulation - EMF, MMF, ZPF and A.S.A methods - Steady state power - Angle characteristics - Two reaction theory - Slip test - Short circuit transients - Capability Curves.

UNIT IV: SYNCHRONOUS MOTOR

Principle of operation - Torque equation - Operation on infinite bus bars - V and Inverted V curves - Power input and power developed equations - Starting methods - Current loci for constant power input, constant excitation and constant power developed-Hunting - Natural frequency of oscillations - Damper windings - Synchronous condenser.

UNIT V: SINGLE PHASE INDUCTION MOTORS AND SPECIAL MACHINES

Constructional details of single phase induction motor - Double field revolving theory and operation - Equivalent circuit - No load and blocked rotor test - Performance analysis -Starting methods of single - Phase induction motors -Capacitor - Start Capacitor run Induction motor - Shaded pole induction motor - Linear induction motor - Repulsion motor - Hysteresis motor - AC series motor - Servo motors - Stepper motors.

TEXT BOOKS

1. Nagrath I. J and Kothari D. P., "Electric Machines", Tata McGraw Hill Publishing Company Ltd, Fourth Edition, Fifth Reprint 2012.
2. Rajput R.K., "Electrical Machines", Lakshmi Publications, New Delhi, First Edition 1992.

REFERENCE BOOKS

1. A.E. Fitzgerald, Charles Kingsely Jr, Stephen D.Umans, "Electric Machinery", McGraw Hill Books Company, Seventh Edition, 2013.
2. P.S. Bhimbhra, "Electrical Machinery", Khanna Publishers, Seventh Edition, 2013
3. Samarajit Ghosh, "Electrical Machines", Pearson Education, Second Edition, 2012.
4. A K Theraja and B L Theraja, "A Textbook of Electrical Technology", Vol.2, S. Chand Publishing, 2014.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Understand the construction, working principles and performance analysis of three phase induction motor.
2. Apply different types of starters and various techniques for controlling the speed of three phase induction motors.
3. Study the construction and analyze the performance of synchronous generator through different tests.
4. Illustrate construction, the principle of operation, starting methods and to determine the performance of synchronous motor
5. Differentiate various methods of starting and working concept of different types of special machines.

Mapping with Programme Outcomes															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	3		2					1	2	3	2	
CO2	3	2	1	3								2	3	3	
CO3	3	2	2	3		2					1	2	3	2	
CO4	3	2	3	3		1					1	2	3	3	
CO5	3	2	3	3		2					1	2	3	3	

22EEPC404	DIGITAL CIRCUITS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To review the fundamental concepts relating to Number Systems, codes, Boolean algebra and functions of the logic gates.
- To bring out the implementation of Boolean function using logic gates, simplification of Boolean Expression using K-map and implementation of various combinational circuits.
- To illustrate the function of various types of flip-flops and counters with the help of circuit diagram, truth table, state equation and timing diagram.
- To understand the operation of A/D and D/A converters.
- To study the classification of semiconductor memories and programmable logic devices.

UNIT I: BOOLEAN ALGEBRA

Signed binary numbers - Binary arithmetic in computers - BCD arithmetic - One's and two's complements arithmetic data representation - Fixed and floating point representation - Exponent representation of floating point binary numbers - Weighted and Non weighted binary codes - Alphanumeric codes - Error detection and correction codes - Laws of Boolean algebra - Boolean expressions and logic diagrams - Negative logic - Introduction to mixed logic.

UNIT II: COMBINATIONAL LOGIC

Combinational logic - Introduction - Min Terms and Max Terms - Truth tables and Maps - Solving digital problems using Maps - Sum of products and product of sums Map reduction - Hybrid functions - Incompletely specified functions - Multiple output minimization - Tabular minimization - Implementation of Boolean expressions using AND, OR, NOT Logic gates and Universal gates - Fault diagnosis in combinational circuits - Classical methods - Boolean difference method.

UNIT III: SEQUENTIAL LOGIC CIRUITS

Sequential logic - Bistable latch - Flip-flops - Counters - Types of counters - Ripple counter design - Type T, type D and type JK design using state equations - Shift registers - Types, Asynchronous counters, ring counter - Fault diagnosis in sequential circuits (Qualitative treatment only)

UNIT IV: DIGITAL INTEGRATED CIRCUITS

Characteristics of digital ICs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-state logic - Multiplexer - Demultiplexer- Decoder - Code converter - Arithmetic functions - Digital to analog converters - Weighted resistor/converter,

R-2R Ladder D/A converter - Analog to digital converters - Successive approximation A/D converter, dual slope A/D converter.

UNIT V: SEMICONDUCTOR MEMORIES AND PROGRAMMABLE LOGIC DEVICES

Memory organization and operation, expanding memory size - Classification and characteristics of memories sequential memory - Read only memory (ROM) - Read and write memory (RAM) - Programmable logic array - Programmable array logic - Complex Programmable logic devices (CPLDS) - Basics of VLSI - Field Programmable Gate Array (FPGA).

TEXT BOOKS

1. Donald P. Leach, Albert Paul Malvino, GoutanSaha, “Digital Principles and Applications” Seventh Edition, 2010
2. R. P. Jain, "Modern Digital Electronics", McGraw Hill Education, 2009.
3. M. M. Mano, "Digital logic and Computer design", Pearson Education India, 2016
4. Fletcher, William I, “An engineering approach to digital design”, Prentice-Hall Of India Pvt Ltd, Fourth Edition, 1996.
5. Samuel C.Lee, “Digital Circuits and Logic Design” PHI; 1984

REFERENCES

1. Gothman W.H. “Digital Electronics (second edition)” PHI; 1990.
2. A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016.
3. ZviKohavi and Niraj K. Jha, “Switching and Finite Automata Theory” Third Edition, 2011.
4. B. Holdsworth and Woods, “Digital Logic Design”, Fourth Edition, 2002.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Acquire knowledge in the basic concepts of digital systems and solve the problems related to number systems and Boolean algebra.
2. Develop the ability to identify, analyze and design combinational circuits.
3. Gain knowledge in design of sequential circuits of various logic families and logic packages.
4. Understand the process of Analog to Digital conversion and Digital to Analog conversion.
5. Be able to use PLDs to implement the given logical problem.

Mapping with Programme Outcomes															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2									2	3	2	
CO2	3	2	2	1	2							2	2		
CO3	3	2	3	2		2					1	2	2	2	
CO4	3	2	2	2	2	2					2	2	2	2	
CO5	3	2	2	2	2						2	2	2	2	

22EEPC405	ELECTRICAL MEASUREMENTS AND INSTRUMENTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce the basic functional elements of instrumentation
- To discuss different methods of power and energy measurement.
- To explain various resistance and impedance measurement methods
- To study various types of storage and display devices
- To learn several types of recorders, transducers and the data acquisition systems

UNIT I: MEASUREMENT OF VOLTAGE AND CURRENT

Units and standards - Dimensional analysis - D'Arsonval Galvanometer - Principle, construction, operation and comparison of moving coil, moving iron meters, dynamometer, induction type - Extension of range and calibration of voltmeter and ammeter - Errors and compensation.

UNIT II: MEASUREMENT OF POWER AND ENERGY

Measurement of power in single phase and three phase circuits - Moving coil - AC and DC potentiometers - Dynamometer type wattmeter - LPF wattmeter - Compensated wattmeter, Hall Effect wattmeter, thermal type wattmeter - Errors and compensation. Measurement of energy in single phase and three phase circuits - Induction type energy meter - Errors and compensation - Calibration - Measurement of Var and Varh.

UNIT III: RESISTANCE AND IMPEDANCE MEASUREMENTS

Measurement of low, medium and high resistance - Ammeter, voltmeter method - Wheatstone bridge - A.C bridges - Measurement of inductance, capacitance - Q of coil - Maxwell Bridge - Wein's bridge - Schering bridge - Anderson bridge - Kelvin double bridge - Series and shunt type ohmmeter - High resistance measurement, Earth resistance measurement.

UNIT IV: STORAGE AND DISPLAY DEVICES

Sampling - CRO dual trace and dual beam oscilloscope - Applications - Digital storage oscilloscope and applications - XY Mode - Phase measurement using oscilloscope - Null balance method - Phase shift to pulse conversion method Magnetic disk and tape, digital plotters and printers - CRT display - digital CRO - LED - LCD.

UNIT V: RECORDERS, TRANSDUCERS AND DATA ACQUISITION SYSTEMS

Recorders - XY recorders. Strip chart recorder - XY plotters - UV recorders - magnetic tape recording - FM digital recording - Interference and screening - Component impurities -

Electrostatic and electromagnetic interference - Practical aspects of interference reduction. Classification of transducers - Selection of transducers - Elements of data acquisition system - Modern Digital Data Acquisition System - Smart sensors.

TEXT BOOKS

1. A.K. Sawhney, "A Course in Electrical and Electronic Measurements and Instrumentation", Dhanpat Rai and Co, New Delhi, 2015.
2. Sachchida N and Shukla, "Introduction to Electrical Measurements", Arcler Press, Oakville, Canada, 2020

REFERENCE BOOKS

1. J.B. Gupta, "A Course in Electronic and Electrical Measurements and Instrumentation", 14th Edition, S.K. Kataria and Sons, New Delhi, 2020.
2. E.W. Golding and F.C. Widdis, "Electrical Measurements and Measuring Instruments", Reem Publications, Vijayawada, 2011.
3. S.K. Singh, "Industrial Instrumentation and Control", Tata McGraw Hill, 3rd Edn, New Delhi, 2017.
4. R.B. Northrop, "Introduction to Instrumentation and Measurements", CRC Press; Taylor and Francis, Boca Raton, 3rd edition, 2014.
5. M.M.S. Anand, "Electronics Instruments and Instrumentation Technology", Prentice Hall India, New Delhi, 2009.
6. J..J. Carr, "Elements of Electronic Instrumentation and Measurement", Pearson Education India, New Delhi, 2011.
7. Martin U. Reissland, "Electrical Measurement: Fundamental Concepts and Applications", New Age International (P) Ltd., 2001.
8. Bouwens A.J, "Digital Instrumentation", 2nd Edn, Tata McGraw Hill Publishing Co. Ltd., New Delhi -1997.
9. H.S. Kalsi, "Electronic Instrumentation", Tata McGraw Hill, New Delhi, 2004.
10. Alan S Morris, Reza Langari, "Measurement and Instrumentation: Theory and Applications", 2nd Edn, Academic Press, London, 2013.
11. Prithwiraj Purkait, Budhaditya Biswas, Santanu Das, Chiranjib Koley, "Electrical and Electronics Measurements and Instrumentation", McGraw Hill Education (India) Ltd, New Delhi, 2013

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Understand basic principle of measuring instruments.
2. Comprehend the concept of measurement of power and energy in single and three phase circuits.
3. Gain knowledge about several methods to measure resistances and impedances

4. Acquire knowledge of various display instruments and CRO
5. Distinguish between recorders, transducers, data acquisition systems and display

Mapping with Programme Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**		**2**			**2**					**1**	**2**	**2**	**2**	
CO2	**3**		**2**			**2**					**1**	**2**	**2**	**2**	
CO3	**3**		**2**	**1**		**2**					**1**	**2**	**2**	**2**	
CO4	**3**	**2**	**2**	**2**	**3**	**2**					**1**	**2**	**2**	**2**	
CO5	**3**	**2**	**2**	**2**	**3**	**3**					**1**	**2**	**2**	**2**	

22EEPC406	ELECTROMAGNETIC FIELDS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To look back mathematical tools like vector calculus for investigating the physics of electric and magnetic fields.
- To understand the concepts of electrostatics, electrostatic field due to various charge distribution, electric potential, energy density.
- To impart knowledge on the concepts of magneto statics, magnetic flux density, scalar and vector potential and their applications.
- To understand Faraday's laws, time varying fields, magnetic boundary conditions and Maxwell's equations.
- To get knowledge of electromagnetic waves and Poynting vector

UNIT I: INTRODUCTION

Vector algebra - Addition, subtraction, scalar and vector multiplications, three orthogonal coordinate systems (rectangular, cylindrical and spherical) - Conversion of a vector from one coordinate system to another - Vector calculus - Vector operator - Del, gradient, divergence and curl.

UNIT II: STATIC ELECTRIC FIELD

Coulombs Law - Electric Field Intensity - Field due to point and continuous charges - Gauss's law and application - Electric Potential - Electric field - Electric flux density - Relation between potential gradient and electric field intensity - Dielectric strength - Boundary conditions, Poisson's and Laplace's equations - Capacitance - Energy density - Conduction current, convection current and displacement current - Equation of continuity - Ohm's law in point form - Electrostatic induction in telephone lines.

UNIT III: STATIC MAGNETIC FIELDS

Lorentz Law of force - Magnetic field intensity - Biot-Savart Law - Ampere's Circuital Law - Magnetic field due to straight conductors - Circular loop - Magnetic flux density (B) - Boundary conditions - Scalar and vector potential - Magnetic force - Forces acting on parallel current carrying conductors - Energy stored in magnetic field - Torque - Inductance - Energy density .

UNIT IV: ELECTRO DYNAMIC FIELDS

Faraday's laws for Electromagnetic induction, Displacement current, Point form of Maxwell's equation, Integral form of Maxwell's equations. Force on a moving charge, Force on a differential current element, Force between differential current elements, Magnetic boundary

conditions, Magnetic circuits, inductances and mutual inductances, Relationship between Field Theory and Circuit Theory.

UNIT V: ELECTROMAGNETIC WAVES

Uniform Plane Waves - Derivation of Wave Equation - plane electromagnetic wave in free space - Poynting vector and Poynting's theorem - Applications of the concepts of Poynting vector - Relation between electric field intensity and magnetic field intensity - Surge impedance of a line in terms of energy balance.

TEXT BOOKS

1. W. Hayt, "Engineering Electromagnetics", McGraw Hill Education, 2012.
2. A.Pramanik, "Electromagnetism - Theory and applications", PHI Learning Pvt. Ltd, New Delhi, 2009.

REFERENCES

1. M. N. O. Sadiku, "Elements of Electromagnetics", Oxford University Publication, 2014.
2. A.Pramanik, "Electromagnetism-Problems with solution", Prentice Hall India, 2012.
3. D. Sathaiah and M. Anitha, "Electromagnetic Fields", Scitech Publications, 2nd Edition 2007.
4. U.A. Bakshi and A.V. Bakshi, "Electromagnetic Fields", Technical Publications, Pune 2010.
5. W.J. Duffin, "Electricity and Magnetism", McGraw Hill Publication, 1980.
6. B.D. Popovic, "Introductory Engineering Electromagnetics", Addison-Wesley Educational Publishers, International Edition, 1971.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Understand the basic laws of electromagnetism.
2. Obtain the electric and magnetic fields for simple configurations under static conditions.
3. Analyze time varying electric and magnetic fields.
4. Familiarize with Maxwell's equations in different forms and different media.
5. Acquire knowledge of the propagation of EM waves.

Mapping with Programme Outcomes															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3									1	2	2		
CO2	3	2									1	2	2	2	
CO3	3	2		1							1	2	2		
CO4	3		2	2		2					3	2	2		
CO5	3		2	2		3					2	2	2		

22ETHS407	UNIVERSAL HUMAN VALUES	L	T	P	C
		2	1	0	3

COURSE OBJECTIVES

- Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature / existence.
- Understanding (or developing clarity) of the harmony in the human being, family, society and nature / existence.
- Strengthening of self-reflection
- Development of commitment and courage to act

UNIT I: COURSE INTRODUCTION - NEED, BASIC GUIDELINES, CONTENT AND PROCESS FOR VALUE EDUCATION

1.1 Purpose and motivation for the course, recapitulation from Universal Human Values-I

1.2 Self-Exploration–what is it? - Its content and process- Natural Acceptance and Experiential Validation- as the process for self-exploration.

1.3 Continuous Happiness and Prosperity- A look at basic Human Aspirations.

1.4 Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority.

1.5 Understanding happiness and Prosperity correctly-A critical appraisal of the current scenario.

1.6 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.

UNIT-II UNDERSTANDING HARMONY IN THE HUMAN BEING - HARMONY IN MYSELF

2.1 Understanding human being as a co-existence of the sentient ‘I’ and the material ‘Body’.

2.2 Understanding the needs of Self (‘I’) and ‘Body’ - happiness and physical facility.

2.3 Understanding the Body as an instrument of ‘I’ (I being the doer, seer and enjoyer).

2.4 Understanding the characteristics and activities of ‘I’ and harmony in ‘ I’.

2.5 Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail.

2.6 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

UNIT-III UNDERSTANDING HARMONY IN THE FAMILY AND SOCIETY- HARMONY IN HUMAN-HUMAN RELATIONSHIP

3.1 Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship.

3.2 Understanding the meaning of Trust; Difference between intention and competence.

3.3 Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship.

3.4 Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals.

3.5 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 example, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.

UNIT-IV UNDERSTANDING HARMONY IN THE NATURE AND EXISTENCE - WHOLE EXISTENCE AS COEXISTENCE

4.1 Understanding the harmony in the Nature.

4.2 Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self- regulation in nature.

4.3 Understanding Existence as Co-existence of mutually interacting units in all-pervasive space.

4.4 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.

UNIT-V IMPLICATIONS OF THE ABOVE HOLISTIC UNDERSTANDING OF HARMONY ON PROFESSIONAL ETHICS

5.1 Natural acceptance of human values.

5.2 Definitiveness of Ethical Human Conduct.

5.3 Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order.

5.4 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.

5.5 Case studies of typical holistic technologies, management models and production systems.

5.6 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.

5.7 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.

TEXT / REFERENCES

1. "Human Values and Professional Ethics by R R Gaur", R Sangal, G P Bagaria, Excel Books, New Delhi,2010
2. Jeevan Vidya: Ek Pari Chaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak,1999.
3. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi,2004.The Story of Stuff(Book).
4. The Story of My Experiments with Truth- by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - JC Kumar Appa
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)

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Students are expected to become more aware of themselves, and their surroundings (family, society, nature);
2. They would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.
3. They would have better critical ability.
4. They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society).
5. They would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

Mapping with Programme Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1										**2**					
CO2		**3**	**3**											**3**	**3**
CO3				**2**											
CO4						**3**			**2**						
CO5									**2**	**2**		**2**			

22EECP408	ELECTRICAL MACHINES LAB	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

- To understand and learn the relative theory.
- To build up appropriate methodology for articulation of circuit / algorithm implementation.
- To set-up the relevant connections for executing the experiment / code the methodology evolved.
- To carry out / employ the methodology.
- To surmise / arrive at inferences from the results.

LIST OF EXPERIMENTS

1. Open circuit characteristics of dc shunt generator
2. Internal and external characteristics of dc shunt and compound generators
3. Swinburne's test and Speed control of dc shunt motor
4. Hopkinson's test
5. Load test on DC Shunt and Series motor
6. Open circuit, short circuit and load tests on single phase transformer
7. Separation of losses in single phase transformer
8. Pseudo load test and load test on three phase transformer
9. Load test on three phase slip ring induction motor and generator
10. Circle diagram of three phase cage induction motor
11. Predetermination of equivalent circuit and load test on single phase induction motor
12. Predetermination of voltage regulation of three phase alternator using
    a) EMF method b) MMF method c) ZPF method
13. Load test on three phase Alternator
14. Synchronization and parallel operation of two three phase alternators
15. V and inverted V curves of Synchronous motor
16. Load test on Phase Advancer set
17. Load test on Cascade Set
18. Load test on Auto Synchronous motor
19. Load test on Schrage motor
20. Torque slip characteristics of Double cage induction motor
21. Characteristics of Repulsion motor

COURSE OUTCOMES

At the end of the course work, the students will be able to

1. Learn the relative theory.

2. Develop the appropriate methodology for articulation of circuit / algorithm implementation.
3. Contrivance the relevant connections for executing the experiment / code the methodology evolved.
4. Execute / implement the methodology.
5. Infer / arrive at inferences from the results

Mapping with Programme Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**2**	**2**	**2**		**2**		**2**	**3**		**3**	**3**	**2**		
CO2	**3**	**2**	**2**	**2**		**2**		**2**	**3**		**3**	**3**	**2**		
CO3	**3**	**2**	**2**	**2**		**2**		**2**	**3**		**3**	**3**	**2**		
CO4	**3**	**2**	**2**	**2**		**2**		**2**	**3**		**3**	**3**	**2**	**3**	
CO5	**3**	**2**	**2**	**2**		**2**		**2**	**2**		**3**	**3**	**2**		

22EECP409	ANALOG AND DIGITAL INTEGRATED CIRCUITS LAB	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES

- To understand and learn the relative theory.
- To build up appropriate methodology for articulation of circuit / algorithm implementation.
- To set-up the relevant connections for executing the experiment / code the methodology evolved.
- To carry out / employ the methodology.
- To surmise / arrive at inferences from the results.

LIST OF EXPERIMENTS

1. Karnaugh map reduction
2. Tabular method of minimization
3. Parity generator and checker circuits
4. a. Design of half adder and full adder circuits
   b. Design of half subtractor and full subtractor
5. Multiplexer and de-multiplexer
6. Code converters
7. Truth table verification of flip flops
8. Design of modulo up and down counters
9. Design of non-sequential counter
10. Precision rectifiers
11. Analog to digital and digital to analog converters using op-amp
12. Voltage to current and current to voltage converters
13. Instrumentation amplifier.
14. Design of active filters using op-amp
15. Hartley and Colpitts Oscillators using op-amp
16. Frequency divider

COURSE OUTCOMES

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

1. Learn the relative theory.
2. Develop the appropriate methodology for articulation of circuit / algorithm implementation.
3. Contrivance the relevant connections for executing the experiment / code the methodology evolved.
4. Execute / implement the methodology.
5. Infer / arrive at inferences from the results

Mapping with Programme Outcomes															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2			1					2	2		2	
CO2	3	2	2			2					2	2	2		
CO3	3	2	2			1					2	2	2		
CO4	3	2	2	2		2					2	2		2	
CO5	2	2	2	2	2	1					2	2		2	

22EECP410	ELECTRICAL MEASUREMENTS LAB	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES

- To understand and learn the relative theory.
- To build up appropriate methodology for articulation of circuit / algorithm implementation.
- To set-up the relevant connections for executing the experiment / code the methodology evolved.
- To carry out / employ the methodology.
- To surmise / arrive at inferences from the results.

LIST OF EXPERIMENTS

1. Measurement of Resistance using
   i. Kelvin's double bridge
   ii. Wheatstone bridge
2. Measurement of Inductance using
   i. Anderson's bridge
   ii. Hay's bridge
3. Measurement of Capacitance using
   i. Schering bridge
   ii. Desauty bridge
4. Measurement of inductance using three ammeter, three voltmeter method
5. Calibration of ammeter, voltmeter and wattmeter using dc potentiometer
6. Calibration of single-phase energy meter
7. Calibration of three phase three wire energy meter
8. Calibration of three phase four wire energy meter
9. Measurement of ABCD constants of a short transmission line
10. Cable fault detection
11. Two wattmeter method for power measurement.
12. Reactive power measurement.
13. Determination of b-h loop in a transformer core using CRO
14. Measurement of core losses in a single phase transformer using LLOYD Fisher magnetic square
15. a. Measurement of earth resistance
    b. Transformer oil testing
16. Determination of the dielectric strength of transformer oil

COURSE OUTCOMES

At the end of the course work, the students will be able to

1. Learn the relative theory.
2. Develop the appropriate methodology for articulation of circuit / algorithm implementation.
3. Contrivance the relevant connections for executing the experiment / code the methodology evolved.
4. Execute / implement the methodology.
5. Infer / arrive at inferences from the results.

Mapping with Programme Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**2**	**2**	**2**		**1**			**2**		**1**	**2**	**3**		
CO2	**3**	**2**	**2**	**2**		**1**			**2**		**1**	**2**	**3**		
CO3	**3**	**2**	**2**	**1**		**2**			**2**		**2**	**2**	**2**		
CO4	**3**	**3**	**2**	**1**		**2**			**2**		**2**	**2**	**2**		
CO5	**3**	**3**	**3**	**1**		**2**			**2**		**2**	**2**	**2**		

SEMESTER V

22EEPC501	MICROCONTROLLER AND ITS INTERFACING TECHNIQUES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- Learn fundamentals of microprocessor and microcontroller architecture
- Acquire an in-depth knowledge on 8051 architectures, instruction set and programming concepts.
- Acquire an in-depth knowledge about On-Chip peripheral interfacing
- Provide deep insight Off-Chip peripheral interfacing.
- Learn about advanced microcontrollers.

UNIT I: INTRODUCTION

Introduction to microprocessor and microcontroller - Evolution - Architecture of microprocessor - Comparison of microprocessor and microcontroller - Overview of 8/16/32/64-bit microprocessors and microcontrollers - Applications of microprocessors and microcontrollers.

UNIT II: MICROCONTROLLER ARCHITECTURE AND INSTRUCTION SET

Functional block diagram and pin diagram of 8051- Power supply, clock and reset circuit - Program Counter and ROM space in 8051 - Program and Data Memory organization - Addressing modes. Instruction Set: data transfer, arithmetic and logical, program branching instructions and Boolean variable manipulation.

UNIT III: ON-CHIP PERIPHERALS AND PROGRAMMING TECHNIQUES

Parallel Port Structure and bit-manipulation programming, timer/counter - Operating Modes - Programming 8051 Timers - Counter Programming - Serial Communication: Basics of Serial Communication - UART - Operating Modes - RS232 Standards-8051 connection to RS232 - Serial Port Programming. Interrupt: 8051 Interrupt - External and Internal Interrupts - Programming timer Interrupts, external hardware interrupts and serial communication interrupts - Interrupt Priority and Programming. Power Saving Modes.

UNIT IV: OFF-CHIP PERIPHERAL INTERFACING AND PROGRAMMING

Led, 7 - Segment and LCD interfacing, push-to-on switch and matrix keyboard interfacing, ADC and sensor interfacing, relay interfacing, dc motor and stepper motor interfacing techniques.

UNIT V: INTRODUCTION TO ADVANCED MICROCONTROLLERS

PIC 16F877 microcontroller - Architecture On chip ADC, Capture/Compare/PWM Module - I^2C - SPI - Watchdog timer - Architecture of ARM**:** RISC vs CISC - ARM7 Processor

fundamentals - Registers - Pipelining - ARM Instruction set and Thumb Instruction set- Exception and Interrupt handling - Memory System (Qualitative treatment only).

TEXT BOOKS

1. Muhammed Ali Mazidi, Janice Gillispie Mazidi, Rolin D Mckinlay, "The 8051 Microcontroller and Embedded Systems", 2nd Edition, Pearson Education India, New Delhi, 2011.
2. Muhammad Ali Mazidi, RolinD.Mckinlay, Danny Causery,"PIC Microcontroller and Embedded systems using assembly and C PIC18", Pearson international edition, 2008.
3. Andrew Sloss, Dominic Symes, Chris Wright, "ARM System Developer‟s Guide", 1st Edition, Elsevier, USA, 2005.

REFERENCES

1. Krishna Kant, "Microprocessor and Microcontroller Architecture, Programming and System Design using 8085, 8086, 8051 and 8096", PHI, 2011.
2. Douglas V.Hall, "Microprocessor and Interfacing, Programming and Hardware", Revised 2nd Edition, Tata McGraw Hill, Indian Edition 2007.
3. John B Peatman, "Designing with PIC Micro Controller", 1stEdition, Pearson, 2003.
4. K. J. Ayala, "8051 Microcontroller", Delmar Cengage Learning, 2004.
5. R. Kamal, "Embedded System", McGraw HillEducation,2009.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Understand the fundamentals of microprocessor and microcontroller architecture
2. Discuss the 8051-instruction set with programming concepts
3. Explain the various on-chip peripheral interfacing techniques.
4. Develop program for interfacing off-chip peripherals.
5. Understand advanced microcontroller architecture.

Mapping with Programme Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**2**	**1**	**1**					**2**		**2**	**1**	**2**	**2**	
CO2	**3**	**2**	**2**	**1**					**2**		**2**	**1**	**2**	**2**	
CO3	**3**	**2**	**2**	**2**		**2**			**2**		**2**	**2**	**2**	**2**	
CO4	**3**	**2**	**2**	**2**	**2**	**2**			**2**		**2**	**2**	**2**		
CO5	**2**	**2**	**2**	**2**		**2**			**2**		**2**	**2**	**2**		

22EEPC502	POWER ELECTRONICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To explain the operation of different types of thyristor rectifiers
- To articulate the operation of the single and three phase voltage controllers
- To elucidate the theory of operation of chopper circuits
- To bring out the switching state from the operation of a single phase and three phase voltage source inverter.
- To explain the benefits of the operation of the Power Electronics Converters on the speed control of ac and dc machines

UNIT I: AC-DC CONVERTERS

Review of operation of SCRs - Turn On and turn OFF characteristics - Protection Circuits - Series and Parallel connections - Single phase half wave and full wave controlled thyristor converters with R, RL and RLE load- Estimation of average load voltage and average load current - Estimation of input power factor for ripple free load current - Effect of freewheeling diode - Dual converters - Three phase half wave and full wave controlled thyristor bridge converters.

UNIT II: AC-AC CONVERTERS

AC Voltage Controllers - Single phase full wave controller with R and RL load - Estimation of RMS load voltage, RMS load current and input power factor. Qualitative Treatment of Three phase AC voltage controller, Single phase AC chopper, and Single phase cycloconverter.

UNIT III: DC-DC CONVERTERS

DC chopper using devices other than thyristors - Step up and step down operation - Time Ratio control single quadrant DC chopper with R, RL and RLE load - Estimation of average load voltage and load current for continuous converter Operation - Two quadrant and four quadrant DC choppers.

UNIT IV: DC-AC CONVERTERS

Inverters using devices other than thyristors - Types of inverters - voltage Source and current source inverters - Single phase bridge inverter - Three phase bridge inverter - Control of AC output voltage - PWM techniques for inverters - Introduction to Multi level inverters.

UNIT V: APPLICATIONS

DC motor drives using phase controlled thyristor converters and DC choppers (using devices other than thyristors) - AC voltage controller and inverter (using devices other than thyristors)

fed induction motor drives - Stator and Rotor side control - Tap changing of transformers - DC and AC circuit breakers - HVDC systems - UPS - Types.

TEXT BOOKS

1. M. H. Rashid, "Power electronics: circuits, devices, and applications", Pearson Education India, 2009.
2. P.S.Bimbhra, " Power Electronics", Khanna Publishers, 2000

REFERENCES BOOKS

1. N. Mohan and T. M. Undeland, "Power Electronics: Converters, Applications and Design", John Wiley and Sons, 2007.
2. R. W. Erickson and D. Maksimovic, "Fundamentals of Power Electronics", Springer Science and Business Media, 2007.
3. L. Umanand, "Power Electronics: Essentials and Applications", Wiley India, 2009.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Understand the details of AC-DC switching devices
2. Gather knowledge of the various type of AC-AC converter
3. Analyze the operation of DC-DC converters
4. Apply the different modulation techniques to single- phase and three phase voltage source inverters
5. Enumerate the theory of Power Electronic Converters to ac, dc drives, dc link systems and UPS.

Mapping with Programme Outcomes															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2		1						2	2	2	
CO2	3	2	2	3		1						2	2	2	
CO3	3	2	3	3		2						2	2	2	
CO4	3	2	3	3		2						2	2	2	
CO5	3	2	2	2		2					2	2	2	2	

22EEPC503	CONTROL SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To develop a mathematical model for physical systems -translational and rotational system block diagram reduction techniques for obtaining transfer function.
- To study time response analysis of various standard inputs for first order and second order systems.
- To study frequency response analysis and frequency domain specification by bode plot and polar plot.
- To analyze stability of system and design of controllers
- To study the concept of controllability and observability and state space analysis. (Obtaining state equation for physical, phase and canonical variable)

UNIT I: SYSTEM MODELING

Basic elements in control systems - Open loop and closed loop systems - Differential equation representation of physical systems - Transfer function - Modeling of translational and rotational systems - Block diagram reduction techniques - Signal flow graph.

UNIT II: TIME DOMAIN ANALYSIS

Types of standard test inputs - Analysis of I order and II order systems - Time domain specifications - Steady state error - Generalized error co-efficient - Stability analysis - Routh Hurwitz criterion - Root locus technique.

UNIT III: FREQUENCY DOMAIN ANALYSIS

Frequency response - Definition - Frequency domain specifications - Bode plot - Polar plot - Nyquist stability criterion - Closed-loop frequency response. .

UNIT IV: CONTROLLERS AND COMPENSATORS

Application of Proportional, Integral and Derivative Controllers - Design of Lag, Lead and Lag Lead compensators - Analog and Digital implementation of controllers

UNIT V: STATE SPACE ANALYSIS

Introduction - State space formulation - State model of continuous time systems - State diagram - State space representation using physical, phase and canonical variables - Solution of state equation for step input - Transfer function decomposition - Transfer matrix - Pole - Zero cancellation and system properties - Controllability, observability and detectability.

TEXT BOOKS

1. Nagarath, I.J. and Gopal, M., "Control Systems Engineering", New Age International Publishers, 2017.
2. Katsuhiko Ogata, "Modern Control Engineering", Pearson, 2015
3. A.Nagoor Kani," Control Systems", 5th Edition CBS Publishers & Distributors Pvt. Ltd, 2019.

REFERENCES

1. M. Gopal, "Control Systems: Principles and Design", 4th Edition, McGraw HillEducation, 2012
2. Benjamin C. Kuo, "Automatic Control Systems", Wiley, 2014
3. Ambikapathy, "Control systems" , Khanna book publishing co.(p) Ltd, Delhi, 2010.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Understand the modeling of linear-time-invariant systems using transfer function and feedback control systems.
2. Gain knowledge about time response analysis and the use of Root -loci to determine stability of systems.
3. Understand the concept of frequency response analysis
4. Design simple feedback controllers.
5. Acquire knowledge about state variable analysis.

Mapping with Programme Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**3**	**2**								**1**	**1**	**3**	**2**	
CO2	**3**	**3**	**2**		**2**						**1**	**1**	**3**	**2**	
CO3	**3**	**3**	**2**	**2**	**2**	**2**					**1**	**2**	**3**	**2**	
CO4	**3**	**3**	**2**	**2**		**2**					**2**	**2**	**3**	**2**	
CO5	**3**	**3**	**2**	**2**	**2**	**2**					**2**	**2**	**3**	**2**	

22EEPC504	POWER SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To understand the fundamentals of transmission lines
- To learn the mathematical modeling and performances of transmission lines.
- To improve the voltage profile of the transmission system by determining voltage regulation and efficiency.
- To analyze the voltage distribution in insulator strings and cable for improving voltage profile.
- To understand the operation of different types of distribution systems.

UNIT I: TRANSMISSION LINE PARAMETERS

Single phase transmission - Three phase transmission - complex power - Inductance of a single phase two wire line - Inductance of composite conductor lines - Inductance of three phase lines - Inductance of double circuit three phase lines - Bundled conductors - Skin effect and proximity effect.

Capacitance of a two-wire line - Capacitance of a three-phase line with equilateral spacing - Capacitance of a three phase line with unsymmetrical spacing - Capacitance of a double circuit line - Effect of earth on transmission line capacitance.

UNIT II: MODELING AND PERFORMANCE OF TRANSMISSION LINES

Characteristics and performance of transmission lines - Representation of lines - Calculation of sending and receiving end voltages and current of Short lines - Medium length lines - Solution by nominal T and π methods - Regulation and efficiency of a transmission line - Long transmission line - Hyperbolic form of equations for long lines - ABCD constants - Ferranti effect - Equivalent circuit of a long line.

Voltage control: Methods of voltage control - Shunt capacitors, series capacitors, tap changing transformers and booster transformers - Sending end and receiving end power circle diagrams.

UNIT III: DESIGN OF TRANSMISSION LINES

Mechanical characteristics of transmission lines: Sag in overhead lines - The catenary curve - calculation of sag with supports at different levels - Effects of wind and ice loading - Stringing Chart-Sag Template.

Corona: Theory of formation - Factors affecting corona - Critical disruptive voltage - Visual critical voltage - Corona loss - Advantages and disadvantages of corona - Methods of reducing corona effect - Radio Interference - Inductive interference between power and communication lines.

UNIT IV: OVERHEAD LINE INSULATORS AND UNDERGROUND CABLES

Overhead line insulators - Types of insulators - Potential distribution over a string of suspension insulators - Methods of equalizing potential - Causes of failure of insulators. Underground Cables - Types of cables-capacitance of single core cable-Grading of cables - Capacitance of three core cable.

UNIT V: DISTRIBUTION SYSTEMS

Feeders, distributors, and service mains: D.C distributors - Singly fed and doubly fed two wire and three wire systems, with concentrated and uniformly distributed loads. A.C. distributor - Single phase and three phase -Division of load between lines in parallel.

Effect of working voltage on the size of feeders and distributors - Effect of system voltage on economy - Voltage drop and efficiency of transmission

Distribution systems: Types of distribution systems - Section and size of feeders - Primary and secondary distribution - Distribution substations - Qualitative Treatment of Rural distribution and industrial distribution.

TEXT BOOKS

1. Wadhwa, C.L., “Electrical Power Systems”, Wiley Eastern, 2015.
2. Nagrath, I.J. and Kothari, D.P., “Power System Engineering” Tata McGraw Hill Publishing Company Limited, New Delhi, 2015.

REFERENCE BOOKS

1. Soni, Gupta, Bhatnagar and Chakrabarthi, “A Text Book on Power System Engineering, Dhanpat Rai and Co; 1998.
2. Stevenson, W.D., “Elements of Power System Analysis”, McGraw Hill, 1985.
3. Ashfaq Husain, “Electrical Power Systems”, CBS Publications and Distributors, 2006.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Understand the concepts of power systems
2. Determine the line parameters and analyze the performance of transmission lines
3. Acquire knowledge of mechanical characteristics of transmission lines
4. Understand concept of insulation and Underground cabling systems
5. Analyze the concepts of distribution systems

Mapping with Programme Outcomes															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2									1	3	1	
CO2	3	2	2									1	3	1	
CO3	2	2	3			2	2				2	2	3	2	
CO4	3	2	2			2	2				2	2	3	2	
CO5	3	2	2	2		2					2	2	3	2	

22EECP508	MICROCONTROLLER LAB	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES

- To understand and learn the relative theory.
- To build up appropriate methodology for articulation of circuit / algorithm implementation.
- To set-up the relevant connections for executing the experiment / code the methodology evolved.
- To carry out / employ the methodology.
- To surmise / arrive at inferences from the results.

LIST OF EXPERIMENTS

1. Study of 8085 microprocessor
    a) Finding out the largest and smallest number
    b) Sorting an array
2. Study of 8051 microcontroller
    a) Arithmetic Operation
    b) Code Conversion
3. Study of 8097 microcontroller
    a) Arithmetic Operation
    b) Code Conversion
4. Multibyte addition and subtraction using 8051 microcontroller
5. Finding out lcm and HCF two 8-bit numbers using 8051 microcontroller
6. Summation of series and multiplication by shift and add method using 8051 microcontroller
7. Study of adc-0809 using 8085 microprocessor
8. Study of programmable peripheral interface-8255 using 8051 microcontroller
9. Study of ADC, DAC and PWM generation using 8051 microcontroller
10. CRO interface -character display using 8051 microcontroller
11. Study of keyboard display interface 8279 using 8051 microcontroller
12. Seven segment LED using 8051 microcontroller
13. Stepper motor control using 8051 microcontroller
14. Serial data communication using timer- 8253 and USART- 8251
15. Serial data communication between two 8051 microcontroller kits
16. Relay control using 8051 microcontroller

COURSE OUTCOMES

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

1. Learn the relative theory.
2. Develop the appropriate methodology for articulation of circuit / algorithm implementation.
3. Contrivance the relevant connections for executing the experiment / code the methodology evolved.
4. Execute / implement the methodology.
5. Infer / arrive at inferences from the results.

Mapping with Programme Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**2**	**1**	**1**						**2**		**1**	**1**	**3**		
CO2	**3**	**3**	**1**						**2**		**1**	**1**	**3**		
CO3	**3**	**3**	**3**	**3**					**2**		**1**	**1**	**3**	**2**	
CO4	**3**	**2**	**2**	**2**	**2**				**2**		**2**	**2**	**3**	**2**	
CO5	**2**	**3**	**3**	**3**	**3**				**2**		**2**	**2**	**3**	**2**	

22EECP509	POWER ELECTRONICS AND DRIVES LAB	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES

- To understand and learn the relative theory.
- To build up appropriate methodology for articulation of circuit / algorithm implementation.
- To set-up the relevant connections for executing the experiment / code the methodology evolved.
- To carry out / employ the methodology.
- To surmise / arrive at inferences from the results.

LIST OF EXPERIMENTS

1. Switching characteristics of IGBT and MOSFET.
2. Performance evaluation of single phase semi and full converters with R load.
3. Extended firing angle control of single-phase semi converter.
4. Performance evaluation of three phase semi and full converters.
5. Performance evaluation of single phase ac voltage controller
6. Performance evaluation of single phase cyclo converter
7. Time ratio control of IGBT based single and two quadrant dc chopper
8. Performance evaluation of series resonant converter.
9. Modulation index control of single phase bridge inverter.
10. Open loop speed control of thyristor fed dc shunt motor
11. Load test on dc drive
12. Load test on ac drive
13. Characteristics of PMDC motor
14. Simulation of ac-dc converter.
15. Simulation of dc chopper
16. Simulation of three phase voltage source inverter

COURSE OUTCOMES

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

1. Learn the relative theory.
2. Develop the appropriate methodology for articulation of circuit / algorithm implementation.
3. Contrivance the relevant connections for executing the experiment / code the methodology evolved.
4. Execute / implement the methodology.
5. Infer / arrive at inferences from the results.

Mapping with Programme Outcomes															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3				1			3	3	3	
CO2	3	3	3	3	3				1			3	3	3	
CO3	3	3	3	3	3				2		2	2	3	3	
CO4	3	3	3	3	3				2		1	2	3	3	
CO5	3	3	3	3	3				2		2	2	3	3	

22EECP510	CONTROL SYSTEMS LAB	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES

- To understand and learn the relative theory.
- To build up appropriate methodology for articulation of circuit / algorithm implementation.
- To set-up the relevant connections for executing the experiment / code the methodology evolved.
- To carry out / employ the methodology.
- To surmise / arrive at inferences from the results.

LIST OF EXPERIMENTS

1. Potentiometer error detector
2. DC position control system
3. DC speed control system
4. PI controller
5. PID controller
6. Temperature control system
7. Lead compensator design
8. Lag compensator design
9. Lag - lead compensator design
10. Stepper motor study
11. Linear system simulator
12. Relay control system
13. Digital control system
14. Electronic PID controller
15. AC position control system
16. AC servo motor control system

COURSE OUTCOMES

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

1. Learn the relative theory.
2. Develop the appropriate methodology for articulation of circuit / algorithm implementation.
3. Contrivance the relevant connections for executing the experiment / code the methodology evolved.
4. Execute / implement the methodology.
5. Infer / arrive at inferences from the results.

Mapping with Programme Outcomes															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3			2				1			1	2			
CO2	3	2	2					2			1	2	2	2	
CO3	3	3	3	3		2		2			1	2	3	3	
CO4	3		2								2	2	2		
CO5	3	2	3	2							2	2	2		

22ETIT511	INTERNSHIP / INDUSTRIAL TRAINING	L	T	P	C
		0	0	0	4

COURSE OBJECTIVES

- To work on a technical topic and acquire the ability of written and oral presentation
- To acquire the ability of writing technical papers for Conferences and Journals
- To train the students in the field work related to Electrical and Electronics Engineering and to have a practical knowledge in carrying out field related works.
- To train and develop skills in solving problems during execution of certain works related to Electrical and Electronics Engineering.

The students will work for two periods per week guided by student counsellor. They will be asked to present a seminar of not less than fifteen minutes and not more than thirty minutes on any technical topic of student's choice and to engage in discussion with audience. They will defend their presentation. A brief copy of their presentation should also be submitted. Evaluation will be done by the student counsellor based on the technical presentation and the report and also on the interaction shown during the seminar.

The students individually undergo a training program in reputed concerns in the field of Electrical and Electronics Engineering during the vacation for a minimum stipulated period of four weeks. At the end of the training, the student has to submit a detailed report on the training he/she had, within ten days from the commencement of the semester. The students will be evaluated, by a team of staff members nominated by Head of the Department, through a viva-voce examination.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Face the audience and to interact with the audience with confidence.
2. Tackle any problem during group discussion in the corporate interviews.
3. Face the challenges in the field with confidence.
4. Manage the situation that arises during the execution of works related to Electrical and Electronics Engineering
5. Develop the ability of writing technical papers for Conferences and Journals

Mapping with Programme Outcomes															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2							2	2			3	2		2
CO2	2							2	1			3		2	2
CO3	2							2				3			2
CO4	3					2	2	2	2		2	3			2
CO5	3							3		3		3	3		3

SEMESTER VI

22EEPC601	POWER SYSTEM ANALYSIS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- Learn the fundamentals of power system modeling
- Understand the formation of bus impedance and bus admittance matrices.
- Learn different sparsity techniques and power flow methods.
- Impart in-depth knowledge on fault analysis using impedance matrix.
- Gain knowledge on ELD and stability analysis.

UNIT I: MODELING OF POWER SYSTEMS COMPONENTS

Representation of power system components: Single phase solution of balanced three phase networks - One line diagram - Impedance or reactance diagram - Per unit system - Per unit impedance diagram - Representation of loads.

Review of symmetrical components - Transformation of voltage, current and impedance (conventional and power invariant transformations) - Phase shift in star-delta transformers - Sequence impedance of transmission lines - Sequence impedance and sequence network of power system components (synchronous machines, loads and transformer banks) - Construction of sequence networks of a power system.

UNIT II: BUS IMPEDANCE AND ADMITTANCE MATRICES

Development of network matrix from graph theory - Primitive impedance and admittance matrices - Bus admittance and bus impedance matrices - Properties - Formation of bus admittance matrix by inspection and analytical methods.

Bus impedance matrix: Properties - Formation using building algorithm - addition of branch, link - Removal of link, radial line - Parameter changes.

UNIT III: POWER FLOW ANALYSIS

Power flow analysis - Bus classification - Development of power flow model - Power flow problem - Solution using Gauss Seidel method and Newton Raphson method - Application of sparsity based programming in Newton Raphson method - Fast decoupled load flow- Comparison of the methods.

UNIT IV: FAULT ANALYSIS

Symmetrical short circuit studies - Unsymmetrical fault analysis - Single line to ground fault, line to line fault, double line to ground fault (with and without fault impedances) using sequence bus impedance matrices - Current limiting reactors - Fault computations for selection of circuit breakers.

Phase and sequence admittance matrix representation for three phase, single line to ground, line to line and double line to ground faults (through fault impedances) - Computation of currents and voltages under faulted condition using phase and sequence fault admittance models.

UNIT V: ECONOMIC LOAD DISPATCH AND STABILITY ANALYSIS

System constraints - Economic dispatch neglecting losses - Optimum load dispatch including transmission losses - Exact transmission loss formula - Modified co-ordination equations - Hydro - Thermal scheduling.

Transient stability - Power angle curve and swing equation of single machine connected to infinite bus - Equal area criterion - Numerical solution of swing equation of single - machine system by point-by-point method - Solution techniques using modified Euler and RK methods

TEXT BOOKS

1. Nagrath, I.J., Kothari. D.P., "Power System Engineering", TMH, New Delhi; 2007.
2. Wadhwa, C.L., "Electric Power Systems", Wiley Eastern, 2007.

REFERENCES

1. Pai, M.A., "Computer Techniques in Power System Analysis", TMH, 2007.
2. Stagg and El-Abad, "Computer Methods in Power System Analysis", McGraw Hill International, Student Edition, 1968.
3. Stevenson, W.D., "Element of Power System Analysis", McGraw Hill, 1975.
4. Ashfaq Husain, "Electrical Power Systems", CBS Publishers and Distributors, 1992.
5. Haadi Saadat, "Power System Analysis", Tata McGraw Hill Edition, 2002.
6. Gupta, B.R., "Power System Analysis and Design", Third Edition, A.H. Wheeler and Co Ltd., New Delhi, 1998.
7. Singh, L.P., "Advanced Power System Analysis and Dynamics", Fourth Edition, NewAge International (P) Limited, Publishers, New Delhi, 2006.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Model power system components.
2. Form power system matrices.
3. Apply load flow analysis to an Electrical power network and interpret the results of the analysis
4. Analyze a network under symmetrical and unsymmetrical fault conditions and interpret the results.
5. Familiarize with ELD and Stability analysis.

Mapping with Programme Outcomes															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1								1		3		
CO2	3	1	1								1		3		
CO3	3	3	3	3								3	3	2	
CO4	3	3	3			1						1	3	2	
CO5	3	3	3			1						1	3	2	

22EEPC602	ELECTRICAL MACHINE DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To learn about the design basics and various cooling methods adopted for rotating machines and transformers.
- To expertise in the calculation of design parameters for DC machines.
- To understand the construction, design, and performance of transformers.
- To develop sound knowledge on the design of induction motors and study the performance characteristics.
- To familiarize with the complete design of a synchronous machine as per the requirements and constraints.

UNIT I: INTRODUCTION

Design considerations - Limitations - Factors - Principle of electrical machine design - MMF for airgap and teeth - Real and apparent flex densities - Heating and cooling: heating and cooling curves - Calculations of temperature rise and fall - Cooling methods for rotating machines and transformers.

UNIT II: DC MACHINE DESIGN

Design of dc machines: standard specifications - Output equation - Output coefficient - Choice of specific magnetic and electric loadings - Choice of number of poles - Length of airgap - Design of armature winding and armature core - Choice of number of armature slots - Dimensions of pole - Design of field windings - Design of commutator and brushes - Design of interpole and its winding.

UNIT III: TRANSFORMER DESIGN

Design of Transformers - Standard specification - EMF per turn - Output equation - Window space factor - Specific loadings - Dimensions of core and yoke - Design of winding - Cooling of transformers - Design of tank with cooling tubes - Estimation of no-load current of transformer.

UNIT IV: INDUCTION MOTOR DESIGN

Design of three phase induction motor - Output equation - Choice of specific loadings - Main dimensions - Design of stator windings and core length of air-gap - Design of cage rotor - Design of wound rotor.

UNIT V: SYNCRONOUS MACHINE DESIGN

Design of synchronous machines: Standard specifications - Output equation - Choice of specific loadings - Design of salient pole machines - Short circuit ratio - Length of air gap

- Armature design - Design of rotor - Design of damper winding - Design of turbo alternator Limitations (assumptions) of traditional designs, need for CAD analysis, design optimization methods, variables, constraints and objective function, problem formulation.

TEXT BOOKS

1. Sawhney A.K. and Chakrabarti A, "A Course in Electrical Machine Design", Dhanpat Rai and Co., VI Edition, 2016.
2. Deshpande MV, "Design and Testing of Electrical Machines", PHI learning, III edition, 2010.

REFERENCES

1. Nagoor Kani, "Electrical Machine Design", RBA publications, II edition, 2014.
2. Agarwal R.K., "Principles of Electrical Machine Design", S.K.Kataria and Sons, V edition, 2014.
3. Sen S.K., "Principle of Electrical Machine Design with C++", Oxford and IBH Publishing, III edition, 2014.
4. KM Vishnu Murthy, "Computer-Aided Design of Electrical Machines", BS publications, 2015.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Understand the various factors which influence the design of electrical machines and become familiar with the design basics.
2. Calculate the design parameters for a DC machine.
3. Design a transformer and estimate its performance characteristics.
4. Relate the output power of an induction motor with its main dimensions and design squirrel cage and slip ring induction motors.
5. Obtain the optimal design of a synchronous machine as per the requirements and constraints specified.

Mapping with Programme Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**		**2**					**2**				**2**	**2**	**2**	
CO2	**3**	**3**	**3**	**2**						**3**		**2**	**2**	**3**	
CO3	**3**	**3**	**3**	**2**		**2**				**3**	**2**	**2**	**2**	**3**	
CO4	**3**	**3**	**3**	**2**		**2**				**3**	**2**	**2**	**2**	**3**	
CO5	**3**	**3**	**3**	**2**	**2**	**2**				**3**	**2**	**2**	**2**	**3**	

22EECP607	ELECTRICAL ESTIMATION AND CADD LAB	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES

- To understand and learn the relative theory.
- To build up appropriate methodology for articulation of circuit / algorithm implementation.
- To set-up the relevant connections for executing the experiment / code the methodology evolved.
- To carry out / employ the methodology.
- To surmise / arrive at inferences from the results.

LIST OF EXPERIMENTS

1. Principles of estimation
2. Cost estimation of a typical residential wiring layout
3. Cost estimation of a pump room wiring layout
4. Cost estimation of a typical industrial wiring layout
5. Cost estimation of a typical commercial building layout
6. Cost estimation of a typical substation layout
7. Cost estimation of a typical office lighting
8. CADD layout for different types of fluorescent lamps
9. CADD layout for SF6 circuit breaker
10. CADD layout for electric towers
11. Isometric and sectional view of different types of insulators using CADD
12. Isometric and sectional view of armature of dc motor using CADD
13. Isometric and sectional view of three phase induction motor using CADD
14. Isometric and sectional view of three phase transformer core using CADD
15. Isometric and sectional view of stator and rotor of synchronous motor using CADD
16. Isometric and sectional view of stator and rotor of switched reluctance motor using CADD

COURSE OUTCOMES

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

1. Learn the relative theory.
2. Develop the appropriate methodology for articulation of circuit / algorithm implementation.
3. Contrivance the relevant connections for executing the experiment / code the methodology evolved.
4. Execute / implement the methodology.
5. Infer / arrive at inferences from the results.

Mapping with Programme Outcomes															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2		2	2		2	2		2		2	2	
CO2	3	2	2		2	2					2	2	2	2	
CO3	2	2	2	2	2						2	2	2	2	
CO4	2	2									2	2	2	2	
CO5	2	2	2		2				2	2	3		2	2	

22EECP608	RENEWABLE ENERGY LAB	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES

- To understand and learn the relative theory.
- To build up appropriate methodology for articulation of circuit / algorithm implementation.
- To set-up the relevant connections for executing the experiment / code the methodology evolved.
- To carry out / employ the methodology.
- To surmise / arrive at inferences from the results.

LIST OF EXPERIMENTS

1. Design of equivalent circuit parameters of a solar cell.
2. Determination of V- I and P -V characteristics of a solar cell.
3. Determination of MPPT of a solar energy conversion system
4. Characteristics of the solar array using simulator.
5. Performance evaluation of a DC Transmission line fed from a solar energy source.
6. Determination MPPT of wind energy conversion system.
7. Determination of characteristics of PMSG driven wind turbine
8. Cost estimation of a solar PV energy conversion system.
9. Cost estimation of wind turbine.
10. Cost estimation of biogas plant
11. P-V and I-V characteristics of PV array using MATLAB simulation.
12. Modeling of wind turbine using MATLAB simulation
13. Characteristics of wind energy conversion systems using MATLAB simulation.
14. Simulation study of hybrid (solar - wind) power system using MATLAB
15. Study of different types of WECS
16. Study of smart grid simulator

COURSE OUTCOMES

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

1. Learn the relative theory.
2. Develop the appropriate methodology for articulation of circuit / algorithm implementation.
3. Contrivance the relevant connections for executing the experiment / code the methodology evolved.
4. Execute / implement the methodology.
5. Infer / arrive at inferences from the results.

Mapping with Programme Outcomes															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2			2	2		1	1	1	1	3		
CO2	3	2	2			2	2		1	1	2	1	3		
CO3	3	3	3	3		2	2		1	1	2	2	3	2	
CO4	3	2	2	2		2	2		1	1	2	2	3	2	
CO5	3	3	3	3	3	2	2		1	1	2	3	3	3	

SEMESTER VII

22ETHS701	ENGINEERING ETHICS	L	T	P	C
		2	0	0	2

COURSE OBJECTIVES

- To understand the moral and ethical dimensions in engineering
- To take balanced decisions.
- To understand the ethical problems and principles through theory, historical case studies and research and presentation.
- To allow students to explore the relationship between ethics and engineering
- To apply classical moral theory and decision making to engineering issues encountered in academic and professional careers.

UNIT I

Senses of engineering ethics - Verity of moral issues - Types of inquiry - Moral dilemmas - moral autonomy - Kohlberg"theory - Gilligan"theory - Consensus and controversy - Professions and professionalism - Professional ideas and virtues - Uses of ethical theories.

UNIT II

Engineering as experimentation - Engineering as responsible experiments - Research ethics - Code of ethics - Industrial standards - A balanced outlook law - The challenger case study.

UNIT III

Safety and risk - Assessment of safety and risk - Risk benefit analysis - Reducing - The government regulator's approach to risk - Chernobyl case studies and bhopal

UNIT IV

Collegiality and loyalty - Respect for authority - Collective bargaining - Confidently - Conflicts of interest - Occupational crime - Professional rights - Employee rights - Intellectual property rights (IPR) - Discrimination.

UNIT V

Multinational corporation - Business ethics - Environmental ethics - Computer ethics - Role in technological development - Weapons developments - Engineering as managers - Consulting engineers - Engineers as expert witness and advisors - Honesty - Moral leadership - Sample code of conduct.

TEXT BOOKS

1. Govindarajan, M, Natarajan.S. and Senthilkumar. V S. "Professional Ethics and Human Values." PHI Learning, New Delhi, 2013.
2. Mike Mertin and Roland Schinzinger, "Ethics Engineering ", McGraw Hill, New York, - 4th Edition, 2005.

REFERENCES

1. Charles E Harries, Michael S Pritchard and Michael J Rabins, "Engineering Ethics - Concepts and Cases," Thompson Learning, 4thEdition,2004
2. Charles.D. Fleddermann, "Engineering Ethics", Prentice Hall, New Mexico, 1999
3. John R Boatright, "Ethics and the Conduct of Business," Pearson Education, 2003
4. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers." Oxford University Press ,2001
5. David Ermann and Michele S Shauf, "Computers, Ethics and Society," Oxford University Press, ThirdEdition2003.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Understand and build the relationship between the Engineer and the Society.
2. Describe the importance of developing ethical codes in engineering practice.
3. Develop the knowledge on the legal, moral and ethical aspects in Engineering.
4. Construct the moral and ethical dimensions in engineering.
5. Improve the Knowledge about Multinational Corporation.

Mapping with Programme Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**					**3**	**3**	**3**							**3**
CO2	**3**					**3**	**2**	**3**							**3**
CO3	**3**			**2**		**3**	**2**	**3**							**3**
CO4	**3**					**3**	**1**	**3**							**3**
CO5	**3**					**3**	**1**	**3**							**3**

22EEPC702	PROTECTION SWITCHGEAR AND UTILIZATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To impart knowledge on different components of protection system.
- To study the construction and operation different types of circuit breakers.
- To explain various equipment protection schemes.
- To study about the various illumination schemes
- To understand various methodologies of electric heating and welding.

UNIT I: PROTECTIVE RELAYS

Functional characteristics of a protective relay - Operating principles of relays - Over current relays - Instantaneous and time over current relays - Definite time and inverse time characteristics - Direct over current relay - Directional over current relay - universal torque equation - Performance characteristics of distance relays - Realization of different characteristics using rectifier bridge amplitude comparator and transistorized phase comparator - Methods of achieving circular, quadrilateral and conic characteristics - Static differential relays - Static under frequency and over frequency relays - Translay scheme

UNIT II: CIRCUIT BREAKERS

Arc in oil - Arc interruption - Current chopping - Bulk oil and minimum oil circuit breaker - Air circuit breakers - Air blast circuit breakers - Vacuum circuit breakers - SF6 circuit breakers - Rating of circuit breakers - Testing of circuit breakers - Auto reclosure. HVDC circuit breakers - Energy consideration in breaking - HVDC system - Commutating principle - Control of di/dt and dv/dt - Surge suppression - Main circuit breakers for HVDC switching.

UNIT III: PROTECTION

Feeder protection - Distance protection - Alternator protection - Short circuit protection of stator windings by percentage differential relays - Protection against turn to turn faults in stator winding - Field ground fault protection - Protection of stator windings by overvoltage relays - Protection of transformers - Typical schemes. Brief introduction to pilot wire and carrier current protective schemes - Digital protection techniques - Microprocessor based protection schemes.

UNIT IV: ILLUMINATION

Visible region of the spectrum - Laws of illumination - Polar curves of different types of sources - Determination of MHCP and MSCP - Design of lighting schemes for factories, auditoriums, offices, hospitals and residences - Incandescent lamps - CFL - LED- Gaseous and discharge lamps - Sodium vapours lamp - Mercury vapour lamp - Arc lamps - Electric luminescence - Energy saving in illumination systems - Street lighting - Floodlighting .

UNIT V: ELECTRIC HEATING AND WELDING

Advantage of electric heating - Methods - Dielectric heating - Induction heating - High frequency eddy current heating - Efficiency and losses - Choice of frequency - Heating of buildings Resistance ovens - Induction furnaces - Types of melting furnaces - Arc furnaces. Electric arc welding - Comparison between D.C and A.C welding - Submerged arc welding - Gas shielded arc welding - Atomic hydrogen arc welding - Resistance welding - Types - Control of welding time.

TEXT/REFERENCES

1. Sunil Serrao, "Protection and Switchgear", Khanna Publishers, New Delhi, 2020.
2. Rabindranath, B., Chander, M., "Protective System Protection and Switchgear", Newage International, New Delhi, 2009.
3. Wadhwa, C.L., "Electrical Power Systems", New Age International, New Delhi, 2016.
4. J. L. Blackburn, "Protective Relaying: Principles and Applications", Marcel Dekker, New York, 2014.
5. Y. G.Paithankar and S. R. Bhide, "Fundamentals of power system protection", Prentice Hall, New Delhi, 2010.
6. G. Phadke and J. S. Thorp, "Computer Relaying for Power Systems", John Wiley and Sons, 2012.
7. G. Phadke and J. S. Thorp, "Synchronized Phasor Measurements and their Applications", Springer,2017.
8. D. Reimert, "Protective Relaying for Power Generation Systems", Taylor and Francis, 2006.
9. Madhava Rao. T.S., "Power System Protection - Static Relays with Microprocessor Applications", Tata McGraw Hill Publishing Co., New Delhi, 2017.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Study the different components of a protection system.
2. Understand the operation of circuit breakers.
3. Analyze the protection schemes for different power system components.
4. Impart knowledge on various illumination schemes and their implementation
5. Gain the various methodologies adopted in electric heating and welding

Mapping with Programme Outcomes															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3		2	1		3	2				1	2	2	2	1
CO2	3	2	2	1	2	3	2				2	1	1	2	
CO3	2		2			3	2				2	1	1	3	2
CO4	2	2	2	2	3	3	2		2	2	3	2	1	3	1
CO5	2	2	2			2					3	1	1	2	1

22EECP706	POWER SYSTEM ANALYSIS LAB	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVE

- To understand and learn the relative theory.
- To build up appropriate methodology for articulation of circuit / algorithm implementation.
- To set-up the relevant connections for executing the experiment / code the methodology evolved.
- To carry out / employ the methodology.
- To surmise / arrive at inferences from the results.

LIST OF EXPERIMENTS

1. Modeling of transmission lines and computation of their parameters
2. Formation of bus admittance matrix by analytical method
3. Formation of bus impedance matrix by building algorithm
4. Solution to load flow problem using Gauss-Seidel method
5. Solution to load flow problem using Newton- Raphson approach
6. Fast Decoupled method for the solution of load flow problem
7. Symmetrical Short circuit analysis
8. Unsymmetrical Short circuit analysis
9. Economic load dispatch without losses
10. Economic load dispatch with losses
11. Solution of Swing equation using modified Euler's method
12. Solution of Swing equation using RK method
13. Characteristics of Over Current Relay and Over Voltage Relay
14. Performance Evaluation of Earth Fault / Restricted Earth Fault Relay
15. Three Phase dead Short Circuit Fault Analysis on Transformer
16. Phase to ground Fault Analysis on a Transformer

COURSE OUTCOMES

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

1. Learn the relative theory.
2. Develop the appropriate methodology for articulation of circuit / algorithm implementation.
3. Contrivance the relevant connections for executing the experiment / code the methodology evolved.
4. Execute / implement the methodology.
5. Infer / arrive at inferences from the results.

Mapping with Programme Outcomes															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	3			2					2	2	
CO2	3	2	2	2	3			2					2	2	
CO3	3	2		2	3			2					2	2	
CO4	3	2		2	3	2		2					2		
CO5	3	2		2	3		2	2					2	2	

22ETIT707	INTERNSHIP / INDUSTRIAL TRAINING	L	T	P	C
		0	0	0	4

COURSE OBJECTIVES

- To work on a technical topic and acquire the ability of written and oral presentation
- To acquire the ability of writing technical papers for Conferences and Journals
- To train the students in the field work related to Electrical and Electronics Engineering and to have a practical knowledge in carrying out field related works.
- To train and develop skills in solving problems during execution of certain works related to Electrical and Electronics Engineering.

The students will work for two periods per week guided by student counsellor. They will be asked to present a seminar of not less than fifteen minutes and not more than thirty minutes on any technical topic of student's choice and to engage in discussion with audience. They will defend their presentation. A brief copy of their presentation should also be submitted. Evaluation will be done by the student counsellor based on the technical presentation and the report and also on the interaction shown during the seminar.

The students individually undergo a training program in reputed concerns in the field of Electrical and Electronics Engineering during the vacation for a minimum stipulated period of four weeks. At the end of the training, the student has to submit a detailed report on the training he/she had, within ten days from the commencement of the semester. The students will be evaluated, by a team of staff members nominated by Head of the Department, through a viva-voce examination.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Face the audience and to interact with the audience with confidence.
2. Tackle any problem during group discussion in the corporate interviews.
3. Face the challenges in the field with confidence.
4. Manage the situation that arises during the execution of works related to Electrical and Electronics Engineering
5. Develop the ability of writing technical papers for Conferences and Journals

Mapping with Programme Outcomes															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2							2	2			3	2		2
CO2	2							2	1			3		2	2
CO3	2							2				3			2
CO4	3					2	2	2	2		2	3			2
CO5	3							3		3		3	3		3

SEMESTER VIII

22EEPV803	PROJECT WORK AND VIVA-VOCE	L	PR	S	C
		0	10	2	6

COURSE OBJECTIVES

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
- To train the students in preparing project reports and to face reviews and viva voce examination.

METHOD OF EVALUATION

1. The students in a group of 3 to 4 works on a topic approved by the Head of the Department under the guidance of a faculty member and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor.
2. The progress of the project is evaluated based on a minimum of three reviews. The review committee will be constituted by the Head of the Department.
3. A project report is required at the end of the semester.
4. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Take up any challenging practical problems and find solution by formulating proper methodology on completion of the project work.
2. Carry out any experimental works.
3. Understand the modeling, analysis and design.
4. Prepare research papers for Conferences and journals
5. Acquire confidence to face any type of audience

Mapping with Programme Outcomes															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	1		1	3	2	3	2	3				3
CO2	3	2	3	2	3	2	3	3	3	3	2			2	3
CO3	3	2	2	1		1	3	3	3	2	2			1	3
CO4	3		2				2	3	3	2	2			3	3
CO5									3	2	3			3	3

PROFESSIONAL ELECTIVE COURSES
SEMESTER V

		L	T	P	C
22EEPESCN	NETWORK ANALYSIS AND SYNTHESIS	3	0	0	3

COURSE OBJECTIVES

- To gain knowledge about two port network
- To understand the reliability and immitance function
- To acquire knowledge about the synthesis of one port network
- To familiarize the concept of two terminal port synthesis
- To design various types of filters, attenuators and equalizers

UNIT I: TWO PORT NETWORK ANALYSIS

Network functions - Poles and zeros of network functions - Complex frequency - Two port parameters - Z, Y, h, ABCD and inverse h and ABCD parameters - Scaling network functions - Analysis of ladder and lattice networks.

UNIT II: REALIZABILITY AND IMMITANCE FUNCTIONS

Causality, Stability - Hurwitz polynomial - Positive real functions - Properties of LC, RC and RL driving point functions. Synthesis of one port networks: Basic synthesis procedure of driving point functions - Synthesis of LC, RC and RL driving point functions - Foster and Cauer forms

UNIT III: SYNTHESIS OF ONE PORT NETWORKS

RLC one terminal pairs - Minimum positive real function - Brune's method of Bott-Duffin - Gewertz method - Characteristics of symmetric networks - Iterative, image and characteristic impedances - Image transfer constant - Propagation constant- Insertion loss - Reactance matching.

UNIT IV: TWO TERMINAL PAIR SYNTHESIS BY LADDER DEVELOPMENT

Properties of - Y12 and Z12 - LC ladder development - RC ladder development - Series and parallel realization: Restriction on Z12 - Residue condition - Cauer's network realization - Symmetrical lattice and constant resistance network: Impedance equations for lattice - Unloaded lattice design - Constant resistance lattice - Bartlett's Bisection theorem - Constant resistance Bridged T and ladder networks.

UNIT V: DESIGN OF FILTERS, ATTENUATORS AND EQUALISERS

Theory of T and n sections - Filter fundamentals - Constant K lowpass and high pass filters - M - Derived filters - Composite filters - Bandpass and band elimination filters - Crystal and lattice filters - Cross-over filters - Butterworth and Chebyshev approximations - Synthesis of low pass filters - Magnitude and frequency normalization - Synthesis of high pass, band pass and band stop filters through frequency transformation - Symmetrical and Asymmetrical attenuator pads - Balanced and Unbalanced attenuators - Inverse networks Equalizers.

TEXT BOOKS

1. Franklin F.Kuo: "Network Analysis and Synthesis", Second Edition, Wiley
2. International, 2006.
3. Van Valkenburg M.E. "Introduction to Modern Network Synthesis", Wiley Eastern, 1986.

REFERENCE BOOKS

1. UmeshSinha: "Network Analysis and Synthesis", SatyaPrakashan Publishers, 2005.
2. Aatre V.K. "Network Theory and Filter Design", Wiley Eastern, 1985.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Able to compute network parameters of two-port networks.
2. Obtain network functions and poles and zeros of network functions.
3. Arrive at methods for synthesizing one port networks
4. Obtained ladder based methods for synthesizing two terminal pair networks
5. Develop methods for the design of filters, attenuators and equalizers

Mapping with Programme Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**3**										**2**	**3**	**2**	
CO2	**3**	**3**	**3**	**2**									**2**	**2**	
CO3	**3**	**3**	**3**	**3**								**2**	**3**	**2**	
CO4	**3**	**3**	**3**	**3**								**2**	**3**	**2**	
CO5	**3**	**2**	**3**									**3**	**3**	**3**	

22EEPESCN	WIND AND SOLAR ENERGY SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To study the wind speed statistics and probability distributions
- To understand various wind generator topologies
- To study the various solar resources and estimation of solar energy availability
- To study the power electronics convertors and MPPT
- To analyze the hybrid and isolated operation of solar PV and wind systems

UNIT I: PHYSICS OF WIND POWER

History of wind power, Indian and Global statistics, Wind physics, Betz limit, Tip speed ratio, stall and pitch control, Basic principles of wind energy conversion - Site selection consideration - Types of wind mills - Basic components of wind energy conversion systems (WECS) - Types of WECS. - Application of wind energy - Safety system - Environmental issues.

UNIT II: WIND GENERATOR TOPOLOGIES

Review of modern wind turbine technologies, Fixed and Variable speed wind turbines, Induction Generators, Doubly - Fed Induction Generators and their characteristics, Permanent Magnet Synchronous Generators - Power electronics converters. Generator - Converter configurations, Converter Control.

UNIT III: SOLAR RESOURCES

Introduction, solar radiation spectra, solar geometry, Earth Sun angles, observer Sun angles, solar day length, Estimation of solar energy availability.

UNIT IV: SOLAR PHOTOVOLTAIC

Technologies-Amorphous, mono crystalline, polycrystalline; V-I characteristics of a PV cell, PV Unit, array, Solar PV system - components of PV system - Design of PV system Power Electronic Converters for Solar Systems, Maximum Power Point Tracking (MPPT) algorithms. Converter Control.

UNIT V: NETWORK INTEGRATION ISSUES

Overview of grid code technical requirements - Fault ride- through for wind farms - Real and reactive power regulation, voltage and frequency operating limits, solar PV and wind farm behaviour during grid disturbances. Power quality issues - Power system interconnection experiences in the world - Hybrid and isolated operations of solar PV and wind systems. Solar thermal power generation: central receivers, solar pond

TEXT BOOKS

1. T. Ackermann, “Wind Power in Power Systems”, John Wiley and Sons Ltd., 2005.
2. G. M. Masters, “Renewable and Efficient Electric Power Systems**”,** John Wiley and Sons, 2004.
3. Mukund R.Patel, “Wind and Solar Power Systems", Taylor and Francis Publishers, Second Edition, 2006.

REFERENCES

1. H. Siegfried and R. Waddington, “Grid integration of wind energy conversion systems” John Wiley and Sons Ltd., 2006.
2. G. N. Tiwari and M. K. Ghosal, “Renewable Energy Applications”, Narosa Publications, 2004.
3. Jean-Claude Sabonnadiere," Renewable Energies", John Wiley and Sons Inc., 2009.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Comprehend the energy scenario and the consequent growth of the power generation from renewable energy sources.
2. Gain knowledge about the basic physics of wind and solar power generation.
3. Familiarize the power electronic interfaces for wind and solar generation.
4. Understand the concept of solar photovoltaic power generation.
5. Acquire awareness about the issues related to the grid-integration of solar and wind energy systems.

Mapping with Programme Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**			**1**		**2**	**2**	**1**				**2**	**3**	**2**	
CO2	**3**					**2**	**2**					**2**	**2**	**2**	
CO3	**3**			**2**								**2**	**3**	**3**	
CO4	**3**			**1**		**2**	**2**					**3**	**3**	**3**	
CO5	**3**			**1**		**1**		**2**				**3**	**3**	**2**	

22EEPESCN	SIGNALS AND SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To learn about signals, systems and their classification
- To explain the theory of continuous time systems
- To understand the basics of Fourier Analysis
- To enumerate the basics of DTFT and DFT Systems
- To enable a framework for operating on Discrete time Systems

UNIT I: CONTINUOUS TIME (CT) AND DISCRETE TIME (DT) SIGNALS

Classification of signals - Signal Energy and Power - Properties - Periodic signals - Even and Odd signals - CT complex exponential and sinusoidal signals - DT complex exponential and sinusoidal signals - CT unit impulse and unit step function - DT unit impulse and unit step sequence - Random signals - Random processes.

UNIT II: CONTINUOUS TIME SYSTEMS

Properties of continuous time systems - Representation of continuous time Linear time invariant (LTI) systems using differential equations - Block diagram representation - Analysis of continuous time LTI systems - Transfer function model - Block diagram reduction - Continuous time unit impulse response - Convolution integral - Unit step response of LTI system - Frequency response - Singularity function - Analysis of LTI systems using Laplace transform.

UNIT III: FOURIER ANALYSIS

Fourier series representation of continuous time periodic signals - Properties of continuous time Fourier series - Convergence of Fourier series - Representation of Aperiodic signals - Continuous time Fourier transform - Properties of continuous time Fourier transform - Analysis of continuous time LTI systems using Fourier transform.

UNIT IV: DTFT AND DFT

Discrete time Fourier transform (DTFT) - Properties of DTFT - Time and frequency shifting - Conjugation - Parseval's relation - Discrete Fourier transform (DFT) - Properties of DFT - DFT Frequency response characteristics - Weighting function - Circular Convolution - Correlation - Auto Correlation.

UNIT V: DISCRETE TIME SYSTEMS

Properties of Discrete time systems - Representation of discrete time systems using difference equation - Block diagram representation - Z Transform and its properties - Pole-Zero

representation - BIBO stability - Solution using Z transform - State variable equation - State space model.

TEXT BOOKS

1. Alan V Oppenheim, Alan Wilskey. S and Hamid Nawab. S: "Signals and systems" Second edition prentice Hall India, 2006.
2. Simon Haykin, Barry Van Veen., “Signals and Systems”. John Wiley and Sons (ASIA) Private limited, 2001.
3. Rodger Ziemer. E., William Tranter. H and Ronald Fannin. D, “Signals and Systems”, Maxwell Macmillman, Canada, 1993.
4. Ramesh Babu . P and Ananda Natarajan. R., “Signals and Systems”, 4 th Edition, Sci-Tech Publications, Chennai, 2011.

REFERENCE BOOKS

1. Gabel. R.A. and Richard. R.A., "Signals and linear systems", John Wiley and sons, 1987.
2. Gordan E Carlson: "Signals and linear systems analysis" Allied Publishers, New Delhi, 1993.
3. A.V.Oppenheim, A.S.Willsky and I.T.Young, "Signals and Systems", Prentice Hall, 1983.
4. R.F. Ziemer, W.H. Tranter and D.R. Fannin, "Signals and Systems - Continuous and Discrete", 4th edition, Prentice Hall, 1998.
5. Robert A.Gabel, Richard A.Roberts, "Signals and Linear Systems", John WileyandSons,1995.
6. M. J. Roberts, "Signals and Systems - Analysis using Transform methods and MATLAB", TMH, 2003.
7. J. Nagrath, S.N.Sharan, R. Ranjan, S. Kumar, "Signals and Systems", TMH New Delhi, 2001.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Represent and classify Continuous Time (CT) and Discrete Time (DT) signals and systems.
2. Analyze LTI systems in time domain.
3. Analyze periodic and aperiodic signals using Fourier transform and Fourier series.
4. Analyze and characterize the DTFT and DFT Systems
5. Arrive at the benefits of Discrete time Systems

Mapping with Programme Outcomes															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2										2	1		
CO2	3	2	2									1			
CO3	3	2	2									2		2	
CO4	3	2	2									2			
CO5	3	2			2							2		1	

22EEPESCN	DIGITAL SYSTEM DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To review the fundamentals of logic design
- To teach the theory of VHDL in Digital design.
- To give an overview of PLD and CPLD relating to the construction of the programmable devices.
- To present issues related to implementation of a digital system in FPGA.
- To introduce advanced features of VHDL, hardware testing of combinational and sequential logic and design for testability.

UNIT I: LOGIC DESIGN FUNDAMENTALS

Review of logic design fundamentals - Combinational logic - Flip-flops and latches - Mealy sequential circuit design - Moore sequential circuit design - Sequential circuit timing - Tri-state logic and busses.

UNIT II: VHDL

Introduction to VHDL - VHDL description of combinational circuits - Sequential statements and VHDL processes - Modeling flip-flops using VHDL processes - Processes using wait statements - VHDL delays - Compilation, simulation and synthesis of VHDL code - VHDL data types and operators - VHDL libraries - Behavioral and structural VHDL - Variables, constants and signals - Arrays and loops in VHDL - Assert and repeat statements.

UNIT III: PLD

Introduction to Programmable Logic Devices (PLDs): overview of PLDs - Simple PLDs - complex PLDs - FPGAs. Design Examples: BCD to seven segment display decoders - BCD adder - Traffic light controller - State graphs for control circuits - Scoreboard and controller - Synchronization and de bouncing- ADD and shift multipliers.

UNIT IV: FPGA

State Machine (SM) charts - Derivation of SM charts - Binary multiplier design - Realization of SM charts - Implementation of binary multiplier controller. Designing with FPGAs: Implementing functions in FPGAs - Shanon’s decomposition - Carry chains - Cascade chains - Logic blocks in commercial FPGAs - Dedicated memory in FPGAs - Dedicated multipliers in FPGAs - FPGA capacity - Design translation, mapping, placement and routing.

UNIT V: DESIGN AND TESTING

VHDL functions - VHDL procedures - Attributes - Multi valued logic and signal resolution - IEEE 9-valued logic system - Generics. Hardware testing and design for testability: testing combinational logic - Testing sequential logic - Scan testing - Boundary scan - Built-in self test.

TEXT BOOKS

1. Charles H. Roth, Lizy Kurian John, "Digital System Design using VHDL", Second Edition, Thomson Learning Inc., 2008.
2. Ian Grout, "Digital Systems Design with FPGAs and CPLDs", Newnes imprint of Elsevier Ltd., 2010.

REFERENCE BOOKS

1. K.C. Chang, "Digital Systems Design with VHDL and Synthesis - An Integrated Approach IEEE Computer Society", 1999.
2. J. Bhasker, "A VHDL Primer", Third Edition, Prentice Hall of India, 1999.

COURSE OUTCOMES

At the end of the course the students will be able to

1. Design of various digital communication systems.
2. Develop VHDL code describing them at various levels.
3. Implement the designed digital system using programmable devices.
4. Utilize advanced features of VHDL with FPGA in their system design.
5. Develop digital system with testability.

Mapping with Programme Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**1**	**3**	**2**	**1**								**3**	**3**	
CO2	**3**	**1**	**3**	**2**	**3**							**1**	**3**	**3**	
CO3	**3**	**1**	**3**	**3**	**3**							**1**	**3**	**3**	
CO4	**3**	**1**	**3**	**3**	**3**							**1**	**3**	**3**	
CO5	**3**	**1**	**3**	**3**	**3**							**1**	**3**	**3**	

22EEPESCN	TRANSDUCER SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To learn about the science of measurement system and its properties.
- To acquire knowledge about characteristics of measurement systems subjected to time invariant and time variant inputs.
- To understand the principle and characteristics of resistive transducers
- To gather knowledge of the theory of capacitive and inductive transducers.
- To study about characteristics and applications of fibre optics, MEMS based transducers and transducers governed by other principles such as hall effect and piezo electric effect.

UNIT I: SCIENCE OF MEASUREMENTS

Methods of measurement - Generalized scheme of a measurement system - Calibration methods - Static calibration- Errors in measurement - Types of errors - Limiting error - Probable error - Statistical analysis of measurement data - Mean and standard deviation - Probability of errors - Gaussian distribution - Reliability of measurement systems.

UNIT II: PERFORMANCE CHARACTERISTICS

Static and dynamic characteristics of measurement system - Transfer function - Characteristics of zero, first and second order type of instruments - Impulse, step, ramp responses of the above types of instruments.

UNIT III: RESISTANCE TRANSDUCERS

Transducer - Difference between sensor and transducer - Basic requirements of a transducer - classification of transducers - Selection of transducer. Resistance potentiometer - Types of potentiometers - Loading effect - Strain gauges - Gauge factor - Types of strain gauges - Strain measuring circuits -Temperature compensation and error cancellation techniques in strain measurement system.Principle of RTD, Thermocouple and Thermistor - Hot wire anemometer - Constant current and constant temperature operation.

UNIT IV: CAPACITANCE AND INDUCTANCE TRANSDUCERS

Capacitive transducers - Variable area type - variable air gap type - Variable permittivity type - signal conditioning circuit - Frequency Response - Capacitor microphone - Capacitive pressure sensor - Proximity sensor. Variable inductance - LVDT -RVDT -Variable reluctance transducers - EI pick up - Eddy current non contacting transducers - Synchros -Microsyn - Principle of operation, construction details.

UNIT V: OPTICAL AND CHEMICAL TRANSDUCERS

Introduction to fibre optic sensors - Types of configurations - Application in temperature, pressure, flow and displacement measurements. Hall effect transducers - IC sensor for temperature and pressure measurement - Piezoelectric transducers - piezoelectric crystals, Silicon Micro sensors - Bio Sensors - Chemical Sensors - Environmental Monitoring sensors (Water Quality and Air pollution).

TEXT BOOKS

1. E.O.Doeblin, “Measurement Systems, Application and Design”, McGraw-Hill, 1998.
2. A.K. Sawhney, “A course in Electrical and Electronics measurement and instrumentation”, Dhanpat Rai and sons, 1996.

REFERENCES

1. John B.Bentley, “Principles of Measurement Systems”, Longman Publishers, 2000.
2. R.K Jain, “Mechanical and Industrial Measurement”, Khanna Publishers, 1990.
3. D. Patranabis, “Sensors and Transducers”, Prentice Hall of India, 2nd edition, 2003.
4. B.C.Nakra and K.K Chaudhry, “Instrumentation measurement and analysis”, TMH, Third edition, 2009.
5. D.A. Krohn, “Fibre Optic Sensors - Fundamentals and Applications”, ISA publication, 2nd edition, 1992.
6. J.B Gupta, “A course in Electronics and Electrical measurements and instrumentation”, S.K.Kataria and Sons, New Delhi, Fifth Edition, 2010.

COURSE OUTCOMES

At the end of the course the students will be able to

1. Select a measurement system to meet the requirements.
2. Knowledge about characteristics of system based on the type of input.
3. Choose among the various types of resistance transducers for particular application.
4. Choose among the various types of capacitive and inductive transducers depending on the principle, range, cost and commercial availability.
5. Understand the recent trends in the development of transducers and the engineering involved in it.

Mapping with Programme Outcomes															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2												2		
CO2	2	2	2										2		
CO3	2	1	1										2	2	
CO4	2	1	1										2	2	
CO5	2	2											2	2	1

22EEPESCN	MEASUREMENT DATA ANALYSIS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE

- To review the theory of random variables and types of distributions.
- To learn the theory relating to the test of hypothesis.
- To understand the methods used for classifying the data.
- To explain the methods used for graphical representation.
- To introduce the fundamentals of R package.

UNIT I: RANDOM VARIABLE AND DISTRIBUTIONS

Sample Spaces - Events - Axioms - Counting - Conditional Probability and Bayes' Theorem - The Binomial Theorem - Random variable and distributions: Mean and Variance of a Random variable - Binomial - Poisson - Exponential and Normal distributions. Curve Fitting and Principles of Least Squares - Regression and correlation

UNIT II: TEST OF HYPOTHESIS

The Central Limit Theorem, distributions of the sample mean and the sample variance for a normal population, Sampling distributions (Chi-Square, t, F, z). Test of Hypothesis - Testing for Attributes - Mean of Normal Population - One-tailed and two-tailed tests, F-test and Chi-Square test - Analysis of variance ANOVA - One way and two way classifications.

UNIT III: PRESENTATION AND CLASSIFICATION OF DATA

Methods of collection of primary data, Discrete and Continuous Variables, Frequency Distributions, Cumulative Frequency distribution and gives, Bivariate Frequency Distributions; Tabulation of data.

Measures Of Location And Dispersion - Arithmetic mean - The Arithmetic mean of grouped Data, The Median - The mode - The variance and standard deviation - Interpretation of SD, Chebyshev's Lemma or Rule (for sample)

UNIT IV: GRAPHICAL REPRESENTATION

Line graphs, Geometric Forms, Pictorial Diagrams, Control Charts, Radar charts, Parteto Diagrams, Histograms, Pie Charts, Histogram, Scatter diagram, Flow charts

Time Series Analysis - Characteristics Movements in a time series; Time series models; Measurement of Trend; Secular Trend; Seasonal Movements; Cyclical Movements; Irregular Movements; Long Cycles

UNIT V: INTRODUCTION TO R- PACKAGES

Scientific Calculator - Inspecting Variables - Vectors Matrices and Arrays - Lists and Data Frames - Functions - Strings and Factors- Flow Control and Loops - Advanced Looping - Date and Times.

Introduction to Python Packages- Fundamentals of Python - Inserting and Exporting Data - Data Cleansing Checking and Filling Missing Data - Merging Data - Operations - Joins.

REFERENCE BOOKS

1. Richard Cotton, "Learning R", O'Reilly, 2013.
2. Dalgaard, Peter, "Introductory statistics with R", Springer Science and Business Media, 2008.
3. Brain S. Everitt, "A Handbook of Statistical Analysis Using R", Second Edition, LLC, 2014.
4. Samir Madhavan, "Mastering Python for Data Science", Packt, 2015.
5. Sheldon M. Ross, "Introduction to Probability and Statistics for Engineers and Scientists",4th edition, Academic Press; 2009.
6. Paul Teetor, "R Cookbook, O'Reilly, 2011.
7. Mark Lutz ,"Learning Python", O'Reilly,5th Edition,2013

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Understand the basics of random variables and types of distributions.
2. Enable the use of the test of hypothesis.
3. Arrive at the methods used for classifying the data.
4. Develop methods used for graphical representation.
5. Use the benefits of R package.

Mapping with Programme Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**1**	**2**											**1**		
CO2	**2**	**1**											**1**	**2**	
CO3	**2**	**1**	**1**	**2**									**3**	**2**	
CO4		**2**	**1**	**2**	**3**								**1**	**1**	
CO5	**2**		**2**	**3**									**2**	**2**	

SEMESTER VI

22EEPESCN	HIGH VOLTAGE TRANSMISSION SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To study HVAC and HVDC for overhead and underground transmission systems and factors governing the choice of them.
- To learn about the bundle conductors and methods of reducing the corona loss.
- To introduce the problems of EHVAC transmission at power frequency an compensation.
- To introduce modern developments in HVDC transmission and FACTS.
- To learn about the overvoltage problem, cables and insulation in extra high voltage system.

UNIT I: INTRODUCTION TO EHVAC AND HVDC TRANSMISSION

EHVAC and HVDC transmission - Comparison between HVAC and HVDC overhead and underground transmission scheme - Standard transmission voltages - Factors concerning choice of HVAC and HVDC transmission - Block diagram of HVAC and HVDC transmission schemes.

UNIT II: CORONA

Properties of bundled conductors - Inductance and capacitance of EHV line - Surface voltage gradient on single, double, and more than three conductor bundles - Corona effects - Power loss - Increase in radius of conductors - Charge-voltage diagram.

UNIT III: EHVAC TRANSMISSION

Problems of EHVAC transmission at power frequency - Generalized constants - Power circle diagram and its use - Voltage control using compensators.

UNIT IV: DC TRANSMISSION

Review of rectification and inversion process - Analysis of DC transmission systems - Harmonics on AC and DC sides and filters for their suppression - Multiterminal DC transmission systems -Parallel operation of AC and DC transmission - Modern developments in HVDC transmission/Introduction to FACTS.

UNIT V: OVERVOLTAGE IN EHV SYSTEMS

Origin and types - Ferro resonance overvoltage - Switching surges, reduction of switching surges on EHV systems. Introduction to EHV cable transmission, electrical characteristics of

EHV cables, properties of cable insulation materials. EHV insulators - Characteristics and pollution performance - Protection of HVAC and HVDC systems.

TEXT BOOKS

1. Rakesh Das Begamudre **"**Extra High Voltage AC Transmission Engineering", New Age International Publishers, Reprint 2014.
2. K. R. Padiyar "HVDC Power Transmission Systems: Technology and System Interactions", New Age International, 1990.

REFERENCE

1. Rao. S, "EHVAC and HVDC Transmission and Distribution Engg. - 3rd edition", Khanna Publication-2007.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Understand the factors governing the choice of HVAC and HVDC for overhead and underground transmission system.
2. Learn about bundled conductors and corona loss.
3. Analyze the problem of EHVAC transmission at power frequency and compensation.
4. Learn the DC transmission system in case of harmonics and as well as multi-terminal DC transmission system.
5. Impart the knowledge of over voltage problem cables and insulating materials.

Mapping with Programme Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**1**					**2**					**1**	**1**		
CO2	**3**		**2**				**2**					**1**			
CO3	**3**	**1**	**2**				**2**					**2**		**2**	
CO4	**3**		**2**				**2**					**1**			
CO5	**3**	**1**			**2**		**2**					**1**		**1**	

22EEPESCN	ELECTRIC AND HYBRID VEHICLES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To understand the fundamental concepts, principles, analysis and design of hybrid and electric vehicles.
- To acquire knowledge on the social and environmental importance, basic concepts and configuration of hybrid EV and electric driven train.
- To study various types of electric machines and energy storage devices used in hybrid and electric drive and to study the configuration and control of various electrical machines.
- To learn in detail about the Energy Storage Requirements in Hybrid and Electric Vehicles apart from the communication and supporting subsystems used.
- To understand the design of different energy management strategies, implementation issues in hybrid electric vehicle and battery electric vehicle.

UNIT I: INTRODUCTION

Conventional Vehicles: Basics of vehicle performance - Vehicle power source characterization - Transmission characteristics - To describe vehicle performance.

UNIT II: HYBRID VEHICLES

Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles - Social and environmental importance of hybrid and electric vehicles - Impact of modern drive - Trains on energy supplies.

Hybrid Electric Drive-trains: Basic concept of hybrid traction - Introduction to various hybrid drive - Train topologies - Power flow control in hybrid drive-train topologies.

UNIT III: ELECTRIC TRAINS

Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive-train topologies - Power flow control in electric drive-train topologies - Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles - Configuration and control of DC Motor drives - Configuration and control of Induction Motor drives - configuration and control of Permanent Magnet Motor drives - Configuration and control of Switch Reluctance Motor drives.

UNIT IV: ENERGY STORAGE

Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage - Fuel Cell based energy storage - Super Capacitor based energy storage - Flywheel based energy storage - 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 - Selecting the energy storage technology - Supporting subsystems.

UNIT V: ENERGY MANAGEMENT STRATEGIES

Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies - Comparison of different energy management strategies - Implementation issues of energy management strategies. Case Studies - Design of a Battery Electric Vehicle (BEV).

TEXT / REFERENCES

1. C. Mi, M. A. Masrur and D. W. Gao, “Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives”, John Wiley and Sons, 2011.
2. S. Onori, L. Serrao and G. Rizzoni, “Hybrid Electric Vehicles: Energy Management Strategies”, Springer, 2015.
3. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design”, CRC Press, 2004.
4. T. Denton, “Electric and Hybrid Vehicles”, Routledge, 2016.
5. A.K.Babu, "Electric and Hybrid Vehicles", Khanna Publishers, New Delhi 2020
6. Anupam Singh, "Electric Vehicles: And the end of ICE Age", Adhyyan Books, NewDelhi 2020.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Understand the models to describe hybrid vehicles and their performance.
2. Identify the different possible strategies in hybridization of EV.
3. Know the various topologies of electric drive and its control.
4. Familiarize the different strategies related to energy storage systems.
5. Gain knowledge about different energy management strategies adopted for EV

Mapping with Programme Outcomes															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2					3	1				2	3		
CO2	3	2	2	2		2	2		2		2	2		2	
CO3	3	2	3		2	2		1	2		2		2		
CO4	3	2	2	2		2	2	2		2		2		2	3
CO5	3	3		2	3	2		2	2		3	2		2	3

22EEPESCN	INDUSTRIAL AUTOMATION AND CONTROL	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To familiarize the methods used for identifying a process.
- To learn the theory of different types of controllers.
- To gather knowledge on the theory of Digital Control Strategies
- To understand the basics of PLCs
- To explain the framework of Distributed Control Systems

UNIT I: PROCESS MODELING

Mathematical modeling of a process - Process Identification - Open loop identification - First order and second order model - Without and with pure delay - Closed loop identification method - Identification of unstable systems - Self regulation characteristics - Inverse response - Tuning theory - Anti-reset windup technique.

UNIT II: CONTROLLERS

Transfer function of control equipment's - ON OFF control - Time proportional control - Proportional plus integral control - Derivative control - PID controller - Electronic controller - Ratio control systems - Split range control - Cascade control - Selective control - Inverse derivative control - Feedback control - Feed forward control - Bumpless automatic control - Typical process - PID algorithms - Design for load changes.

UNIT III: DIGITAL CONTROL STRATEGIES

Introduction - Basics of a digital control system - Sampling - Sample and hold circuits - Discrete time signal - Linear discrete time systems - Pulse transfer functions - Analysis of digital control system using Z transform - Stability analysis - Jury's stability criterion.

UNIT IV: PROGRAMMABLE LOGIC CONTROLLERS

Evolution of modern-day PLC - Relay based PLC - Microprocessor based PLC - Input and output UNITs - Other functional elements - Personal computer as PLC - Programming the PLC - Ladder logic diagram - Boolean language - On line and off line programming aids - Communication in PLC - Typical applications of PLC - PID control capability in programmable controllers.

UNIT V: DISTRIBUTED CONTROL SYSTEMS

Evolution of DCS - Factors to be considered in selecting a DCS - Typical architecture - Local control unit (LCU) and architecture - LCU languages - LCU - Process interfacing issues - Communication system requirements - Architectural issues - Protocol issues -

Communication media - Message security - Communication system standards - Field bus, HART. Operation interface - Requirements - Display - Alarms and alarm management - Engineering interface - Requirements - Comparison of DCS with direct digital control and supervisory control.

TEXT BOOKS

1. George Stephanopoulos, “Chemical Process Control, An introduction to the theory and Practice”, Prentice Hall of India, 2005.
2. Gopal.M, "Digital control and state variable methods” Tata McGraw Hill Private Ltd., Third Edition,2011.
3. Michal P Lucas., "Distributed Control Systems" Van Noster and Reinhold Co., 1986

REFERENCE BOOKS

1. Donald R Coughanowr,” Process System and Control, Second Edition” , McGraw Hill 2006.
2. F.DPetruzella., “Programmable Logic Controllers” McGraw Hill 2006.
3. Thomas Hughes, "Programmable Controller" Instrument Society of America, 1992.
4. Krishna Kant, " Computer -Based Industrial Control", PHI Learning Pvt. Ltd.,2017.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Understand the basics of process modeling.
2. Acquire knowledge about various controller configurations.
3. Gain knowledge in the field of digital control system.
4. Familiarize with PLC and its programming.
5. Understand the fundamentals of distributed control system.

Mapping with Programme Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**2**										**2**	**3**		
CO2	**3**	**2**	**2**								**1**	**2**			
CO3	**3**	**1**	**1**			**2**					**1**	**1**	**3**		**2**
CO4	**3**	**2**	**3**			**2**					**2**	**3**			**2**
CO5	**3**	**1**	**1**			**2**					**2**	**2**	**2**		**2**

22EEPESCN	DIGITAL SIGNAL PROCESSING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The course is intended to:

- Classify the type of signals and systems and Perform operation
- Analyze the discrete time systems.
- Compute Discrete Fourier Transform.
- Design Finite Impulse Response (FIR) and Infinite Impulse Response (IIR) digital filters.
- Analyze the effects of finite word length.

UNIT I: CLASSIFICATION OF SIGNALS AND SYSTEMS

Classification of systems: Continuous, discrete, linear, causal, stable, dynamic, recursive, time variance - Classification of signals: continuous and discrete, energy and power - Mathematical representation of signals - Typical signal processing operations: Linear convolution, Circular Convolution, Correlation - Sampling of CT signals**,** Sampling Theorem, Effect of under Sampling - Aliasing - Reconstruction of CT signal from Samples

UNIT II: ANALYSIS OF SIGNALS

Fourier Series representation of DT periodic signals (DTFS) - Properties, Representation of DT aperiodic signals by Fourier Transform (DTFT), properties - Z-transform and its properties, inverse z-transforms; difference equation - Solution by z transform - Application to discrete systems - Stability analysis, frequency response - Convolution using Z-transform - Introduction to DFT - Properties of DFT.

UNIT III: FAST FOURIER TRANSFORM

FFT algorithms - Radix-2 FFT algorithms - Decimation in Time (DIT-FFT) and Decimation in Frequency (DIF-FFT) algorithms - DFT analysis of sinusoidal signals. Fast convolution-overlaps save method - Overlap add method.

UNIT IV: DESIGN OF DIGITAL FILTERS

IIR design: Approximation of analog filter design - Butterworth and Chebyshev; digital design using impulse invariant and bilinear transformation - Warping, prewarping - Frequency transformation. FIR design: Windowing Techniques - Need and choice of windows - Linear phase characteristics. FIR and IIR filter realization - Parallel and cascade forms.

UNIT V: FINITE WORD LENGTH EFFECTS

Number representations - Quantization - Truncation and Rounding - Quantization noise - Oversampling A/D and D/A Conversion - Quantization of filter coefficients - Effects of finite word length on digital filters - Finite word length effects in FFT algorithms.

TEXT BOOKS

1. John G. ProakisandDimitris G. Manolakis, "Digital Signal Processing - Principles, Algorithms and Applciations", 4th Edition, Pearson Education/ Prentice Hall, 2007.
2. S.Salivahanan, A. Vallavaraj, C. Gnanapriya, "Digital Signal Processing", Tata McGraw Hill, New Delhi,2nd Edition, 2010.

REFERENCE BOOKS

1. Emmanuel C. Ifeachorand Barrie. W. Jervis, "Digital Signal Processing", 2nd Edition, Pearson Education,Prentice Hall, 2002.
2. Sophocles J. Orfanidis, "Introduction to Signal Processing, Prentice Hall, 1996.
3. Li Tan, "Digital Signal Processing: Fundamentals and Applications", Academic Press, 2008.
4. Johnny R. Johnson, "Introduction to Digital Signal Processing", Prentice-Hall International, 1989.
5. Lonnie C. Ludeman, "Fundamentals of digital signal processing", Harper and Row, 1986.
6. Allan V. Oppenheim and Ronald W. Schafer, "Discrete Time Signal Processing", Prentice Hall, 3rd Edition, 2009.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Classify the type of signals and systems and Perform operation on signals
2. Analyze the discrete time systems using Z and Fourier transforms
3. Compute Discrete Fourier Transform of a given discrete time sequence using FFT.
4. Design Finite Impulse Response (FIR) and Infinite Impulse Response (IIR) digital filters for a given specification
5. Analyze the effects of finite word length on filter implementation

Mapping with Programme Outcomes															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2										1	2		
CO2	3	2										2	2		
CO3	3	2	2							3	2	2	2		
CO4	3	2	2									2	2		
CO5	3	2	2									2	2		

22EEPESCN	DIGITAL CONTROL SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To develop mathematical models to represent discrete continuous system.
- To analyze and obtain solution methodology for the discrete time systems with Z and inverse Z transforms.
- To study the stability of discrete time system
- To learn the state space analysis of discrete time systems
- To analyze the design of discrete PID controller, discrete observer and discrete compensator

UNIT I: DISCRETE REPRESENTATION OF CONTINUOUS SYSTEMS

Basics of Digital Control Systems - Discrete representation of continuous systems - Sample and hold circuit - Mathematical Modeling of sample and hold circuit - Effects of Sampling and Quantization - Choice of sampling frequency - OH equivalent.

UNIT II: DISCRETE SYSTEM ANALYSIS

Z Transform and Inverse Z Transform for analyzing discrete time systems - Pulse Transfer function- Pulse transfer function of closed loop systems - Mapping from s-plane to z plane - Solution of Discrete time systems - Time response of discrete time system.

UNIT III: STABILITY OF DISCRETE TIME SYSTEM

Stability analysis by Jury test - Routh Criterion using the Bilinear Mobius Transformation - Stability analysis using bilinear transformation - Design of digital control system with dead beat response - Practical issues with dead beat response design.

UNIT IV: STATE SPACE APPROACH FOR DISCRETE TIME SYSTEMS

State space models of discrete systems, State space analysis - Lyapunov Stability - Controllability, reach-ability, Constructability and observability analysis - Effect of pole zero cancellation on the controllability and observability.

UNIT V: DESIGN OF DIGITAL CONTROL SYSTEM

Structure of Digital Controllers - Digital Controller Canonical Structure - Control System with PI Digital Controller - Design of Discrete PID Controller - Deadbeat Digital Controller - Design of discrete state feedback controller - Design of set point tracker - Design of Discrete Observer for LTI System - Design of Discrete compensator - Design of discrete output feedback control.

TEXT BOOKS

1. M. Sami Fadali, "Digital Control Engineering: Analysis and Design", Academic Press, Third Edition, University of Nevada, Reno, USA, 2020.
2. B.C. Kuo, "Digital Control System", Oxford University Press; Second edition, New Delhi, 2012.

REFERENCE BOOKS

1. Anastasia Veloni, Nikolaos I. Miridakis, "Digital Control Systems": Theoretical Problems and Simulation Tools, CRC Press, Boca Raton, 2018
2. Chi-Tsong Chen, "Analog and Digital Control System Design" Transfer Function, State Space and Algebraic Methods, Sounders College Publishing, New York, 2006
3. Ioan D. Landau and Gianluca Zito, "Digital Control Systems: Design, Identification and Implementation", Springer-Verlag London Limited 2006
4. Charles L. Phillips, H. Troy Nagle, Aranya Chakrabortty, "Digital Control System: Analysis and Design", Fourth Edition Global Edition, Pearson Education Limited, Harlow, England, 2015
5. Kannan M. Moudgalya, "Digital Control", John Wiley and Sons, Ltd, West Sussex, England, 2007
6. Constantine H. Houpis, Gary B. Lamont, "Digital Control Systems: Theory, Software, Hardware", McGraw Hill Inc, Singapore, 1992.
7. K. Ogata, "Discrete Control System", Dorling Kindersley Pvt Ltd, London, 2006.
8. M. Gopal, "Digital Control Engineering", New Age International (P) Ltd., Publishers, New Delhi, 2014.
9. G. F. Franklin, J. D. Powell and M. L. Workman, "Digital Control of Dynamic Systems", Addison-Wesley, Menlo Park, California, 1998.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Obtain knowledge on discrete representation of continuous systems.
2. Understand the usage of Z and inverse Z transform in discrete-time systems.
3. Gain knowledge about stability of discrete time systems.
4. Acquire knowledge about state space approach for discrete time systems.
5. Design discrete controllers and discrete compensators.

Mapping with Programme Outcomes															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1										3	1	
CO2	3	3	3	2	1								3	2	
CO3	3	2	2	1									3	2	
CO4	3	3	2	1									3	1	
CO5	3	2	2	2									3	3	

22EEPESCN	POWER PLANT INSTRUMENTATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To acquaint with theory and working principles of different types of instruments and control used in power plant Automation.
- To have familiarity with various components/equipment in power plants.
- To understand about the theory of Boiler instrumentation.
- To familiarize with monitoring and control of turbine systems.
- To get exposure to automation of power plants.

UNIT I: INTRODUCTION TO UNIT OPERATION AND UNIT PROCESS

Material and energy balance - Significance of instrumentation and layout of thermal, hydroelectric, nuclear, gas turbine, solar, wind power plant - Concept of regional and national power grid - Concept of distance protections and islanding types of power plant.

UNIT II: INSTRUMENTATION AND EQUIPMENTS OF VARIOUS UNIT OPERATIONS

Evaporation - Distillation - Leaching - Gas absorption - Heat exchangers - Humidification and dehumidification - Drying - Size reduction - Crystallization - Mixing.

UNIT III: BOILER INSTRUMENTATION AND OPTIMIZATION

Combustion control - Three element drum level control - Steam pressure - Oxygen/co/co2 - flue gases control - Furnace draft- boiler interlocks - Start-up and shut-down procedures - Boiler load calculation - Boiler efficiency calculation - SCADA controls - Boiler inspection and safety procedures

UNIT IV: TURBINE INSTRUMENTATION AND CONTROL

Valve actuation - Auto-start up, start up and shut down - Thermal stress control - Condition monitoring and power distribution instrumentation - Auxiliary control of water treatment plant - Electrostatic precipitator and oil automation system.

UNIT V: AUTOMATION

Thermal power plant, boiler automation - Diagnostic functions and protection - Digital electro - Hydraulic governor, man-machine interface - Graphic display of automated power plant - Simulation experiments on scada - Power plant monitoring and so on.

TEXT BOOK

1. Mccabe w.l, Smith j, Peter Harriot, "Unit Operation of Chemical Engineering", Seventh rev edition, Tata Mc Graw Hill publishing Company, , 2005.
2. Popovic and Bhatkar, "Distributed Computer Control in Industrial Automation", second edition, CRC Press, 1990.

REFERENCE

1. B.G.Liptak, "Instrument Engineers Handbook: Process Measurement and Analysis", Third Edition, Butter Worth Heinemann, 1995.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Familiarize with all types of power plant and its operation.
2. Understand about the various equipments and instruments.
3. Know how to maintain the stability of boiler
4. Learn the parameters that control the turbine
5. Know about the automation process involved in the power plants

Mapping with Programme Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**1**					**2**						**1**		
CO2	**3**		**2**				**2**								**1**
CO3	**3**	**1**	**2**				**2**					**2**		**2**	
CO4	**3**		**2**				**2**								**1**
CO5	**3**	**1**			**2**		**2**							**1**	

SEMESTER VII

22EEPESCN	EMBEDDED SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To study the fundamentals of embedded systems, design paradigms and architectures.
- To study the basics of PIC Microcontroller PIC and their programming.
- To study the ARM Architecture and their programming.
- To understand the Real Time Operating System, and Task Management.
- To acquaint with RTOS based embedded system design

UNIT I: OVERVIEW OF EMBEDDED SYSTEMS

Embedded system concept - Microcontroller - Embedded hardware devices - Clock Oscillator - Watch dog timer - Real Time Clock- Brownout and Reset - Memory devices - Memory management methods - In circuit emulator - Target hardware - Debugging - Embedded processors.

UNIT II: PIC MICROCONTROLLER AND INTERFACING

Introduction to PIC microcontrollers - PIC 16C74A Architecture - Comparison of PIC with other CISC and RISC based systems - Memory organization - Registers and addressing modes - Instruction set - PIC programming in Assembly language.

I/O ports, I/O bit manipulation programming, timers / counters, Programming to generate delay and waveform generation, Interrupts - Data Conversion- A/D converter, SPI - I2C bus-UART Memories, LED, LCD, stepper motor interfacing, D.C motor interfacing, sensor interfacing

UNIT III: ARM ARCHITECTURE AND PROGRAMMING

RISC Machine - Architectural Inheritance - Core and Architectures - Registers - Pipeline - Interrupts - ARM organization - ARM processor family - Co-processor - Instruction set - Thumb instruction set - ARM Assembly Language.

UNIT IV: OPERATING SYSTEM OVERVIEW

Introduction to OS - Function of OS - Defining an RTOS - Differences in Embedded Operating Systems - Introduction to Kernel - Resources - Shared Resources - Task - Multitasking - Task Management Functions - Scheduling and Scheduling Algorithms - Implementation of scheduling and rescheduling.

UNIT V: RTOS BASED EMBEDDED SYSTEM DESIGN

Introduction to basic concepts of RTOS - Task, process and threads - Interrupt routines in RTOS - Multiprocessing and Multitasking - Preemptive and non-preemptive scheduling - Task communication shared memory - Message passing - Inter process Communication - Synchronization between processes-semaphores.

TEXT / REFERENCES

1. M. A.Mazidi, J. G. Mazidi and R. D. McKinlay, "The 8051Microcontroller and Embedded Systems: Using Assembly and C", Pearson Education,2007.
2. K. J. Ayala, "8051 Microcontroller", Delmar CengageLearning,2004.
3. R. Kamal, "Embedded System", McGraw Hill Education, 2009.
4. R. S. Gaonkar, ", Microprocessor Architecture: Programming and Applications with the 8085", Penram International Publishing,1996
5. D. A. Patterson and J.H. Hennessy, "Computer Organization and design: The Hardware/Software interface", Morgan Kaufman Publishers, 2013.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Understand the fundamental of embedded systems
2. Explore the architecture of various microcontrollers and its interfacing
3. Develop assembly language programs for the processors.
4. Gather an overview of operating system.
5. Arrive at the study of RTOS systems

Mapping with Programme Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**											**2**	**3**		
CO2	**3**	**2**										**2**			
CO3	**3**	**2**									**2**	**2**			
CO4	**3**		**3**		**2**						**2**	**2**		**3**	
CO5	**3**				**3**				**3**		**2**	**2**	**2**	**2**	

22EEPESCN	VLSI DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To provide an understanding of VLSI Design process and to bring both system and circuit view on design together.
- To familiarize the MOS circuit realization of the various building blocks that is common to any microprocessor or digital VLSI circuit.
- To learn transistor level CMOS logic design and to understand NMOS and Calibration process.
- To impart knowledge about designing digital circuits like adders and multipliers.
- To study programming technologies and architectures of FPGAs and understand the concepts of modeling a digital system using VHDL.

UNIT I: VLSI DESIGN CONCEPTS

Evolution of VLSI - VLSI design flow - Design domains Behavioural, Structural and Physical design - Concept of Regularity, Modularity and Locality - Layout styles: Full custom - Semi custom approaches - MOS structure - MOS current equation - Channel length modulation - Body effect - MOSFET capacitance - CMOS Logic Design: Static characteristics of CMOS Inverter, Dynamic behaviour of CMOS inverter - Static and dynamic power dissipation in CMOS - Basic and Complex gates realization in CMOS - Transistor sizing - Sheet resistance and area capacitance of layers - Wiring capacitance - Driving large capacitive loads.

UNIT II: VLSI FABRICATION TECHNIQUES

An overview of wafer fabrication, Wafer Processing - Oxidation - Patterning - Diffusion - Ion Implantation - Deposition - Silicon gate NMOS process - CMOS processes - N-well, P-well - Twin tub, Silicon on insulator - CMOS process enhancements - Interconnects, Circuit elements - CMOS latch up - Design Rules - Need for Design Rules - CMOS lambda - Based design Rules - Stick diagram and layout for CMOS inverter.

UNIT III: ANALOG VLSI

Introduction to analog VLSI - Analog circuit building blocks - Switches- active resistors - Current sources and sinks - Current mirrors/amplifiers - Voltage and Current References - CMOS inverting amplifiers - CMOS Differential Amplifiers - CMOS Two stage op-amp - Modulators and Multipliers - Switched capacitor filter.

UNIT IV: DIGITAL VLSI

Logic design: Switch logic and Gate logic - Dynamic CMOS logic - Structured design examples: Simple combinational logic and clocked sequential design - Sub-system design: Design of shifters - Design of Adders: Ripple carry adders, Carry select adder, carry save adder, Manchester carry - chain adder, Carry Look- ahead adder, Design of Multipliers: Serial, Parallel and pipelined multiplier arrays, Booth multiplier, Wallace tree multiplier.

UNIT V: PROGRAMMABLE ASCIS AND VHDL

Architecture and Programming technologies of ROMs, EPROMs, PLA, PAL, Gate arrays, CPLD and FPGA - Xilinx FPGA's LCA, I/O block and interconnect - Programming technology. VHDL overview - Hardware modeling issues - VHDL code structure: Library declaration, Entities and Architectures - Data types - Operators - Concurrent and Sequential Statements - Signals and Variables - Packages and Libraries - Introduction to behavioural, dataflow and structural modeling - Simple VHDL code examples.

TEXT BOOKS

1. Neil, H.E. Waste, David Money Harris, "CMOS VLSI Design": A Circuits and Systems Perspective, Pearson Education India, 3rd edition, 2012.
2. Wayne Wolf, "Modern VLSI Design", Ip-Based Design, Pearson Education India, 4th edition, 2009.

REFERENCE BOOKS

1. Deepak Garg, "VLSI Design", S.K. Katarinaand Sons; 1st edition, 2013.
2. R. Sakthivel, "VLSI Design", S.Chandand Company Ltd, 4th edition, 2008.
3. SaritaChauhan, "VLSI Design" S.K., Katariaand Sons; edition, 2012.
4. Sharat C. Prasad Kaushik Roy, "Low-Power CMOS VLSI Circuit Design", Wiley Publications, 2009.
5. AL. Visalatchi, B.Priya, S.Pravenaa,"Modern VLSI Design", Anuradha Publications,1st edition, 2010.
6. Douglas. A. Puknell and Kamran Eshraghian, "Basic VLSI Design", PHI, 3rd Edition, 2005.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Provide comprehensive idea about the techniques of chip design using programmable devices.
2. Analyze VLSI systems, VHDL and MOS circuit realization of the various building blocks that is common to any microprocessor or digital VLSI circuit.
3. Design and analyze of analog circuit

4. Design and analyze digital circuits like multipliers, adders and understand the architecture and programming technologies of FPGA.
5. Model a simple digital system using VHDL.

Mapping with Programme Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**2**	**2**									**1**	**2**	**2**	
CO2	**3**	**2**	**1**		**2**							**1**	**2**	**2**	
CO3	**3**	**2**	**2**								**1**	**2**	**2**	**2**	
CO4	**3**	**2**	**2**		**2**						**2**	**2**	**2**	**2**	
CO5	**3**	**2**	**2**								**2**	**3**	**2**	**2**	

22EEPESCN	INDUSTRIAL ELECTRICAL SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To impart a wide knowledge about the components of LT system wiring components and their selection.
- To provide basic concepts regarding residential and commercial wiring systems and guide lines for their installation.
- To learn about various industrial electrical system and their production schemes.
- To familiarize the student with different automation schemes of Industrial Electrical systems.
- To understand different types of illumination systems and methods involved in design.

UNIT I: ELECTRICAL SYSTEM COMPONENTS

LT system wiring components - Selection of cables - Wires - Switches - Distribution box - Metering system - Tariff structure - Protection components - Fuse - MCB - MCCB - ELCB, - Symbols, single line diagram (SLD) of a wiring system - Contactor - Isolator - Relays - MPCB - Electric shock and Electrical safety practices.

UNIT II: RESIDENTIAL AND COMMERCIAL SYSTEMS

Types of residential and commercial wiring systems - General rules and guidelines for installation - Load calculation and sizing of wire - Rating of main switch - Distribution board and protection devices - Earthing system calculations - Requirements of commercial installation - Deciding lighting scheme and number of lamps - Earthing of commercial installation - Selection and sizing of components.

UNIT III: INDUSTRIAL SYSTEMS

HT connection - Industrial substation - Transformer selection - Industrial loads - Motors - starting of motors - SLD - Cable and Switchgear selection - Lightning Protection - Earthing design - Power factor correction - Specifications of LT Breakers - MCB and other LT panel components.

UNIT IV: INDUSTRIAL SYSTEM AUTOMATION

DG Systems - UPS System, Electrical Systems for the elevators - Battery banks - Sizing the DG - UPS and Battery Banks - Selection of UPS and Battery Banks. Study of basic PLC - Role of in automation - Advantages of process automation - PLC based control system design - Panel Metering.

UNIT V: ILLUMINATION SYSTEMS

Understanding various terms regarding light - Lumen - Intensity - Candle power - Lamp efficiency - Specific consumption - Glare - space to height ratio - Waste light factor - Depreciation factor - Various illumination schemes - Incandescent lamps and modern luminaries like CFL - LED and their operation - Energy saving in illumination systems - Floodlighting.

TEXT BOOKS

1. S.L. Uppal and G.C. Garg, "Electrical Wiring, Estimating and Costing", Khanna Publishers, 2008.
2. K. B. Raina, "Electrical Design, Estimating and Costing", New Age International, 2007.

REFERENCES

1. S. Singh and R. D. Singh, "Electrical estimating and costing", Dhanpat Rai and Co., 1997.
2. Web site for IS Standards.
3. H. Joshi, "Residential Commercial and Industrial Systems", McGraw Hill Education, 2008.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Familiarize with different electrical wiring systems for residential, commercial and industrial consumers, representing the systems with standard symbols &drawings, SLD.
2. Understand various components of industrial electrical systems.
3. Analyze and select the proper size of various electrical system components.
4. Acquire knowledge about various industrial automation system.
5. Train and get exposed with the design of illumination system.

Mapping with Programme Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**2**	**3**			**2**		**3**				**1**	**1**	**1**	
CO2	**3**	**2**	**2**			**3**		**2**				**2**	**3**	**2**	
CO3	**2**	**2**	**2**			**3**		**2**				**2**	**3**	**2**	
CO4	**2**	**3**	**2**	**3**	**3**	**2**						**1**	**3**	**2**	
CO5	**2**	**3**	**2**			**2**						**2**	**2**	**2**	

22EEPESCN	VIRTUAL INSTRUMENTATION AND SMART SENSORS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To understand the basic components of Virtual Instrumentation system
- To impart knowledge pertaining to Data Acquisition System
- To learn to develop VIs based on Lab VIEW software.
- To learn to develop applications based on Virtual Instrumentation system.
- To know about various smart sensors.

UNIT I: INTRODUCTION

Review of Digital Instrumentation, Concept of Virtual Instrumentation Historical perspective - need of VI advantages - definition of VI - Block diagram and architecture of a Virtual Instrument - Traditional Instruments versus Virtual Instruments - dataflow techniques, graphical programming in data flow, VI Debugging Techniques.

UNIT II: DATA ACQUISTION AND COMMUNICATION

Hardware PC based data acquisition - Typical on board DAQ card- Organization of the DAQ VI system-Data acquisition interface requirements - Embedded system buses Selection of Data acquisition cards - Buffered data acquisition - VI Chassis requirements. Data acquisition cards with serial and parallel communication system controllers. Ethernet - Networking basics for office and Industrial applications - VI customization-Instrument Drivers.

UNIT III: PROGRAMMING TECHNIQUES

VIs and sub VIs, loops and charts, arrays, clusters and graphs, case and sequence structures, formulae nodes, local and global variables, State machine, string and file I/O, Publishing measurement data in the web, Internet Connectivity.

UNIT IV: APPLICATION OF VI ANALYSIS TOOL

Signal Processing Tool set- Fourier transforms, power spectrum, correlation methods, windowing and filtering. Math Toolsets, Hybrid Programming Concept, Control and Simulation Toolkit, On-Off controller, PID Control, Fuzzy algorithms - Application of VI in process control designing of equipment's like oscilloscope, Multimeter, Design of digital Voltmeters with transducer input- Applications of VI for Process Control and Instrumentation

UNIT V: SMART SENSORS

Definition - Sensor classification- General architecture of smart sensors Description of smart

sensor architecture - Block level design consideration for smart sensor - Importance and adoption of smart sensor - Types of smart sensors compensation.

TEXT BOOKS

1. Gary Johnson, "LabVIEW Graphical Programming", McGraw Hill, 2006.
2. Skolkoff, "Basic concepts of LABVIEW 4", PHI, 1998.

REFERENCES

1. Paul Bates, "Practical Digital and Communications", Prentice-Hall, 1987.
2. J.B.Dixit, AmitYadav, "Intelligent Instrumentation for Engineers", University Science Press, 2012.
3. Lisa .K, Wells and Jeffrey Travis, LABVIEW for Everyone, Prentice Hall, 2009.
4. Kevin James, "PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control", Newnes, 2000.
5. Jovitha Jerome, "Virtual Instrumentation using LabVIEW", Eastern Economy edition, PHI learning private Ltd., 2010.
6. Gupta. S, Gupta. J.P, "PC Interfacing for Data Acquisition and Process Control", ISA, 1994.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Gain the basic knowledge of virtual instrument
2. Understand the concept of Data acquisition using DAQ VI's.
3. Understand the Virtual Instruments basis concepts and programming
4. Acquire knowledge to incorporate various VI Toolsets.
5. Familiarize with smart sensors

Mapping with Programme Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**2**	**3**					**2**				**1**	**1**	**1**		
CO2	**1**		**2**			**3**	**2**				**1**	**1**			
CO3	**1**	**2**	**2**		**2**		**2**				**1**	**2**		**2**	
CO4		**2**	**2**		**2**		**2**				**1**	**2**			
CO5		**2**	**3**		**3**	**3**	**2**				**1**	**3**		**1**	

22EEPESCN	ROBOTICS AND AUTOMATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To understand the basic anatomy of robots and trajectory planning list of objectives about the course
- To enable students to understand about the work envelopes of robots and its role in automation
- To give an overview of the various methods of control of robots
- To explain methods used in the automation of Robots
- To select robots based on their applications and their related issues in industrial automation

UNIT I: FUNDAMENTALS OF ROBOTS

Definition - Historical background - Robot Anatomy : Polar, Cylindrical, Cartesian coordinate, Joint-arm configuration - Work volume - Robot Drive System : Hydraulic, Electric, Pneumatic - Control System: Limited sequence, Play back with point to point and Continuous path control Intelligent Robots - Dynamic performance: Speed of response and Stability - Precision of movement: Spatial Resolution, Accuracy, Repeatability and Compliance - Introduction to End effectors, Robotic Sensors, Robot Programming and work cell control.

UNIT II: ROBOT END EFFECTORS AND SENSORS

Types - Mechanical grippers - Magnetic grippers, Vacuum cups, Adhesive gripper, Hooks and Scoops - Tools as end effectors - Robot/ End-effectors interface - Consideration in Gripper selection and Design. Sensors: Transducers and Sensors - Sensors in Robotics: Tactile, Proximity and Range Sensors, Miscellaneous sensors and sensor based systems - Machine Vision System.

UNIT III: ROBOT PROGRAMMING

Methods of Programming-: Lead through Methods, Robot program as a path in space - Motion interpolation, wait, signal and delay Commands, Branching, Capabilities and limitations of Lead through Methods Textual Robot Programming - Structure, Motion, End effectors and Sensor commands, Program control communication, Monitor mode commands 105 Robot Control: Open and Closed loop control - Control Problem - Linear control Schemes- Design of Partitioned PD, PID and Adaptive Controllers for Linear Second order SISO Model of robot and their Block schematic representation - Control of Industrial Robots Using PLCs.

UNIT IV: AUTOMATION

Fixed automation, Flexible Automation and Programmable Automation. Intelligent Industrial Automation, Industrial Networking, Bus Standards Automatic Feeders, Automatic Storage and Retrieval Systems (AS/RS), Transfer Lines, Automatic Inspection Systems

UNIT V: APPLICATIONS OF ROBOTS

Factors influencing the selection of Robots - Robots for Welding, Painting, Assembly, Nuclear, Thermal and Chemical Plants. Introduction to Mobile Robots, Legged Robots and Remote Controlled Robots, Automated Guided Robots, Micro Robots - Control and Safety Issues.

TEXT BOOKS

1. Groover, M.P., Weiss, M., Nagel, R.N., Odrey, N.G., "Industrial Robots: Technology, Programming and Applications", McGraw-Hill Book Company, 2012.
2. Mittal R K, Nagrath I J, "Robotics and control", Tata McGraw Hill, 2010.

REFERENCES

1. Groover, M.P., "Automation, Production Systems, and Computer-Integrated Manufacturing", Prentice-Hall of India Private Limited, New Delhi, 2007
2. S.R.Deb, "Robotics Technology and Flexible Automation", Tata McGraw Hill, 1994
3. Yoran Koren, Robotics for Engineers, McGraw Hill, 1980.
4. Saeed B. Niku, "An Introduction to Robotics- Analysis, Systems", Applications, Second Edition, John Wiley and Sons Inc., 2010.
5. Wesley, E. Sryda, "Industrial Robots: Computer interfacing and Control" PHI, 1985.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Expertise the fundamentals of Robotics
2. Understand the issues related to end effectors and sensors
3. Acquire knowledge in Programming and Control of Robots
4. Understand the issues related to implementation of Industrial Automation with Robot Application
5. Gain an in depth understanding of the selection of robots for various application and their safety issues

Mapping with Programme Outcomes															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2					2				1	1	1		
CO2	3	2	2		2		2				1	1			
CO3	3	2	2		2		2				1	2		2	
CO4	3	3	2	2	2	3	2				1	2			
CO5	3	3		2	3	3	2				1	2		1	

22EEPESCN	FIBRE OPTICS AND LASER INSTRUMENTATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To provide basic knowledge of optical fibres and their properties.
- To expose adequate knowledge about the fibre optic sensors
- To disseminate the students, the fundamental characteristics, types and industrial applications of optical laser.
- To gain knowledge about laser application for various measurements
- To provide adequate facts about holography and medical applications of optical laser.

UNIT I: INTRODUCTION

Principles of light propagation through a fibre - Basic optical laws and definitions - Different types of fibres and their properties, fibre characteristics - Wave Propagation - Fibre Losses - Dispersion - Connectors and splicers - Optical sources and detectors.

UNIT II: FIBRE OPTIC SENSORS

Measurement of pressure, temperature, current, voltage and liquid level - Polarimetric fibre sensor - Interferometric method of measurement of length - Moire fringes - Optical Multiplexer.

UNIT III: LASER PRINCIPLES

Absorption process - Emission process - Fundamental characteristics of lasers - Properties of laser - Laser modes - Resonator configuration - Q-switching - Types of lasers: Gas lasers, solid lasers, liquid lasers, semiconductor lasers.

UNIT IV: INDUSTRIAL APPLICATIONS

Laser for measurement of distance, length, velocity, acceleration and current, voltage - Material processing: Laser heating, welding, melting and trimming of material - Laser spectroscopy.

UNIT V: MEDICAL APPLICATIONS

Holography - Basic principles - Holography for NDT - medical application of lasers: laser and tissue interaction, laser instruments for surgery, removal of tumors of vocal chords, brain surgery, plastic surgery, gynecology, and oncology.

TEXT BOOKS

1. Keiser, “Optical Fibre Communication Systems”, McGraw Hill Ltd., 2008.

2. S. Nagabhushana and N. Sathyanarayana, "Lasers and Optical Instrumentation", I.K. International publishing, 2010.

REFERENCES

1. Govind P. Agrawal, "Fibre-Optic Communication Systems", 4th Edition, Wiley publication, 2010.
2. Pallab Bhattacharya, "Semiconductor Opto-Electronics", PHI, 2002.
3. John and Harry, "Industrial lasers and their application", McGrawHill,2002.
4. Introduction to Holography, CRC press, 2012.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Understand the Characteristics and properties of optical fibres.
2. Use of optical fibre sensors in industries.
3. Identify the characteristics and principles of optical lasers.
4. Develop optical laser for industry applications.
5. Apply laser principle in medical electronics.

Mapping with Programme Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**1**												**1**		
CO2	**2**												**2**		
CO3	**2**												**2**		
CO4	**2**	**2**											**2**	**2**	
CO5	**2**	**2**	**2**		**3**	**2**							**2**	**2**	

22EEPESCN	IoT FOR ELECTRICAL ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To provide knowledge on the basic concepts of IoT.
- To convey the significance of computing techniques for IoT.
- To describe how IoT be applied for power system.
- To study in depth about the IoT application to Electric Vehicles.
- To familiarize with the design considerations and application of IIoT

UNIT I: INTRODUCTION TO INTERNET OF THINGS (IOT)

Internet of Things Concepts - Core Concepts - Machine-to-Machine communications - Industrial Internet of Things - Internet of Things framework - Characteristics of IoT - application of IoT - Information and Communication Technology Infrastructure - Architecture and Reference Models

UNIT II: COMPUTING TECHNIQUES FOR IOT

Cloud and Fog Computing in IoT - IoT system requirements - Cloud Computing in IoT - characteristics of cloud computing - Cloud computing service models - Common cloud-based IoT architecture - Advantages of using Cloud for IoT - Industrial domain - Smart Cities - Key Challenges of Cloud-Based IoT - Fog Computing in IoT - Need for and requirements - architecture of Fog computing - Revised fog-enabled architecture combining fog and cloud - based IoT - advantages of using Fog for IoT - Potential Future Fog usages in IoT for Smart grid - Connected Vehicles - Smart buildings.

UNIT III: IoT FOR POWER SYSTEMS

Evolution of the electric power grid - Extended energy value chain and IoT use cases - Generation - Transmission - Distribution and Metering - Storage - Marketing, Sales, and Service - Customers - Smart grid IoT connections - Energy Case Studies - Smart Monitoring and Diagnostics Systems at Major Power Plants - Smart generation architecture - Smart logging and analytics architecture - Smart Monitoring and Diagnostics Systems in Major Power Plants - Asset Integration Architecture of Smart MandD - Microgrids and Virtual Power Plants - Overview of virtual power plant / microgrid management system (VPP/MMS).

UNIT IV: IoT FOR ELECTRIC VEHICLES

Electric Vehicles (EV) - Classifications - Charging - eMobility - EV charging services - eRoaming - EV remote management - AIA for Reva Remote Management - EVs and cross - Energy management - Intermodal Services - Automated driving: technologies - System

architecture - Digital Horizon - Automated parking smart parking - Smart City - Projects - Relevance for IoT - Ignite | IoT Strategy Execution - IoT opportunity categories - Innovation Project Canvas with AIA - IoT Opportunity Management Indian EV - 4 wheelers - 3 wheelers - 2 wheelers - Electric bus - E Trucks - V2V - V2I - V2C - Vehicle-to-Everything (V2X) paradigm - Intelligent connected Vehicles - Benefits and challenges of V2X communication.

UNIT V INDUSTRIAL IoT (IIoT)

Introduction - Requirements - Design considerations - Application of IIoT - Benefits and challenges of IIoT - Real-time monitoring and control of processes - Deploying smart machines, smart sensors, and smart controllers with proprietary communication and internet technologies - Maximize safety, security and reliability through high precision automation and control

REFERENCE BOOKS

1. Qusay F. Hassan, “Internet of Things A to Z Technologies and Applications”, John Wiley and Sons, Inc., NewJersey, 2018.
2. Jeeva Jose, “Internet of Things, Khanna Publishers”, New Delhi, 2018.
3. Dirk Slama, Frank Puhlmann, Jim Morrish and Rishi M. Bhatnagar, “Enterprise IoT Strategies and Best Practices for Connected Products and Services”, O’Reilly Media, Inc., Sebastopol, USA, 2016
4. Stuart Borlase, “Smart Grids Advanced Technologies and Solutions”, Second Edition, CRC Press, Boca Raton, 2018.
5. Ravi Ramakrishnan, Loveleen Gaur, “Internet of Things Approach and Applicability in Manufacturing”, CRC Press, Boca Raton, 2019.
6. Gilchrist, Alasdair, “Industry 4.0: the Industrial Internet of Things”, Apress (Springer Group), New York,2016

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Understand the basic concepts of IoT.
2. Gain knowledge about the significance of computing techniques for IoT.
3. Familiarize with how IoT can be applied for power system.
4. Understand various in- depth concepts about the IoT application to Electric Vehicles.
5. Familiarize with the design considerations and application of IIoT

Mapping with Programme Outcomes															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		3	2			3						1	2		
CO2		2	2			2						1	2		
CO3	2	3				2	3				1	2		2	
CO4	2	3				2	3				2	2	2		
CO5	2	2	2			3	3				2	2		2	

22EEEPSCN	EMBEDDED SYSTEM LAB	L	T	P	C
		0	0	6	3

COURSE OBJECTIVES

- To learn the functioning of programmable processors and controllers.
- To study the basic operations of programmable processors and controllers.
- To develop processor and controller based programs.
- To study the functioning of different peripheral interfacing devices.
- To study the role of programmable devices in real-world applications

LIST OF EXPERIMENTS

1. Study of 89c51 Microcontroller
2. Application of 89c51 Microcontroller
    a. Frequency Measurement
    b. Boolean Algebra
3. Stepper Motor Control using 89c51 Microcontroller
4. Seven Segment LED Display using 89c51 Microcontroller
5. Study of PIC16F877 Microcontroller
6. Applications of PIC16F877 Microcontroller
    a. Seven Segment LED Display
    b. Analog to Digital Conversion
    c. Generation of PWM output
7. Real-time clock using PIC16F877 Microcontroller
8. I^2C based Character Display using PIC16F877 Microcontroller
9. Study of ARM Processor LPC2148
10. Analog to Digital Conversion using ARM Processor LPC2148
11. Graphics LCD display using ARM Processor LPC2148
12. Study of ARM Cortex M4 Processor
13. Arithmetic operations using DSP TMS320C50
14. Study of DSP TMS320VC5416
15. DAC using DSP TMS320VC5416
16. Study of DSP TMS32OC6713

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Understand the architecture and operations of MICROCHIP microcontrollers.
2. Write programs in Embedded C for performing a task.
3. Validate the theoretical concepts by performing experiments in practical sessions.

4. Distinguish the various categories of programmable devices.
5. Acquire knowledge about different interfacing capabilities of 89C51, PIC and ARM7.

Mapping with Programme Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**2**								**1**	**1**		**1**	**3**		
CO2	**3**								**2**	**1**		**1**	**3**		
CO3	**3**	**3**	**3**	**3**					**3**	**1**	**2**	**2**	**3**	**2**	
CO4	**1**	**2**	**2**	**2**	**2**				**2**	**1**	**2**	**2**	**3**	**2**	
CO5	**2**	**3**	**3**	**3**	**3**				**3**	**1**	**3**	**3**	**3**	**3**	

OPEN ELECTIVE COURSES

22YYOESCN	AUTOMOTIVE ELECTRICAL AND ELECTRONICS SYSTEM	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To impart knowledge about the types of lighting system, batteries and accessories.
- To introduce the basics concepts of starting systems.
- To understand the aspects of charging systems.
- To learn the various processes in automotive electronics.
- To familiarize the sensors and activators using Arduino.

UNIT I: ELECTRICAL SYSTEMS

Principle and Construction of Lead Acid and Lithium-Ion Battery - Characteristics of Battery Rating Capacity and Efficiency of Batteries - Various Tests on Batteries - Maintenance and Charging - Lighting System and Photometry: insulated and Earth Return System - Details of Head Light and Side Light - LED Lighting System- Head Light Dazzling and Preventive Methods Horns - Wiper System.

UNIT II: STARTING AND IGNITION SYSTEM

Condition at Starting- Behavior of Starter During Starting - Series Motor and Its Characteristics - Principle and Construction of Starter Motor - Over Running Clutch Working of Different Starter Drive Units - Care and Maintenances of Starter Motor - Starter Switches - Spark Plugs - Advance Mechanisms - Different Types of Ignition Systems.

UNIT III: CHARGING SYSTEM

Generation of Direct Current - Shunt Generator Characteristics - Armature Reaction - Third Brush Regulation - Cutout - Voltage and Current Regulators - Compensated Voltage Regulator Alternators Principle and Constructional Aspects and Bridge Rectifiers - New Developments.

UNIT IV: ELECTRONICS SYSTEMS

Current Trends in Automotive Electronic Engine Management System - Types of EMS Electromagnetic interference Suppression - Electromagnetic Compatibility - Electronic Dashboard Instruments - Onboard Diagnostic System - Security - Warning System infotainment and Telematics.

UNIT V: SENSORS AND ACTUATORS

Types of Sensors: Sensor for Speed - Throttle Position - Exhaust Oxygen Level - Manifold Pressure - Crankshaft Position - Coolant Temperature - Exhaust Temperature - Air Mass Flow

for Engine Application - Solenoids - Stepper Motors - Relay - Introduction to Arduino about actuators and sensors.

TEXT BOOKS

1. Tom denton, "Automotive Electrical And Electronics Systems", Allied Publishers, 2016.
2. L. Statini, "Automotive Electrical and Electronics", Delmar Publications, 2013.

REFERENCES

1. William B.Ribbens "Understanding Automotive Electronics", Butter worth Heinemann Woburn, 2017.
2. Robert Bosch "Automotive Hand Book", SAE, 2018.
3. Ganesan.V. "Internal Combustion Engines", Tata McGraw Hill Private Limited, New Delhi, 2017.
4. Young A.P. & Griffiths. L. "Automotive Electrical Equipment", ELBS & New Press. Bechhold "Understanding Automotive Electronics", SAE, 8th Edition - June 15, 2017.
5. Kohli P L., "Automotive Electrical Equipment", Tata McGraw Hill Publishing Co., Delhi, 2004.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Distinguish the types of lighting system, batteries and accessories.
2. Understand the basics concepts of starting systems.
3. Acquire the aspects of charging systems.
4. Gather an insight on the various processes in automotive electronics.
5. Develop the sensors and activators using Arduino.

Mapping with Programme Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**						**3**						**3**		
CO2	**3**						**3**						**3**		
CO3	**3**						**3**						**3**		
CO4	**3**						**3**						**3**		
CO5	**3**						**3**						**3**		

22YYOESCN	QUANTITATIVE MANAGEMENT TECHNIQUES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To familiarize with the basic concepts of Operations Research and Management Information Systems
- To impart knowledge on decision making / probability analysis
- To understand the concept of Inventory and Production models
- To comprehend the solution methodologies involved in Linear Programming.
- To gain knowledge in implementing PERT -CPM techniques

UNIT I: INTRODUCTION

Development of scientific management - Application of operations research - Classification of Operation Research (OR) models - Procedures to obtain optimum solution - Scope of OR - Management information systems (MIS)- Classification of MIS - Cost Volume and Profit (CVP) analysis - Relationships - Various approaches - Limitation of CVP analysis.

UNIT II: PROBABILITY ANALYSIS

Decision making: Analysis for decision making - Cautions about use of decision making under uncertain future conditions - Review of probability techniques and applications - Calculation of conditional and expected profits - Expected value with perfect information - Use of marginal analysis - Utility as a decision criterion. Probability distributions -Normal distribution and cost, volume, profit analysis - Unit monetary values with probability distribution - Decision tree analysis.

UNIT III: INVENTORY AND PRODUCTION MODELS

Inventory decisions - Selective approach to management inventory - EOQ - Different models - Application of EOQ to production process. Reordering - Determination of optimum level - Optimal level of safety stock - Joint ordering - Reordering with planned stock outs - discounts.

UNIT IV: LINEAR PROGRAMMING

Introduction - Simplex method - Maximisation and minimisation - Duality in linear programming - Sensitivity analysis - Transportation method - Unbalanced problem - Degeneracy - Assignment method - Applications.

UNIT V: CPM - PERT ANALYSIS

Introduction - Definition of PERT - Network replanning and adjustment - CPM - Time estimate - Crashing - Indirect and utility project costs - PERT cost analysis - Project budgeting - Control of project cost - Network scheduling - Maximal flow problem - Limitation of PERT and CPM.

TEXT BOOK

1. Levin and Kirkpatrick "Quantitative Approaches to Management", McGraw Hill Int. St. Ed., 2002.
2. Vohra N D, "Quantitative Techniques in Management", McGraw Hill India, 5th edition, 2017

REFERENCE BOOKS

1. Lenine, Render, "Quantitative Techniques for Management", Pearson Education India, 1st edition, 2012.
2. Anderson, Sweeney, "An Introduction to Management Science: Quantitative Approaches to Decision Making", Cengage, 2016
3. Kothari C R, "Quantitative Techniques", Vikas Publishing House, 3rd edition, 2013.
4. Samir Kumar Chakravarthy, "Theory and problems on Quantitative Techniques, Management Information system and Data processing" Central Educational Enterprises, 1989 (First Edition)
5. Chidambaram I.A, Sridhar. N.D and Paramasivam B, "Quantitative Management Techniques", Sci Tech Publications, Chennai, 2009.
6. Sundaresan V., Ganapathy Subramanian K.S., Ganesan K. "Resource Management Techniques (Operation Research)", A.R.Publications, Chennai,:1999.
7. Gupta P.K, Manmohan, "Problems in Quantitative Techniques", 2nd Edn, Sultan Chand and Sons, New Delhi, 1990.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Understand the need for Operations Research and Management Information Systems
2. Acquire knowledge about various methods for decision making / probability analysis
3. Gain knowledge significantly about the various Inventory and Production models
4. Learn about the solution methodologies involved in Linear Programming.
5. Familiarize with the practices followed for PERT -CPM analysis

Mapping with Programme Outcomes															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3				1			2	2		2	
CO2	3	3	3	3							2	2		2	
CO3	3	3	3	3							2	2		2	
CO4	3	3	3	3							2	2		2	
CO5	3	3	3	3							2	2		2	

22YYOESCN	SOFT COMPUTING TECHNIQUES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To understand the basis of neural networks classification and their suitability for different engineering applications.
- To introduce various architectures and learning algorithms of Artificial Neural Network.
- To enable the students to acquire knowledge on the structure of fuzzy logic and their operations
- To acquire the ability of designing fuzzy logic controllers and neuro Controllers.
- To introduce the concept of genetic algorithm and its operators for solving engineering problems.

UNIT I: ARTIFICIAL NEURAL NETWORKS

Motivation for the development of neural networks - Biological neural networks - Artificial neural networks - Fundamental Concepts - Weights - Biases and thresholds - Common activation functions - McCulloch-pitts neuron: Architecture, algorithm - Hebb Net- Architecture - Algorithm - Perceptron - Architecture - Algorithm - Applications- Linear separability - Perceptron learning rule convergence theorem - Delta rule.

UNIT II: NEURAL NETWORK ARCHITECTURE AND ALGORITHMS

Back propagation Neural Net: Standard back propagation - Architecture - Algorithm - Number of hidden layers - Discrete Hopfield neural net - Architecture - Algorithm - Competitive Neural Networks - Fixed-weight competitive nets -Kohonen self-organizing Maps - Adaptive Resonance Theory- Basic architecture - Algorithm - Introduction to Neuro controllers - Case Studies.

UNIT III: FUZZY LOGIC

Fuzzy sets - Properties of Classical and Fuzzy sets - Operations on Fuzzy sets- Fuzzy relations - Linguistic variables - Linguistic Hedges - Fuzzy statements - Assignment statements - Conditional statements - Unconditional statements - Fuzzy rule base - Canonical rule formation - Decomposition of compound rules.

UNIT IV: FUZZY LOGIC CONTROLLER

Fuzzy logic controller: Functional diagram - Fuzzification - Membership value assignments using intuition - Membership functions - Defuzzification: Max-Membership principle - centroid method - weighted average method - Inference Engine - Knowledge Base - Rule base - Case studies.

UNIT V: GENETIC ALGORITHM

Optimization Formulation of optimization model - Traditional optimization methods - Concept of Evolutionary Algorithm - Genetic Algorithm - encoding and decoding of variables - GA operators - Reproductions - Cross over - Mutation - Fitness function - Fitness scaling.

TEXT BOOKS

1. Lawrene Faussett, "Fundamental of neural networks", Prentice Hall, 2004.
2. Rajasekaran and Vilyalakshmi Pai G.A, “Neural Networks, Fuzzy Logic and Genetic Algorithms -Synthesis and Applications”, Prentice Hall, 2015
3. David Goldberg. E,” Genetic algorithms in search optimization and machine learning,” Addison Wesley, Pearson Education, Asia, 2001.

REFERENCE BOOKS

1. Driankov. Hellendoornarow D.H, Rein frank M., "An introduction to Fuzzy Control”, Narosa Publishing co., New Delhi, 2006.
2. Ross T.J, "Fuzzy Logic with Engineering Applications", McGraw-Hill, New York, 2005.
3. Sivanandham. SN and Deepa. SN, “Neural networks with Matlab”, TMH 2007.

COURSE OUTCOMES

At the end of this course, students will able to

1. Recognize and analyze the merits and demerits of applying different ANN models for engineering applications.
2. Understand the model of artificial neural network and learning algorithms.
3. Gain knowledge on fuzzy sets, fuzzy relations, and fuzzy operators for handling uncertainty in engineering problems.
4. Develop Fuzzy Logic Controller for non-linear controlling applications.
5. Solve combinatorial optimization problems using genetic algorithm

Mapping with Programme Outcomes															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3										1	3	2	
CO2	3	2	3	3	2						3	3	3	3	
CO3	3	2	3		3							1	2	2	
CO4	3		3	3	3						3	3		2	
CO5	3	3	2	3	3						3	3	3	2	

22YYOESCN	PRINCIPLES OF MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To enable the students to study the evolution of Management,
- To study the functions and principles of management.
- To learn the application of the principles in an organization.
- To enable the effective and barriers communication in the organization
- To study the system and process of effective controlling in the organization.

UNIT I: BASIC CONCEPTS OF MANAGEMENT

Definition - Essence, functions, roles, level. Functions of management: planning - Concept, nature, types, analysis, management by objectives; organization structure - Concept, structure, principles, centralization, decentralization, span of management; organizational effectiveness.

UNIT II: MANAGEMENT AND SOCIETY

Concept, external environment, csr, corporate governance, ethical standards. People management - Overview, job design, recruitment and selection, training and development, stress management. Managerial competencies - Communication, motivation, team effectiveness, conflict management, creativity, entrepreneurship

UNIT III: LEADERSHIP

Concept, nature, styles. Decision making: concept, nature, process, tools and techniques. Economic, financial and quantitative analysis - Production, markets, national income accounting, financial function and goals, financial statement and ratio analysis, quantitative methods - Statistical interference, forecasting, regression analysis, statistical quality control

UNIT IV: CUSTOMER MANAGEMENT

Market planning and research, marketing mix, advertising and brand management - Operations and technology management - Production and operations management, logistics and supply chain management, tqm, kaizen and six sigma, mis - Management control systems - Security analysis and portfolio management - Organizational change and development - Online social media - Project management

UNIT V: CONTROL TECHNIQUES

Process of controlling - Types of control - Budgetary and non-budgetary control techniques - Mis-Managing productivity - Constant control - Purchase control - Maintenance control - quality control - Planning operations - Performance standards - Measurement of performance - Remedial actions

TEXT/REFERENCES

1. Anil Bhat, Arya Kumar, "Principles of Management": Competencies, Processes, Practices, Oxford University Press, Oxford, London, 2019.
2. Harold Koontz, "Essentials for Management", Tata McGraw Hill, New Delhi, 2010.
3. Stephen P. Robbins, Mary Coulter, Nancy Langton, Management, Pearson Education Canada, 2006.
4. Ghuman, Management, Tata McGraw Hill, Noida, 2010.
5. Kenneth A. Merchant, "Modern Management Control Systems": Text and Cases, Prentice Hall, New Delhi, 1998.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Understand managerial functions like planning, and have some basic knowledge on international aspect of management
2. Gain the knowledge about the planning process in the organization
3. Understand the concept of organization
4. Demonstrate the ability to directing ,leadership and communicate effectively
5. Analyze and isolate issues and formulate best control methods.

Mapping with Programme Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1						**2**		**2**	**2**	**1**	**3**	**1**		**2**	
CO2	**3**					**2**		**2**	**2**		**2**	**1**		**2**	
CO3	**2**					**2**		**2**	**2**	**3**		**1**		**2**	**3**
CO4		**3**				**2**		**2**	**2**		**2**	**1**		**2**	**3**
CO5		**3**				**2**		**2**	**2**			**1**		**2**	**2**

22YYOESCN	TOTAL QUALITY MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To impart the importance of quality in manufacturing and service
- To understand the various quality principles
- To know the importance of six sigma concepts
- To study about the tools and techniques involved in quality standards
- To learn about types of quality system available in manufacturing and service sectors

UNIT I: INTRODUCTION

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM framework - Contributions of deming, juran and crosby - Barriers to TQM - Quality statements - Customer focus - Customer orientation, customer satisfaction, customer complaints, customer retention - Costs of quality.

UNIT II: TQM PRINCIPLES

Leadership - Strategic quality planning, quality councils - Employee involvement - Motivation, empowerment, team and teamwork, quality circles recognition and reward, performance appraisal - Continuous process improvement - PDCA cycle, 5s, kaizen - supplier partnership - Partnering, supplier selection, supplier rating.

UNIT III: TQM TOOLS AND TECHNIQUES I

The seven traditional tools of quality - New management tools - Six sigma: concepts, methodology, applications to manufacturing, service sector including it - Bench marking - Reason to bench mark, bench marking process - FMEA - Stages, types.

UNIT IV: TQM TOOLS AND TECHNIQUES II

Control charts - Process capability - Concepts of six sigma - Quality function development (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.

UNIT V: QUALITY SYSTEMS

Need for ISO 9000 - ISO 9001-2008 quality system - Elements, documentation, quality auditing - QS 9000 - ISO 14000 - Concepts, requirements and benefits - TQM implementation in manufacturing and service sectors.

TEXTBOOKS

1. Dale H. Besterfiled, "Total quality Management", Pearson Education Asia, Third Edition, Indian Reprint 2006.

REFERENCES

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012.
2. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.
3. Janakiraman. B and Gopal .R.K., "Total Quality Management -Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Understand the importance of quality in manufacturing and service sectors
2. Gain knowledge about the quality process and principles to be followed
3. know how to use the quality tools and techniques
4. Have a understanding of various control and improvements concepts
5. know about different ISO standards requirements and implementation

Mapping with Programme Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**2**								**2**			**2**	**2**		
CO2	**3**											**3**		**2**	
CO3	**2**						**2**				**3**	**3**		**2**	
CO4	**2**									**2**	**2**	**3**			
CO5	**2**							**2**			**2**	**3**	**2**		

22YYOESCN	OPERATIONS RESEARCH	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To define and formulate linear programming problems and appreciate their limitations.
- To develop transportation and assignment problems
- To provide an understanding of the systematic approach in using project management techniques.
- To enable the students to acquire knowledge on the various project management techniques.
- To enhance the decision-making skills through the application of appropriate models.

UNIT I: LINEAR PROGRAMMING

Introduction to operations research - Linear programming, Mathematical formulation of real - life problems - Graphical solution - Mathematical formulation of a problem - Simplex Algorithm: Algebraic form, Tabular form, BIG-M, Two phase method.

UNIT II: TRANSPORTATION AND ASSIGNMENT MODELS

Transportation problems - Introduction - Problem formulation, balancing the transportation problem - Northwest Corner method - Least cost method - Vogel's method, Optimality test - MODI Method - Assignment problems - Hungarian Algorithm, Travelling salesman problem.

UNIT III: PROJECT MANAGEMENT AND NETWORK MODELS

PERT and CPM - Basic steps - Rules for constructing the network - Fulkerson's rule - Time estimates - PERT calculations - Probability of meeting the time schedule - Time - Cost trade off (crashing) - Difference between PERT and CPM - Applications. Network models - Minimal spanning tree problem, shortest route problem and Maximum flow problem.

UNIT IV: INVENTORY MODELS

Inventory planning and control: Need, inventory costs, Determination of EOQ, EPQ/ELS (without shortages) - Effect of quantity discounts. Determination of ROL, Safety Stocks - Methods of calculating safety stock using Normal - Single period inventory model, Inventory control systems - P, Q, and S-s System.

UNIT V: WAITING LINE MODELS AND DECISION THEORY

Elements of waiting line models - Cost of waiting and cost of providing service - Single channel - Single stage type of problems - Monte Carlo simulation for queue problems. Decision Theory - Decision making under risk condition - Expected monetary value criteria - Decision

trees - Decision making under uncertain conditions - Minimax, maximin, maximax, Hurwitz and Regret criteria.

REFERENCES

1. Sharma, S.D., "Operations Research", Kedarnath Ramnath and Co., Meerut, 1998.
2. Barry Render, Ralph M. Stair Jr., "Quantitative analysis for Management", Pearson New Delhi, 2010.
3. Ravindran, A., Phillips, D.T., and Solberg, J.J., "Operations Research, Principles and Practice", John Wiley and Sons, Singapore, 1987.
4. Taha, "Operations Research", Tata McGraw-Hill, 1998.
5. Bronson, R., "Theory and Problems of Operations Research", Schaum's outline series,1997.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Formulate real life situations into linear programming problems and solve using the algorithms.
2. Construct and solve industrial problems using transportation and assignment modeling.
3. Apply project management techniques for optimum time schedule and analyze and solve various routing issues using network models
4. Choose and design inventory models to help decision making of purchase and production department.
5. Formulate queuing models for service systems and solve them optimally and select appropriate decision making models for the real life problems

Mapping with Programme Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**1**					**2**				**1**		**1**		
CO2	**3**		**2**				**2**				**1**				**1**
CO3	**3**	**1**	**2**				**2**				**1**	**2**		**2**	
CO4	**3**		**2**				**2**				**1**				**1**
CO5	**3**	**1**			**2**		**2**				**1**			**1**	

22YYOESCN	BIOMEDICAL ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To give an exposure to the physiology and anatomy of human system and to give exposure to students about the bio-potential electrodes and amplifiers used in biomedical engineering.
- To learn the various types of biological transducers used in medical engineering field for signal acquisition.
- To familiarize the students with various used for cardia vascular measurements.
- To focus on various respiratory, therapy equipment's used in medical field.
- To familiarize the students about recent trends in medical imaging.

UNIT I: ELECTROPHYSIOLOGY

Brief review of physiology and anatomy - Cell structure - Resting potential - Action potential - Propagation of action potentials - Bioelectric potentials - Cardiovascular dynamics - Electrode theory - Microelectrodes - Types of microelectrodes - Depth/Needle electrodes - Surface electrodes - Transducers for bio-medical applications.

UNIT II: BIOELECTRIC SIGNAL ACQUISITION

Biomedical instrumentation - Classification - Design factors of biomedical instrumentation - Bio potential amplifiers - Instrumentation amplifier - Carrier amplifiers - Chopper amplifiers - telemetry - Safety of biomedical equipment's.

UNIT III: BIOELECTRIC POTENTIAL AND CARDIOVASCULAR MEASUREMENTS

Electrocardiograph - Phonocardiography - Vector cardiograph - Blood Pressure - Blood flow - Cardiac output - Plethysmography - Impedance cardiology - Cardiac arrhythmias - Pacemakers - Defibrillators - Electroencephalograph - Electromyograph - Fetal monitor.

UNIT IV: RESPIRATORY, PULMONARY MEASUREMENTS AND REHABILITATION

Physiology of respiratory system - Respiratory rate measurement - Temperature - Pulmonary function measurement - Oximeter - Functional neuromuscular stimulation - Physiotherapy - Diathermy - Nerve simulator/pain killer.

UNIT V: RECENT TRENDS IN MEDICAL IMAGING

Medical imaging - LASER applications in medical field - Ultrasound scanner - Echo cardiograph - CT scan -Magnetic Resonance Imaging (MRI) - X-Ray imaging using special

techniques.

TEXT BOOKS

1. Leslie Cromwell, Fred Weibull and Erich A.Pfeiffer, "Biomedical Instrumentation and Measurements", Prentice Hall of India, New Delhi, 2006.
2. R.Anandanatarajan, "Biomedical Instrumentation and Measurements", PHI Learning Private Limited, Delhi-110092, 2013.

REFERENCES

1. G.S.Sawhney, "Biomedical Electronics and Instrumentation", I.K. International Pvt. Ltd, 1st Edition, 2012.
2. R.S. Khandpur, "Handbook of Biomedical Instrumentation", Third Edition, McGraw Hill Education (India) Private Limited, 2014.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Explain the anatomy and physiology of various subsystems of human body. Provide idea about different types of physiological transducers used in medical engineering which can be used to acquire biological signals from the human body
2. Gain knowledge about acquiring biological signal and the safety features to be incorporated
3. Understand the principles of cardiovascular and neuro measurements along assisting device needed in correcting cardiac arrhythmias.
4. Provide idea about respiratory and therapeutic assisting devices used in bio-medical field.
5. Describe the recent trends used in medical imaging.

Mapping with Programme Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**						**1**					**1**	**1**		
CO2	**1**	**1**				**2**						**1**	**2**	**1**	
CO3		**2**				**2**						**2**	**1**	**2**	
CO4			**2**									**2**	**1**	**2**	
CO5						**2**						**2**	**2**	**2**	

22YYOESCN	MICRO ELECTRO MECHANICAL SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To provide a conceptual understanding of micro fabrication techniques and the issues surrounding them.
- To learn Bulk micromachining process and to understand the concept of different etching process and etching materials in fabrication process.
- To impart knowledge about surface micromachining process.
- To understand the types and concept of bonding process.
- To study and design of different types of MEMS actuators, Micro grippers, MEMS resonators and their applications.

UNIT I: INTRODUCTION TO MICRO MACHINED DEVICES

Microsystems vs. Mems - Markets for microsystems and mems, scaling principles - Materials for micromachining, micromachining terms - Mechanical properties of silicon - Native oxides of silicon and other semiconductors -Typical silicon wafer types.

UNIT II: BULK MICRO MACHINING

Wet etching of silicon-Isotropic etching - Anisotropic etching, alkali hydroxide etchants - Ammonium hydroxide - Tetramethyl ammonium hydroxide (TMAH) - Ethylene diaminepyrochatechol (EDP) - Ultrasonic agitation in wet etching stop layers for dopant elective etchants. Porous - Silicon formation - Antistrophic wet etching of porous aluminium - Antistrophic wet etching - Quartz - Vapor phase etches - RIE laser driven bulk processing.

UNIT III: SURFACE MICROMACHINING

Thin film processes - Non-metallic thin film for micromachining - Silicon dioxide - Silicon nitride - Silicon carbide - Polycrystalline diamond - Polysilicon and other semiconductors and thin film transition - Wet etching of non-metallic thin film - Metallic thin film for micromachining - Resistive evaporation - E-beam evaporation-sputter deposition - Comparison of evaporation and sputtering - CVD of metals - Adhesion layer for metals - Electro deposition (E plating) - Electro deposition mechanism - DC electroplating-pulsed electroplating - Agitation for electroplating-Black metal film - Electro less plating.

UNIT IV: BONDING PROCESSES

Anodic bonding - Anodic bonding using deposited glass - Silicon fusion bonding - Other bonding and techniques - Compound processes using bonding. Sacrificial Processes and other

Techniques: Sticking problem during wet releasing prevention of sticking - Phase change release methods - Geometry - Examples of sacrificial processes.

UNIT V: MEMS ACTUATORS AND THEIR APPLICATIONS

Actuation mechanisms - Electrostatic actuation - Electrostatic cantilever actuators -Torsional electrostatic actuators - Electrostatic comb drives - Feedback stabilization of electrostatic actuators - Electrostatic rotary micro motors - Electrostatic linear micro motors - Electrostatic micro grippers - Electrostatic relays and switches - Thermal actuation - Thermal expansion of solids - Thermal array actuators - Piezoelectric actuation - Cantilever resonators.

REFERENCES

1. Chang Liu, "Foundations of MEMS", Pearson Education,2nd edition, 2014.
2. Muhammad H. Rashid, "Micro Electronic Circuits: Analysis and Design", Cenage Learning,2nd edition 2012.
3. Reza Ghodssi, Pinyen Lin, "MEMS materials and processes Handbook", Springer science business media, 2011
4. Chang Liu, "Foundations of MEMS", (ILLINOIS ECE Series), Pearson Education International, 2006.
5. Tai-Ran-Hsu, "MEMS and Microsystems Design and Manufacture", Tata McGrawHill, New Delhi, 2002
6. Stephen D. Senturia, "Microsystems Design", Springer International Edition, 2001.
7. Gregory T.A. Kovacs, "Micro machined Transducers", WCB McGraw Hill, 1998.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Understand the concept of scaling laws that are used extensively in the design of micro devices and systems.
2. Analyze the basic principles and applications of micro-fabrication processes, such as photolithography, ion implantation, diffusion, oxidation, CVD, PVD, and etching. Impart knowledge about thin film process and etchants used for isotropic and anisotropic etching.
3. Study about the semiconductor materials for common micro components and devices.
4. Understand the types of bonding process and the techniques used for MEMS

Mapping with Programme Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1		**2**								**2**			**2**	**2**	1
CO2	**3**						**2**						**2**	**2**	**1**
CO3			**2**										**2**	**2**	**1**
CO4	**3**	**2**											**2**	**2**	**1**
CO5		**2**								**2**			**2**	**2**	**1**

22YYOESCN	COMMUNICATION ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To give an exposure of different types of analog modulation techniques and their significances in communication systems.
- To familiarize the students about angle modulation techniques in communication systems.
- To introduce pulse modulation techniques
- To introduce the concepts of Pulse Code Modulation techniques and multiple access techniques used in communication systems for enhancing the number of users.
- To focus on various media for digital communication and future data communication.

UNIT I: LINEAR MODULATION / DEMODULATION

Need for modulation - Amplitude modulation - Power spectrum - Power relation - Different types of modulation - Double sideband suppressed carrier (DSB/SC), Single sideband suppressed carrier (SSB) and Vestigial sideband (VSB) generation. AM transmitters - Block diagram - Amplitude demodulation - Detection of DSB, SSB signals - Receiver characteristics - Super heterodyne reception - Automatic volume control.

UNIT II: ANGLE MODULATION

Principle of frequency and phase modulation - Generation of FM and PM signals - Direct and indirect methods - FM transmitters - Block diagram - Pre-emphasis circuit - Frequency demodulation - Detection of FM and PM signals - Automatic frequency control - De-emphasis circuit.

UNIT III: PULSE MODULATION

Analog and digital communication systems and techniques: Pulse modulation systems - Sampling Theorem - Pulse amplitude modulation - Channel Bandwidth-Detection of PAM signals - Cross talk in PAM signals - Pulse time modulation - Generation of PDM and PPM - Conversion of PDM to PPM - Detection of PTM signals - Cross talk in PTM signals.

UNIT IV: PULSE CODE MODULATION SYSTEMS

Quantization - Compounding - Pulse code modulation - Sampling and digitizing - Aliasing - Sample and hold circuit - Practical implementation of sampling and digitizing - Equalization - Multiplexing - Frequency Division Multiplexing (FDM) and Time Division Multiplexing (TDM) - Data communications - Serial synchronous, a synchronous communication protocol - Hardware USARTS - Software USART.

UNIT V: WIRELESS COMMUNICATION SYSTEMS

Evolution of generations (1G, 2G, 2.5, 3G, 4G and beyond 4G), - GSM and CDMA systems - Cellular structure - Frequency reuse - Handoff-Bluetooth and UWB network - Wi-Fi and Wi-Max. (Quantitative treatment only).

TEXT BOOKS

1. Herbert Taub, Donald L. Schiling and Gautam Saha "Principles of Communication Systems",Tata McGraw Hill Education Pvt. Ltd., Third Edition, 2008.
2. Bernard Davis and George Kennedy, "Electronic Communication Systems", Tata McGraw Hill Education Pvt. Ltd., Fifth Edition, 2011.

REFERENCE BOOKS

1. K.N. Hari Bhatand Ganesh Rao, "Analog Communications", Pearson Publications, 2nd Edition, 2008.
2. Anokh Singh, "Principles of Communication Engineering", 6th Reprint, S.Chand and Company Ltd., 2006.
3. Sanjay Sharma, "Analog and Digital Communication", S.K. Kataria and Sons Publications, 2013.
4. Bernard Sklar and Pabitra Kumar Ray, "Digital Communications - Fundamentals and Applications", Pearson Publications, Second Edition, 2010.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Provide idea about modulation and demodulation techniques employed in communication systems.
2. Understand angle modulation technique in communication system
3. Understand pulse modulation technique and its conversion
4. Explain the concepts of pulse modulation systems and multiple access techniques used in communication field applications.
5. Understand the various broadband communication systems and recent advancements in communication systems.

Mapping with Programme Outcomes															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2												1		
CO2	2	2											2		
CO3	2	2											1		
CO4	2	2				1						2	1	2	
CO5	2	1				3		2				3		2	

22YYOESCN	WIRELESS COMMUNICATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To acquire knowledge of Wireless channels and parameters
- To impart knowledge on mobile communication and cellular system architecture
- To understand various Modulation Techniques used in wireless communication.
- To create exposure to multipath mitigation techniques and wireless standards
- To gain knowledge about mobile communication system

UNIT I: WIRELESS CHANNELS

Large scale path loss - Path loss models - Free space and two - Ray models - Link budget design - Small scale fading - Parameters of mobile multipath channels - Time dispersion parameters - Coherence bandwidth - Doppler spread and coherence time - Fading due to multipath time delay spread - Flat fading, frequency selective fading - Fading due to doppler spread - Fast fading, slow fading.

UNIT II: FUNDAMENTALS OF CELLULAR COMMUNICATION

Multiple access technique - FDMA, TDMA and CDMA - Operation of cellular systems - Frequency reuse - Channel assignment strategies - Interference and system capacity - Co-channel interference - Adjacent channel interference - Trunking and grade of service - Improving coverage and capacity in cellular systems - Cell splitting - Sectoring - Repeaters for range extension - A Micro cell zone concept.

UNIT III: MODULATION TECHNIQUES

Introduction to modulation techniques, modulation and demodulation - Quadrature phase shift keying, $\pi/4$ - Differential quadrature phase shift keying, offset quadrature phase shift keying, binary frequency shift keying, minimum shift keying, Gaussian minimum shift keying, power spectrum and error performance in fading channels, OFDM principle - Cyclic prefix, Papr, inter carrier interference.

UNIT IV: MULTIPATH MITIGATION TECHNIQUES

Equalization - Adaptive equalization, linear and non - Linear equalization, zero forcing and LMS algorithms, diversity - Micro and macro diversity, diversity combining techniques, error probability in fading channels with diversity reception.

UNIT V: MOBILE COMMUNICATION SYSTEMS

Overview of amps - DECT - CT2 - PACS - PHS - international mobile telecommunication2000 - GSM architecture - USSD - GPRS - edge - is95, CDMA 2000 - WCDMA - UMTS - HSPDA - Bluetooth -WIFI -WIMAX - introduction to LTE.

TEXT BOOKS

1. Rappaport, "Wireless and Mobile Communication", Pearson Education, 2009.
2. Yi-Bing Lin and Imrichchlantae., “Wireless and Mobile Network Architecture”John Wiley and Sons, 2008.

REFERENCE BOOKS

1. ITI SahaMisra, “Wireless Communications and Networks: 3G and Beyond”, Tata McGraw Hill Edition, 2013.
2. K. Fazel and S. Kaiser, "Multicarrier and Spread Spectrum Systems", Wiley, 2003.
3. D. Tse and P. Vishwanath, “Fundamentals of Wireless Communication”, Cambridge University Press, 2005.
4. Lee W.C.Y., "Mobile Cellular Telecommunication Systems", McGraw Hill International Edition,1990.
5. AndreasF. Molisch, “Wireless Communications”, John Wiley -India, 2010.
6. Ramjee Prasad**,"** OFDM for Wireless Communications Systems", Artech House,2004.

COURSE OUTCOMES

At the end of this course, students will able to

1. Determine the type and appropriate model of wireless fading channel based on the system parameters and the property of the wireless medium.
2. Apply cellular concepts and evaluate signal reception performance in cellular Systems.
3. Design and Implement various Modulation schemes for fading channels
4. Analyze and design transmitter and receiver diversity techniques
5. Design wireless communication systems with 3G and 4G technologies.

Mapping with Programme Outcomes															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2			3								3	3	3
CO2	2	2	3										3	3	3
CO3			3	2	3								3	3	3
CO4				2								2	3	3	3
CO5			3		3	1						2	3	3	3

22YYOESCN	COMPUTER NETWORKS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To understand the concept of network architecture and protocols
- To understand the division of network functionalities into layers.
- To be familiar with the components required to build different types of networks.
- To be exposed to the required functionality at each layer
- To learn the flow control and congestion control algorithms

UNIT I: INTRODUCTION TO COMPUTER NETWORKS AND THE INTERNET

Application layer: Principles of network applications, The Web and Hyper Text Transfer Protocol, File transfer, Electronic mail, Domain name system, Peer-to-Peer file sharing, Socket programming, Layering concepts.

UNIT II: SWITCHING IN NETWORKS

Classification and requirements of switches, a generic switch, Circuit Switching, Time-division switching, Space-division switching, Crossbar switch and evaluation of blocking probability, 2-stage, 3-stage and n-stage networks, Packet switching, Blocking in packet switches, Three generations of packet switches, switch fabric, Buffering, Multicasting, Statistical Multiplexing.

UNIT III: NETWORK LAYER

Virtual circuit and Datagram networks, Router, Internet Protocol, Routing algorithms, Broadcast and Multicast routing Link layer: ALOHA, Multiple access protocols, IEEE 802 standards, Local Area Networks, addressing, Ethernet, Hubs, Switches.

UNIT IV: TRANSPORT LAYER

Connectionless transport - User Datagram Protocol, Connection - Oriented transport - Transmission Control Protocol, Remote Procedure Call.

UNIT V: CONGESTION CONTROL AND RESOURCE ALLOCATION

Issues in Resource Allocation, Queuing Disciplines, TCP congestion Control, Congestion Avoidance Mechanisms and Quality of Service.

TEXTBOOKS

1. J.F. Kurose and K. W. Ross, “Computer Networking -A top down approach featuringthe Internet”, Pearson Education, 7th Edition,2016.
2. L. Peterson and B. Davie, “Computer Networks -A Systems Approach” Elsevier Morgan

Kaufmann Publisher, 5th Edition, 2011.
3. T. Viswanathan, "Telecommunication Switching System and Networks", Prentice Hall,1992.
4. S. Keshav, "An Engineering Approach to Computer Networking", Pearson Education,2002.

REFERENCES

1. B. A. Forouzan, "Data Communications and Networking", Tata McGrawHill,4th Edn, 2012.
2. Andrew Tanenbaum, "Computer Networks", Prentice Hall, 5thedition, 2016.
3. D. Comer, "Computer Networks and Internet/TCP-IP", Prentice Hall, 6th2014.
4. William Stallings, "Data and computer communications", Prentice Hall,10th edition, 2013.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Outline the functions and utilization of application layer and internet
2. Categorize different switching techniques to enhance the network performance
3. Solve various issues in routing and congestion and multiple access protocols.
4. Demonstrate various connection-oriented transport layer protocols to ensure end to end delivery.
5. Interpret the issues in Resource Allocation and analyze congestion Avoidance Mechanisms and Quality of Service improvement.

Mapping with Programme Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**											**2**	**3**		
CO2	**3**											**2**	**3**		
CO3	**3**											**2**	**3**		
CO4	**3**	**3**	**2**									**2**	**3**		
CO5	**3**	**2**										**2**	**3**		

22YYOESCN	CLOUD COMPUTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To impart basic knowledge about the principles of cloud computing.
- To partake a detailed study of the various cloud service models
- To make the students recognize the basics of virtualization
- To familiarize with the programming models available in cloud
- To get an insight on some applications and prospects of cloud computing

UNIT I: FUNDAMENTALS

Motivation - Definition - Principles of cloud computing - Cloud ecosystem - Requirements for cloud services - Cloud application - Benefits and drawbacks - Cloud architecture-Anatomy of the cloud - Network connectivity in cloud computing - Applications on the cloud - Managing the cloud - Migrating application to cloud.

UNIT II: CLOUD DEPLOYMENT MODELS AND SERVICE MODELS

Private cloud - Public cloud - Community cloud - Hybrid cloud - Cloud service models - Infrastructure as a service - Platform as a service - Software as a service - Other cloud service models - Technological drivers for cloud computing - SOA and cloud - SOA and SOC - Benefits of SOA - Technologies used by SOA - Similarities and differences between SOA and cloud computing.

UNIT III: VIRTUALIZATION

Introduction - Virtualization opportunities - Processor virtualization - Memory virtualization storage virtualization - Network virtualization - Data virtualization application virtualization - Approaches to virtualization - Full virtualization - Para virtualization - Hardware - Assisted virtualization -Types of hypervisors - From virtualization to cloud computing - IAAS - PAAS - SAAS.

UNIT IV: PROGRAMMING MODELS FOR CLOUD COMPUTING

Existing and extended programming models for cloud - BSP model - Mapreduce model - Mapreduce - Model - Cloud Haskell - Multimillion - Erlang - Sorcer: Object-oriented programming - Programming models in Aneka - New programming models proposed for cloud - Orleans - Boom and bloom - Grid batch - Simple API for grid applications.

UNIT V: NETWORKING FOR CLOUD COMPUTING

Overview of data center environment - Networking issues in data centers - Transport layer issues in DCNS - TCP enhancements for DCNS - Cloud service providers - EMC- Google - Amazon web services - Microsoft - IBM - Sap labs -Salesforce - Rackspace - Vmware - Manjra soft - An overview of open source in cloud computing - Advanced concepts in cloud computing - Inter cloud - Cloud management - Mobile cloud - Media cloud - Cloud governance - Green cloud - Cloud analytics.

TEXT BOOKS

1. K. Chandrasekaran, "Essentials of Cloud Computing", CRC Press, 2015.
2. RajkumarBuyya, James Broberg, Andrzej M. Goscinski, "Cloud Computing: Principles and Paradigms", Wiley, 2011.

REFERENCE BOOKS

1. Dan C. Marinescu, "Cloud Computing: Theory and Practice, Morgan Kaufmann, 2013.
2. San Murugesan, Irena Bojanova, "Encyclopedia of Cloud Computing", Wiley-IEEE Press, 2016.
3. Derrick Rountree, Ileana Castrillo, "The Basics of Cloud Computing: Understanding the Fundamentals of Cloud Computing in Theory and Practice", Syngress, 2013.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Conceptualize the basic ideas and motivation for cloud computing
2. Familiarize with the cloud models and services offered by the companies
3. Understand the concept and significance of Virtualization
4. Discuss the suitability of each programming model to different kinds of application
5. Identify the areas of application and explore future prospects

Mapping with Programme Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**2**					**2**					**1**		**2**	
CO2	**3**							**1**	**3**			**1**		**2**	
CO3	**3**		**2**		**3**							**2**		**2**	
CO4	**3**		**3**		**3**				**3**			**2**		**3**	
CO5	**3**	**2**	**3**		**3**		**2**	**1**	**2**			**2**		**3**	

22YYOESCN	DATA SCIENCE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce the core concepts and technologies of data science.
- To familiarize about data collection and storage management system
- To impart the knowledge of statistical methods and distribution models
- To illustrate the concepts of data mapping variables in encoding.
- To develop the recent trends in various data collections using Python

UNIT I: INTRODUCTION

Core concepts and technologies: Introduction, Terminology, data science process, data science toolkit, Types of data, Example applications.

UNIT II: DATA COLLECTION AND MANAGEMENT

Introduction, Sources of data, Data collection and APIs, Exploring and fixing data, Data storage and management, using multiple data sources.

UNIT III: DATA ANALYSIS

Introduction, Terminology and concepts, Introduction to statistics, Central tendencies and distributions, Variance, Distribution properties and arithmetic, Samples/CLT, Basic machine learning algorithms, Linear regression, SVM, Naive Bayes.

UNIT IV: DATA VISUALISATION

Introduction, Types of data visualization, Data for visualization: Data types, Data encodings, Retinal variables, Mapping variables to encodings, Visual encodings.

UNIT V: APPLICATIONS OF DATA SCIENCE

Technologies for visualization, Bokeh (Python) Recent trends in various data collection and analysis techniques, various visualization techniques, application development methods of used in data science.

REFERENCES

1. Rachel Schutt, Cathy O'Neil, "Doing Data Science, Straight Talk from The Frontline", O'Reilly Media Inc,2013.
2. Jure Leskovec, Anand Rajaraman and Jeffrey D. Ullman. "Mining of Massive Datasets", Cambridge University Press,2014.

3. Joel Grus, "Data Science from Scratch: First Principles with Python", O'Reilly Media,2015.
4. Cathy O'Neil, Rachel Schutt, "Doing Data Science", O'Reilly Media,2013.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Explain the data science process and various tool kits associated.
2. Understand the fundamentals of data collection, management and storage for data science.
3. Analyze and evaluate statistical and classification model in data science using any advanced tools.
4. Describe data visualization techniques and data encodings.
5. Build the suitable application development in data science.

Mapping with Programme Outcomes														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**1**				**1**							**1**		**2**	
CO2	**2**													**2**	
CO3	**1**	**2**		**1**	**1**							**2**		**2**	
CO4	**3**	**2**										**2**		**2**	
CO5	**2**	**2**		**1**								**2**		**2**	

22YYOESCN	BIG DATA ANALYTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce the fundamentals of data science, big data analytics and its applications
- To familiarize with R programming to write simple programs
- To impart programming skills on Map Reduce processing technique
- To illustrate the concept of data analysis techniques with case studies
- To develop the skills required to perform data visualization

UNIT I: INTRODUCTION

Data science process - Roles, stages in data science project - State of the practice in analytics - Role of data scientists - Key roles for successful analytic project - Main phases of life cycle - Working with data from files - Exploring data - Managing data - Cleaning and sampling for modeling and validation - Challenges of conventional systems - Web data - Evolution of Analytic scalability, analytic processes and tools, Analysis vs reporting - Modern data analytic tools. Introduction to Big Data Platform - Big Data and its importance, Five Vs, Drivers for Big data, Big data analytics, Big data applications.

UNIT II: R PROGRAMMING

R basics - Reading and getting data into R - Ordered and unordered factors - Arrays and matrices - Lists and data frames - Reading data from files - Probability distributions - Statistical models in R - Manipulating objects - Data distribution - Simple programs using R.

UNIT III: MAP REDUCE

Introduction - Distributed file system - Algorithms using map reduce, Matrix - Vector Multiplication by Map Reduce - Hadoop- Understanding the Map Reduce architecture - Writing Hadoop Map Reduce Programs - Loading data into HDFS - Executing the Map phase - Shuffling and sorting - Reducing phase execution.

UNIT IV: DATA ANALYSIS TECHNIQUES

Linear and logistic regression modeling - Naïve Baye's classifier - Support vector machine - Neural networks - Principal component analysis - Linear Discriminant Analysis - Decision Trees - Fuzzy logic - Clustering Techniques : Hierarchical, agglomerative, K - Means - Associative Rule Mining. Case Studies: Social Network Analysis - Text analysis - Marketing analysis.

UNIT V: DATA VISUALIZATION

Documentation and deployment - Producing effective presentations - Introduction to graphical analysis - plot() function - Displaying multivariate data - Matrix plots - Multiple plots in one

window - Exporting graph - Using graphics parameters - Visualizations - Visual data analysis techniques, interaction techniques; Systems and applications.

TEXT BOOKS

1. Nina Zumel, John Mount, "Practical Data Science with R",ManningPublications,2014.
2. Chris Eaton, Dirk Deroos et al. , "Understanding Big data ", McGraw Hill,2012.

REFERENCES

1. Big Data andHadoop, V.K. Jain, Khanna Publishing House, 1st edition,2016.
2. Big Data Black Book, DT Editorial Services, Wiley India, Dreamtech Press,2015
3. Data Science andAnalytics,V.K. Jain, Khanna Publishing House, 1 st edition,2018.
4. Beginner's Guide for Data Analysis using R Programming, Jeeva Jose Khanna Book Publishing; 1st edition, 2018.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Understand the fundamentals of data science, big data analytics and its applications.
2. Solve simple problems using R programming.
3. Implement Map Reduce processing technique.
4. Build applications with suitable data analysis technique.
5. Perform data visualization for graphical analysis.

Mapping with Programme Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**1**														
CO2	**2**	**2**	**1**		**2**							**2**			
CO3	**1**		**1**		**2**										
CO4	**3**	**2**	**2**	**2**		**1**									
CO5	**2**	**2**	**1**	**2**	**1**							**1**			

22YYOESCN	ENTERPRISE RESOURCE PLANNING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To know the basics of ERP
- To understand the key implementation issues of ERP
- To know the business modules of ERP
- To be aware of some popular products in the area of ERP
- To appreciate the current and future trends in ERP

UNIT I: INTRODUCTION

ERP: an overview, Enterprise - An overview, benefits of ERP, ERP and related technologies, business process reengineering (BPR), data warehousing, data mining, OLAP, SCM

UNIT II: ERP IMPLEMENTATION

ERP implementation lifecycle, implementation methodology, hidden costs, organizing the implementation, vendors, consultants and users, contracts with vendors, consultants and employees, project management and monitoring

UNIT III: THE BUSINESS MODULES

Business modules in an ERP package, finance, manufacturing, human resources, plant maintenance, materials management, quality management, sales and distribution

UNIT IV: THE ERP MARKET

ERP Market Place, SAP AG, peoplesoft, Baan, JD Edwards, Oracle, QAD, SSA

UNIT V: ERP - PRESENT AND FUTURE

Turbo charge the ERP system, EIA, ERP and e-Commerce, ERP and internet, future directions

TEXT BOOK

1. Alexis Leon, “ERP demystified”, Tata Mcgraw hill, New Delhi, 2000

REFERENCES

1. Joseph A Brady, Ellen F Monk, Bret Wagner, “Concepts in enterprise resource planning”,Thompson Course Technology, USA, 2001.
2. Vinod kumar Garg and Venkitakrishnan N K, “Enterprise resource planning -concepts andpractice”, PHI, New Delhi, 2003

COURSE OUTCOMES

At the end of this course, students will able to

1. Understand the technical aspects of ERP systems;
2. Learn concepts of reengineering and how they relate to ERP system
3. Understand the steps and activities in ERP implementation;
4. Have an idea about typical functional modules in ERP system;
5. Know the technology areas of ERP and enterprise applications

Mapping with Programme Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1		**3**											**1**		
CO2		**3**													
CO3		**3**												**1**	
CO4								**3**	**3**	**1**		**1**			
CO5	**3**				**1**								**1**		

The Syllabi for the Courses that include

1. **22EEOESCN - MACHINE LEARNING WITH APPLICATION TO OBJECT RECOGNITION (VI Sem)**
2. **22EEOESCN - POWERING IOT USING RASPBERRY PI OR ARDUINO (V Sem)**
3. **22EEOESCN - BLOCK CHAIN (VIII Sem)**
4. **22EEOESCN - SMART ENERGY GRID (VII Sem)**

shall be taken from the Naan Mudhalvan Portal since it forms part of the scheme

22YYOESCN	INTELLECTUAL PROPERTY RIGHTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To understand the concepts IPR
- To understand Trademarks, Trade Secretes and GI of goods.
- To understand Copyrights, Patents and Industrial Designs.
- To learn about how to manage IP rights and legal aspects.
- To understand the concepts of Cyber laws in IPR.

UNIT I

Introduction to Intellectual Property: IPR - Definition - Types of IPR: Patents, Trademarks, Copyright and Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications, IP as a factor in RandD; Few Case Studies WTO - Definition - Functions - Forms of IPR Protection.

UNIT II

Trade Marks: Purpose and function of trademarks, Acquisition of trade mark rights, transfer of rights, Selecting and evaluating trademark, registration of trademarks, claims.

Trade Secrets: Trade secret law, Determination of trade secret status, Liability for misappropriation of trade secrets, Trade secret litigation. Geographical Indication of Goods: Basic aspects and need for the registration

UNIT III

Copyrights: Fundamentals of copyright law, Originality of material, Right of reproduction, right to perform the work publicly, Copyright ownership issues, Notice of copyright.

Patents: Foundation of patent law, Patent searching process, Basic Criteria of Patentability

Industrial Designs: Kind of protection provided in Industrial design

UNIT IV

Managing IP Rights: Acquiring IP Rights: Letters of instruction, Joint collaboration agreement.

Protecting IP Rights: Nondisclosure agreement, Cease and desist letter, Settlement memorandum.

Transferring IP Rights: Assignment contract, License agreement, Deed of assignment

UNIT V

Introduction to Cyber law: Information Technology Act, Cybercrime and e-commerce, Data security, Confidentiality, Privacy, International aspects of computer and online crime.

REFERENCE BOOKS

1. Bare Act, The Indian Patent Act 1970 and the Patent Rules, Universal Law Publishing Co. Pvt. Ltd., 2007.
2. Mittal D.P., Indian Patents Law. Taxmann Allied Services (p) Ltd., 1999.
3. Deborah E Bouchoux, Intellectual Property: Right: The Law of Trademarks, Copyrights, Patents and Trade Secrets, 2012.
4. Gerald R. Ferrera, Cyber law: Text and Cases, South-Western Cengage Learning, 2012.
5. N.K Acharya, Intellectual property rights, Scandinavian Languages Edition, 2021.
6. Kompal Bansal, Fundamentals of Intellectual Property for Engineers, BS Publications 2013.
7. P. Radhakrishna, Intellectual Property Rights: Text and Cases, Excel Books, 2008.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Learner should be able to demonstrate understanding of basic concepts of IPR.
2. Differentiate between Trademarks, Trade secrets and GI of goods.
3. Understand Copyrights, Patents and Industrial Designs.
4. Manage and protect IP
5. Gain Knowledge on Cyber law

Mapping with Programme Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**2**					**2**			**2**	**2**			**2**		
CO2	**2**					**2**			**2**	**3**			**2**		
CO3	**2**					**3**		**3**	**2**	**2**			**2**		
CO4	**2**					**2**		**3**	**2**	**3**			**2**		
CO5	**2**					**2**		**3**	**2**	**3**			**2**		

22YYOESCN	NCC STUDIES (ARMY WING) -I	L	T	P	C
		2	0	2	3

COURSE OBJECTIVE

This course is designed especially for NCC Cadets. This course will help develop character, camaraderie, discipline, secular outlook, the spirit of adventure, sportsman spirit and ideals of selfless service amongst cadets by working in teams, learning military subjects including weapon training.

UNIT I: NCC ORGANISATION AND NATIONAL INTEGRATION

NCC Organisation - History of NCC- NCC Organization - NCC Training- Promotion of NCC cadets - Aim and advantages of NCC Training - NCC badges of Rank - Honours and Awards - Incentives for NCC cadets by central and state govt. National Integration - Unity in diversity - contribution of youth in nation building - national integration council - Factors affecting national integration.

UNIT II: PERSONALITY DEVELOPMENT AND LEADERSHIP

Introduction - Factors influencing/shaping Personality - Self-Awareness - Know yourself/ Insight - Communication Skills - Leadership Traits - Types - Attitude - Time Management - Effects of Leadership - Stress Management Skills - Interview Skills - Conflict Motives - Resolution - Importance of Group/Team Work - Influencing Skills - Body Language - Sociability: Social Skills

UNIT III: SOCIAL AWARENESS AND COMMUNITY DEVELOPMENT

Aims of Social service -Various Means and ways of social services - Family planning - HIV and AIDS - Cancer its causes and preventive measures - NGO and their activities - Drug trafficking - Rural development programs - MGNREGA-SGSY-JGSY-NSAP-PMGSY- Terrorism and counter terrorism - Corruption - Female foeticide - Dowry - Child abuse - RTI Act - RTE Act - Protection of children from sexual offences act - Civic sense and responsibility

UNIT IV: SPECIALIZED SUBJECT (ARMY WING)

Basic structure of Armed Forces- Military History - War heroes - battles of Indo-Pak war - Param Vir Chakra - Career in the Defence forces - Service tests and interviews - Fieldcraft and Battlecraft - Basics of Map reading.

UNIT V: BASIC PHYSICAL TRAINING AND WEAPON TRAINING

Basic physical Training - various exercises for fitness (with Demonstration) - Food -Hygiene and Cleanliness. Drill - Words of commands - Position and commands - Sizing and forming - Saluting - Marching (WITH DEMONSTRATION)

Main Parts of a Rifle - Characteristics of .22 rifle - Characteristics of 7.62mm SLR - Characteristics of 5.56mm INSAS rifle - Stripping and assembling - Position and holding - Safety precautions - Range procedure - Firing simulation.

TEXT BOOK

1. "National Cadet Corps- A Concise handbook of NCC Cadets", Ramesh Publishing House, New Delhi, 2014.

REFERENCES

1. "Cadets Handbook -Common Subjects SD/SW", published by DG NCC, New Delhi.
2. "Cadets Handbook- Specialized Subjects SD/SW", published by DG NCC, New Delhi.
3. "NCC OTA Precise", published by DG NCC, New Delhi.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Display sense of patriotism, secular values and shall be transformed into motivated youth who will contribute towards nation building through national unity and social cohesion
2. Acquaint and provide knowledge on personality development, self awareness, communication skills with leadership traits to work as a team and sociability values
3. Understanding about social evils and shall inculcate sense of whistle blowing against such evils and ways to eradicate such evils
4. Acquaint, expose & provide knowledge about Army/Navy/ Air force and to acquire information about expansion of Armed Forces, service subjects and important battles.
5. Demonstrate health exercises, the sense of discipline, improve bearing, smartness, turnout, develop the quality of immediate and implicit obedience of orders and basic knowledge of weapons and their use and handling.

Mapping with Programme Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1								**3**	**3**	**2**	**1**	**2**			
CO2								**3**	**3**	**3**	**2**	**3**			
CO3								**3**	**3**	**2**	**2**	**2**			
CO4								**3**	**3**	**3**	**1**	**2**			
CO5								**3**	**3**	**3**	**1**	**2**			

HONOURS DEGREE COURSES

22EEHESCN	SPECIAL ELECTRICAL MACHINES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To Differentiate the stepper motor from other motors and study it's performance characteristics
- To Distinguish between Switched Reluctance Motor from synchronous reluctance motor
- To Analyzethe controllers and performance characteristics of permanent magnet brushless DC motor drives.
- To familiarise with the working principle and control techniques of a permanent magnet synchronous motor.
- To get a Comprehensive idea about the linear motor

UNIT I: STEPPER MOTORS

Constructional features - Principle of operation types and torque equations - Modes of excitation,Characteristics, driver circuits, and microprocessor control of stepper motors, concept of lead angle,Applications.

UNIT II: RELUCTANCE MOTORS

Switched reluctance motors: Constructional feature - Principle of operation - Torque production - Power convertersand their controllers - Methods of rotor position sensing sensor less operationcharacteristics - Closed loop control applications.

Synchronous reluctance motors: Constructional feature - Axial and radial flux motor-Operating principles - Voltage andTorque equation - Phasor diagram - Performance characteristics - Applications.

UNIT III: PERMANENT MAGNET BRUSHLESS DC MOTORS

Permanent magnet materials-magnet characteristics - Permeance coefficient-permanent magnet vs Electromagnet. Magnetic circuit analysis - Emf and torque equations - Commutation - Powerconverter and their controllers - Characteristics - Applications.

UNIT IV: PERMANENT MAGNET SYNCHRONOUS MOTORS

Permanent magnet synchronous motors - Principle of operation - Ideal pmsm - Emf and torque equations - armature mmf - SynchronousReactance - sine wave motor with practical windings - Phasor diagram - Characteristics - Power converter and their controllers -Converter volt ampere requirements - Applications.Advanced synchronous machines - Flux switching motors

- flux reversal motors - Claw pole alternators - Construction and Working - Characteristics - Applications.

UNIT V: LINEAR MOTORS

Linear dc motors - Linear induction motor - Linear synchronous motors - Linear switched Reluctance motors - Constructions and working - Applications.Line start synchronous motors: line start permanent magnet synchronous motor - Line startSynchronous reluctance motor - Line start permanent magnet synchronous reluctance motor -Applications.

TEXT BOOKS

1. T.J.E. Miller, "Brushless Permanent Magnet and Reluctance Motor Drives", clarendon Press, Oxford 1989.
2. E.G. Janardanan, " Special Electrical Machines", PHI, 2014

REFERENCE BOOKS

1. T. Kenjo, A. Sugawara, "Stepping Motors and Their Microprocessor Controls", Clarendon Press london, 1994.
2. R. Krishnan, "Permanent Magnet and Brushless Dc Motors Drives", CRC press, new york,2010.
3. Ion boldea, "Linear Electric Machines, Drives, and maglevs handbook", CRC press, London, 2013.
4. P. P. Acarnley, "Stepping Motors - a guide to motor theory and practice", fourth Edition, Peter Peregrinus, London, 2007.
5. Srinivasan, "Special Electrical Machines", Lakshmi Publications, 5th edition, 2013.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Categorise the stepper motor and analyzethe performance characteristics
2. Familiarise with the operating principle and control techniques of a Reluctance Motor.
3. Differentiate between PMDC motor and other motors
4. Analyze the characteristics of permanent magnet synchronous motor
5. Explain the concept of linear motor.

Mapping with Programme Outcomes															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3				2						2	3		
CO2	3	3										2	3		
CO3	3	3				1						2	3		
CO4	3	3										2	3		
CO5	3	3				1						2	3		

22EEHESCN	HIGH VOLTAGE ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To provide exposure to ionization and deionization process and types of discharge.
- To understand the basic physics related to various breakdown processes in solid, liquid and gaseous insulating materials.
- To gain knowledge of generation and measurement of D. C., A.C., and Impulse voltages.
- To learn the theory of Lightning and Switching over voltages.
- To explain about the testing of high voltage apparatus

UNIT I: BREAKDOWN IN GASES

Ionization processes and de-ionization processes - Types of Discharge - Gases as insulating materials - Breakdown in Uniform gap - Non-uniform gaps - Streamer mechanism - Corona discharge.

UNIT II: BREAKDOWN IN LIQUID AND SOLID INSULATING MATERIALS

Breakdown in pure and - Commercial liquids, Solid die-electrics and composite die-electrics - Intrinsic breakdown - Electromechanical breakdown and thermal breakdown - Partial discharge - Applications of insulating materials.

UNIT III: GENERATION AND MEASUREMENTS OF HIGH VOLTAGES

Generation of high voltages - Generation of high D. C. and A.C. voltages - Generation of impulse voltages - Generation of impulse currents - Tripping and control of impulse generators Measurements Peak voltage - Impulse voltage and high direct current measurement method - partial discharge measurements.

UNIT IV: LIGHTNING AND SWITCHING OVER-VOLTAGES

Charge formation in clouds - Stepped leader, Dart leader - Lightning Surges - Switching over - voltages - Protection against over-voltages - Surge diverters - Surge modifiers.

UNIT V: HIGH VOLTAGE TESTING OF ELECTRICAL APPARATUS

Various standards for HV Testing of electrical apparatus - IS, IEC standards - Testing of insulators and bushings - Testing of isolators and circuit breakers - Testing of cables - Power transformers and some high voltage equipment - High voltage LAB layout - Testing facility requirements - Safety precautions in H. V. Labs.

TEXT BOOKS

1. M. S. Naidu and V. Kamaraj, "High Voltage Engineering", McGraw Hill Education, 2013.
2. C. L. Wadhwa, "High Voltage Engineering", New Age International Publishers, 2007.
3. D. V. Razevig (Translated by Dr. M. P. Chourasia), "High Voltage Engineering Fundamentals", Khanna Publishers, 1993.

REFERENCES

1. E. Kuffel, W. S. Zaengl and J. Kuffel, "High Voltage Engineering Fundamentals", Newnes Publication, 2000.
2. R. Arora and W. Mosch "High Voltage and Electrical Insulation Engineering", John Wiley and Sons, 2011.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Understand the breakdown mechanism gaseous insulating materials.
2. Analyzethe processes lead to breakdown of solid and liquid insulating materials.
3. Gain knowledge about high voltage and current generation equipment.
4. Understand how Lightning and Switching Over-voltages arises in the system
5. Analyzethe suitable H.V tests required for particular equipment as per the standards.

Mapping with Programme Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**2**		**3**		**2**						**2**	**3**	**2**	
CO2	**3**	**2**		**3**								**2**	**2**	**3**	
CO3	**2**	**3**			**2**								**2**		
CO4	**3**			**2**									**3**	**2**	
CO5	**2**	**3**			**2**								**3**	**3**	

22EEHESCN	COMPUTER AIDED POWER SYSTEM ANALYSIS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES

- To study the hydro thermal scheduling of the system.
- To implement the load frequency control and familiarize different unit commitment methods.
- To acquire knowledge of restructuring and deregulated operation of the system.
- To gather an insight into the reliability issues of the system.
- To understand the basics of estimating the system state.

UNIT I: OPTIMAL SYSTEM OPERATION

Hydrothermal Coordination - Hydroelectric plant models - Scheduling Problems - Short Term Hydro Thermal Scheduling - Lambda-Gamma method with losses - Gradient approach - Hydro units in series - Pumped storage hydro scheduling

UNIT II: LOAD FREQUENCY CONTROL AND UNIT COMMITMENT

Load frequency problem - Speed governing system - P-F and Q-V control loops - Control of single area and two area cases. Cost Function Formulation - Constraints for Plant Commitment Schedules - Priority - List Method - Dynamic Programming - Unit Commitment by Dynamic Programming.

UNIT III: POWER SYSTEM RESTRUCTURING

Need for restructuring and deregulation - Different entities in deregulated electricity markets - Benefits from a competitive electricity market - After effects of deregulation - Formation of power pools - The energy brokerage system -Role of the independent system operator (Iso) - The iso in pool markets - The Iso in bilateral markets - Operational planning activities of a Genco - The Genco in pool markets - The Genco in bilateral markets - Market participation issues - Transmission system operator - Pricing of power transactions - Congestion management in deregulation.

UNIT IV: POWER SYSTEM RELIABILITY

General reliability function - The exponential distribution meantime to failure - Series and parallel systems - Markov processes - Continuous markov processes - Recursive techniques - Probability array for two systems - Loss of load approach - Load forecast uncertainty - Interconnection benefits.

UNIT V: STATE ESTIMATION AND SECURITY ANALYSIS

Principles of power system state estimation from redundant data - Algorithm for WLS state estimation (without proof) - Problems using d.c. model.Security analysis by simulation of line and generator outages - line outage distribution factors and generation shift factors for d.c. model of power systems (without derivation) - Evaluation of overloads by outage simulation using these factors.

TEXT BOOKS

1. Nagrath I.J., Kothari D.P "Power System Engineering" TMH, Delhi; 2007.
2. Wood and Wollenberg "Power System Generation, Operation and Control", John Wiley and Sons; 2006.

REFERENCE BOOKS

1. Wadhwa C.L. "Electrical Power Systems", Wiley Eastern; 2007.
2. Elgerd O.I "Electric Energy Systems Theory - An Introduction" TMH; 2006.
3. Murty PSR "Power System Operation and Control", TMH;1984.
4. Loe Lei Lai " Power System Restructuring and Deregulation " John Wiley and sons March 2001
5. Roy Billington "Power System Reliability Evaluation" Gordon and Breach Science Publishers, New York,1970.

COURSE OUTCOME

At the end of this course work, students will be able to

1. Understand the hydro-thermal scheduling of the power system.
2. Enhance skills relating to controlling the active and reactive power and explore the theory of unit Commitment.
3. Enable the need for restructuring and deregulated operation of the system.
4. Learn the methods for reliable operation of the power system.
5. Develop new approaches for estimating the system state.

Mapping with Programme Outcomes															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2				2		2	2		2		3		
CO2	3	2	2			2		2					2	2	
CO3	3	2	2				1					2	3		
CO4	3	2						1	2			2	2	2	
CO5	3	2	2			2		2					2	2	

22EEHESCN	POWER QUALITY STUDIES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To learn the various categories of power quality problems and its sources
- To acquire an in-depth knowledge on voltage sag and interruptions
- To acquire an in-depth knowledge on transient over voltages
- To provide deep insight to harmonics in power system
- To learn about various aspects of power quality measurements

UNIT I: FUNDAMENTALS OF POWER QUALITY

Power quality: definition and importance - Power quality issues defined by IEEE-1159: Short duration voltage variations, long duration voltage variations, Transients, Waveform distortion, Voltage imbalance, Voltage fluctuation and Power frequency variations - Sources and Effects of power quality problems - Power quality terms - CBEMA and ITI curves - Overview of power quality standards.

UNIT II: VOLTAGE SAGS AND INTERRUPTIONS

Sources of sags and interruptions - Estimating voltage sag performance - Fundamental principle of protection - Solutions at end user level - Economic evaluation of different ride-Through alternatives - Motor starting sag.

UNIT III: TRANSIENT OVER VOLTAGES

Sources of transient overvoltage: capacitor switching, lightning, ferro resonance - Principle of overvoltage protection - Devices for overvoltage protection - Utility capacitor - Switching transients - Lightning protection - Switching transients with load - computer analysis tools for transients: PSCAD, EMTP

UNIT IV: HARMONICS

Harmonics: Types, harmonic distortion, harmonic indices, voltage vs current distortion, harmonics vs transients, harmonic evaluation - industrial and commercial harmonic sources, locating harmonic sources - effects of harmonic distortion - system response characteristics - Principles of controlling harmonics - Harmonic filters: passive and active power filters, design and case study - Harmonic standards.

UNIT V: POWER QUALITY MONITORING

Monitoring considerations - Historical perspective of PQ measuring instruments - PQ measurement equipment - Assessment of PQ measurement data - Expert system for PQ

monitoring - Planning, Conducting and Analyzing power quality survey - PQ monitoring standards.

TEXT BOOKS

1. Roger C. Dugan, Mark, F. McGranaghan and H.WayneBeaty, "Electrical Power Systems Quality", 3rd Edition, McGraw-Hill, New York, 2009.
2. Barry W. Kennedy, "Power Quality Primer", McGraw-Hill, New York, 2000.

REFERENCES

1. Ewald Fuchs and Mohammad Masoum "Power Quality in Power Systems and Electrical Machines", 2nd Edition, Academic press, 2015.
2. Bhim Singh, Ambrish Chandra and Kamal Al-Haddad, "Power Quality Problems and Mitigation Techniques", John Wiley and Sons Ltd, 2015
3. Suresh Mikkili and Anup Kumar Panda, "Power Quality Issues: Current Harmonics", CRC Press, 2016
4. Surajit Chattopadhyay, Madhuchh and Mitra and Samarjit Sengupta, "Electric Power Quality" , Springer, 2011.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Understand the power quality issues and its sources in electrical distribution network
2. Examine the severity of voltage sag and the solutions at end user level
3. Analyze the impact of transients and its mitigation practices
4. Design a suitable filter for harmonic mitigation
5. Identify the power quality monitoring instruments used in power system.

Mapping with Programme Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**3**		**2**			**2**	**2**	**2**				**3**	**2**	
CO2	**3**	**3**	**2**					**2**					**3**	**2**	
CO3	**2**	**2**	**2**	**2**				**2**					**3**	**3**	
CO4	**3**		**2**					**2**				**2**		**2**	
CO5	**2**	**2**	**2**	**3**				**2**				**2**	**3**	**2**	

22EEHESCN	SEMICONDUCTOR DEVICES AND MODELING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce the basics of semiconductor materials, their electrical properties and quantitative analysis of such materials based on energy band diagrams.
- To acquaint the students with the construction, theory and operation of theP-N junction diode, its characteristics and quantitative analysis of P-N junction diodes.
- To teach the concepts of Bipolar Junction Transistors and quantitative analysis to estimate the performance factors.
- To make the students understand the effect of junction capacitance, their effect on the performance of diodes and BJTs and Breakdown characteristics of these devices
- To impart knowledge of the operation and characteristics of Photodiodes and phototransistors and qualitative analysis of these devices.

UNIT I: QUANTITATIVE ANALYSIS OF SEMICONDUCTORS

Atomic picture of Silicon and Germanium - Electric current, free electron density and mobility in Semiconductors - Effect of doping on minority carrier density in Semiconductors - Energy band picture of P and N type Semiconductors - Temperature dependence of conductivity - Degeneracy. Calculation of free electron density and hole density in a Semiconductor - Determination of position of Fermi level for a given Semiconductor - Carrier density expressed in terms of departure of Fermi level from intrinsic Fermi level - Fermi level in N-type and P-type samples as measured from intrinsic Fermi level - Very lightly doped samples - representation of energy band diagram in terms of potential - Equation governing potential distribution in a Semiconductor - Equation governing distribution of hole density and electron density - Continuity equation for Semiconductors - Determination of steady state excess carrier density - Concepts of Quasi Fermi level.

UNIT II: QUANTITATIVE ANALYSIS OF P-N JUNCTION DIODE

P-N junction under thermal equilibrium - P-N junction under Forward bias - P-N junction under Reverse bias - Behavior under large forward voltage - Temperature dependence of P-N junction characteristics - Break down under reverse bias - Thermal Break down, Zener Break down and Avalanche Break down - Transition capacitance of a P-N junction. Band diagram for a Semiconductor with an applied voltage - P-N junction in thermal equilibrium - Minority carrier densities in a P-N junction under Forward bias - Expression for total current in a P-N junction - Calculation of carrier density and current in a reverse biased junction - P-N junction behavior in terms of minority carrier stored charge - Calculation of electric field and voltage drop in the bulk.

UNIT III: QUANTITATIVE ANALYSIS OF BIPOLAR JUNCTION TRANSISTOR

Operation of a BJT - Performance parameters - Effect of collector junction voltage on current - Dependence of I_C on V_E and I_E. Uniform Base PNP transistor with Forward biased B-E junction and Reverse biased C-B junction - Calculation of performance parameters - Transit time of minority carriers through base - Effect of floating collector on transistor V-I characteristics - Effect of floating emitter junction characteristics - Collector current with base floating - Temperature effects in Transistors - Effect of device geometry on the transistor performance - Ebermoll's equation.

UNIT IV: JUNCTION TRANSITION CAPACITANCE AND JUNCTION BREAK DOWN VOLTAGES

Electric field and potential distribution in P-N junction at thermal equilibrium - Transition capacitance and Break down voltages in linearly graded junction and an abrupt junction - C_T in PIN Diode - Break down voltage in transistor.

UNIT V : QUANTITATIVE ANALYSIS OF PHOTO DIODES AND PHOTO TRANSISTORS

Carrier generation by light in a uniform piece of semiconductor - P-N junction photo diode for light detection - Open circuit photo voltages - Short circuit current in photo diode - Photo diode current under combined action of light and reverse bias - Photo diode current under combined action of light and forward bias - Photo transistor - Expression for current in photo transistor - Solar cells using photo diodes.

REFERENCES

1. M.K. Achuthan and K. N. Bhat, "Fundamentals of Semiconductor devices", Tata McGraw Hill, New Delhi, 2007.
2. Ben G Streetman, "Solid State Electronics", Prentice Hall, 1999.
3. S.M.Sze, "Modern Semiconductor Devices Physics", John Wiley and Sons, 1998.
4. Donald A. Meamen, "Semiconductor Physics and Devices - Basic Principles", McGraw Hill, 2003.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Describe the equations based on energy band diagrams, acceptable approximations and for intrinsic, p and N type semiconductors
2. Explain the operation of p-n junction diodes quantitatively and qualitatively.
3. Describe the fabrication, device operation of a BJT quantitatively and model its characteristics from basic principles
4. Understand the effects of junction capacitance and break down voltages on the

performance of P-N junction diodes and BJTs the Classify and describe the semiconductor devices for special applications

5. Analyze and develop models of optoelectronic devices such as Solar Cells and LEDs.

Mapping with Programme Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**2**										**2**	**3**		
CO2	**2**		**3**									**2**	**2**		
CO3	**2**	**2**	**3**	**2**	**2**								**2**	**2**	
CO4	**2**		**3**										**3**	**2**	
CO5	**2**		**3**	**2**	**2**							**3**	**3**	**2**	

22EEHESCN	HIGH SPEED ELECTRONICS	L	T	P	C
		3	1	0	3

COURSE OBJECTIVES

- To introduce transmission line basics and various parameters that affects the performance of High speed circuits.
- To give exposure on analysis and design of RF circuits and components.
- To explain the various techniques for fabricating printed circuit board and assembling printed circuit board
- To learn the theory of RF mixers and oscillators
- To enable a framework for the use of PCB

UNIT I: BASICS

Transmission line theory (basics) crosstalk and non-ideal effects; signal integrity: impact of packages, vias, traces, connectors; non-ideal return current paths, high frequency power delivery, methodologies for design of high speed buses; radiated emissions and minimizing system noise. Noise Analysis: Sources, Noise Figure, Gain compression - Harmonic distortion - Intermodulation-Cross - Modulation - Dynamic range.

UNIT II: PASSIVE AND ACTIVE COMPONENTS

Passive components: RF behavior of Resistor, Inductor and Capacitor; Active RF components: RF diodes, BJT, MOSFET, High electron mobility transistor - Modeling Diodes and Transistors at Radio frequencies.

UNIT III: RF AMPLIFIERS

RF Amplifier Design - Stability - Low Noise Amplifiers - Broadband Amplifiers (and Distributed) Power Amplifiers, Class A, B, AB and C, D E Integrated circuit realizations - Cross-over distortion Efficiency RF power output stages.

UNIT IV: RF MIXERS AND OSCILLATORS

Mixers - Up conversion, down conversion - Conversion gain and spurious response. Oscillators, PLL, Transceiver architectures.

UNIT V: PRINTED CIRCUIT BOARD

Printed Circuit Board: Anatomy - CAD tools for PCB design - Standard fabrication - Micro via Boards. Board Assembly: Surface Mount Technology - Through Hole Technology - Process Control and Design challenges.

TEXT BOOKS

1. Thomas H. Lee, "Design of CMOS Radio-Frequency Integrated Circuits",
2. Cambridge University Press, 1998(2013 Reprint), ISBN: 9780521639224.
3. Stephen H. Hall, Garrett W. Hall, James A. McCall "High-Speed Digital System Design: "A Handbook of Interconnect Theory and Design Practices", Wiley-IEEE Press,2000.
4. Reinhold Ludwig,Pavel Bretchko,"RF Circuit Design:Theory and Applications", Pearson Edition,2000,ISBN:9788131702437.

REFERENCES

1. Chris Bowick, "RF Circuit Design", Elsevier, U.S./India, 2007(2nd Edition), ISBN:9780750685184
2. Behzad Razavi, "RF Microelectronics", Pearson India, 2014(2nd Edition), ISBN: 9789332518636.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Explain various factors that affect the performance of high speed circuits.
2. Describe the behavior of Passive and active components at Radio frequencies.
3. Design and analyze RF amplifiers for various applications.
4. Demonstrate the working of RF Oscillators and Mixers.
5. Demonstrate various techniques for fabricating and assembling PCB.

Mapping with Programme Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**3**		**2**								**2**	**3**		
CO2	**3**	**3**										**2**	**3**		
CO3	**3**	**3**	**3**	**2**								**2**	**3**		
CO4	**3**	**3**										**2**	**2**		
CO5	**3**		**3**	**2**	**2**							**2**	**2**	**2**	

22EEHESCN	NON LINEAR CONTROL SYSTEMS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES

- To give exposure to nonlinear control and to discuss about the stability and applications of nonlinear systems
- To understand the describing function analysis
- To learn the methods of different types of stability analysis.
- To develop methods for modelling and control of Non linear systems
- To understand the need for sliding mode control

UNIT I: NON LINEAR SYSTEMS

Behavior of non-linear systems, jump resonance, sub harmonic oscillation - Phase plane analysis: Singular points - Construction of phase portraits using isoclines and delta method - Limit cycles - Existence of limit cycles.

UNIT II: DESCRIBING FUNCTION ANALYSIS

Describing function fundamentals - Applications of describing functions - Basic assumptions and definitions - Computing describing functions. Common nonlinearities in control systems - Describing functions for common nonlinearities - Describing function analysis of non-linear systems examples

UNIT III: STABILITY ANALYSIS

Stability in the sense of Lyapunov's - second method of Lyapunov's - Lyapunov's stability analysis of linear time invariant systems and nonlinear system - Krasovskii's theorem - variable gradient method of generating Lyapunov's functions.

UNIT IV: MODELING AND CONTROL OF NON-LINEAR SYSTEMS

Models for nonlinear systems - Hammerstein and wiener models - Input signal design for identification - Real-time parameter estimation for nonlinear systems - Nonlinear PID controller - Gain scheduling control - Case studies. Feedback linearization - Input-state and input-output linearization using lie derivative and lie brackets

UNIT V: SLIDING CONTROL SLIDING CONTROL

Sliding Surfaces - Sliding condition - Filippov's construction of the equivalent dynamics - Examples. Direct implementation of switching control laws switching control in place of PWM and Dither signals. Continuous Approximations of switching control laws.

TEXT BOOKS

1. I.J. Nagarath and M.Gopal, "Control Systems Engineering", Fourth Edition, New AgeInternational (P) Ltd., Publishers, 2005.
2. Gibson, J.E, "Nonlinear Automatic Control", McGraw Hill Book Co, 1963.

REFERENCES

1. Hassan K Khalil, "Nonlinear Systems", Prentice Hall, 2002, Third Edition, 2002.
2. HenkNimeijer, "Nonlinear Dynamical Control Systems", Springer Verlag,NewYork, 1990.
3. Alberto Isidori, "Nonlinear Control Systems (3rd edition)", Springer Verlag, 1995.
4. Jean-Jacques Slotine and Weiping Li, "Applied Nonlinear Control", Prentice Hall, New jersey, 1991. 5. K.M.Hangos,J.Bokor and G.Szederkrnyi, "Analysis and control of Nonlinear Process systems", Springer

COURSE OUTCOMES

At the end of this course, students will able to

1. Understand the basics of nonlinear systems.
2. Derive the describing function.
3. Understand the stability analysis of nonlinear systems.
4. Implement modeling of nonlinear systems and feedback linearization design.
5. Understand the recent trends in sliding mode control.

Mapping with Programme Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**												**3**		
CO2	**3**	**2**											**3**		
CO3	**3**	**2**	**2**	**2**									**3**	**1**	
CO4	**3**	**2**	**2**	**2**									**3**	**1**	
CO5	**3**	**2**	**3**	**3**	**3**								**3**	**2**	**3**

22EEHESCN	INTRODUCTION TO NANO ELECTRONICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To understand basic concepts of Nano electronics.
- To learn the fundamentals of Nano electronics devices
- To gather knowledge on the use of MOSFETs
- To explain the operation of CNT
- To introduce the theory of Molecular Electronics

UNIT I: INTRODUCTION TO NANOTECHNOLOGY

Background to nanotechnology: Types of nanotechnology and Nano machines - Periodic table - Atomic structure - Molecules and phases - Energy - Molecular and atomic size -Surface and dimensional space - Top down and bottom up; molecular nanotechnology: electron microscope - Scanning electron microscope - Atomic force microscope - Scanning tunneling microscope - Nano manipulator - Nano tweezers - Atom manipulation - Nano dots - Self-assembly - Dip-pen nanolithography. Nano materials: preparation - Plasma arcing - Chemical vapor deposition - Sol-gels - Electro deposition - Ball milling - Applications of nano materials.

UNIT II: FUNDAMENTALS OF NANOELECTRONICS

Fundamentals of logic devices: dynamic properties - Threshold gates; classifications - Two terminal devices - Field effect devices - Design of logic gates using Nano devices - Coulomb blockade devices - Spintronics - Quantum cellular automata - Quantum computing - DNA computer; performance of information processing systems: basic binary operations, measure of performance processing capability of biological neurons - Performance estimation for the human brain, ultimate computation

UNIT III: SILICON MOSFETS AND QUANTUM TRANSPORT DEVICES

Silicon MOSFETS - Novel materials and alternate concepts:- Fundamentals of MOSFET Devices - Scaling rules - Silicon-dioxide based gate dielectrics - Metal gates - Junctions and contacts - Advanced MOSFET concepts. Quantum transport devices based on resonant tunneling: - Electron tunneling - Resonant tunneling diodes - Resonant tunneling devices; Single electron devices for logic applications:- Single electron devices - Applications of single electron devices to logic circuits.

UNIT IV: CARBON NANOTUBES

Carbon Nano tube: Fullerenes - Types of Nano tubes - Formation of Nano tubes - Assemblies - Purification of Carbon Nano tubes - Electronic properties - Synthesis of Carbon Nano tubes - Carbon Nano tube interconnects - Carbon nanotube FETs - Nano tube for memory applications.

UNIT V: MOLECULAR ELECTRONICS

Electrodes and contacts - Functions - Molecular electronic devices - First test systems - simulation and circuit design - Fabrication; Future applications: MEMS - Robots - Random access memory - Mass storage devices.

TEXT BOOKS

1. Phani Kumar, "Principles of Nano Technology:-Materials, Tools and Process at Nano Scale" SCITECHPublications,2017
2. T. Pradeep, NANO: "The Essentials-Understanding Nano science and Nano technology",TMH,2007
3. G.W. Hanson, "Fundamentals of Nano electronics", Pearson,2009.
4. W. Ranier, "Nano electronics and Information Technology (Advanced Electronic Material and Novel Devices)", Wiley-VCH,2003.

REFERENCES

1. K.E. Drexler, "Nano systems", Wiley, 1992.
2. J.H. Davies, "The Physics of Low-Dimensional Semiconductors", Cambridge University Press, 1998.
3. C.P. Poole, F. J. Owens, "Introduction to Nanotechnology", Wiley, 2003.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Discuss the types of nanotechnology, molecular technology and the preparation of Nano materials.
2. Explain the fundamentals of logic devices and classifications
3. Describe the concepts of silicon MOSFET and Quantum Transport Devices.
4. Summarize the types, synthesis, interconnects and applications of carbon nano tubes.
5. Explain the concepts, functions, fabrications and applications of molecular electronics.

Mapping with Programme Outcomes															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2									2	2		
CO2	3		2									2	3		
CO3	3		2									2	2		
CO4	3		2									2	2		
CO5	3		2									3	3	2	

22EEHESCN	ADAPTIVE SIGNAL PROCESSING	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES

1. To introduce the concepts of adaptive filtering
2. To explain the fundamentals of LMS adaptive filter for signal enhancement and channel equalization
3. To learn the methods for representing signals in orthogonal space.
4. To enumerate the describe signals in vector space
5. To evolve procedures for the design of RLS filter.

UNIT I: BASIC CONCEPTS

General concept of adaptive filtering and estimation, applications and motivation, Review of probability, Random variables and stationary random processes, Correlation structures, properties of correlation matrices.

UNIT II: LMS ALGORITHM

Optimal FIR (Wiener) filter, Method of steepest descent, extension to complex valued. The LMS algorithm (real, complex), convergence analysis, weight error correlation matrix, excess mean square error and mis-adjustment. Variants of the LMS algorithm: the sign LMS family, normalized LMS algorithm, block LMS and FFT based realization, frequency domain adaptive filters, Sub-band adaptive filtering.

UNIT III: SIGNAL SPACE CONCEPTS

Signal space concepts - Introduction to finite dimensional vector space theory, subspace, basis, dimension, linear operators, rank and nullity, inner product space, orthogonality, Gram-Schmidt orthogonalization, concepts of orthogonal projection, orthogonal decomposition of vector spaces.

UNIT IV: VECTOR SPACE

Vector space of random variables, correlation as inner product, forward and backward projections, Stochastic lattice filters, recursive updating of forward and backward prediction errors, relationship with AR modeling, joint process estimator, gradient adaptive lattice.

UNIT V: RECURSIVE LEAST SQUARES

Introduction to recursive least squares (RLS), vector space formulation of RLS estimation, pseudo inverse of a matrix, time updating of inner products, development of RLS lattice filters, RLS transversal adaptive filters. Advanced topics: affine projection and subspace based adaptive filters, partial update algorithms, QR decomposition and systolic array.

TEXT BOOKS

1. S. Haykin, "Adaptive filter theory", Prentice Hall, 1986.
2. C.Widrow and S.D. Stearns, "Adaptive signal processing", Prentice Hall, 1984.

REFERENCES

1. "Adaptive Signal Processing" Next Generation Solutions by Tülay Adali and Simon Haykin, Wiley publications,2010.
2. "Adaptive Filters", by Ali H. Sayed, Wiley, NJ, 2008.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Discuss the concepts of adaptive filtering
2. Design LMS adaptive filter for signal enhancement and channel equalization
3. Represent signals in orthogonal space.
4. Describe signals in vector space
5. Design RLS filter.

Mapping with Programme Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1		**3**							**2**				**3**		
CO2	**2**							**2**					**3**		
CO3	**2**	**3**						**2**		**1**			**3**		
CO4		**3**		**2**								**1**	**3**		
CO5		**3**	**1**	**2**	**1**	**1**	**1**		**2**		**1**		**3**		

22EEHESCN	SOLAR CELL DESIGN AND FABRICATION	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES

- To learn the fundamentals of solar energy conversion systems, available solar energy and the local and national needs, photovoltaic and photo thermal engineering applications, emerging technologies.
- To understand the interdisciplinary approach for designing stand-alone PV systems, predicting performance with different systems, Implementing design with cost analysis, Gain system engineering expertise related to photovoltaic energy conversion: generation, storage, and grid connection processes for residential and industrial applications,
- Be able to advance the current technology of the solar energy systems for making the process economical, environmentally safe and sustainable. Be able to serve industries or academia involved in sustainable energy engineering.

UNIT I: CONCEPTS OF SOLAR ENERGY

The sun, Available solar energy from the sun, insolation vs. world energy demand, Blackbody radiation, Planck's Radiation Law, Wien's displacement Law, Stefan Boltzmann Equation, spectral distribution of extraterrestrial and terrestrial radiations, solar constant, properties of solar radiation Sun-Earth Geometry: Motion of the earth relative to the sun, Apparent motion of the sun relative to a fixed observer on the earth, Air Mass, estimation of available solar radiation on earth, absorption of solar radiation by earth's atmosphere, direct, diffused and albedo components of sunlight, solar radiation table, global radiation data. Mean annual irradiance on horizontal surface across the world, Effects of latitude, declination, slope, surface azimuth angle, hour angle, and the angle of incidence. Radiation on an inclined surface: direct, reflected, and diffused radiations, radiation on inclined surfaces, calculation of angles of incidence, direction of beam radiation, angles for tracking surfaces, ratio of beam radiation on tilted surface to that of horizontal surface

UNIT II: PHOTOVOLTAIC TECHNOLOGY

Introduction to PV, conversion of solar radiation to electrical energy, PV sizing for meeting the world's energy need, how much land area is needed, advantages and disadvantages of PV systems. Reliability and sizing of the PV/PT systems, uncertainty and risk factors in PV/PT design, Cost analysis, Terawatt challenge, Energy payback, different options of PV modules, thin film solar cells. Light absorption, Direct-bandgap and indirect bandgap semiconductors, light absorption coefficient, Reflection and reflection losses, Absorption as a function of photon energy, Carrier transport.

UNIT III: PERFORMANCE PARAMETERS OF PV CELLS

Fundamental principles of solar cell operation, Solar cell device physics, Basic structure of solar cells, Quasi Fermi energy levels, Law of junctions, Carrier generation rate, Recombination rate, Dark current, Light generated current, Current-voltage (I-V) relationship. Solar cell output parameter, Fill factor, solar cell efficiency, Short circuit current, Open circuit voltage, Maximum power point operation, Effect of finite width of the solar cell, Solar cell equivalent circuit, Effect of bandgap, maximum thermodynamic efficiency. Practical efficiency limit, Losses in short circuit current, open circuit voltage, efficiency, Temperature effects, Fill factor losses, I-V characteristic measurement, Efficiency measurement, Parasitic resistances, Effects of series and shunt resistances

UNIT IV: SOLAR CELL MODULE DESIGN AND FABRICATION

Silicon solar cells to Photovoltaic Module (PV) production, Cell fabrication and interconnections, Top and Bottom connections, Manufacturing process, Cell matrix, encapsulation, vacuum lamination, Post-lamination steps, Bifacial modules, Electrical and optical performance of modules, Local shading and hot spot formation, Field performance. Introduction to concentrated Solar Power (CSP) systems, Energy generation and capacity factor, Tracking requirements, Photovoltaic and solar thermal concentrators, concentrator optics, solar collectors for CSP systems. Concentrated Photovoltaic (CPV) systems: Principles and Practices, Fresnel lens, tracking systems. CPV modules, and engineering practices for CPV solar plants.

UNIT V: PERFORMANCE EVALUATION OF SOLAR MODULES

Measurements and characterization of solar cells and PV modules, V-I characteristics, spectral response measurements, measurements and characterization of thin film solar cells Domestic, industrial and commercial applications, Lifetime of the PV modules, Degradation caused by UV radiation, Moisture penetration, Corrosion, Dust deposition/soiling losses, Reflection losses, Thermal effects, Delamination of the module, prevention of energy yield losses.

REFERENCES

1. "Solar Cells: Operating Principles, Technology and System Applications", Martin Green published by the University of New South Wales, 1980 (Required) available at the BU Barnes and Noble book store
2. "Solar Engineering of Thermal Processes", Fourth Edition, John A. Duffie and William A.Beckman, John Wiley and Sons. Inc. 2005 (Chapters 1, 2, 3, and 7) Recommended
3. "Photovoltaic Science and Engineering Handbook", Second Edition, Antonio Luque and Steven Hegedus, John Wiley and Sons, 2012 An excellent Resource
4. "Thin film Solar Cells", Jeff Poortmans and Vladimir Arkhipov (Ed) John Wiley and Sons Ltd. 2006

5. "Solar Cell Device Physics", Second Edition, Stephen J. Fonash, Elsevier, Inc., 2010
6. "Solar Electricity", Second Edition, Thomas Markvart (Editor), John Wiley and Sons, Ltd., 2000.
7. "Concentrating Solar Power Technology", principles, developments and applications, Keith Lovegrove and Wes Stein, Woodhead Publishing series in Energy, Woodhead Publishing, 1518 Walnut Street, Suite 1100, Philadelphia, PA 19102-3406, USA 2012
8. www.pveducation.org

COURSE OUTCOMES

At the end of this course, students will able to

1. Gain an understanding of the available solar energy and the current solar energy conversion and utilization processes,
2. Have a working knowledge of semiconductor physics, optical systems, load matching, and storage and grid connections related to photovoltaic engineering,
3. Be able to comprehend the challenges in sustainable energy processes, perform cost analysis, design photovoltaic systems for different applications meeting residential and industrial needs, predict and test performance, and
4. Understand the manufacturing processes involved, environmental challenges that need to be solved, economic aspects, and future potentials of solar energy utilization
5. Evaluate the performance of a PV solar module using various measurement techniques

Mapping with Program Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**2**										**2**	**3**		
CO2	**2**		**3**	**2**	**2**							**2**	**2**		
CO3	**2**	**2**	**3**										**2**	**2**	
CO4	**2**		**3**										**3**	**2**	
CO5	**2**		**3**	**2**	**3**							**3**	**3**	**2**	

MINOR ENGINEERING COURSES

22EEMISCN	ELECTRICAL TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To review the basics of the Magnetic circuits
- To know the different types of DC machines and their applications.
- To understand the construction, principle and operation of single phase and three phase transformers, classification and their applications.
- To learn the operating theory of Induction Machines
- To gather knowledge on the working of Synchronous Machines

UNIT I: MAGNETIC CIRCUIT

Magneto motive force - Magnetic field strength - Permeability of free space - Relative permeability - Reluctance - comparison of electric and magnetic circuits - Composite magnetic circuit - Magnetic leakage and fringing - Kirchoff's laws for the magnetic circuit - Magnetization curve - Hysteresis loop - Current-ring theory of magnetism - Hysteresis loss - minimum volume of a permanent magnet - Load line of a permanent magnet - Magnetic field of a long solenoid - Magnetic energy in a non-magnetic medium - Magnetic pull. Inductance of a coil and factors determining inductance of a coil.

UNIT II: DC MACHINES

Construction details of machine - Operation of DC generators - EMF equation - characteristics of different types of DC generators - Commutation - Armature reaction - Operation of DC motors - Torque equation - Characteristics of different types of DC motors. Starters - Breaking and speed control of DC motors.

UNIT III: TRANSFORMERS

Principle - Types - General constructional features of single phase transformers - Phasor diagram and equivalent circuit - Regulation, efficiency and all-day efficiency - Open circuit and short circuit tests - Applications. Autotransformer and three phase transformer - Types and applications.

UNIT IV: INDUCTION MACHINES

Three phase - Types - Constructional features - Equivalent circuit - Slip - Torque characteristics - Starters - Breaking and speed control methods. Principle of operation, types and applications of single phase induction motors.

UNIT V: SYNCHRONOUS MACHINES

Principle - Types and general constructional features - Synchronous generators - Characteristics - EMF equation - Armature reaction - Regulation - Phasor diagram of synchronous motor - V curve - Starting methods. Applications of synchronous generators and synchronous motors.

TEXT BOOKS

1. Theraja and Theraja. "A Text book of Electrical Technology - Vol.II, AC and DC Machines", 23 rd Revised Edition, S.Chand and Co., Ltd. 2002.

REFERENCE BOOKS

1. R.Muthusubramanian, S. Salivahanan and K.A.Muraleedharan, "Basic Electrical Electronics and Computer Engineering", Tata McGraw -Hill Publishing Company Limited, 2000
2. I.J.Nagrath and D.P.Kothari, "Electric Machines", Second Edition, Tata McGraw -Hill Publishing Company Limited, 1997.
3. S K Bhattacharya, "Electrical Machines", Third Edition, Tata McGraw - Hill Publishing Company Limited, 2009.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Acquire knowledge on magnetic circuits.
2. Arrive at the working of DC machines.
3. Understand the operation of transformers for different industrial applications.
4. Enable the use of Induction Machines
5. Gather knowledge on the applications of Synchronous Machines.

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Mapping with Program Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**		**3**			**2**	**2**					**2**	**3**		
CO2	**3**	**2**				**2**	**2**						**3**	**3**	
CO3	**3**	**2**											**3**	**2**	
CO4	**3**	**2**	**3**										**3**	**3**	
CO5	**3**		**3**										**3**	**3**	

22EEMISCN	ELECTRICAL MEASUREMENTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To understand the basic principles and the laws governing the operation of electrical measuring instruments.
- To learn about the methods used for measuring Power.
- To explain the methods used for measuring Resistance.
- To enable the framework for operating Potentiometers.
- To enumerate the significance of Magnetic Measurements.

UNIT I: MEASURING INSTRUMENTS

D'Arsonal galvanometer, Principle, operation and constructional details of Moving-coil, Moving-iron, dynamometer type, thermal type instruments, errors and compensations, extension of range using shunt, multiplier, Principle of C.T. and V.T.

UNIT II: MEASUREMENT OF POWER

Ammeter and Voltmeter method - Electrodynamic wattmeter, errors and compensation, thermal type wattmeter, single and 3- phase power measurements. Energy measurement - Induction type energy meter, principle, construction, errors and compensation. Calibration of wattmeters and energy meters.

UNIT III: MEASUREMENT OF RESISTANCE

Series and shunt type ohmmeter. Wheatstone bridge, Kelvin bridge, Megger.AC bridges - Maxwell bridge, Wien bridge, Anderson bridge, Hays bridge, Schering bridge - Campbell bridge to measure mutual inductance - detectors in bridge measurements.

UNIT IV: DC POTENTIOMETER

Standardization - student type, Leeds and Northrup potentiometer, Vernier potentiometer, Brooks deflection potentiometer. AC potentiometer - Drysdale potentiometer, Gall potentiometer. Applications of AC and DC potentiometers. Maximum demand meter, Power factor meter.

UNIT V: MAGNETIC MEASUREMENTS

Flux meter - testing of ring specimen - B-H curve by method of reversal and step by step method - testing of bar specimen - Hopkinson's permeameter - Iron loss measurement by Lloyd Fisher square.

TEXT BOOKS

1. E.W. Golding and F.C.Widdis, Electrical Measurements and Measuring Instrumen ts, A.H.Wheeler and Co, 2001.
2. A.K. Sawhney, Electrical and Electronics Measurements and Instrumentation, DhanpathRaiand Co (P) Ltd, 2004.

REFERENCE BOOKS

1. J.B.Gupta, A Course in Electronic and Electrical Measurements and Instru mentation,S.KKataria and Sons, Delhi, 2003.
2. H.S.Kalsi, Electronic Instrumentation, Tata McGraw Hill, 2004.
3. Martin U. Reissland, Electrical Measurement -Fundamental Concepts and Applications, New Age International (P) Ltd, 2001.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Understand the internal structure of the instruments used in electrical measurements and to decide the types of instruments to be used for measuring AC and DC quantities.
2. Understand the practical application of Wattmeters and Energy meters.
3. Construct and determine the circuit parameters using AC and DC bridges.
4. Construct and determine the circuit parameters using AC and DC potentiometers.
5. Explain the importance of Magnetism in electrical measuring instruments.

Mapping with Programme Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**		**2**										**2**		
CO2	**3**		**2**										**2**		
CO3	**3**	**3**	**2**										**2**		
CO4					**2**								**2**	**3**	
CO5					**2**								**2**		

22EEMISCN	FUNDAMENTALS OF ELECTRONIC DEVICES AND CIRCUITS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE

- To provide basic knowledge about semiconductor diodes
- To enable to understand various application of various diode circuits
- To impart the knowledge pertaining to transistor and its characteristics
- To familiarize with the construction and operation of MOSFET
- To acquaint with power amplifier

UNIT I: SEMICONDUCTOR DIODES

Introduction, Semiconductor materials, covalent bond and intrinsic materials, energy levels, extrinsic materials: p-type and n-type semiconductors, semiconductor diodes, ideal versus practical diodes, resistance levels, diode equivalent circuits, transition and diffusion capacitance, Zener diode, Light Emitting diode

UNIT II: DIODE CIRCUITS

Introduction Typical diode circuits, Half-wave and Full wave rectifier, Clippers, Clampers, Zener Diode as voltage regulators, Voltage multiplier circuits, Practical Applications of diode circuits

UNIT III: BIPOLAR JUNCTION TRANSISTOR

Introduction, Transistor construction, Operation, Common-base configuration and characteristic, Transistor Amplifying action, Common-Emitter configuration and characteristic, Common collector configuration and characteristic, Limits of operation, study of Transistor data sheet

UNIT IV: MOS FIELD-EFFECT TRANSISTORS

Device structure and physical operation, current-voltage characteristics, MOSFET circuits at dc, the MOSFET as an amplifier and as a switch, biasing in MOS amplifier circuits, small - signal operation and models, single-stage MOS amplifiers, the depletion-type MOSFET,JFET - construction, operation and characteristics

UNIT V: POWER AMPLIFIERS

Introduction, Series - fed Class A amplifier, Transformer - Coupled Class A amplifier, Class B amplifier operation, Class B amplifier circuits, Amplifier distortion, Class C and Class D Amplifier.

TEXT BOOKS

1. Millman and Halkias, "Integrated Electronics," McGraw Hill Publications, 1992.
2. Boylestad and Nashlesky, "Electronic Devices and Circuit Theory," PHI, 10th Edition.
3. Albert Malvino and David J. Bates, "Electronic Principles," Tata McGraw Hill, 7th Edition 2007.
4. Floyd, "Electronic Devices", PHI, 7th Edition.

REFERENCE BOOKS

1. Sedra, Smith, "Microelectronic Circuits', Oxford University Press", fifth edition, 2004.
2. Paul Horowitz and Winfield Hill, "The art of electronics", Cambridge university press, third edition, 2011.

COURSE OUTCOMES

At the end of this course, students will able to

1. Understand the basic concepts about semiconductor devices
2. Study various application of various diode circuits
3. Explore the construction and operation of various types of transistors
4. Acquire knowledge about the characteristics and operation of MOSFET
5. Know the various types of various power amplifier

Mapping with Programme Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**1**					**2**				**1**	**1**	**2**		
CO2	**3**	**2**	**2**				**2**				**1**	**1**	**1**		
CO3	**3**	**2**	**2**				**2**				**1**	**2**		**2**	
CO4	**3**	**3**	**2**			**3**	**2**				**1**	**2**			
CO5	**3**	**3**	**3**		**2**	**3**	**2**				**1**	**2**		**1**	

22EEMISCN	ANALOG INTEGRATED CIRCUITS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce the fabrication process of monolithic IC technology
- To explain the basics of operational amplifiers with relevance to their configuration and characteristics
- To illustrate the different applications of operational amplifiers
- To articulate the use of op-amp as multivibrators and oscillators
- To develop the role of op-amps as active filters

UNIT I: INTEGRATED CIRCUIT FABRICATION

Introduction - Classification - Fundamentals of monolithic IC technology - Basic planar processes - Fabrication of a typical circuit - Fabrication of active and passive components - Bipolar transistor fabrication - Fabrication of FET -complementary MOSFET fabrication - Thick and thin film technology.

UNIT II: BASICS OF OPERATIONAL AMPLIFIERS

Introduction - Fundamentals of differential amplifier - Current sources - Voltage source - Voltage references - Operational amplifier and terminals - Block diagram representation of operational amplifier - Open loop configuration of operational amplifier - Closed loop operation of operational amplifier - Characteristics of ideal and practical operational amplifiers.

UNIT III: APPLICATIONS OF OPERATIONAL AMPLIFIERS

Inverting amplifier - Non-inverting amplifier - phase shift circuit - Mathematical operations - Slew rate model - Precision rectifier - Voltage regulator - Instrumentation amplifier - Log amplifier - V/I AND I/V converter - Comparators - Zero crossing detectors.

UNIT IV: OP-AMP MULTIVIBRATORS AND OSCILLATORS

Operational amplifier as an a stable, Bistable, Monostable multivibrators - Triangular wave generator - Saw tooth wave generator - Schmitt trigger - Oscillators - Phase shift - Wein bridge - Hartley - Collpitts and quadrature type - A/D and d/a converters - VCO - PLL - IC 555 timer applications.

UNIT V: ACTIVE FILTERS

Introduction to active filters - RC active filters - First order - Second order low pass and high pass filters - Band pass filter - Narrow band pass filter - Wide band filter - Band reject filter - State variable filter - Switched capacitor filter - State variable switched capacitor filter IC.

TEXT BOOKS

1. Gray Paul, R. and Meyer Robert, G., "Analysis and Design of Analog Integrated Circuits", 4th Edition, John Wiley, 2001.
2. Ramakant A. Gayakwad, "Op-Amps and Linear Integrated Circuits", 4th edition, Pearson education, 2002.
3. GaneshBabu, T.R. and Suseela, "Linear Integrated Circuits", 6th edition, Scitech Publications (India) Pvt. Ltd., 2015.

REFERENCE BOOKS

1. Coughlin and Driscoll, "Operational-Amplifiers and Linear Integrated Circuits", 6th edition, Pearson education, 2001.
2. Sergio Franco, "Design with operational amplifier and analog integrated circuits", McGraw Hill, 2003.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Understand the fabrication process of monolithic IC technology
2. Study the basics of operational amplifiers
3. Analyze the different applications of operational amplifiers
4. Illustrate op-amps as multivibrators and oscillators
5. Apply op-amps as active filters

Mapping with Programme Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**2**	**2**	**3**	**3**								**3**	**2**	
CO2	**3**	**2**	**2**	**2**	**3**								**2**	**2**	
CO3	**3**	**2**	**2**	**2**	**3**								**2**	**2**	
CO4	**3**	**2**	**2**	**2**	**3**								**2**	**2**	
CO5	**3**	**3**	**3**	**2**	**3**								**3**	**2**	

22EEMISCN	ELECTRIC MACHINES AND DRIVES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To explain the operation of DC Machines and Transformers
- To learn the theory of Induction Machines
- To understand the theory of operation of Synchronous Machines
- To introduce te basics of Electrical Drives
- To articulate the theory for controlling the operation of Electric Drives

UNIT I: DC MACHINES AND TRANSFORMERS

Construction details of machine - Operation of DC generators - EMF equation - Characteristics of different types of DC generators - Commutation - Armature reaction - operation of DC motors - Torque equation - Characteristics of different types of DC motors - Speed control of DC motors - Principle - Types - general constructional features of single phase transformers - Regulation, efficiency - Autotransformer and three phase transformer - Types and applications.

UNIT II: INDUCTION MACHINES

Three phase - Types - Constructional features - Equivalent circuit - Slip - Torque characteristics - Starters - Speed control methods - Principle of operation, types and applications of single phase induction motors

UNIT III: SYNCHRONOUS MACHINES

Principle - Types and general constructional features - Synchronous generators - Characteristics - EMF equation - Regulation - Synchronous motors - V curve - Starting methods. Applications of synchronous generators and synchronous motors

UNIT IV: ELECTRIC DRIVES

Types of electric drives - Characteristics of Electric Drives - Advantages of electric drives - Speed torque characteristics of various types of loads and drive motors - Selection of power rating for drive motors based on thermal limits, overload capacity and load variation factors.

UNIT V: CONTROL OF ELECTRIC DRIVES

Open loop and closed loop speed control - DC motor transfer function - Speed and current control loops - Single, two and four quadrant operations - Reversible drives - Armature and field current reversal - Dynamic and regenerative braking.

TEXT BOOKS

1. I.J.Nagrath and D.P.Kothari, "Electric Machines, Second Edition", Tata McGraw - Hill Publishing Company Limited, 1997.
2. S K Bhattacharya, "Electrical Machines, Third Edition", Tata McGraw - Hill Publishing Company Limited, 2009.
3. Pillai, S.K., "A First course on Electric Drives", Wiley Eastern Ltd, Bombay, 1988
4. Dubey, G.K., "Fundamentals of Electrical Drives", Narosa Publishing House, New Delhi, 2004.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Understand the basics of DC Machines and Transformers
2. Analyze the operation of Induction Machines
3. Apply the theory of Synchronous Machines
4. Gather an insight on the basics of Electric Drives
5. Enable methods for the control of Drives

Mapping with Programme Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**2**	**2**	**1**	**3**	**2**	**1**	**1**				**1**	**1**	**2**	**2**	**1**
CO2	**2**	**2**	**2**	**3**	**3**	**1**	**1**				**1**	**1**	**2**	**2**	**1**
CO3	**2**	**2**	**2**	**3**	**3**	**1**	**1**				**1**	**1**	**2**	**2**	**1**
CO4	**2**	**2**	**2**	**2**	**3**	**1**	**1**				**1**	**1**	**2**	**2**	**1**
CO5	**2**	**2**	**2**	**2**	**3**	**1**	**1**				**1**	**1**	**2**	**2**	**1**

22EEMISCN	DIGITAL ELECTRONICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To review the fundamental concepts relating to Number Systems, codes, Boolean algebra and functions of the logic gates.
- To bring out the implementation of Boolean function using logic gates
- Simplification of Boolean Expression using K-map and implementation of various combinational circuits.
- To illustrate the function of various types of flip-flops and counters with the help of circuit diagram, truth table, state equation and timing diagram.
- To study the classification of semiconductor memories and programmable logic devices and understand the operation of A/D and D/A converters.

UNIT I: BOOLEAN ALGEBRA

Signed binary numbers - Binary arithmetic in computers - BCD arithmetic - Data representation - Fixed and floating point representation - Exponent representation of floating point binary numbers

UNIT II: BINARY CODES

Weighted and non-weighted binary codes - Alphanumeric codes - Error detection and correction codes - Laws of boolean algebra - Boolean expressions and logic diagrams - Negative logic - Introduction to mixed logic.

UNIT III: COMBINATIONAL LOGIC

Combinational logic - Introduction - Min Terms and Max Terms - Truth tables and maps - Solving digital problems using maps - Sum of products and product of sums map reduction Implementation of Boolean expressions using AND, OR, INVERT Logic gates and Universal gates.

UNIT IV: SEQUENTIAL LOGIC

Sequential logic - Flip-flops - Counters - Types of counters - Ripple counter design - Type T, type D and type JK design - Design using state equations - Shift registers - Asynchronous sequential circuits

UNIT V: DIGITAL INTEGRATED CIRCUITS

Multiplexer - Demultiplexer - Decoder - Code converter - Arithmetic functions - Memory circuit and systems ROM, PROM, EPROM, EEPROM, RAM, DRAM - D/A converters - A/D converters.

TEXT BOOKS

1. Donald P. Leach, Albert Paul Malvino, GoutanSaha, “Digital Principles and Applications” Seventh Edition, 2010
2. Gothman W.H. “Digital Electronics (second edition)” PHI; 1990.

REFERENCE BOOKS

1. A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016
2. M. M. Mano, "Digital logic and Computer design", Pearson Education India, 2016

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Explain number system, Boolean postulates and Realize Boolean functions with minimum number of logics.
2. Describe various logic families in digital IC.
3. Design combinational circuits and analyze faults in combinational circuits..
4. Design synchronous and asynchronous sequential circuits.
5. Discuss semiconductor memories and related technology.

Mapping with Programme Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**											**3**	**3**	**2**	
CO2	**2**	**2**										**2**	**2**		
CO3	**3**	**3**	**3**	**2**								**2**	**2**		
CO4	**3**	**2**	**3**	**2**								**2**	**3**		
CO5	**2**	**2**	**2**									**2**	**3**		

22EEMISCN	BASICS OF CONTROL SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To develop a mathematical model for physical systems - translational and rotational system block diagram reduction techniques for obtaining transfer function.
- To understand the theory relating to the working of pneumatic systems
- To study time response analysis of various standard inputs for first order and second order systems.
- To analyze stability of system by Root locus
- To study frequency response analysis and frequency domain specification by bode plot

UNIT I: INTRODUCTION

Control system - Servo mechanism - Differential equations of physical systems - Transfer function - Block diagram algebra - Signal flow graph.

UNIT II: CONTROL SYSTEM COMPONENTS

Electrical systems - Hydraulic and pneumatic systems - Potentiometers - d.c. and a.c. servo motors - Stepper motor - Synchros - Gyroscope - Tachogenerators.

UNIT III: TIME RESPONSE ANALYSIS

Time response analysis of a second order systems for unit step input - Time response specifications - Steady state error and error constants - Proportional, derivative and integral control - Performance indices.

UNIT IV: STABILITY

Concept of stability - Hurwitz criterion - Routh's criterion - Root locus - Concept - Construction of root locus - Root contour.

UNIT V: FREQUENCY RESPONSE ANALYSIS

Introduction - Bode plots - Stability in frequency domain - Assessment of relative stability using Bode plot

TEXT BOOK

1. I.J.Nagrata and M.Gopal “Control Systems Engineering” 2nd edition; New Age International (P) Ltd. Publisher; 1996.
2. A.NagoorKani,”Control Systems” 5th Ed.CBS Publishers & Distributors Pvt.Ltd,2019.

REFERENCE BOOKS

1. Katsuhiko Ogata, "Modern Control Engineering", Pearson, 2015
2. Benjamin C. Kuo, "Automatic Control Systems", Wiley, 2014

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Develop the modeling of linear-time-invariant systems using transfer function
2. Gain knowledge about control system components
3. Derive an insight into the time response characteristics of the second order system
4. Test the stability of the system by Root -loci
5. Understand the concept of frequency response analysis

Mapping with Programme Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**2**										**3**	**1**		
CO2	**3**	**2**										**3**		**3**	
CO3	**3**	**2**										**3**		**3**	
CO4	**3**	**2**	**2**		**2**							**3**		**3**	
CO5	**3**	**3**	**2**		**2**							**3**		**3**	

ONE CREDIT COURSES

22EEOCSCN	PCB DESIGNING LAB	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES

- To learn the fundamentals of PCB layers
- To teach the mapping concepts of electronic circuits
- To educate the details of PCB layout
- To instill measures for modeling and simulation
- To provide mechanisms for testing circuits

LIST OF EXPERIMENTS

1. Study on types of PCB layers, through Hole and SMD Components.
2. Schematic Creation and simulation of an electronic circuit
3. Mapping Components of an electronic circuit
4. Set Parameters for PCB Design.
5. Laying Tracks on PCB.
6. Create PCB Layout of an Electronic Circuit.
7. Create Device Model and simulation.
8. Create PCB layout of an amplifier design.
9. Create PCB layout of an Astable Multivibrator using IC's.
10. Create PCB layout of a Voltage Regulator using IC's.
11. Create PCB layout of a Galvanic isolation circuit.
12. Printing on PCB.
13. Etching and Drilling of PCB.
14. Soldering PCB.
15. Testing of an electronic Circuit-1 on PCB.
16. Testing of an electronic Circuit-2 on PCB.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Determine appropriate components to make circuits.
2. Interpret test results and measurements on electric circuits.
3. Analyze the fabrication processes of printed circuit boards.
4. Apply the software and hardware for PCB Design.
5. Evaluate an electronic printed circuit board for a specific application using industrystandard software.

Mapping with Programme Outcomes															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3		2	2							2	2		
CO2	3												2		
CO3	3	2	2	2									2	1	
CO4	3											2	2		
CO5	3	2										2	2		

22EEOCSCN	MATLAB PROGRAMMING	L	T	P	C
		0	0	2	1

LEARNING OBJECTIVES

- To learn the features of MATLAB as a programming tool.
- To promote new model for inculcating programming skills.
- To educate techniques for solving mathematical problems.
- To understand MATLAB graphic feature and its applications.
- To use MATLAB as a simulation tool.

UNIT I: INTRODUCTION TO MATLAB

- The MATLAB Environment
- MATLAB Basics - Variables, Numbers, Operators, Expressions, Input and output.
- Vectors, Arrays - Matrices

UNIT II: MATLAB FUNCTIONS

- Built-in Functions
- User defined Functions

UNIT III: GRAPHICS WITH MATLAB

- Files and File Management - Import/Export
- Basic 2D, 3D plots
- Graphic handling

UNIT IV: PROGRAMMING WITH MATLAB

- Conditional Statements, Loops
- MATLAB Programs - Programming and Debugging.
- Applications of MATLAB Programming.

UNIT V: APPLICATIONS OF MATLAB PROGRAMMING

- Case Studies with examples

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Understand the features of MATLAB
2. Articulate on the theory of teaching models
3. Gather a knowledge on programming skills
4. Infer methods for solving numerical problems
5. Explore the benefits of graphic features of MATLAB

Mapping with Programme Outcomes															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3		2	2							2	2		
CO2	3												2		
CO3	3	2	2	2									2	1	
CO4	3											2	2		
CO5	3	2										2	2		

22EEOCSCN	ELECTRONIC HARDWARE TROUBLE SHOOTING	L	T	P	C
		0	1	0	1

COURSE OBJECTIVES

- To learn the fundamentals of mother board and its auxiliaries
- To teach the fundamental concepts of memory devices
- To study the features of output devices.
- To provide a mechanism for testing of hardware devices.
- To develop measures for monitoring the performance of hardware devices.

UNIT I: INTRODUCTION

Mother boards and its types-ports, slots, connectors, add on cards, power supply units, and cabinet types.

UNIT II: STORAGE DEVICES

Primary and secondary storage medium-magnetic disc, RAM, ROM, PROM, EPROM, Floppy, CD Rom, CDRW, DVD, Virtual memory, Cache memory, Linear and Physical memory, video memory.

UNIT III: OUTPUT DEVICES

Printers, floppy drive, Microphone.

UNIT IV: TESTING

Scanner, Network, Hardware failure, Testing, CMOS, CDROM, Hard disk drive,

UNIT V: MONITORING

Mother Board, Sound Card, Video Card, Tips.

REFERENCE

1. G.Dalin. M.Sc software engineering, HSI PUBLICATIONS

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Understand the fundamental of embedded systems
2. Gather an insight on the operation of storage devices
3. Explore the use output devices
4. Arrive at indices for testing
5. Infer the performance of the hardware devices

Mapping with Programme Outcomes															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3		2	2							2	2		
CO2	3												2		
CO3	3	2	2	2									2	1	
CO4	3											2	2		
CO5	3	2										2	2		

VALUE ADDED COURSES

22EEEEVAC01	TESTING OF ELECTRICAL APPARATUS	L	T	P	C
		3	0	0	0

COURSE OBJECTIVES

- To learn about the basics relating to the installation of Electrical Apparatus.
- To understand the installation and commissioning aspects of Rotating Machines.
- To enable methods for testing of Transformers.
- To gather knowledge on the operation of Switchgear and Protection Devices
- To enable measures for the Safety Management.

UNIT I: INSTALLATION OF ELECTRICAL APPARATUS

Inspection of Electrical Equipment at site, Storage Electrical Equipment at site, Foundation of Electrical Equipment at site, Alignment of Electrical Machines, Tools / Instruments necessary for installation.

UNIT II: INSTALLATION AND COMMISSIONING OF ROTATING ELECTRICAL MACHINES

Degree of protection, cooling system, enclosures, rating of industrial rotating electric machine, installation, commissioning and protection of induction motor and rotating electric machine, dying out of electric rotating machine, insulation resistance measurement, site testing and checking, care, services and maintenance of motors.

UNIT III: TESTING OF TRANSFORMERS

Routine and special tests, Measurement of winding resistance; Measurement of voltage ratio and check of voltage vector relationship; Measurement of impedance voltage/short-circuit impedance and load loss; Measurement of no-load loss and current; Measurement of insulation resistance; Dielectric tests; Temperature-rise, Insulation and HV test, dielectric absorption, switching impulse test. Testing of current transformer and voltage transformer, power transformer, distribution transformer.

UNIT IV: SWITCH GEAR AND PROTECTIVE DEVICES

Standards, Classification, specifications, rating and duties of CB, installation, commissioning tests, Maintenance schedule and routine tests.

UNIT V: SAFETY MANAGEMENT DURING OPERATION AND MAINTENANCE

Clearance and Creepages, electric shock, need of earthing, different methods of earthing, factors affecting the Earth Resistance, methods of measuring the earth resistance, equipment earthing and system grounding.

EXPERIMENTS

1. Measure insulation resistance of a winding / cables / wiring installation.
2. Perform various tests on insulating oil.
3. To carry out routine tests on a given contactor used in the 3-phase supply.
4. To find out Phase shift in a transformer.

REFERENCES

1. Paul Gill, "Electrical power equipment maintenance and testing", CRC Press, Boca Raton 2008. (e-book: 2016)
2. Rao, "Testing, commissioning, operation and maintenance of electrical equipment", 6/E., Khanna Publishers, New Delhi, 1991.
3. Singh Tarlok, "Installation, commissioning and maintenance of Electrical equipment", S.K. Kataria and Sons, New Delhi, 1998.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Acquire knowledge on the installation of Electrical Apparatus.
2. Arrive at procedures for the installation and commissioning aspects of Rotating Machines.
3. Offer methods for testing of Transformers.
4. Able to operate the Switchgear and Protection Devices
5. Include measures for the Safety Management.

Mapping with Programme Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**		**2**					**2**				**2**	**2**	**2**	
CO2	**3**	**3**	**3**	**2**						**3**		**2**	**2**	**3**	
CO3	**3**	**3**	**3**	**2**		**2**				**3**	**2**	**2**	**2**	**3**	
CO4	**3**	**3**	**3**	**2**		**2**				**3**	**2**	**2**	**2**	**3**	
CO5	**3**	**3**	**3**	**2**	**2**	**2**				**3**	**2**	**2**	**2**	**3**	

22EEEEVAC02	ALTERNATIVE SOURCES OF ENERGY	L	T	P	C
		3	0	0	0

COURSE OBJECTIVES

- To review the conventional resources and bring out the need for alternative forms
- To study the Solar PV system as an energy source and identify its characteristics
- To learn the wind as a source of energy and understand the principle of energy conversion
- To introduce Biogas as a source and explain the theory of energy conversion
- To analyze the benefits of Geothermal and Ocean forms of energy

UNIT I: INTRODUCTION

Overview of conventional resources - Depleting nature - Environmental issues and challenges - Compliance of clean energy act - Need for alternative sources - Merits and demerits.

UNIT II: SOLAR ENERGY

Introduction - Solar radiation spectra - Estimation of solar energy availability - Solar PV Technologies - Principle of Solar Photo voltaic cell - Solar Photo Voltaic Power generation - V-I characteristics of a PV panel - Solar energy storage systems - Solar pump - Solar hydrogen energy - Solar refrigerator.

UNIT III: WIND ENERGY

History of wind power- Indian and Global statistics - Wind physics - Tip speed ratio - Basic principle of wind energy conversion - Site selection consideration - Fixed and Variable speed wind turbines - Basic theory of Induction Generators - Applications of wind energy - Environmental aspects.

UNIT IV: ENERGY FROM BIO-MASS

Bio-gas generation principle - Types of bio-gas plants - Bio-mass as a source of energy - Energy plantation - Energy from agricultural waste - Agro thermal power plant - Bagasse based co-generation programme - Integrated waste management.

UNIT V: GEO-THERMAL ENERGY

Nature of geo-thermal energy sources - Advantages and Disadvantages of Geo-thermal energy - Principle of ocean thermal energy conversion (OTEC) - Open cycle OTEC system - Basic principle and components of tidal power plant - Site requirements - Storage advantages and limitations of tidal power generation.

TEXT BOOKS

1. Non-Conventional Energy Sources, G.D. Rai, Khanna Publishers, Delhi, 2000.
2. Solar Energy Utilization, G.D. Rai, Khanna Publishers, Delhi, 2000.
3. Generation of Electrical Energy, B.R. Gupta, S. Chand and Company Ltd., New Delhi, 2001.

REFERENCES

1. Non-conventional Energy Resources, B.H. Khan, Tata McGraw Hill, Second Edition, 2010.
2. Solar Energy Utilization, G.D. Rai, Khanna Publishers, Delhi, 2000.
3. Renewable Energy Applications, G. N. Tiwari and M. K. Ghosal, Narosa Publications, 2004.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Understand the challenges in the use of conventional energy resources.
2. Learn the basics of Solar PV Systems.
3. Understand the basic concepts of wind energy conversion system.
4. Acquire knowledge to use biomass as a source of energy.
5. Explore the use of geothermal as an energy source.

Mapping with Programme Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**2**	**1**				**2**	**2**	**1**					**2**	**1**	**1**
CO2	**2**	**2**		**2**		**2**	**2**	**2**					**2**	**1**	**1**
CO3	**2**	**2**		**1**		**2**	**2**	**2**					**2**	**1**	**1**
CO4	**3**	**2**		**2**		**2**	**2**	**2**					**2**	**2**	**1**
CO5	**3**	**2**		**1**		**2**	**2**	**1**					**2**	**1**	**1**

22EEEEVAC03	ELECTRICAL SAFETY	L	T	P	C
		3	0	0	0

COURSE OBJECTIVES

- To impart knowledge about safety requirements
- To provide guidance on prevention of electrical shocks
- To study about various first aid methods
- To create awareness about various Hazardous areas
- To familiarize with safety management

UNIT I: INTRODUCTION

General Background - Objectives of safety and security measures - Hazards associated with electric current and voltage - principles of electrical safety - Approaches to Prevent Accidents - Fundamentals of fire, initiation of fire, types - Fire Prevention and Fire Fighting - Objectives and scope of IE act and IE rules-General requirements for electrical safety as per IE rules - Do's and Don'ts for safety in the use of electrical appliances.

UNIT II: ELECTRICAL SHOCKS AND THEIR PREVENTION

Primary and Secondary Electric Shocks - Occurrence of Electric Shock - Shocks Due to Flashovers/Spark-overs - Lightning Strokes on Overhead Transmission Lines and Outdoor Substations - Safety Precautions in Small LV Installations, Residential Buildings, Shops - Safety Procedures in Electrical Plant Installation and description of Earthing System - Equipment Earthing - Substation Earthing.

UNIT III: FIRST AID

Introduction - Removal of Contact with Live Conductor- First Principles of Actions after Electric Shock - Artificial Respiration - Schafer’s Prone Pressure Method - Silvester’s Method - Nielson’s Arm-lift Back - pressure Method - Mouth to Mouth Method - Use of Artificial Resuscitator - External Cardiac Massage - Cardiac Pulmonary Resuscitation - First aid treatment of Heat Exhaustion and heat stroke.

UNIT IV: ELECTRICAL SAFETY IN HAZARDOUS AREAS

Introduction - Classification of Hazardous zones - Causes of sparks and flashovers in electrical plants and machines - Functional requirements of electrical equipment and installations for hazardous area/zones - Classification of equipment/enclosure for hazardous locations.

UNIT V: FIRE EXTINGUISHER AND ELECTRICAL SAFETY MANAGEMENT

Fire Extinguisher - Extinguishing techniques - Prevention of fire - Types of fire extinguishers - Fire detection and alarm system - CO_2 and Halogen schemes - Foam schemes. Principles of safety management - Management's safety policy - Safety organization - Organization charts for construction phase of a project, maintenance mode of a plant and for safety department - Safety auditing.

TEXT BOOKS

1. S. Rao and H.L. Saluja, "Electrical Safety, Fire Safety and Safety Management", Khanna Publishers, 2012.
2. W.F.Cooper, "Electrical Safety Engineering", Butterworth and Company, London, 1998.

REFERENCES

1. J. Cadick, D. Neitzel and A. Winfield, "Electrical Safety Handbook", McGraw Hill Education, 2012.
2. J. Maxwell Adams, "Electrical Safety-A Guide to the Causes and Prevention of Electric Hazards", The Institution of Electric Engineers, 3rd Reprint, 2009.
3. Martha J. Boss and Gayle Nicoll, "Electrical Safety - Systems, Sustainability and Stewardship", CRC Press, 2015.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Get an insight on Electrical safety, IE act and IE rules
2. Acquire knowledge about prevention of electrical shocks
3. Familiarize with various first aid measures
4. Recommend electrical safety measures in hazardous areas
5. Understand the significance of safety management

Mapping with Programme Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**		**3**			**1**						**2**	**3**		
CO2	**3**		**2**			**2**			**2**			**2**	**3**		
CO3	**3**		**3**			**2**						**2**	**3**		
CO4	**3**		**3**			**2**			**2**			**2**	**3**		
CO5	**3**	**2**	**2**			**2**		**1**	**3**	**3**	**3**	**2**	**3**		**2**

22EEEEVAC04	SOLAR PV SYSTEM DESIGN	L	T	P	C
		3	0	0	0

COURSE OBJECTIVES

- To understand the basics of solar photovoltaic system.
- To learn the components of a solar PV System
- To evolve a guide for the design of a Solar PV System
- To study the methods for simulating the performance of the Solar PV System
- To explore approaches for experimental evaluation

UNIT I: BASICS OF SOLAR PHOTOVOLTAICS

Solar Technologies: Crystalline technology, thin film technology, Bi-facial technology, Comparison between PV module technologies. Solar PV Module: Rating of Solar PV Module, PV Module Parameters and Efficiency of PV Module. Solar photovoltaic system configuration: Grid Connected solar Power Plant, Grid interactive solar power plant, Off-Grid / Hybrid solar power plant, Schemes of solar power plant.

UNIT II: COMPONENTS OF A SOLAR PV SYSTEM

Solar panels: Connection of PV Module in Series and Parallel, Estimation and Measurement of PV Module Power, Selection of PV Module. Inverters: Types of solar inverter, Selection of string /central / off grid inverter, Selection of power conditioning unit (PCU), Sizing of solar inverter for roof top and grid connected projects. Batteries: Battery function, Types of Batteries, Battery parameters, Selection of Battery, Charge Controllers: Functions, PWM charge controllers, MPPT charge controllers.

UNIT III: DESIGN GUIDE FOR SOLAR PV SYSTEM

Introduction: Energy calculations of a system, Preliminary Planning, Calculating the Energy Yield for a PV Grid-Connected System, Specific Yield. Load calculations: Sizing of Module /Array, Sizing of Storage Battery, Sizing of Charge Controller, Sizing of Wire/ Cable, Sizing of Inverter, Sizing of DC- DC Converter.

UNIT IV: COMPUTER SIMULATIONS

Simulation of Solar PV system: Modeling of solar PV energy conversion system using MATLAB/Simulink, Solar PV Characteristics, Maximum power point tracking. Case Study: Design of 100kW, 500kw and 1MW solar power plant, economic calculations, performance measurements.

UNIT V: EXPERIMENTATION

Off grid solar PV system: Demonstration, irradiance and temperature measurement, plotting of characteristics Curves, performance analysis, Maximum power point tracking, Determination of characteristics Curves using solar array simulator, Cost Estimation of a Solar PV Energy Conversion System.

REFERENCES

1. Chetansingh Solanki, "Solar Photovoltaic", PHI Learning Private Ltd., New Delhi, 2018.
2. Kothari and K.C. Signal, "Renewable Energy Sources and Emerging Technologies", Second Edition, PHI, New Delhi, 2011.
3. Rai, "Non-conventional Sources of Energy", Khanna Publishers, Delhi, 2008.
4. Sukhatme and J K Nayak, Solar Energy, 4th Edition, McGraw Hill, New Delhi,2017
5. Tiwari, "Fundamentals Design, Modeling and Application", GN Solar Energy, Narosa Publishers, New Delhi, 2015.

COURSE OUTCOMES

At the end of this course work, students will be able to

1. Understand the concept of solar photovoltaic power generation.
2. Gather details of the components of the system
3. Learn the guide for designing the system
4. Evaluate the performance through simulation
5. Validate the performance using experimentation

Mapping with Programme Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**			**1**		**2**	**2**	**1**				**2**	**3**	**2**	
CO2	**3**					**2**	**2**					**2**	**2**	**2**	
CO3	**3**			**2**								**2**	**3**	**3**	
CO4	**3**			**1**		**2**	**2**					**3**	**3**	**3**	
CO5	**3**			**1**		**1**		**2**				**3**	**3**	**2**	