JIS College of Engineering

Department of Information Technology

Curriculum -Syllabus
[Regulation-R21]

(Effective from 2021-22 Admission Batch)

1st Year 1st Semester

Sl. No.	Category	Course Code	Course Title	Hours per week				Credit
				L	T	P	Total	
A. THEORY								
1	Basic Science course	CH101	Chemistry	3	0	0	3	3
2	Basic Science course	M101	Mathematics –I	4	0	0	4	4
3	Engineering Science Courses	EE101	Basic Electrical Engineering	3	0	0	3	3
4	Humanities and Social Sciences including Management courses	HSMC101	Professional Communication	2	0	0	2	2
B. PRACTICAL								
5	Basic Science course	CH191	Chemistry Lab	0	0	3	3	1.5
6	Engineering Science Courses	EE 191	Basic Electrical Engineering Lab	0	0	3	3	1.5
7	Engineering Science Courses	ME 192	Engineering Graphics & Design Lab	0	0	3	3	1.5
8	Project	PR191	Theme based Project I	0	0	1	1	0.5
9	Project	PR192	Skill Development I: Soft Skill	0	0	1	1	0.5
MANDATORY ACTIVITIES / COURSES								
10	Mandatory Course	MC181	Induction Program	0	0	0	0	2Units
	TOTAL CREDIT							**17.5**

1st Year 2nd Semester

Sl. No.	Category	Course Code	Course Title	Hours per week				Credit
				L	T	P	Total	
A. THEORY								
1	Basic Science courses	PH201	Physics-I	3	0	0	3	3
2	Basic Science courses	M201	Mathematics –II	4	0	0	4	4
3	Engineering Science Courses	CS201	Programming for Problem Solving	3	0	0	3	3
B. PRACTICAL								
4	Basic Science course	PH291	Physics-I Lab	0	0	3	3	1.5
5	Humanities and Social Sciences including Management courses	HSMC291	Professional Communication Lab	0	0	3	3	1
6	Engineering Science Courses	ME291	Workshop & Manufacturing Practices Lab	0	0	3	3	1.5
7	Engineering Science Courses	CS291	Programming for Problem Solving Lab	0	0	3	3	1.5
8	Project	PR291	Theme based Project II	0	0	1	1	0.5
9	Project	PR292	Skill Development II: Life Skill	1	0	0	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
10	Mandatory Course	MC281	NSS/ Physical Activities / Meditation & Yoga / Photography/ Nature Club	0	0	3	3	3 Units
	TOTAL CREDIT							**16.5**

2nd Year 3rd Semester

Sl. No.	Category	Course Code	Course Title	Hours per week				Credit
				L	T	P	Total	
A. THEORY								
1	Basic Science Course	PH(IT)301	Semiconductor Physics	3	0	0	3	3
2	Engineering Science Courses	IT302	Numerical Methods and Programming	3	0	0	3	3
3	Engineering Science Courses	IT303	Analog and Digital Electronics	3	0	0	3	3
4	Professional Core Course	IT304	Data Structure and Algorithm	3	0	0	3	3
5	Professional Core Course	IT305	Formal Language and Automata Theory	3	0	0	3	3
6	Humanities and Social Sciences including Management courses	HSMC302	Gender Culture and Development	2	0	0	2	2
B. PRACTICAL								
7	Basic Science course	PH(IT)391	Semiconductor Physics Lab	0	0	2	2	1.0
8	Engineering Science Courses	IT392	Numerical Methods and Programming Lab	3	0	0	3	1.5
9	Engineering Science Courses	IT393	Analog and Digital Electronics Lab	3	0	0	3	1.5
10	Professional Core Course	IT394	Data Structure and Algorithm Lab	3	0	0	3	1.5
11	Project	PR391	Theme based Project III	0	0	1	1	0.5
12	Project	PR392	Skill Development III: Technical Seminar Presentation	1	0	0	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
13	Mandatory Course	MC381	Learning an Art Form [vocal or instrumental, dance, painting, clay modelling, etc.] or Environmental Protection Initiatives	0	0	0	3	3Units
TOTAL CREDIT WITHOUT MOOCS COURSES								23.5
D.MOOCS COURSES**								
14	MOOCS COURSES	HM301	MOOCS COURSE-I	0	3	1	4	4
TOTAL CREDIT WITH MOOCS COURSES								**27.5**

** MOOCS COURSES for HONOURS/MINOR Degree are Program specific and to be taken from MOOCS BASKET

2nd Year 4thSemester

Sl. No.	Category	Course Code	Course Title	Hours per week				Credit
				L	T	P	Total	
A. THEORY								
1	Basic Science Course	M(IT)401	Mathematics III	3	0	0	3	3
2	Professional Core Course	IT402	Computer Organization and Architecture	3	0	0	3	3
3	Professional Core Course	IT403	Operating System	3	0	0	3	3
4	Professional Core Course	IT404	Software Engineering	3	0	0	3	3
5	Professional Core Course	IT405	Object Oriented Programming Using Java	3	0	0	3	3
6	Humanities and Social Sciences including Management courses	HSMC403	Universal Human Values	3	0	0	3	3
B. PRACTICAL								
7	Engineering Science Course	IT491	Python Programming Lab	0	0	3	3	1.5
8	Professional Core Course	IT492	Computer Organization and Architecture Lab	0	0	3	3	1.5
9	Professional Core Course	IT493	Operating System Lab	0	0	3	3	1.5
10	Professional Core Course	IT494	Software Engineering Lab	0	0	3	3	1.5
11	Professional Core Course	IT495	Object Oriented Programming Lab	0	0	3	3	1.5
12	Project	PR 491	Theme based Project IV	0	0	1	1	0.5
13	Project	PR492	Skill Development IV: Soft Skill & Aptitude-I	1	0	0	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
14	Mandatory Course	MC401	Environmental Science	0	0	3	3	3 Units
TOTAL CREDIT WITHOUT MOOCS COURSES								26.5
D.MOOCS COURSES								
15	MOOCS COURSES	HM401	MOOCS COURSE-II	3	1	0	4	4
TOTAL CREDIT WITH MOOCS COURSES								**30.5**

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3rd Year 5th Semester

Sl. No	Category	Course Code	Course Title	Hours per week				Credit
				L	T	P	Total	
A. THEORY								
1	Professional Core Course	IT501	Database Management System	3	0	0	3	3
2	Professional Core Course	IT502	Computer Networking	3	0	0	3	3
3	Professional Core Course	IT503	Design and Analysis of Algorithm	3	0	0	3	3
4	Humanities and Social Sciences including Management courses	HSMC504	Economics for Engineers	2	0	0	2	2
5	Professional Elective Courses	IT505A	Microprocessor and Microcontroller	3	0	0	3	3
		IT505B	Artificial Intelligence					
		IT505C	Programming Practice Using C++					
		IT505D	E-Commerce and ERP					
B. PRACTICAL								
6	Professional Core Course	IT591	Database Management System Lab	0	0	3	3	1.5
7	Professional Core Course	IT592	Computer Networking Lab	0	0	3	3	1.5
8	Professional Core Course	IT593	Design and Analysis of Algorithm Lab	0	0	3	3	1.5
9	Professional Elective Courses	IT595A	Microprocessor and Microcontroller Lab	0	0	3	3	1.5
		IT595B	Artificial Intelligence Lab					
		IT595C	Programming Practice Using C++ Lab					
		IT595D	E-Commerce Lab					
10	Project	PR591	Minor Project I	0	0	3	3	1
11	Project	PR592	Skill Development V: Soft Skill & Aptitude-II	1	0	0	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
12	Mandatory Course	MC501	Intellectual Property Right	0	0	3	3	3 Units
TOTAL CREDIT WITHOUT MOOCS COURSES								21.5
D. MOOCS COURSES**								
13	MOOCS COURSES	HM501	MOOCS COURSE-III	3	1	0	4	4
TOTAL CREDIT WITH MOOCS COURSES								**25.5**

** MOOCS COURSES for HONOURS/MINOR Degree are Program specific and to be taken from MOOCS BASKET

3rd Year 6th Semester

Sl. No	Category	Course Code	Course Title	Hours per week				Credits
				L	T	P	Total	
A. THEORY								
1	Professional Core Course	IT601	Web Technology	3	0	0	3	3
2	Professional Core Course	IT602	Machine Learning	3	0	0	3	3
3	Professional Elective Course	IT603A	Computer Graphics	3	0	0	3	3
		IT603B	Multimedia Technology					
		IT603C	Soft Computing					
		IT603D	Digital Image Processing					
4	Professional Elective Course	IT604A	Data Warehouse and Data Mining	3	0	0	3	3
		IT604B	Cryptography and Network Security					
		IT604C	Compiler Design					
		IT604D	Pattern Recognition					
5	Humanities and Social Sciences including Management Course	HU605	Principles of Management	2	0	0	2	2
6	Open Elective Course	IT606A	Computational Geometry	3	0	0	3	3
		IT606B	Mobile Communication					
		IT606C	Robotics					
		IT606D	Wireless Sensor Network					
B. PRACTICAL								
7	Professional Core Course	IT691	Web Technology Lab	0	0	3	3	1.5
9	Professional Core Course	IT692	Machine Learning Lab	0	0	3	3	1.5
10	Professional Elective Course	IT693A	Computer Graphics	0	0	3	3	1.5
		IT693B	Multimedia Technology					
		IT693C	Soft Computing					
		IT693D	Digital Image Processing					
11	Project	PR691	Minor Project II	0	0	3	2	1
12	Project	PR692	Skill Development V: Soft Skill & Aptitude-III	1	0	0	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
13	Mandatory Course	MC601	Constitution of India	3	0	0	3	3Units
TOTAL CREDIT WITHOUT MOOCS COURSES								23.0
D.MOOCS COURSES**								
14	MOOCS COURSES	HM601	MOOCS COURSE-IV	3	1	0	4	4
TOTAL CREDIT WITH MOOCS COURSES								**27.0**

** MOOCS COURSES for HONOURS/MINOR Degree are Program specific and to be taken from MOOCS BASKET.

4th Year 7thSemester

Sl. No	Category	Course Code	Course Title	Contact Hours /Week				Credit Point
				L	T	P	Total	
A. THEORY								
1	Professional Elective Course	IT701A	Cloud Computing	3	0	0	3	3
		IT701B	Internet Technology					
		IT701C	Big Data Analytics					
		IT701D	Distributed System					
2	Professional Elective Course	IT702A	Internet of Things	3	0	0	3	3
		IT702B	Advanced Database Management System					
		IT702C	Block Chain Technology					
		IT702D	Deep Learning					
3	Open Elective Course	IT703A	Mobile Application Development	3	0	0	3	3
		IT703B	Fuzzy Logic and Application					
		IT703C	Microelectronics and VLSI Design					
		IT703D	Operational Research and Optimization Technique					
4	Open Elective Course	IT704A	Advanced Computer Architecture	3	0	0	3	3
		IT704B	Modelling and Simulation					
		IT704C	Virtual and Augmented Reality					
		IT704D	Entrepreneurship Development					
B. PRACTICAL								
5	Professional Elective Course	IT791A	Cloud Computing Lab	0	0	0	3	1.5
		IT791B	Internet Technology Lab					
		IT791C	Big Data Analytics Lab					
		IT791D	Distributed System Lab					
6	Open Elective Course	IT793A	Mobile Application Development Lab	0	0	3	3	1.5
		IT793B	Fuzzy Logic Lab					
		IT793C	VLSI Design Lab					
		IT793D	Operational Research Lab					
7	Project	PR791	Major Project-I	0	0	0	4	2
8	Project	PR792	Industrial Training / Internship	0	0	0	0	1
9	Project	PR793	Skill Development VII: Seminar & Group Discussion	1	0	0	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
10	Mandatory Course	MC781	Entrepreneurship & Innovation Skill	0	0	3	3	3 Units
TOTAL CREDIT WITHOUT MOOCS COURSES								18.5
D.MOOCS COURSES**								
11	MOOCS COURSES	HM701	MOOCS COURSE-V	3	1	0	4	4
TOTAL CREDIT WITH MOOCS COURSES								**22.5**

*Collective Data from 3rd to 6th Semester (Summer/Winter Training during Semester Break & Internship should be done after 5th Semester or 6th Semester). All related certificates to be collected by the training/internship coordinator(s). ** MOOCS COURSES for HONOURS/MINOR Degree are Program specific and to be taken from MOOCS BASKET

4th Year 8th Semester

Sl. No	Category	Course Code	Course Title	Contact Hours /Week				Credit Point
				L	T	P	Total	
A. THEORY								
1	Professional Elective Course	IT801A	Data Sciences	3	0	0	3	3
		IT801B	Business Analytics					
		IT801C	Cluster and Grid Computing					
		IT801D	Information Theory and Coding					
2	Open Elective Course	IT802A	Enterprise Resource Planning	3	0	0	3	3
		IT802B	Natural Language Processing					
		IT802C	Bioinformatics					
		IT802D	Embedded System					
3	Open Elective Course	IT803A	Cyber Law and Security Policy	3	0	0	3	3
		IT803B	Human Computer Interaction					
		IT803C	Human Resource Management					
		IT803D	Control System					
B. PRACTICAL								
4	Project	PR891	Major Project-II	0	0	0	12	6
5	Project	PR892	Grand Viva	0	0	0	0	1
C. MANDATORY ACTIVITIES / COURSES								
6	Mandatory Course	MC 881	Essence of Indian Knowledge Tradition	0	0	3	3	3 Units
TOTAL CREDIT								**16**

Credit Point		
Semester	**Without MOOCS**	**With MOOCS**
1st	17.5	17.5
2nd	16.5	16.5
3rd	23.5	27.5
4th	26.5	30.5
5th	21.5	25.5
6th	23.0	27.0
7th	18.5	22.5
8th	16.0	16
Total	**163**	**183 (for Honors/Minor)**

Credit Distribution

Subject Category	**Subjects**	**Credit Distribution as per AICTE (%)**	**Suggested Breakup of Credits (Total 160) as per AICTE Model Curriculum**	**R21 Curriculum [Credit Point (%)]**
Humanities and Social Sciences including Management Courses (HSMC)	Humanities & Social Science: • English • Language / English Lab Management courses • Principle of Management, • Economics for Engineers • Principles of Management • Values & Ethics in Profession	5 to 10%	12	9+3 (5.63%)
Basic Science Course (BS)	Physics • Introduction to Electromagnetic Theory • Introduction to Mechanics • Quantum Mechanics for Engineers • Oscillation, Waves and Optics • Semiconductor Optoelectronics • Semiconductor Physics	15 to 20%	25	24 (15.00%)
	Chemistry & Biology • Chemistry – I (Concepts in chemistry for engineering) • Chemistry Laboratory • Chemistry-II (Chemical Applications) • Polymer Chemistry • Experiments in			

	Polymer Chemistry • Biology Mathematics • Mathematics (Option 1) • Mathematics 1 • Mathematics 2 • Mathematics 3 • Mathematics (Option 2)			
Engineering Sciences and Skills (ES)	Workshop / Manufacturing Practice • Drawing / Engineering Graphics & Design, • Basics of Electrical • Computer / Programming for Problem Solving • Numerical Methods • Circuit theory	15 to 20%	24	22.5 (14.06%)
Professional Core Course (PC)	Courses relevant to chosen branch	30 to 40%	48	48.0 (30.37%)
Professional Elective Course (PE)	Elective courses relevant to chosen specialization/branch	10 to 15%	18	22.5 (13.80%)
Open Elective Course (OE)	Elective Courses from other technical programs and /or emerging subjects:	5 to 10%	18	16.5 (10.31%)
Project work, seminar and internship in industry or elsewhere	(i)Project (PR….91): Project work (ii)Project (PR….92): (iii) Project (PR …93): (iv)Grand Viva - 1	10 to 15%	15	17.5 (10.94%)
Mandatory Course [Environmental Sciences, Induction training, Indian Constitution, Essence of Indian Knowledge Tradition]	MC Courses: • Environmental Science, • Foreign language, • Constitution of India • Behavioral & Interpersonal skills • Essence of Indian Knowledge Tradition & others as mentioned in AICTE guidelines •	No Credit Course	Minimum 2 units per semester min. Max: 28 Units/Program	26 Units

	MC Activities: • (Induction Programming • NSS/NCC/Yoga • Technical Lecture Presentation & others as mentioned in AICTE guidelines			

Sub Category	**Credit Point**	**%**	**AICTE Ref Curriculum %**
Humanities and Social Sciences including Management courses (HSMC)	9	5.63	5 to 10
Basic Science Course (BS)	24	15.00	15 to 20
Engineering Science Course (ES)	22.5	14.06	15 to 20
Professional Core Course (PC)	48	30.00	30 to 40
Professional Elective Course (PE)	22.5	14.06	10 to15
Open Elective Course (OE)	16.5	10.31	5 to 10
Project	17.5	10.94	10 to 15
	160	100.00	

MOOCs (It is expected Options in a vertical column would lead to expertise in a specific/allied domain)						
	Sem	Credit	Option 1	Option 2	Option 3	Option 4
MOOCS COURSE-I	III	4	Related to Minor/Honors	Related to Minor/Honors	Related to Minor/Honors	Related to Minor/Honors
MOOCS COURSE-II	IV	4	Related to Minor/Honors	Related to Minor/Honors	Related to Minor/Honors	Related to Minor/Honors
MOOCS COURSE-III	V	4	Related to Minor/Honors	Related to Minor/Honors	Related to Minor/Honors	Related to Minor/Honors
MOOCS COURSE-IV	VI	4	Related to Minor/Honors	Related to Minor/Honors	Related to Minor/Honors	Related to Minor/Honors
MOOCS COURSE-V	VII	4	Related to Minor/Honors	Related to Minor/Honors	Related to Minor/Honors	Related to Minor/Honors

**Please define Honors/Minor programme credit point of 20 to be earned by the student. Related BoS would endorse the selection of these courses followed by the necessary intimation at the Academic Council of the Institute.

1st Semester

1st Year 1st Semester

Sl. No.	Category	Course Code	Course Title	Hours per week				Credit
				L	T	P	Total	
C. THEORY								
1	Basic Science course	CH101	Chemistry	3	0	0	3	3
2	Basic Science course	M101	Mathematics –I	4	0	0	4	4
3	Engineering Science Courses	EE101	Basic Electrical Engineering	3	0	0	3	3
4	Humanities and Social Sciences including Management courses	HSMC101	Professional Communication	2	0	0	2	2
D. PRACTICAL								
5	Basic Science course	CH191	Chemistry Lab	0	0	3	3	1.5
6	Engineering Science Courses	EE 191	Basic Electrical Engineering Lab	0	0	3	3	1.5
7	Engineering Science Courses	ME 192	Engineering Graphics & Design Lab	0	0	3	3	1.5
8	Project	PR191	Theme based Project I	0	0	1	1	0.5
9	Project	PR192	Skill Development I: Soft Skill	0	0	1	1	0.5
MANDATORY ACTIVITIES / COURSES								
10	Mandatory Course	MC181	Induction Program	0	0	0	0	2Units
	TOTAL CREDIT							**17.5**

PAPER NAME: CHEMISTRY
PAPER CODE: CH 101
CONTACT: 3:0:0
TOTAL CONTACT HOURS: 36
CREDIT: 3

Prerequisites: A basic knowledge in 10+2 science with chemistry

Course Objective:

The concepts developed in this course will aid in quantification of several concepts in chemistry that have been introduced at the 10+2 levels in schools. Technology is being increasingly based on the electronic, atomic and molecular level modifications.

Course Outcome:

After completion of this course students will be able to

CO1	Able to describe the fundamental properties of atoms & molecules, atomic structure and the periodicity of elements in the periodic table
CO2	Able to apply fundamental concepts of thermodynamics in different engineering applications.
CO3	Able to apply the knowledge of water quality parameters, corrosion control & polymers to different industries.
CO4	Able to determine the structure of organic molecules using different spectroscopic techniques.
CO5	Capable to evaluate theoretical and practical aspects relating to the transfer of the production of chemical products from laboratories to the industrial scale, in accordance with environmental considerations.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	2	2	--	--	--	--	1	2	2	2
CO2	3	3	3	3	--	--	--	--	1	1	2	3
CO3	3	3	2	1	--	2	2	--	1	-	3	3
CO4	3	2	3	2	--	-	2	--	1	2	3	3
CO5	3	3	3	3	2	2	2	--	1	-	2	3

Course Content
Module- I: Inorganic Chemistry [**9L**]

(i) Atomic structure

Bohr's theory to hydrogen-like atoms and ions; spectrum of hydrogen atom. Quantum numbers, Introduction to the concept of atomic orbitals, diagrams of s, p and d orbitals, Pauli's exclusion principle, Hund's rule, exchange energy, Aufbau principle and its limitation, introduction to Schrodinger equation.

(ii) Periodic properties

Modern Periodic table, group trends and periodic trends in physical properties: electron affinity, electronegativity, polarizability, oxidation states, effective nuclear charges, penetration of orbitals, variations of s, p and d orbital energies of atoms.

Module II: Physical Chemistry [8L]

(i) Use of free energy in chemical equilibria

Thermodynamic functions: internal energy, enthalpy, entropy and free energy. 2nd Law of Thermodynamics, Estimations of entropy and free energies, Free energy and emf, Cell potentials, the Nernst equation and applications.

(ii) Real Gases

Reason for deviation of real gases from ideal behavior, Equations of state of real gases, Vander Waals' equation, pressure & volume correction, validity, critical state of gas.

Module III: Organic Chemistry [8L]

(i) Stereochemistry

Representations of 3 dimensional structures, Chirality, optical activity, isomerism, structural isomerism, stereoisomers, enantiomers, diastereomers, configurations (D,L & cis trans), racemization.

(ii) Organic reactions

Concepts of inductive effect, resonance, hyperconjugation, introduction to reactions involving substitution, addition, elimination, oxidation (Baeyer villiger oxidation), reduction (Clemmensen reduction, Wolff-Kishner reduction).

Module IV: Industrial Chemistry [8L]

(i) Water

Hardness, alkalinity, numerical

(ii) Corrosion.

Types of corrosion: wet & dry, preventive measures

(iii) Polymers

Classification of polymers, conducting polymers, biodegradable polymers

(iv) Synthesis of a commonly used drug molecule.

Paracetamol, Aspirin

Module V: Spectroscopic techniques in Chemistry [3L]

Electromagnetic radiation, Principles of spectroscopy, spectrophotometer, infrared spectroscopy, fingerprint region, functional group region, UV-VIS spectroscopy, ^{1}H Nuclear magnetic resonance spectroscopy, chemical shift.

Textbooks

1. A Text Book of Organic Chemistry, Arun Bahl & Arun Bahl
2. General & Inorganic Chemistry, P.K. Dutt
3. General & Inorganic Chemistry, Vol I, R.P. Sarkar
4. Physical Chemistry, P.C. Rakshit

Reference Books

1. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane
2. Fundamentals of Molecular Spectroscopy, by C. N.Banwell

3. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan
4. Physical Chemistry, by P. W. Atkins
5. Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Edition

Project Domain

1. Application of Thermodynamics
2. Application of polymers in daily life
3. Nanomaterials and its applications
4. Determination of water quality parameters
5. Electronic storage devices
6. Managing E –wastes
7. Application of chemistry in core engineering
8. Application of spectroscopy in medical field
9. Applications of green chemistry
10. Merits of commercial organic products
11. Bioplastics
12. Any other related topics

PAPER NAME: MATHEMATICS-I
PAPER CODE : M 101
CONTACT: 3:1:0
TOTAL CONTACT HOURS: 48
CREDIT: 4

Prerequisite: The students to whom this course will be offered must have the concept of (10+2) standard matrix algebra, calculus, and vector algebra.

Course Objective:

The objective of this course is to disseminate the prospective engineers with techniques in matrix algebra and calculus. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

Course Outcome:

On successful completion of the learning sessions of the course, the learner will be able to

CO1	Recall the distinctive characteristics of Matrix Algebra, Calculus of Single and Several Variables and Vector Analysis.
CO2	Understand the theoretical concept of Matrix Algebra, Calculus of Single and Several Variables and Vector Analysis.
CO3	Apply the principles of Matrix Algebra, Calculus of Single and Several Variables and Vector Analysis to solve various problems.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	--	--	--	--	--	--	--	--	--	1
CO2	3	2	--	--	--	--	--	--	--	--	--	1
CO3	3	2	2	--	--	--	--	--	--	--	--	1

Course Content:

Module I: Matrix Algebra [11L]

Echelon form and Normal (Canonical) form of a matrix; Inverse and rank of a matrix; Consistency and inconsistency of system of linear equations, Solution of system of linear equations; Eigenvalues and eigenvectors; Diagonalization of matrices; Cayley-Hamilton theorem.

Module II: Differential Calculus and Infinite Series [10L]

Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; Concept of sequence and series, Tests for convergence of infinite series: Comparison test, D'Alembert's ratio test, Raabe's test, Cauchy's root test, Leibnitz's Test, Power series; Taylor's series, Series for exponential, trigonometric and logarithm functions.

Module III: Multivariable Calculus (Differentiation) [13L]

Function of several variables, Concept of limit, continuity and differentiability; Partial derivatives, Total derivative and its application; Chain rules, Derivatives of implicit functions Euler's theorem on homogeneous function, Jacobian. Maxima and minima of functions of two variables, Method of Lagrange multipliers.

Module IV: Multivariable Calculus (Integration) [6L]

Line Integral, Double Integral, Triple Integral, Change of order in multiple integrals, Change of variables in multiple integrals.

Module V: Vector Calculus [8L]

Gradient, Directional derivatives, Divergence, Curl, vector line integrals, vector surface integrals, vector volume integrals, Green's theorem, Gauss divergence theorem and Stokes' theorem.

Project Domain:

1. Study on eigenvalues and eigenvectors.
2. Study on convergence of infinite series.
3. Application of partial derivatives.
4. Application of vector calculus
5. Application of integral calculus.

Text Books:

1. Kreyszig, E., Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. Ramana, B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
3. Veerarajan, T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
4. Grewal, B.S., Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
5. Bali, N.P. and Goyal, M., A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
6. Samanta Guruprasad, A text book of Engineering Mathematics-I, New age International Publishers

Reference Books:

1. Thomas, G.B. and Finney, R.L., Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
2. Apostol, M., Calculus, Volumes 1 and 2 (2nd Edition), Wiley Eastern, 1980.
3. Kumaresan, S., Linear Algebra - A Geometric approach, Prentice Hall of India, 2000.
4. Poole, D., Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
5. Bronson, R., Schaum's Outline of Matrix Operations. 1988.
6. Piskunov, N., Differential and Integral Calculus, Vol. I & Vol. II, Mir Publishers, 1969

PAPER NAME: BASIC ELECTRICAL ENGINEERING
PAPER CODE: EE101
CONTACT: 3:0:0
TOTAL CONTACT HOURS: 36
CREDIT: 3

Pre-requisite: Basic 12th standard Physics and Mathematics, Concept of components of electric circuit.

Course Objective:

To introduce the students to basic principles of DC and AC circuits, Electrical Machines and Electrical Systems.

Course Outcome:

After attending the course students' would be able to

CO1	To understand Basic Electrical circuits, Power distribution and Safety measures.
CO2	Apply basic engineering knowledge to understand basics terms used in electrical ac circuits, study RLC circuits with phasor diagrams, determine impedance and admittance, power factor and power and describe and illustrate RLC resonance phenomena.
CO3	Apply basic engineering knowledge to understand basics of three phase system and determine the power by two-watt meters method
CO4	Apply basic engineering knowledge to study construction, classification, working principles, performance characteristics of dc machines, transformer and three phase induction motor.
CO5	Apply basic engineering knowledge to understand basics of power system, earthing of electrical equipment and electrical wiring.

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	--	3	--	--	2	--	--	--	--	--	--
CO2	2	2		--	--	--	--	--	--	--	--	2
CO3	2	3	2	--	--	--	--	--	--	--	--	3
CO4	3	3		--	--	--	--	--	--	--	--	--
CO5	2	2	1	--	--	--	--	--	--	--	--	3

Course Content

Module- I: DC Circuits [8L]

Definition of electric circuit, linear circuit, non-linear circuit, bilateral circuit, unilateral circuit, Dependent source, node, branch, active and passive elements, Kirchhoff's laws, Source equivalence and conversion, Network Theorems - Superposition Theorem, Thevenin's Theorem, Norton Theorem, Maximum Power Transfer Theorem, Star-Delta Conversions.

Module- II: AC Fundamentals [8L]

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L,

C, RL, RC, RLC combinations (series and parallel), resonance. Three phase balanced circuits, voltage and current relations in star and delta connections.

Module- III: Electrical Machines [10L]

Transformer: Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

Rotating Machines - DC Machines: Brief idea on constructional features, classifications, working principle of both motor and generator. Simple problems on Voltage equation. Three-Phase Induction Motor: Basic concept of three phase circuit and production of rotating magnetic field. Working principle of three-phase induction motor and torque-speed characteristics (concept only).

Module- IV: Electrical Installations [3L]

Earthing of Electrical Equipment, ideas of basic components- MCB, MCCB, ELCB, SFU, Megger. Types of Wires and Cables, Earthing.

Module- V: Fundamentals of Power Systems [5L]

Generation of power: Block schematic representation of Thermal and nuclear power plants. Renewable energy sources: solar, wind, tidal and geothermal (Block diagram and working only- No Problems). Power transmission: Typical electrical power transmission scheme-need for high voltage transmission- (Derivation is not needed, No Problems). Power Distribution: substation equipment, primary and secondary transmission and distribution systems- feeder, service mains.

Module- VI: Introduction to Control Systems [2L]

Concept control systems, Objectives of control system, Types of control systems, Real examples of control systems.

Text books:

A. P. Kothari & I. J. Nagrath, Basic Electrical Engineering, TMH.
1. V. Mittle& Arvind Mittal, Basic Electrical Engineering, TMH.
2. Ashfaq Hussain, Basic Electrical Engineering, S. Chand Publication.
3. Chakrabarti, Nath& Chanda, Basic Electrical Engineering, TMH.
4. C.L. Wadhwa, Basic Electrical Engineering, Pearson Education.

Reference books:

1. E. Hughes, ―Electrical and Electronics Technology‖, Pearson, 2010.
2. V. D. Toro, ―Electrical Engineering Fundamentals‖, Prentice Hall India, 1989.

PAPER NAME: PROFESSIONAL COMMUNICATION
PAPER CODE: HSMC 101
CONTACT: 2:0:0
TOTAL CONTACT HOURS: 24
CREDIT: 2

Pre-requisites: Basic (10+2) level of knowledge of English grammar, vocabulary reading and writing skills.

Course Objective:

The basic objectives of this course are to impart professional communication skills in the globalized workplace context, to enable functional competence in reading and writing so as to create industry-ready personnel.

Course Outcome:

After attending the course students' should be able to

CO1	Comprehend and communicate in English through exposure to communication skills theory and practice.
CO2	Apply the basic grammatical skills of the English language through intensive practice.
CO3	Apply/illustrate all sets of English language and communication skills in creative and effective ways in the professional sphere of their life.
CO4	Develop writing proficiency skills by writing official letters, technical report, memo, notice, minutes, agenda, resume, curriculum vitae.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	--	--	--	--	--	--	--	--	--	3	--	3
CO2	--	--	--	--	--	--	--	--	--	3	--	3
CO3	--	--	--	--	--	1	--	--	3	3	--	3
CO4	--	--	--	--	--	2	--	--	--	3	--	3

Course Content:

Module- 1: Verbal and Non-verbal communication [4L]

1.1: Definition, Relevance and Effective Usage

1.2: Components of Verbal Communication: Written and Oral Communication

1.3: Components of Non-verbal Communication: Kinesics, Proxemics, Chronemics, Haptics Paralanguage

1.4: Barriers to Effective Communication

Module- 2: Social Communication Essentials and Cross-Cultural Communication [6L]

2.1: Communication in Society and the Workplace

2.2: Greetings, Courtesies and Socially Useful Language

2.3: Cultural Contexts: High Context and Low Context Cultures

2.4: Understanding Cultural Nuances and Stereotyping
2.5: Achieving Culturally Neutral Communication in Speech and Writing

Module- 3: Meetings [4L]
3.1: Meetings: Nature and Types
3.2: Conducting Meetings: Organization and Procedures
3.3: Meeting Coordination: Roles of Chairpersons and Members
3.4: Notice and Agenda for a Meeting
3.5: Preparing the Minutes of a Meeting (MOM)

Module- 4: Report Writing [4L]
4.1: Nature and Function of Reports
4.2: Types of Reports
4.3: Researching for a Business Report
4.4: Format, Language and Style
4.5: Report Documentation

Module 5: Employment Communication [6L]
5.1: Writing Business Letters- (Enquiry, Order, Sales, Complaint, Adjustment, Job Application, Offer)
5.2: Preparing a CV or Resume
5.3: Creating a Digital/Online Profile – LinkedIn (Résumé/Video Profile)
5.4: Writing E-mails: types, convention, and etiquette
5.5: Memo, Notices and Circulars
5.6: Writing Technicalities—Paragraphing, Sentence Structure and Punctuation

Text Books &Reference Books:

1. Meenakshi Raman and Sangeetha Sharma. Technical Communication. 3rd edition. New Delhi: Oxford University Press, 2015.
2. Mark Ibbotson. Cambridge English for Engineering. Cambridge: Cambridge University Press, 2008.
3. Mark Ibbotson. Professional English in Use: Engineering. Cambridge: Cambridge UP, 2009.
4. Lesikar et al. Business Communication: Connecting in a Digital World. New Delhi: Tata McGraw-Hill, 2014.
5. John Seeley. Writing Reports. Oxford: Oxford University Press, 2002.
6. Judith Leigh. CVs and Job Applications. Oxford: Oxford University Press, 2002.
7. Judith Leigh. Organizing and Participating in Meetings. Oxford: Oxford University Press, 2002.
8. Michael Swan. Practical English Usage. Oxford: OUP, 1980.
9. Pickett, Laster and Staples. Technical English: Writing, Reading & Speaking. 8th ed. London: Longman, 2001.
10. Diana Booher. E-writing: 21st Century Tools for Effective Communication.

Links:
1. Purdue University's Online Writing Lab (OWL)-https://owl.purdue.edu/
2. Business English Pod-https://www.businessenglishpod.com/

PAPER NAME: CHEMISTRY LAB
PAPER CODE: CH191
CONTACT: 0:0:3
CREDIT: 1.5

Pre-requisite: A basic knowledge in 10+2 science with chemistry.

Course Objective:

Study the basic principles of pH meter and conductivity meter for different applications; analysis of water for its various parameters & its significance in industries; learn to synthesis Polymeric materials and drugs; study the various reactions in homogeneous and heterogeneous medium.

Course Outcome:

After attending this course, students would be able to

CO1	Operate different types of instruments for estimation of small quantities chemicals used in industries and scientific and technical fields.
CO2	Analyse and determine the composition of liquid and solid samples working as an individual and also as an team member
CO3	Analyse different parameters of water considering environmental issues
CO4	Synthesize drug and polymer materials.

CO-PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	3	1	2	3	--	--	--	--	--	1
CO2	2	2	1	1	1		--	--	--	--	--	1
CO3	--	--	--	--	--	--	--	--	3	3	2	2
CO4	2	1	2	2	--	2	--	--	--	--	--	2

Course Content:

Choice of 10-12 experiments from the following:

1. Determination of surface tension and viscosity
2. Thin layer chromatography
3. Determination 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 conductometric tritration
7. pH metric titrations
8. Synthesis of a polymer/drug
9. Saponification/acid value of an oil
10. Chemical analysis of a salt Chemical oscillations- Iodine clock reaction
11. Determination of the partition coefficient of a substance between two immiscible liquids
12. Adsorption of acetic acid by charcoal
13. Estimation of iron in Mohr's salt solution by permanganate (Redox Titration)
14. Innovative experiments.

Textbooks

1. A Text Book of Organic Chemistry, Arun Bahl & Arun Bahl
2. General & Inorganic Chemistry, P.K. Dutt
3. General & Inorganic Chemistry, Vol I, R.P. Sarkar
4. Physical Chemistry, P.C. Rakshit

Reference Books

1. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane
2. Fundamentals of Molecular Spectroscopy, by C. N.Banwell
3. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan
4. Physical Chemistry, by P. W. Atkins
5. Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Edition

PAPER NAME: BASIC ELECTRICAL ENGINEERING LAB
PAPER CODE: EE191
CONTACT: 0:0:3
CREDIT: 1.5

Prerequisite: Basic Physics and applied physics, Basic Mathematics, Basic concept of Electric Circuit.

Course Objective:
To impart and apply knowledge about the Basic Electrical Components, Machineries, Instruments and Safety measures.

Course Outcome:

After completion of this course students will be able to

CO1	Identify and use common electrical components.
CO2	Develop electrical networks by physical connection of various components and analyze the circuit behavior.
CO3	Apply and analyse the basic characteristics of transformers and electrical machines.

CO-PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	--	2	--	--	--	--	--	2	--	--	1
CO2	3	2	--	--	--	--	--	--	2	--	--	2
CO3	2	--	3	--	--	--	--	--	2	--	--	2

List of Experiments

1. Basic safety precautions – earthing, introduction to measuring instruments – Voltmeter, Ammeter, Multimeter, Wattmeter, Real life Resistor, Capacitor, Inductor.
2. Verification of Thevenin's and Norton's Theorem.
3. Verification of Superposition and Maximum Power Transfer Theorem.
4. Characteristics of Fluorescent, Tungsten and Carbon filament lamps.
5. Study of R-L-C series circuit.
6. Three-phase Power measurement with two wattmeter methods.
7. Demonstration of cut-out sections of machines: DC Machine (commutator-brush arrangement), Induction Machine (squirrel cage rotor).
8. Measurement of primary and secondary voltage and current of single-phase transformer – Open Circuit and Short Circuit Test.
9. Starting, Reversing and speed control of DC shunt motor.
10. Torque-Speed characteristics of DC Machine.
11. Torque-Speed characteristics of Three-phase Induction Motor.
12. Test on single-phase Energy Meter.
13. Innovative experiments

Text books:

1. P. Kothari & I. J. Nagrath, Basic Electrical Engineering, TMH.
2. V. Mittle& Arvind Mittal, Basic Electrical Engineering, TMH.
3. Ashfaq Hussain, Basic Electrical Engineering, S. Chand Publication.
4. Chakrabarti, Nath& Chanda, Basic Electrical Engineering, TMH.
5. C.L. Wadhwa, Basic Electrical Engineering, Pearson Education.

Reference books:

1. Hughes, ―Electrical and Electronics Technology‖, Pearson, 2010.
2. V. D. Toro, ―Electrical Engineering Fundamentals‖, Prentice Hall India, 1989.

PAPER NAME: ENGINEERING GRAPHICS & DESIGN LAB
PAPER CODE: ME192
PAPER: 0:0:3
CREDIT: 1.5

Prerequisites: Basic knowledge of geometry

Course Objective:

To learn detailed drawing and modelling of a system, component, or process which meets desired needs within realistic constraints. It will help students to use the techniques, skills, and modern engineering tools and communicate effectively.

Course Outcome:

After attending the course students would be able to

CO1	Learn basics of drafting and use of drafting tools which develops the fundamental skills of industrial drawings
CO2	Know about engineering scales, dimensioning and various geometric curves necessary to understand design of machine elements
CO3	Understand projection of line, surface and solids to create the knowledge base of orthographic and isometric view of structures and machine parts
CO4	Become familiar with computer aided drafting useful to share the design model to different section of industries as well as for research & development.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	--	1	2	--	1	--	--	1	--	--	1
CO2	3	--	2	2	--	1	--	--	1	1	--	1
CO3	2	2	2	1	--	2	--	--	1	--	--	1
CO4	1	--	2	2	2	2	--	--	1	1	--	1

List of Drawing:

Traditional Engineering Graphics:

Principles of Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Perspective; Reading a Drawing; Sectional Views; Dimensioning & Tolerances; True Length, Angle; intersection, Shortest Distance.

Module 1: Introduction to Engineering Drawing

Principles of Engineering Graphics and their significance, Usage of Drawing instruments, lettering, Conic sections including Rectangular Hyperbola (General method only); Cycloid, Epicycloid and Involute; Scales – Plain, Diagonal and Vernier Scales.

Module 2: Orthographic & Isometric Projections

Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes; Projections of planes on inclined Planes - Auxiliary Planes; Projection of Solids inclined to both the Planes- Auxiliary Views; Isometric Scale, Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa.

Module 3: Sections and Sectional Views of Right Angular Solids

Drawing sectional views of solids for Prism, Cylinder, Pyramid, Cone and project the true shape of the sectioned surface, Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw sectional orthographic views of objects from industry and dwellings (foundation to slab only).

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 Modelling; Solid Modelling.

Module 4: Overview of Computer Graphics

Demonstration of CAD software [The Menu System, Toolbars (Standard, Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), Zooming methods, Select and erase objects].

Module 5: CAD Drawing, Customization, Annotations, layering

Set up of drawing page including scale settings, ISO and ANSI standards for dimensioning and tolerancing; Using various methods to draw straight lines, circles, applying dimensions and annotations to drawings; Setting up and use of Layers, changing line lengths (extend/lengthen); Drawing sectional views of solids; Drawing annotation,
CAD modelling of parts and assemblies with animation, Parametric and nonparametric solid, surface and wireframe modelling, Part editing and printing documents.

Module 6: Demonstration of a simple team design project

Illustrating Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; Meshed topologies for engineering analysis and tool-path generation for component manufacture, use of solid-modelling software for creating associative models at the component and assembly levels.

Text Books:

1. Bhatt N.D., Panchal V.M. & Ingle P.R, (2014), Engineering Drawing, Charotar Publishing House
2. K. Venugopal, Engineering Drawing + AutoCAD, New Age International publishers

Reference Books:

1. Pradeep Jain, Ankita Maheswari, A.P. Gautam, Engineering Graphics & Design, Khanna Publishing House.
2. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication.
3. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
4. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers.

2nd Semester

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1st Year 2nd Semester

Sl. No.	Category	Course Code	Course Title	Hours per week				Credit
				L	T	P	Total	
D. THEORY								
1	Basic Science courses	PH201	Physics-I	3	0	0	3	3
2	Basic Science courses	M201	Mathematics –II	4	0	0	4	4
3	Engineering Science Courses	CS201	Programming for Problem Solving	3	0	0	3	3
E. PRACTICAL								
4	Basic Science course	PH291	Physics-I Lab	0	0	3	3	1.5
5	Humanities and Social Sciences including Management courses	HSMC291	Professional Communication Lab	0	0	3	3	1
6	Engineering Science Courses	ME291	Workshop & Manufacturing Practices Lab	0	0	3	3	1.5
7	Engineering Science Courses	CS291	Programming for Problem Solving Lab	0	0	3	3	1.5
8	Project	PR291	Theme based Project II	0	0	1	1	0.5
9	Project	PR292	Skill Development II: Life Skill	1	0	0	1	0.5
F. MANDATORY ACTIVITIES / COURSES								
10	Mandatory Course	MC281	NSS/ Physical Activities / Meditation & Yoga / Photography/ Nature Club	0	0	3	3	3 Units
	TOTAL CREDIT							**16.5**

PAPER NAME: PHYSICS –I
PAPER CODE: PH 201
CONTACT: 3:0:0
TOTAL CONTACT HOURS: 36
CREDIT: 3

Prerequisites:
Knowledge of Physics up to 12th standard.

Course Objective:
The aim of courses in Physics is to provide an adequate exposure and develop insight about the basic physics principles along with the possible applications. The acquaintance of basic principles of physics would help engineers to understand the tools and techniques used in the industry and provide the necessary foundations for inculcating innovative approaches. It can also create awareness of the vital role played by science and engineering in the development of new technologies.

Course Outcome :

After attending the course students' should be able to

CO1	Describe various types mechanical resonance and its electrical equivalence
CO2	Explain basic principles of Laser, Optical fibers and various types of semiconductors
CO3	Apply superposition to explain interference and diffraction as well as apply wave mechanics to attainment of Heisenberg's uncertainty principle
CO4	Analyze importance of light as a carrier of information and examine different crystallographic structures according to their co-ordination number and packing factors
CO5	Justify the need of a quantum mechanics as remedy to overcome limitations imposed by classical physics

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	--	--	--	--	--	--	--	--	--	--	--
CO2	3	2	--	--	--	--	--	--	--	--	--	--
CO3	3	--	--	--	--	--	--	--	--	--	--	2
CO4	3	--	--	--	--	--	--	--	--	--	--	2
CO5	3	--	--	--	--	--	--	--	--	--	--	2

Course Content:
Module 1 :- Waves & Oscillations:- [5L]
Simple Harmonic Motion (Recap), superposition of waves, damped harmonic motion-over damped, critically damped and under damped motion, energy decay, logarithmic decrement, force vibration and resonance (amplitude, velocity resonance), sharpness of resonance, quality factor, related numerical problems.

Module 2 :- Classical Optics: [12L]

2.01- Interference of light: Huygens's principle, conditions of sustained interference, classification of interference, Newton's ring (qualitative descriptions of working principles and procedures-no deduction required). Engineering applications, related numerical problems.

2.02-Diffraction of light: Fresnel and Fraunhofer class, Fraunhofer diffraction of a single slit, double slit, multiple slits, intensity distributions, missing order, Rayleigh criterion (no deduction) and resolving power of grating and microscope (no deduction), related numerical problems.

2.03-Polarization: Definition, Plane of polarization, Plane of vibration, Malus Law, Fundamental concepts of plane, circular & elliptical polarizations (only qualitative idea) with examples, Brewster's law, Double refraction: Ordinary & Extra ordinary rays, positive and negative crystal, Nicol's prism, Numerical problems

Module 3 :- Quantum Mechanics-I [8L]

3.01 Quantum Theory: Inadequacy of classical physics-concept of quantization of energy, particle concept of electromagnetic wave (example: photoelectric and Compton Effect; no derivation required, origin of modified and unmodified lines), wave particle duality; phase velocity and group velocity; de Broglie hypothesis; Davisson and Germer experiment.

3.02 Quantum Mechanics 1: Concept of wave function, physical significance of wave function, probability interpretation; normalization of wave functions; uncertainty principle, relevant numerical problems. Introduction of Schrödinger wave equation (only statement).

Module 4 :- Solid State Physics-I: [3L]

4.01 Crystal Structure: Structure of solids, amorphous and crystalline solids (definition and examples), lattice, basis, unit cell, Fundamental types of lattices –Bravais lattice, simple cubic, fcc and bcc lattices, Miller indices and miller planes, co-ordination number and atomic packing factor, Bragg's equation, applications, numerical problems.

Module 5 :Modern Optics-I:[8L]

5.01- Laser: Concepts of various emission and absorption processes, Einstein A and B coefficients and equations, working principle of laser, metastable state, population inversion, condition necessary for active laser action, optical resonator, illustrations of Ruby laser, He-Ne laser, Semiconductor laser, applications of laser, related numerical problems.

5.02-Fibre optics-Principle and propagation of light in optical fibers (Step index, Graded index, single and multiple modes) - Numerical aperture and Acceptance angle, Basic concept of losses in optical fiber, related numerical problems.

Recommended Text Books

Waves & Oscillations:

1. Sound-N. K. Bajaj (TMH)
2. Advanced Acoustics-D. P. Roy Chowdhury (Chayan Publisher)
3. Principles of Acoustics-B.Ghosh (Sridhar Publisher)
4. A text book of sound-M. Ghosh (S. Chand publishers)
5. A text book of Light- K.G. Mazumder & B.Ghoshs, (Book & Allied Publisher)
6. Physics of Oscillations and Waves- R.P. Singh
7. College Physics Vol. II - A.B. Gupta
8. Vibration, Waves and Acoustics- Chattopadhyay and Rakshit

Classical & Modern Optics:

1. A text book of Light- K.G. Mazumder & B.Ghoshs (Book & Allied Publisher)
2. A text book of Light-Brijlal & Subhramanium, (S. Chand publishers)
3. Modern Optics-A. B. Gupta (Book & Allied Publisher)
4. Optics-Ajay Ghatak (TMH)
5. Optics-Hecht
6. Optics-R. Kar, Books Applied Publishers
7. Physical Optics Möler
8. Optics -F.A. Jenkins and H.E White

Quantum Mechanics-I

1. Introduction to Quantum Mechanics-S. N. Ghoshal (Calcutta Book House)
2. Quantum Mechanics-Bagde and Singh (S. Chand Publishers)
3. Perspective of Quantum Mechanics-S. P. Kuilla (New Central Book Agency)
4. Quantum Mechanics-Binayak Datta Roy (S. Chand Publishers)
5. Quantum Mechanics-Bransden (Pearson Education Ltd.)
6. Perspective of Modern Physics-A. Beiser (TMH)
7. Quantum mechanics -A.K. Ghatak and S Lokenathan
8. Modern Physics -E.E. Anderson
9. Physics Volume 2 -Haliday, Resnick & Krane, Published by Wiley India

Solid State Physics-I:

1. Solid state physics-Puri & Babbar (S. Chand publishers)
2. Materials Science & Engineering-Kakani Kakani
3. Solid state physics- S. O. Pillai
4. Introduction to solid state physics-Kittel (TMH)
5. Solid State Physics and Electronics-A. B. Gupta and Nurul Islam (Book & Allied Publisher)
6. Problem in Solid state physics -S.O. Pillai (a. b.)

Text Books:

1. Refresher courses in physics (Vol. 1, Vol. 2 & Vol. 3)-C. L. Arora (S. Chand Publishers)
2. Basic Engineering Physics-Amal Chakraborty (Chaya Prakashani Pvt. Ltd.)
3. Perspective & Concept of Modern Physics -Arthur Baiser
4. Principles of engineering physics – Md. N Khan and S Panigrahi.
5. Basic Engineering Physics-Sujoy Bhattacharya, Saumen Pal (MG)
6. Engineering Physics (Vol. 1, Vol. 2)-S.P. Kuila (S. Chand Publishers)
7. Engineering Physics-A. S. Vasudeva

Project Domains

1. Study of Superposition of waves: Lissajous figures.
2. Electrical analogue of mechanical vibrations: application to electrical circuit (LC and LCR circuits), Electrical and mechanical impedance, quality factor, complex representation and phasor diagram.
3. Study of N-slit diffractions
4. Optical Fiber & its applications: Study of losses, estimation of numerical aperture in practical problems.
5. Photonic nature of electromagnetic waves
6. Optical Rotation

PAPER NAME: MATHEMATICS-II
PAPER CODE: M 201
CONTACT: 3:1:0
TOTAL CONTACT HOURS: 48
CREDIT: 4

Prerequisite: The students to whom this course will be offered must have the concept of (10+2) calculus.

Course Objective:

The objective of this course is to disseminate the prospective engineers with techniques in multivariable calculus, ordinary differential equations and Laplace transform. It aims to equip the students with concepts and tools at an intermediate to advanced level of mathematics and applications that they would find useful in their disciplines.

Course Outcome:

On successful completion of the learning sessions of the course, the learner will be able to

CO1	Recall the distinctive characteristics of Ordinary Differential Equations, Graph Theory and Laplace Transform
CO2	Understand the theoretical workings of various algorithms related to graph theory and the theorems of differential equation and Laplace transforms.
CO3	Apply the principles of differential equation, graph theory and Laplace transforms to solve various problems.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**P10**	**P11**	**P12**
CO1	3	2	--	--	--	--	--	--	--	--	--	1
CO2	3	2	--	--	--	--	--	--	--	--	--	1
CO3	2	2	2	--	--	--	--	--	--	--	--	1

Course Content:

Module I: First Order Ordinary Differential Equations (ODE): [10L]

Solution of first order and first degree ODE: Exact ODE, Rules for finding Integrating factors, Linear ODE, Bernoulli's equation, Solution of first order and higher degree ODE: solvable for p, solvable for y solvable for x and Clairaut's equation.

Module II: Second Order Ordinary Differential Equations (ODE): [10L]

Solution of second order ODE with constant coefficients: C.F. & P.I., Method of variation of parameters, Cauchy-Euler equations, Solution of simultaneous linear ODEs.

Module III: Laplace Transform (LT): [14L]

Improper integrals; Beta and Gamma functions and their properties. Definition and existence of LT, LT of elementary functions, First and second shifting properties, Change of scale property, LT of $t\,f\,(t)$, LT of $\frac{f\,(t)}{t}$, LT of derivatives of $f\,(t)$, LT of integral of $f(t)$, Evaluation of improper integrals using LT, LT of periodic and step functions, Inverse LT: Definition and its properties, Convolution

theorem (statement only) and its application to the evaluation of inverse LT, Solution of linear ODE with constant coefficients (initial value problem) using LT.

Module IV: Numerical Methods [14L]

Introduction to error analysis, Calculus of finite difference. Interpolation: Newton forward and backward interpolation, Lagrange's interpolation, Newton's divided difference interpolation formula. Numerical integration: Trapezoidal rule, Simpson's 1/3 rule, Weddle's rule. Numerical solution of ordinary differential equation: Euler method, Modified Euler method, Fourth order Runge-Kutta method.

Project Domains:

- Mathematical modeling using ODE.
- Application of ODE.
- Application of Laplace Transform in different engineering branches.
- Application of Numerical Methods in different engineering branches.

Text Books:

1. Kreyszig, E., Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. Ramana, B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
3. Veerarajan, T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
4. Grewal, B.S., Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
5. Bali, N.P. and Goyal, M., A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
6. Samanta Guruprasad, A text book of Engineering Mathematics-II, New age International Publishers
7. Mollah, S. A, Numerical Analysis and Computational Procedures, Books and Allied (P) Ltd.

Reference Books:

1. Thomas, G.B. and Finney, R.L., Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
2. Boyce, W. E. and DiPrima, R. C., Elementary Differential Equations and Boundary Value Problems, 9th Edn., Wiley India, 2009.
3. Ross, S. L., Differential Equations, 3rd Ed., Wiley India, 1984.
4. Piskunov, N., Differential and Integral Calculus, Vol. I & Vol. II, Mir Publishers, 1969.
5. Coddington, E. A., An Introduction to Ordinary Differential Equations, Prentice Hall, India, 1995.
6. Dey, Sukhendu, Gupta Sisir, Numerical Methods, MsGraw Hill Education(India) Private Limited.
7. Jain, M. K., Iyengar, S. R. K., Jain, R. K., Numerical Methods, New age International Publishers

PAPER NAME: PROGRAMMING FOR PROBLEM SOLVING
PAPER CODE: CS 201
CONTACT: 3:0:0
TOTAL CONTACT HOURS: 36
CREDIT: 3

Prerequisites: Number system, Boolean Algebra

Course Objective:

The course is designed to provide complete knowledge of C language; students will be able to develop logics which will help them to create programs, applications; learners would be able to enhance their analysing and problem solving skills and use the same for writing programs in C.

Course Outcome:

After completion of the course students will be able to

CO1	Understand and differentiate among different programming languages for problem solving.
CO2	Describe the way of execution and debug programs in C language.
CO3	Define, select, and compare data types, loops, functions to solve mathematical and scientific problem.
CO4	Understand the dynamic behavior of memory by the use of pointers.
CO5	Design and develop modular programs using control structure, selection structure and file.

CO–PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	--	--	2	--	--	--	--	1
CO2	2	2	3	1	--	--	2	--	--	--	--	2
CO3	2	2		--	--	--	--	--	--	--	--	2
CO4	3	2	1	--	--	--	--	--	--	--	--	3
CO5	3	3	3	--	--	--	--	--	--	--	--	3

Course Content:

Module-1: Fundamentals of Computer [9L]

History of Computer, Generation of Computer, Classification of Computers, Basic structure of Computer System, Primary & Secondary Memory, Processing Unit, Input & Output devices. Number System: basic of Binary, Octal, Decimal and Hexadecimal number systems; Representation and interchanging of number in different number systems. Introduction to complements system, Representation of signed and unsigned numbers in singed magnitude singed 1's complement system and signed 2's complement system. Arithmetic– Addition and Subtraction (using1'scomplementand2'scomplement). Representation of Characters-ASCII Code Basics of Compiler, Interpreter and Assembler Problem solving – Basic concept of Algorithm.

Representation of algorithm using flow chart and pseudo code. Some basic examples.

Module-2: Introduction to C Programming [5L]

Overview of Procedural vs Structural language; History of C Programming Language. Variable and Data Types: The C characterise identifiers. And keywords, data type & sizes, variable names, declaration, statements. Operators & Expressions: Arithmetic operators, relational operators, logical operators, increment and decrement operators, bitwise operators, assignment operators, conditional operators, special operators-type conversion, C expressions, precedence and associativity. Input and Output: Standard input and output, formatted output–print f, formatted input scan f.

Module-3: Branch and Loop [5L]

Branching: Concept of Statement and Blocks in C, Simple if, if -else, nested if-else and if-else ladder. Switch Case: break and continue; switch-case, concept of go to and labels
Loops - while, for, do while

Module-4: Program Structures [4L]

Function: Basics of Functions, function types, function prototypes, formal and actual parameter, function calling, functions returning values, functions not returning values. Recursion and Recursive Function. Storage Class in C: Storage Class-auto, external, static and register storage class, scope rules and life time of variables C pre-processor: Pre-processing directive and macro, parameterized macro.

Module-5: Array and Pointer [7L]

Arrays: One dimensional arrays, Two-dimensional arrays, Passing an array to a function Pointers: Pointers, Pointer andArray, Pointer and functions. Strings: Character array and string, array of strings, Passing a string to a function, String related functions, Pointer and String. Dynamic memory allocation: Malloc, calloc, realloc and free with example.

Module-6: Structures, Unions and Enum [3L]

Basic of structures, arrays of structures, structures and pointers, bit fields. Basics of union and enum, difference between structure and union.

Module-7: File in C [3L]

Files handling- opening and closing a file in different mode, formatted and unformatted files, Command line arguments, f open, f close, f get c, f put c, f print f, f scan f function.

Textbook:

1. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
2. KanetkarY.-LetusC,BPBPublication,15thEdition

Reference Books:

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India
2. K R Venugopal & S R Prasad – MASTERING C, TMH, 2nd Edition

PAPER NAME: PHYSICS-I LAB
PAPER CODE: PH 291
CONTACT: 0:0:3
CREDIT: 1.5

Prerequisites: Knowledge of Physics up to 12th standard.

Course Objective:
The aim of courses is to provide necessary exposure to the practical aspects, which is an essential component for learning sciences.

Course Outcome:

After attending the course students' will be able to

CO1	Demonstrate experiments allied to their theoretical concepts
CO2	Conduct experiments using LASER, Optical fiber, Torsional pendulum, Spectrometer
CO3	Participate as an individual, and as a member or leader in groups in laboratory sessions actively
CO4	Analyze experimental data from graphical representations, and to effectively communicate them in Laboratory reports including innovative experiments

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	--	--	--	--	--	--	--	--	--	1
CO2	1	2	--	3	--	--	--	--	--	--	--	2
CO3	1	2	--	--	--	--	--	--	3	--	--	2
CO4	1	2	--	--	--	--	--	--	--	3	--	2

General idea about Measurements and Errors (One Mandatory):
i) Error estimation using Slide calipers/ Screw-gauge/travelling microscope for one experiment.
ii) Proportional error calculation using Carrey Foster Bridge.

Experiments on Waves & Oscillations:
1. Study of Torsional oscillation of Torsional pendulum & determination of time using various load of the oscillator.
2. Determination of elastic moduli of different materials (Young's modulus /Rigidity modulus)
3. Determination of Q factor using LCR Circuit.
4. Calibration of an oscillator using Lissajous Figure.

Experiments on Classical Optics:
5. Determination of wavelength of light by Newton's ring method.
6. Determination of wavelength of light by Laser diffraction method.
7. To determine the angle of optical rotation of a polar solution using polarimeter

Experiments on Quantum Physics-I:
8. Determination of Planck's constant using photoelectric cell.
9. Verification of Bohr's atomic orbital theory through Frank-Hertz experiment.
10. Determination of Stefan's Constant

In addition it is **recommended that each student should carry out at least one experiment beyond the syllabus/one experiment as Innovative experiment

Probable experiments beyond the syllabus:

1. Determination of wavelength of light by Fresnel's bi-prism method (beyond the syllabus).
3. Study of dispersive power of material of a prism.
4. Study of viscosity using Poiseuille's capillary flow method/using Stoke's law.
5. Measurement of nodal and antipodal points along transmission wire and measurement of wavelength.
6. Any other experiment related to the theory**.**

Recommended Text Books

Waves & Oscillations:

1. Vibration, Waves and Acoustics- Chattopadhyay and Rakshit

Classical & Modern Optics:

1. A text book of Light- K.G. Mazumdar & B.Ghoshs (Book & Allied Publisher)

Quantum Mechanics-I

1. Introduction to Quantum Mechanics-S. N. Ghoshal (Calcutta Book House)

Solid State Physics-I:

1. Solid State Physics and Electronics-A. B. Gupta and Nurul Islam (Book & Allied Publisher)

Text Books:

1. Practical Physics by Chatterjee & Rakshit (Book & Allied Publisher)
2. Practical Physics by K.G. Mazumder (New Central Publishing)
3. Practical Physics by R. K. Kar (Book & Allied Publisher)

PAPER NAME: WORKSHOP/MANUFACTURING PRACTICES
PAPER CODE: ME291
CONTACT: 0:0:3
CREDIT: 1.5

Prerequisite: Higher Secondary with Mathematics, Physics and Chemistry.

Course Objective:
To understand the basic knowledge of Workshop Practice and Safety; identify and use of different hand tools and other instruments like Hack Saw, Jack lane, Chisels etc. and operations like Marking, Cutting etc.; expose students to different types of manufacturing/fabrication processes

Course Outcome:

After completion of this course students will be able to

CO1	Gain basic knowledge of Workshop Practice and Safety useful for our daily living
CO2	Identify Instruments of a pattern shop like Hand Saw, Jack Plain, Chisels etc and performing operations like such as Marking, Cutting etc used in manufacturing processes.
CO3	Gain knowledge of the various operations in the Fitting Shop using Hack Saw, various files, Scriber, etc to understand the concept of tolerances applicable in all kind of manufacturing
CO4	Get hands on practice of in Welding and various machining processes which give a lot of confidence to manufacture physical prototypes in project works.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	--	--	--	--	2	--	1	2	1	2	2
CO2	2	--	--	--	--	2	--	2	2	1	2	3
CO3	2	--	--	--	--	2	--	1	2	2	2	3
CO4	1	--	--	--	1	3	--	3	2	2	2	3

Course Content:

(i) Theoretical discussion & videos:
1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods
2. Fitting operations & power tools
3. Carpentry
4. Welding (arc welding & gas welding), brazing
5. Electrical & Electronics
6. Metal casting
7. CNC machining, Additive manufacturing
8. Plastic moulding& Glass Cutting

(ii) Workshop Practice:

Module 1 - Machine shop
Typical jobs that may be made in this practice module:
i. To make a pin from a mild steel rod in a lathe.
ii. To make rectangular and vee slot in a block of cast iron or mild steel in a shaping and / or milling machine.

Module 2 - Fitting shop
Typical jobs that may be made in this practice module:
i. To make a Gauge from MS plate.

Module 3 - Carpentry
Typical jobs that may be made in this practice module:
i. To make wooden joints and/or a pattern or like.

Module 4 - Welding shop (Arc welding 3P + gas welding 3P)
Typical jobs that may be made in this practice module:
i. ARC WELDING (3P): To join two thick (approx. 5mm) MS plates by manual metal arcwelding.
ii. GAS WELDING (3P): To join two thin mild steel plates or sheets by gas welding.

Module 5 - Electrical & Electronics
House wiring, soft Soldering

Module 6 – Smithy
Typical jobs that may be made in this practice module:
i. A simple job of making a square rod from a round bar or similar.
For further study (Optional)

Module 7 - Casting
Typical jobs that may be made in this practice module:
i. One/ two green sand moulds to prepare, and a casting be demonstrated.

Module 8 - Plastic moulding & Glass Cutting
Typical jobs that may be made in this practice module:
i. For plastic moulding, making at least one simple plastic component should be made.
ii. At least one sample shape on glass should be made using laser cutting machine.
Examinations could involve the actual fabrication of simple components, utilizing one or more of the techniques covered above.

Text Books:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
2. Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGrawHill House, 2017.

Reference Books:

1. Gowri P., Hariharan and A. Suresh Babu, Manufacturing Technology – I, Pearson Education, 2008.
2. Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998.
3. Kalpakjian S. and Steven S. Schmid, Manufacturing Engineering and Technology, 4th edition, Pearson Education India Edition, 2002.
4. Manufacturing Science by A. Ghosh and A.K. Mallick, Wiley Eastern.
5. Principles of Metal Cutting/Principles of Machine Tools by G.C. Sen and A. Bhattacharya, New Central Book Agency, Kolkata.

PAPER NAME: PROFESSIONAL COMMUNICATION LAB
PAPER CODE: HSMC291
CONTACT: 0:0:3
CREDIT: 1

Pre requisites:
A basic knowledge of listening and speaking skills and the ability to infer meaning from audio-video/online lessons.

Course Objective:
To train the students in acquiring interpersonal communication skills by focusing on language skill acquisition techniques and error rectification through feedback.

Course Outcome:

After attending the course students' would be able to

CO1	Study the taxonomy of listening and speaking skills and sub-skills.
CO2	Apply the knowledge of the basics of note taking of factual data/ information in English and write technical reports.
CO3	Analyse communication behaviours
CO4	Identify, analyse in day-to-day communication the needs of specific vocabulary, language function and pronunciation in conversations, role plays and group discussions

CO-PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	--	--	--	--	--	1	--	--	3	3	--	2
CO2	--	--	--	--	--	1	--	--	2	3	--	2
CO3	--	--	--	--	--	2	--	--	3	3	--	3
CO4	--	--	--	--	--	2	--	2	3	3	--	3

Course Content:
Module- 1: Introduction to the Language Lab
a. The Need for a Language Laboratory
b. Tasks in the Lab
c. Writing a Laboratory Note Book

Module- 2: Active Listening
a. What is Active Listening?
b. Listening Sub-Skills—Predicting, Clarifying, Inferencing, Evaluating, Note-taking
c. Academic Listening vs Business Listening
d. Listening in Business Telephony
e. Study of Contextualized Examples based on Lab Recordings

Module- 3: Speaking
a. Speaking—Accuracy and Fluency Parameters
b. Pronunciation Guide—Basics of Sound Scripting, Stress and Intonation
c. Fluency-focussed activities—JAM, Conversational Role Plays, Speaking using Picture/Audio

Visual inputs
d. Accuracy-focussed activities—Identifying Minimal Pairs, Sound Mazes, Open and Closed Pair Drilling, Student Recordings (using software)
e. Group Discussion: Principles and Practice
f. Business Meetings and Sales Talks

Module- 4: Lab Project Work
a. Making a brief Advertisement video (1-2 minutes)
b. Making a brief Business Documentary film (5-7 minutes)
c. Client interaction video (5-7 minutes)
d. Making a short video CV (1-2 minutes)

References:
1. IIT Mumbai, Preparatory Course in English syllabus
2. IIT Mumbai, Introduction to Linguistics syllabus
3. Sasikumar et al. A Course in Listening and Speaking. New Delhi: Foundation Books, 2005.
4. Tony Lynch, Study Listening. Cambridge: Cambridge UP, 2004.

PAPER NAME: PROGRAMMING FOR PROBLEM SOLVING LAB
PAPER CODE: CS291
CONTACT: 0:0:3
CREDIT: 1.5

Prerequisites: Number system, Boolean Algebra

Course Objective:
To develop an understanding of the design, implementation, and compilation of a C program, to gain the knowledge about pointers, a fundamental for understanding data structure issues, to understand the usage of user defined data type for application development.

Course Outcome:

After completion of the course students will be able to

CO1	Apply the conception of data type, variable declaration to solve the problem.
CO2	Analyze the conception of data handling to solving problem and identify and correct syntax errors / logical errors as reported during compilation time and run time.
CO3	Create program using Arrays, Pointers, Structures, Union and Files. for solving different problem both recursive and non-recursive method

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	--	--	--	--	--	--	--	--	--	--	3
CO2	3	3	3	--	--	--	--	--	--	--	--	3
CO3	2	2	2	2	2	--	--	--	--	--	--	3

Course Content:

Module-1: Familiarization with some basic commands of DOS and Linux. File handling and Directory structures, file permissions, creating and editing simple C program in different editor and IDE, compilation and execution of C program. Introduction to Code block.

Module-2: Problem based on

a) Basic data types
b) Different arithmetic operators.
c) Print f( ) and scan f( ) functions.

Module-3: Problem based on conditional statements using

a) if-else statements
b) different relational operators
c) different logical operators

Module-4: Problem based on

a) **for** loop
b) **while** loop
c) **do-while** loop

Module-5: Problem based on

a) How to write a menu driven program using **switch-case** statement
b) How to write a function and passing values to a function
c) How to write a **recursive function.**

Module-6: Problem based on

a) How to use **array (both I-Dand2-D).**
b) How to pass an **array** to a **function.**

Module-7: Problem based on manipulation of strings in different way.

Module-8: Problem based on

a) How to handle compound variables in C
b) How to handle file in C
c) How to use command line argument in C

Textbook:

1. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
2. KanetkarY.-LetusC,BPBPublication,15th Edition

Reference Books:

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India
2. K R Venugopal & S R Prasad – MASTERING C, TMH, 2nd Edition

3rd Semester

2nd Year 3rd Semester

Sl. No.	Category	Course Code	Course Title	Hours per week				Credit
				L	T	P	Total	
A. THEORY								
1	Basic Science Course	PH(IT)301	Semiconductor Physics	3	0	0	3	3
2	Engineering Science Courses	IT302	Numerical Methods and Programming	3	0	0	3	3
3	Engineering Science Courses	IT303	Analog and Digital Electronics	3	0	0	3	3
4	Professional Core Course	IT304	Data Structure and Algorithm	3	0	0	3	3
5	Professional Core Course	IT305	Formal Language and Automata Theory	3	0	0	3	3
6	Humanities and Social Sciences including Management courses	HSMC302	Gender Culture and Development	2	0	0	2	2
B. PRACTICAL								
7	Basic Science course	PH(IT)391	Semiconductor Physics Lab	0	0	2	2	1.0
8	Engineering Science Courses	IT392	Numerical Methods and Programming Lab	3	0	0	3	1.5
9	Engineering Science Courses	IT393	Analog and Digital Electronics Lab	3	0	0	3	1.5
10	Professional Core Course	IT394	Data Structure and Algorithm Lab	3	0	0	3	1.5
11	Project	PR391	Theme based Project III	0	0	1	1	0.5
12	Project	PR392	Skill Development III: Technical Seminar Presentation	1	0	0	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
13	Mandatory Course	MC381	Learning an Art Form [vocal or instrumental, dance, painting, clay modelling, etc.] or Environmental Protection Initiatives	0	0	0	3	3Units
TOTAL CREDIT WITHOUT MOOCS COURSES								23.5
D.MOOCS COURSES**								
14	MOOCS COURSES	HM301	MOOCS COURSE-I	0	3	1	4	4
TOTAL CREDIT WITH MOOCS COURSES								**27.5**

** MOOCS COURSES for HONOURS/MINOR Degree are Program specific and to be taken from MOOCS BASKET

PAPER NAME: **SEMICONDUCTOR PHYSICS**
PAPER CODE: **PH(IT)301**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **38**
CREDIT: **3**

Prerequisite:
Knowledge of Physics up B.Tech 1st year Physics course

Course Objective:
The course will provide the exposure to the physics of materials that are applied in digital circuitry, storage devices; exposure to the physics of quantum logic gate operation and quantum computation; an insight into the science & technology of next generation; foundations of electromagnetic theory and communication systems; concept of fundamental particles and associated applications in semiconductors.

Course Outcome:
After completion of this course students will be able to

CO1	Describe various types quantum mechanical systems, action of storage and display devices, relate laws of static & time of varying electric, magnetic fields and illustrate the importance of nanomaterials in respect of modern quantum computing circuits.
CO2	Classify and compare fundamental particles based on statistical mechanics, switching from Schrodinger approach to Heisenberg approach while making transition from Classical to Quantum computation, interpret Maxwell's electromagnetic equations.
CO3	Apply quantum mechanics to explain various microscopic and nanoscopic phenomena and apply laws of static and dynamic electric and magnetic fields to develop electromagnetic theory.
CO4	Analyze operations of different types of quantum logic gates, examine nature of electron confinement in various nanostructures and their areas of application.
CO5	Access the need of a quantum computation as a remedy to overcome limitations imposed in Classical Computation, evaluate the importance of statistical mechanics in explaining actions of semiconductor devices.

CO-PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	1	--	1	--	2	--	--	--	--	--	1
CO2	2	1	--	1	--	--	--	--	--	--	--	1
CO3	2	2	--	--	--	--	--	--	--	--	--	1
CO4	2	1	--	2	--	2	--	--	--	--	--	2
CO5	2	1	--	2	--	2	--	--	--	--	--	2

Course Contents:
Module I: Quantum Mechanics-II, Quantum Computation and Communication:[14L]
1.01: Quantum Mechanics-II
Formulation of quantum mechanics and Basic postulates; Operator correspondence-Measurements in Quantum Mechanics- Eigen value, Eigen function, superposition principle, orthogonality of wave function, expectation value. Commutator. Time dependent Schrödinger's equation, formulation of time

independent Schrödinger's equation by method of separation of variables, Schrödinger's equation as energy eigen value equation, Application of Schrödinger equation – Particle in an infinite square well potential (1-D and 3-D potential well; Discussion on degenerate levels), 1D finite barrier problem and concept of quantum tunneling (solve only $E<V_0$).

1.02: Quantum Computation and Communication

The idea of n- dimensional vector space, use of 'bra-ket' notation, matrix representation of bra &kets; basis, Hilbert space; Pauli matrices. Idea of qubit and examples of single qubit logic gates- Classical bits, qubit as a two level system; Bloch vector, Pauli gate, Hadamard gate, Phase shift gate, Quantum circuits related to Quantum gates. Bells Inequality, Examples of Multi Qubit Quantum Gates.

Module II: Statistical Mechanics [10L]

Module 2.01: Basics of Statistical Mechanics:

Concept of energy levels and energy states, phasespace, microstates, macrostates and thermodynamic probability, MB, BE, FD, statistics (Qualitative discussions)- physical significance, conception of bosons, fermions, classical limits of quantum statistics, Fermi distribution at zero & non-zero temperature, Concept of Fermi level.

Module 2.02: Applications of Statistical Mechanics:

Intrinsic and extrinsic semiconductors, Dependence of Fermi level on carrier-concentration and temperature (equilibrium carrier statistics). Carrier generation and recombination, Carrier transport: diffusion and drift, p-n junction, Metal-semiconductor junction (Ohmic and Schottky)

Module III: Electronic materials & Semiconductors [6L]

3.01: Free electron theory, Density of states and energy band diagrams, Kronig-Penny model (to introduce origin of band gap), Energy bands in solids, E-k diagram, Direct and indirect bandgaps, Types of electronic materials: metals, semiconductors, and insulators, Density of states, Occupation probability, Fermi level, Effective mass, Phonons.

Module IV: Light-semiconductor interaction [4**L]**

4.01: Semiconductor materials of interest for optoelectronic devices. Optical transitions in bulk semiconductors: absorption, spontaneous emission, and stimulated emission; Joint density of states, Density of states for photons.

Module V: Physics of Nanomaterials [4L]

Reduction of dimensionality, properties of nanomaterials, Quantum wells (two dimensional), Quantum wires (one dimensional), Quantum dots (zero dimensional); Application of nanomaterials (CNT, grapheme, electronic, environment, medical). Density of states in 2D, 1d and 0D (qualitatively). **4L**

Text books:

1. Integrated Engineering Physics by Amal Kumar Chakraborty
2. Engineering Physics by Khan and Panigrahi Publisher: Oxford.

Reference books:

Module 1:

1. Advanced Quantum Mechanics-J. J. Sakurai (TMH)
2. Quantum Mechanics-Schiff (Addison-Wesley)
3. Quantum Computation and Quantum Information(10th Anniversary Edition)-Nielsen & Chuang (Cambridge University Press)
4. The physics of quantum information-Dirk Bouwmeester, Artur K. Ekert, Anton Zeilinger

(Springer)
5. Quantum Mechanics-Cohen Tanuje.

Module 2.
1. Statistical Mechanics by B.B. Laud
2. Statistical Mechanics by Singh and Singh
3. Statistical Mechanics by Satyaprakash

Module 3
1. Introduction to solid state physics-Kittel (TMH)
2. Solid State Physics- Ali Omar (Pearson Eduction)
3. Solid state physics- S. O. Pillai
4. Solid State Physics-A. J. Dekker (Prentice-Hall India)
5. Materials Science-Raghavan

Module 4:
1. Electromagnetics-B.B. Laud (TMH)
2. Electricity Magnetism-B.Ghosh (Book & Allied Publisher)
3. Electricity Magnetism-Chattopadhyay & Rakshit (New Central Book Agency)
4. Electricity Magnetism-Fewkes and Yardwood (Oxford University Press)
5. Optics-A. K. Ghatak (TMH)
6. Optics-B.D. Gupta (Books and Allied Publ)

Module 5
1. Nanotechnology-Rakesh Rathi (S. Chand Publishers)
2. Integrated Electronics-Millman Halkias (TMH)
3. Nanotechnology-Rakesh Rathi (S. Chand Publishers)
4. Nanoscience-H. E. Schaefer(Springer)

PAPER NAME: **NUMERICAL METHODS AND STATISTICS**
PAPER CODE: **IT302**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **36**
CREDIT: **3**

Prerequisite:
Number System, Algebra, Calculus

Course Objective:
The purpose of this course is to provide basic understanding of the derivation and the use of the numerical methods along with the knowledge of finite precision arithmetic.

Course Outcome:
After completion of this course students will be able to

CO1	Recall the distinctive principles of numerical analysis and the associated error measures.
CO2	Apply numerical methods used to obtain approximate solutions to intractable mathematical problems such as interpolation, integration, the solution of linear and nonlinear equations, and the solution of ordinary differential equations.
CO3	Select appropriate numerical methods to apply to various types of problems in engineering and science in consideration of the mathematical operations involved, accuracy requirements, and available computational resources.
CO4	Interpret complex statistical findings using the understanding of inferential statistics.

CO-PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	1	1	--	--	--	--	--	--	--	--	1
CO2	3	2	2	2	--	--	1	--	--	--	--	2
CO3	3	3	2	2	--	--	2	--	--	--	--	--
CO4	3	3	3	--	--	--	1	--	--	--	--	2

Course Contents:

MODULE-1: Error Analysis and Interpolation [8L]
Approximation in Numerical Computation: Truncation and rounding errors, Propagation of errors, Fixed and floating point arithmetic. Interpolation: Difference Operators: Forward and Backward, Shift Operator; Newton forward interpolation, Newton backward interpolation, Lagrange‘s Interpolation.

MODULE-2: Numerical Solution of Linear and Non-linear Equations [8L]
Numerical Solution of a System of Linear Equations: Gauss elimination method, LU Factorization method, Gauss-Seidel iterative method. Solution of Polynomial and Transcendental Equations: Bisection method, Regula-Falsi, Newton- Raphson method.

MODULE-3: Numerical Integration and Numerical Solution of Differential Equation [6L]
Numerical Integration: Trapezoidal rule, Simpson‘s1/3 rule, Expression for corresponding error

terms. Numerical solution of ordinary differential equation: Euler‘s method, Euler‘s modified method, Fourth order Runge-Kutta method.

MODULE-4: Statistics and Application [14L]

Basic Statistics: Basic statistics, measure of central tendency, mean median, mode, dispersion, Correlation coefficient and regression. Sampling theory: Random sampling. Statistic and its Sampling distribution. Sampling distribution of sample mean and variance in random sampling from a normal distribution (statement only) and related problems. Estimation of parameters: Unbiased and consistent estimators. Confidence intervals and related problems. Introduction to regression analysis.

Text books:

1. Dutta& Jana: Introductory Numerical Analysis. PHI
2. Learning Kanetkar Y. - Let us C, BPB Publication, 15thEdition
3. N. G. Das: Statistical Methods, TMH.
4. Shishir Gupta &S.Dey, Numerical Methods, Mc. Grawhill Education Pvt. Ltd.
5. Balagurusamy, E. Numerical Methods, Scitech. TMH.

Reference books:

1. C. Xavier: C Language and Numerical Methods, New age International Publisher .K R Venugopal & S R Prasad – MASTERING C, TMH, 2ndEdition
2. Sancheti , D. S. & Kapoor ,V.K. : Statistics Theory , Method & Application, Sultan chand & sons , NewDelhi
3. Guha, S. and Srivastava, R. Numerical Methods, Oxford Universities Press

PAPER NAME: **ANALOG AND DIGITAL ELECTRONICS**
PAPER CODE: **IT303**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **36**
CREDIT: **3**

Prerequisite:
Mathematics, Physics, Basic Electronics

Course Objective:
The objective of the course is to prepare students to perform the analysis and design of various digital and analog electronic circuits

Course Outcome:
After completion of this course students will be able to

CO1	Understand basic analog and digital electronics, including semiconductor properties, operational amplifiers, combinational and sequential logic and analog-to-digital digital-to-analog conversion techniques
CO2	Identify different symbols, working principles of basic Digital electronics circuits for data processing application
CO3	Analyze the characteristics of basic digital circuits
CO4	Design analog amplifiers, combinational logic devices and sequential logic devices like counters and registers

CO-PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	--	--	--	--	--	--	--	--	1	--	1
CO2	2	--	--	--	--	--	--	--	--	--	--	2
CO3	2	3	--	3	--	--	--	--	--	--	--	2
CO4	2	2	3	2	--	--	3	--	1	1	--	2

Course Contents:

MODULE I: [10L]
Analog Electronics: Diodes, Transistors, Feedback and Op-amp, Power Amplifiers – Class A, B, AB and C - basic concepts, power, efficiency calculation; Phase Shift, Wein Bridge oscillators; 555 Timer and Multivibrators; Schimtt Trigger circuit.

MODULE II :[8L]
Introduction to Number Systems: Binary, Octal and Hexadecimal representation and their conversions; BCD, ASCII, EBDIC, Gray codes and their conversions; Signed binary number representation with 1's and 2's complement methods, Binary arithmetic; Boolean algebra; Various logic gates; Representation in SOP and POS forms; Minimization of logic expressions by algebraic method, K-MAP method and Quin Mc-Clusky Method.

MODULE III: [6L]
Combinational Circuits: Adder and Subtractor; Applications and circuits of Encoder, Decoder, Comparator, Multiplexer, De-Multiplexer and Parity Generator and Checker.

MODULE IV :[8L]

Sequential Circuits: Basic Flip-flop & Latch; SR, JK, D, T and JK Master-slave Flip Flops Registers (SISO, SIPO, PIPO, PISO); Ring counter, Johnson counter; Basic concept of Synchronous and Asynchronous counters; Design of synchronous and asynchronous Mod N Counter.

MODULE V :[2L]

A/D and D/A conversion techniques: Basic concepts of R-2R, A/D and D/A; successive approximation ADC

MODULE VI: [2L]

Logic families: TTL, ECL, MOS and CMOS - basic concept

Textbooks:

1. 'Digital Circuits and Design', Salivahanan, S. Arivazhagan, Vikas Publishers
2. 'Electronics Fundamentals and Applications', D. Chattopadhyay, P. C. Rakshit, New Age International Publishers

Reference books:

1. **'**Digital Design', M. Morris Mano, Pearson Education

PAPER NAME: **DATA STRUCTURE AND ALGORITHM**
PAPER CODE: **IT304**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **36**
CREDIT: **3**

Prerequisite:
Basic Mathematics, Programming language

Course Objective:
The objective of the course is to provide knowledge of various data structures and algorithms; to introduce difference techniques for analyzing the efficiency of computer algorithms and provide efficient methods for storage, retrieval and accessing data in a systematic manner and explore the world of searching, sorting, traversal and graph tree algorithm along with demonstrate understanding of the abstract properties of various data structures such as stacks, queues, lists and trees.

Course Outcome:
After completion of this course students will be able to

CO1	Understand the concept of large amounts of data efficiently, such as large databases and indexing services.
CO2	Use some formal design methods and programming languages which emphasize on data structures, as the key organizing factor in software design
CO3	Analyze different kinds of data structures which are suited to different kinds of applications, and some are highly specialized to specific tasks
CO4	Create efficient data structures which are a key to designing efficient algorithms

CO-PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	--	3	--	--	--	--	--	--	--	--	2
CO2	3	--	--	--	--	--	--	--	--	--	--	1
CO3	3	3	3	2	--	--	--	--	--	--	--	1
CO4	3	--	3	2	--	--	--	--	--	--	--	3

Course Contents:

Module I: Concepts of data structures [7L]
a) Data and data structure b) Abstract Data Type and Data Type. Algorithms and programs, basic idea of pseudo-code. Algorithm efficiency and analysis, time and space analysis of algorithms – order notations. Array: Different representations – row major, column major. Sparse matrix - its implementation and usage. Array representation of polynomials. Linked list: Singly linked list, circular linked list, doubly linked list, linked list representation of polynomial and applications.

Module II: Stack and Queue [7L]
Stack and its implementations (using array, using linked list), applications. Queue, circular queue,

Dequeue. Implementation of queue- both linear and circular (using array, using linked list), applications. Recursion: Principles of recursion – use of stack, differences between recursion and iteration, tail recursion. Applications-The Tower of Hanoi, Eight Queens Puzzle

Module III: Trees [12L]

Basic terminologies, forest, tree representation (using array, using linked list). Binary trees - binary tree traversal (pre-, in-, post- order), threaded binary tree (left, right, full) - non-recursive traversal algorithms using threaded binary tree, expression tree. Binary search tree- operations (creation, insertion, deletion, searching). Height balanced binary tree – AVL tree (insertion, deletion with examples only). B- Trees –operations (insertion, deletion with examples only). Huffman tree.
Graphs: Graph definitions and Graph representations/storage implementations–adjacency matrix,adjacencylist,adjacencymulti-list.Graphtraversalandconnectivity–Depth-firstsearch(DFS),Breadth-first search (BFS) – concepts of edges used in DFS and BFS (tree-edge, back-edge, cross-edge, Forward-edge),applications. Minimal spanning tree– Prim‘s algorithm

Module IV: Sorting Algorithm [10L]

Internal sorting and external sorting Bubble sort and its optimizations, insertion sort, shell sort, selection sort, merge sort, quick sort, heap sort (concept of max heap), and radix sort. Tree Sort technique .Searching: Sequential search, binary search, interpolation search. Hashing: Hashing functions, collision resolution techniques

Textbooks:

1. Data Structures ,by Reema Thereja, OXFORD Publications
2. Data Structures and Algorithms Using C by Amitava Nag and Joyti Prakash Singh, VIKASH Publication
3. Data Structures by S. Lipschutz.

Reference books:

1. Data Structure using C ,by E. Balagurusamy .Mcgraw Hill)
2. Data Structures Using Cand C++,by Moshe J.Augenstein, ,Aaron, M. Tenenbaum

COURSE NAME: **FORMAL LANGUAGE AND AUTOMATA THEORY**
COURSE CODE: **IT305**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **36**
CREDIT: **3**

Prerequisite:
Elementary discrete mathematics including the notion of set, function, relation, product, partial order, equivalence relation, graph & tree. They should have a thorough understanding of the principle of mathematical induction and various proof techniques

Course Objective:
Being familiar with a broad overview of the theoretical foundations of computer science. Students will learn about a variety of issues in the mathematical development of computer science theory, particularly finite representations for languages and machines, as well as gain a more formal understanding of algorithms and procedures. Understand basic properties of formal languages and formal grammars.

Course Outcome:
After completion of this course students will be able to

CO1	Understand situations in related areas of theory in computer science.
CO2	Model, compare and analyze different computational models using combinatorial methods and Identify limitations of some computational models and possible methods of proving them.
CO3	Analyze rigorously formal mathematical methods to prove properties of languages, grammars and Automata.
CO4	Construct algorithms for different problems and argue formally about correctness on different restricted Machine models of computation.

CO-PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	3	2	--	--	--	--	--	--	--	2
CO2	2	3	3	3	2	--	--	--	--	--	--	1
CO3	3	3	3	2	--	--	--	--	--	--	--	2
CO4	3	3	2	3	--	--	--	--	--	--	--	2

Course Contents:
Module I: [10L]
Fundamentals: Definition of Automata, Use of Automata. Definition of sequential circuit, block diagram, mathematical representation, and concept of transition table and transition diagram (Relating of Automata concept to sequential circuit concept) Design of sequence detector, Introduction to finite state model Finite state machine: Definitions, capability & state equivalent, Finite memory definiteness, testing table & testing graph. Minimization of FSM-completely specified and incompletely specified (Merger graph, Merger table, Compatibility graph). Limitations of FSM Application of finite automata, Finite Automata with output-Moore & Mealy machine.

Module II: [10L]

Deterministic finite automaton and non-deterministic finite automaton. Transition diagrams and Language recognizers. Chomsky Hierarchy. Finite Automata: NFA with Î transitions - Significance, acceptance of languages. NFA to DFA conversion. DFA minimization. Myhill-Nerode theorem Regular Languages: Regular sets. Regular expressions, identity rules. Arden‘s theorem state and prove Constructing finite Automata for a given regular expressions, Regular string accepted by NFA/DFA. Pumping lemma of regular sets. Grammar Formalism: Regular grammars-right linear and left linear grammars. Equivalence between regular linear grammar and FA.

Module III: [10L]

Introduction to Context free grammars, Derivation trees, sentential forms. Right most and leftmost derivation of strings. Basic applications of the concept of CFG, Ambiguity in context free grammars. Minimization of Context Free Grammars: Removal of useless, null and unit productions .Chomsky normal form and Greibach normal form. Pumping Lemma for Context Free Languages. Enumeration of properties of CFL. Closure property of CFL. Push down Automata: Push down automata, definition. Acceptance of CFL, Acceptance by final state and acceptance by empty state and its equivalence. Equivalence of CFL and PDA,

Module IV: [6L]

Turing Machine: Turing Machine, definition, model, Design of TM, TM as language accepter, TM as transducers. Recursively enumerable and recursive languages. Computable functions. Church‘s hypothesis, counter machine, Types of Turing machines Universal Turing Machine, Decidability, Undesirability, Halting problem.

Textbooks:

1. “Theory of Computer Science-Automata Languages and Computation”, Mishra andChandrashekaran,2ndedition,PHI
2. “Switching&FiniteAutomata”,ZVIKohavi,2ndEdn.,TataMcGrawHill
3. “An Introduction to Computing”, Peter Linz, Narosa.

Reference books:

1. Introduction to Automata Theory Language and Computation”, Hopcroft H.E.and Ullman J.D

COURSE NAME: **GENDER CULTURE AND DEVELOPMENT**
COURSE CODE: **HSMC302**
CONTACT: **2:0:0**
TOTAL CONTACT HOURS: **24**
CREDIT: **2**

Course Outcome:
After completion of this course students will be able to

CO1	Provide an analysis of the location of women in the processes of economic development; to understand what economic development is, the scales or levels at which it occurs, and the centrality of gender at every level.
CO2	Examine theoretical and conceptual frameworks for that analysis.
CO3	Reflect upon linkages between the global economy and the gendered macro and micro process of development and transitions from 'government' to 'governance.'
CO4	Explain the usefulness of a rights-based approach to gender justice.
CO5	Provide basis for research, practical action and policy formulation and or evaluating for evaluating directions and strategies for social change from a gender perspective.

CO-PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	--	--	1	--	2	1	--	--	--	2	3	2
CO2	--	--	--	1	3	2	--	1	2	--	3	2
CO3	--	--	2	--	2	3	1	--	2	1	3	3
CO4	--	--	--	2	--	--	--	2	--	3	3	3
CO5	--	--	--	1	--	1	2	--	2	--	3	3

Course Contents:

Module1: [4L]
Introduction to Gender, Definition of Gender, Basic Gender Concepts and Terminology, Exploring Attitudes towards Gender, Social Construction of Gender

Module 2:[6L]
Gender Roles and Relations, Types of Gender Roles, Gender Roles and Relationships Matrix, Gender-based Division and Valuation of Labor

Module 3: [5L]
Gender Development Issues, Identifying Gender Issues, Gender Sensitive Language, Gender, Governance and Sustainable Development, Gender and Human Rights, Gender and Main streaming.

Module 4: [5L]
Gender-based Violence, The concept of violence, Types of Gender-based violence, The relationship between gender, development and violence, Gender-based violence from a human rights perspective.

Module 5: [4L]
Gender and Culture Gender and Film, Gender and Electronic Media, Gender and Advertisement, Gender and Popular Literature.

Textbooks:

1. Beneria, Lourdes. (2004). Gender, Development, and Globalization: Economics as if All People Mattered. Roultedge Press. (GDGE)
2. Molyneux and Razavi. (2002). Gender Justice, Development and Rights. Oxford University Press (GJDR or WGD)
3. Visvanathan, Duggan,Wiegersma and Nisonoff. (2011). the Women, Gender and Development Reader. 2nd Edition. Zed Press (WGD)

COURSE NAME: **NUMERICAL METHODS AND PROGRAMMING LAB**
COURSE CODE: **IT392**
CONTACT: **0:0:3**
CREDIT: **1.5**

Prerequisite:
Any introductory course on programming language (example. C/ MATLAB).

Course Objective:
The purpose of this course is to provide basic programming skills for solving the Problems in numerical methods.

Course Outcome:
After completion of this course students will be able to

CO1	Recall the distinctive principles of numerical analysis and the associated error measures.
CO2	Apply numerical methods used to obtain approximate solutions to intractable mathematical problems such as interpolation, integration, the solution of linear and nonlinear equations, and the solution of ordinary differential equations.
CO3	Select appropriate numerical methods to apply to various types of problems in engineering and science in consideration of the mathematical operations involved, accuracy requirements, and available computational resources.
CO4	Interpret complex statistical findings using the understanding of inferential statistics.

CO-PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**P10**	**P11**	**P12**
CO1	3	1	1	--	--	--		--	--	--	--	1
CO2	3	2	2	2	--	--	1	--	--	--	--	2
CO3	3	3	2	2	--	--	2	--	--	--	--	--
CO4	3	3	3	--	--	--	1	--	--	--	--	2

Course Contents:
List of Experiments:
List of Experiment:
1. Assignments on Newton forward /backward, Lagrange‘s interpolation.
2. Assignments on numerical integration using Trapezoidal rule, Simpson‘s 1/3 rule
3. Assignments on numerical solution of a system of linear equations using Gauss elimination, Gauss Jacobi and Gauss-Seidel iterations.
4. Assignments on numerical solution of Algebraic Equation by Bisection method, Regula-Falsi method, Newton-Raphson method.
5. Assignments on ordinary differential equation: Euler‘s method, Euler‘s modified method, Runge-Kutta methods.
6. Simple problems as assignment on Measures of Central Tendency- mean, median, mode, Measures of Dispersion- variance, standard deviation. Problems related to simple regression.
7. Innovative Experimen

Implementation of numerical methods on computer through commercial Software Packages:
C/ Matlab /Python/ Scilab / Labview / Mathematica/NAG (Numerical Algorithms Group/Python).

Textbooks:

1. Dutta& Jana: Introductory Numerical Analysis. PHI Learning
2. KanetkarY.-LetusC, BPBPublication
3. N. G. Das: Statistical Methods, TMH.
4. Shishir Gupta &S. Dey, Numerical Methods, Mc. Grawhill Education Pvt. Ltd.
5. Balagurusamy, E. Numerical Methods, Scitech. TMH

Reference books:

1. C.Xavier: C Language and Numerical Methods, New age International Publisher. K R Venugopa l & S R Prasad–MASTERINGC,TMH,2nd Edition
2. Sancheti , D. S. & Kapoor ,V.K. : Statistics Theory , Method & Application, Sultan chand &sons , New Delhi
3. Guha, S. and Srivastava, R. Numerical Methods, Oxford Universities Press

COURSE NAME: ANALOG AND DIGITAL ELECTRONICS LAB
COURSE CODE: IT393
CONTACT: 0:0:3
CREDIT: 1.5

Prerequisite:
Mathematics, Basic Electronics, Concepts of Basic Electrical components

Course Objective:
The objective of the course is to illustrate the students different electronic circuit and their application in practice.

Course Outcome:
After completion of this course students will be able to

CO1	Make use of analog electronic circuit devices such as BJTs and FETs, amplifiers.
CO2	Examine the characteristics of different basic logic gates and universal gates.
CO3	Construct different combinational and sequential circuits using basic logic gates.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	--	1	2	2	--	--	--	1	1	--	1
CO2	2	2	1	--	2	--	--	--	--	--	--	2
CO3	2	2	2	3	2	--	3	--	1	1	--	2

Course Contents:
List of Experiments:
List of Experiment:
1. Design of a Class A amplifier.
2. Design of a Phase-Shift Oscillator.
3. Design of a Schmitt Trigger using Op-amp.
4. Design of a Multivibrator circuit using 555 timer.
5. Design of Half and Full adder and Half and Full Subtractor
6. Construction of simple Multiplexer & Demultiplexer circuits using logic gates
7. Construction of simple Decoder & Encoder circuits using logic gates
8. Realization of RS / JK / D/ T flip flops using logic gates
9. Design of Shift Register using J-K / D Flip Flop.
10. Realization of Synchronous Up/Down counters.
11. Design of MOD- N Counter (Synchronous and Asynchronous).
12. Study of DAC and ADC.

Textbooks:
1. 'Digital Circuits and Design', Salivahanan, S. Arivazhagan, Vikas Publishers
2. 'Electronics Fundamentals and Applications', D. Chattopadhyay, P. C. Rakshit, New Age International Publishers

Reference books:
1. **'**Digital Design', M. Morris Mano, Pearson Education

COURSE NAME: **DATA STRUCTURE AND ALGORITHM LAB**
COURSE CODE: **IT394**
CONTACT: **0:0:3**
CREDIT: **1.5**

Prerequisite:
Basic Mathematics, Programming language

Course Objective:
To develop the conceptual understanding for solving problems using data structures such as linear lists, stacks, queues, hashing, trees and graphs and writing programs for the solutions

Course Outcome:
After completion of this course students will be able to

CO1	Apply the concept of dynamic memory management, data types, basic data structures, and complexity analysis.
CO2	Analyze the complexity of the different data structure and algorithm
CO3	Design and implement the appropriate linear and non-linear data structure and algorithm design method for a specified application design

CO-PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	1	--	--	--	--	--	--	--	--	2
CO2	3	2	--	--	--	--	--	--	--	--	--	2
CO3	2	2	3	--	--	--	--	--	--	--	--	2

Course Contents:
List of Experiments:

1. Experiments should include but not limited to Implementation of array operations:
2. Stack and Queues:adding,deleting,elementscircularQueue:Adding&deletingelements
3. Merging Problem:
4. Evaluation of expressions operations on Multiple stacks & queues:
5. Implementation of linked list: inserting, deleting, inverting a linked list
6. Implementation of stacks and queues
7. Using linked lists: Polynomial addition, Polynomial multiplication
8. Sparse Matrices: Multiplication, addition
9. Recursive and Non Recursive traversal Trees
10. Threaded binary tree traversal. AVL tree implementation
11. Application of Trees. Application of sorting and searching algorithms
12. Hash tables implementation: searching, inserting and deleting, searching and sorting techniques.
13. Innovative Experiments

Textbooks:

1. Data Structures Using C, by Reema Thereja, OXFORD Publications
2. Data Structures and Algorithms Using C by Amitava Nag and Joyti Prakash Singh, VIKASH Publication
3. Data Structures by S. Lipschutz.

Reference books:

1. Data Structures Using C, by E. Balagurusamy E. Mc graw Hill)
2. Data Structures Using C and C++, by Moshe J. Augenstein, Aaron M. Tenenbaum

COURSE NAME: **SEMICONDUCTOR PHYSICS LAB**
COURSE CODE: **PH(IT)391**
CONTACT: **0:0:3**
CREDIT: **1.5**

Course Outcome:
After completion of this course students will be able to

CO1	Demonstrate experiments allied to their theoretical concepts
CO2	Conduct experiments using semiconductors, dielectric and ferroelectrics
CO3	Classify various types of magnetic materials
CO4	Participate as an individual, and as a member or leader in groups in laboratory sessions actively
CO5	Analyze experimental data from graphical representations, and to effectively communicate them in Laboratory reports including innovative experiments

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	--	--	--	--	--	--	--	--	--	--	1
CO2	2	1	--	3	--	--	--	--	--	--	--	--
CO3	--	--	2	--	--	--	--	--	--	--	--	2
CO4	--	--	--	--	--	--	--	--	3	--	--	--
CO5	--	--	--	--	--	--	--	--	--	1	--	2

Course Contents:

Module 1: Electric and Magnetic properties of materials

1. Study of dipolar magnetic field behavior using deflection magnetometer.
2. Study of hysteresis curve of a ferromagnetic material using CRO.
3. Use of paramagnetic resonance and determination of Lande-g factor using ESR setup.
4. Measurement of Curie temperature of the given sample.
5. Determination of dielectric constant of given sample (frequency dependent)

Module 2: Ultrasound

6. Determination of velocity of ultrasonic wave using piezoelectric crystal

Module 3: Display, Optical Instruments & optoelectronic devices

7. Measurement of specific charge of electron using CRT

Module 4: Quantum Mechanics-II

8. Determination of Stefan's radiation constant.
9. To study current-voltage characteristics, load response, areal characteristics and spectral response of photo voltaic solar cells & measurement of maximum workable power.
10. Determination of band gap of a semiconductor.
11. Determination of Hall co-efficient of a semiconductor and measurement of Magnetoresistance of a given semiconductor
12. Study of I-V characteristics of a LED.
13. Study of I-V characteristics of a LDR

In addition to regular 7 experiments it is **recommended that each student should carry out at least

one experiment beyond the syllabus/one experiment as Innovative experiment.

Probable experiments beyond the syllabus:

1. Determination of thermal conductivity of a bad conductor by Lees and Chorlton's method.
2. Determination of thermal conductivity of a good conductor by Searle's mothod.
3. Study of transducer property: Determination of the thermo-electric power at a certain temperature of the given thermocouple.

Textbooks:

1. Integrated Engineering Physics by Amal Kumar Chakraborty
2. Engineering Physics by Khan and Panigrahi Publisher: Oxford.

Reference books:

1. Advanced Quantum Mechanics-J. J. Sakurai (TMH)
2. Quantum Mechanics-Schiff (Addison-Wesley)
3. Quantum Computation and Quantum Information(10th Anniversary Edition)-Nielsen & Chuang (Cambridge University Press)
4. The physics of quantum information-Dirk Bouwmeester, Artur K. Ekert, Anton Zeilinger (Springer)
5. Quantum Mechanics-Cohen Tanuje.

4th Semester

2nd Year 4thSemester

Sl. No.	Category	Course Code	Course Title	Hours per week				Credit
				L	T	P	Total	
A. THEORY								
1	Basic Science Course	M(IT)401	Mathematics III	3	0	0	3	3
2	Professional Core Course	IT402	Computer Organization and Architecture	3	0	0	3	3
3	Professional Core Course	IT403	Operating System	3	0	0	3	3
4	Professional Core Course	IT404	Software Engineering	3	0	0	3	3
5	Professional Core Course	IT405	Object Oriented Programming Using Java	3	0	0	3	3
6	Humanities and Social Sciences including Management courses	HSMC403	Universal Human Values	3	0	0	3	3
B. PRACTICAL								
7	Engineering Science Course	IT491	Python Programming Lab	0	0	3	3	1.5
8	Professional Core Course	IT492	Computer Organization and Architecture Lab	0	0	3	3	1.5
9	Professional Core Course	IT493	Operating System Lab	0	0	3	3	1.5
10	Professional Core Course	IT494	Software Engineering Lab	0	0	3	3	1.5
11	Professional Core Course	IT495	Object Oriented Programming Lab	0	0	3	3	1.5
12	Project	PR 491	Theme based Project IV	0	0	1	1	0.5
13	Project	PR492	Skill Development IV: Soft Skill & Aptitude-I	1	0	0	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
14	Mandatory Course	MC401	Environmental Science	0	0	3	3	3 Units
TOTAL CREDIT WITHOUT MOOCS COURSES								26.5
D.MOOCS COURSES								
15	MOOCS COURSES	HM401	MOOCS COURSE-II	3	1	0	4	4
TOTAL CREDIT WITH MOOCS COURSES								**30.5**

** MOOCS COURSES for HONOURS/MINOR Degree are Program specific and to be taken from MOOCS BASKET

COURSE NAME: **MATHEMATICS**
COURSE CODE: **M(IT)401**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **36**
CREDIT: **3**

Prerequisite:
The students to whom this course will be offered must have the concept of (10+2) standard set theory, calculus, basic probability.

Course Objective:
The objective of this course is to provide foundational skills and knowledge in probability distribution, algebraic structure and graph theory. Students will gain a deeper understanding of its relevance and applications in computational field. The course is intended for the students of Information Technology.

Course Outcome:
After completion of this course students will be able to

CO1	Recall the basic properties related to probability distribution, algebraic structures and graph theory.
CO2	Determine the solution the problems related to probability distribution, algebraic structure sand graph theory.
CO3	Apply the appropriate mathematical tools of probability distribution, algebraic structures and graph theory for the solutions of the problems in computational field.
CO4	Analyze the real world uncertain phenomena by identifying probability distribution and the real life problems using the algorithms of graph theory.

CO-PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	1	1	--	--	--	--	--	--	--	--	1
CO2	3	2	1	--	--	--	--	--	--	--	--	1
CO3	2	2	2	--	--	--	--	--	--	--	--	1
CO4	3	2	2	--	--	--	--	--	--	--	--	1

Course Contents:

Module I: Probability Distributions [12L]
Random Variable: Discrete and Continuous, Probability Distribution, Probability Mass Function and Probability Density Function for single variable only, Distribution Function, Expectation and Variance, Special Types of Distributions: Binomial, Poisson and Normal, Binomial Approximation to Poisson distribution and Normal Distribution.

Module II: Algebraic Structures [12L]

Group, Commutative Group, Order of a Group, Order of an element of a Group, Properties of Group, Subgroup, Cyclic group, Coset, Lagrange‘s theorem, Normal subgroup, Permutation group, Symmetric group(S3). Ring, Properties of Ring, Sub ring, Integral Domain, Field.

Module III: Graph Theory [12L]

Graph: Properties and Theorems, Digraphs, Weighted Graph, Connected and Disconnected Graph, Bipartite Graph, Complement of a Graph, Regular Graph, Complete Graph, Walk, Path, Circuit, Euler Graph, Hamiltonian Circuit, Cut Set and Cut Vertices, Adjacency and Incidence Matrices of a Graph, Isomorphism, Tree: Properties and Theorems, Binary Tree, Spanning Tree, Minimal Spanning Tree, Dijkstra's algorithm, Kruskal's Algorithm, Prim's Algorithm

Textbooks:

1. Das, N.G. Probability and Statistics; The McGraw Hill Companies.
2. Gupta, S. C. and Kapoor, V.K. Fundamentals of Mathematical Statistics, Sultan Chand & Sons
3. Deo, N. Graph Theory with Applications to Engineering and Computer Science, Prentice Hall
4. Mapa, S.K .Higher algebra: Abstract and Linear, Levant , 2011
5. Chakraborty, S.K.and Sarkar, B.K. Discrete Mathematics, Oxford University Press.

Reference books:

1. Chandrasekaran, N. and Umaparvathi, M. Discrete Mathematics, PHI
2. Lipschutz, S. Theory and Problems of Probability (Schaum's Outline Series), McGraw Hill
3. Spiegel, M. R. Theory and Problems of Probability and Statistics (Schaum's Outline Series),
4. Grewal, B. S. Higher Engineering Mathematics, Khanna Pub.
5. Kreyzig, E. Advanced Engineering Mathematics, John Wiley and Sons.
6. Sharma, J.K. Discrete Mathematics, Macmillan.
7. Spiegel, M. R., Schiller, J.J. and Srinivasan, R.A. Probability and Statistics (Schaum's Outline Series),
8. Wilson: Introduction to graph theory, Pearson Education.

COURSE NAME: **COMPUTER ORGANIZATION AND ARCHITECTURE**
COURSE CODE: **IT402**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **38**
CREDIT: **3**

Prerequisite:
Basic Programming, Basic concept of Digital Electronics

Course Objective:
To study the basic organization and architecture of digital computers (CPU, memory, I/O, software).Discussions on digital logic and microprogramming. Understanding and utilization of digital computers. Design and application of computer systems as foundation for more advanced computer-related studies.

Course Outcome:
After completion of this course students will be able to

CO1	Describe the structure and functioning of a digital computer, including its overall system architecture, operating system, and digital components.
CO2	Illustrate the organization of the Control unit, Arithmetic and Logical unit, Memory unit and the I/O unit.
CO3	Determine different hazards of the computer system and develop identical solutions
CO4	Analyze the performance of various components of Computer System and Compare the performance of different units of Computer Architecture
CO5	Judge the quality of something based on its adequacy, value, logic.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	--	1	--	--	--	--	--	--	--	--	1
CO2	2	2	--	--	--	--	--	--	--	--	--	--
CO3	--	2	3	3	--	--	1	--	--	--	--	1
CO4	--	3	--	2	2	--	1	--	2	--	--	1
CO5	--	2	--	3	--	--	1	--	--	--	--	3

Course Contents:
Module I : [4L]
Basic Computer Functions and Interconnection Structures, Discussion between computer architecture and organization, Role of Operating System, Quantitative techniques in computer design. Fetch, decode and execute cycle, Concept of operator, operand, registers and storage, Instruction format. Instruction sets and addressing modes.

Module II :[8L]
Memory classification, Memory Hierarchy and characteristics; Organization of RAM, Magnetic memory recording formats & methods, Disk & tape units with detailed working principles. Memory Inclusion, Coherence and locality properties; Associative memory organization; Cache memory Organizations, Techniques for reducing cache misses; Virtual memory organization, Paging, Mapping and management techniques, memory replacement policies.

Module III: [8L]
The ALU – ALU organization, Integer representation, Input/output Organization: Introduction to Bus architecture, effect of bus widths, Programmed & Interrupt I/O, DMA. Serial & Parallel Address; implementation of high speed Address Carry Look Ahead & carry Save Address. Multiplication of signed binary numbers-Booth's algorithm; Divide algorithms Restoring & Non- Restoring: Floating point - IEEE 754 standard; Floating point number arithmetic; Overflow detection, status flags. Flynn's classification –SISD, SIMD, MISD, MIMD architectures.

Module IV:[8L]
Timing diagrams; T-States, Controlling arithmetic & logic instruction, control structures; Hardwired & Micro programmed, CISC & RISC characteristics. Pipelining: Basic concepts, instruction and arithmetic pipeline, data hazards, control hazards and structural hazards, techniques for handling hazards, Exception handling, Pipeline optimization techniques; Instruction-level parallelism: basic concepts, techniques for increasing ILP, superscalar, super pipelined and VLIW processor architectures. Array and vector processors.

Module V: [10L]
Multiprocessor architecture: taxonomy of parallel architectures; Centralized shared- memory architecture: synchronization, memory consistency, interconnection networks. Distributed shared-memory architecture. Cluster computers. Non von Neumann architectures: data flow computers, reduction computer architectures, systolic architectures

Textbooks:
1.Mano, M.M., ―Computer System Architecture‖, PHI.
2. Kai Hwang, ―Advance Computer Architecture‖ McGraw Hill.
3. Behrooz Parhami, ―Computer Architecture‖, Oxford University Press.
4. Nicholas P Carter, ―Computer Architecture & Organization‖ McGraw Hill.

Reference books:
1. Hayes J. P., ―Computer Architecture &Organization, McGraw Hill,
2. Hamacher, ―Computer Organization, McGraw Hill,
3. N. Senthil Kumar, M. Saravanan, S. Jeevananthan, ―Microprocessors and Microcontrollers‖
4. Chaudhuri P. Pal, ―Computer Organization& Design, PHI,
5. P N Basu- ―Computer Organization &Architecture, Vikas PuB.

COURSE NAME: **OPERATING SYSTEM**
COURSE CODE: **IT403**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **36**
CREDIT: **3**

Prerequisite:
Data Structures, Algorithms & Programming Concept

Course Objective:
The objective of the course is to present an introduction to operating systems, with an emphasis on concurrency and control of asynchronous processes, deadlocks, memory management, processor and disk scheduling, parallel processing, and file system organization

Course Outcome:
After completion of this course students will be able to

CO1	Demonstrate competence in recognizing and using operating system features.
CO2	Apply knowledge of different operating system algorithms.
CO3	Analyze theory and implementation of different operating system aspect and the structure and basic architectural components involved in operating system.
CO4	Evaluate different operating system approaches.

CO-PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	2	2	2	1	--	1	--	--	--	--	1
CO2	3	3	2	2	1	--	1	--	--	--	--	1
CO3	3	3	3	3	2	--	1	--	--	--	--	1
CO4	3	2	2	3	2	--	1	--	--	--	--	3

Course Contents:
MODULE-1: Introduction [2L]
Introduction to OS. Operating system functions, evaluation of O.S., Different types of O.S.: batch, multi-programmed, timesharing, real-time, distributed, parallel

MODULE-2: Processes:[**3L]**
Concept of processes, process scheduling, operations on processes, co-operating processes, inter-process communication**.**

MODULE-3: Threads: [1L]
Overview, benefits of threads, user and kernel threads.

MODULE-4: CPU Scheduling :[3**L]**
Scheduling criteria, preemptive & non-preemptive scheduling, scheduling algorithms (FCFS, SJF, RR, priority), algorithm evaluation, multi-processor scheduling

MODULE-5: Synchronization: [4L]

Background, critical section problem, critical region, synchronization hardware, classical problems of synchronization, semaphores

MODULE-6: Deadlock: [4L]
System model, deadlock characterization, methods for handling deadlocks, deadlock prevention, deadlock avoidance, deadlock detection, recovery from deadlock.

MODULE-7: Memory Management : [3L]
Background, logical vs. physical address space, swapping, contiguous memory allocation, Pre-paging, paging, segmentation, segmentation with paging.

MODULE-8: Virtual Memory :[3L]
Background, demand paging, performance, page replacement, page replacement algorithms (FCFS, LRU), allocation of frames, thrashing, Virtualization (VMware).

MODULE-9:File Systems :[3L]
File concept, access methods, directory structure, file system structure, allocation methods (contiguous, linked, indexed), free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency & performance. Cases studies, access methods and matrices, file security, user authentication; Case studies of UNIX-LINUX Operating System and Mobile OS

MODULE-10: I/O Management: [2L]
I/O hardware, polling, interrupts, DMA, application I/O interface (block and character devices, network devices, clocks and timers, blocking and non blocking I/O), kernel I/O subsystem (scheduling, buffering, caching, spooling and device reservation, error handling), performance.

MODULE-11: Disk Management: [3L]
Disk structure, disk scheduling (FCFS, SSTF, SCAN,C-SCAN), disk reliability, disk formatting, boot block, bad blocks.

MODULE-12: CASE STUDY: [5L]
Linux System -Design Principles, Kernel Modules, Process Management, Scheduling, Memory Management, Input-Output Management, File System, Inter-process Communication; Mobile OS –iOS and Android – Architecture and SDK Framework, Media Layer, Services Layer, Core OS Layer, File System

Textbooks:
1. Milenkovie M., “Operating System: Concept & Design”, McGraw Hill.
2. Silbersehatz A. and Peterson J. L., “Operating System Concepts”, Wiley.
3. Dhamdhere: Operating System TMH

Reference books:
1. Tanenbaum A.S., “Operating System Design & Implementation”, Practice Hall NJ.
2. Stalling, William, “Operating Systems”, Maxwell McMillan International Editions, 1992.

COURSE NAME: **SOFTWARE ENGINEERING**
COURSE CODE: **IT404**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **36**
CREDIT: **3**

Prerequisite:
Mathematics, Data Structure and Basic Computations.

Course Objective:
In this course, students will gain a broad understanding of the discipline of software engineering and its application to the development of and management of software systems. Knowledge of basic software engineering methods and practices and their appropriate application.

Course Outcome:
After completion of this course students will be able to

CO1	Identify the need for engineering approach to software development and various processes of requirements analysis for software engineering problems.
CO2	Apply software engineering principles, techniques to develop and maintain, large scale software systems
CO3	Analyze and design of complex systems and meet ethical standards, legal responsibilities
CO4	Produce efficient, reliable, robust and cost-effective software solutions and perform independent research and analysis as an effective member or leader of software development team to achieve personal and team goals

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	--	2	--	1	1	--	--	--	--	1
CO2	1	2	2	1	--	2	2	--	1	--	1	1
CO3	1	3	3	2	--	--	--	--	2	2	1	1
CO4	1	2	3	2	--	3	2	--	3	2	2	2

Course Contents:

Module I: Introduction : [2L]
Definition of Software Engineering, Software crisis, Evolution of technology- Hype curve, Exploratory style of Software development vs. Software Engineering, Human cognition mechanism, Software Engineering principle- abstraction and decomposition

Module II: Software Development Life Cycle (SDLC) models : [4L]
Water fall model, V-shape Model, Prototyping Model, Spiral Model, RAD Agile Model, Verification and Validation.

Module III: Software Project Management [7L]
Responsibility of a project manager, Project planning, Metrics for project size estimation, Project estimation techniques, COCOMO model, Halstead's Software Science, Scheduling- CPM, PERT, Gantt chart, Risk management, Software configuration management, Staffing and team leader project and planning.

Module IV: Requirement analysis and specification [3L]
SRS, Requirement gathering and specification, Functional requirement, Traceability

Module V: Software Design [8L]
Characteristics of a good software, Cohesion and coupling, Function oriented design- DFD, Structure chart. Design phase in life cycle, System Design Definitions, Concept and methodologies, data flow oriented Design, Program Design and the requirements. Object oriented design- class and relationship, UML diagrams.

Module VI: Coding and Testing [7L]
Coding Standard, software documentation, Testing- unit testing, black box testing- equivalence class partitioning, boundary value analysis, white box testing- McCabe's Cyclometric complexity, Mutation Testing, Debugging, Program analysis tool, Integration Testing, Grey box testing, System testing- Smoke and performance testing.

Module VII: Software Reliability and Quality Management [2L]
Reliability, Hazard, MTTF, Repair and Availability, Software quality, Software reliability and fault-tolerance, six-sigma.

Module VIII: Computer-aided software engineering [3L]
Computer-aided software engineering (CASE)-environment and benefit. Function point methods (FSM, ISO,OMG) & Metrics. Standards: Capability Maturity Model Integration, ISO 9001.

Textbooks:
1. Rajib Mall: Software Engineering, PHI
2. Roger S. Pressman, "Software Engineering – A Practitioner's Approach",
Seventh Edition, Mc Graw-Hill International Edition

Reference books:
4. Ian Somerville, "Software Engineering", 9th Edition, Pearson Education Asia, 2011.
5. Pankaj Jalote, "Software Engineering, A Precise Approach", Wiley India, 2010.
6. Software Engineering: Iyan Somerville, 7th Edition

COURSE NAME: **OBJECT ORIENTED PROGRAMMING USING JAVA**
COURSE CODE: **IT405**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **36**
CREDIT: **3**

Prerequisite:
Basic Programming, Computer Fundamentals

Course Objective:
Understand basic of Object-Oriented Programming. Understanding the features of Java. Enable students to write Java program and develop projects

Course Outcome:
After completion of this course students will be able to

CO1	Understand the key concepts of Object-oriented Programming
CO2	Apply basic to advanced features of Object-Oriented Programming for problem solving
CO3	Analyze various programming approaches with different feature of Object-Oriented Programming
CO4	Evaluate the application and use of different feature of Object-Oriented Programming
CO5	Design project by the acquired concepts form Object Oriented Programming

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	1	1	--	--	--	--	--	--	--	1
CO2	3	2	3	2	--	--	--	--	--	--	--	3
CO3	2	3	2	3	--	--	--	--	--	--	--	2
CO4	2	2	2	3	--	--	--	--	--	--	--	2
CO5	3	2	3	--	--	3	--	3	--	--	--	3

Course Contents:

Module I: OBJECT ORIENTED CONCEPTS : [2L]
Class, object, message passing, inheritance, encapsulation, polymorphism Difference between OOP and other conventional programming – advantages and disadvantages. relationships among objects, aggregation, links, relationships among classes-association, aggregation

Module II : UNDERSTANDING JAVA PROGRAMMING LANGUAGE :[2L]
History of Java Programming languages, Purpose of invention of Java. Structure of a basic Java Program, Component of Java Development Kit-API, JRE, Understanding the steps to run a complete Java Program.

Module III: COMPONENTS OF JAVA PROGRAM : [2L]
Java Tokens-Literals, identifier, keywords, operator, separator, Data types, variables, constant, Type casting-defining type casting, requirement of type casting, implicit and explicit type casting. Control structure. Access specifier, JShell

Module IV: CLASS AND OBJECT PROPERTIES: [9L]
Defining class and object, Class Members-Local variable, instance variable, class variable, Primitive and Reference variable, Constructor, this keyword, finalize and garbage collection, Array-Declaring and defining array, accessing array elements, length properties, 2D array, anonymous array, array of Objects. Understanding method- method returning object, passing objects, method passing and returning arrays, use of method overloading. Static-Static block and non static block, static variable, static method. Nested& inner classes. Lambda expression.

Module V: REUSABILITY PROPERTY :[7L]

Super class & subclasses including multilevel hierarchy, process of constructor calling in inheritance, use of super and final keywords with super () method, dynamic method dispatch, use of abstract classes & methods, interfaces. Creation of packages, importing packages, member access for packages. Annotation, Introduction to the concept of Module

Module VI: STRING HANDLING :[1L]

Basic string handling concepts- String (discuss charAt() , compareTo(),equals(), equalsIgnoreCase(), indexOf(), length() , substring(), toCharArray() , toLowerCase(), toString(), toUpperCase() ,trim() , valueOf() methods) &StringBuffer classes (discuss append(), capacity(), charAt(), delete(), deleteCharAt(),ensureCapacity(), getChars(), indexOf(), insert(), length(), setCharAt(), setLength(), substring(), toString() methods),concept of mutable and immutable string, command line arguments.

Module VII: EXCEPTION HANDLING & MULTITHREADING :[5**L]**
Exception handling basics, different types of exception classes, use of try & catch with throw, throws & finally, creation of user defined exception classes, exception with arguments. Basics of multithreading, main thread, thread life cycle, creation of multiple threads, thread priorities, thread synchronization, inter-thread communication, deadlocks for threads, suspending & resuming threads. Assertion

Module VIII: : BASIC IO OPERATION AND FILE HANDLING :[3L]
Understanding unformatted and formatted IO. Reading and writing files. Serialization and deserialization.

MODULE-IX: COLLECTION AND GENERICS : [3L]
Array List class , LinkedList class, List Iterator interface, HashSet class, Linked HashSet class, Tree Set class, Priority Queue class, Array Deque class, Map interface, HashMap class, Linked HashMap class, Tree Map class, Hash table class, Comparable and Comparator, Properties class Generics class, Generic interface, Generic Type, Generic Method, Generics Bounded Type parameter

MODULE-X: Unit Testing : [2L]
Concept of unit testing, introduction to JUnit test, Assertions, Different test methods, Test suits

Textbooks:
1. Herbert Schildt Java Complete Reference TMH

Reference books:
1. Mr Kotiyana JAVA The Complete Core Reference ORACLE

COURSE NAME: **UNIVERSAL HUMAN VALUES**
COURSE CODE: **HSMC403**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **36**
CREDIT: **3**

Course Outcome:

After completion of this course students will be able to

CO1	Develop holistic perspective based on self-exploration about themselves, family, society and nature/existence.
CO2	Cultivate the harmony in the human being, family, society and nature/existence.
CO3	Strengthen self-reflection.
CO4	Build commitment and courage to act.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	--	2	1	--	--	--	2	3	3
CO2	3	2	--	1	3	2	--	1	2	--	3	3
CO3	3	2	2	--	2	3	1	--	2	1	3	3
CO4	3	1	--	2	--	--	--	2	--	3	3	3

Course Contents:

Module I: Introduction [8L]

Self-Exploration–what is it? - Its content and process; 'Natural Acceptance 'and Experiential Validation-as the process for self-exploration. Continuous Happiness and Prosperity-A look at basic Human Aspirations. Right understanding, Relationship and Physical Facility-the basic requirements for fulfilment of aspirations of every human being with their correct priority. Understanding Happiness and Prosperity correctly-A critical appraisal of the currents scenario. Method to fulfil the above human aspirations: understanding and living in harmony at various selves. Practices 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.

Module II: Understanding Harmony in the Human Being-Harmony [6L]

Understanding human being as a co-existence of the sentient 'I' and the material 'Body'. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer).Understanding the characteristics and activities of 'I' and harmony in 'I'. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail. Programs to ensure Sanyam and Health. 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. Ensuring health vs. dealing with disease discussion.

Module III: Harmony in the Family and Society- Harmony in Human-Human Relationship :[7L]

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. Understanding the meaning of Trust; Difference Between intention and competence. Understanding the Meaning of Respect, Difference between respect and differentiation; the other salient values In relationship. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals. Visualizing a universal Harmonious order in society-Un divided Society, Universal Order-from family to world family. Practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Elicit examples from students' lives.

Module IV: Harmony in the Nature and Existence: [8L]

Understanding the harmony in the Nature. Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self- regulation in nature. Understanding Existence as Co-existence of mutually interacting units in all-pervasive space. Holistic perception of harmony at all levels of existence. 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.

Module V: Holistic Understanding of Harmony on Professional Ethics: [7L]

Natural acceptance of human values. Definitiveness of Ethical Human Conduct. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order.
Competence in professional ethics:
a. Ability to utilize the professional competence for augmenting universal human order
b. Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems,
c. Ability to identify and develop appropriate technologies and management patterns for above production systems.
Case studies of typical holistic technologies, management model and productions systems. Strategy for transition from the present state to Universal Human Order:
a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers
b. At the level of society: as mutually enriching institutions and organizations.
Practice Exercises and Case Studies in Practice (tutorial) Sessions to discuss the conduct as an engineer or scientist etc.

Textbooks:

1.Human Values and Professional Ethics by R R Gaur, R Sangal, GP Bagaria,ExcelBooks,NewDelhi,2010

Reference books:

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak,1999.
2. Human Values, A.N.Tripathi, New Age Intl .Publishers, New Delhi, 2004.
3. The Story of Stuff(Book).
4. The Story of My Experiments with Truth-by Mohandas Karamch and Gandhi
5. Small is Beautiful-E.F Schumacher.
6. Slowis Beautiful- CecileAndrews
7. Economy of Permanence-J C Kumarappa
8. Bharat Mein Angreji Raj-PanditSunderlal
9. Rediscovering India-by Dharampal
10. Hind Swarajor Indian Home Rule-by Mohandas K. Gandhi

COURSE NAME: **PYTHON PROGRAMMING LAB**
COURSE CODE: **IT491**
CONTACT: **0:0:3**
CREDIT: **1.5**

Prerequisite:
Basic knowledge of computers, basic knowledge of programming

Course Objective:
Use basic concept of python programming language for developing solutions, Develop small projects.

Course Outcome:
After completion of this course students will be able to

CO1	Apply different Programming Concept for application development
CO2	Analyze the application of different features of Python in application development
CO3	Evaluate the performance of different solutions using python to find an optimal solution
CO4	Develop different application using Python

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	--	2	--	--	--	--	--	--	2
CO2	3	3	3	2	3	--	--	--	--	--	--	2
CO3	3	2	1	3	3	--	--	--	--	--	--	2
CO4	3	3	3	3	3	2	2	3	2	--	--	2

Course Contents:

Module 1: Introduction to Python
Installation of Python, Understanding the environment setup of python, Different phases for execution of python program, Basic features of Python, Major Application areas, Advantages and disadvantages.

Module 2: Variable and Functions
Values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments

Module 3: Control Structure
Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion;

Module 4: List Tuple String Packages
Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing – list comprehension; Strings, Concepts of packages

Module 5: Object Oriented Concepts
Defining class, creation of objects, Built in class, garbage collection, operator overloading,

Inheritance.

Module 6: Exception Handling

Exception Handling, Assertion, except clause, try-finally, exception with arguments, raising exception, and user defined exception

Module 7:.GUI Programming

Turtle Graphics, Writing GUI Programs

Module 8: File Operations

File related modules in Python, File modes and permissions, Reading & Writing data from a file, Redirecting output streams to files, Working with directories, CSV files and Data Files

Module 9:

ODBC and Python, Working with Databases in MySQL, Working with Tables in MySQL, Working with SQLite Database

Module 10: Innovative Idea Development:

Applying Python features for developing innovative projects

Textbooks:

1. Core Python Programming by R. Nageswara Rao

Reference books:

1. 'Python for Education', Ajith Kumar B. P., Inter University Accelerator Center, New Delhi, 2010.
2. 'Python Cookbook: Recipes for Mastering Python 3', 3rd Edition - David Beazley & Brian K. Jones, O'Reilly Media, Inc., 2013.

COURSE NAME: **COMPUTER ORGANIZATION AND ARCHITECTURE LAB**
COURSE CODE: **IT492**
CONTACT: **0:0:3**
CREDIT: **1.5**

Prerequisite:
Basic concept of Digital Electronics.

Course Objective:
Implementation of digital logic using XLINX tool. Simulate digital circuit design using XLINX tool

Course Outcome:
After completion of this course students will be able to

CO1	Apply the knowledge of mathematics, science, and engineering in simulation.
CO2	Use Hardware Description Language (HDL) in order to implement skills in designing Architectural solutions and describing designs using VHDL
CO3	Construct and examines digital circuit design using XLINX tool.

CO-PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	3	--	--	--	--	--	--	--	--	--	--
CO2	2	--	2	2	2	--	--	--	--	--	--	--
CO3	--	3	3	2	3	3	--	--	2	--	2	2

List of Experiment:

All laboratory assignments are based on Hardware Description Language (VHDL or Verilog) Simulation.

- HDL introduction.
- Design Implementation of Basic digital logic base programming with HDL.
- Implementation of 8-bitAddition, Multiplication, Division.
- Implementation of combinational circuit Design
- Implementation of 8 -bit Register design.
- Implementation of Sequential circuit.
- Memory unit design and perform memory operations.
- Implementation of 8-bitsimpleALUdesign.
- Implementation of8-bitsimpleC PUdesign.
- Innovation in implementation of Interfacing of CPU and Memory

Textbooks:
1.Mano, M.M., ―Computer System Architecture‖, PHI.
2. Kai Hwang, ―Advance Computer Architecture‖ McGraw Hill.
3. Behrooz Parhami, ―Computer Architecture‖, Oxford University Press.
4. Nicholas P Carter, ―Computer Architecture & Organization‖ McGraw Hill.
Reference books:
1. Hayes J. P., ―Computer Architecture &Organization, McGraw Hill,
2. Hamacher, ―Computer Organization, McGraw Hill.

COURSE NAME: **OPERATING SYSTEM LAB**
COURSE CODE: **IT493**
CONTACT: **0:0:3**
CREDIT: **1.5**

Prerequisite:
Basic knowledge of computers, Basic knowledge of programming

Course Objective:
Th The objective of the course is to have students understand and appreciate the principles in the design and implementation of operating systems software.

Course Outcome:
After completion of this course students will be able to

CO1	Experiment with Unix commands and shell programming
CO2	Analyze the best CPU scheduling algorithm, memory management algorithm, synchronization techniques for a given problem instance
CO3	Develop algorithm for deadlock avoidance, detection and file allocation strategies

CO-PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	2	2	3	--	--	--	--	--	--	2
CO2	2	3	2	3	3	--	--	--	--	--	--	2
CO3	3	3	3	3	3	1	1	1	--	--	--	3

Course Contents:

Module 1: Basic Commands of UNIX:
File and Directory Related commands, Process and status information commands, Text related commands, File Permission commands, Pipes and filters, Managing Local Users and Groups

Module 2: Shell programming
Variables, Control Structure, Loop, Array, Function

Module 3: System Calls
I/O and Unix System Calls

Module 4: Process Synchronization
Implementation of Classical Synchronization problems using Semaphore

Module 5: CPU Scheduling Algorithm

Module 6: Memory Management Schemes

Module 7:.Page Replacement Algorithm

Textbooks:

1. Russ Cox, Frans Kaashoek, Robert Morris, xv6: a simple, Unix-like teaching operating system", Revision8.
2. Sumitabha Das , UNIX Concepts and Applications, Tata McGraw-Hill.

COURSE NAME: **SOFTWARE ENGINEERING LAB**
COURSE CODE: **IT494**
CONTACT: **0:0:3**
CREDIT: **1.5**

Prerequisite:
Familiar with MS Office Package and Basic Computations

Course Objective:
Demonstrate the UML diagrams with ATM system descriptions; demonstrate the working of software testing tools with c language, Understanding Project Planning Tools.

Course Outcome:
After completion of this course students will be able to

CO1	Make use of efficient models for development of software for various projects.
CO2	Analyze a specification and examine the corresponding design for developing software.
CO3	Produce efficient, reliable, robust and cost-effective software solutions Designing valid test cases.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	2	--	2	1	1	--	--	1	1	--	1
CO2	1	3	--	3	3	2	--	--	2	2	--	1
CO3	1	3	3	3	3	3	2	3	3	3	3	1

Course Contents:
List of Experiments:

1. Identifying the Requirements from Problem Statements
2. Requirements, Characteristics of Requirements, Categorization of Requirements, Functional Requirements, Identifying Functional Requirements
3. Estimation of Project Metrics
4. Project Estimation Techniques -COCOMO, Basic COCOMO Model, Intermediate COCOMO Model, Complete COCOMO Model, Advantages of COCOMO, Drawbacks of COCOMO, Halstead's Complexity Metrics
5. Modelling UML Use Case Diagrams and Capturing Use Case Scenarios
6. Use case diagrams, Actor, Use Case, Subject, Graphical Representation, Association between Actors and Use Cases, Use Case Relationships, Include Relationship, Extend Relationship, Generalization Relationship, Identifying Actors, Identifying Use cases, Guidelines for drawing Use Case diagrams
7. Identifying Domain Classes from the Problem Statements
8. Introduction to selenium tool for software testing.
9. JUnit, Static analysis, Junit Framework
10. Prepare a SRS document in line with the IEEE recommended standards
11. Draw the use case diagram and specify the role of each of the actors. Also state the

precondition, post condition and function of each use case.

12. Draw the sequence diagram for any two scenarios.
13. Draw the collaboration diagram.
14. Draw the state chart diagram & component diagram.
15. Draw the deployment diagram.

Textbooks:

1. Rajib Mall: Software Engineering, PHI
2. Roger S. Pressman, "Software Engineering – A Practitioner's Approach", Seventh Edition, Mc Graw-Hill International Edition

Reference books:

1. Ian Somerville, "Software Engineering", 9th Edition, Pearson Education Asia, 2011.
2. Pankaj Jalote, "Software Engineering, A Precise Approach", Wiley India, 2010.
3. Software Engineering: Iyan Somerville, 7th Edition

COURSE NAME: **OBJECT ORIENTED PROGRAMMING LAB**
COURSE CODE: **IT495**
CONTACT: **0:0:3**
CREDIT: **1.5**

Prerequisite:
Basic knowledge of computers, basic knowledge of programming

Course Objective:
Enable students to use basic object-oriented features in coding. Enable students to develop small projects

Course Outcome:
After completion of this course students will be able to

CO1	Apply different Object-Oriented Programming Concept for application development
CO2	Analyze the application of different features of Java in application development
CO3	Evaluate the performance of different solutions using Java in search of an optimal solution
CO4	Develop different application using the concept of Java

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1		2	--	--	--	--	--	--	2
CO2	3	3	3	2	3	--	--	--	--	--	--	2
CO3	3	2	1	3	3	--	--	--	--	--	--	2
CO4	3	3	3	3	3	2	2	3	2	--	--	2

Course Contents:
Module 1: Basic Program introduction
Writing simple java program, compiling and running.
Understanding the main () method.

Module 2: Basic Java Concepts
Using basic java token, control structures.
Illustrating class objects, constructor, final, finalize.
Understanding Arrays and hands on application using array.
Understanding and writing methods.
Static and non static concepts.

Module 3: Reusable properties
Class Relationship.
Using inheritance
Creating abstract classes, interfaces.

Module 4: String
String handling, Basic string handling concepts

Module 5: Exception and Threading:
Illustrating exception handling

Illustrating multi threading applications

Module 6: IO:
Basic IO and File IO operation

Module 7: Generics and Collection:
Test application using generics and collection classes

Module 8: Unit Test
JUnit Test

Module 9: Innovative Idea Development:
Applying Java new features for developing innovative projects

Textbooks:
1. Herbert Schildt Java Complete Reference TMH

Reference books:
1. Mr Kotiyana JAVA The Complete Core Reference ORACLE
2. Kathie Seira Head First Java Orielley

COURSE NAME: **ENVIRONMENTAL SCIENCE**
COURSE CODE: **MC401**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **22**
CREDIT: **3 UNITS**

Prerequisite:
Knowledge of Basic Chemistry

Course Objective:
The objective of the course is to apply the knowledge of environmental science to 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; to analyze and discuss the relevance of environmental science to use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions; function in multi/inter- disciplinary teams with a spirit of tolerance, patience and understanding so necessary for team work; 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

Course Outcome:
After completion of this course students will be able to

CO1	Apply the knowledge of environmental science to 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.
CO2	Analyze and discuss the relevance of environmental science to use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions.
CO3	Function in multi/inter-disciplinary teams with a spirit of tolerance, patience and understanding so necessary for team work
CO4	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.

CO-PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	--	2	--	3	--	--	--	--	--	3
CO2	3	3	--	3	--	1	3	--	1	--	2	3
CO3	--	--	--	--	--	2	3	2	2	--	--	3
CO4	--	--	--	--	--	3	--	--	--	--	--	3

Course Contents:
Module I: [6L]
General: Natural Resources: Forest Resource, water resource, mineral resource, energy resources (renewable, non-renewable, potentially renewable). Population Growth: Exponential Growth, logistic growth, Maximum sustainable yield Disaster Management: Types of disasters (Natural & Man-made), Floods, Earthquake, Tsunamis, Cyclones, landslides (cause, effect & control). Ecology & Ecosystem: Elements of ecology, definition of ecosystem- components types and function, Food chain & Food web, Structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem, and Aquatic ecosystems. Environmental Management: Environmental

impact assessment, Environmental laws and protection act of India, Different international environmental agreement.

Module II :[6L]

Air Pollution: Sources of Pollutants: point sources, nonpoint sources and manmade sources primary & secondary pollutant. Types of air pollutants: primary & secondary pollutant;
Suspended particulate matter, oxides of carbon, oxides of nitrogen, oxides of sulphur, particulate, PANS, Smog (Photochemical smog and London smog). Effects on human health & climate: Greenhouse effect, Global Warming, Acid rain, Ozone Layer Depletion. Air pollution and meteorology: Ambient Lapse Rate, Adiabatic Lapse Rate, Atmospheric stability & Temperature inversion. control of air pollution (ESP, cyclone separator, bag house, catalytic converter, scrubber(ventury)

Module III: [6L]

Water Pollution: Classification of water (Ground & surface water). Pollutants of water, their origin and effects: Oxygen demanding wastes, pathogens, nutrients, Salts, heavy metals, pesticides, volatile organic compounds. Surface water quality parameters: pH, DO, 5 day BOD test, BOD reaction rate constants, COD. Numerical related to BO Lake: Eutrophication [Definition, source and effect]. Ground water: Aquifers, hydraulic gradient, ground water flow (Definition only), ground water pollution (Arsenic & Fluoride; sources, effects, control) , Quality of Boiler fed water: DO, hardness, alkalinity, TDS and Chloride, Layout of waste water treatment plant (scheme only).

Module IV:[2L]

Land Pollution: Types of Solid Waste: Municipal, industrial, commercial, agricultural, domestic, hazardous solid wastes (bio-medical), E-waste , Solid waste disposal method: Open dumping, Land filling, incineration, composting, recycling (Advantages and disadvantages).

Module V: [2L]

Noise Pollution : Definition of noise, effect of noise pollution on human health, Average
Noise level of some common noise sources, Definition of noise frequency, noise pressure,
noise intensity, noise threshold limit value, equivalent noise level, L10 (18 hr Index) .
Noise pollution control.

Textbooks:

1. A Textbook of Environmental Studies, Shashi Chawla. Tata McGraw Hill Education Private Limited
2. 2. Environmental Studies, Dr. J P Sharma, University Science Press

Reference books:

1. Environmental Engineering, J K Das Mohapatra, Vikas Publication

5th Semester

3rd Year 5th Semester

Sl. No	Category	Course Code	Course Title	Hours per week				Credit
				L	T	P	Total	
A. THEORY								
1	Professional Core Course	IT501	Database Management System	3	0	0	3	3
2	Professional Core Course	IT502	Computer Networking	3	0	0	3	3
3	Professional Core Course	IT503	Design and Analysis of Algorithm	3	0	0	3	3
4	Humanities and Social Sciences including Management courses	HSMC504	Economics for Engineers	2	0	0	2	2
5	Professional Elective Courses	IT505A	Microprocessor and Microcontroller	3	0	0	3	3
		IT505B	Artificial Intelligence					
		IT505C	Programming Practice Using C++					
		IT505D	E-Commerce and ERP					
B. PRACTICAL								
6	Professional Core Course	IT591	Database Management System Lab	0	0	3	3	1.5
7	Professional Core Course	IT592	Computer Networking Lab	0	0	3	3	1.5
8	Professional Core Course	IT593	Design and Analysis of Algorithm Lab	0	0	3	3	1.5
9	Professional Elective Courses	IT595A	Microprocessor and Microcontroller Lab	0	0	3	3	1.5
		IT595B	Artificial Intelligence Lab					
		IT595C	Programming Practice Using C++ Lab					
		IT595D	E-Commerce Lab					
10	Project	PR591	Minor Project I	0	0	3	3	1
11	Project	PR592	Skill Development V: Soft Skill & Aptitude-II	1	0	0	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
12	Mandatory Course	MC501	Intellectual Property Right	0	0	3	3	3 Units
TOTAL CREDIT WITHOUT MOOCS COURSES								21.5
D. MOOCS COURSES**								
13	MOOCS COURSES	HM501	MOOCS COURSE-III	3	1	0	4	4
TOTAL CREDIT WITH MOOCS COURSES								**25.5**

** MOOCS COURSES for HONOURS/MINOR Degree are Program specific and to be taken from MOOCS BASKET

COURSE NAME: **DATABASE MANAGEMENT SYSTEM**
COURSE CODE: **IT501**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **38**
CREDIT: **3**

Prerequisite:
Logic of programming language , Basic concepts of data structure and algorithms

Course Objective:
To develop conceptual understanding of database management system for solving different industry level problems & to learn its applications.

Course Outcome:
After completion of this course students will be able to

CO1	Understand Database Management System, explain fundamental elements of a database management system, compare the basic concepts of relational data model, entity-relationship model, file organization and use appropriate index structure.
CO2	Apply efficient query optimization techniques, suitable transaction management, concurrency control mechanism and recovery management techniques.
CO3	Analyze the database design techniques and improve the design by normalization.
CO4	Design entity-relationship diagrams to represent simple database application scenarios, translate entity-relationship diagrams into relational tables, populate a relational database and formulate SQL queries on the data.

CO-PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	3	1	1	--	--	--	--	--	--	--	1
CO2	3	3	1	1	2	--	--	--	--	--	--	2
CO3	3	3	2	2	1	--	--	--	--	--	--	3
CO4	3	3	3	3	2	1	1	2	1	--	--	3

Course Contents:
Module I: [2L]
Introduction: Concept & Overview of DBMS, Data Models, Database Languages, Database Administrator, Database Users, Three Schema architecture of DBMS.

Module II :[9L]
Entity-Relationship and Relational Database Model
Basic concepts, Design Issues, Mapping Constraints, Keys, Entity-Relationship Diagram, Weak Entity Sets, Extended E-R features, case study on E-R Model. Structure of relational Databases, Relational Algebra, Relational Calculus, Extended Relational Algebra Operations, Views, Modifications of the Database

Module III: [6L]
SQL and Integrity Constraints
Concept of DDL, DML, DCL. Basic Structure, set operations, Aggregate Functions, Null Values, Domain Constraints, Referential Integrity Constraints, assertions, views, Nested Subqueries, Database security application development using SQL, Stored procedures and triggers

Module IV: [8**L]**
Relational Database Design
Functional Dependency, Different anomalies in designing a Database., Normalization using functional dependencies, Decomposition, Boyce-Codd Normal Form, 3NF, Normalization using multi-valued dependencies, 4NF, 5NF, Case Study

Module V: [7L]
Internals of RDBMS
Physical data structures, Query optimization: join algorithm, statistics and cost bas optimization. Transaction processing, Concurrency control and Recovery Management: transaction model properties, state serializability, lock base protocols; two phase locking, Dead Lock handling.

Module VI: [6L]
File Organization & Index Structures
File & Record Concept, Placing file records on Disk, Fixed and Variable sized Records, Types of Single-Level Index (primary, secondary, clustering), Multilevel Indexes.

Text books:
1. Henry F. Korth and Silberschatz Abraham, "Database System Concepts", Mc.Graw Hill.
2. Elmasri Ramez and Novathe Shamkant, "Fundamentals of Database Systems", Benjamin Cummings Publishing. Company.

Reference books:
1. Fundamentals of Database Systems", Ramez Elmasri, Shamkant B.Navathe, Addison Wesley Publishing.
2. Ramakrishnan: Database Management System, McGraw-Hill

COURSE NAME: **COMPUTER NETWORKING**
COURSE CODE: **IT502**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **36**
CREDIT: **3**

Prerequisite:
Basic Digital Communication, Computer Architecture and Operating System.

Course Objective:
Understanding the basic concept of different network models, explaining the network architecture, Analyzing and evaluating different network protocols.

Course Outcome:
After completion of this course students will be able to

CO1	Illustrate the network model and architecture
CO2	Apply different networking protocol for problem solving
CO3	Analyse different networking features for devising optimal solution
CO4	Evaluate routing algorithms for implementing solution for the real life problems
CO5	Design real network architecture

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	2	2	1	--	--	--	--	--	--	2
CO2	3	3	2	2	3	--	3	--	--	--	--	3
CO3	3	3	2	3	2	3	--	--	--	--	--	2
CO4	3	3	2	3	3	--	--	--	--	--	--	2
CO5	3	3	3	1	3	3	3	3	2	--	--	3

Course Contents:
Module I: [4L]
Overview of Data Communication and Networking:
Introduction; Data communications: components, data representation (ASCII,ISO etc.), direction of data flow (simplex, half duplex, full duplex); network criteria, physical structure (type of connection, topology), categories of network (LAN, MAN,WAN); Internet: brief history, Protocols and standards; Reference models: OSI and TCP/IP.

Module II : [**5L]**
Physical Layer:
Overview of data, signal, transmission & transmission media; Circuit switching: time division & space division switch, TDM bus; Telephone Network.

Module III: [8L]
Data link Layer:
Types of errors, framing, error detection & correction methods; Flow control; Protocols: Stop & wait ARQ, Go Back- N ARQ, Selective repeat ARQ, HDLC; Point to Point Protocol, LCP, NCP, Token Ring; Reservation, Polling, Multiple access protocols: Pure ALOHA, Slotted ALOHA, CSMA, CSMA/CD, CSMA/CA Traditional Ethernet, fast Ethernet,

Module IV: [7**L]**
Network layer:
Internetworking & devices: Repeaters, Hubs, Bridges, Switches, Router, Gateway; Addressing: IP addressing, subnetting; Routing: techniques, Routing Protocols, ARP, IP, ICMP, IPV6.

Module V: [6**L]**
Transport layer:
Process to Process delivery; UDP; TCP; Congestion Control: Open Loop, Closed Loop choke packets; Quality of service: techniques to improve QoS: Leaky bucket algorithm, Token bucket algorithm..

Module VI: [6L]
Application Layer:
DNS, SMTP, SNMP, FTP, HTTPS, Firewalls, IP Filtering

Text books:

1. B. A. Forouzan – "Data Communications and Networking (5th Ed.) " – TMH
2. W. Stallings – "Data and Computer Communications (5th Ed.)" – PHI/ Pearson Education

Reference books:

A. S. Tanenbaum – "Computer Networks (4th Ed.)" – Pearson Education/PHI
1. Black, Data & Computer Communication, PHI
2. Zheng & Akhtar, Network for Computer Scientists & Engineers, OUP

COURSE NAME: **DESIGN AND ANALYSIS OF ALGORITHM**
COURSE CODE: **IT503**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **36**
CREDIT: **3**

Prerequisite:
Discrete Mathematics Data Structure and Basic Programming Knowledge

Course Objective:
The objective of the course is to study paradigms and approaches used to analyze and design algorithms and to appreciate the impact of algorithm design in practice, use different computational models, order notation and various complexity measures to analyze the complexity/performance of different algorithms.

Course Outcome:
After completion of this course students will be able to

CO1	Understanding the time complexity of the basic algorithms for the classic problems in various domains.
CO2	Apply the classic algorithms to solve different problems
CO3	Evaluate existing algorithms by calculating the time complexity
CO4	Design algorithm to solve various problems in different domains

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	--	--	--	--	--	--	--	--	2
CO2	3	--	--	1	--	--	--	--	--	--	--	1
CO3	3	--	2	--	--	--	--	--	--	--	--	1
CO4	--	--	3	2	--	--	--	--	--	--	--	2

Course Contents:
Module I: [2L]
Introduction: Time and Space Complexity, Different Asymptotic notations and their mathematical significance

Module II : [**8L]**
Divide and Conquer: Basic method, use, Merge Sort, Quick Sort and their complexity, Heap Sort and its complexity
Dynamic Programming: Basic method, use, Matrix Chain multiplication, All pair shortest paths, single source shortest path, Strassen's matrix multiplication algorithm.

Module III: [8L]
Backtracking: Basic method, use, 8 queens problem, Graph coloring problem.
Greedy Method: Basic method, use, Knapsack problem, traveling sales man, Job sequencing with deadlines, Minimum cost spanning tree by Prim's and Kruskal's algorithm.

Module IV: [3L]
Branch and bound technique: integer programming, 0/1 knapsack problem

Module V: [4L]
Disjoint set manipulation: Set manipulation algorithm like UNION-FIND, union by rank.
String matching problem: Different techniques – Naive algorithm, Knuth, Morris, Pratt (KMP) algorithm with their complexities.

Module VI: [6L]
Amortized Analysis: Aggregate, Accounting, and Potential Method. Network Flow: Ford Fulkerson algorithm, Max-Flow Min-Cut theorem (Statement and Illustration)

Module VII: [5L]
Notion of NP-completeness: P class, NP class, NP hard class, NP complete class – their interrelationship, Satisfiability problem, Cook's theorem (Statement only).
Approximation Algorithms: Necessity of approximation scheme, performance guarantee, polynomial time approximation schemes.

Text books:
1. A. Aho, J. Hopcroft and J. Ullman "The Design and Analysis of Algorithms"
2. D. E. Knuth "The Art of Computer Programming", Vol. 3
3. E. Horowitz and Shani "Fundamentals of Computer Algorithms"

Reference books:
1. T. H. Cormen, C. E. Leiserson, R. L. Rivest and C. Stein, "Introduction to Algorithms

COURSE NAME: **ECONOMICS FOR ENGINEERS**
COURSE CODE: **HSMC504**
CONTACT: **2:0:0**
TOTAL CONTACT HOURS: **24**
CREDIT: **2**

Course Objective:
To develop decision making skills using basic economic Principles, to educate the students in evaluating various Business Projects.

Course Outcome:
After completion of this course students will be able to

CO1	Identify various uses for scares resources
CO2	Understand key economic concepts and implement in real world problems
CO3	Apply critical thinking skills to analyze financial data and their impacts.
CO4	Evaluate business performance through cost accounting principles

CO-PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	--	3	--	--	--	--	--	--	--	--	2	--
CO2	--	--	--	--	--	--	3	--	--	--	2	--
CO3	--	--	--	2	2	3	--	--	--	--	2	2
CO4	--	--	--	3	--	--	--	--	--	--	3	2

Course Contents:
Module I: [2L]
Introduction to Economics: Meaning, Nature and Scope of Economics

Module II : [**4L]**
Theory of Demand and Supply: Concept of demand, Determinants of demand, Individual and Market Demand, Exception to the law of demand. Concept of Supply, Shift in Demand and Supply Curve, Movement along the demand and supply curve, Determinants of equilibrium price and quantity, Elasticity of Demand and Supply.

Module III: [6L]
Theory of Production and Costs: concept of Production function, types of Production function, Laws of return to scale and variable Proportion, Cost Function, Types of Cost Function, Different Cost curves, Relation between Average and marginal cost, Relationship between Short Run costs and Long Run costs, Profit maximization

Module IV: [3**L]**
Macroeconomic Aggregates and Concepts: GDP, GNP. Concepts of National Income. Concept of Business Cycle.

Module V: [2L]
Inflation: Concept, Causes and Remedies of Inflation**.**

Module VI: [4L]
Accounting Basic concept of Journal, Preparation of Income Statement and Balance Sheet

Module VII: [3L]
Cost Volume Profit Analysis:
Contribution, P/V Ratio, Break-Even Point, Margin of Safety, Short term decision making: Make or Buy, Shut-down point, Export Pricing, Opportunity and Sunk cost.

Text books:

1. Economics, by Lipsey and Chrystal, Oxford university Press
2. Modern Accountancy, Vol.-I-, by Hanif &Mukherjee, Tata Mgrow Hill

Reference books:

1. Modern Economic Theory, by K.K. Dewett, S.Chand Principles of Economics, by H.L. Ahuja, S. Chand
2. Engineering Economics, by R. Paneer Seelvan, PHI
3. Economics for Engineers, by Dr. Shantanu Chakraborty & Dr. Niranjana Singha Roy, Law Point Publication

COURSE NAME: **MICROPROCESSOR AND MICROCONTROLLER**
COURSE CODE: **IT505A**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **36**
CREDIT: **3**

Prerequisite:
Digital Electronics, Computer Programming, Computer Organization and Architecture

Course Objective:
To develop an in-depth understanding of the operation of microprocessors and microcontrollers, machine language programming & interfacing techniques

Course Outcome:
After completion of this course students will be able to

CO1	Correlate the architecture, instructions, timing diagrams, addressing modes, memory interfacing, interrupts, data communication of 8085
CO2	Apply instructions for assembly language programs of 8085, 8086 and 8051
CO3	Analyze Micro controller hardware, input/output pins, ports, external memory, counters and timers, instruction set, addressing modes, serial data i/o, interrupts

CO-PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	--	--	--	--	--	--	--	--	--	--
CO2	--	3	--	2	3	2	2	--	2	--	--	2
CO3	2	2	2	--	--	--	--	--	--	--	--	--

Course Contents:

Module I: [10L]

Introduction to Microcomputer based system: History of evolution of Microprocessor and Microcontrollers and their advantages and disadvantages. Architecture of 8085 Microprocessor, Pin description of 8085. Address/data bus De multiplexing, Status Signals and the control signals. Instruction set of 8085 microprocessors, Addressing modes Timing diagram of the instructions (a few examples).

Module II: [**10L]**

Assembly language: programming with examples, counter and Time Delays, Stack and Subroutine Interrupts of 8085 processor (software and hardware), I/O Device Interfacing-I/O Mapped I/O and Memory Mapped I/O, Serial (using SID and SOD pins and RIM, SIM
Instructions) and transfer

Module III: [8L]

The 8086 microprocessors: Architecture, Addressing modes, interrupts. Introduction to 8051 Microcontroller –Architecture, Pin Details Addressing modes, Instruction set, Examples of Simple Assembly Language.

Module IV: [8**L]**

Memory interfacing with 8085, 8086 Support IC chips- 8255, 8251, 8237/8257, 8259, Support IC chips- 8255, 8251, 8237/8257, 8259, Interfacing of 8255 PPI with 8085 and Microcontroller 8051. Brief

introduction to PIC microcontroller (16F877)

Text books:

1. Microprocessor architecture, programming and application with 8085 – R. Gaonkar, Penram International
2. Fundamentals of microprocessor and microcontroller- B.Ram
3. An Introduction to Microprocessor and Applications –Krishna Kant, Macmillan

Reference books:

1. Microprocessors and microcontrollers - N. Senthil Kumar, M. Saravanan and Jeevananthan, Oxford university press
2. 8086 Microprocessor –K Ayala, Cengage learning
3. Ray & Bhurchandi, Advanced Microprocessors & Peripherals, TMH
4. The 8051 microcontrollers – Uma Rao and Andhe Pallavi, Pearson

COURSE NAME: **ARTIFICIAL INTELLIGENCE**
COURSE CODE: **IT505B**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **36**
CREDIT: **3**

Prerequisite:
Data Structure, Design and Analysis of Algorithms, Statistics

Course Objective:
Comprehend the fundamental concepts of Knowledge Representation and Inference in Artificial Intelligence and its utilitarian importance in current technological context, Formulate a problem as State-Space Exploration Framework or an Inference Framework of Artificial Intelligence, Use the strategies of AI-Heuristics to find acceptable solutions avoiding brute-force techniques.

Course Outcome
After completion of this course students will be able to

CO1	Understand various AI search algorithms for instance uninformed, informed, heuristic, constraint satisfaction.
CO2	Apply facts, rules, and concepts of knowledge representation for instance logic-based, frame-based, semantic nets, inference and theorem proving.
CO3	Analyze working knowledge of reasoning in the presence of incomplete and/or uncertain information.
CO4	Evaluate and create knowledge representation, reasoning, and machine learning techniques for the solution of real-world problems.

CO-PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	2	3	3	--	--	--	--	--	--	1	1
CO2	2	1	3	3	--	--	--	--	--	--	1	1
CO3	2	3	1	3	--	--	--	--	--	--	3	2
CO4	2	3	1	3	--	1	2	2	--	--	3	2

Course Contents:
Module I: [2L]

Introduction to Artificial Intelligence:

Basic Concepts, History of Artificial Intelligence, Architecture of an Artificial Intelligent Agent, Applications of Artificial Intelligence

Module II :[4L]

Artificial Intelligence Problem Formulation as State-Space Exploration Problem for Goal Searching:

Basic Concepts, State-Space Exploration Formulation for Water Jug Problem, Missionaries and Cannibals Problems, Farmer-Wolf-Goat-Cabbage Problem, 8-Puzzle Problem, Constraint Satisfaction Problem and Production System for Goal Searching.

Blind Search Techniques for Goal Searching: Breadth First Search, Depth First Search, Depth Limited Search, Iterative Deepening Search, Uniform Cost Search, Bi-directional Search.

Module III: [8L]

Heuristic Techniques for Goal Searching
Basic Concepts of Heuristic Techniques and Properties of Heuristic Functions, Hill Climbing Search. Best First Search, A* Search, Memory-bounded heuristic search: Iterative-deepening A* Search, Recursive Best First Search, Simplified Memory Bounded A* Search. Simulated Annealing Based Stochastic Search, Genetic Algorithm Based Evolutionary Search, Ant Colony Optimization, Particle Swarm Optimization

Module IV: [2**L]**

Adversarial Search for Game Playing: Basic Concepts, Minimax Search, Alpha-Beta Pruning.

Module V: [5**L]**
Knowledge Representation and Inference using Propositional Logic and Predicate Logic:
Propositional Logic: Knowledge Representation and Inference using Propositional Logic Predicate Logic: Knowledge Representation, Inference and Answer Extraction using First Order Predicate Logic

Module VI: [2L]

Slot-and-Filler Structure for Knowledge Representation:

Weak Slot-and-Filler Structure for Knowledge Representation: Semantic Nets and Frames. Strong Slot-and-Filler Structure for Knowledge Representation: Conceptual Dependency and Script.

Module VII: [11L]

Reasoning under Uncertainty:

Bayesian Inferencing and Bayesian Belief Network, Dempster-Shafer Theory, Overview of Fuzzy Logic and Inferencing, Overview of Hidden Markov Model.

Planning:

Basic Concepts, Problem of Blocks World, Components of a Planning System, Algorithms for Planning: Goal Stack, Nonlinear Planning Using Constraint Posting, Hierarchical Planning, Algorithms for Planning as State-Space Search, Heuristics for planning, Planning Graphs and GRAPHPLAN Algorithm.

Introduction to Natural Language Processing:

Basic Concepts, Steps of Natural Language Processing, Morphological, Syntactic and Semantic Analysis, Discourse Integration and Pragmatic Analysis, Applications of Natural Language Processing.

Module VII: [2L]

Introduction to Machine Learning;
Basic concepts of Machine Learning Model, Supervised Learning, Unsupervised Learning, and Reinforced Learning, Overview of Artificial Neural Network

Text books:

1. Russell, S. and Norvig, P. 2015. Artificial Intelligence - A Modern Approach, 3rd edition, Prentice Hall.
2. Rich, E., Knight, K and Shankar, B. 2009. Artificial Intelligence, 3rd edition, Tata McGrawHill.

Reference books:

1. Padhy, N.P. 2009. Artificial Intelligence and Intelligent Systems, Oxford University Press.
2. Deepak Khemani, "A First Course in Artificial Intelligence", McGraw Hill.

COURSE NAME: **PROGRAMMING PRACTICE WITH C++**
COURSE CODE: **IT505C**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **36**
CREDIT: **3**

Prerequisite:
Basic computer programming concepts

Course Objective:
The objective of the course is to introduce with the object-oriented programming paradigm using C++ and make the students understand different concept of C++ and apply the features in application development.

Course Outcome:
After completion of this course students will be able to

CO1	Understand different programming paradigm and Object-Oriented programming concept.
CO2	Determining best possible feature of Object-Oriented Programming in solution providing.
CO3	Analyze different feature of Object-Oriented Programming in search of optimal solution.
CO4	Evaluate use and application of different Object-Oriented programming concept.
CO5	Design solution in application development.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	--	--	--	--	--	--	--	1
CO2	3	2	3	2	--	--	--	--	--	--	--	3
CO3	2	3	2	3	--	--	--	--	--	--	--	2
CO4	2	2	2	3	--	--	--	--	--	--	--	2
CO5	3	2	3	--	--	3	--	3	--	--	--	3

Course Contents:
Module I: [2L]
Introduction: Introduction to Object oriented design, Declaration, Expression and statements.
Concepts of object oriented programming language, Language translator, Basics of OOPs, Structure of C++ program, Class and object, Abstraction and encapsulation, Polymorphism.

Module II : [8L]
Array, Function, Pointer & Data abstraction through classes and user defined data types:
Array, Addresses, Pointer. Function: Declaration, Definition and call, Inline function, Main function argument, Reference variable, Function overloading, Default argument, Parameter passing, Recursion, Scope of variable, Return-by-value and Return-by-reference, Pointer to function. Class, Members, Constructor and destructor, Copy constructor. Dynamic memory management: Operators new and delete, Malloc and free, Static member, Scope of class names, Scope of variables. Friend Function: understanding friend function and its use Pre-processor

Module III: [12L]
Class relationships: Operator Overloading, Polymorphism & Standard Library in C++
Overloading unary and binary operator, Overloaded function calls, Subscripting, class member access, Non-member operator, New and delete, Cast operator. Introduction, Polymorphism, Coercion,

Overloading, Parametric and inclusion polymorphism Inheritance: direct and indirect super classes, Multiple inheritance, Virtual base class, Friend, Virtual function, Abstract class, Overriding and hiding, Dynamic binding of functions, Virtual destructor and operators. Standard library in C++: Standard library function, Input and output, Iostream class hierarchy, Class ios, Other stream classes, File Handling.

Module IV: [8**L]**
Template, Exception Handling & UML Diagram:
Class template, Member function inclusion, Function template, Specialization, Inheritance, Namespace. Concept of exception handling, Catch block, Nested try-catch block, Condition expression in throw expression, Constructor & destructor, Runtime standard exception. Object oriented design and modeling: Software architecture, Process life cycle, phases, Modularity, OO methodology, Modeling, UML overview, Object oriented design patterns.

Module V: [6**L]**
Introduction to C++11 Features
Lambda Expressions, Automatic Type Deduction and decl type, Uniform Initialization Syntax, Deleted and Defaulted Functions, null ptr, Delegating Constructors, Rvalue References, Threading Library

Text books:
1. Schildt, H., The Complete Reference C++, McGraw – Hill.
2. Balaguruswamy, Object Oriented Programming C++ McGraw – Hill

Reference books:
1. C++ object oriented programming paradigm, Debasish Jana, PHI
2. Programming In C++, Y.I. Shah and M.H. Thaker, ISTE/EXCEL BOOKS

COURSE NAME: **E-COMMERCE**
COURSE CODE: **IT505D**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **36**
CREDIT: **3**

Prerequisite:
Concepts of Computer Networking, Operating System, Database Management System

Course Objective:
The objective of the course is to explain the characteristics and functions of electronic commerce including mobile commerce, fundamental characteristics of electronic markets, common business models used in B2C and B2B electronic commerce.

Course Outcome
After completion of this course students will be able to

CO1	Understand the policy issues related to privacy, intellectual property rights, and establishing identity those are germane to electronic commerce along with the Internet and related technologies.
CO2	Apply the underlying economic mechanisms and driving forces of E-Commerce.
CO3	Analyze the impact that electronic commerce is facing and outlines the different digital transaction process and basic concepts of e-commerce.
CO4	Evaluate the importance of digital library and specify the development of electronic commerce capabilities in a company.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	--	--	--	--	2	2	1	--	--	--	2
CO2	1	2	2	1	2	3	3	2	--	--	2	3
CO3	1	3	2	1	2	3	3	3	--	--	--	3
CO4	3	3	3	2	3	3	3	3	--	1	3	3

Course Contents:
Module I: [4L]
Introduction to E-Commerce:
Definition, Scope of E-Commerce, Hardware requirements, E-Commerce and Trade Cycle, Electronic Markets, Electronic Data Interchange and Internet Commerce**.**

Module II : [6**L]**
Business to Business E-Commerce:
Electronic Markets, Electronic Data Interchange (EDI): Technology, Standards (UN/EDIFACT), Communications, Implementations, Agreements, Security, EDI and Business, Inter-Organizational E-commerce. Business models for E-commerce, Business Process Re-Engineering.

Module III: [7L]
Legal issues:
Risks: Paper Document vs. Electronic document, Authentication of Electronic document, Laws, Legal issues for Internet Commerce: Trademarks and Domain names, Copyright, Jurisdiction issues, Service

provider liability, Enforceable online contract.

Module IV: [7**L]**
Security Issues:
Security Solutions: Symmetric and Asymmetric Cryptosystems, RSA, DES, and Digital Signature, Protocols for secure messaging, Secure Electronic Transaction (SET) Protocol, Electronic cash over internet, Internet Security, Search engines, Intelligent agents in E-Commerce Electronic payment systems, E-security

Module V: [7**L]**
Business to Consumer E-Commerce and E-Business:
Consumer trade transaction, Web metrics, Elements of E-Commerce, Industry impacts of E-business. Integrating Intranet and internet web applications across multiple networks. Internet bookshops, Software supplies and support, Electronic Newspapers, Internet Banking, Virtual Auctions, Online Share Dealing, Gambling on the net, E-Diversity, Case studies through internet.

Module VI: [5L]
Mobile Commerce:
Overview, Infrastructure, Applications, Mobile Payment, Limitations, Security in M-Commerce, ERP and Data warehousing, ERP and E-business.

Text books:
1. E-Commerce-Strategy, Technologies & Applications by David Whitley, TMH
2. Handbook on Electronic Commerce, Shaw et al., Springer publication.
3. Enterprise Resource Planning –Alexis Leon, Tata McGraw Hill

Reference books:
1. E-Commerce-Strategy, Technologies & Applications by David Whitley, TMH.
2. Applied E-Commerce, Langer, John Wiley Publication.
3. E-Commerce- The cutting edge of business by Kamlesh K. Bajaj, TMH.

COURSE NAME: **DATABASE MANAGEMENT SYSTEM LAB**
COURSE CODE: **IT591**
CONTACT: **0:0:3**
CREDIT: **1.5**

Prerequisite:
Knowledge about the basics of electronics and basic concepts in logic design, basic knowledge of data structure and programming concept.

Course Objective:
To develop conceptual understanding of database management system for solving different industry level problems & to learn its applications

Course Outcome:
After completion of this course students will be able to

CO1	Applying SQL and PL/SQL for processing database
CO2	Analyze the database using queries to retrieve records
CO3	Develop solutions using database concepts for real time requirements.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	3	2	3	--	--	--	--	--	--	2
CO2	3	3	2	2	3	--	--	--	--	--	--	2
CO3	3	3	3	3	3	1	2	2	2	--	--	3

Course Contents:
1. 1.Study of Backend Tool – Oracle.
2. Data Definition Language (DDL) commands in RDBMS.
3. Data Manipulation Language (DML) and Data Control Language (DCL) commands in RDBMS.
4. High-level language extension with Cursors.
5. High level language extension with Triggers
6. Procedures and Functions.
7. Embedded SQL.
8. Database design using E-R model and Normalization.
9. Mini project (Application Development using Oracle and Visual Basic)
   i. Inventory Control System.
   ii. Material Requirement Processing
   iii. Hospital Management System
   iv. Railway Reservation System
   v. Personal Information System
   vi. Web Based User Identification System
   vii. Time-table Management System

Text books:
1. ORACLE PL/SQL by example. Benjamin Rosenzweig, Elena Silvestrova, Pearson Education 3rd Edition

Reference books:
1. ORACLE DATA BASE LOG PL/SQL Programming SCOTT URMAN, Tata Mc- Graw Hill.
2. SQL & PL/SQL for Oracle 10g, Black Book, Dr.P.S. Deshpande.

COURSE NAME: **COMPUTER NETWORKING LAB**
COURSE CODE: **IT592**
CONTACT: **0:0:3**
CREDIT: **1.5**

Prerequisite:
Basic Operating System.

Course Objective:
Understanding the basic concept of different network models, explaining the network architecture, Apply different computer routing algorithms in real life problems.

Course Outcome:
After completion of this course students will be able to

CO1	Apply the concept of networking for implementing the solution.
CO2	Analyze different networking protocols for optimal solution.
CO3	Develop solutions for real time requirements.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	2	2	--	--	--	--	--	--	2
CO2	3	3	2	2	3	--	--	--	--	--	--	2
CO3	3	3	3	3	3	1	1	2	2	--	--	3

Course Contents:
1. Familiarization with: Different networking cables, Different connectors, Hubs, Switches, Routers
2. NIC Installation & Configuration (Windows/Linux)
3. Understanding IP address, subnet etc, Connect the computers in Local Area Network.
4. Study of basic Network Configuration commands.
5. Configure a Network topology using packet tracer software
6. Link Layer Error Detection Mechanism (Cyclic Redundancy Check), Data Link Layer Error Control mechanism (Selective Repeat, Go Back N)
7. Implementation of Data Link Layer Flow Control Mechanism (Stop & Wait, Sliding Window), Data
8. Server Setup/Configuration: FTP, TELNET, NFS, DNS, Firewall.
9. TCP/UDP Socket Programming: Simple, TCP based, UDP based Multicast & Broadcast Sockets
10. CISCO Packet Tracer Example

Text books:
1. A. Forouzan – "Data Communications and Networking (5th Ed.) " – TMH
2. W. Stallings – "Data and Computer Communications (5th Ed.)" – PHI/ Pearson Education

Reference books:
1. A.S. Tanenbaum – "Computer Networks (4th Ed.)" – Pearson Education/PHI
2. Black, Data & Computer Communication, PHI
3. Zheng & Akhtar, Network for Computer Scientists & Engineers, OUP.

COURSE NAME: **DESIGN ANALYSIS OF ALGORITHM LAB**
COURSE CODE: **IT593**
CONTACT: **0:0:3**
CREDIT: **1.5**

Prerequisite:
Discrete Mathematics, Data Structure, Basic Programming Knowledge

Course Objective:
The objective of the course is to analyze and design algorithms, use different computational models, order notation and various complexity measures to analyze the performance of different algorithms.

Course Outcome
After completion of this course students will be able to

CO1	Apply different algorithmic approaches for solving the problems.
CO2	Analyze a problem and design the solution for the problem and analyse the efficiency of algorithms using time and space complexity theory.
CO3	Design and Optimize the solution with respect to time complexity & memory usage.

CO-PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	2	--	3	--	--	--	--	3	3	--	1
CO2	3	1	--	--	--	--	--	--	--	--	--	2
CO3	3	1	--	--	--	--	--	--	--	--	--	1

Course Contents:
1. Implement Merge Sort using Divide and Conquer approach
2. Implement Quick Sort using Divide and Conquer approach
3. Find the minimum number of scalar multiplication needed for chain of matrix using dynamic programming
4. Implement all pair of shortest path for a graph (Floyd-Warshall Algorithm) using dynamic programming
5. Implement Traveling Salesman Problem using dynamic programming
6. Implement Single Source shortest Path for a graph using Bellman Ford Algorithm
7. Implement 15 Puzzle Problem using Branch and Bound technique.
8. Implement 8 Queen Problem using Backtracking.
9. Implement any one of the following problems using Backtracking:
   - Graph Coloring Problem
   - Hamiltonian Problem
10. Implement any one of the following problem using Greedy method:
    - Knapsack Problem
    - Job sequencing with deadlines
11. Implement KMP algorithm for string matching.
12. Implement Ford Fulkerson algorithm.

Text books:
1. Hopcroft and J. Ullman "The Design and Analysis of Algorithms"
2. D. E. Knuth "The Art of Computer Programming", Vol. 3
3. E. Horowitz and Shani "Fundamentals of Computer Algorithms"

COURSE NAME: **MICROPROCESSOR AND MICROCONTROLLER LAB**
COURSE CODE: **IT595A**
CONTACT: **0:0:3**
CREDIT: **1.5**

Prerequisite:
Basic Knowledge of Digital Electronics.

Course Objective:
To apply Assembly Level Programming for arithmetic-logical solutions and also to interpret the interfacing programming by conducting experiments

Course Outcome
After completion of this course students will be able to

CO1	Able to solve small assignments using the 8085 basic instruction sets and memory mapping through trainer kit and simulator.
CO2	Able to write 8085 assembly language programs like Addition, Subtraction, Multiplication, Square, Complement, Look up table, Copying a block of memory, Shifting, Packing and unpacking of BCD numbers, Ascending order, Descending order etc. using trainer kit.
CO3	Able to validate the interfacing technique using 8255 trainer kit through subroutine calls and IN/OUT instructions like glowing LEDs accordingly, stepper motor rotation etc
CO4	Able to test fundamental of 8051 programs using the trainer kit.

CO-PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	3	--	--	1	--	--	--	--	--	--	2
CO2	3	3	2	--	2	2	--	--	--	--	--	--
CO3	3	--	--	--	3	--	2	--	--	--	--	2
CO4	3	2	--	--	3	--	2	--	--	--	--	2

Course Contents:
1. Familiarization with 8085 register level architecture, the basic instruction sets (data transfer, arithmetic, logical, branching) and the trainer kit components including the memory map.
2. Familiarization with the process of storing, executing and viewing the contents of memory as well as registers in the trainer kit 8085 and simulator through small assignments.
3. Programming using 8085 kit and simulator for: Addition, Subtraction, Multiplication by repeated addition method, Square, Complement, Look up table, Copying a block of memory, Shifting, Packing and unpacking of BCD numbers, Addition of BCD numbers, Binary to ASCII conversion, Smallest and Largest number from an array of numbers, Ascending order, Descending Order, String Matching, Multiplication using shift and add method.
4. Program using subroutine calls and IN/OUT instructions using 8255 PPI on the trainer kit e.g. subroutine for delay, reading switch state and glowing LEDs accordingly, glowing of seven segment display.

Program for serial communication between two trainer kits.
1. Interfacing of 8255: Keyboard, Stepper motor rotation.
2. Study of 8051 Micro controller kit and writing programs

Text books:

1. Microprocessor architecture, programming and application with 8085 – R. Gaonkar, Penram International
2. Fundamentals of microprocessor and microcontroller- B.Ram

Reference books:

1. Microprocessors and microcontrollers - N. Senthil Kumar, M. Saravanan and Jeevananthan, Oxford university press
2. 8086 Microprocessor –K Ayala, Cengage learning
3. Ray & Bhurchandi, Advanced Microprocessors & Peripherals, TMH
4. The 8051 Microcontroller and Embedded System- Mazidi

COURSE NAME: **ARTIFICIAL INTELLIGENCE LAB**
COURSE CODE: **IT595B**
CONTACT: **0:0:3**
CREDIT: **1.5**

Prerequisite:
Data Structure, Design and Analysis of Algorithms, Statistics.

Course Objective:
Gain foundational knowledge of PROLOG to implementing Artificial Intelligent Agent as an executable computer program for Knowledge Representation and Inferencing; Formulate a problem by analyzing its characteristics to fit a State-Space Exploration Framework or an Inferencing Framework of Artificial Intelligence.

Course Outcome
After completion of this course students will be able to

CO1	Understand and recognize various AI search algorithms and AI tools.
CO2	Apply the fundamentals of knowledge representation, inference and theorem proving using AI tools.
CO3	Analyze working knowledge of reasoning in the presence of incomplete and/or uncertain information.
CO4	Evaluate and create knowledge representation, reasoning, and machine learning techniques for the solutions of real-world problems.

CO-PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	2	3	2	--	--	--	--	--	--	2	2
CO2	2	1	3	3	--	--	--	--	--	--	3	2
CO3	2	1	1	2	--	--	--	--	--	--	2	2
CO4	2	1	1	3	--	1	2	2	--	--	3	2

Course Contents:

WEEK-1: Introduction to PROLOG Programming along with the IDE and its Basic Components

Assignments for understanding the Basic Components of Knowledge Representation and Inferencing in Artificial Intelligence using PROLOG Programming and its working strategy.

WEEK -2: Arithmetic, Boolean Expression, Decision Making Strategies

Assignments for understanding implementation of Arithmetic Expression, Boolean Expression, and Decision-Making Strategies.

WEEK -3: Recursion and Looping through Recursion

Assignments for understanding implementation of Recursion and Looping through Recursion.

WEEK -4: List of Data Items in PROLOG

Assignments for understanding the utility of List in solving various problems.

WEEK -5: Blind Search Techniques – BFS, DFS

Implementation of BFS and DFS Algorithms for Goal Searching to solve Puzzles (8-Puzzle, Water Jug Puzzle)

WEEK -6: Heuristic Search Techniques – A* Search

Implementation of A* Search Algorithm for Goal Searching to solve Puzzles (8-Puzzle, Route Finding Puzzle)

WEEK-7: Constraint Satisfaction Problem Solving

Implementation of Backtracking Strategies to solve Constraint Satisfaction Problems (Graph Coloring Problem, 8-Queens Problem)

WEEK -8: Game Playing

Implementation of Adversarial Search Algorithm with alpha-beta pruning strategy for Game Playing (Tic-Tac-Toe)

WEEK -9: Discussion on Project Problems and Allocation (Problem Description Report Submission)

WEEK -10: Designing Solution Model and Proposal Report Submission

WEEK -11: Project Implementation, Verification and Documentation

WEEK -12: Project Demonstration and Project Report Review

Text books:

1. Ivan Bratko, Prolog Programming for Artificial Intelligence, 4th Edition, Addison-Wesley
2. Russell, S. and Norvig, P. 2015. Artificial Intelligence - A Modern Approach, 3rd edition, Prentice Hall.
3. Rich, E., Knight, K and Shankar, B. 2009. Artificial Intelligence, 3rd edition, Tata McGrawHill.

Reference books:

1. Padhy, N.P. 2009. Artificial Intelligence and Intelligent Systems, Oxford University Press.
2. Deepak Khemani, “A First Course in Artificial Intelligence”, McGraw Hill.

COURSE NAME: **PROGRAMMING PRACTICE WITH C++ LAB**
COURSE CODE: **IT595C**
CONTACT: **0:0:3**
CREDIT: **1.5**

Prerequisite:
Basic Computer concepts

Course Objective:
The objective of the course is to introduce with the object oriented programming paradigm using C++ and make the students understand different concept of C++ and apply the features in application development.

Course Outcome
After completion of this course students will be able to

CO1	Apply the concept Object oriented programming concept using C++ in developing solution
CO2	Analyze different characteristics of Object-Oriented programming using C++ for choosing in developing solution
CO3	Evaluate the application of Inheritance and polymorphism in developing solution
CO4	Create application using different feature of C++

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	--	2	--	--	--	--	--	--	1
CO2	3	3	3	2	3	--	--	--	--	--	--	2
CO3	3	2	1	3	3	--	--	--	--	--	--	2
CO4	3	3	3	3	3	2	2	3	2	--	3	3

Course Contents:

1. **Introduction:** Introduction of UNIX/Linux Operating System which includes preliminary commands, start-up & shutdown methodology, file handling as well as introduction to editors like Vi editor, introduction to GNU C & C++ compiler, as well as introduction to GNU & GDB script.

2. **Basic Programming Concepts:** Introduction to C++, basic loop control, executing programs, writing functions, selection statements, review of functions and parameters, command line arguments, recursion

3. **Stream and Structure:** I/O streams, arrays and string manipulation, pointers, structures & unions Template , Exception

4. **Object Oriented Concepts:** Object-Oriented Programming in C++, fundamentals of classes, constructors-destructors. Dealing with member functions

5. **Overloading:** Operator overloading and Polymorphism (both static & dynamic).

6. **Inheritance:** Introduction to Inheritance, derived class handling, abstract class, virtual class, overriding, template class, name-space & exception handling.

7. **Memory Management:** Dynamic memory allocation, implementation of Linked Lists, using C++.

8. **C++11 Features:** Basic C++11 features

9. **Innovative Experiments:** Design innovative projects using C++

Text books:

1. Schildt, H., The Complete Reference C++, McGraw – Hill.
2. Balaguruswamy, Object Oriented Programming C++ McGraw – Hill.

Reference books:

1. C++ object oriented programming paradigm, Debasish Jana, PHI
2. Programming In C++, Y.I. Shah and M.H. Thaker, ISTE/EXCEL BOOKS

COURSE NAME: **E-COMMERCE LAB**
COURSE CODE: **IT595D**
CONTACT: **0:0:3**
CREDIT: **1.5**

Prerequisite:
Object Oriented Programming, Computer Networking, Web Application Development, Database Management System

Course Objective:
Understanding basic concept of object-oriented programming and PHP framework, Explaining the client-side components, Appling the PHP web application development concept in web application development

Course Outcome:
After completion of this course students will be able to

CO1	Apply the concept for developing MVC application and describe and differentiate different Web Extensions and Web Services.
CO2	Analyzing different client and server side components for developing application and build dynamic web site using server side PHP programming and database connectivity
CO3	Implement the solution to real life problem using PHP concepts and Demonstrate web application using Python web Framework.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	--	--	3	--	--	--	--	--	2
CO2	2	2	1	3	--	--	--	--	--	--	--	2
CO3	3	3	3	2	3	2	2	--	--	--	--	3

Course Contents:
Introduction to PHP:
Evaluation of PHP, Basic syntax, Variable constant, Data Types, control structure, function, array, string.
Web Designing:
Introduction to HTML, HTML Tags Creating Forms Creating tables Managing home page, Java Script, CSS.
Database Connectivity with MySQL:
Introduction to RDBMS Connection with MySql Database Performing basic database operation(DML) (Insert, Delete, Update, Select) Setting query parameter Executing query Join (Cross joins, Inner joins, Outer Joins, Self joins.)
E-Commerce/M-Commerce Applications:
Online Store, Online Banking, Credit Card Transaction Processing. Comparison Shopping in B2C, Exchanges Handling in B2B, Interaction Examples: Virtual Shopping Carts.

Text books:
1. PHP Complete Reference Steven Holzner

Reference books:
1. Programming PHP Kevin Tatroe

COURSE NAME: **INTELLECTUAL PROPERTY RIGHT**
COURSE CODE: **MC501**
CONTACT: **2:0:0**
TOTAL CONTACT HOURS: **24**
CREDIT: **3 UNITS**

Course Outcome:
After completion of this course students will be able to

CO1	Explain fundamental aspects of Intellectual property Rights to students
CO2	Disseminate knowledge on patents, patent regime, copyright and trademarks in India and abroad and registration aspects,
CO3	Disseminate knowledge on Design, Geographical Indication (GI), Plant Variety and Layout Design Protection and their registration aspects.
CO4	Aware about current trends in IPR and Govt. steps in fostering IPR.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	--	1	2	3	--	--	2	--	2	3	3
CO2	3	1	--	1	--	--	1	--	1	--	3	3
CO3	3	--	1	2	3	--	--	2	--	2	3	3
CO4	3	1	--	1	--	--	1	--	1	--	3	3

Course Contents:

Module I: [4L]

Overview of the IPR: Introduction and the need for intellectual property right (IPR) - Kinds of Intellectual Property Rights: Patent, Copyright, Trade Mark, Design, Geographical Indication, Plant Varieties and Layout Design – Genetic Resources and Traditional Knowledge – Trade Secret - IPR in India: Genesis and development – IPR in abroad - International organizations. agencies and treaties,

Module II : [**4L]**

Patents- Trips Definition, kind of inventions protected by patent-Patentable and Non patentable inventions. Elements of Patentability: Novelty, Non-Obviousness (Inventive Steps), Le8al requirements for patents — Granting of patent - Rights of a patent-exclusive right. Patent application process: Searching a patent- Drawing of a patent- Filing of a patent- Types of patent applications- Parent document: specification and Claims. Registration Procedure, Rights and Duties of Patentee, Restoration of lapsed Patents, Surrender and Revocation of Patents, Infringement, Remedies & Penalties.

Module III: [4L]

Trademarks-Concept of Trademarks - Different kinds of marks (brand names, logos, signatures, symbols, well known marks, certification marks and service marks) - Non-Registrable Trademarks - Registration of Trademarks - Rights of holder and assignment and licensing of marks - Infringement, Remedies & Penalties – trade mark registration processes

Module IV: [**4L]**

Copyrights: Right and protection covered by copyright- Law of copy rights: Fundamental of copyright law. originality of material, rights of reproduction, right stopper form the worth publicly, copy right owner ship issues, obtaining copy right registration notice of copy right. International copyright law. Infringement of Copy right under Copy right Act. The Role arid Liabilities of lPRs

in India – Cyber law issues: Criminal law. data safety, online privacy. Health privacy, Freedom of expression and human rights, net neutrality, national security

Module V: [4L]
Geographical Indication of Goods: Types, why and how GI need protection and GI laws. Indian GI act. Industrial Designs: protection. Kind of protection provided by industrial designs. Integrated Circuits.

Module VI: [2L]
India`s New National IP Policy, 2016 – Govt. of India step towards promoting IPR – Govt. Schemes IPR – Career Opportunities in IP - IPR in current scenario with case studies

Text books:
1. Fundamentals oflP for Engineers: K.Bansl & P.Bansal
2. Nithyananda, K V. (2019). Intellectual Property Rights: Protection and Management. India, IN: Cengage Learning India Private Limited.
3. Neeraj, P., &Khusdeep, D. (2014). Intellectual Property Rights. India, IN: PHI learning Private Limited.

Reference books:
1. Ahuja, V K. (2017). Law relating to Intellectual Property Rights. India, IN: Lexis Nexis.

6th Semester

3rd Year 6th Semester

Sl. No	Category	Course Code	Course Title	Hours per week				Credits
				L	T	P	Total	
A. THEORY								
1	Professional Core Course	IT601	Web Technology	3	0	0	3	3
2	Professional Core Course	IT602	Machine Learning	3	0	0	3	3
3	Professional Elective Course	IT603A	Computer Graphics	3	0	0	3	3
		IT603B	Multimedia Technology					
		IT603C	Soft Computing					
		IT603D	Digital Image Processing					
4	Professional Elective Course	IT604A	Data Warehouse and Data Mining	3	0	0	3	3
		IT604B	Cryptography and Network Security					
		IT604C	Compiler Design					
		IT604D	Pattern Recognition					
5	Humanities and Social Sciences including Management Course	HU605	Principles of Management	2	0	0	2	2
6	Open Elective Course	IT606A	Computational Geometry	3	0	0	3	3
		IT606B	Mobile Communication					
		IT606C	Robotics					
		IT606D	Wireless Sensor Network					
B. PRACTICAL								
7	Professional Core Course	IT691	Web Technology Lab	0	0	3	3	1.5
9	Professional Core Course	IT692	Machine Learning Lab	0	0	3	3	1.5
10	Professional Elective Course	IT693A	Computer Graphics	0	0	3	3	1.5
		IT693B	Multimedia Technology					
		IT693C	Soft Computing					
		IT693D	Digital Image Processing					
11	Project	PR691	Minor Project II	0	0	3	2	1
12	Project	PR692	Skill Development V: Soft Skill & Aptitude-III	1	0	0	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
13	Mandatory Course	MC601	Constitution of India	3	0	0	3	3Units
TOTAL CREDIT WITHOUT MOOCS COURSES								23.0
D.MOOCS COURSES**								
14	MOOCS COURSES	HM601	MOOCS COURSE-IV	3	1	0	4	4
TOTAL CREDIT WITH MOOCS COURSES								**27.0**

** MOOCS COURSES for HONOURS/MINOR Degree are Program specific and to be taken from MOOCS BASKET.

COURSE NAME: **WEB TECHNOLOGY**
COURSE CODE: **IT601**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **36**
CREDITS: **3**

Prerequisite:
Computer Networking, Database Management System, JAVA Programming Language

Course Objective:
Describing the web application architecture and protocols, illustrating different technologies those are used to develop web applications, describing different frameworks those used to develop web applications

Course Outcome:
After completion of this course students will be able to

CO1	Understand web application architecture, technologies, and frameworks
CO2	Apply the concept of different front end and back-end components in problem solving
CO3	Analyze different architecture and web components
CO4	Evaluate different solutions in field of web application development
CO5	Design web application architecture to provide solution in web application development fields

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	--	--	1	--	--	--	--	--	--	--	1
CO2	3	3	3	--	--	--	--	--	--	--	--	2
CO3	1	2	--	3	--	--	--	--	--	--	--	2
CO4	1	2	--	3	--	--	--	--	--	--	--	2
CO5	3	3	3	3	--	2	2	3	--	--	--	3

Course Contents:
Module I: [2L]
Introduction to World Wide Web:
Web Architecture, Web Applications, Web servers, Web Browsers and Agents, Internet standards, DNS, SMTP, Pull and Push mechanism: Pros and Cons. HTTP, HTTPS, XMPP

Module II: [**2L]**
Mark-up:
HTML: Elements, Attributes, Tags, Forms, Input, Frames, Tables

Module III: [2L]
Cascading Style Sheets:
Advantages, Rules, CSS, inline and external, using template Layouts

Module IV: [**5L]**
Java Script and Node JS:

Basic java Script concepts, Use of Java Script, Variable, Object, function, Event Handling. Evaluation of Java Scrip. Create, Publish, Extend & Manage, Node.js HTTPs: Create Server and Get Data, Node.js Express, Node JS Mongo DB. Node.js Promise, Node.js Generators & Compare with Callbacks, Node js Streams: File stream, Pipes, Node.js Testing with Jasmine

Module V: [7L]
Server-side Programming:
Servlets: HTTP Tunneling, Programmatically issuing HTTP GET, POST etc. and retrieval of content Concept of Dynamic Web pages, Web server versus Application server, Role of threading in a Server, Servlet-2.x API conforming to Web 2.0: Role of web.xml as deployment descriptor, request and response, Basic request handling, parameter retrieval, multiple parameter retrieval, inter-Servlet collaboration: Dispatching the request, Concept of state of web: Sessions , tracking session, Using Cookies and session Id, Parameter passing to and from session, Servlet Filters and common uses of Filters and Cookies. Migration to Servlet 3.x plus and omission of web.xml and concept of Web Socket.

Module VI: [6L]
Persistence: JDBC 3.x framework:
Need and different approaches of persistence of data, Connecting to databases using c, ODBC bridge and Type-4 drivers, Executing basic CRUD using JDBC: Statement, Prepared Statement, Result Set. Execution of batch SQL, Stored Procedures using Callable Statement, Transaction Failure management: Save Point and roll back concepts, Prevention of SQL injection, Concept of connection URL in details: Connecting to a remote database host (server). Concept of roles of Drivers: Java reflection in Action.

Module VII: [6L]
Java Server Pages:
Benefits of JSP over Servlets, JSP scriptlets, page directives, declarations, action tags: <jsp:useBeabn/>, <jsp:include/><jsp:forward/> , introduction to MVC and Spring MVC.

Module VIII: [2L]
XML Technologies:
XML, Namespace, DTD, W3C XML Schema.

Module IX: [2L]
Ajax:
Introduction to Asynchronous pattern and Using XML to communicate over XML Http Request object. Handling 5 states and finding response state. Migration of Ajax to AJAJ.

Module X: [2L]
Web Service
Introduction to web service architecture. Simple object access protocol, Web service description language, RESTful web service.

Text books:

1. Professional Java Server Programming Allamaraju, Apress

Reference books:

1. Web Technology: A Developer's Perspective, N.P. Gopalan and J. Akilandeswari, PHI Learning, Delhi, 2013.
2. Web Technologies Black Book: HTML, JavaScript, PHP, Java, JSP, XML and AJAX, Kogent Learning Solutions INC.

COURSE NAME: **MACHINE LEARNING**
COURSE CODE: **IT602**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **36**
CREDITS: **3**

Prerequisite:
Probability, Linear Algebra, Multivariable Calculus, Programming

Course Objective:
This introductory course gives an overview of many concepts, techniques, and algorithms in machine learning related to classification and regression problems. The course will give the student the basic ideas and intuition behind modern machine learning methods as well as a bit more formal understanding of how, why, and when they work.

Course Outcome:
After completion of this course students will be able to

CO1	Understand the basics of machine learning techniques that make it useful to real-world problems.
CO2	Apply machine learning algorithms such as supervised, semi-supervised, and unsupervised.
CO3	Analyze various machine learning techniques to investigate real world applications.
CO4	Evaluate and create model for finding the solution of real world industry issues and problems.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	1	1	--	--	1	--	--	--	--	2
CO2	3	3	3	2	2	--	--	--	--	--	3	2
CO3	2	2	1	2	3	--	--	--	2	--	--	3
CO4	3	3	3	1	2	--	--	--	--	--	--	3

Course Contents:
Module I: [8L]
Basics of Linear Algebra
Introduction to Machine Learning, linear classification, perceptron update rule, Perceptron convergence, generalization, Maximum margin classification, Classification errors, regularization

Module II : [9L]
Logistic regression
Linear regression, estimator bias and variance, active learning, Active learning, non-linear predictions, Regression/Classification Basic methods: Distance-based methods, Nearest Neighbors, Decision Trees, Kernel regression, kernel optimization, Model selection criteria, Description length, feature selection, expectation maximization..

Module III: [10L]
Classification
Classification problems; decision boundaries; nearest neighbor methods, Probability and classification,

Naive Bayes, Bayes' Rule and Naive Bayes Model, Hidden Markov models (HMMs), Bayesian networks, Learning Bayesian networks, Logistic regression, online gradient descent, neural network, support vector machine (SVM), kernel ridge regression.

Module IV: [9**L]**
Ensemble methods
Bagging, random forests, boosting, Unsupervised learning: clustering, k-means, hierarchical agglomeration, Advanced discussion on clustering, Latent space methods; PCA, Text representations; multinomial models; clustering and latent space models.

Text books:

1. Machine Learning. Tom Mitchell. First Edition, McGraw-Hill.
2. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012.

Reference books:

1. Simon Haykin, Neural Networks and Learning Machines Third Edition, Pearson Publisher.
2. Christopher M. Bishop, Pattern Recognition and Machine Learning (Information Science and Statistics), Springer, 2006.
3. Pattern Classification. Richard Duda, Peter Hart and David Stock. Second Edition, Wiley Interscience.

COURSE NAME: **COMPUTER GRAPHICS**
COURSE CODE: **IT603A**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **36**
CREDITS: **3**

Prerequisite:
Mathematics, Computer Fundamentals & Principle of Computer Programming.

Course Objective:
To introduce the use of the components of a graphics system and become familiar with building approach of graphics system components and algorithms related with them.

Course Outcome:
After completion of this course students will be able to

CO1	Understand the basic computer graphics and Identify different media representations of different multimedia data and data formats, windows, clipping and view-ports object representation.
CO2	Comprehend the concept of geometric, mathematical and algorithmic concepts necessary for programming computer graphics.
CO3	Differentiate windows, clipping and view-ports object representation in relation to images displayed on screen.
CO4	Distinguish different coding technique and software tools for solving real world problems related to graphics and multimedia.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	3	2	--	--	--	--	--	--
CO2	3	2	2	--	3	2	--	--	--	--	--	--
CO3	3	--	3	--	2	--	--	--	--	--	--	--
CO4	3	3	3	3	3	2	--	--	--	--	--	3

Course Contents:

Module I: [6L]
Introduction to computer graphics: Overview of computer graphics, Basic Terminologies in Graphics, lookup table,3D viewing devices, Plotters, printers, digitizers, light pens etc., Active &Passive graphics, Computer graphics software. Display: Light &Color models, Raster Scan and Random scan displays, CRT basics, video basics, Flat panel displays, Interpolative shading model.

Module II : [8**L]**
Scan conversion: Points & lines, Line drawing algorithms; DDA algorithm, Bresenham's line algorithm, Circle generation algorithm, Ellipse generating algorithm. Scan line polygon fill algorithm, boundary fill algorithm, flood fill algorithm

Module III: [14L]
2D and 3D Transformation Basic transformations: translation, rotation, scaling, Matrix representations & homogeneous coordinates, transformations between coordinate systems, reflection shear, Transformation of points, lines, parallel lines, intersecting lines.3D transformations: translation, rotation, scaling.2D-Viewing & Clipping Viewing pipeline, Window to viewport co-ordinate

transformation. Clipping operations: Point clipping, Cohen Sutherland line clipping algorithm, Weiler Atherton line clipping algorithm, Polygons Clipping, Viewport clipping

Module IV: [8**L]**
Projection Basic concepts of different type of projections Curves Bezier curves, B-spline curves. Hidden Surface Removal. Z-buffer algorithm, Back face detection, BSP tree method, Painter's algorithm

Text books:

1. Computer Graphics C Version by Donald Hearn, M. Pauline Baker, Pearson education.
2. Computer Graphics by Samit Bhattacharya, Oxford University Press.

Reference books:

1. Schaum's outlines Computer Graphics (2nd Ed.) by Ray A. Plastock, Gordon Kalley, McGraw-Hill Inc.
2. Mathematical Elements for Computer Graphics by David Rogers, J. Alan Adams,McGraw Hill Education.

COURSE NAME: **MULTIMEDIA TECHNOLOGY**
COURSE CODE: **IT603B**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **36**
CREDITS: **3**

Prerequisite:
Computer Fundamentals

Course Objective:
After understanding different technical aspects of Multimedia Systems specially the standards available for different audio, video and text applications, students can be able to Design and develop various Multimedia Systems applicable in real time. Then can deal with various network related issues used for multimedia audio, video and image related applications. The knowledge is very essential for a student to develop any audio-visual multimedia application and analyze the performance of the same

Course Outcome
After completion of this course students will be able to

CO1	Describe optical storage media along with different coding technique for solving real life multimedia application.
CO2	Apply the use of different media; representations of different multimedia data and data formats.
CO3	Analyze various compression techniques.
CO4	Evaluate and create various audio and video file formats.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	--	--	--	--	2	2	1	--	--	--	2
CO2	1	2	2	1	2	3	3	2	--	--	2	3
CO3	1	3	2	1	2	3	3	3	--	--	--	3
CO4	3	3	3	2	3	3	3	3	--	1	3	3

Course Contents:
Module I: [6L]
Introduction, Text and Audio: Multimedia: Impact of Multimedia, Multimedia Systems, Components and Its Applications. Text: Types of Text, Ways to Present Text, Aspects of Text Design, Character, Character Set, Codes, Unicode, Encryption. Audio: Basic Sound Concepts, Types of Sound, Digitizing Sound, Computer Representation of Sound (Sampling Rate, Sampling Size, Quantization), Audio Formats, Audio tools, MIDI.

Module II: [15L]
Image and Video: Image: Formats, Image Color Scheme, Image Enhancement, Image representation, segmentation; Lossless Image Compression: Huffman Coding, Arithmetic and Lempel-Ziv Coding; Lossy Image Compression Systems: Theory of Quantization, Delta Modulation and DPCM, Transform Coding & K-L Transforms, Discrete Cosine Transforms; Image retrieval: Image retrieval by color, shape and texture. Video: Analogue and Digital Video, Recording Formats and Standards (JPEG, MPEG, H.261) Transmission of Video Signals, Video Capture, and Computer based Animation, Different Case studies- QBIC, Virage. Video Content, querying, video segmentation, Indexing- kd trees, R-trees, quad trees.

Module III: [8L]
Synchronization, Multi-Resolution Analysis, Storage models and Access Techniques : Temporal relationships, synchronization accuracy specification factors, quality of service, Magnetic media, optical media, file systems (traditional, multimedia); Multimedia devices: Output devices, CD-ROM, DVD, Scanner, CCD, Theory of Wavelets, Theory of Sub band Coding (z-transform), Multi-resolution Analysis: Discrete Wavelet Transforms.

Module IV: [7L]
Embedded Wavelet Coding and Multimedia Applications: Zerotree Approach, SPIHT algorithm and EBCOT Algorithm, Interactive television, Video-on-demand, Video Conferencing, Educational Applications, Industrial Applications, Multimedia archives and digital libraries, media editors.

Text books:

1. Ralf Steinmetz and Klara Nahrstedt , Multimedia: Computing, Communications & Applications , Pearson Ed.
2. Fred Halsall, Multimedia Communications, Pearson Ed.

Reference books:

1. Koegel Buford , Multimedia Systems , Pearson Ed.
2. Nalin K. Sharda , Multimedia Information System , PHI.
3. Fred Hoffstetter , Multimedia Literacy , McGraw Hill.
4. J. Jeffcoate , Multimedia in Practice: Technology and Application , PHI.
5. Prabhat K. Andleigh& Kiran Thakrar , Multimedia Systems Design , PHI.

COURSE NAME: **SOFT COMPUTING**
COURSE CODE: **IT603C**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **36**
CREDITS: **3**

Prerequisite:
Mathematics, Set theory.

Course Objective:
To give students knowledge of soft computing theories fundamentals, that is of fundamentals of non-traditional technologies and approaches to solving hard real-world problems, namely of fundamentals of artificial neural networks, fuzzy sets, fuzzy logic and genetic algorithms.

Course Outcome
After completion of this course students will be able to

CO1	Understand the basics of various soft computing techniques.
CO2	Apply different soft computing techniques like Genetic Algorithms, Fuzzy Logic, Neural Networks and their combination.
CO3	Analyze the applications of various soft computing techniques.
CO4	Evaluate and create soft computing techniques to solve engineering or real-life problems.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	--	--	--	2	--	--	1
CO2	3	3	2	2	--	--	--	--	1	--	--	1
CO3	3	3	2	2	1	--	--	--	1	--	--	2
CO4	3	3	3	2	2	--	--	--	2	--	--	2

Course Contents:
Module I: [4L]
Introduction:
Soft Computing. Difference between Hard and Soft computing, Requirement of Soft Computing, Major Areas of Soft Computing, Applications of Soft Computing.

Module II : [10L]
Fuzzy Systems:
Fuzzy Set theory, Fuzzy versus Crisp set, Fuzzy Relation, Fuzzification, Min-max Composition, Defuzzification Method, Fuzzy Logic, Fuzzy Rule based systems, Fuzzy Decision Making, Fuzzy Control Systems, Fuzzy Classification**.**

Module III: [10L]
Genetic Algorithm: History of Genetic Algorithms (GA), Working Principle, Various Encoding methods, Fitness function, GA Operators- Reproduction, Crossover, Mutation, Convergence of GA, Bit wise operation in GA, Multi-level Optimization.

Module IV: [8L]
Genetic Algorithm: History of Genetic Algorithms (GA), Working Principle, Various Encoding methods, Fitness function, GA Operators- Reproduction, Crossover, Mutation, Convergence of GA,

Bit wise operation in GA, Multi-level Optimization.

Module V: [4L]

Hybrid Systems: Introduction to Hybrid Systems, Neuro Fuzzy Hybrid Systems, Neuro-Genetic Hybrid Systems, Fuzzy-Genetic Hybrid Systems.

Text books:

1. Fuzzy Logic with Engineering Applications, Timothy J. Ross, Willey.
2. Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis & Applications, S.Rajasekaran, G. A. Vijayalakshmi, PHI.
3. Genetic Algorithms: Search and Optimization, E. Goldberg

Reference books:

1. Neuro-Fuzzy Systems, Chin Teng Lin, C. S. George Lee PHI.
2. Elements of Artificial Neural Network, Kishan Mehrotra, MIT Press.
3. An Introduction to Genetic Algorithms, Melanie Mitchell, MIT Press.

COURSE NAME: **DIGITAL IMAGE PROCESSING**
COURSE CODE: **IT603D**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **36**
CREDITS: **3**

Prerequisite:
Mathematics, Computer Programming

Course Objective:
The aim of this course is to introduce to the students the basics of digital image processing. The students will gain overview about the available techniques and possibilities of this field. They will learn basic image transformation, segmentation algorithms and problems of object measurements

Course Outcome:
After completion of this course students will be able to

CO1	Understand the fundamental concepts of a digital image processing system
CO2	Identify images in the spatial as well as frequency domain using various transformation techniques for improving the image quality
CO3	Analyze various compression techniques.
CO4	Evaluate image segmentation and representation techniques.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	--	--	--	--	--	--	--	--	--	--	1
CO2	2	2	2	1	3	2	2	--	--	--	--	1
CO3	2	2	2	1	3	2	2	--	--	--	--	1
CO4	2	2	2	1	3	2	2	--	1	--	--	1

Course Contents:
Module I: [3L]
Introduction to Digital Image Processing:
Elements of digital image processing systems, Elements of visual perception Brightness, contrast, hue, saturation, match band effect, Image sampling and quantization.

Module II : [8L]
Image Enhancement: Spatial Basic grey level transformation, Histogram equalization, Histogram specification techniques, Noise Distributions, Image subtraction and Image averaging, Smoothing, sharpening filters, Frequency Domain methods: Introduction to Fourier Transform and DFT, Discrete Cosine Transform (DCT) and its properties, Smoothing in Frequency- Domain, Sharpening in Frequency- Domain, Homomorphic filtering.

Module III: [5L]
Image Restoration: Model of Image Degradation/restoration process, Noise models, Unconstrained restoration, Lagrange multiplier, least mean square filtering, Constrained least mean square filtering, Wiener filtering.

Module IV: [**3L]**
Color Image Processing: Different color Models, Color Transformations, Smoothing & Sharpening Color Image, Color Segmentation, Noise.

Module V: [6L]
Image Compression: Need for data compression, Different types of compression, Variable length coding-Huffman Coding, Run Length Encoding, Arithmetic coding, Lossy Compression: Vector Quantization, Transform coding, Basics of Image compression standards: JPEG.

Module VI: [6L]
Image Segmentation: Thresholding, Region Base2d2qx2d segmentation, Region growing, Region splitting and Merging, Edge detection, Canny edge detector..

Module VII: [3L]
Image registration: Geometric transformations: translation, rotation, scaling, homomorphic coordinate system; ground control points, affine transformation

Module VIII: [2L]
Representation & Description: Representation of segmented image, Boundary & Regional Descriptors, Use of Principal components for description

Text books:
1. Digital Image Processing by Woods, Gonzalves, Pearson
2. Digital Image Processing & Analysis by Chanda & Majumder, PHI

Reference books:
1. Digital Image Processing by Jahne by Springer India
2. Image Processing, Analysis & Machine Vision by Sonka, VIKAS
3. Fundamentals of Digital Image Processing by Jain, PHI

COURSE NAME: **DATA WAREHOUSING AND DATA MINING**
COURSE CODE: **IT604A**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **35**
CREDITS: **3**

Prerequisite:
Database Management System, Mathematics.

Course Objective:
The student should be made to be familiar with the concepts of data warehouse and data mining and be acquainted with the tools and techniques used for knowledge discovery in databases

Course Outcome:
After completion of this course students will be able to

CO1	Understand the basic concepts of data warehousing and data mining.
CO2	Apply the various mining algorithms for extract knowledge from data warehouse.
CO3	Analyze different data warehousing methodologies and data mining algorithms
CO4	Design a data warehouse

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	2	--	--	--	--	--	--	--	--	1
CO2	3	2	3	1	1	--	--	--	--	--	--	2
CO3	3	2	2	2	1	--	--	--	--	--	--	2
CO4	3	2	3	2	2	1	1	1	--	--	--	3

Course Contents:
Module I: [7L]
Data Warehouse:
Data Warehousing Components, Building A Data Warehouse, Mapping The Data Warehouse To A Multiprocessor Architecture, DBMS Schemas For Decision Support, Data Extraction, Cleanup, And Transformation Tools, Metadata

Module II: [7**L]**
Business Analysis:
Reporting And Query Tools and Applications, Tool Categories, The Need For Applications, Cognos Impromptu, Online Analytical Processing (OLAP), Need, Multidimensional Data Model, OLAP Guidelines, Multidimensional Versus Multi-relational OLAP, Categories of Tools, OLAP Tools And The Internet

Module III: [7L]
Data Mining:
Introduction, Data Types, Data Mining Functionalities, Interestingness of Patterns, Classification of Data Mining Systems, Data Mining Task Primitives, Integration of A Data Mining System With A Data Warehouse, Issues, Data Pre-processing.

Module IV: [7**L]**
Association Rule Mining and Classification:

Mining Frequent Patterns, Associations and Correlations, Mining Methods, Mining Various Kinds Of Association Rules, Correlation Analysis, Constraint Based Association Mining, Classification And Prediction, Basic Concepts, Decision Tree Induction, Bayesian Classification, Rule Based Classification, Classification By Back Propagation, Support Vector Machines, Associative Classification, Lazy Learners, Other Classification Methods, Prediction.

Module V: [7L]

Clustering and Trends in Data Mining:

Cluster Analysis, Types of Data, Categorization of Major Clustering Methods, K-Means, Partitioning Methods, Hierarchical Methods, Density-Based Methods, Grid Based Methods, Model-Based Clustering Methods, Clustering High Dimensional Data, Constraint, Based Cluster Analysis, Outlier Analysis, Data Mining Applications.

Text books:

1. Alex Berson And Stephen J.Smith, "Data Warehousing, Data Mining And OLAP", Tata McGraw – Hill Edition, Thirteenth Reprint 2008.
2. Jiawei Han And Micheline Kamber, "Data Mining Concepts And Techniques", Third Edition, Elsevier, 2012.

Reference books:

1. Data Mining, Practical Machine Learning Tools and Techniques, Third Edition; Ian H.
2. Witten, Eibe Frank, Mark A. Hall
3. Data Warehousing, Data Mining, & OLAP – Second Edition by Alex Berson and
4. Stephen J. Smith, TataMcGraw Hill Education
5. Data warehouse Toolkit by Ralph Kimball, Wiley India
6. Data Warehousing in the real world; Anahory; Pearson Education.

COURSE NAME: **CRYPTOGRAPHY AND NETWORK SECURITY**
COURSE CODE: **IT604B**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **36**
CREDITS: **3**

Prerequisite:
Discrete Mathematics, Computer Networking,

Course Objective:
The objective of the course is to study the about how to maintain the Confidentiality, Integrity and Availability and Authenticity of the data over insecure channel by various means and to understand various protocols for network security to protect against the threats in the networks.

Course Outcome:
After completion of this course students will be able to

CO1	Identify computer and network security threats, classify the threats, and understand different technique of cryptography and security.
CO2	Apply different algorithm and technique of encryption and decryption method over information and security techniques to the existing computer and network platforms.
CO3	Analyze existing cryptographic algorithm, authentication, and key agreement protocols; identify the strength and weaknesses of existing algorithm.
CO4	Design and develop cryptography algorithm and network technique security product or code, investigate the strong and weak points of the product or code.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	1	2	2	--	--	--	--	--	--	--	1
CO2	3	2	2	--	--	--	--	--	--	--	--	1
CO3	3	1	2	--	--	--	--	--	--	--	--	1
CO4	3	1	2	1	1	--	--	--	--	--	--	1

Course Contents:
Module I: [4L]
Attacks on Computers & Computer Security Introduction, Need for Security, Security approaches, Principles of Security, Types of attack.

Module II : [**7L]**
Cryptography: Concepts & Techniques Introduction, Plaintext & Cipher text, Substitution Techniques, Transposition Techniques, Encryption & Decryption, and Symmetric & Asymmetric key Cryptography, Key Range & Key Size.

Module III: [8L]
Symmetric Key Algorithm: Introduction, Algorithm types & Modes, Overview of Symmetric Key Cryptography, DES (Data Encryption Standard) algorithm, IDEA (International Data Encryption Algorithm) algorithm, RC5(Rivest Cipher 5) algorithm

Module IV: [**5L]**
Asymmetric Key Algorithm, Digital Signature and RSA Introduction, Overview of Asymmetric key Cryptography, RSA algorithm, Digital Signature, Basic concepts of Message Digest and Hash Function (Algorithms on Message Digest and Hash function not required).

Module V: [5L]
Internet Security Protocols, User Authentication Basic Concepts, SSL protocol, Authentication Basics, Password, Authentication Token, Certificate based Authentication, Biometric Authentication.

Module VI: [4L]
Electronic Mail Security Basics of mail security, Pretty Good Privacy, S/MIME

Module VII: [3L]
Firewall Introduction, Types of firewalls, Firewall Configurations.

Text books:
1. Cryptography and Network Security, William Stallings, 2nd Edition, Pearson Education Asia
2. Network Security private communication in a public world, C. Kaufman, R. Perlman and M. Speciner, Pearson
3. Cryptography & Network Security: Atul Kahate, TMH.

Reference books:
1. Network Security Essentials: Applications and Standards by William Stallings, Pearson
2. Designing Network Security, Merike Kaeo, 2nd Edition, Pearson Books
3. Building Internet Firewalls, Elizabeth D. Zwicky, Simon Cooper, D. Brent Chapman, 2nd Edition
4. Practical Unix & Internet Security, Simson Garfinkel, Gene Spafford, Alan Schwartz, 3rd Edition, Oreilly .

COURSE NAME: **COMPILER DESIGN**
COURSE CODE: **IT604C**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **36**
CREDITS: **3**

Prerequisite:
Mathematics, Concept of programming languages, Formal languages and automata theory

Course Objective:
To make the student understand the process involved in a compiler, to understand the syntax analysis and, intermediate code generation, type checking, the role of symbol table and its organization, Code generation, machine independent code optimization and instruction scheduling.

Course Outcome:
After completion of this course students will be able to

CO1	Understand the knowledge of parsing, lexical and syntax analysis.
CO2	Apply the knowledge about the compilers they practically use.
CO3	Analyze various parsing techniques, code optimization.
CO4	Learn how the parse trees are generated, errors are handled and code is optimized

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	1	3	3	--	--	--	2	--	1	2
CO2	3	1	2	2	--	--	--	--	1	--	--	1
CO3	3	1	2	--	2	--	--	--	1	--	--	2
CO4	3	2	1	1	1	--	--	--	2	--	--	1

Course Contents:
Module I: [7L]
Compilers, Cousins of the Compiler, Analysis-synthesis model, Phases of the compiler, Role of the lexical analyser, Tokens, Patterns, Lexemes, Input buffering, Specifications of a token, Recognition of tokens, Finite automata, From a regular expression to an NFA, From a regular expression to DFA, Design of a lexical analyser generator (Lex).

Module II : [10L]
The role of a parser, Context free grammars, Writing a grammar, Top down Parsing, Non-recursive Predictive parsing (LL), Bottom up parsing, Handles, Viable prefixes, Operator precedence parsing, LR parsers (SLR, LALR, Canonical LR), Parser generators (YACC), Error Recovery strategies for different parsing techniques, Syntax directed translation: Syntax directed definitions, Construction of syntax trees, Bottom-up evaluation of S-attributed definitions, L-attributed definitions, Bottom- up evaluation of inherited attributes.

Module III: [7L]
Type systems, Specification of a simple type checker, Equivalence of type expressions, Type conversions, Source language issues (Activation trees, Control stack, scope of declaration, Binding of names), Symbol tables, dynamic storage allocation techniques.

Module IV: [**4L]**
Intermediate languages, Graphical representation, Three-address code, Implementation of three address statements (Quadruples, Triples, Indirect triples).

Module V: [8L]
Consideration for Optimization, scope of optimization, local optimization, loop optimization, folding, DAG representation, Flow Graph, Data flow equation, global optimization, redundant sub expression elimination, induction variable elimination, copy propagation, basic blocks & flow graphs, transformation of basic blocks, DAG representation of basic blocks, peephole optimization, Object code forms, machine dependent code optimization, register allocation and assignment, generic code generation algorithms, DAG for register allocation.

Text books:

1. Aho, A. V., Sethi, R., & Ullman, J. D. Addison-Wesley, 2007. Compilers-Principles, Techniques, and Tools.
2. Holub, A. I. (1990). Compiler design in C (Vol. 5). Englewood Cliffs, NJ: Prentice Hall.

Reference books:

1. Chattopadhyay, S. (2005). Compiler Design. PHI Learning Pvt. Ltd.
2. Tremblay, J. P., & Sorenson, P. G. (1985). Theory and Practice of Compiler Writing. McGraw-Hill, Inc.
3. Appel, A. W. (2004). Modern compiler implementation in C. Cambridge university press.
4. Barrett, W. A., Bates, R. M., Gustafson, D. A., & Couch, J. D. (1986). Compiler construction: theory and practice. SRA School Group.

COURSE NAME: **PATTERN RECOGNITION**
COURSE CODE: **IT604D**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **35**
CREDITS: **3**

Prerequisite:
Fundamentals of probability and linear algebra

Course Objective:
The objective of this course is to learn the fundamentals of pattern recognition and its relevance to classical and modern problems. The main objective is to be able to identify where, when and how pattern recognition can be applied.

Course Outcome:
After completion of this course students will be able to

CO1	Understand basic concepts in pattern recognition techniques, feature extraction techniques and representation of patterns in feature space.
CO2	Apply the various real world applications in pattern recognition techniques.
CO3	Analyze the application of machine vision, speech recognition and movement recognition used in pattern recognition research.
CO4	Evaluate and create model for Machine Vision, Speech Recognition, Speaker Identification, and Process Identification.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	1	1	1	1	--	--	--	--	--	--	3
CO2	2	2	2	1	1	1	--	--	--	--	--	2
CO3	2	1	1	1	3	--	--	--	--	--	--	2
CO4	3	1	2	1	1	--	--	--	--	--	--	2

Course Contents:
Module I: [5L]
Introduction to Pattern Recognition :
Importance of Pattern Recognition, Features, Feature Vectors, and Classifiers, Supervised, Unsupervised, and Semi-Supervised Learning.

Module II : [10L]
Classifiers Based on Bayes Decision Theory:
Introduction, Bayes Decision Theory: Minimizing the Classification Error Probability, Minimizing the Average Risk, Discriminant Functions and Decision Surfaces, Bayesian Classification for Normal Distributions: The Gaussian Probability Density Function, The Bayesian Classifier for Normally Distributed Classes, Decision Hyper planes, Minimum Distance Classifiers, Estimation of Unknown Probability Density Functions: Maximum Likelihood Parameter Estimation, Maximum a Posteriori Probability Estimation, Bayesian Inference, Maximum Entropy Estimation, Mixture Models, The Expectation Maximization (EM) Algorithm, Application to the Mixture Modelling Problem, Nonparametric Estimation, The Naive-Bayes Classifier, The Nearest Neighbour Rule, Bayesian Networks, Problems.

Module III: [10L]
Linear Classifiers
Introduction, Linear Discriminant Functions and Decision Hyperplanes, The Perceptron Algorithm: Proof of the Perceptron Algorithm Convergence, Variants of the Perceptron Algorithm, The Perceptron, The Pocket Algorithm, Kesler's Construction, Least Squares Methods: Mean Square Error Estimation, Multiclass Generalization, Stochastic Approximation and the LMS Algorithm, Sum of Error Squares Estimation, Mean Square Estimation Revisited: Mean Square Error Regression, MSE Estimates Posterior Class Probabilities, The Bias–Variance Dilemma, Logistic Discrimination, Support Vector Machines: Separable Classes, Non separable Classes, The Multiclass Case, *v*-SVM, Support Vector Machines: A Geometric Viewpoint, Reduced Convex Hulls, Problems

Module IV: [10L]
Feature Selection
Introduction, Preprocessing: Outlier Removal, Data Normalization, Missing Data, The Peaking Phenomenon, Feature Selection Based on Statistical Hypothesis Testing: Hypothesis Testing Basics-The Known Variance Case, The Unknown Variance Case, Application of the *t*-Test in Feature Selection. The Receiver Operating Characteristics (ROC) Curve, Class Separability Measures, Divergence, Chernoff Bound and Bhattacharyya Distance, Scatter Matrices, Feature Subset Selection: Scalar Feature Selection, Feature Vector Selection, Suboptimal Searching Techniques, Optimal Feature Generation, Neural Networks and Feature Generation/Selection, Support Vector Machines: A Last Touch, The Bayesian Information Criterion.

Text books:
1. Pattern Recognition, S.Theodoridis and K.Koutroumbas, 4th Ed., Academic Press, 2009

Reference books:
1. Pattern Recognition and Machine Learning, C.M.Bishop, Springer, 2006
2. Pattern Classification, R.O.Duda, P.E.Hart and D.G.Stork, John Wiley, 2001

COURSE NAME: **PRINCIPLES OF MANAGEMENT**
COURSE CODE: **HU605**
CONTACT: **2:0:0**
TOTAL CONTACT HOURS: **30**
CREDITS: **2**

Course Objective:
To develop ability to critically analyze and evaluate a variety of management practices in the contemporary context .

Course Outcome:

After completion of this course students will be able to	
CO1	Recall and identify the relevance of management concepts.
CO2	Apply management techniques for meeting current and future management challenges faced by the organization.
CO3	Compare the management theories and models critically to solve real life problems in an organization.
CO4	Apply principles of management in order to execute the role as a manager in an organization.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	--	--	--	--	2	--	--	--	--	--	1	3
CO2	--	--	--	--	2	--	--	--	--	--	1	2
CO3	--	--	--	--	--	2	--	--	--	--	1	3
CO4	--	--	--	--	2	2	--	3	--	--	1	3

Course Contents:

Module I: [4L]
Introduction to Management: definitions, managerial roles and functions; Science or Art perspectives- External environment-global, innovative and entrepreneurial perspectives of Management – Managing people and organizations in the context of New Era- Managing for competitive advantage - the Challenges of Management.

Module II : [6L]
Early Contributions and Ethics in Management: Scientific Management- contributions of Taylor, Gilbreths, Human Relations approach-contributions of Mayo, McGregor's Theory, Ouchi's Theory Z .Systems Approach, the Contingency Approach, the Mckinsey 7-S Framework Corporate Social responsibility- Managerial Ethics.

Module III: [6L]
Planning: Nature and importance of planning, -types of plans - Steps in planning, Levels of planning - The Planning Process. – MBO Organizing for decision making: Nature of organizing, organization levels and span of control in management Organizational design and structure –departmentation, line and staff concepts Leading and Controlling: Leading Vs Managing – Trait approach and Contingency approaches to leadership - Dimensions of Leadership - Leadership Behavior and styles – Transactional and Transformational Leadership Basic control process control as a feedback system – Feed Forward Control – Requirements for effective control – control techniques – Overall controls and preventive controls – Global controlling.

Module IV: [6L]
Management of Physical Resources Plant: site selection procedures, factors affecting selection. Layout-types and relative merits and demerits, Maintenance-Objectives, different types of associated decisions, strategies for effective maintenance, computer applications. Material : Functions, objectives, planning and control including inventory models with or without storage costs, price break. Different classes of inventory. Material Requirement Planning (MRP).

Module V: [4L]
Quality management: Quality definition, quality planning, quality control and quality management, Total quality management, ISO 9000 systems, simple quality control techniques like control charts and acceptance sampling, Kaizen & Six Sigma.

Module VI: [4L]
Marketing management consumer behavior, market research, product design and development pricing and promotion.

Text books:
1. Harold Kooritz & Heinz Weihrich "Essentials of Management", Tata McGraw-Hill.

Reference books:
1. M. Prasad, Principles of Management , Sultan Chand & sons, New Delhi.
2. Sherlekar & sherlekar, Principles of Management, Himalaya Publishing House, New Delhi

COURSE NAME: **COMPUTATIONAL GEOMETRY**
COURSE CODE: **IT606A**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **36**
CREDITS: **3**

Prerequisite:
Data Structure & Algorithm

Course Objective:
Ability to apply and expand geometric techniques in computing.

Course Outcome
After completion of this course students will be able to

CO1	Exposure to algorithms and data structures for geometric problems.
CO2	Exposure to techniques for addressing degenerate cases.
CO3	Exposure to randomization as a tool for developing geometric algorithms
CO4	Apply the techniques to specific application domains of interest or pursue independent research in this area.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	--	2	3	--	2	1	--	--	--	--	--
CO2	2	2	--	2	3	1	--	--	--	--	--	--
CO3	2	3	2	--	2	--	2	1	--	1	--	2
CO4	3	--	3	3	3	3	2	--	1	--	1	2

Course Contents:
Module I: [4L]
Introduction: Algorithmic design paradigms (divide and conquer, incremental, sweep line, and prune and search) and basic data structures (segment and interval trees).

Module II : [4**L]**
Geometric searching: Point locations (slab and chain methods) and range searching (kD and range trees).

Module III: [6L]
Convex Hull: Graham's scan, gift wrapping, quick hull, divide-and-conquer Voronoi diagram

Module IV: [6**L]**
Delayney Triangulations: polygon triangulations, representations, point-set triangulations., algorithms (divide-and-conquer, flip, incremental), duality of Voronoi diagrams, properties (min-max angle). Geometric searching: point-location, 2d linear programming with prune and search

Module V: [6L]
Visibility: algorithms for weak and strong visibility, visibility with reflections, art-gallery problems. Arrangements of lines: 2d arrangements, zone theorem, many-faces complexity, algorithms.

Module VI: [6L]
Sweep techniques: plane sweep for segment intersections, Fortune s sweep for Voronoi diagrams, topological sweep for line arrangements. Combinatorial geometry: Ham-sandwich cuts, Helly s theorems, k-sets.

Module VII: [4L]
Rectilinear Geometry: intersection and union of rectangles, rectangle searching. Robust geometric computing. Applications of computational geometry.

Text books:
1. F. P. Preparata and M. I. Shamos, Computational Geometry: An Introduction, Springer-Verlag, 1985

Reference books:
1. J. O'Rourke, Computational Geometry in C, 2nd Ed, Cambridge University Press, 1998.
2. M. Laszlo, Computational Geometry and Computer Graphics in C++, Prentice-Hall, 1996.
3. M. De Berg, M. van Kreveld, M. Overmars, O. Schwarzkopf, Computational Geometry: Algorithms and Applications, Springer -Verlag, 1997.

COURSE NAME: **MOBILE COMMUNICATION**
COURSE CODE: **IT606B**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **36**
CREDITS: **3**

Prerequisite:
Computer Networking, Operating System, Mathematics.

Course Objective:
The objective of the course is to presents the basic principles of mobile communication systems, analysis the operation of mobile communications system with wireless network.

Course Outcome:
After completion of this course students will be able to

CO1	Understand the basic of Mobile Communication system & its generation in wireless network
CO2	Analyze the network infrastructure requirements to support mobile devices and users.
CO3	Apply the knowledge to determine the functionalities, techniques, protocols and architecture employed in wireless local area networks, cellular networks, and performs basic requirements analysis.
CO4	Evaluate the techniques and technologies to design and communicate a simple mobile application for smaller devices.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	1	--	--	--	--	--	--	--	--	1
CO2	2	3	3	1	--	--	1	--	--	--	--	1
CO3	2	3	3	2	--	--	1	--	--	--	--	1
CO4	2	3	3	3	--	--	1	--	--	--	--	1

Course Contents:
Module I: [5L]
Overview:
Introduction to Mobile Communication – Applications of Mobile Communication - Generations of Mobile Communication Technologies-MAC Protocols – SDMA- TDMA- FDMA- CDMA Transmission Medium, Need, Advantages, Disadvantages. Transmission Media, Advantages & Disadvantages.

Module II :[**4L]**
Global System for Mobile Communication & General Packet Radio Services:
Global System for Mobile Communication (GSM) system overview: GSM Architecture, Mobility management, Network signaling. GPRS Architecture, GPRS Network Nodes.

Module III: [6L]
Wireless LANs
Characteristics, IEEE 802.11: Architecture, Physical Layer, MAC Layer, And MAC Management, 802.11a and 802.11b. HIPERLAN: History, WATM, BRAN and HiperLAN2.Bluetooth: Architecture, Radio Layer, Baseband Layer, Link Management Protocol, L2CAP and Security.

Module IV: [**10L]**
Network Layer:
Introduction, Traditional TCP: Congestion Control, Slow Start, Fast Retransmit and Implications of Mobility. Classical TCP Improvements: Indirect TCP, Snooping TCP, Mobile TCP and Fast Retransmit. Mobile IP: Introduction, IP Packet Delivery, Agent Discovery, Registration, Tunneling and Encapsulation, Optimizations and Reverse Tunneling. Mobile Ad-hoc Networks: Routing, Destination Sequence Distance Vector, Dynamic Source Routing and Alternative Metrics.

Module V: [8L]
Cellular Networks:
Cellular Concept, Frequency Reuse, Channel Allocation Management, Call Setup, Location Management, Cell Handoffs, Interference: Co-channel and Adjacent Interference. System Capacity, Improving Cell Capacity and Coverage: Cell Splitting, Sectoring, Repeaters and Microcell Zone Concept.

Module VI: [3L]
Wireless Application Protocol [3L]
The Mobile Internet standard, WAP Gateway and Protocols.

Text books:
1. J. Schiller, Mobile Communications, Addison –Wesley, 2003

Reference books:
1. T. S. Rapport, Wireless Communications, Principle and Practices
2. Forouzan, Data Communications and Networking, TMH

COURSE NAME: **ROBOTICS**
COURSE CODE: **IT606C**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **35**
CREDITS: **3**

Prerequisite:
Microprocessor & Microcontroller, Computer Organization & Architecture

Course Objective:
To learn how Microchip PIC micro PIC16F627 can be erased and re programmed, to learn how different sensors, outputs, and peripherals can be wired to a microcontroller to work cooperatively and create a high-level control program.

Course Outcome:
After completion of this course students will be able to

CO1	Understand the computational methods necessary to model and solve kinematic problems involving robot manipulators and mobile robots.
CO2	Experiment with the most common robot sensors and understand fundamental sensor processing algorithms and their engineering trade-offs.
CO3	Analyze the computational challenges inherent in fundamental mobile robotic tasks.
CO4	Develop simple robot control systems integrating perception, planning, and action.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	1	1	--	--	--	--	--	--	--	1
CO2	3	2	2	2	1	1	2	2	--	--	--	1
CO3	2	3	2	3	3	1	2	--	--	--	--	1
CO4	2	2	3	3	3	2	2	2	3	2	--	1

Course Contents:

Module I: [5L]
Brief history, types, classification and usage, Science and Technology of robots, Some useful websites, textbooks and research journals.
Position and orientation of a rigid body, Homogeneous transformations, Representation of joints, link representation using D-H parameters, Examples of D-H parameters and link transforms, different kinds of actuators – stepper, DC servo and brushless motors, model of a DC servo motor, Types of transmissions, Purpose of sensors, internal and external sensors, common sensors – encoders, tachometers, strain gauge based force-torque sensors, proximity and distance measuring sensors, and vision.

Module II : [8**L]**
Introduction, Direct and inverse kinematics problems, Examples of kinematics of common serial manipulators, workspace of a serial robot, Inverse kinematics of constrained and redundant robots, Tractrix based approach for fixed and free robots and multi-body systems, simulations and experiments, Solution procedures using theory of elimination, Inverse kinematics solution for the general 6R serial manipulator. Degrees-of-freedom of parallel mechanisms and manipulators, Active and passive joints, Constraint and loop-closure equations, Direct kinematics problem, Mobility of

parallel manipulators, Closed-from and numerical solution, Inverse kinematics of parallel manipulators and mechanisms, Direct kinematics of Gough-Stewart platform.

Module III: [8L]

Linear and angular velocity of links, Velocity propagation, Manipulator Jacobians for serial and parallel manipulators, Velocity ellipse and ellipsoids, Singularity analysis for serial and parallel manipulators, Loss and gain of degree of freedom, Statics of serial and parallel manipulators, Statics and force transformation matrix of a Gough-Stewart platform, Singularity analysis and statics. Mass and inertia of links, Lagrangian formulation for equations of motion for serial and parallel manipulators.

Module IV: [**9L]**

Joint and Cartesian space trajectory planning and generation, Classical control concepts using the example of control of a single link, Independent joint PID control, Control of a multi-link manipulator, Non-linear model based control schemes, Simulation and experimental case studies on serial and parallel manipulators, Control of constrained manipulators, Cartesian control, Force control and hybrid position/force control, Advanced topics in non-linear control of manipulators

Module V: [5L]

Introduction and some well known wheeled mobile robots (WMR), two and three-wheeled WMR on flat surfaces, Slip and its modeling, WMR on uneven terrain, Design of slip-free motion on uneven terrain, Kinematics, dynamics and static stability of a three-wheeled WMR‘s on uneven terrain, Simulations using Matlab and ADAMS. Introduction to chaos, Non-linear dynamics and chaos in robot equations, Simulations of planar 2 DOF manipulators, Analytical criterion for unforced motion. Gough-Stewart platform and its singularities, use of near singularity for fine motion for sensing, design of Gough-Stewart platform based sensors. Over-constrained mechanisms and deployable structures, Algorithm to obtain redundant links and joints, Kinematics and statics of deployable structures with pantographs or scissor-like elements (SLE‘s).

Text books:

1. Myke Predko, ―Programming Robot Controllers‖ – McGrawHill, 1st edition, 2003.

Reference books:

1. Michael slater, ―Microprocessor – based design: A comprehensive Guide to Effective Hardware Design, Prentice Hall, 1989.
2. Myke Predko, ―Programming and customizing the 8051- micro-controller‖, Tata McGraw-Hill, New Delhi, 2000.
3. Kenneth J. Ayala, ―The 8051 micro-controller architecture, programming and applications, Penram International publishers, Mumbai, 1996.
4. Murphy Robin R,‖ Introduction to AI Robotics‖, MIT Press, 2000.
5. Siegwart R and Nourbakhsh I.R, ―Introduction to Autonomous mobile Robots‖, Prentice Hall India, 2005.
6. Roland Siegwart, Illah R. Nourbakhsh, ―Introduction to Autonomous mobile Robots‖, MIT Press, 2005.

COURSE NAME: **WIRELESS SENSOR NETWORKS**
COURSE CODE: **IT606D**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **36**
CREDITS: **3**

Prerequisite:
Discrete Mathematics, Computer Networking,

Course Objective:
To understand the fundamentals of wireless sensor networks and its application to critical real time scenarios.

Course Outcome
After completion of this course students will be able to

CO1	Understand and explain common wireless sensor node architectures.
CO2	Apply the various ad hoc routing protocols and transport layer mechanisms.
CO3	Analyse the issues of routing in wsn and QoS related performance measurements.
CO4	Design a wireless sensor network for given sensor data using microcontroller, transceiver, middleware and operating system.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	3	2	2	1	--	--	--	--	--	--	2
CO2	3	3	2	2	3	--	--	--	--	--	--	3
CO3	3	3	2	3	2	--	--	--	--	--	--	2
CO4	3	3	2	3	3	--	--	--	--	--	--	2

Course Contents:
Module I: [7L]
Introduction: Fundamentals of wireless communication technology, the electromagnetic spectrum radio propagation, characteristics of wireless channels, modulation techniques, multiple access techniques, wireless LANs, PANs, WANs, and MANs, Wireless Internet.

Module II : [**8L]**
Introduction to adhoc/sensor networks: Key definitions of adhoc, sensor networks, unique constraints and challenges, advantages of ad-hoc/sensor network, driving applications, issues in adhoc wireless networks, issues in design of sensor network, sensor network architecture, data dissemination and gathering

Module III: [7L]
MAC Protocols : Issues in designing MAC protocols for adhoc wireless networks, design goals, classification of MAC protocols, MAC protocols for sensor network, location discovery, quality, other issues, S-MAC, IEEE 802.15.4.

Module IV: [**8L]**
Routing Protocols: Issues in designing a routing protocol, classification of routing protocols, table-driven, on-demand, hybrid, flooding, hierarchical, and power aware routing protocols.

Module V: [6L]
QoS and Energy Management : Issues and Challenges in providing QoS, classifications, MAC, network layer solutions, QoS frameworks, need for energy management, classification, battery, transmission power, and system power management schemes.

Text books:
1. C. Siva Ram Murthy, and B. S. Manoj, "AdHoc Wireless networks ", Pearson Education.

Reference books:
1. Feng Zhao and Leonides Guibas, "Wireless sensor networks ", Elsevier publication
2. Jochen Schiller, "Mobile Communications", Pearson Education, 2nd Edition, 2003.
3. William Stallings, "Wireless Communications and Networks ", Pearson Education.

COURSE NAME: **WEB TECHNOLOGY LAB**
COURSE CODE: **IT 691**
CONTACT: **0:0:3**
CREDITS: **1.5**

Prerequisite:
Basic knowledge on Java and computer networking and database.

Course Objective:
Describing the web application architecture and protocols; Illustrating different technologies those are used to develop web applications; Describing different frameworks those used to develop web applications.

Course Outcome
After completion of this course students will be able to

CO1	Apply the concept of web technology in designing solution
CO2	Analyze different features of web technology for best suitable solution providing
CO3	Evaluate different web application solution applying the concept of different front end and back end technologies
CO4	Create web application solution for different problems

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	1	1	1	--	--	--	--	--	--	--	--
CO2	--	2	2	1	2	--	--	--	--	--	--	--
CO3	--	3	1	2	1	--	--	1	--	--	--	--
CO4	1	1	3	--	2	--	--	--	--	1	--	--

Course Contents:
HTML
Developing application using different HTML elements, designing forms using HTML, Apply DOM

CSS
Using different CSS Styles for designing interactive forms and interfaces.

Java Script
Using Java script variables, operators, control structure, functions and event handling, Form validation using java script, Node js server implementation, express js for implementing web application handling get, put, post, etc.

JDBC
Connecting to databases using jdbc:odbc bridge and Type-4 drivers, Batch execution, Stored Procedure

Servlet
Developing web application using servlet: get/post, Developing filter application, Session handling.

JSP
Developing web application using JSP as view, Session handling using JSP, Using JSP components,

Custom tag development.

AJAX
Developing web application using AJAX: accessing XML, text files.

Web Service
Development web service as reusable components

Innovative Experiments
Develop some innovative experiments.

Text books:
1.Professional Java Server Programming Allamaraju.

Reference books:
1. Web Technology: A Developer's Perspective, N.P. Gopalan and J. A kilandeswari, PHI Learning, Delhi, 2013.
2. Web Technologies Black Book: HTML, JavaScript, PHP, Java, JSP, XML and AJAX, Kogent Learning Solutions INC.

COURSE NAME: **MACHINE LEARNING LAB**
COURSE CODE: **IT692**
CONTACT: **0:0:3**
CREDITS: **1.5**

Prerequisite:
Probability, Linear Algebra, Calculus, R/Python Programming

Course Objective:
This course provides the knowledge to Install and use R/Python for simple programming tasks, extended R/Python libraries and packages.

Course Outcome
After completion of this course students will be able to

CO1	Apply machine learning algorithms such as supervised, semi-supervised, and unsupervised.
CO2	Analyze various machine learning techniques to investigate real world applications.
CO3	Evaluate and create model for finding the solution of real world industry issues and problems.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	1	--	--	--	--	--	--	--	2
CO2	1	2	2	1	2	--	--	--	--	--	--	2
CO3	1	3	1	2	1	--	--	1	--	--	--	3

Course Contents:
1. Write R/Python program to calculate the square root of 2345, and perform a log2 transformation on the result.
2. Print the 1 to10 numbers in reverse order in R/Python Programming language.
3. Find 10 random numbers between 0 and100 in R/Python Programming language.
4. Compute the truth table for logical AND in R/Python Programming language.
5. Use R/Python to find all the numbers between 1 and n which are multiples of some m.
6. Write a program in R/Python to check the leap year or not.
7. Find the Factorial of a given Number in R/Python.
8. Program to check whether the given number is Prime or not in R/Python.
9. Check whether the given number is Arm strong number or not.
10. Program to display multiplication table in R.
11. Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.
12. Write a program to implement the Naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.
13. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
14. Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.

Text books:

1. The Art of R Programming, Norman Matloff, Cengage Learning.
2. R for Everyone, Lander, Pearson.

Reference books:

1. R Cookbook, PaulTeetor, Oreilly.
2. R in Action, Rob Kabacoff, Manning.

COURSE NAME: **COMPUTER GRAPHICS LAB**
COURSE CODE: **IT693A**
CONTACT: **0:0:3**
CREDITS: **1.5**

Prerequisite:
Computer Programming, Mathematics

Course Objective:
The objective of the course is to become familiar with graphics programming and expertise in text, image, audio, video enhancement and manipulation using different software/tools through projects..

Course Outcome:
After completion of this course students will be able to

CO1	Apply 3D graphical scenes using open graphics library suits.
CO2	Analyze the effects of scale and use on both presentation and lower-level requirements.
CO3	Compare interactive multimedia presentation by using multimedia devices and identify theoretical and practical aspects in designing multimedia applications surrounding the emergence of multimedia technology.
CO4	Implement image manipulation, enhancement, and basic transformations on objects and clipping algorithm on lines.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	2	1	3	2	2	--	--	--	--	3
CO2	2	2	3	3	2	--	--	--	--	--	--	2
CO3	3	2	2	3	3	2	--	--	--	--	--	2
CO4	3	2	3	--	2	3	1	1	2	--	--	3

Course Contents:
IMPLEMENT THE EXERCISES USING C /C++/ OPENGL / JAVA

- Implementation of Algorithms for drawing 2D Primitives – Line (DDA, Bresenham) – all slopes, Circle(Midpoint)
- 2D Geometric transformations – Translation, Rotation Scaling , Reflection Shear, Window-Viewport
- Composite 2DTransformations
- Line Clipping
- 3D Transformations - Translation, Rotation, Scaling.
- 3D Projections – Parallel, Perspective.
- Creating 3DScenes.
- Image Editing and Manipulation - Basic Operations on image using any image editing software, Creating gif animated images, Image Optimization.
- 2D Animation – To create Interactive animation using any authoring tool.
- VLC and Video Streaming
- HTML 5 and media publishing with Projects based learning.
- Web document creation using Dreamweaver.

- Creating Animation using Flash.

Text books:

2. Hearn Baker Carithers, - "Computer Graphics with Open GL", Pearson New International Edition

Reference books:

1. Donald Hearn and Pauline Baker M, ―Computer Graphics", Prentice Hall, New Delhi, 2007
2. P. K and Kiran Thakrar, ―Multimedia Systems and Design‖, PHI,2003.

COURSE NAME: **MULTIMEDIA TECHNOLOGY LAB**
COURSE CODE: **IT693B**
CONTACT: **0:0:3**
CREDITS: **1.5**

Prerequisite:
Computer Graphics Programming

Course Objective:
The objective of the course is to become familiar with graphics programming and expertise in text, image, audio, video enhancement and manipulation using different software/tools through projects..

Course Outcome:
After completion of this course students will be able to

CO1	Understand about various latest interactive multimedia devices, the basic concepts about images and image format.
CO2	Apply and analyze data compression techniques, image compression techniques like JPEG, video compression techniques like MPEG, and the basic concepts about animation.
CO3	Evaluate and develop an interactive multimedia presentation by using multimedia devices and identify theoretical and practical aspects in designing multimedia applications are surrounding the emergence of multimedia technology.
CO4	Analyze the effects of scale and use on both presentation and lower level requirements along with feedback evaluation in response to an objective set of criteria for multimedia design.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	3	3	3	2	--	--	2	2	--	--
CO2	3	3	3	3	3	2	--	--	2	2	2	--
CO3	3	3	3	3	3	2	2	1	2	2	2	2
CO4	3	3	3	3	3	3	2	--	2	1	2	3

Course Contents:
- Perceptual and cognitive psychology related to visual and auditory perception.
- Methods of data sampling and digitization relative to different formats of audio and video media: frequency- and spatial-based sampling., vector-based and sampling-based media representations, audio and video files including AVI and WAV, uses and application of XML, media data compression.
- Sound capturing & editing using tools like SOUNDFORGE
- Image editing using tools like Adobe Photoshop Creating/editing motion video/animation clips (using tools like Flash / Adobe Premier)

Text books:
1. Adobe Photoshop CC Classroom in a Book (2018 release), Pearson Ed.,
2. Anushka Wirasinha , Flash in a Flash- Web Development , PHI

Reference books:
1. Macromedia Flash5 fast and easy Web Development, Design, PHI,
2. Lozano, Multimedia- Sound & Video , PHI.

COURSE NAME: **SOFT COMPUTING LAB**
COURSE CODE: **IT693C**
CONTACT: **0:0:3**
CREDITS: **1.5**

Prerequisite:
Set theory and basic computation.

Course Objective:
To give students knowledge of soft computing theories fundamentals, that is of fundamentals of non-traditional technologies and approaches to solving hard real-world problems, namely of fundamentals of artificial neural networks, fuzzy sets, fuzzy logic and genetic algorithms.

Course Outcome:
After completion of this course students will be able to

CO1	Apply different soft computing techniques like Genetic Algorithms, Fuzzy Logic, Neural Networks and their combination.
CO2	Analyze and implement real life problems based on soft computing techniques.
CO3	Evaluate and create soft computing model to solve real life problems of the society.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	3	2	2	2	--	--	--	1	--	1	1
CO2	3	2	2	2	--	--	--	--	1	--	1	1
CO3	2	3	2	2	1	--	--	--	1	--	1	2

Course Contents:

1) Overview of Matrix, Matrix Operations, Giving input to Matrix, Displaying elements of Matrix.
2) Performing Operations on Matrix like Addition, Subtraction, and Multiplication.
3) Performing Transpose Operations on Matrix.
4) Plotting of mathematical functions like log(x), sin(x), cos(x). etc
5) Write a Program in MATLAB to check whether a number is even or odd
6) Write a program in MATLAB to find out the sum of "N" natural numbers.
7) Write a Program in MATLAB to generate the Fibonacci series upto N , where N is the desired value input by user
8) Write a MATLAB program to solve MATRIX based problems.
9) Write a MATLAB Program to implement LMS Learning rule.
10) Write a MATLAB program to verify McCulloch OR Function.
11) Write a MATLAB program to verify Hebb's Rule.
12) Write a MATLAB program to implement various Fuzzy Operations. (EgUnion , Intersection , Complement, XOR Operation) For two Fuzzy Set
    P = (0.3/a) + (0.9/b) + (1.0/c) + (0.7/d) + (0.5/e) + (0.4/f) + (0.6/g)
    Q = (1/a) + (1/b) + (0.5/c) + (0.2/d) + (0.2/e) + (0.1/f) + (0.4/g)
13) Write a MATLAB program to implement Max-Min Composition
    For Two Fuzzy sets

P = [0.3 0.7 ; 0.9 0.4 ; 0.2 0.5]
Q = [0.4 0.1 0.8;0.3 0.7 0.6]

14) Implementation of Union , Intersection , Complement , XOR Operation and Demorgan's Law
15) Write a MATLAB program to implement MAX Composition for the two set of Matrix
S = [0.3 0.7;0.9 0.4;0.2 0.5]
R = [0.4 0.1 0.8;0.3 0.7 0.6]
16) Write a MATLAB program to implement Defuzzification α-cut method
For the following fuzzy set
F = (0.6/a) + (0.3/b) + (0.7/c) + (1.0/d).

Projects assigned by instructor to model and solve real world problems.

Text books:

1. Fuzzy Logic with Engineering Applications, Timothy J. Ross, Willey.
2. Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis & Applications, S.Rajasekaran, G. A. Vijayalakshami, PHI.
3. Genetic Algorithms: Search and Optimization, E. Goldberg.

Reference books:

1. Neuro-Fuzzy Systems, Chin Teng Lin, C. S. George Lee PHI.
2. Elements of Artificial Neural Network, Kishan Mehrotra, MIT Press.
3. An Introduction to Genetic Algorithms, Melanie Mitchell, MIT Press

COURSE NAME: **DIGITAL IMAGE PROCESSING LAB**
COURSE CODE: **IT693D**
CONTACT: **0:0:3**
CREDITS: **1.5**

Prerequisite:
Knowledge on Computer Programming.

Course Objective:
The aim of this course is to familiarize the students in the regular Image Processing Software with respect to basic processing required to generate thematic maps from different sources of images..

Course Outcome
After completion of this course students will be able to

CO1	Apply enhancing operations on the image using spatial filters and frequency domain filters.
CO2	Analyse the characteristics of the image using different transformation techniques.
CO3	Estimate the efficiency of the compression techniques on the images.
CO4	Plan different segmentation operations of images.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	--	--	--	1	--	--	--	--	--	--	1
CO2	2	3	2	3	--	--	--	--	--	--	--	--
CO3	1	1	1	2	1	--	--	--	1	--	--	--
CO4	1	3	3	1	2	1	1	--	1	1	--	1

Course Contents:
Simulation using MATLAB

1. Image sampling and quantization
2. Analysis of spatial and intensity resolution of images.
3. Intensity transformation of images.
4. DFT analysis of images
5. Different types of Transforms
6. Histogram Processing
7. Image Enhancement-Spatial filtering
8. Image Enhancement- Filtering in frequency domain
9. Image segmentation – Edge detection, line detection and point detection.
10. Region based Segmentation
11. Analysis of images with different color models.
12. Image compression techniques
13. Image restoration
14. A mini project based on medical image processing

Text books:
1. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, Digital Image Processing using MATLAB, Pearson Education

COURSE NAME: **CONSTITUTION OF INDIA**
COURSE CODE: **MC 601**
CONTACT: **2:0:0**
TOTAL CONTACT HOURS: **24**
CREDITS: **2 UNITS**

Course Outcome
After completion of this course students will be able to

CO1	Identify and explore the basic features and modalities of Indian constitution**.**
CO2	Differentiate and relate the functioning of Indian parliamentary system at the centre and state level.
CO3	Differentiate the various aspects of Indian Legal System and its related bodies.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	--	2	2	--	2	--	3	--	1	3	3
CO2	3	2	--	1	--	1	--	2	2	3	3	3
CO3	3	--	1	--	--	3	--	2	--	1	3	3

Course Contents:
Module I: [4L]
Constitution- Historical Background of the Constituent Assembly, Indian Constitution and its Salient Features, the Preamble of the Constitution.

Module II: [8L]
Fundamental Rights, Fundamental Duties, Directive Principles of State Policy:
The Right to Equality
The Right to Freedom: I (Article 19)
The Right to Freedom: II (Articles 20, 21 and 22)
The Right against Exploitation
The Right to freedom of Religion
Cultural and Educational rights
The Right to Property
The Right to Constitutional Remedies
The Directive Principles
Fundamental Duties

Module III: [6L]
Union Government and its Administration
Structure of the Indian Union, Parliamentary System, Federal System, Centre-State Relations, Amendment of the Constitutional Powers and Procedure, The historical perspectives of the constitutional amendments in India, Emergency Provisions: National Emergency, President Rule, Financial Emergency, and Local Self Government – Constitutional Scheme in India.

Module IV: [6L]

The Machinery of Government in the State

Powers of Indian Parliament Functions of Rajya Sabha, Functions of Lok Sabha, Powers and Functions of the President, Comparison of powers of Indian President with the United States, Powers and Functions of the Prime Minister, Judiciary – The Independence of the Supreme Court, Appointment of Judges State Executives – Powers and Functions of the Governor, Powers and Functions of the Chief Minister, Functions of State Cabinet, Functions of State Legislature, Functions of High Court and Subordinate Courts

Text books:

1. Indian Constitution by D.D.Basu, The Publisher, LexisNexis
2. Constitution of India by Subhas C Kasyap, Vitasta Publishing

Reference books:

1. The Constitution of India, P.M Bakshi, Universal Law Publishing Co.Ltd, New Delhi, 2003.
2. Indian Constitution Text Book - Avasthi, Avasthi,Publisher: LAKSHMI NARAIN AGARWAL

7th Semester

4th Year 7thSemester

Sl. No	Category	Course Code	Course Title	Contact Hours /Week				Credit Point
				L	T	P	Total	
A. THEORY								
1	Professional Elective Course	IT701A	Cloud Computing	3	0	0	3	3
		IT701B	Internet Technology					
		IT701C	Big Data Analytics					
		IT701D	Distributed System					
2	Professional Elective Course	IT702A	Internet of Things	3	0	0	3	3
		IT702B	Advanced Database Management System					
		IT702C	Block Chain Technology					
		IT702D	Deep Learning					
3	Open Elective Course	IT703A	Mobile Application Development	3	0	0	3	3
		IT703B	Fuzzy Logic and Application					
		IT703C	Microelectronics and VLSI Design					
		IT703D	Operational Research and Optimization Technique					
4	Open Elective Course	IT704A	Advanced Computer Architecture	3	0	0	3	3
		IT704B	Modelling and Simulation					
		IT704C	Virtual and Augmented Reality					
		IT704D	Entrepreneurship Development					
B. PRACTICAL								
5	Professional Elective Course	IT791A	Cloud Computing Lab	0	0	0	3	1.5
		IT791B	Internet Technology Lab					
		IT791C	Big Data Analytics Lab					
		IT791D	Distributed System Lab					
6	Open Elective Course	IT793A	Mobile Application Development Lab	0	0	3	3	1.5
		IT793B	Fuzzy Logic Lab					
		IT793C	VLSI Design Lab					
		IT793D	Operational Research Lab					
7	Project	PR791	Major Project-I	0	0	0	4	2
8	Project	PR792	Industrial Training / Internship	0	0	0	0	1
9	Project	PR793	Skill Development VII: Seminar & Group Discussion	1	0	0	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
10	Mandatory Course	MC781	Entrepreneurship & Innovation Skill	0	0	3	3	3 Units
TOTAL CREDIT WITHOUT MOOCS COURSES								18.5
D.MOOCS COURSES**								
11	MOOCS COURSES	HM701	MOOCS COURSE-V	3	1	0	4	4
TOTAL CREDIT WITH MOOCS COURSES								**22.5**

*Collective Data from 3rd to 6th Semester (Summer/Winter Training during Semester Break & Internship should be done after 5th Semester or 6th Semester). All related certificates to be collected by the training/internship coordinator(s). ** MOOCS COURSES for HONOURS/MINOR Degree are Program specific and to be taken from MOOCS BASKET

COURSE NAME: **CLOUD COMPUTING**
COURSE CODE: **IT701A**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **36**
CREDITS: **3**

Prerequisite:
Networking, Operating System, Web Technology.

Course Objective:
The objective of the course is to learn and understand Cloud computing in details and identify the usage of it.

Course Outcome
After completion of this course students will be able to

CO1	Understand the basic architecture of cloud computing
CO2	Apply the knowledge of cloud computing in the evaluation of the computing model.
CO3	Analyze different features of Cloud Computing
CO4	Evaluate the different models and solutions provided in the field of cloud computing.
CO5	Design different solution with different services in cloud computing

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	1	--	--	--	--	--	--	--	1
CO2	2	2	3	--	--	--	--	--	--	--	--	2
CO3	1	3	2	3	--	--	--	--	--	--	--	2
CO4	1	3	2	3	--	--	--	--	--	--	--	2
CO5	3	3	3	--	3	2	2	3	--	--	--	3

Course Contents:

Module I: Overview of Computing Paradigm [3L]
Recent trends in Computing Grid Computing, Cluster Computing, Distributed Computing, Utility Computing, Cloud Computing Evolution of cloud computing Business driver for adopting cloud computing.

Module II: Introduction to Cloud Computing [3L]
Cloud Computing (NIST Model) Introduction to Cloud Computing, History of Cloud Computing, Cloud service providers Properties, Characteristics and Disadvantages Pros and Cons of Cloud Computing, Benefits of Cloud Computing, Cloud computing vs. Cluster computing vs. Grid computing

Module III: Cloud Computing Architecture and Services [4L]

Backtracking: Basic method, use, 8 queens problem, Graph coloring problem.
Greedy Method: Basic method, use, Knapsack problem, traveling sales man, Job sequencing with deadlines, Minimum cost spanning tree by Prim's and Kruskal's algorithm.

Module IV: Virtualization [5L]
Introduction to virtualization, Different approaches tovirtualization, Hypervisors, Machine Image,

Virtual Machine (VM) Resource Virtualization Server, Basics of VMWare, advantages of VMware virtualization,-understanding virtual machines, create a new virtual machine on local host, cloning virtual machines, virtualize a physical machine, starting and stopping a virtual machine.

Module V: Cloud Storage Management [2L]

Storage as a service, Data storage in cloud computing (storage as a service)

Module VI: Service Oriented Architecture [5L]

Web Services and Primitive SOA: The Web services framework- Services, Service descriptions, messaging with SOAP. Message exchange patterns- Service activity coordination-Atomic transactions-Business activities-Orchestration-Choreography, Service-Oriented Design Introduction to service-oriented design- WSDL-related XML Schema language basics- WSDL language basics- SOAP language basics- Service interface, design tools. WS-BPEL language basics WS Coordination

Module VII: Service Management in Cloud Computing [5L]

Service Level Agreements (SLAs) Billing And Accounting Comparing Scaling Hardware: Traditional. Cloud Economics of scaling: Benefitting enormously Managing Data Looking at Data, Scalability And Cloud Services Database And Data Stores in Cloud Large Scale Data Processing.

Module VIII: Cloud Security [5L]

Infrastructure Security Network level security, Host level security, Application-level security Data security, Identity And Access Management Access Control Trust, Reputation, Risk Authentication in cloud computing

Module IX: Case Study on Open Source and Commercial Clouds [4L]

Google Cloud Microsoft Azure Amazon EC2

Textbooks:

1. Cloud Computing Bible, Barrie Sosinsky, Wiley-India, 2010

Reference books:

2. Cloud Computing: Principles and Paradigms, Editors: Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, Wile, 2011
3. Cloud Computing: Principles, Systems and Applications, Editors: Nikos Antonopoulos, Lee, Gillam, Springer, 2012
4. Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz, Russell Dean Vines, Wiley-India, 2010

COURSE NAME: **INTERNET TECHNOLOGY**
COURSE CODE: **IT701B**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **36**
CREDITS: **3**

Prerequisite:
Networking, Web Application Development

Course Objective:
Understanding the architecture of enterprise application and developing enterprise applications.

Course Outcome:
After completion of this course students will be able to

CO1:	Understand advanced networking concepts and internet and web application architectures
CO2:	Apply and Analyze d different advanced routing protocols being used in web application development
CO3:	Evaluate and analyze different solution available in the field of networking and web application development such as http and the World Wide Web, HTML, and Java Scripts;
CO4:	Implement solution for different critical network related issues as; implementing the design using the client/server model, testing, and documenting the solutions developed.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	2	2	2	--	--	--	--	--	--	--	--
CO2	2	3	2	2	2	--	--	--	--	--	--	1
CO3	3	3	3	2	2	--	--	--	--	--	--	1
CO4	3	3	3	3	3	--	--	--	--	--	2	3

Course Contents:

Module 1: An Overview on Internet [2L]
Properties of the Internet, Internet Architecture, Interconnection through IP Gateways or routers, Internet and Intranet.

Module 2: Internet Address: [6L]
Introduction, Universal identifiers, Three primary classes of IP addresses, Classless IP address, Network and Broadcast addresses, Mapping internet addresses to physical addresses (ARP), ARP protocol format, Transport Gateways and subnet addressing, Multicast addressing. IPV6, Conversion from IPV4 to IPV6

Module 3: Internet Protocol: [4L]

The Internet Datagram, Routing direct and indirect delivery, Table driven IP routing, Protocol layering, Reliable stream transport, TCP performance, Bootstrap protocol (BOOTP).

Module 4: Routing: [4L]
The origin of Gateway routing tables, Original Internet Architecture and Cores, Core Gateways, Automatic route propagation, Vector distance (Bellman-Ford), routing, Gateway to Gateway Protocol (GGP), Autonomous system concept, Exterior Gateway Protocol (EGP), Interior Gateway Protocol (RIP, OSPF, HELLO), Routing Information Protocol (RIP), Combining RIP, HELLO, and EGP, Routing with partial information.

Module 5: Internet Servers: [4L]
DNS, DHCP Servers, FTP, TELNET, E-Mail

Module 6: Firewall & Networking [6L]
Introduction, Implementation of Firewall, Activities of Firewall, Configuration of firewall, Firewalls & SSL, SSL implementation, Bit implementation of SSL, Use of SSL.

Module 7: ASP .NET: [10L]
Architecture and Component, Page life cycle, Control: Check Box, Radio Button, List, Label. Session Management, Web Form Handling, Accessing database, Hosting of Web application.

Textbooks:
1. Computer Networks and Internets - Douglas E. Comer; PE.

Reference books:
1. Communication Networks - Leon-Garcia-Widjaja; TMH.
2. Internetworking with TCP / IP - Douglas E .Comer; PE.
3. TCP/IP protocol suite - Forouzan Behrouz A; TMH.

COURSE NAME: **BIG DATA ANALYTICS**
COURSE CODE: **IT701C**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **36**
CREDITS: **3**

Prerequisite:
Data Structure, Design and Analysis of Algorithms, Database Management Systems, Statistics, Artificial Intelligence, Programming skills of Python

Course Objective:
Comprehend the fundamental concepts of the Big Data Analytics exploring machine learning strategies such as Supervised and Unsupervised Learning etc. for analyzing various types of large scale structured as well as unstructured data distributed across multiple locations (Map Reduce, Hadoop and NoSQL Framework).

Course Outcome:
After completion of this course students will be able to

CO1	Understand basic concepts and requirements of big data analytics
CO2	Apply the concept of big data analytics to handle huge dataset
CO3	Analyze big data with different available algorithm and theorem
CO4	Design and develop different analytical solution organizing huge dataset

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	1	2	2	--	--	--	--	--	--	--	1
CO2	3	2	2	--	2	--	--	--	--	--	--	1
CO3	3	1	2	--	2	--	--	--	--	--	--	2
CO4	3	1	2	1	1	--	--	--	--	--	--	2

Course Contents:
Module – 1: Introduction to Basic Analytics [10L]
Introduction: Big data overview, Analyst's perspective on data repositories, Current analytical architecture, Drivers of big data, Examples of big data analytics.
Life Cycle of Data Analytics: Phase 1: Discovery, Phase 2: Data preparation, Phase 3: Model planning, Phase 4: Model building, Phase 5: Communication of results, Phase 6: Making operational.

Basic Analytic Methods: Visualization, Dirty data, Data exploration versus presentation, Statistical methods for evaluation – hypothesis testing, difference of means, rank sum test, type I and type II errors, ANOVA.

Module - 2: Advanced Analytic Methods I [8L]
Clustering: Overview, K-means, Determining the number of clusters, Diagnostics.
Association Rules: Overview, Apriori algorithm, Evaluation of candidate rules, Application of association rules, Validation and testing, Diagnostics.
Regression: Linear regression - model description, Logistic regression – model description, Other regression models.
Classification: Decision trees – overview, General algorithm, Decision tree algorithms, Evaluating a

decision tree, Naïve Bayes – Bayes theorem, Naïve Bayes classifier, Diagnostics of classifiers.

Module – 3: Advanced Analytic Methods II [8L]

Time Series Analysis: Overview, Box-Jenkins methodology, Autocorrelation function (ACF), Autoregressive model, Moving average model, ARMA and ARIMA model, Building and evaluating an ARIMA model.
Text Analysis: Steps in text analysis, Collecting raw text, Representing text, Term Frequency-Inverse Document Frequency (TFIDF), Categorizing documents by types, Determining sentiments.
Map Reduce and Hadoop:Analytics for unstructured data – map reduce, Apache Hadoop, Hadoop Ecosystem – Pig, Hive, Hbase, Mahout.

Module – 4: Advanced Analytic Methods III [10L]

Technology and Tools: SQL essentials - Join, Set, Grouping extensions, Advanced SQL – Window functions, User-defined functions, Ordered aggregates, MADlib, NoSQL.
Integration of Techniques: Communicating and operationalizing an analytic project.
Creating final deliverables – Developing core materials, project goals, Main findings, Approach, Model description and model details, Recommendations, Providing technical specifications and code.

Data visualization basics - Key points, evolution of a graph, common representation methods, how to clean up a graphic.

Textbooks:

1. EMC Education Services (Editor), Data Science and Big Data Analytics. John Wiley & Sons, 2015.
2. Mike Barlow, Real-Time Big Data Analytics: Emerging Architecture. O'Reilly, 2013.

Reference books:

1. Nathan Marz and James Warren, Big Data: Principles and Best Practices for Scalable Real-time Data Systems. Manning Publications, 2015.
2. Venkat Ankam, Big Data Analytics. Packt Publishing Ltd., UK, 2016.

COURSE NAME: **DISTRIBUTED SYSTEM**
COURSE CODE: **IT701D**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **35**
CREDITS: **3**

Prerequisite:
Operating System, Computer Networking

Course Objective:
This course introduces the fundamentals of distributed computer systems, assuming the availability of facilities for data transmission.

Course Outcome
After completion of this course students will be able to

CO1	Understand the knowledge of the basic elements and concepts related to distributed system technologies for identify core architectural aspects of distributed systems
CO2	Use and apply important methods in distributed systems to support scalability and fault tolerance
CO3	Analyse the utility of main underlying components of distributed systems
CO4	Build a distributed system by using the required components

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	1	--	--	--	--	--	--	1
CO2	2	2	2	2	2	--	--	--	--	--	--	1
CO3	3	2	2	2	2	--	--	--	--	--	--	2
CO4	2	-	3	2	3	1	1	--	--	--	2	2

Course Contents:
Module – 1: Introduction to distributed Systems: [2L]
Definition and goals, Hardware and Software concepts, Design issues

Module - 2: Communication in Distributed System: [4L]
Computer Network and Layered protocols, Message passing and related issues, synchronization, Client Server model & its implementation, remote procedure call and implementation issues, Case Studies: SUN RPC, DEC RPC

Module – 3: Synchronization in Distributed Systems: [4L]

Clock synchronization and related algorithms, mutual exclusion, Deadlock in distributed systems

Module – 4: Processes and Processors in Distributed Systems: [3L]
Threads, system model, processor allocation, scheduling in distributed systems: Load balancing and sharing approach, fault tolerance, Real time distributed systems, Process migration and related issues.

Module – 5: Distributed File Systems: [4L]
Introduction, features & goal of distributed file system, file models, file accessing models, file sharing

semantics, file caching scheme, file replication, fault tolerance, trends in distributed file system, case study

Module – 6: Distributed Shared Memory: [5L]
Introduction, general architecture of DSM systems, design and implementation issues of DSM, granularity, structure of shared memory space, consistency models, replacement strategy, thrashing.

Module – 7: Naming: [4L]
Overview, Features, Basic concepts, System oriented names, Object locating mechanisms, Issues in designing human oriented names, Name caches, Naming and security, DNS.

Module – 8: Distributed Web-based Systems: [3L]
Architecture, Processes, Communication, Naming, Synchronization, Consistency and Replication: Web Proxy Caching, Replication for Web Hosting Systems, Replication of Web Applications

Module – 9: Security: [3L]
Introduction of Security in Distributed OS, Overview of security techniques, features, Need, Access Control, Security Management

Module – 10: Case Study: [3L]
Oracle Network File System, Google case study

Textbooks:
1.Distributed Operating Systems Concepts and Design, Pradeep K. Sinha, PHI
2.Distributed Systems: Concepts and Design by George Coulouris, Jean Dollimore, TimKindberg, Pearson

Reference books:
1.Distributed Operating Systems by Andrew S Tannenbaum, Pearson.

COURSE NAME: **INTERNET OF THINGS**
COURSE CODE: **IT702A**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **36**
CREDITS: **3**

Prerequisite:
Operating System, Wireless Sensor Networks, Computer Networks, Cryptography, Communication Technology, Python Programming Language, and Cloud computing.

Course Objective:
The objective of the course is to learn and understand Internet of Things in detail and identifies the application potentials of this technology.

Course Outcome:
After completion of this course students will be able to

CO1	Understand the basic concepts of IoT and it's architectures.
CO2	Apply the concepts of IoT to design different smart tools.
CO3	Analyze different issues in the domain of IoT and understand the practical applications of IoT.
CO4	Evaluate and analyze different solution for the real life problems of IoT.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	1	2	1	1	2	2	2	--	--	3
CO2	1	3	3	2	3	3	3	3	2	1	--	3
CO3	1	3	2	3	3	2	2	2	1	1	--	2
CO4	1	3	1	2	2	1	1	2	3	1	--	2

Course Contents:

Module – 1: Wireless Sensor Network [4L]
Network and Communication aspects, Wireless medium access issues, MAC protocol, Routing protocols, Sensor deployment and Node discovery, Data aggregation and dissemination, Topology, Connectivity, Single-hop and Multi-hop communications.

Module - 2: Fundamental of IoT [4L]
The Internet of Things, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Design challenges, Development challenges, Security challenges, Other challenges.

Module – 3: IoT and M2M [5L]

Main design principles and needed capabilities, IoT architecture outline, standards , M2M and IoT Technology Fundamentals, Devices and gateways, Local and wide area networking, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies. M2M to IoT Architectural Overview, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.

Module – 4: IoT Architecture [6L]
Introduction, Architecture Reference Model- Introduction, Reference Model and architecture, IoT reference Model, IoT Reference Architecture- Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.

Module – 5: IoT Privacy, Security and Governance [7L]
Introduction, Overview of Governance, Privacy and Security Issues, Access Control, Authentication and Authorization, Distributed trust in IoT, Secure Platform design, Smart Approach. Data Aggregation for the IoT in smart cities, Intrusion detection and prevention, Security attacks and functional threats.

Module – 6: IoT Layers Architecture [6L]
PHY/MAC Layer - 3GPP MTC, IEEE 802.11, IEEE 802.15, Wireless HART, Z-Wave, Bluetooth Low Energy, Zigbee Smart Energy, DASH7; Network Layer - IPv4, IPv6, 6LoWPAN, 6TiSCH, ND, DHCP, ICMP, RPL, CORPL, CARP ; Transport Layer - TCP, MPTCP, UDP, DCCP, SCTP TLS, DTLS; Session Layer - HTTP, CoAP, XMPP, AMQP, MQTT; Service Layer - oneM2M, ETSI M2M, OMA, BBF.

Module – 7: IoT Applications for Value Creations [4L]
Introduction, IoT applications for industry: Future Factory Concepts, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Big Data and Serialization, IoT for Retailing Industry, Oil and Gas Industry, Real-time monitoring and control of processes - Deploying smart machines, smart sensors, and smart controllers with proprietary communication and Internet technologies, Remote control operation of energy consuming devices.

Textbooks:
1. Internet of Things: Architecture and Design Principles, Raj Kamal, McGraw Hill Education; First edition.
2. Internet of Things fundamentals, David, Pearson Education.
3. Internet of Things by Tripathy and Anuradha, CRC Press.

Reference books:
1. Getting Started With The Internet Of Things: Connecting Sensors and Microcontrollers to the Cloud, Cuno Pfister O'Reilly
2. Internet of Things (A Hands-on-Approach), Vijay Madisetti and Arshdeep Bahga, Orient Blackswan Private Limited - New Delhi; First edition.

COURSE NAME: **ADVANCED DATABASE MANAGEMENT SYSTEM**
COURSE CODE: **IT702B**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **36**
CREDITS: **3**

Prerequisite:
Database Management System, Operating System, Computer Networking

Course Objective:
The objective of the course is to present an introduction to different database management systems, with an emphasis on advanced transaction processing and recovery system.

Course Outcome:
After completion of this course students will be able to

CO1	Evaluate and Apply Advanced Database Development Techniques.
CO2	Evaluate different Database Systems
CO3	Perform administrator's job for database systems.
CO4	Design & Implement Advanced Database Systems

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	3	3	--	--	--	--	2	--	--	--
CO2	2	3	3	3	--	--	--	--	--	--	--	--
CO3	1	3	3	3	--	--	--	--	2	--	--	--
CO4	2	3	3	3	--	--	--	--	2	1	--	2

Course Contents:

Module – 1: Database-System Architectures: [3L]
Centralized and client–server architectures, Server system architectures, Parallel systems, Distributed systems, Network types.

Module - 2: Parallel Databases: [4L]
Parallel databases, I/O parallelism, Inter query parallelism, Intra query parallelism, Intra operation parallelism, Interoperation parallelism, Design of parallel systems.

Module – 3: Distributed Databases: [8L]

Homogeneous and heterogeneous databases, Distributed data storage, Distributed transactions, Commit protocols, Concurrency control in distributed databases, Availability, Distributed query processing, Heterogeneous distributed databases, Directory systems.

Module – 4: Object-Based Databases: [4L]
Overview of object-based databases, Complex data types, Structured types and inheritance in SQL, Table inheritance, Array and multi set types in SQL, Introduction of object-identity and reference types in SQL, Object-oriented versus object-relational.

Module – 5: Advanced Application Development: [2L]
Performance tuning, Performance benchmarks, Standardization, Application migration.

Module – 6: Advanced Data Types & New Applications: [5L]
Motivation, Time in databases, Spatial and geographic data, Multimedia databases, Mobility and personal databases, Temporal database.

Module – 7: Advanced Transaction Processing : [6L]
Transaction-processing Monitors, Transactional workflows, E-Commerce, Main-memory databases, Real-time transaction systems, Long-duration transactions, Transaction management in multi-databases.

Module – 8: XML: [4L]
Motivation, Structure of XML data, XML document schema, Querying and transformation, Application program interfaces to XML, Storage of XML data, XML applications, UML.

Textbooks:

1. Henry F. Korth and Silberschatz Abraham, "Database System Concepts", Mc.Graw Hill.
2. Elmasri Ramez and Novathe Shamkant, "Fundamentals of Database Systems", Benjamin Cummings Publishing.Company.

Reference books:

1. Raghu Ramakrishnan and Johannes Gehrke, Database Management Systems (3/e), McGrawHill.
2. Peter Rob and Carlos Coronel, Database Systesm- Design, Implementation and Management (7/e), Cengage Learning.

COURSE NAME: **BLOCK CHAIN TECHNOLOGY**
COURSE CODE: **IT702C**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **36**
CREDITS: **3**

Prerequisite:
The students must have concept of Distributed Systems, Computer Networks, Cryptography, Python Programming Language

Course Objective:
The objective of the course is to learn and understand Blockchain technology in detail and identifies the application potentials of this technology.

Course Outcome:
After completion of this course students will be able to

CO1	Understand the basic concepts of blockchain and it's architectures.
CO2	Analyze different issues in the domain of blockchain and understand the practical applications of blockchain.
CO3	Evaluate and analyze different solutions for the real life problems related to the blockchain.
CO4	Design different solution applying and analyzing concept of Block chain

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	3	2	--	--	--	--	--	--	--	--
CO2	2	--	3	2	--	--	--	--	--	--	--	--
CO3	3	3	2	3	--	--	--	--	--	--	--	--
CO4	3	--	3	--	--	--	--	--	--	--	3	3

Course Contents:

MODULE I: Centralized - Distributed Systems: [6L]
Client-Server Model, Distributed System, P2P Network Model, Distributed Database, Two General Problem in distributed database, Byzantine General problem and Fault Tolerance, Hadoop Distributed File System, Distributed Hash Table, ASIC resistance, Turing Complete.

MODULE II: Security, Trust and Privacy: [6L]
Confidentiality; Integrity; Availability; Authentication; Authorization; Access Control; Accounting; Non-Repudiation, Symmetric Key and Asymmetric Key Cryptography, Hash function, Merkle tree hash, Digital Signatures – RSA, Schnorr, and ECDSA, Memory Hard Algorithm, Zero Knowledge Proof, User privacy.

MODULE III: Fundamentals of Blockchain:[6L]

Introduction, Benefits over traditional distributed database, Blockchain Network, Data structure of block, Block construction and addition, Block mining mechanisms, Merkle Pa-tricia Tree, Gas Limit, Transactions and Fee, Anonymity, Reward, Chain policy, Real-time application of Blockchain, Soft & Hard Fork, Private, Public, and Consortium blockchain.

MODULE IV: Consensus algorithms in Blockchain:[9L]
Distributed Consensus, Nakamoto consensus, Proof of Work (PoW), Proof of Stake (PoS), Proof of Burn (PoB), Delegated Proof of Stake (DPoS), Byzantine Fault Tolerance (BFT), Practical Byzantine Fault Tolerance (PBFT), Ripple Protocol Consensus Algorithm (RPCA), Difficulty Level, Sybil Attack, Energy utilization and alternate.

MODULE V: Cryptocurrency and Blockchain Applications: [9L]
History, Distributed Ledger Technology (DLT),Bitcoin protocols - Mining strategy and rewards, Ethereum - Construction, DAO, Smart Contracts and Distributed Applications (Apps), GHOST, Vulnerability, Attacks, Sidechain, Namecoin, Stakeholders, Roots of Bitcoin, Legal Aspects - Cryptocurrency Exchange, Black Market and Global Economy, Application of Blockchain in Finance and Banking, Energy trading, Internet of Things (IoV, IoD, IIoT, Smart city, Smart Home, and so on), Medical Record Management System, Real estate business, Entertainment, Future scope of Blockchain.

Textbooks:

1. Roger Wattenhofer, Distributed Ledger Technology: The Science of the Blockchain, Second Edition, 2017.
2. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Gold feder, Bitcoin and Cryp-tocurrencyTechnologies: A Comprehensive Introduction, Princeton University Press, 2016.
3. Andreas M. Antonopoulos, Mastering Bitcoin: Unlocking Digital Cryptocurrencies, O'Reilly Publication House, 2014.

Reference books:

1. Melanie Swan Blockchain: Blueprint for a new Economy, O'Reilly Publication House, 2015.
2. Andreas M. Antonopoulos and Dr. Gavin Wood, Mastering Ethereum Building Smart Contracts and DApps, O'Reilly Publication House, First Edition, 2018.

COURSE NAME: **DEEP LEARNING**
COURSE CODE: **IT702D**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **36**
CREDITS: **3**

Prerequisite:
Linear Algebra, Machine Learning

Course Objective:
The objective of the course is to present an introduction to deep learning systems, with an emphasis on introducing major deep learning algorithms, the problem settings, and their applications to solve real world problems.

Course Outcome:
After completion of this course students will be able to

CO1	Understand the basics of Machine Learning & Deep Learning techniques that make it useful to real-world problems.
CO2	Apply Deep learning algorithms such as supervised, semi-supervised, and unsupervised.
CO3	Analyze various Deep learning techniques to investigate real world applications.
CO4	Evaluate and create model for finding the solution of real world industry issues and problems.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	3	1	1	--	--	1	--	--	--	--	2
CO2	3	3	3	2	2	--	--	--	--	--	2	2
CO3	2	2	1	2	3	--	--	--	1	--	--	3
CO4	3	3	3	1	2	--	--	--	--	--	--	3

Course Contents:

Module I: Introduction [6L]
Feed forward Neural networks. Gradient descent and the back propagation algorithm. Unit saturation, aka the vanishing gradient problem, and ways to mitigate it. RelU Heuristics for avoiding bad local minima. Heuristics for faster training. Regularization. Dropout.

Module II: Convolution Neural Networks [4L]
Architectures, convolution / pooling layers.

Module III: Recurrent Neural Networks [4L]
LSTM, GRU, Encoder Decoder architectures

Module IV: Deep Unsupervised Learning [6L]
Autoencoders (standard, sparse, denoising, contractive, etc), Variational Autoencoders, Adversarial Generative Networks, Autoencoder and DBM

Module V: Models [3L]
Attention and memory models, Dynamic memory networks

Module VI: Computer Vision [6L]
Image segmentation, object detection, automatic image captioning, Image generation with Generative adversarial networks, video to text with LSTM models. Attention models for computer vision tasks.

Module VII: Applications of Deep Learning to NLP [7L]
Introduction to NLP and Vector Space Model of Semantics
Word Vector Representations: Continuous Skip-Gram Model, Continuous Bag-of- Words model (CBOW)**,** Glove, Evaluations and Applications in word similarity, analogy reasoning

Textbooks:
1. Bengio, Yoshua, Ian J. Goodfellow, and Aaron Courville. "Deep learning." An MIT Press book in preparation. (2015).
2. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education

Reference books:
1. Bishop, C. ,M., Pattern Recognition and Machine Learning, Springer, 2006.

COURSE NAME: **MOBILE APPLICATION DEVELOPMENT**
COURSE CODE: **IT703A**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **36**
CREDITS: **3**

Prerequisite:
The students to whom this course will be offered must have the concept of mobile communication, java and android.

Course Objective:
The objective of this course is to create different user-friendly apps which will be helpful for the society also.

Course Outcome:
After completion of this course students will be able to

CO1	Understand different mobile applications.
CO2	Interpret the architecture of hardware and software of mobile application.
CO3	Combine GPS and social media networking applications.
CO4	Improve different exiting applications.
CO5	Solve problems calendar and address book problems with social media application – Using Wifi - iPhone marketplace.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	2	2	2	--	--	--	--	2	--	--	2
CO2	3	2	3	2	--	--	--	--	--	3	--	2
CO3	2	3	3	3	--	--	4	2	--	--	--	2
CO4	3	2	2	2	--	--	--	--	--	--	--	2
CO5	3	3	2	3	--	--	--	3	--	--	--	2

Course Contents:

MODULE I: INTRODUCTION [7L]
Introduction to mobile applications – Embedded systems - Market and business drivers for mobile applications – Publishing and delivery of mobile applications – Requirements gathering and validation for mobile applications

MODULE II: BASIC DESIGN [7L]
Introduction – Basics of embedded systems design – Embedded OS - Design constraints for mobile applications, both hardware and software related – Architecting mobile applications – user interfaces for mobile applications – touch events and gestures – Achieving quality constraints – performance, usability, security, availability and modifiability.

MODULE III: ADVANCED DESIGN [7L]
Designing applications with multimedia and web access capabilities – Integration with GPS and social media networking applications – Accessing applications hosted in a cloud computing environment – Design patterns for mobile applications.

MODULE IV: TECHNOLOGY I – ANDROID [8L]

Introduction – Establishing the development environment – Android architecture – Activities and views – Interacting with UI – Persisting data using SQLite – Packaging and deployment – Interaction with server side applications – Using Google Maps, GPS and Wifi – Integration with social media applications.

MODULE V: TECHNOLOGY II – IOS [7L]]

Introduction to Objective C – iOS features – UI implementation – Touch frameworks – Data persistence using Core Data and SQLite – Location aware applications using Core Location and Map Kit – Integrating calendar and address book with social media application – Using Wifi - iPhone marketplace.

COURSE NAME: **FUZZY LOGIC AND APPLICATION**
COURSE CODE: **IT703B**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **36**
CREDITS: **3**

Prerequisite:
The students must have the concept of calculus, basic probability and differential equations.

Course Objective:
The objective of this course is to introduce concepts of fuzzy set theory and its applications in some areas and to understand the basics of fuzzy logic along with applications like fuzzy control and fuzzy decision making.

Course Outcome
After completion of this course students will be able to

CO1:	Examine the Set Theory problems.
CO2:	Interpret the systems which include fuzziness within the scope of fuzzy set theory.
CO3:	Combine the information of decision theory and the information of fuzzy set theory.
CO4:	Improve the proof techniques of Fuzzy Set Theory.
CO5:	Solve problems that include uncertainty with using Fuzzy Set Theory.

CO-PO Mapping:

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

Course Contents:
MODULE I: [5L]
Introduction: Background, Uncertainty and imprecision, Statistics and random processes, Uncertainty in information, Fuzzy sets and membership, Chance versus ambiguity, Classical sets - operations on classical sets to functions, Fuzzy sets-fuzzy set operations, Properties of fuzzy sets, sets as points in hypercube.

MODULE II: [7L]
Classical Relations And Fuzzy Relations: Cartesian product, Crisp relations-cardinality of crisp relations, Operations on crisp relations, Properties of crisp relations, Compositions, Fuzzy relations cardinality of fuzzy relations, Operations on fuzzy relations, Properties of fuzzy relations, Fuzzy Cartesian product and composition, Non interactive fuzzy sets, Tolerance and equivalence relations-crisp equivalence relation, Crisp tolerance relation, Fuzzy tolerance, Max-min Method, other similarity methods.

MODULE III: [5L]
Membership Functions: Features of the membership function, Standards forms and boundaries, fuzzification, Membership value assignments-intuition, Inference, Rank ordering, Angular fuzzy sets.

MODULE IV: [5L]
Fuzzy-To-Crisp Conversions And Fuzzy Arithmetic: Lambda-cuts for fuzzy sets, Lambda-cuts for fuzzy relations, Defuzzification methods. Extension principle-crisp functions, Mapping and relations, Functions of fuzzy sets-extension principle, Fuzzy transform (Mapping), Fuzzy numbers Interval analysis in Arithmetic.

MODULE V: [7L]
Fuzzy Logic &Fuzzy Rule-Based Systems: Fuzzy logic, approximate reasoning, Fuzzy tautologies, Contradictions, Equivalence and logical proofs. Natural language, Linguistic hedges, Rule-based system canonical rule forms, Decomposition of compound rules, Likelihood and truth qualification, Aggregation of fuzzy rules.

MODULE VI: [7L]
Fuzzy Decision Making, Classification & Hybrid formation: Fuzzy synthetic evaluation, Fuzzy ordering, Preference and consensus, Multi-objective decision making under fuzzy states and fuzzy actions. Classification by equivalence relations-crisp relations, Fuzzy relations cluster analysis, neuro fuzzy and fuzzy genetic system, applications to engineering problems.

Textbooks:
1. Neural Networks and Fuzzy Logic System by Bart Kosko, PHI Publications.
2. Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications by Rajase kharan and Rai – PHI Publication.
3. Fuzzy Sets, Fuzzy Logic, and Fuzzy Systems by Lotfi A. Zadeh
4. Zimmermann, H. J., Fuzzy Set theory and its Applications, Allied Publishers Limited.
5. Fuzzy logic with engineering application by Timothy J. Ross-wiley

Reference books:
1. Klir.G, Yuan B.B. "Fuzzy sets and Fuzzy Logic Prentice Hall of India private limited, 1997.
2. John Yen and Reza Lengari, ―Fuzzy Logic: Intelligence, Control and Information‖, Pearson Education, 1999.
3. Jerry M Mendel, ―Uncertain Rule-based Fuzzy Logic Systems: Introduction and New Directions, PH PTR, 2000.
4. Hung Nguyen and Elbert Walker, ―A First Course in Fuzzy Logic, 2/e,, Chapman and Hall/CRC, 1999.

COURSE NAME: **MICROCONTROLLER AND VLSI DESIGN**
COURSE CODE: **IT703C**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **35**
CREDITS: **3**

Prerequisite:
The students to whom this course will be offered must have the basic concept of courses Solid State Devices, Analog Electronic Circuits, Digital Electronic and Circuits.

Course Objective:
The objective of this course is to motivate students to design VLSI circuits in the area of digital, analog and also to encourage for the design of IC with low power and high speed.

Course Outcome
After completion of this course students will be able to

CO1	Understand of the characteristics of CMOS circuit construction and the comparison between different state-of-the-art CMOS technologies and processes
CO2	Use mathematical methods and circuit analysis models in analysis of CMOS digital electronics circuits, including logic components and their interconnect
CO3	Categorize different VLSI Fabrication Process
CO4	Complete a significant VLSI design project having a set of objective criteria and design constraints

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	--	--	--	--	--	--	--	--	--	--
CO2	3	3	--	--	--	--	--	--	--	--	--	--
CO3	3	2	3	2	2	2	--	--	--	--	1	2
CO4	3	--	2	2	--	--	--	--	--	--	1	2

Course Contents:
MODULE I: Introduction to IC: [6L]
Integrated Circuits – Advantages, disadvantages, limitations; Scale of Integration – SSI, MSI, LSI, VLSI, ULSI; Moor's Law; Scaling of MOSFET-Constant field scaling and constant voltage scaling, Short Channel Effects; VLSI design flow, Y-Chart, IC Classification –Standard IC and ASIC, PAL, PLA, FPGA Architecture.

MODULE II: Digital VLSI Circuit Design: [11L]
Inverter Characteristics: Resistive load inverter – Voltage transfer characteristics (VTC, significance of parameters (only expression, no derivation) –VIL, VIH, VOL, VOH, Vth; CMOS inverter - VTC, Noise margin and aspect ratio of symmetric CMOS inverter.

Combinational Logic Circuit Design Circuit design using Static CMOS style – basic gates, design of circuit for product of sum (POS) and sum of product (SOP) expression, Complex logic circuit, full adder; Circuit design using pseudo NMOS logic, DCVSL Logic, TG Logic, Pass Transistor Logic, Complementary pass transistor logic, Dynamic logic, domino logic, NORA logic.

Sequential Circuit and Semiconductor Memory Design: Bistable Circuit -Design of CMOS S-R &

J-K Latch, CMOS Clocked SR & JK Latch /Master –slave JK Flipflop, CMOS D Flip-flop; 6T SRAM cell and 3T DRAM cell design.

MODULE III: Analog VLSI Circuit Design: [10L]
Small Signal model of MOSFET; Analog sub-circuits -MOS Switch, Active resistors/MOS Diode, Current source and Sink, Current Mirror; Current and voltage references-voltage divider, MOS equivalent of P-N junction Voltage reference, Threshold voltage reference, Band gap reference (Basic Principle); Switch Capacitor Circuit – resistance emulation of series, parallel and series-parallel circuit, Switch capacitor integrator and filter (1st order only);CMOS differential amplifier – design parameters; Output amplifier (basic circuit); Two-Stage CMOS OP-AMP design.

MODULE IV: Layout Design Rules and Fabrication Steps of ICs: [6L]
Micron and lambda design rules; Stick diagram and Layout - CMOS Inverter, NAND and NOR gate; Fabrications steps of IC – Wafer preparation, Oxidation, photolithography, etching, diffusion, ion implantation, metallization and packaging. CMOS N-Well Process, overview of P-well and twin-tub process.

MODULE V: Introduction to Low Power and High-Speed VLSI Circuit Design: [3L]
Dynamic power, short circuit power and leakage power in CMOS Inverter; Timing parameters (concept only) –Critical path, arrival time, slack, skew, set-up time, hold time, gate delay and path delay, delay time expression of CMOS inverter (expression only), Adiabatic logic (basic concept).

Textbooks:
1. Digital Integrated Circuit, J.M.Rabaey, Chandrakasan, Nicolic, Pearson Education.
2. CMOS Digital Integrated Circuits Analysis and Design, S.M.Kang & Y.Leblebici,TMH.
3. CMOS Analog Circuit Design, Allen &Holberg, Oxford
4. Design of Analog CMOS Integrated Circuits, Behzad Razavi, TMH.

Reference books:
1. Microelectronic Circuits, Sedra& Smith, Oxford
2. Introduction to VLSI Circuits and System, Uyemura, Wiley
3. VLSI Design, Debaprasad Das, Oxford
4. VLSI Design and EDA Tools, Angsuman Sarkar, Swapnadip De, C.K. Sarkar, Scitech
5. VLSI Design Techniques for Analog and Digital Circuits, Geiger, Allen, Strader, TMH

COURSE NAME: **OPERATIONAL RESEARCH AND OPTIMIZATION TECHNIQUE**
COURSE CODE: **IT703D**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **36**
CREDITS: **3**

Prerequisite:
The students must have basic Knowledge of Function, plotting of Equation and inequations, Formulation of Mathematical Problem. Finding maximum and minimum from row or column or from Matrix.

Course Objective:
The objective of the course is to develop models and then analyze the model using the techniques of Operations Research, Decision making under uncertainty and risk.

Course Outcome
After completion of this course students will be able to

CO1	Understand knowledge-base representation models.
CO2	Apply different rule-based expert systems and planning tools.
CO3	Analyze the performance of rule-based-systems.
CO4	Develop heuristic search algorithms for real life problem solving.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	1	--	--	--	--	--	--	--	--	1
CO2	2	1	2	1	--	--	1	--	--	--	--	1
CO3	2	3	3	2	--	--	1	--	--	--	--	1
CO4	2	3	3	3	2	2	1	--	--	--	2	1

Course Contents:
MODULE I: [10L]
Linear Programming Problem (LPP): Basics of Linear Programming Problem(LPP) and its Applications. General Mathematical Formulation of LPP; Definitions: Convex set, Solution, Feasible Solution, Basic and Non-Basic Variables, Basic Feasible Solution, Degenerate and Non-Degenerate solution, Optimum/Optimal Solution; Solution of LPP by Graphical Analysis/Method, Simplex Method, Charnes' Big M-Method; Duality Theory.

MODULE II:[6L]
Transportation Problem, Assignment Problem.

MODULE III:[5L]
Game Theory: Introduction; Two person Zero Sum game, Saddle Point; Mini-Max and Maxi-Min Theorems (statement only) and problems; Games without Saddle Point; Graphical Method; Principle of Dominance.

MODULE IV:[5L]
Distributed Consensus, Nakamoto consensus, Proof of Work (PoW), Proof of Stake (PoS), Proof of Burn (PoB), Delegated Proof of Stake (DPoS), Byzantine Fault Tolerance (BFT), Practical Byzantine

Fault Tolerance (PBFT), Ripple Protocol Consensus Algorithm (RPCA), Difficulty Level, Sybil Attack, Energy utilization and alternate.

MODULE V:[2L]
Sequencing: Johnson's Algorithm (1957) For n Jobs and two machines, Jobs and three machines.

MODULE VI:[5L]
Queuing Theory: Introduction and Basic Structure of Queuing Theory; Basic Definitions and Notations; Birth-and-Death Model (Poisson / Exponential distribution); Poisson Queue Models: (M/M/1):(∞/FIFO) and (M/M/1):(N/FIFO) and Problems.

MODULE VII:[3L]
Inventory Control: Determination of EOQ, Components, Deterministic Continuous & Deterministic Periodic Review Models, Stochastic Continuous & Stochastic Periodic Review Models.

Textbooks:
1. Operations Research by Kanti Swaroop and P.K. Man Mohan, Sultan Chand and Sons
2. Linear Programming and Theory of Games by Ghosh and Chakraborty, Central Book Agency

Reference books:
1. Linear Programming and Theory of Games by P.M.Karak, ABS Publishing House
2. Operations Research, D.K.Jana & T.K.Roy, Chhaya Prakashani Pvt. Ltd.
3. Operations Research, Kalavati,VIKAS
4. Operations Research, Humdy A Taha, PHI / Pearson
5. Operations Research Theory and Applications by J.K.Sharma, Macmillan India Limited.

COURSE NAME: **ADVANCED COMPUTER ARCHITECTURE**
COURSE CODE: **IT704A**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **36**
CREDITS: **3**

Prerequisite:
Mathematics**,** Computer Organization and Architecture

Course Objective:
The objective of the course is to learn technical competence in computer architecture and performance comparisons of modern and high-performance computer systems

Course Outcome:
After completion of this course students will be able to

CO1	Understand the cost, performance, Trends in Technology, data flow in arithmetic algorithms and Principles of computer design.
CO2	Model the architectural features of advanced processors.
CO3	Analyze the working of pipelining, exploring instruction level parallelism using static, dynamic & advanced techniques of scheduling
CO4	Explain memory organization and mapping techniques.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	2	2	--	--	1	--	--	--	--	--
CO2	2	2	3	3	--	--	1	--	--	--	--	1
CO3	2	3	2	3	--	--	1	--	--	--	--	1
CO4	2	3	3	1	--	--	1	--	--	--	--	-

Course Contents:
Module 1: [7L]
Fundamentals of Computer Design: Review of Fundamentals of CPU, Memory and I/O, Trends in technology, power, energy and cost, Dependability, Performance Evaluation.

Module 2: [8L]
Instruction Level Parallelism: ILP concepts, Pipelining overview, Compiler Techniques for Exposing ILP, Dynamic Branch Prediction, Dynamic Scheduling, Multiple instruction Issue, Hardware Based Speculation, Static scheduling, Multi-threading, Limitations of ILP, Case Studies.

Module 3: [7L]
Data Level Parallelism: Vector architecture, SIMD extensions, Graphics Processing units, Loop level Parallelism.

Module 4: [7L]
Thread Level Parallelism: Symmetric and Distributed Shared Memory Architectures, Performance Issues, Synchronization, Models of Memory Consistency, Case studies: Intel i7 Processor, SMT & CMP Processors

Module 5: [7L]

Memory and I/O: Cache Performance, Reducing Cache Miss Penalty and Miss Rate, Reducing Hit Time, Main Memory and Performance, Memory Technology. Types of Storage Devices, Buses, RAID, Reliability, Availability and Dependability, I/O Performance Measures.

Textbooks:

1. Kai Hwang and Faye Briggs, "Computer Architecture and Parallel Processing", Mc Graw-Hill International Edition, 2000.
2. Sima D, Fountain T and Kacsuk P, "Advanced Computer Architectures: A Design Space Approach", Addison Wesley, 2000.

Reference books:

1. Parallel Computer Architecture: D. Culler, J.P.Singh, A.Gupta, Elsevier

COURSE NAME: **MODELING AND SIMULATION**
COURSE CODE: **IT704B**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **36**
CREDITS: **3**

Prerequisite:
Programming and Data Structures, Discrete Mathematics and Probability theory, Game theory, Numerical Analysis

Course Objective:
To understand the Models and Simulation of Continuous and Discrete Systems, enable students to analyze Continuous Uniformly Distributed Random Numbers, assess the strengths and weaknesses of various methods and to analyze their behavior.

Course Outcome
After completion of this course students will be able to

CO1	Investigate and summarize various issues in modeling and simulation.
CO2	Apply the knowledge of system dynamics and probability theories in simulation.
CO3	Demonstrate the ability to simulate a generic system like Queuing Systems
CO4	Evaluate and analyze various results obtained from the simulation process
CO5	Identify the application potentials of modeling and simulation and apply the same knowledge to solve complex problems in various engineering disciplines.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	2	3	--	--	--	--	--	--	--	--
CO2	3	2	3	2	3	--	--	--	--	--	--	3
CO3	3	3	2	2	3	--	--	--	--	--	--	2
CO4	3	3	2	2	3	--	--	--	--	--	--	2
CO5	3	3	3	3	3	--	--	--	--	--	--	3

Course Contents:

Module-1: Introduction to Modeling and Simulation [7L]
Nature of Simulation. Systems , Models and Simulation, Continuous and Discrete Systems, system modeling, Components of a simulation study, Introduction to Static and Dynamic System simulation , Application areas, Advantages ,Disadvantages and pitfalls of Simulation.

Module –2 : System Dynamics & Probability concepts in Simulation [10L]
Exponential growth and decay models, Generalization of growth models , Discrete and Continuous probability functions, Continuous Uniformly Distributed Random Numbers, Generation of a Random numbers, Generating Discrete distributions, Non-Uniform Continuously Distributed Random Numbers, Rejection Method.

Module-3 : Simulation of Queuing Systems and Discrete System Simulation [14L]
Data Level Paral Poisson arrival patterns, Exponential distribution, Service times, Normal Distribution Queuing Disciplines, Simulation of single and two server queue. Application of queuing theory in

computer system. Discrete Events ,Generation of arrival patterns ,Simulation programming tasks Gathering statistics, Measuring occupancy and Utilization , Recording Distributions and Transit times. lelism: Vector architecture, SIMD extensions, Graphics Processing units, Loop level Parallelism.

Module-4 : Analysis of Simulation output [5L]
Sensitivity Analysis, Validation of Model Results

Textbooks:

1. Jerry Banks, John Carson, B.L.Nelson and D.M.Nicol ― Discrete Event System Simulation‖, Fifth Edition, Pearson.
2. NarsinghDeo, 1979, System Simulation with Digital Computers, PHI.

Reference books:

1. Averill M. Law and W.DavidKelton, ―Simulation Modeling and Analysis‖, Third Edition, McGraw Hill 5. J. N. Kapoor.. Mathematical Modeling, Wiley eastern Limited
2. Geoffrey Gordon, ―System Simulation‖, PHI.

COURSE NAME: **VIRTUAL AND AUGMENTED REALITY**
COURSE CODE: **IT704C**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **36**
CREDITS: **3**

Prerequisite:
Computer Architecture, Networking, Operating System.

Course Objective:
This course provides students with an opportunity to explore the research issues in Augmented Reality and Virtual Reality.

Course Outcome:
After completion of this course students will be able to

CO1	Understand the basic concept of Virtual Reality
CO2	Apply the knowledge of virtual reality in the evaluation of different models.
CO3	Analyze different problems in the domain of Virtual Reality
CO4	Evaluate the different solutions provided in the field of virtual reality

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	3	--	--	--	3	--	--	--	--	--	--
CO2	3	3	3	2	2	2	--	--	--	--	--	--
CO3	3	3	3	2	3	3	--	--	--	--	--	--
CO4	3	3	3	3	2	2	--	--	--	--	--	3

Course Contents:

MODULE I: Introduction [4L]
Fundamental Concept and Components of Virtual Reality. Primary Features and Present Development on Virtual Reality.

MODULE II: Multiple Models of Input and Output [6L]
Input -- Tracker, Sensor, Digital Glove, Movement Capture, Video-based Input, 3D Menus & 3DScanner etc. Output -- Visual /Auditory / Haptic Devices.

MODULE III: Visual Computation [4L]
Fundamentals of Computer Graphics. Software and Hardware Technology on Stereoscopic Display. Advanced Techniques in CG: Management of Large Scale Environments & Real Time Rendering.

MODULE IV: Interactive Techniques [4L]
Body Track, Hand Gesture, 3D Manus, Object Grasp

MODULE V: Development Tools and Frameworks [4L]
Frameworks of Software Development Tools in VR. X3D Standard; Vega, MultiGen, Virtools etc.

MODULE VI: Application of VR in Digital Entertainment:[6L]
VR Technology in Film & TV Production. VR Technology in Physical Exercises and Games.

Demonstration of Digital Entertainment by VR.

MODULE VII: Augmented and Mixed Reality: [8L]
Taxonomy, technology and features of augmented reality, difference between AR and VR, Challenges with AR, AR systems and functionality, Augmented reality methods, visualization techniques for augmented reality, wireless displays in educational augmented reality applications, mobile projection interfaces, marker-less tracking for augmented reality, enhancing interactivity in AR environments, evaluating AR systems.

Textbooks:
1. Burdea, G. C. and P. Coffet. Virtual Reality Technology, Second Edition. Wiley-IEEE Press

Reference books:
1. MAlan B. Craig, Understanding Augmented Reality, Concepts and Applications, Morgan Kaufmann, 2013
2. Alan Craig, William Sherman and Jeffrey Will, Developing Virtual Reality Applications, Foundations of Effective Design, Morgan Kaufmann, 2009.

COURSE NAME: **ENTREPRENEURSHIP DEVELOPMENT**
COURSE CODE: **IT704D**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **34**
CREDITS: **3**

Course Objective:
The objective of the course is to inspire students and help them imbibe an entrepreneurial mind-set.

Course Outcome
After completion of this course students will be able to

CO1	Understand the meaning and importance of term Entrepreneurship
CO2	Apply the knowledge in the evaluation of different models.
CO3	Analyze different problems in the domain entrepreneurship skill development
CO4	Evaluate the different solutions, rules and regulation provided in the field of developing enterprises

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	1	1	1	--	--	--	--	--	--	1
CO2	1	1	1	2	3	--	2	2	2	2	--	1
CO3	1	2	1	2	3	3	2	2	2	2	--	1
CO4	1	--	1	3	3	3	3	3	3	3	3	2

Course Contents:

MODULE I: [8L]
Introduction to Entrepreneurship Meaning and concept of entrepreneurship, the history of entrepreneurship development, role of entrepreneurship in economic development, Myths about entrepreneurs, agencies in entrepreneurship management and future of entrepreneurship types of entrepreneurs.

MODULE II: [8L]
The Entrepreneur Why to become entrepreneur, the skills/ traits required to be an entrepreneur, Creative and Design Thinking, the entrepreneurial decision process, skill gap analysis, and role models, mentors and support system, entrepreneurial success stories.

MODULE III: [6L]
E-Cell Meaning and concept of E-cells, advantages to join E-cell, significance of E-cell, various activities conducted by E-cell

MODULE IV: [6L]
Communication Importance of communication, barriers and gateways to communication, listening to people, the power of talk, personal selling, risk taking & resilience, negotiation.

MODULE V: [6L]
Introduction to various form of business organization (sole proprietorship, partnership, corporations, Limited Liability company), mission, vision and strategy formulation.

Textbooks:

1. Arya Kumar, Entrepreneurship, Pearson, Delhi
2. Poornima MCH, Entrepreneurship Development –Small Business Enterprises, Pearson, Delhi
3. Sangeetha Sharma, Entrepreneurship Development, PHI Learning
4. KanishkaBedi, Management and Entrepreneurship, Oxford University Press, Delhi
5. Anil Kumar, S., ET.al., Entrepreneurship Development, New Age International Publishers, New Delhi

Reference books:

1. Khanka, SS, Entrepreneurship Development, S. Chand, New Delhi
2. Peter F. Drucker ,Innovation and Entrepreneurship
3. A.Sahay, M. S. Chhikara, New Vistas of Entrepreneurship: Challenges &Opportunities
4. Dr B E V L Naidu, Entrepreneurship. Seven Hills Publishers

COURSE NAME: **CLOUD COMPUTING LAB**
COURSE CODE: **IT791A**
CONTACT: **0:0:3**
CREDITS: **1.5**

Prerequisite:
Networking, Operating System, Web Technology.

Course Objective:
The objective of the course is to learn and apply the concept of cloud computing in real world application

Course Outcome:
After completion of this course students will be able to

CO1	Apply the concept cloud computing to solve practical use cases
CO2	Analyzing different services in cloud computing
CO3	Evaluate different available services provided by cloud vendors
CO4	Design Cloud based application

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	3	--	--	--	--	--	--	--	--	--	3
CO2	3	3	3	2	2	--	--	--	--	--	--	1
CO3	3	3	3	2	3	--	--	--	--	--	--	2
CO4	3	3	3	4	2	--	--	--	--	--	--	3

Course Contents:
Module 1: Virtual Machine:
Creation of vpc, vnet, virtual machine, Private and Public IP configuration

Module 2: Application Development:
Implementation of SOAP Web services in JAVA Applications.
Use Azure to launch the web applications. Test Simple Application

Module 3: Security:
Identity and access management, Multifactor Authentication.

Module 4: Bot and AI service:
Test AWS and AZURE Bot and AI services

Text books:
1. Cloud Computing: Principles, Systems and Applications, Editors: Nikos Antonopoulos, Lee Gillam, Springer, 2012

Reference books:
1. Cloud Computing: Principles and Paradigms, Editors: Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, Wile, 2011

COURSE NAME: **INTERNET TECHNOLOGY LAB**
COURSE CODE: **IT791B**
CONTACT: **0:0:3**
CREDITS: **1.5**

Prerequisite:
Computer Networking, Web Technology

Course Objective:
The objective of the course is to make students understand different routing algorithm and mail server configurations and explaining C# and .NET Frame work for implementing web applications

Course Outcome
After completion of this course students will be able to

CO1	Understanding and apply the basic networking concepts for configuration of network server and routing protocols
CO2	Analyzing and understanding the concept of .NET framework
CO3	Apply the concept of .NET for implementing web applications
CO4	Evaluate different web application to implement optimal solutions for real life problems.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	2	3	3	--	--	--	--	--	--	--
CO2	2	3	2	3	3	--	--	--	--	--	--	--
CO3	2	3	3	3	3	--	--	--	--	--	--	--
CO4	2	3	3	3	3	--	3	3	3	--	3	3

Course Contents:
Configuration of Routing Protocol
Configure, implement and debug the following: Use open source tools for debugging and diagnostics. a. ARP/RARP protocols b. RIP routing protocols c. BGP routing d. OSPF routing protocols e. Static routes (check using netstat) Mail Server Configuration: Configure a mail server for IMAP/POP protocols and write a simple SMTP client in C/C++/Java client to send and receive mails.

C#
Getting Started with .Net Framework, Exploring Visual Studio .NET, Inside a C# Program, Data Types, Statements, Arrays, Using Strings, Objects, Classes and Structs, Properties, Inheritance, Indexers, Delegates, Events, Namespaces, Generics, Collections and Data Structures, Exception Handling, Threading, Using Streams and Files, Reflection, Assemblies, versioning, Windows Forms, Controls, Data binding to Conrols, Advanced Database Programming using ADO.net, Using GDI +,Networking,.net Remoting, Manipulating XML.

ASP.NET
Building a Web Application, Examples Using Standard Controls, Using HTML Controls, Validating Form Input Controls using Validation Controls, Understanding Applications and State, Applying Styles, Themes, and Skins, Creating a Layout Using Master Pages, Binding to Databases using Controls, Data Management with ADO.net, Creating a Site Navigation Hierarchy, Navigation Controls , Membership and Role Management, Login Controls, Securing Applications, Caching For Performance, Working with XML, Using Crystal Reports in WebForms

DBMS

Introduction, Using SQL to work with database, retrieving and manipulating data with SQL, working with ADO.NET, ADO.NET architecture, ASP.NET data control, data source control, deploying the web site. Crystal reports. LINQ: Operators, implementations, LINQ to objects, XML, ADO.NET, Query Syntax.

Text books:

1. Beginning ASP.NET 4 in C# 2010 Matthew MacDonald

Reference books:

1. ASP .NET Complete Reference Matthew Mac Donald
2. C# Complete Reference Herbert Schildt

COURSE NAME: **BIGDATA ANALYTICS LAB**
COURSE CODE: **IT791C**
CONTACT: **0:0:3**
CREDITS: **1.5**

Course Objective:

The objective of this course is to impart necessary and practical knowledge of components of Big Data Analytics and develop skills required to build real-life based projects.

Course Outcome

After completion of this course students will be able to

CO1	Understand and implement the basics of data structures like linked list, stack, queue, set and map in Java.
CO2	Demonstrate the knowledge of Big Data Analytics and implement different file management task in Hadoop.
CO3	Understand Map Reduce Paradigm and develop data applications using variety of Systems.
CO4	Analyze and perform different operations on data using Pig Latin Scripts.
CO5	Illustrate and apply different operations on relations and databases using Hive.

CO-PO Mapping:

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

Course Contents:

1. Implement the following Data structures in Java
i)Linked Lists ii)Stacks iii)Queues iv)Set v)Map
2. Perform setting up and Installing Hadoop in its three operating modes:
Standalone, Pseudo distributed, Fully distributed.
3. Implement the following file management tasks in Hadoop:
• Adding files and directories
• Retrieving files
• Deleting files Hint: A typical Hadoop workflow creates data files (such as log files) elsewhere and copies them into HDFS using one of the above command line utilities.
4. Run a basic Word Count Map Reduce program to understand Map Reduce Paradigm.
5. Write a Map Reduce program that mines weather data. Weather sensors collecting data every hour at many locations across the globe gather a large volume of log data, which is a good candidate for analysis with MapReduce, since it is semi structured and record-oriented.
6. Implement Matrix Multiplication with Hadoop Map Reduce.
7. Install and Run Pig then write Pig Latin scripts to sort, group, join, project, and filter your data.
8. Install and Run Hive then use Hive to create, alter, and drop databases, tables, views, functions, and indexes.
9. Solve some real life big data problems.

COURSE NAME: **DISTRIBUTED SYSTEM LAB**
COURSE CODE: **IT791D**
CONTACT: **0:0:3**
CREDITS: **1.5**

Prerequisite:
Operating System, Computer Networking

Course Objective:
This course introduces the fundamentals of distributed computer systems, assuming the availability of facilities for data transmission.

Course Outcome:
After completion of this course students will be able to

CO1	Use the knowledge of the basic elements and concepts related to distributed system technologies for identify core architectural aspects of distributed systems;
CO2	Analyse the functions of main underlying components of distributed systems (such as RPC, file systems)
CO3	Built a distributed systems to support scalability and fault tolerance;

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	3	--	--	--	--	--	--	2
CO2	2	3	2	3	3	--	--	--	--	--	--	2
CO3	3	3	3	3	3	1	1	1	--	--	--	3

Course Contents:
The following programs may be developed preferably on 'UNIX' platform:-
1. Simulate the functioning of Lamport's Logical Clock in 'C'.
2. Simulate the Distributed Mutual Exclusion in 'C'.
3. Implement a Distributed Chat Server using TCP Sockets in 'C'.
4. Implement RPC mechanism for a file transfer across a network in 'C'
5. Implement 'Java RMI' mechanism for accessing methods of remote systems.
6. Simulate Balanced Sliding Window Protocol in 'C'.
7. Implement CORBA mechanism by using 'C++' program at one end and 'Java program on the other.

Text books:
1. Distributed Operating Systems Concepts and Design, Pradeep K. Sinha, PHI
2. Distributed Systems: Concepts and Design by George Coulouris, Jean Dollimore, Tim Kindberg, Pearson

Reference books:
1. Distributed Operating Systems by Andrew S Tannebaum, Pearson

COURSE NAME: **MOBILE APPLICATION DEVELOPMENT LAB**
COURSE CODE: **IT793A**
CONTACT: **0:0:3**
CREDITS: **1.5**

Course Objective:
To understand the components and structure of mobile application development frameworks for Android and windows OS based mobiles.

Course Outcome
After completion of this course students will be able to

CO1	Understand different mobile applications.
CO2	Interpret the architecture of hardware and software of mobile application.
CO3	Combine GPS and social media networking applications.
CO4	Improve different exiting applications.
CO5	Solve problems calendar and address book problems with social media application – Using Wifi - iPhone marketplace.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	2	2	2	--	--	--	--	2	--	--	2
CO2	3	2	3	2	--	--	--	--	--	3	--	2
CO3	2	3	3	3	--	--	4	2	--	--	--	2
CO4	3	2	2	2	--	--	--	--	--	--	--	2
CO5	3	3	2	3	--	--	--	3	--	--	--	2

Course Contents:
1. Develop an application that uses GUI components, Font and Colours
2. Develop an application that uses Layout Managers and event listeners.
3. Write an application that draws basic graphical primitives on the screen.
4. Develop an application that makes use of databases.
5. Develop an application that makes use of Notification Manager
6. Implement an application that uses Multi-threading
7. Develop a native application that uses GPS location information
8. Implement an application that writes data to the SD card.
9. Implement an application that creates an alert upon receiving a message
10. Write a mobile application that makes use of RSS feed
11. Develop a mobile application to send an email.
12. Develop a Mobile application for simple needs (Mini Project)

COURSE NAME: **FUZZY LOGIC LAB**
COURSE CODE: **IT793B**
CONTACT: **0:0:3**
CREDITS: **1.5**

Prerequisite:
probability and differential equations and programming skill.

Course Objective:
The objective of this course is to acquaint student with various computing fuzzy based algorithms using software tools, to make them understand operation of basic elements in fuzzy logic and neural network through simulation and the development of algorithms to solve real life problems.

Course Outcome
After completion of this course students will be able to

CO1	Demonstrate basic concepts fuzzy logic and neural network through simulation.
CO2	Develop the logic given in problem statement using algorithms in NN and basic of toolbox studied.
CO3	Develop the logic given in problem statement using operations in fuzzy logic and basics of toolbox studied.
CO4	Develop real life applications using NN and Fuzzy Logic.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	2	2	--	--	--	--	--	--	--	2
CO2	3	2	2	2	--	--	--	--	--	--	--	2
CO3	3	2	2	3	--	--	--	--	--	--	--	2
CO4	3	2	2	2	--	--	--	--	--	--	--	2

Course Contents:
1. Learning rules and activation functions in NN
2. Development of logic using MP and Hebb neuron model
3. Development of supervised learning using NN Toolbox
4. Development and testing of perceptron NN algorithm
5. Development of ADALINE algorithm with bipolar inputs and outputs
6. Development of auto associative network using outer product rule
7. Development of fuzzy membership functions and fuzzy set properties
8. Development of logic for fuzzy relations
9. Verification of logic using fuzzy relations
10. Design of a fuzzy controller systems using fuzzy tool of MATLAB
11. Application development using NN/Fuzzy logic

Project Domains:
1. Study of Fuzzy decision based systems.
2. Application of Fuzzy logic in real world engineering problems.
3. Application of Fuzzy logic in AI

Text books:

1. Neural Networks and Fuzzy Logic System by Bart Kosko, PHI Publications.
2. Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications by Rajase kharan and Rai – PHI Publication.
3. Fuzzy Sets, Fuzzy Logic, and Fuzzy Systems by Lotfi A. Zadeh
4. Zimmermann, H. J., Fuzzy Set theory and its Applications, Allied Publishers Limited.
5. Fuzzy logic with engineering application by Timothy J. Ross-wiley

Reference books:

1. Klir.G, Yuan B.B. "Fuzzy sets and Fuzzy Logic Prentice Hall of India private limited, 1997.
2. John Yen and Reza Lengari, ―Fuzzy Logic: Intelligence, Control and Information‖, Pearson Education, 1999.
3. Jerry M Mendel, ―Uncertain Rule-based Fuzzy Logic Systems: Introduction and New Directions, PH PTR, 2000.
4. Hung Nguyen and Elbert Walker, ―A First Course in Fuzzy Logic, 2/e,, Chapman and Hall/CRC, 1999.

COURSE NAME: **VLSI DESIGN LAB**
COURSE CODE: **IT793C**
CONTACT: **0:0:3**
CREDITS: **1.5**

Course Objective:
The objective of this course is to motivate students to design VLSI circuits in the area of digital, analog and also to encourage for the design of IC with low power and high speed.

Course Outcome
After completion of this course students will be able to

CO1	Measure VIL, VIH, VOL, VOH, noise margin, CMOS inverter gate delay and average power consumption of CMOS inverter.
CO2	Design combinational circuit - CMOS AND/NAND, OR/NOR, XOR/XNOR gate, CMOS full adder circuit, sequential circuit -CMOS SR latch, clocked SR latch & D flip-flop at schematic level for functional verification with the help of SPICE tools.
CO3	Construct layout of CMOS inverter, CMOS NAND, CMOS NOR gate using layout design tools of SPICE based on design rules.
CO4	Design of combinational circuits - logic gates, Full adder using half adder, 4:1 MUX using 2:1MUX, Sequential circuits-S-R Flip-Flop, 8-bit synchronous counter, 8 Bit bi-directional register with tri-stated input output using VHDL and 4:1 MUX using FPGA.
CO5	Design of CMOS differential amplifier with active load and biased with current mirror for given specification using SPICE tools at schematic level.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	2	2	--	--	--	--	--	--	--	2
CO2	3	2	2	2	--	--	--	--	--	--	--	2
CO3	3	2	2	3	--	--	--	--	--	--	--	2
CO4	3	2	2	2	--	--	--	--	--	--	--	2
CO5	3	3	2	3	--	--	--	--	--	--	--	2

Course Contents:
1. SPICE simulation of CMOS inverter to plot voltage transfer characteristics (VTC) for different values of kn/kp ratio for VDD=1 V and nano dimensional channel length
a) Measurement of critical voltages VIL, VIH, VOL, VOH from VTC .
b) Calculation of noise margin from critical voltages.
2. Functional verification, gate delay and average power consumption analysis of CMOS inverter circuit for VDD $\leq$ 1.2 V and with the nano dimensional channel length of MOS transistor through SPICE simulation.
3. Design and testing of functionality of the following gate and combinational circuit with the help of SPICE tools at schematic level.
a) CMOS AND/NAND, OR/NOR, XOR/XNOR gate
b) CMOS full adder circuit
4. Layout design and functional verification of CMOS inverter, CMOS NAND, CMOS NOR gate using layout design tools of SPICE based on design rules.

5. Design and examination of functionality of the sequential circuits - CMOS SR latch, clocked SR latch & D flip-flop at schematic level using SPICE tools.
6. Design and simulation with the help of VHDL applying suitable modelling style (structural, behavioral, dataflow, mixed) for the following combinational circuits
 a) Logic gates
 b) Full adder using half adder
 c) 4:1 MUX using 2:1 MUX
7. Design using VHDL for the following Sequential circuits
 a) S-R Flip-Flop
 b) 8-bit synchronous counter
 c) 8 Bit bi-directional register with tri-stated input output
8. Familiarity with FPGA based system design and realization of 4:1 Mux using FPGA.
9. Design of CMOS differential amplifier with active load and biased with current mirror for given specification using SPICE tools at the level of schematic.
10. Innovative experiment.

COURSE NAME: **OPERATIONAL RESEARCH LAB**
COURSE CODE: **IT793D**
CONTACT: **0:0:3**
CREDITS: **1.5**

Course Objective:
The purpose of this course is to provide practical knowledge of OR and optimization techniques.

Course Outcome:

After completion of this course students will be able to

CO1	Understand the workings procedures of various OR techniques.
CO2	Execute basic command and scripts in a mathematical way using C
CO3	Apply the programming skills to solve the problems.
CO4	Analyze basic optimization techniques.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	--	--	--	--	--	--	--	--	1
CO2	3	2	2	--	--	--	--	--	--	--	--	1
CO3	3	2	2	--	--	--	--	--	--	--	--	1
CO4	3	3	2	3	--	--	--	--	--	--	--	1

Course Contents:
Software based lab using C

- Linear Programming (Transportation , Assignment , Duality , Simplex)
- For C-Language:
- Shortest Path(Dijkstra's , Floyd's Algorithm)
- Maximal Flow.
- PERT/CPM
- Queueing Theory
- Integer Programming Problem (Branch & Bound Problem)

N:B:-Familiarization with any O.R package.

COURSE NAME: **ENTREPRENEURSHIP & INNOVATION SKILL**
COURSE CODE: **MC701**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **24**
CREDITS: **3 UNITS**

Course Outcome
After completion of this course students will be able to

CO1	Comprehend the role of bounded rationality, framing, causation and effectuation in entrepreneurial decision making.
CO2	Demonstrate an ability to design a business model canvas.
CO3	Evaluate the various sources of raising finance for startup ventures.
CO4	Explain the fundamentals of developing and presenting business pitching to potential investors.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	--	1	2	3	--	--	2	--	2	3	3
CO2	3	1	--	1	--	--	1	--	1	--	3	3
CO3	3	--	2	--	2	3	--	--	--	2	3	3
CO4	3	2	--	1	--	--	--	2	2	--	3	3

Course Contents:

Module I: [4L]

Introduction to Entrepreneurship: Entrepreneurs; entrepreneurial personality and intentions - characteristics, traits and behavioral; entrepreneurial challenges. Entrepreneurial Opportunities: Opportunities. discovery/ creation, Pattern identification and recognition for venture creation: prototype and exemplar model, reverse engineering.

Module II :[**4L]**

Entrepreneurial Process and Decision Making: Entrepreneurial ecosystem, Ideation, development and exploitation of opportunities; Negotiation, decision making process and approaches, Effectuation and Causation; Advantage and Limitations of Entrepreneurship; Process of Entrepreneurship.

Module III: [4L]

Crafting business models and Lean Start-ups: Introduction to business models; Creating value propositions-conventional industry logic, value innovation logic; customer focused innovation; building and analyzing business models; Business model canvas, Introduction to lean startups, Business Pitching.

Module IV: [4L]

Organizing Business and Entrepreneurial Finance: Forms of business organizations; organizational structures; Evolution of Organization, sources and selection of venture finance options and its managerial implications. Policy Initiatives and focus; role of institutions in promoting entrepreneurship.

Module V: [4L]

Entrepreneurs as problem solvers: Innovations and Entrepreneurial Ventures – Global and Indian; Role of Technology – E-commerce and social media; Social Entrepreneurship – Concept; Entrepreneurship – The Indian Scenario

Module VI: [4L]

Project/Case Study: (Any One)

1. Visit of the District Industries Centre and prepare a report of activities and programs undertaken by them
2. Conduct a case study of any entrepreneurial venture in your nearby area.

3. Field Visit: Visit any business firm near your locality; interact with the owner of the business firm and prepare a field report on parameters like: type of business, scale of business, product/service dealing in, target customer, problems faced and measures to solve the faced challenges.

4. Know your State Handicraft and Handlooms as a means of economic activity

Textbooks:

1. Bessant, J. (2003) High Involvement Innovation: Building and Sustaining Competitive Advantage Through Continuous Change. Chicester: John Wiley & Sons.
2. Bygrave, W and Zackarakis, A (2013) Entrepreneurship, 3rd Edition, John Wiley and Co. Drucker, P. (1999) Innovation and Entrepreneurship, Butterworth Heinemann, Oxford.
3. Fagerberg, J, Mowery, DC and Nelson, RR (2005) The Oxford Handbook of Innovation, Oxford University Press, NY.
4. Hisrich, R.D., Peters, M.P., and Shepherd, D. (2013) Entrepreneurship, McGraw-Hill Irwin, Boston.
5. Kuratko, D. (2013) Entrepreneurship: Theory, Process, and Practice, 9th Edition, Wiley online library.
6. Moore, Geoffrey, (1999) Crossing the Chasm, Harper & Collins.
7. Porter, ME, Competitive Advantage: Creating and Sustaining Superior Performance, Free Press, New York, NY, 1985

8th Semester

4th Year 8th Semester

Sl. No	Category	Course Code	Course Title	Contact Hours /Week				Credit Point
				L	T	P	Total	
A. THEORY								
1	Professional Elective Course	IT801A	Data Sciences	3	0	0	3	3
		IT801B	Business Analytics					
		IT801C	Cluster and Grid Computing					
		IT801D	Information Theory and Coding					
2	Open Elective Course	IT802A	Enterprise Resource Planning	3	0	0	3	3
		IT802B	Natural Language Processing					
		IT802C	Bioinformatics					
		IT802D	Embedded System					
3	Open Elective Course	IT803A	Cyber Law and Security Policy	3	0	0	3	3
		IT803B	Human Computer Interaction					
		IT803C	Human Resource Management					
		IT803D	Control System					
B. PRACTICAL								
4	Project	PR891	Major Project-II	0	0	0	12	6
5	Project	PR892	Grand Viva	0	0	0	0	1
C. MANDATORY ACTIVITIES / COURSES								
6	Mandatory Course	MC 881	Essence of Indian Knowledge Tradition	0	0	3	3	3 Units
TOTAL CREDIT								**16**

COURSE NAME: **DATA SCIENCE**
COURSE CODE: **IT801A**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **35**
CREDITS: **3**

Prerequisite:
Basic knowledge in data storage and retrieval, Knowledge in Quantitative Aptitude and Statistics, Proficiency in Algorithms and Computer Programming Skills.

Course Objective:
Demonstrate knowledge of statistical data analysis techniques utilized in business decision making, Use data mining software to solve real-world problems.

Course Outcome
After completion of this course students will be able to

CO1	Demonstrate proficiencies with statistical and probabilistic data analysis.
CO2	Evaluate different statistical analysis mechanisms over various datasets utilizing modern software tools.
CO3	Apply the statistical knowledge to build and assess different data-driven models.
CO4	Demonstrate skill in data engineering like storage, extraction, transformation, loading, pre-processing, feature identification, and data mining.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	2	--	--	--	--	--	--	--	--	--
CO2	3	3	3	2	3	--	--	--	--	--	--	3
CO3	3	3	3	2	3	--	--	--	--	--	--	3
CO4	3	3	2	3	3	--	--	--	--	--	--	2

Course Contents:
Module 1: Introduction [4L]
Introduction to Data Science – Evolution of Data Science – Data Science Roles – Stages in Data Science Project – Applications of Data Science in various fields – Data Security Issues.

Module 2: Data Collection and Data Pre-Processing [8L]
Data Collection Strategies – Data Pre-Processing Overview – Data Cleaning – Data Integration and Transformation – Data Reduction – Data Discretization.

Module 3: Exploratory Data Analytics [8L]
Descriptive Statistics – Mean, Standard Deviation, Skewness and Kurtosis – Box Plots – Pivot Table – Heat Map – Correlation Statistics – ANOVA

Module 4: Model Development [8L]
Simple and Multiple Regression – Model Evaluation using Visualization – Residual Plot –Distribution Plot – Polynomial Regression and Pipelines – Measures for In-sample, Evaluation – Prediction and Decision Making.

Module 5: Model Evaluation [7L]
Generalization Error – Out-of-Sample Evaluation Metrics – Cross Validation – Overfitting , Under Fitting and Model Selection – Prediction by using Ridge Regression – Testing, Multiple Parameters by using Grid Search.

Textbooks:
1. Jojo Moolayil, “Smarter Decisions : The Intersection of IoT and Data Science”, PACKT, 2016.
2. Cathy O’Neil and Rachel Schutt , “Doing Data Science”, O'Reilly, 2015.
3. David Dietrich, Barry Heller, Beibei Yang, “Data Science and Big data Analytics”, EMC 2013

Reference books:
1. Raj, Pethuru, “Handbook of Research on Cloud Infrastructures for Big Data Analytics”, IGI Global.

COURSE NAME: **BUSINESS ANALYTICS**
COURSE CODE: **IT801B**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **36**
CREDITS: **3**

Prerequisite:
Basic knowledge of Statistical Inference, Multiple Linear Regression and Probability Distributions. Proficiency in Algorithms and Computer Programming Skills.

Course Objective:
The objective of this course is to cover fundamental algorithms and techniques used in Business Analytics its applications along with the statistical foundations.

Course Outcome:
After completion of this course students will be able to

CO1	Find a meaningful pattern in data
CO2	Graphically interpret data
CO3	Implement the analytic techniques
CO4	Handle large scale analytics projects from various domains

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	3	2	2	3	--	--	--	2	--	--	--
CO2	2	3	3	3	3	--	--	--	--	--	--	--
CO3	2	3	3	3	3	--	--	--	2	--	--	--
CO4	2	3	3	3	3	--	--	--	2	1	--	2

Course Contents:
Module 1: [4L]
Foundations of Business Analytics: Introduction to Business Analytics, Analytics on Spreadsheets. Data Definitions and Analysis Techniques. Elements, Variables, and Data categorization, Levels of Measurement, Data management and indexing, Introduction to statistical learning and R-Programming

Module 2: [4L]
Product-Market Fit: Gap Analysis, Carrying Out Gap Analysis, Steps in Gap Analysis, Conducting a Representative Survey for Gap Analysis, Predicting Consumer Behavior and Gap Analysis in Smartphone Market.

Module 3: [6L]
Analytical Modeling by Factor and Cluster Analysis, Factor Analysis Concepts, Application of Factor Analysis Concepts of Cluster Analysis, Similarity Measures, Application of Cluster Analysis.

Module 4: [7L]
Analytical Modeling by Logistics Regression and Discriminant Analysis: Linear Discriminant Analysis Model, Predictive Modeling using Discriminant Analysis, Application of Linear Discriminant Analysis for Credit Scoring of Loan Applicants. Theoretical Formulation of Logistics Regression, Mathematical Interpretation of Logistics Regression, Indicator for Model Fit, Applying Logistics

Regression, Application of Logistics Regression in Predicting Risk in Portfolio Management Testing the Reliability/Consistency of the Different Factors Measured.

Module 5: [4L]
Segmentation of primary target market by Heuristic Modeling: Introduction to RFM Analysis, Enhancing Response Rates with RFM Analysis.

Module 6: [5L]
Segmentation of target market based on large databases using Decision Tree approach. Introduction to Chi-square Automatic Interaction Detection (CHAID), Predictive Modelling by CHAID.

Case Studies and Projects: [6L]
Understanding business scenarios, Feature engineering and visualization. Scalable and parallel computing with Hadoop and Map-Reduce, Sensitivity Analysis, Practice and analysis with R.

Textbooks:
1. Business Analytics: An Application Focus, Purba Halady Rao, Prentice Hall.
2. Business Analytics, James R. Evans, Pearson.

Reference books:
1. Modeling Techniques in Predictive Analytics, Thomas W. Miller, Pearson
2. Enterprise Analytics: Optimize Performance, Process, and Decisions Through Big Data, Thomas H. Davenport, Pearson.
3. Fundamentals of Business Analytics, Seema Acharya, Wiley India.
4. Business Intelligence: A Managerial Perspective on Analytics, Ramesh Sharda, Dursun Delen, Efraim Turban, David King, Prentice Hall

COURSE NAME: **CLUSTER AND GRID COMPUTING**
COURSE CODE: **IT801C**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **36**
CREDITS: **3**

Prerequisite:
Networking, Operating System, Computer Architecture

Course Objective:
The objective of the course is to learn and understand Cluster and Grid computing in details and identify the usage of it.

Course Outcome:
After completion of this course students will be able to

CO1:	Understand the basic architecture of Cluster and Grid Computing
CO2:	Apply the knowledge of Cluster and Cluster computing in the evaluation of the computing model
CO3:	Analyze different problems in the domain of Cluster and Grid computing
CO4:	Evaluate the different models and solutions provided in the field of Cluster and Grid computing

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	3	2	2	3	--	--	--	2	--	--	--
CO2	2	3	3	3	3	--	--	--	--	--	--	--
CO3	2	3	3	3	3	--	--	--	2	--	--	--
CO4	2	3	3	3	3	--	--	--	2	1	--	2

Course Contents:

Module 1: Cluster Computing [3L]
Approaches to Parallel Computing, How to Achieve Low Cost Parallel Computing through Clusters, Definition and Architecture of a Cluster, What is the Functionality a Cluster can Offer? Categories of Clusters

Module 2: Cluster Middleware [3L]
Levels and Layers of Single System Image (SSI), Cluster Middleware Design Objectives, Resource Management and Scheduling, Cluster Programming Environment and Tools

Module 3: Cluster Architecture [4L]
Early Cluster Architectures, High Throughput Computing Clusters, Condor.

Module 4: Network Protocols and IO [5L]
Networks and Inter-connection/Switching Devices, Design Issues in Interconnection Networking/Switching, Design Architecture-General Principles and Trade-offs, HiPPI, ATM (Asynchronous Transmission Mode), Gigabit Ethernet

Module 5: Introduction to Grid Computing [4L]
The Data Centre, the Grid and the Distributed / High Performance Computing, Cluster Computing and Grid Computing, Meta computing – the Precursor of Grid Computing, Scientific, Business and e-Governance Grids, Web Services and Grid Computing, Business Computing and the Grid – a Potential Win – win Situation, e-Governance and the Grid.

Module 6: Technologies and Architecture [2L]
Clustering and Grid Computing, Issues in Data Grids, Key Functional Requirements in Grid Computing, Standards for Grid Computing, Recent Technological Trends in Large Data Grids

Module 7: Grid Monitoring [4L]
Grid Monitoring Architecture (GMA) - An Overview of Grid Monitoring Systems- R-GMA - Grid ICE – MDS- Service Level Agreements (SLAs) - Other Monitoring Systems- Ganglia, Grid Mon, Hawkeye and Network Weather Service.

Module 8: Grid Security and Resource Management [3L]
Grid Security-A Brief Security Primer-PKI-X509 Certificates-Grid Security-Grid Scheduling and Resource Management, Grid way and Grid bus Broker-principles of Local Schedulers Overview of Condor, SGE, PBS, LSF-Grid Scheduling with QoS

Module 9: Data Management and Grid Protocol [4L]
Data Management-Categories and Origins of Structured Data-Data Management Challenges Architectural Approaches-Collective Data Management Services-Federation Services-Grid Portals-Generations of Grid Portals.

Module 10: Grid Middleware [4L]
List of globally available Middleware - Case Studies-Recent version of Globus Toolkit and gLite - Architecture, Components and Features. Features of Next generation grid.

Textbooks:
1.C.S.R.Prabhu – "Grid and Cluster Computing"-PHI(2008)

Reference books:
1. Fran Berman , Geoffrey Fox, Anthony J.G. Hey, Grid Computing: Making The Global Infrastructure a Reality,Wiley, 2003
2. Maozhen Li , Mark Baker , The Grid: Core Technologies, Wiley, 2005
3. JoshyJoseph , Craig Fellenstein Grid Computing, IBM Press, 2004

COURSE NAME: **INFORMATION THEORY & CODING**
COURSE CODE: **IT801D**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **36**
CREDITS: **3**

Prerequisite:
Mathematics, Physics, Electronics.

Course Objective:
To comprehend basics of communication system and coding techniques, apply the basic concept of PCM systems and baseband transmission schemes.

Course Outcome

After completion of this course students will be able to

CO1	Understand basics of communication system and coding schemes.
CO2	Apply the basic concept of PCM systems and baseband transmission schemes.
CO3	Analyze and evaluate band pass signaling schemes.
CO4	Create spectral characteristics of band pass signaling schemes and asses noise performance.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	2	3	--	--	--	--	--	--	--	2	--
CO2	1	2	3	--	--	--	--	--	--	--	--	--
CO3	1	2	3	--	--	--	--	--	--	--	--	--
CO4	1	3	--	--	--	1	--	--	--	--	--	--

Course Contents:
Module I: [6L]
Elements of communication system, introduction to signals and modulation. Basic concept of a signal(Amplitude, frequency, wavelength, bandwidth), introduction to baseband transmission - modulation. Elements of Communication systems, origin of noise and its effect on communication system. Concept and need for modulation - types of modulation, concept of time domain and spectral representation of a signal.

Module II: [5L]
Linear Modulation: Basic principles of Amplitude Modulation with Time domain representation of AM signal, modulation index calculation, transmission bandwidth, power & efficiency calculations. Basic concept of square law modulator and balanced modulator. Detection of AM by envelope detector, Synchronous detection for AM-SC. Basic principles of Sideband suppressed techniques and the need for it. Need for carrier suppression .Basic concept of SSB-SC, DSB-SC, VSB-SC. Generation of SSB: Filter method, Phase shift method. Names of SSB-SC, DSB-SC generator and detector

Module III: [4L]
Non linear Modulation & Demodulation: Frequency Modulation and Phase Modulation: Time domain representations, total power calculation for a single tone message. Generation of FM & PM: basic concept and difference of wide band frequency modulation and narrowband frequency modulation.

basic concept on direct and indirect method of FM generation : introductory discussion on Armstrong method. Basic block diagram representation of generation of FM & PM: basic Concept of VCO & Reactance modulator only. Demodulation of FM and PM: Only Basic Concept of frequency discriminators Phase Locked Loop Comparison of various Analog modulation techniques, inter relation between PM and FM

Module IV: [10L]
Sampling and digital transmission: Sampling theorem, Sampling rate, sampling theorem, Nyquist rate, Impulse sampling, Reconstruction from samples, Aliasing; Analog Pulse Modulation – basic discussiononPAM,PWM,PPM.ConceptofQuantisation&UniformQuantiser,Non-uniformQuantiser,Quantisation error, signal to quantization noise ratio calculation, A-law & μ-law commanding (afterdiscussiononcompandingmentiononlythetwotypesandtheiruse),Encoding,Codingefficiency.Basic concept of Pulse Code Modulation, Block diagram of PCM, basic concept of DPCM, Delta modulation, basic concept of slope overload and Granular. Distortion, Adaptive delta-modulation. Multiplexing-TDM, FDM, SDM. Line coding & properties, NRZ & RZ, AMI, Manchester coding. Brief discussion on: ISI, Raised cosine function, Nyquist criterion for distortion-less base-band binary transmission, Eye pattern

Module V: [5L]
Digital Carrier Modulation & Demodulation Techniques: Introduction to the different digital modulation techniques ASK, FSK, PSK, BPSK, QPSK, MSK, Introduction to QAM,. Spread Spectrum Modulation–DSSS, FHSS –concept only.

Module VI: [6L]
Information Theory & Coding: Introduction to Information Theory, Entropy, Mutual information, Information rate, channel and bandwidth, Bit rate, Baud rate, Information capacity, Shanon‘s limit, Shanon-Fano algorithm for encoding, Huffman coding for numerical, Shannon's Theorem- Source Coding Theorem, Information Capacity Theorem. Error control Strategies: (Basic Concept of Data communication, concept of FEC, ARQ and CRC).

Textbooks:
1. An Introduction to Analog and Digital Communications, Simon Haykin; Published by Wiley India.
2. Principle of Communication Systems by Herbert Tauband D. L.Schilling
3. Modern Digital and Analog Communication Systems–
4. Data Communication and Networking by BehrouzA. Forouzan, Published by Tata McGraw-Hill

Reference books:
1. CommunicationSystems4thEdition by Simon Haykin; Published by Wiley India (Student Edition)
2. Principles and Analog and Digital Communication by Jerry D Gibson, Published by MacMillan.
3. Communication Systems by A.B.Carlson, Published by McGraw-Hill.
4. Understanding Signals and Systems by Jack Golten, Published by McGraw Hill.

COURSE NAME: **ENTERPRISE RESOURCE PLANNING**
COURSE CODE: **IT802A**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **36**
CREDITS: **3**

Prerequisite:
Basic knowledge on management, managerial tasks, enterprise, and networking.

Course Objective:
To acquire an overview to ERP and the knowledge on related technologies. Skill to ERP Manufacturing Perspective and ERP modules.

Course Outcome
After completion of this course students will be able to

CO1	Understand the basic concepts and benefits of ERP for identifying different technologies and IT support used in ERP.
CO2	Apply the concepts of ERP Manufacturing Perspective and ERP Modules.
CO3	Analyze different tools used in ERP
CO4	Evaluate the ERP life cycle for different business scenario.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	2	--	--	--	1	--	--	--	2	1
CO2	3	2	1	2	--	--	--	--	--	--	1	1
CO3	2	--	2	--	2	2	--	--	--	--	--	2
CO4	--	2	1	--	2	--	--	--	--	--	1	3

Course Contents:

MODULE I: Overview of ERP: [9L]
The evolution of ERP systems: Evolution through Payroll system, Inventory Control system, Materials Requirement Planning, Manufacturing Resource Planning, advantages and disadvantages. Definition and Concept of ERP, Business reasons for rise and popularity of ERP system and Benefits. Business processes supported by ERP systems: Various business functions in an Organization– Purchasing, Materials Management, Manufacturing, Sales & Distribution, Plant Maintenance, Quality Management, Finance & Accounting including Costing, Human Resources etc. ERP market place: SAP, Oracle, PeopleSoft, JD Edwards, Baan, Microsoft's suit of products etc. Business modules in these ERP packages – a brief comparative description of business function modules and sub-modules. Overview of key end-to-end business processes supported in two major ERP systems – Order to Cash, Procure to Pay, Plan to Produce and Dispatch.

MODULE II: Information Technology and ERP System: [9L]
The evolution of Information Technology (IT): Evolution of computer generations – Operating systems, File systems to Database Management systems, Communication Networks. Enabling of ERP systems by IT evolution. The evolution of ERP systems architecture: Client-Server based architecture, Multi-Tier architecture Presentation layer, Application layer, and Database layer. Brief discussion on Extended ERP systems - Web-enabled ERP architecture, Service- Oriented Architecture and Cloud Computing. Open Source ERP. Related technology concepts: ERP and Supply Chain Management,

and Customer Relationship Management, ERP and Business Intelligence, ERP and Data warehousing, ERP and E-business.

MODULE III: Implementation of ERP System: [9L]

ERP implementation approach: Single vendor versus Best-of Breed ERP implementation, Big Bang versus Phased implementation, Using ERP of Application Service Provider. ERP implementation life cycle: Planning different aspects, Understanding requirements and Process preparation – Gap analysis and Business Process Engineering, User Acceptance criteria, Design, Configuration, Customization, Extensions, Data migration, End-user training, User Acceptance, Going live, Roll-out. Differences between ERP implementation life cycle and Custom Software development phases. Drawbacks of ERP system. Organizing implementation: Interaction with Vendors, Consultants, and Users. Contracts with Vendors, Consultants, and Employees. Project Management and Monitoring. ERP Project Organization– Formation of Steering Committee and different User Groups. Top Management Commitment and Steering Committee meetings. Change Management, Risks and Challenges in ERP implementation. Post-implementation Support, Review, Maintenance and Security of ERP systems: A typical Support Cycle. Post-implementation Review of ERP systems – measures of review, and approaches for review System maintenance and ERP system maintenance. Software upgrade Security and Access control of ERP systems.

MODULE IV: Emerging Trends and Future of ERP Systems: [9L]

Emerging Technologies and ERP: Service-oriented Architecture: Enterprise SOA layers – Business processes, Business services, Components and Integration services, Advantages and Drawbacks of SOA, Difference between multi-layered Client-server architecture and SOA, basic awareness of NetWeaver from SAP, WebSphere from Oracle and .Net from Microsoft. Enterprise Application Integration: Basic understanding of the concept, Types of EAI – User Interface, Method, Application Interface, Data. Radio Frequency Identification and ERP: awareness of RFID technology, Benefits of RFID integrated with ERPs. M-Commerce: basic concept and applications, difference with E-Commerce, benefits of integration with ERPs. Future of ERP: Technology transformation to SOA, more E-Commerce features, Growing mobile applications, Economical and Easy models of ERP deployment etc.

Textbooks:

1. B Electronic commerce (second edition) –Pete Loshin & Paul A. Murphy, Jaico Publishers
2. 2.E-commerce (second edition) – Bajaj & Nag, Tata McGraw Hill
3. Enterprise Resource Planning –Alexis Leon, Tata McGraw Hill

Reference books:

1. Enterprise Resource Planning, 2nd Edition by Alexis Leon, Tata McGraw Hill Education, 2008
2. Guide to Planning ERP Application, Annetta Clewwto and Dane Franklin, McGraw Hill, 1997
3. The SAP R/3 Handbook, Jose Antonio, McGraw Hill

COURSE NAME: **NATURAL LANGUAGE PROCESSING**
COURSE CODE: **IT802B**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **36**
CREDITS: **3**

Prerequisite:
Mathematics, Computer Programming, Formal Language and Automata Theory

Course Objective:
The objective of the course is to learn the basics of NLTK toolkit, principles of NLP through programming, to build an application using different algorithms and natural language processing techniques.

Course Outcome:
After completion of this course students will be able to

CO1	Understand the basics of text processing including basic pre-processing, spelling correction, language modeling, Part-of-Speech tagging, Constituency and Dependency Parsing, Lexical Semantics, distributional Semantics and topic models
CO2	Apply the text mining such as entity linking, relation extraction, text summarization, text classification, sentiment analysis and opinion mining.
CO3	Analyze the application of text mining such as entity linking, relation extraction, text summarization, text classification, sentiment analysis and opinion mining
CO4	Evaluate and create various texts mining model to solve real world tasks using NLP tool kits

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	2	3	3	2	--	--	--	--	--	3
CO2	2	3	2	1	3	2	--	--	--	--	--	1
CO3	3	1	2	1	3	3	--	--	--	--	--	2
CO4	3	3	2	3	2	2	--	--	--	--	--	2

Course Contents:
Module I: [5L]
Introduction: Knowledge in Speech and Language Processing, Ambiguity, Models and Algorithms, Language, Thought, and Understanding, The State of the Art and the Near-Term Future. Regular Expressions and Automata: Regular Expressions, Finite-State Automata, Regular Languages and FSAs.

Module II: [5L]
Word Classes and Part-of –Speech Tagging: (Mostly) English Word Classes, Tag sets for English, Part-of –Speech Tagging, Rule-Based Part-of –Speech Tagging, Stochastic Part-of –Speech Tagging, Transformation-Based Tagging, Other Issues.

Module III: [5L]
Context-Free Grammars for English: Constituency, Context-Free Rules and Trees, Sentences-Level Constructions, The Noun Phrase, Coordination, Agreement, The Verb Phrase and Sub categorization, Auxiliaries, Spoken Language Syntax, Grammar Equivalence and Normal Form, Finite-State and

Context- Free Grammars, Grammars and Human Processing.

Module IV: [5L]
Parsing with Context-Free Grammars: Parsing as Search, A Basic Top-Down Parser, Problems with the Basic Top-Down Parser, The Early Algorithm, Finite – State Parsing Methods.

Module V: [5L]
Features and Unification: Feature Structures, Unification of Features Structures, Features Structures in the Grammar, Implementing Unification, Parsing with Unification Constraints, Types and Inheritance.

Module VI: [5L]
Representing Meaning: Computational Desiderata for Representations, Meaning Structure of Language, First Order Predicate Calculus, and Some Linguistically Relevant Concepts. Semantic Analysis: Syntax-Driven Semantic Analysis, Attachments for a Fragment of English, Integrating Semantic Analysis into the Early Parser, Idioms and Composionality, Robust Semantic Analysis.

Module VII: [6L]
Discourse: Reference Resolution, Text Coherence, Discourse Structure, Psycholinguistic Studies of Reference and Coherence. Natural Language Generation: Introduction to Language Generation, An Architecture for Generation, Surface Realization, Discourse Planning, Other Issues.

Textbooks:
1. Steven Bird, Ewan Klein, and Edward Loper. "Natural Language Processing– Analyzing Text with the Natural Language Toolkit". 2009, O'Reilly, 1ed.
2. Robert Dale, Hermani Moisi, Harold Somers, Handbook Of Natural Language Processing, Markcel Dekker Inc.

Reference books:
1. Ruslan Mitkov, The Oxford Handbook of Computational Linguistics, Oxford University Press, 2003.
2. Daniel Jurafsky, James Martin, Speech and Language Processing, Prentice Hall,
3. James Allen, Natural Language Processing, Pearson Education, 2003.
4. Christopher D.Manning& Henrich Schutze, Foundations Of Statistical Natural Language Processing, The MIT Press, 2001
5. Douglas Biber, Susan Conrad, Randi Reppen, Corpus Linguistics – Investigating Language Structure And Use, Cambridge University Press, 2000.
6. David Singleton, Language And The Lexicon: An Introduction, Arnold Publishers, 2000.

COURSE NAME: **BIO-INFORMATICS**
COURSE CODE: **IT802C**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **35**
CREDITS: **3**

Prerequisite:
Concepts of Computer Networking, Network Security, Database Management Systems

Course Objective:
The basic objective is to learn about different bio molecules, their structures and functions, various data sets in bioinformatics, computational techniques useful in bioinformatics.

Course Outcome:
After completion of this course students will be able to

CO1	Acquire the knowledge of Bioinformatics technologies with the related concept of DNA, RNA and their implications
CO2	Understand the concept and techniques of different types of Data Organization and Sequence Databases with different types of Analysis Tools for Sequence Data Banks
CO3	Acquire the knowledge of the DNA Sequence Analysis
CO4	Analyze the performance of different types of Probabilistic models used in Computational Biology

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	2	3	3	2	--	--	--	--	--	--
CO2	2	3	2	--	3	2	--	--	--	--	--	1
CO3	3	--	2	--	3	3	--	--	--	--	--	2
CO4	3	3	2	3	2	2	--	--	--	--	--	2

Course Contents:

Module I: Introduction to Molecular Biology [10L]
Concepts of Cell, tissue, types of cell, components of cell, organelle. Functions of different organelles. Concepts of DNA: Basic Structure of DNA; Double Helix structure; Watson and crick model. Exons and Introns and Gene Concept. Concepts of RNA: Basic structure, Difference between RNA and DNA. Types of RNA. Concept of Protein: Basic components and structure. Introduction to Central Dogma: Transcription and Translation Introduction to Metabolic Pathways.

Module II: Sequence Databases [4L]
Introduction to Bioinformatics. Recent challenges in Bioinformatics. Protein Sequence Databases, DNA sequence databases. sequence database search programs like BLAST and FASTA. NCBI different modules: GenBank, OMIM, Taxonomy browser, PubMed

Module III: DNA Sequence Analysis [10L]
DNA Mapping and Assembly: Size of Human DNA, Copying DNA: Polymerase Chain Reaction (PCR), Hybridization and Microarrays, Cutting DNA into Fragments, Sequencing Short DNA Molecules, Mapping Long DNA Molecules. DeBruijn Graph. Sequence Alignment: Introduction, local and global alignment, pair wise and multiple alignment, Dynamic Programming Concept. Alignment

algorithms: Needleman and Wunsch algorithm, Smith-Waterman.

Module IV: Introduction Probabilistic models used in Computational Biology [7L]
Probabilistic Models; Hidden Markov Model: Concepts, Architecture, Transition matrix, estimation matrix. Application of HMM in Bioinformatics: Gene finding, profile searches, multiple sequence alignment and regulatory site identification. Bayesian networks Model: Architecture, Principle, Application in Bioinformatics.

Module V: Biological Data Classification and Clustering [4L]
Assigning protein function and predicting splice sites: Decision Tree

Textbooks:
1. Bio Informatics and Molecular Evolution by Paul G. Higgs and Teresa K. Attwood
2. Bio Informatics Computing by Bryan Bergeron

Reference books:
1. Bio Informatics and Functional Geneomics, by Jonathan Pevsner
2. Gene Cloning DNA Analysis, by T.A. Brown

COURSE NAME: **EMBEDDED SYSTEM**
COURSE CODE: **IT802D**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **35**
CREDITS: **3**

Prerequisite:
Knowledge of basic microprocessor and microcontroller.

Course Objective:
An ability to design a system, component, or process to meet desired needs within realistic constraints, to become familiar with the programming environment used to develop embedded systems.

Course Outcome:
After completion of this course students will be able to

CO1	Understand the architecture and classifications of different embedded systems and the related programming knowledge.
CO2	Apply the key concepts of embedded systems like I/O, timers, interrupts, interaction with peripheral devices.
CO3	Analyze the case-specific debugging technique for an embedded system.
CO4	Design Embedded system for specific scenario.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	1	2	1	2	--	--	--	--	--	--	1
CO2	2	1	3	2	--	--	--	--	--	--	--	--
CO3	2	2	3	3	2	--	--	--	--	--	--	1
CO4	2	2	2	2	2	--	--	--	--	--	--	2

Course Contents:
Module I: [4L]
Introduction to the Embedded System: Embedded system Vs General computing systems, Purpose of Embedded systems, classifications of embedded systems, fundamentals of embedded processor and microcontrollers, CISC vs. RISC.

Module II: [8L]
Serial and parallel communication: devices and protocols, wireless communication: devices and protocols, parallel communication network using ISA, PCI, PCT-X, Internet embedded system network protocols, USB, Bluetooth.

Module III: [7L]
Program Modeling Concepts; Fundamental issues in Hardware software co-design, Unified Modeling Language (UML), Hardware Software trade-offs DFG model, state machine programming model, model for multiprocessor system.

Module IV: [6L]
Real Time Operating Systems: Operating system basics, Tasks, Process and Threads, Multiprocessing and multitasking, task communication, task synchronization, qualities of good RTOS.

Module V: [10L]
PIC microcontroller: introduction, architecture, comparison of PIC with other CISC and RISC based systems and microprocessors, assembly language programming, addressing modes, instruction set, Interfacing with various sensors and actuators using PIC microcontroller. Programming concepts and embedded programming.

Textbooks:
1. Introduction to Embedded Systems: Shibu K. V. (TMH)
2. Embedded System Design – A unified hardware and software introduction: F. Vahid (John Wiley)

Reference books:
1. Embedded Systems: Rajkamal (TMH)
2. Embedded Systems: L. B. Das (Pearson)
3. Embedded System design: S. Heath (Elsevier)
4. Embedded microcontroller and processor design: G. Osborn (Pearson)

COURSE NAME: **CYBER LAW AND SECURITY POLICY**
COURSE CODE: **IT803A**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **35**
CREDITS: **3**

Prerequisite:
The students to whom this course will be offered must have the familiarity in Computer Networking and basic concepts about Network Security and Cryptography.

Course Objective:
The objectives of this course are to enable learner to understand, explore and acquire a critical understanding Cyber Law, develop competencies for dealing with frauds and deceptions (confidence tricks, scams) and other Cyber Crimes.

Course Outcome:
After completion of this course students will be able to

CO1	Understand the policy issues related to electronic filing of documents.
CO2	Identify the importance of lawful recognition for transactions through electronic data interchange and other means of electronic communication.
CO3	Analyze the effectiveness of the prevailing information security law practices.
CO4	Judge the architecture that can cater to the needs of the social information security.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	--	1	1	--	2	--	1	--	--	--	1
CO2	1	3	2	1	--	2	--	2	--	--	--	1
CO3	1	2	2	2	--	1	--	2	--	--	--	1
CO4	1	2	2	2	1	3	--	3	--	--	--	1

Course Contents:

MODULE I: Introduction of Cybercrime: [6L]
Cybercrime and Offences, Forgery, Hacking, Software Piracy, Computer Network Intrusion, Jurisdiction to Prescribe/Legislative Jurisdiction; Jurisdiction to Adjudicate to Enforce; Cyber Jurisdiction in Civil, Criminals Plan Attacks, Passive Attack, Active Attacks, Unicitral Model Law.

MODULE II: Information Technology Act: [6L]
Overview of IT Act, Amendments and Limitations of IT Act, Legal Aspects, Indian Laws, IT Act 2000, Public Key Certificate, Electronic Governance, Legal Recognition of Electronic Records, Legal Recognition of Digital Signature Certifying Authorities, Network Service Providers Liability, Cyber Regulations Appellate Tribunal, Penalties and Adjudication.

MODULE III: Cybercrime Mobile & Wireless Devices: [8L]
Security Challenges Posted by Mobile Devices, Cryptographic Security for Mobile Devices, Attacks on Mobile/Cell Phones, Theft, Virus, Hacking, Bluetooth; Different Viruses on Laptop.

MODULE IV: Tools and Methods used in Cybercrime:[8L]
Proxy Servers, Panword Checking, Random Checking, Trojan Horses and Backdoors; DOS &DDOS

Attacks; SQL Injection: Buffer Over Flow. Most Common Attacks, Scripts Kiddies and Packaged Defense.

MODULE V: Phishing & Identity Theft:[4L]
Phising Methods, ID Theft, Online Identity Method.

MODULE VI: Case Study on Cyber Crimes:[3L]
Harassment Via E-Mails, Email Spoofing (Online a Method of Sending E-Mail using a False Name or E-Mail Address to Make It Appear that the E-Mail Comes from Some body other than the True Sender), Cyber-Stalking.

Textbooks:

1. Nina Gobole & Sunit Belapune. Cyber security, Pub: Wiley India.
2. Chris Reed & John Angel, Computer Law, OUP, New York, 2007.
3. Justice Yatindra Singh, Cyber Laws, Universal Law Publishing Co, New Delhi, 2012.
4. Verma S, K, Mittal Raman, Legal Dimensions of Cyber Space, Indian Law Institute, New Delhi, 2004.
5. K. Kumar, Cyber Laws: Intellectual property & E Commerce, Security,1st Edition, Dominant Publisher,2011.
6. Rodney D. Ryder, Guide to Cyber Laws, Second Edition, Wadhwa and Company, New Delhi, 2007.

Reference books:

1. Kenneth J. Knapp, Cyber Security and Global Information Assurance: Threat Analysis and Response Solutions, IGI Global, 2009.
2. Jonathan Rosenoer, Cyber law: the Law of the Internet, Springerverlag, 1997.
3. Sudhir Naib, The Information Technology Act, 2005: A Handbook, OUP, New York.
4. Vasu Deva, Cyber Crimes and Law Enforcement, Commonwealth Publishers, New Delhi, 2003.
5. Vakul Sharma, Handbook of Cyber Law, Macmillan India Ltd, 2ndEdition, PHI,2003.
6. Sharma, S.R., Dimensions of Cyber Crime, Annual Publications Pvt. Ltd., 1st Edition, 2004.

COURSE NAME: **HUMAN COMPUTER INTERACTION**
COURSE CODE: **IT803B**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **34**
CREDITS: **3**

Course Objective:
The objective of this course is to provide technical knowledge of the foundations of Human Computer Interaction.

Course Outcome
After completion of this course students will be able to

CO1:	Understand the design and development processes and life cycle of Human Computer Interaction
CO2:	Apply the interface design standards/guidelines for cross cultural and disabled users.
CO3:	Analyze product usability evaluations and testing methods.
CO4:	Design and Develop Human Computer Interaction in proper architectural structures.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	--	--	--	--	--	--	--	--	--
CO2	3	2	1	--	--	--	--	--	--	--	--	1
CO3	2	2	1	--	--	--	--	--	--	--	--	--
CO4	3	2	2	--	--	--	--	--	--	--	--	1

Course Contents:
MODULE I: HCI Foundations: [8L]
Input–output channels, Human memory, Thinking: reasoning and problem solving, Emotion, Individual differences, Psychology and the design of interactive systems, Text entry devices, Positioning, pointing and drawing, Display devices, Devices for virtual reality and 3D interaction, Physical controls, sensors and special devices, Paper: printing and scanning.

MODULE II: Designing: [10L]
Programming Interactive systems- Models of interaction, Frameworks and HCI, Ergonomics, Interaction styles, Elements of the WIMP interface, The context of the interaction, Experience, engagement and fun, Paradigms for interaction, Cantered design and testing- Interaction design basics- The process of design, User focus, Scenarios, Navigation design, Screen design and layout, Iteration and prototyping, Design for non-Mouse interfaces, HCI in the software process, Iterative design and prototyping, Design rules, Principles to support usability, Standards and Guidelines, Golden rules and heuristics, HCI patterns.

MODULE III: Implementation Support:[6L]
Elements of windowing systems, Programming the application, Using tool kits User interface management systems, Evaluation techniques, Evaluation through expert analysis, Evaluation through user participation, Universal design, User support.

MODULE IV: Models and Theories:[10L]
Cognitive models, Goal and task hierarchies, Linguistic models, The challenge of display-based systems, Physical and device models, Cognitive architectures. Collaboration and communication - Face-to-face communication, Conversation, Text-based communication, Group working, Dialog design notations, Diagrammatic notations, Textual dialog notations, Dialog semantics, Dialog analysis and design. Human factors and security - Groupware, Meeting and decision support systems, Shared applications and artifacts, Frameworks for groupware Implementing synchronous groupware, Mixed, Augmented and Virtual Reality.

Textbooks:
1. A Dix, Janet Finlay, G D Abowd, R Beale., Human-Computer Interaction, 3rd Edition, Pearson Publishers,2008.
2. Shneiderman, Plaisant, Cohen and Jacobs, Designing the User Interface: Strategies for Effective Human Computer Interaction, 5th Edition, Pearson Publishers, 2010.

Reference books:
1. Brian Fling, ―Mobile Design and Development, First Edition, O'Reilly Media Inc., 2009 (UNIT – IV)
2. Bill Scott and Theresa Neil, ―Designing Web Interfaces, First Edition, O'Reilly, 2009. (UNIT-V)

COURSE NAME: **HUMAN RESOURCE MANAGEMENT**
COURSE CODE: **IT803C**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **36**
CREDITS: **3**

Prerequisite:
The students to whom this course will be offered must have concept of Project Management.

Course Objective:
Learn fundamental HRM frameworks and analyze the overall role of HRM in business. It improves their ability to think about how HRM should be used as a tool to execute strategies and achieve a competitive advantage.

Course Outcome
After completion of this course students will be able to

CO1	Explain the importance of human resources and their effective management in organizations and the meanings of terminology used.
CO2	Apply the tools used in managing employees Effectively and Record governmental regulations affecting employees and employers.
CO3	Analyze the key issues related to administering the human elements such as motivation, compensation, appraisal, career planning, diversity, ethics, and training.
CO4	Evaluate the different tools used in planning and maintenance of human resource needs.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	--	1	1	--	--	--	--	2	3	2	3	--
CO2	--	--	--	--	2	2	1	1	--	2	3	--
CO3	--	--	--	--	2	--	--	1	--	2	3	2
CO4	--	--	--	--	--	--	2	--	--	2	3	2

Course Contents:
MODULE I: Introduction: [4L]
Introduction to Human Resource Management and its definition, functions of Human Resource Management & its relation to other managerial functions. Nature, Scope and Importance of Human Resource Management in Industry, Role & position of Personnel function in the organization.

MODULE II: Procurement and Placement: [3L]
Need for Human Resource Planning, Process of Human Resource Planning, Methods of Recruitment, Psychological tests and interviewing, Meaning and Importance of Placement and Induction, Employment Exchanges Act 1959, The Contract Labour Act 1970.

MODULE III: Training & Development: [3L]
Difference between training and Development, Principles of Training, Employee Development, Promotion-Merit v/s seniority Performance Appraisal, Career Development & Planning.

MODULE IV: Job analysis & Design: [2L]
Job Analysis, Job Description & Job Description, Job Specification

MODULE V: Job Satisfaction: [8L]
Job satisfaction and its importance, Motivation, Factors affecting motivation, introduction to Motivation Theory, Workers' Participation, Quality of work life. The Compensation Function: Basic concepts in wage administration, company's wage policy, Job Evaluation, Issues in wage administration, Bonus & Incentives, Payment of Wages Act 1936, Minimum Wages Act 1961.

MODULE VI: Integration: [8L]
Human Relations and Industrial Relations, Difference between Human Relations and Industrial Relations, Factors required for good Human Relation Policy in Industry, Employee Employer relationship Causes and Effects of Industrial disputes, Employees Grievances & their Redressal, Administration of Discipline, Communication in organization, Absenteeism, Labour Turnover, Changing face of the Indian work force and their environment, Importance of collective Bargaining; Role of trade unions in maintaining cordial Industrial Relations.

MODULE VII: Maintenance: [8L]
Fringe & retirement terminal benefits, Administration of welfare amenities, Meaning and Importance of Employee Safety, Accidents-Causes & their Prevention, Safety Previsions under the Factories Act 1948, Welfare of Employees and its Importance, Social security, Family Pension Scheme, ESI Act 1948, Workmen's Gratuity Act 1972, Future challenges for Human Resource Management.

Textbooks:
1.T.N. Chhabra-Human Resource Management, Dhanpat Rai & Co.

Reference books:
1. Lowin B .Flippo –Principles of Personnel Management, McGraw-Hill
2. R.C.Saxena- Labour Problems and Social Welfare, K.Math & Co.
3. A Minappaand, M.S.Saiyada- Personnel Management, TataMc.Graw-Hill
4. C. B. Mamoria –Personnel Management, Himalaya Publishing House

COURSE NAME: **CONTROL SYSTEM**
COURSE CODE: **IT803D**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **36**
CREDITS: **3**

Prerequisite:
Associated mathematical concepts.

Course Objective:
The objective of this course is to provide technical and professional skills to the chosen fields of the learners such as circuit theory, field theory, control theory and computational platforms.

Course Outcome
After completion of this course students will be able to

CO1	Recall and introduce stability analysis and design of compensators.
CO2	Understand the use of transfer function models for analysis physical systems and introduce the control system components.
CO3	Apply and provide adequate knowledge in the time response of systems and steady state error analysis.
CO4	Analyzing the principles of state variable representation of physical systems.
CO5	Design the open loop and closed–loop frequency responses of systems according the basic knowledge.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	1	1	--	--	--	--	--	--	--	--	1
CO2	3	2	1	--	--	--	--	--	--	--	--	1
CO3	3	2	2	--	--	--	--	--	--	--	--	1
CO4	3	2	2	--	--	--	--	--	--	--	--	1
CO5	3	3	2	3	--	--	--	--	--	--	--	1

Course Contents:

MODULE I: SYSTEMS AND REPRESENTATION: [8L]
Basic elements in control systems: – Open and closed loop systems – Electrical analogy of mechanical and thermal systems – Transfer function – AC and DC servomotors – Block diagram reduction techniques – Signal flow graphs.

MODULE II: TIME RESPONSE: [7L]
Time response: – Time domain specifications – Types of test input – I and II order system response – Error coefficients – Generalized error series – Steady state error – Root locus construction- Effects of P, PI, PID modes of feedback control –Time response analysis.

MODULE III: FREQUENCY RESPONSE: [7L]
Frequency response: – Bode plot – Polar plot – Determination of closed loop response from open loop response - Correlation between frequency domain and time domain specifications

MODULE IV: STABILITY AND COMPENSATOR DESIGN:[7L]
Characteristics equation – Routh Hurwitz criterion – Nyquist stability criterion- Performance criteria – Effect of Lag, lead and lag-lead compensation on frequency response-Design of Lag, lead and lag lead compensator using bode plots.

MODULE V: STATE VARIABLE ANALYSIS: [7L]
Concept of state variables – State models for linear and time invariant Systems – Solution of stateand output equation in controllable canonical form – Concepts of controllability and observability.

Textbooks:

1. Nagarath, I.J. and Gopal, M., "Control Systems Engineering", New Age International Publishers, 2017.
2. Benjamin C. Kuo, "Automatic Control Systems", Wiley, 2014. The McGraw Hill Companies

Reference books:

1. Katsuhiko Ogata, "Modern Control Engineering", Pearson, 2015.
2. Richard C.Dorf and Bishop, R.H., "Modern Control Systems", Pearson Education,2009.
3. John J.D., Azzo Constantine, H. and Houpis Sttuart, N Sheldon, "Linear Control System Analysis and Design with MATLAB", CRC Taylor& Francis Reprint 2009.
4. Rames C.Panda and T. Thyagarajan, "An Introduction to Process Modelling Identification and Control of Engineers", Narosa Publishing House, 2017.
5. M.Gopal, "Control System: Principle and design", McGraw Hill Education, 2012.
6. NPTEL Video Lecture Notes on "Control Engineering "by Prof. S. D. Agashe, IIT Bombay.

COURSE NAME: **ESSENCE OF INDIAN KNOWLEDGE TRADITION**
COURSE CODE: **MC881**
CONTACT: **3:0:0**
TOTAL CONTACT HOURS: **36**
CREDITS: **3 UNITS**

Course Objective:
The course aims at imparting basic principles of thought process, reasoning and inferencing. Sustainability is at the core of Indian Traditional Knowledge Systems connecting society and nature. Holistic life style of yogic science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technological advancements and societal disruptions.

Course Outcome:
After completion of this course students will be able to

CO1	Understand the concept of Traditional knowledge and its importance.
CO2	Use the connection between Modern Science and Indian Knowledge System.
CO3	Analyze the importance of Yoga for health care.
CO4	Evaluate the effect of traditional knowledge on environment.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	--	--	--	--	--	1	--	--	2	1	2	1
CO2	--	--	--	--	--	--	--	3	2	1	2	2
CO3	3	--	--	1	--	2	--	--	2	--	--	1
CO4	--	1	--	--	2	--	1	2	--	--	1	--

Course Contents:

MODULE I: Basic structure of Indian Knowledge System: [9L]
Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, Indigenous Knowledge (IK), characteristics, traditional knowledge vis-a-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge.

MODULE II: Modern Science and Indian Knowledge System: [9L]
Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge.

MODULE III: Yoga and Holistic Health Care: [9L]
Yoga for positive health, prevention of stress related health problems and rehabilitation, Integral approach of Yoga Therapy to common ailments.

MODULE IV: Traditional Knowledge and Environment: [9L]
Traditional knowledge and engineering, Traditional medicine system, Importance of conservation and sustainable development of environment, Management of biodiversity.

Textbooks:

1. V. Sivaramakrishnan (Ed.), Cultural Heritage of India-course material, Bharatiya Vidya Bhavan, Mumbai. 5th Edition, 2014
2. Swami Jitatmanand, Modern Physics and Vedant, Bharatiya Vidya Bhavan
3. Swami Jitatmanand, Holistic Science and Vedant, Bharatiya Vidya Bhavan
4. Fritzof Capra, The Wave of life
5. VN Jha (Eng. Trans.), Tarkasangraha of Annam Bhatta, International Chinmay Foundation, Velliarnad, Arnakulam
6. Yoga Sutra of Patanjali, Ramakrishna Mission, Kolkata