NATIONAL INSTITUTE OF TECHNOLOGY, WARANGAL

SCHEME OF INSTRUCTION AND SYLLABI
FOR B.TECH PROGRAM

Effective from 2014-15

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

NATIONAL INSTITUTE OF TECHNOLOGY WARANGAL

VISION

Towards a Global Knowledge Hub, striving continuously in pursuit of excellence in Education, Research, Entrepreneurship and Technological services to the society

MISSION

- Imparting total quality education to develop innovative, entrepreneurial and ethical future professionals fit for globally competitive environment.
- Allowing stake holders to share our reservoir of experience in education and knowledge for mutual enrichment in the field of technical education.
- Fostering product oriented research for establishing a self-sustaining and wealth creating centre to serve the societal needs.

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

VISION

Attaining global recognition in Computer Science & Engineering education, research and training to meet the growing needs of the industry and society.

MISSION

- Imparting quality education through well-designed curriculum in tune with the challenging software needs of the industry.
- Providing state-of-art research facilities to generate knowledge and develop technologies in the thrust areas of Computer Science and Engineering.
- Developing linkages with world class organizations to strengthen industry-academia relationships for mutual benefit.

GRADUATE ATTRIBUTES

The Graduate Attributes are the knowledge skills and attitudes which the students have at the time of graduation. These attributes are generic and are common to all engineering programs. These Graduate Attributes are identified by National Board of Accreditation.

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. Problem analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. Design/Development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. Project management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

B.TECH IN COMPUTER SCIENCE AND ENGINEERING

PROGRAM EDUCATIONAL OBJECTIVES

PEO1	Apply computer science theory blended with mathematics and engineering to model computing systems.
PEO2	Design, implement, test and maintain software systems based on requirement specifications.
PEO3	Communicate effectively with team members, engage in applying technologies and lead teams in industry.
PEO4	Assess the computing systems from the view point of quality, security, privacy, cost, utility, etiquette and ethics.
PEO5	Engage in lifelong learning, career enhancement and adapt to changing professional and societal needs.

Mapping of Mission statements with program educational objectives

Mission Statement	PEO1	PEO2	PEO3	PEO4	PEO5
Imparting quality undergraduate and graduate education through well-designed curriculum tuned to the changing needs of the software industry	3	3	2	3	2
Providing state-of-art research facilities to generate knowledge and develop technologies in the thrust areas of Computer Science and Engineering	2	3	3	3	2
Developing linkages with world class organizations to strengthen industry-academia relationships for mutual benefits.	2	3	2	3	2

Mapping of program educational objectives with graduate attributes

PEO	GA 1	GA 2	GA 3	GA 4	GA 5	GA 6	GA 7	GA 8	GA 9	GA10	GA11	GA12
PEO 1	3	3	3	3	1	1	1	-	-	-	2	2
PEO 2	3	3	3	3	3	1	1	-	2	2	3	1
PEO 3	2	2	2	2	2	1	2	-	3	3	3	2
PEO 4	2	2	2	3	2	2	1	3	-	1	2	1
PEO 5	1	1	1	1	2	3	2	3	2	2	1	3

Mapping of program objectives with graduate attributes

PO	GA 1	GA 2	GA 3	GA 4	GA 5	GA 6	GA 7	GA 8	GA 9	GA10	GA11	GA12
PO1	3	3	3	1	1	-	-	-	2	-	-	-
PO 2	3	3	-	-	-	2	1	-	2	-	3	-
PO 3	3	3	3	3	3	3	3	-	2	-	2	2
PO 4	3	1	2	2	2	-	-	-	1	-	-	2
PO 5	3	3	2	3	2	-	-	-	-	-	-	-
PO 6	2	1	3	1	-	-	-	2	-	-	-	-
PO 7	-	-	-	-	-	2	-	3	-	3	-	2
PO 8	-	-	-	2	2	-	-	-	-	-	-	3

PO 9	-	-	-	-	2	-	3	-	3	3	2	-

PROGRAM OUTCOMES: At the end of the program the student will be able to:

PO1	Design algorithms for real world computational problems and analyze their complexities.
PO2	Design, develop and maintain computing systems using concepts from mathematics, engineering and program core courses.
PO3	Design and develop web based applications with professional expertise to solve complex problems in the domains including banking and healthcare and communications.
PO4	Design and develop interfaces among subsystems of computing.
PO5	Analyze large data samples and discover knowledge to provide solutions to engineering problems.
PO6	Assess security, privacy, quality and cost parameters in developing software systems.
PO7	Communicate effectively and practice professional ethics with societal responsibilities.
PO8	Engage in lifelong learning through independent study of new techniques and tools.
PO9	Work in teams using common tools and environment to achieve project objectives.

Mapping of program outcomes with program educational objectives

POs	PEO1	PEO2	PEO3	PEO4	PEO5
PO1	3	3	2	3	1
PO2	2	3	3	3	2
PO3	2	3	3	3	2
PO4	2	3	3	2	2
PO5	2	2	3	3	3
PO6	2	2	3	3	2
PO7	1	1	3	3	3
PO8	1	2	2	3	3
PO9	1	2	3	2	3

CURRICULAR COMPONENTS

Degree Requirements for B. Tech in Computer Science and Engineering

Category of Courses	Credits Offered	Min. credits to be earned
Basic Science Core (BSC)	24	24
Engineering Science Core (ESC)	36	36
Humanities and Social Science Core (HSC)	07	07
Program Core Courses (PCC)	93	93
Departmental Elective Courses (DEC)	24	18
Open Elective Courses (OPC)	6	6
Program major Project (PRC)	6	6
EAA: Games & Sports (MDC)	0	0
Total	**196**	**190**

SCHEME OF INSTRUCTION

B.Tech. (Computer Science Engineering) Course Structure

B. Tech. I - Year I - Semester

S. No.	Course Code	Course Title	L	T	P	Credits	Cat. Code
1	MA101	Mathematics – 1	4	0	0	4	BSC
2	HS101	English for Communication	3	0	2	4	HSC
		(or)					
	ME102	Engineering Graphics	2	0	3	4	ESC
3	PH101	Physics	4	0	0	4	BSC
		(or)					
	CY101	Chemistry	4	0	0	4	BSC
4	EC101	Basic Electronic Engineering	3	0	0	3	ESC
		(or)					
	EE 101	Basic Electrical Engineering	3	0	0	3	ESC
5	CE102	Environmental Science & Engineering	3	0	0	3	ESC
		(or)					
	ME101	Basic Mechanical Engineering	3	0	0	3	ESC
6	CS101	Problem Solving and Computer Programming (PSCP)	4	0	0	4	ESC
		(or)					
	CE101	Engineering Mechanics	4	0	0	4	ESC
7	PH102	Physics Laboratory	0	0	3	2	BSC
		(or)					
	CY102	Chemistry laboratory	0	0	3	2	BSC
8	CS102	PSCP Lab	0	0	3	2	ESC
		(or)					
	ME103	Workshop Practice	0	0	3	2	ESC
9	EA 151	EAA: Games and Sports	0	0	3	0	MDC
		Total	**21**	**0**	**11**	**26**	

I Year II Semester

S. No.	Course Code	Course Title	L	T	P	Credits	Cat. Code
1	MA151	Mathematics – 2	4	0	0	4	BSC
2	ME102 HS101	Engineering Graphics (or) English for Communication	2 3	0 0	3 2	4 4	ESC HSC
3	CY101 PH101	Chemistry (or) Physics	4 4	0 0	0 0	4 4	BSC BSC
4	EE101 EC101	Basic Electrical Engineering (or) Basic Electronics Engineering	3 3	0 0	0 0	3 3	ESC ESC
5	ME101 CE102	Basic Mechanical Engineering (or) Environmental Science & Engineering	3 3	0 0	0 0	3 3	ESC ESC
6	CE101 CS101	Engineering Mechanics (or) Problem Solving and Computer Programming	4 4	0 0	0 0	4 4	ESC ESC
7	CY102 PH102	Chemistry laboratory (or) Physics Laboratory	0 0	0 0	3 3	2 2	BSC BSC
8	ME103 CS102	Workshop Practice (or) PSCP Lab	0 0	0 0	3 3	2 2	ESC ESC
9	EA151	EAA: Games and Sports	0	0	3	0	MDC
		Total	**20**	**0**	**12**	**26**	

II Year I Semester

S. No.	Course Code	Course Title	L	T	P	Credits	Cat. Code
1	MA238	Statistical and Numerical Methods for Engineers	4	0	0	4	BSC
2	EE236	Network Analysis	3	0	0	3	ESC
3	EC237	Digital Logic Design	3	0	0	3	ESC
4	CS201	Discrete Mathematics	4	0	0	4	PCC
5	CS202	Data Structures and Algorithms	4	0	0	4	PCC
6	CS203	File Structures	2	0	3	4	PCC
7	EC238	Basic Electronics Lab	0	0	3	2	ESC
8	CS204	Data Structures Lab	0	0	3	2	PCC
		Total	**20**	**0**	**9**	**26**	

II Year, II Semester

S. No.	Course Code	Course Title	L	T	P	Credits	Cat. Code
1	EC287	IC Applications	3	0	0	3	ESC
2	CS251	Object Oriented Programming	4	0	0	4	PCC
3	CS252	Computer Architecture	4	0	0	4	PCC
4	CS253	Database Management Systems	4	0	0	4	PCC
5	CS254	Systems Programming	4	0	0	4	PCC
6	EC288	IC Applications Lab	0	0	3	2	ESC
7	CS255	Database Management Systems Lab	0	0	3	2	PCC
8	CS256	Programming Lab	0	0	3	2	PCC
		Total	**19**	**0**	**9**	**25**	

III Year, I Semester

S. No.	Course Code	Course Title	L	T	P	Credits	Cat. Code
1	SM335	Engineering Economics and Accountancy	3	0	0	3	HSC
2	CS301	Theory of Computation	4	0	0	4	PCC
3	CS302	Operating Systems	4	0	0	4	PCC
4	CS303	Data Warehousing and Data Mining	4	0	0	4	PCC
5	CS304	Software Engineering	4	0	0	4	PCC
6	CS305	Operating Systems Lab	0	0	3	2	PCC
7	CS306	Knowledge Engineering Lab	0	0	3	2	PCC
8	CS307	CASE Tools Lab	0	0	3	2	PCC
		Total	**19**	**0**	**9**	**25**	

III Year, II Semester

S. No.	Course Code	Course Title	L	T	P	Credits	Cat. Code
1	CS351	Language Processors	4	0	0	4	PCC
2	CS352	Computer Networks	4	0	0	4	PCC
3	CS353	Language Processors Lab	0	0	3	2	PCC
4	CS354	Computer Networks Lab	0	0	3	2	PCC
5		Open Elective – 1	3	0	0	3	OPC
6		Department Elective -1	3	0	0	3	DEC
7		Department Elective – 2	3	0	0	3	DEC
8		Department Elective – 3	3	0	0	3	DEC
		Total	**20**	**0**	**6**	**24**	

IV Year, I Semester

S. No.	Course Code	Course Title	L	T	P	Credits	Cat. Code
1	CS401	Distributed Computing	4	0	0	4	PCC
2	CS402	Cryptography and Network Security	4	0	0	4	PCC
3	CS403	Security Lab	0	0	3	2	PCC
4		Open Elective – II	3	0	0	3	OPC
5		Department Elective – 4	3	0	0	3	DEC
6		Department Elective – 5	3	0	0	3	DEC
7	CS449	Project Work – Part A	0	0	4	2	PRC
		Total	**17**	**0**	**7**	**21**	

IV Year, II Semester

S. No.	Course Code	Course Title	L	T	P	Credits	Cat. Code
1	ME435	Industrial Management	3	0	0	3	ESC
2	CS451	Wireless and Mobile Computing	3	0	0	3	PCC
3	CS452	Machine Learning & Soft Computing	3	0	0	3	PCC
4		Department Elective – 6	3	0	0	3	DEC
5		Department Elective – 7	3	0	0	3	DEC
6		Department Elective – 8	3	0	0	3	DEC
7	CS491	Seminar	0	0	3	1	PCC
	CS499	Project Work – Part B	0	0	6	4	PRC
		Total	**18**	**0**	**9**	**23**	

List of Electives

III Year, II Semester

CS361	Design and Analysis of Algorithms
CS362	Computational Neuroscience
CS363	Web Technologies
CS371	Software Metrics and Software Project Management
CS372	Programming Language Concepts
CS373	Unix Tools and Programming
CS374	Parallel Processing
CS381	Advanced Data Structures
CS382	Advanced Databases
CS383	Advanced Data Mining

IV Year, I Semester

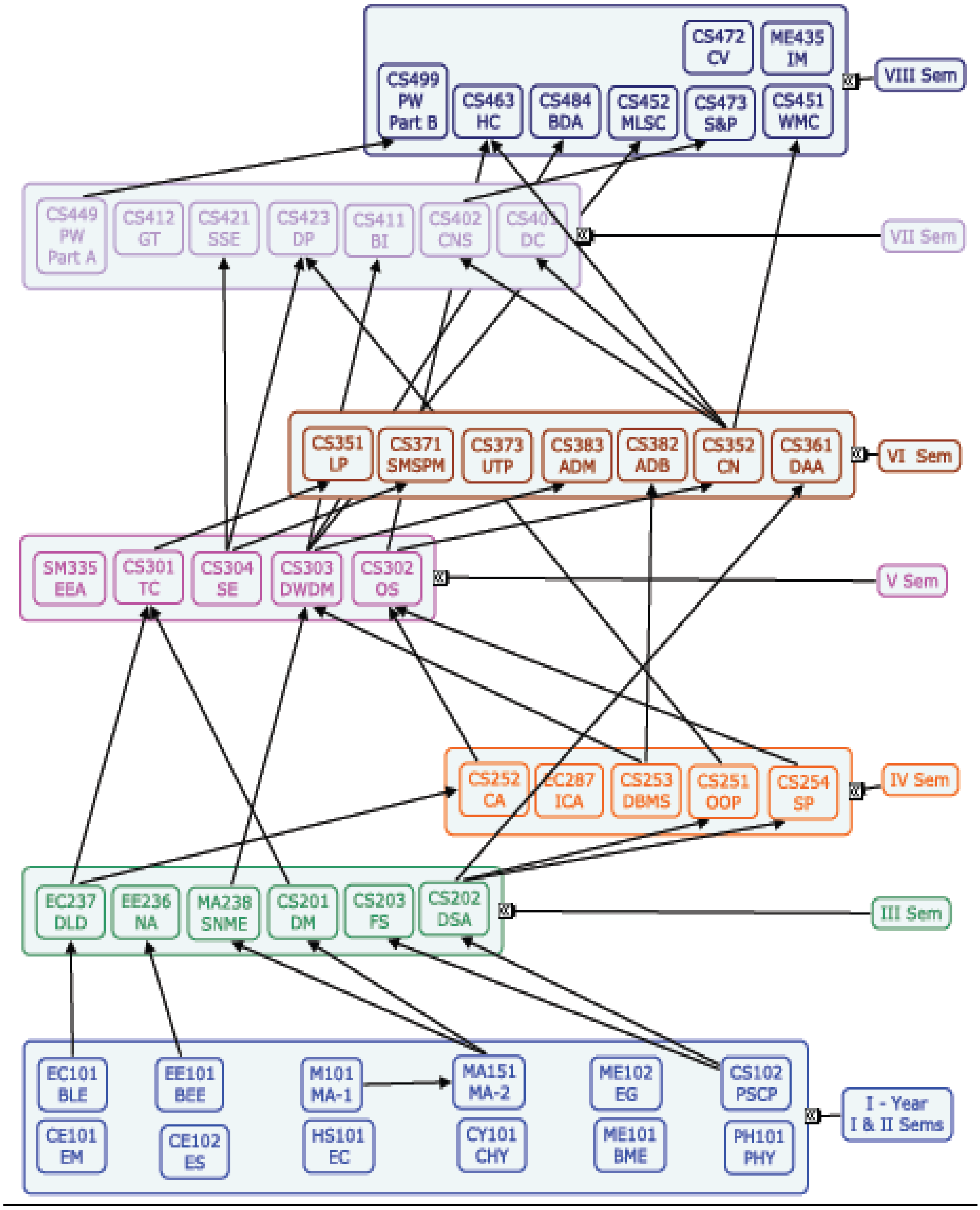
CS411	Business Intelligence
CS412	Game Theory
CS413	Pattern Recognition
CS414	Semantic Web
CS421	Secure Software Engineering
CS422	Distributed Object Technologies
CS423	Design Patterns
CS424	Advanced Compiler Design

IV Year, II Semester

CS461	Model-driven Frameworks
CS462	Service Oriented Architecture
CS463	Heterogeneous Computing
CS464	Bio-Informatics
CS465	DNA Computing
CS471	Advanced Computer Networks
CS472	Image Processing
CS473	Security and Privacy
CS474	Information Security & Auditing
CS475	Real Time Systems
CS481	Cloud Computing
CS482	Social Network Analysis
CS483	Intelligent Agents
CS484	Big Data Analytics

B.TECH IN COMPUTER SCIENCE AND ENGINEERING

PRE-REQUISITE CHART



DETAILED SYLLABUS

MA101	MATHEMATICS – I	BSC	4 – 0 – 0	4 Credits

Pre-requisites: None.

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

CO1	Solve linear system equation
CO2	Determine the Eigen values and vectors of a matrix
CO3	Determine the power series expansion of a function
CO4	Estimate the maxima and minima of multivariable functions
CO5	Solve any given first order ordinary differential equation
CO6	Solve any higher order linear ordinary differential equation with constant coefficients

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	2						1	
CO2	2	2						1	
CO3	2	2						1	
CO4	2	2						1	
CO5	2	2						1	
CO6	2	2						1	

Detailed Syllabus:

Matrix Theory: Elementary row and column operations on a matrix, Rank of matrix – Normal form – Inverse of a matrix using elementary operations –Consistency and solutions of systems of linear equations using elementary operations, linear dependence and independence of vectors - Characteristic roots and vectors of a matrix - Caley-Hamillton theorem and its applications, Complex matrices, Hermitian and Unitary Matrices - Reduction to diagonal form - Reduction of a quadratic form to canonical form – orthogonal transformation and congruent transformation.

Differential Calculus: Rolle's theorem; Mean value theorem; Taylor's and Maclaurin's theorems with remainders, Expansions; Indeterminate forms; Asymptotes and curvature; Curve tracing; Functions of several variables, Partial Differentiation, Total Differentiation, Euler's theorem and generalization, maxima and minima of functions of several variables (two and three variables) – Lagrange's method of Multipliers; Change of variables – Jacobians.

Ordinary differential equations of first order: Formation of differential equations; Separable equations; equations reducible to separable form; exact equations; integrating factors; linear first order equations; Bernoulli’s equation; Orthogonal trajectories and Newton’s law of cooling.

Ordinary linear differential equations of higher order : Homogeneous linear equations of arbitrary order with constant coefficients - Non-homogeneous linear equations with constant coefficients; Euler and Cauchy’s equations; Method of variation of parameters; System of linear differential equations, Vibrations of a beam.

Reading:

1. R.K.Jain and S.R.K.Iyengar, Advanced Engineering Mathematics, Narosa Pub. House, 2008.
2. Erwyn Kreyszig, Advanced Engineering Mathematics, John Wiley and Sons, 8^{th} Edition, 2008.
3. B.S.Grewal, Higher Engineering Mathematics, Khanna Publications, 2009.

HS101	ENGLISH FOR COMMUNICATION	HSC	3 – 0 – 2	4 Credits

Pre-requisites: None.

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

CO1	Understand basic grammar principles
CO2	Write clear and coherent passages
CO3	Write effective letters for job application and complaints
CO4	Prepare technical reports and interpret graphs
CO5	Enhance reading comprehension
CO6	Comprehend English speech sound system, stress and intonation

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1							3		2
CO2							3		2
CO3							3		2
CO4							3		2
CO5							3		2
CO6							3		2

Detailed syllabus

Grammar Principles and Vocabulary Building: -Exposure to basics of grammar- parts of speech, with emphasis on tenses—active and passive voice- their usage- reported speech - Idioms and Phrases—their meanings and usage, Vocabulary development through prefixes, suffixes and word roots

Effective Sentence Construction –clarity and precision in construction—strategies for effectiveness in writing

Paragraphs: Definition- structure- Types and Composition-unity of theme- coherence- organisation patterns

Note-making – its uses- steps in note-making—identification of important points-reduction to phrases –selection of suitable note format- types of notes—tree diagram, block list, table

Letter Writing: Business, Official and Informal letters-- communicative purpose-strategy- letter format and mechanics- letters of request , complaint and invitation-

Reading techniques: Skimming and Scanning – quick reading for gist and –suggesting titles- looking for specific information

Description of Graphics- kinds of graphs- their construction and use and application in scientific texts- interpretation of graphs using expressions of comparison and contrast

Reading Comprehension – reading to retrieve information ––techniques of comprehension - find clues to locate important points- answering objective type questions –inference, elimination

Technical Report-Writing - kinds of reports-proposals, progress and final reports- their structure- features- process of writing a report-editing

Book Reviews- Oral and written review of a chosen novel/play- a brief written analysis including summary and appreciation- oral presentation of the novel before class

Reading

1. A Textbook of English for Engineers and Technologists (combined edition, Vol. 1 & 2); Orient Black Swan 2010.

PH101	PHYSICS	BSC	4 – 0 – 0	4 Credits

Prerequisites: None.

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

CO1	Solve engineering problems using the concepts of wave and particle nature of radiant energy
CO2	Understand the use of lasers as light sources for low and high energy applications
CO3	Understand the nature and characterization of acoustic design, nuclear accelerators and new materials
CO4	Apply the concepts of light in optical fibers, light wave communication systems, and holography and for sensing physical parameters
CO5	Construct a quantum mechanical model to explain the behaviour of a system at microscopic level

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	2					2		
CO2	2	2					2		
CO3	2	2					2		
CO4	2	2					2		
CO5	2	2					2		

Detailed Syllabus:

Interference: Superposition principle, Division of amplitude and wave front division, Interferometers (Michelson, Fabry-Perot, Mach Zehnder), Applications; DIFFRACTION: Fraunhoffer diffraction (single, double & multiple slits), Resolving power, Dispersive power, Applications.

Polarization: Production & detection of polarized light, wave plates, optical acivity, Laurents Half-shade polarimeter, photoelasticity and applications; LASERS: Basic principles of Lasers, He-Ne, Nd-YAG, CO_2 and semiconductors lasers, applications of lasers, Holography and holographic NDT.

Optical fibers: Light propagation in Optical fibers, types of optical fibers, optical fibers for communication and sensing.

Functional materials: Fiber reinforced plastics, fiber reinforced metals, surface acoustic wave materials, biomaterials, high temperature materials, smart materials and their applications, Introduction to Nano materials.

Modern physics: Qualitative review of different experiments, de-Broglie waves, Dual nature of matter, Schrodinger wave equation, wave function and its interpretation, potential well problems in one dimension, Tunneling, Uncertainty principle, Particle Accelerators: Cyclotron, Synchro Cyclotron, Betatron and applications.

Acoustics: Introduction, Reverberation and reverberation time, growth and decay of energy, Sabine's formula, absorption coefficient and its measurement, factors affecting architectural acoustics, production, detection and applications of Ultrasound.

Reading:

1. Halliday, Resnic and Walker, Fundamentals of Physics, 9th Ed.,John Wiley, 2011.
2. Beiser A, Concepts of Modern physics, 5th Ed., McGraw Hill International, 2003.
3. Ajoy Ghatak, Optics, 2nd Ed., Tata McGraw Hill, 1994.
4. M. Armugam, Engineering Physics, Anuradha Agencies, 2003.

CY101	CHEMISTRY	BSC	4 – 0 – 0	4 Credits

Pre-requisites: None.

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

CO1	Understand and apply the concepts in electrochemistry and corrosion science
CO2	Understand the concepts in molecular interactions
CO3	Understand the synthesis and analysis of modern materials
CO4	Apply the concepts of organic chemistry for synthesis
CO5	Understand the synthesis and applications of polymer science
CO6	Identify the structure of organic molecules using photo chemistry and chemical spectroscopy

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1							2	2	
CO2							2	2	
CO3							2	2	
CO4							2	2	
CO5							2	2	
CO6							2	2	

Detailed Syllabus:

Electrochemistry - Review of the concepts of electrode potentials, Nernst equation, Reference electrodes, Ion selective electrodes – Concept – Glass electrode – Determination of pH of a solution using a glass electrode – Derivation of equation between E_{cell} and pH, Determination of F^- ion using fluoride electrode (Numerical calculations), Chemically modified electrodes (CMEs) – Concept, CMEs as potentiometric and amperometric sensors, Electrochemical energy systems, Electrochemistry of secondary cells e.g. Lead – acid and Ni-Cd cells, Rechargeable lithium batteries, Fuel cells – Electrochemistry of a H_2–O_2 fuel cell, methanol–O_2 fuel cell.

Corrosion and Its Prevention - Electrochemical theory of corrosion, Corrosion due to dissimilar metal cells (galvanic cells), Corrosion due to differential aeration cells, Uniform corrosion, pitting corrosion and stress corrosion cracking, Effect of pH, Potential-pH diagram for Iron, temperature and dissolved oxygen on corrosion rate, Corrosion prevention and control by cathodic protection.

Molecular Interactions - Molecular orbital theory applicable to understanding of bonding in heteronuclear diatomic molecules, e.g. CO and NO, Molecular orbital energy diagram of an Octahedral complex, MO diagram of a molecule involving charge transfer (e.g. $KMnO_4$), Nature of supramolecular interactions: ion-ion interactions, ion-dipole interactions, dipole-dipole interactions, hydrogen bonding, cation-л interactions, л-л interactions, van der Walls forces, Concept of self-assembly involving different types of interactions (Micellar formation; Membrane Formation; Surface films).

Chemistry of Nanomaterials - Introduction to Nanomaterials, Chemical synthesis of nanomaterials: sol-gel method, Reverse micellar method, electrolytic method, Characterization of nanoparticles by BET method, Characterization of nanomaterials by TEM (includes basic principle of TEM), Applications of nanomaterials in Industry as drug delivery materials, as catalysts, in water treatment.

Basic Principles Of Organic Chemistry – Introduction, Homolytic and Heterolytic cleavages and free radicals Carbocations, carbanions and addition reactions Elimination and substitution reactions.

Stereochemistry: chirality, optical activity, enantiomers and diastereomers, Projection formulae and geometrical isomerism, Reactions - Hofmann reaction and Riemer-Tiemann reaction, Diels-Alder reaction and Cannizaro reaction, Skraup synthesis.

Polymer Chemistry - Concept of polymerization – Types of polymerization, Chain growth polymerization – mechanisms of free radical and cationic polymerizations, Mechanisms of simple anionic polymerization and co-ordination anionic polymerization (complex forming mechanism), Step-growth polymerization ,Mechanism and examples.

Thermoplastic resins and Thermosetting resins- examples and applications, conducting polymers: Mechanism of conduction in polymers – Examples – and applications.

Review Of Chemical Spectroscopy - Review of electromagnetic spectrum, Quantization of energy, Born – Oppenheimer approximation, Frank Condon Principle Vibrational spectra (Infra-red) of diatomic molecules – Selection rules Determination of force constant Problems, Identification of functional groups using IR spectroscopy Electronic spectroscopy - Types of electronic transitions –calculation of chromophoric absorptions For Diene and ene-one chromophors Qualitative analysis by electronic spectroscopy, Lambert – Beer's law-Applications in Quantitative analysis and problems.

NMR spectroscopy: Basic principles, Concept of chemical shift. Concept of spin-spin splitting and examples, Applications of UV,I.R and ^{1}H NMR spectra in the determination of structures of Ethyl alcohol, Dimethyl ether, Acetic acid and Benzyl alcohol.

Photo Chemistry – Principles of photochemistry – Rates of intermolecular processes, Jablonski diagram – fluorescence, phosphorescene and Chemiluminescence, Types of Photochemical Organic reactions, Laws of photochemistry and quantum yields-problems, Photosensitized reactions.

Reading:

1. P. W. Atkins & Julio de Paula, Atkins Physical Chemistryl Chemistry, Oxford University Press York, 7th Edn, 2002.
2. Shashi Chawla, A Text Book of Engineering Chemistry, 3rd Edition, Dhanpat Rai & Co New Delhi, 2007.
3. S. Vairam, P. Kalyani & Suba Ramesh, Engineering Chemistry, Ist Edn, John Wiley & Sons, India, 2011.
4. Lee J.D., Concise Inorganic Chemistry, 7th Edn, Blackwel Science Publications Oxford, London, 2004.
5. Jerry March., Advanced Organic Chemistry, 6th Edn, John Wiley & Sons, New Jersy, 2007.

6. FehFuYen, Chemistry for Engineers, Imperial College Press, 2008.
7. Octave Levenspiel, Chemical Reaction Engineering, 2nd Edition, Wiley India, 2006.
8. Smith J.M., Chemical Engineering Kinetics, 3rd Edition, McGraw Hill, 1981.

EC101	BASIC ELECTRONICS ENGINEERING	ESC	3 – 0 – 0	3 Credits

Pre-requisites: None.

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

CO1	Characterize semiconductors, diodes, transistors and operational amplifiers
CO2	Design simple analog circuits
CO3	Design simple combinational and sequential logic circuits
CO4	Understand functions of digital multimeter, cathode ray oscilloscope and transducers in the measurement of physical variables
CO5	Understand fundamental principles of radio communication

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	2						2	
CO2	2	2						2	
CO3	2	2						2	
CO4	2	2						2	
CO5	2	2						2	

Detailed Syllabus:

Electronics Systems: Introduction to electronics, review of p-n junction operation, diode applications, Zener diode as regulator.

Transistor and applications: Introduction to transistors, BJT Characteristics, biasing and applications, simple RC coupled amplifier and frequency response. Cascaded amplifiers, FET and MOSFET characteristics and applications.

Feedback in Electronic Systems: open loop and closed loop systems, Negative and positive feedback merits and demerits, Principle of oscillators, LC and RC oscillators.

Integrated Circuits: Operational amplifiers, Applications: adder, subtractor, Integrator and Differentiators.

Digital Circuits: Number systems and logic gates, Combinational Logic circuits, Flip-Flops, counters and shift registers, data converters, Analog to Digital and Digital to Analog converters (ADC/DAC's).

Electronic Instrumentation: Measurement, Sensors, Laboratory measuring instruments: digital multi-meters and Cathode Ray Oscilloscopes (CRO's).

Principles of Communication: Need for Modulation, Modulation and Demodulation techniques.

Reading:

1. Neil Storey, "Electronics A Systems Approach", 4/e - Pearson Education Publishing Company Pvt Ltd, 2011.

2. Salivahanan, N Suresh Kumar, “Electronic Devices and Circuits” 3/e, McGraw Hill Publications, 2013.
3. Bhargava N. N., D C Kulshreshtha and S C Gupta, “Basic Electronics & Linear Circuits”, Tata McGraw Hill, 2/e, 2013 .

EE101	BASIC ELECTRICAL ENGINEERING	ESC	3 – 0 – 0	3 Credits

Pre-requisites: None.

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

CO1	Analyze and solve electric and magnetic circuits
CO2	Identify the type of electrical machines for a given application
CO3	Recognize the ratings of different electrical apparatus
CO4	Identify meters for measuring electrical quantities

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	2					2		
CO2	2	2					2		
CO3	2	2					1		
CO4	2	2					1		

Detailed Syllabus:

DC Circuits: Kirchhoff's Voltage & Current laws, Superposition Theorem, Star – Delta Transformations.

AC Circuits: Complex representation of Impedance, Phasor diagrams, Power & Power Factor, Solution of Single Phase Series & Parallel Circuits. Solution of Three Phase circuits and Measurement of Power in Three Phase circuits.

Magnetic Circuits: Fundamentals and Solution of Magnetic Circuits, Concepts of Self and Mutual Inductances, Coefficient of Coupling.

Single Phase Transformers: Principle of Operation of a Single Phase Transformer, EMF equation, Phasor diagram, Equivalent Circuit, Determination of Equivalent Circuit Parameters, Regulation and Efficiency of a single phase transformer. Principle of operation of an Auto Transformer.

DC Machines: Principle of Operation, Classification, EMF and Torque equations, Characteristics of Generators and Motors, Speed Control Methods and Starting Techniques.

Three Phase Induction Motor: Principle of Rotating Magnetic Field, Principle of Operation of 3-φ I.M., Torque-Speed Characteristics of 3-φ I.M., Starting Methods and Applications of Three Phase Induction Motors.

Measuring Instruments: Moving Coil and Moving Iron Ammeters and Voltmeters, Dynamometer Type Wattmeter and Induction Type Energy Meter.

Reading:

1. Edward Hughes, Electrical Technology, 10th Edition, ELBS, 2010.
2. Vincent Del Toro, Electrical Engineering Fundamentals, 2nd Edition, PHI, 2003.
3. V.N. Mittle, Basic Electrical Engineering, TMH, 2000.

CE101	ENGINEERING MECHANICS	ESC	4 – 0 – 0	4 Credits

Pre-requisites: None.

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

CO1	Determine the resultant force and moment for a given system of forces
CO2	Analyze planar and spatial systems to determine the forces in members of trusses, frames and problems related to friction
CO3	Calculate the motion characteristics of a body subjected to a given force system
CO4	Determine the deformation of a shaft and understand the relationship between different material constants
CO5	Determine the centroid and second moment of area

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2						1		
CO2	2						1		
CO3	2						1		
CO4	2						1		
CO5	2						1		

Detailed syllabus:

Introduction - Specification of force vector, Formation of Force Vectors, Moment of Force – Cross product – Problems, Resultant of a general force system in space, Degrees of freedom - Equilibrium Equations, Kinematics – Kinetics – De’ Alemberts principle, Degree of Constraints – Freebody diagrams.

Spatial Force systems - Concurrent force systems - Equilibrium equations – Problems, Problems (Vector approach) – Tension Coefficient method, Problems (Tension Coefficient method), Parallel force systems - problems, Center of Parallel force system – Problems.

Coplanar Force Systems - Introduction – Equilibrium equations – All systems, Problems on Coplanar Concurrent force system, Coplanar Parallel force system, Coplanar General force system – Point of action, Method of joints, Method of sections, Method of sections, Method of members, Friction – Coulombs laws of dry friction – Limiting friction, Problems on Wedge friction, Belt Friction-problems.

Mechanics of Deformable Bodies - Stress & Strain at a point- Normal and shear stresses, Axial deformations – Problems on prismatic shaft, tapered shaft and deformation due to self-weight, Deformation of Stepped shaft due to axial loading, Poisson’s Ratio – Bulk Modulus - Problems, change in dimensions and volume.

Centroid & Moment of Inertia - Centroid & M.I – Arial & Mass M.I – Radius of Gyration, Parallel axis– Perpendicular axis theorem – Simple Problems.

Dynamics of Particles - Rectilinear Motion – Kinematics Problems, Kinetics – Problems, Work & Energy – Impulse Moment, Direct Central Impact – coefficient of restitution, Curvilinear Motion – Projectile Motion, Work & Energy in Curvilinear motion.

Dynamics of Rigid Bodies - Rigid body rotation – Kinematics - Kinetics, Problems – Work & Energy in Rigid body rotation, Plane Motion – Kinematics, Problem – Instantaneous center of rotation.

Reading:

1. J.L.Meriam and L.G. Kraige, Engineering Mechanics, 7th Ed, John Wiley & Sons, 2012.
2. Timoshenko and Young, Engineering Mechanics, 3rd Ed, McGraw Hill Publishers, 2006.
3. Gere and Timoshenko, Mechanics of Materials, 2nd Ed, CBS Publishers, 2011.

CE102	ENVIRONMENTAL SCIENCE & ENGINEERING	ESC	3 – 0 – 0	3 Credits

Pre-requisites: None

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

CO1	Understand environmental problems arising due to developmental activities
CO2	Identify the natural resources and suitable methods for conservation and sustainable development
CO3	Realize the importance of ecosystem and biodiversity for maintaining ecological balance.
CO4	Identify the environmental pollutants and abatement devices.

Mapping of course outcomes with program outcomes

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	2		3			2	3	2			2	1
CO2	2		3			2	3	2			2	1
CO3	2		3			2	3	2			2	1
CO4	2		3			2	3	2			2	1

Detailed syllabus:

Introduction: Environment, Definition, scope and importance, Multidisciplinary nature of environmental studies.

Natural Resources: Forest Resources – use and over – exploitation of forests, deforestation, timber extraction, mining, dams and their effects on forests and tribal people. Water Resources-Use and over – utilization of surface and groundwater, floods, droughts, conflicts over water, dams – benefits and problems. Mineral Resources – Use and exploitation, environmental effects of extracting and using mineral resources. Agricultural Land and Food Resources – Land as a resources, land degradation, man induces landslides, soil erosion and desertification; World food problems, changes caused agricultural and overgrazing, effects of modern agricultural practices, fertiliser and pesticide problems, water logging, salinity, case studies. Energy Resources – Growing energy needs, renewable and non-renewable, energy sources, Sources of alternate energy sources, Case studies, Energy Conservation.

Ecosystem and Biodiversity: Ecosystems – Concept of an ecosystem, structure and function of an ecosystem, Food chain, food webs and ecological pyramids, Energy flow in ecosystem, producers and consumers, Ecological succession. Biodiversity and its Conservation – Introduction, definition, genetic, species and ecosystem diversity, value of biodiversity, Consumptive use, productive use, Social, ethical, aesthetic and optional values, biodiversity at global, national and local values, India as a mega-diversity nation, hotspots of biodiversity, threats to biodiversity – habitat loss, poaching of wildlife, man-wildlife conflicts, endangered and endemic species of India, conservation of biodiversity – In-situ and ex-situ conservation of biodiversity.

Environmental Pollution: Causes, effects and control measures of air pollution, water pollution, soil pollution, marine pollution, noise pollution, thermal pollution, nuclear radiation hazards, Solid waste management- sources of solid wastes, effects and control measures of urban industrial wastes; Pollution case studies, disaster Management – floods, earthquakes, cyclones and landslides.

Environment and Society: Role of an individual in prevention of pollution, consumerism and waste products, unsustainable to sustainable development, water conservation, rainwater harvesting, watershed management, wasteland reclamation, observance and popularization of Environmental Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and Control of Pollution) Act, Wildlife protection act, Forest conservation act, Issues involved in enforcement of environmental legalizations, population growth, variation among nations, Environment and human health: epidemics, Women and child welfare, Role of information technology in environment and human health.

Reading

1. Henry J.G. and Heinke G.W. (2004), "Environmental Science and Engineering", Second Edition, Prentice Hall of India, New Delhi
2. Chandrasekhar M (2004), "Environmental Science", Hi-Tech Publishers, Hyderabad
3. Masters G.M. (2004)," Introduction to Environmental Engineering and Science", Second Edition, Prentice Hall of India, New Delhi
4. Garg, S.K and Garg, R., (2006), Ecological and Environmental Studies, Khanna Publishers, Delhi.
5. Bharucha, E .,(2003), "Environmental Studies", University Publishing Company, New Delhi.
6. De A.K. (2002), "Environmental Chemistry", New Age India Publication Company, New Delhi.
7. Chauhan, A.S., (2006), EnvironmentalStudies, Jain Brothers, New Delhi
8. Deswal, S and Deswal A., (2004), A Basic Course in Environmental Studies, Dhanpat Rai & Co. Delhi.

ME101	BASIC MECHANICAL ENGINEERING	ESC	3 – 0 – 0	3 Credits

Pre-requisites: None.

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

CO1	Understand basics of thermodynamics and components of a thermal power plant
CO2	Identify engineering materials, their properties, manufacturing methods encountered in engineering practice
CO3	Understand basics of heat transfer, refrigeration and internal combustion engines
CO4	Understand mechanism of power transfer through belt, rope, chain and gear drives
CO5	Understand functions and operations of machine tools including milling, shaping, grinding and lathe machines

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2							2	
CO2	2							2	
CO3	2							2	
CO4	2							2	
CO5	2							2	

Detailed Syllabus:

Introduction: Introduction to Thermodynamics - Concept of a System – Types of Systems, Thermodynamic Equilibrium, Properties, State, Process and Cycle, Zeroth Law, Energy Interactions - Heat and Work, Types of Work, Work interactions in a closed System for various processes

First and Second Laws of Thermodynamics: First Law: Cycle and Process, Specific Heats (c_p and c_v), Heat interactions in a Closed System for various processes, Limitations of First Law, Concept of Heat Engine (H.E.) and Reversed H.E. (Heat Pump and Refrigerator), Efficiency/COP, Second Law: Kelvin-Planck and Clausius Statements, Carnot Cycle, Carnot Efficiency, Statement of Clausius Inequality, Property of Entropy, T-S and P-V Diagrams

Thermal Power Plant: Thermal Power Plant Layout – Four Circuits, Rankine Cycle, Boilers: Fire Tube vs Water Tube; Babcock & Wilcox, Cochran Boilers, Steam Turbines : Impulse vs Reaction Turbines, Compounding of Turbines: Pressure Compounding, Velocity Compounding, Pressure-Velocity Compounding, Condensers: Types – Jet & Surface Condensers, Cooling Towers

Manufacturing Processes: Engineering Materials: Classification, Properties of Materials, Manufacturing Processes: Metal Casting, Moulding, Patterns, Metal Working: Hot Working and Cold Working, Metal Forming: Extrusion, Forging, Rolling, Drawing

Internal Combustion Engines and Refrigeration: IC Engines: 2 - Stroke and 4 - Stroke Engines, S.I. Engine and C.I. Engine: Differences, P-V and T-S Diagrams

Refrigeration System and Refrigerants: Principle and working of standard vapor compression refrigeration system and Brief description of Refrigerants

Heat Transfer: Heat Transfer: Modes; Thermal Resistance Concept, Conduction: Composite Walls and Cylinders, Combined Conduction and Convection: Overall Heat Transfer Co-efficient, Simple Numerical Problems: Heat Transfer

Welding: Welding: Gas Welding and Arc Welding, Soldering, Brazing

Power Transmission: Transmission of Mechanical Power: Belt Drives – Simple Numerical Problems, Gear Drives – Simple Numerical Problems

Basics of Automotive Vehicle: Lay out of Automobile Transmission; Brakes – Types, Clutch, Differential

Machine Tools and Machining Processes: Machine Tools Machine Tools: Lathe Machine, Lathe Operations, Milling Machine-Types, Milling Operations, Shaper and Planer Machines: Differences, Quick-Return Motion Mechanism, Drilling Machine: Operations, Grinding Machine: Operations

Reading:

1. Mathur, M.L., Mehta, F.S., and Tiwari, R.P., Elements of Mechanical Engineering, Jain Brothers, New Delhi, 2011.
2. Roy, K.P., and Hazra Chowdary, S.K.., Elements of Mechanical Engineering, Media Promoters and Publishers Pvt. Ltd., 2002.
3. Rudramoorthy, R.., Thermal Engineering, Tata McGraw Hill Book Company, New Delhi, 2003.
4. Hazra Chowdary., S.K. and Bose, Workshop Technology, Vol. I and II, Media Promoters and Publishers Pvt. Ltd., 2002.

ME102	ENGINEERING GRAPHICS	ESC	2 – 0 – 3	4 Credits

Pre-requisites: None.

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

CO1	Draw Orthographic projections of Lines, Planes, and Solids
CO2	Construct Isometric Scale, Isometric Projections and Views
CO3	Draw Sections of various Solids including Cylinders, cones, prisms and pyramids
CO4	Draw projections of lines, planes, solids, isometric projections and sections of solids including Cylinders, cones, prisms and pyramids using AutoCAD

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1		2						2	
CO2		2						2	
CO3		2						2	
CO4		2						2	

Detailed Syllabus:

Introduction: Overview of the course, Examination and Evaluation patterns.

Lines Lettering and Dimensioning: Types of lines, Lettering, Dimensioning, Geometrical Constructions, Polygons, Scales.

Orthographic projection of points: Principles of Orthographic projection, Projections of points.

Projections of Lines: Projections of a line parallel to one of the reference planes and inclined to the other, line inclined to both the reference planes, Traces

Projections of Planes: Projections of a plane perpendicular to one of the reference planes and inclined to the other, Oblique planes.

Projections of Solids: Projections of solids whose axis is parallel to one of the reference planes and inclined to the other, axis inclined to both the planes.

Section of Solids: Sectional planes, Sectional views - Prism, pyramid, cylinder and cone, true shape of the section.

Isometric views: Isometric axis, Isometric Planes, Isometric View, Isometric projection, Isometric views – simple objects.

Auto-CAD practice: Introduction to Auto-CAD, DRAW tools, MODIFY tools, TEXT, DIMENSION, PROPERTIES tool bar, Standard Tool bar, LAYERS

Reading:

1. N.D. Bhat and V.M. Panchal, Engineering Graphics, Charotar Publishers 2013
2. E. Finkelstein, “AutoCAD 2007 Bible”, Wiley Publishing Inc., 2007

CS101	PROBLEM SOLVING AND COMPUTER PROGRAMMING	ESC	4 – 0 – 0	4 Credits

Pre-requisites: None.

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

CO1	Develop algorithms for mathematical and scientific problems
CO2	Explore alternate algorithmic approaches to problem solving
CO3	Understand the components of computing systems
CO4	Choose data types and structures to solve mathematical and scientific problem
CO5	Develop modular programs using control structures
CO6	Write programs to solve real world problems using object oriented features

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	3	3					2
CO2	3	3	2	2				2	2
CO3	3	3	2	2				2	2
CO4	2	3	2	1					2
CO5	2	3	2	2					2
CO6	2	3	2	2					2

Detailed Syllabus:

Problem solving techniques – algorithms.

Introduction to computers - Basics of C++ - Number representation, Basic data types - int, float, double, char, bool, void.

Flow of Control - Conditional statements - If-else, Switch-case constructs, Loops - while, do-while, for.

Functions - user defined functions, library functions, parameter passing - call by value, call by reference, return values, Recursion.

Arrays - Single, Multi-Dimensional Arrays, initialization, accessing individual elements, passing arrays as parameters to functions.

Pointers and Dynamic Arrays - Multidimensional Dynamic Arrays, creation and deletion of single and multi-dimensional arrays.

C Strings, Standard String Class

I/O Streams, stream flags, stream manipulators, formatted I/O, binary I/O, Character I/O, File I/O - Opening, closing and editing files.

Structures and Classes - Declaration, member variables, member functions, access modifiers, inheritance, function overloading, overriding, redefinition, virtual functions, operator overloading, polymorphism - compile time and runtime binding.

Reading:

1. Walter Savitch, Problem Solving with C++, Sixth Edition, Pearson, 2007.
2. Cay Horstmann, Timothy Budd, Big C++, Wiley, Indian Edition, 2006.

PH102	PHYSICS LABORATORY	BSC	0 – 0 – 3	2 Credits

Pre-requisites: None.

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

CO1	Use CRO, signal generator, spectrometer, polarimeter and GM counter for making measurements
CO2	Test optical components using principles of interference and diffraction of light
CO3	Determine the selectivity parameters in electrical circuits
CO4	Determine the width of narrow slits, spacing between close rulings using lasers and appreciate the accuracy in measurements

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	1					2		
CO2	2	1					2		
CO3	2	1					2		
CO4	2	1					2		

Detailed Syllabus:

1. Determination of Wavelength of Sodium light using Newton’s Rings.
2. Determination of Wavelength of He-Ne laser – Metal Scale.
3. Measurement of Width of a narrow slit using He- Ne Laser.
4. Determination of Specific rotation of Cane sugar by Laurent Half-shade Polarimeter.
5. Determination of capacitance by using R-C circuit.
6. Determination of resonating frequency and bandwidth by LCR circuit.
7. Measurement of half-life of radioactive source using GM Counter.
8. Diffraction grating by normal incidence method.

Reading:

1. Physics Laboratory Manual.

CY102	CHEMISTRY LABORATORY	BSC	0 – 0 – 3	2 Credits

Pre-requisites: None.

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

CO1	Synthesize polymers
CO2	Analyze ores and bleaching powder
CO3	Estimate the Hardness of water in terms of Calcium and Magnesium ions
CO4	Determine salt content using chromatographic techniques
CO5	Standardize solutions using titration, conductivity meter, pH-meter, potentiometer and colorimeter
CO6	Verify the Freundlich adsorption isotherm

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1							1	2	
CO2							1	2	
CO3							1	2	
CO4							1	2	
CO5							1	2	
CO6							1	2	

Detailed Syllabus:

Cycle 1

1. Standardization of potassium permanganate.
2. Determination of MnO2 in Pyrolusite.
3. Determination of Iron in Haematite.
4. Determination of available Chlorine in bleaching powder and of Iodine in Iodized salt.
5. Determination of hardness of water and of calcium in milk powder.
6. Chemistry of blue printing.
7. Preparation of phenol formaldehyde resin.

Cycle 2

1. Conductometric titration of an Acid vs Base.
2. pH-metric titration of an Acid vs Base.
3. Potentiometric titration of Fe^{2+} against $K_2Cr_2O_7$.
4. Colorimetric titration of potassium permanganate.

5. Determination of rate of corrosion of mild steel in acidic environment in the absence and presence of an inhibitor.

6. Determination of salt content by Ion-exchange.

7. Separation of Ions by paper chromatography.

8. Verification of Freundlich adsorption isotherm.

Reading:

1. Valentin, W. G. “A Course of Qualitative Chemical Analysis” Read Books Design, 2010; ISBN: 1446022730, 9781446022733.
2. G. Svehla: Vogel's Qualitative Inorganic Analysis. J. Mendham, R. C. Denny, J. D. Barnes, M. J. K. Thomas: Vogel’s Text Book of Quantitative Chemical Analysis.
3. G. N. Mukherjee: Semi-Micro Qualitative Inorganic Analysis (CU Publications) Vogel’s Text Book of Practical Organic Chemistry (5th Edition).
4. N. G. Mukherjee: Selected Experiments in Physical Chemistry.

CS102	PROBLEM SOLVING AND COMPUTER PROGRAMMING LABORATORY	ESC	0 – 0 – 3	2 Credits

Pre-requisites: None.

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

CO1	Design and test programs to solve mathematical and scientific problems
CO2	Develop and test programs using control structures
CO3	Implement modular programs using functions
CO4	Develop programs using classes

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	3	3		2		2	2
CO2	3	3	3	3		2		2	2
CO3	3	3	3	2		1		2	2
CO4	3	3	3					2	2

Detailed Syllabus:

1. Programs on conditional control constructs.
2. Programs on loops (while, do-while, for).
3. Programs using user defined functions and library functions.
4. Programs on arrays, matrices (single and multi-dimensional arrays).
5. Programs using pointers (int pointers, char pointers).
6. Programs on structures.
7. Programs on classes and objects.
8. Programs on inheritance and polymorphism.

Reading:

1. Walter Savitch, Problem Solving with C++, 6th Edition, Pearson, 2008.
2. R.G. Dromey, How to solve it by Computer, Pearson, 2008.

ME103	WORKSHOP PRACTICE	ESC	0 – 0 – 3	2 Credits

Pre-requisites: None.

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

CO1	Study and practice on machine tools and their operations
CO2	Practice on manufacturing of components using workshop trades including fitting, carpentry, foundry and welding
CO3	Identify and apply suitable tools for machining processes including turning, facing, thread cutting and tapping
CO4	Apply basic electrical engineering knowledge for house wiring practice

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1								2	
CO2								2	
CO3								2	
CO4								2	

Detailed Syllabus:

Fitting Trade: Preparation of T-Shape Work piece as per the given specifications, Preparation of U-Shape Work piece which contains: Filing, Sawing, Drilling, Grinding, and Practice marking operations.

Plumbing: Practice of Internal threading, external threading, pipe bending, and pipe fitting, Pipes with coupling for same diameter and with reducer for different diameters and Practice of T-fitting, Y-fitting, Gate valves fitting.

Machine shop: Study of machine tools in particular Lathe machine (different parts, different operations, study of cutting tools), Demonstration of different operations on Lathe machine, Practice of Facing, Plane Turning, step turning, taper turning, knurling and parting and Study of Quick return mechanism of Shaper.

Power Tools: Study of different hand operated power tools, uses and their demonstration and Practice of all available Bosch Power tools.

Carpentry: Study of Carpentry Tools, Equipment and different joints, Practice of Cross Half lap joint, Half lap Dovetail joint and Mortise Tenon Joint

House Wiring: Introduction to House wiring, different types of cables. Types of power supply, types of motors, Starters, distribution of power supply, types of bulbs, parts of tube light, Electrical wiring symbols, Stair case wiring: Demo and Practice (2 switches with one lamp control) and Godown wiring

Foundry Trade: Introduction to foundry, Patterns, pattern allowances, ingredients of moulding sand and melting furnaces. Foundry tools and their purposes, Demo of mould preparation and Practice – Preparation of mould by using split pattern.

Welding: Introduction, Study of Tools and welding Equipment (Gas and Arc welding), Selection of welding electrode and current, Bead practice and Practice of Butt Joint, Lap Joint.

Reading:

1. Raghuwanshi B.S., Workshop Technology Vol. I & II, Dhanpath Rai & Sons.
2. Kannaiah P. and Narayana K.L., Workshop Manual, 2nd Edn, Scitech publishers.
3. John K.C., Mechanical Workshop Practice. 2nd Edn. PHI 2010.
4. Jeyapoovan T.and Pranitha S., Engineering Practices Lab Manual, 3rd Edn. Vikas Pub.2008.

MA151	MATHEMATICS – II	BSC	4 – 0 – 0	4 Credits

Prerequisites: Mathematics – I.

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

CO1	Solve linear differential equations using Laplace transforms
CO2	Evaluate multiple integrals and improper integrals
CO3	Convert line integrals to area integrals
CO4	Convert surface integrals to volume integrals
CO5	Determine potential functions for irrotational force fields

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3						2	
CO2	2	2						2	
CO3	2	2						2	
CO4	2	2						2	
CO5	2	2						2	

Detailed Syllabus:

Laplace Transformation: Laplace transform - Inverse Laplace transform - properties of Laplace transforms - Laplace transforms of unit step function, impulse function and periodic function - convolution theorem - Solution of ordinary differential equations with constant coefficients and system of linear differential equations with constant coefficients using Laplace transform.

Integral Calculus: Fundamental theorem of integral calculus and mean value theorems; Evaluation of plane areas, volume and surface area of a solid of revolution and lengths. Convergence of Improper integrals – Beta and Gamma integrals – Elementary properties – Differentiation under integral sign. Double and triple integrals – computation of surface areas and volumes – change of variables in double and triple integrals.

Vector Calculus : Scalar and Vector fields; Vector Differentiation; Level surfaces - directional derivative - Gradient of scalar field; Divergence and Curl of a vector field - Laplacian - Line and surface integrals; Green's theorem in plane; Gauss Divergence theorem; Stokes' theorem.

Reading:

1. R.K.Jain and S.R.K.Iyengar, Advanced Engineering Mathematics, Narosa Pub. House, 2008.
2. Erwyn Kreyszig, Advanced Engineering Mathematics, John Wiley and Sons, 8th Edition, 2008.
3. B.S.Grewal, Higher Engineering Mathematics, Khanna Publications, 2009.

MA238	STATISTICAL AND NUMERICAL METHODS FOR ENGINEERS	BSC	4 – 0 – 0	4 Credits

Pre-requisites: None

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

CO1	Construct a curve by least squares method
CO2	Analyze the data based on large and small sample sizes.
CO3	Determine service time and waiting time in a queue.
CO4	Determine an interpolating function for data
CO5	Solve initial value problems.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	2		3			2	
CO2	3	3	2		3			2	
CO3	3	3	2		3			2	
CO4	3	3	2		3			2	
CO5	3	3	2		3			2	

Detailed syllabus:

Statistical Methods:

Random variables and their distributions:

Random variables (discrete and continuous), probability functions, desity and distribution functions, special distributions (Binomial, Hypergeometric, Poisson, Uniform, exponential and normal). Mean and variance. Chebyshev’s inequality, joint probability mass function, marginal distribution function, joint density function.

Testing of Hypothesis:

Testing of Hypothesis, Null and alternative hypothesis, level of significance, one-tailed and two-tailed tests, tests for large samples (tests for single mean, difference of means, single proportion, difference of proportions), tests for small samples (T,F and Chi-square tests), goodness of fit, contingency tables, analysis of variance (one way and two way classification), Non-parametric tests, regression, correlation.

Queuing theory:

Concepts, applicability, classification, birth and death process, Poisson queues, single server, multiple server, queuing models, infinite (including waiting times) and finite capacities, Erlangian distribution, Erlangian service time queuing models.

Numerical Methods:

Lagrange interpolation, Forward, backward and central differences, Newton's forward and backward interpolation formulae, Gauss's forward and backward interpolation formulae, Numerical differentiation at the tabulated points with forward backward and central differences. Numerical Integration with Trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8 rule and Romberg integration. Taylor series method, Euler's method, modified Euler's method, Runge-Kutta method of 2^{nd} & 4^{th} orders for solving first order ordinary differential equations.

Curve fitting by the method of least squares. Fitting of (i) Straight line (ii) Second degree parabola (iii) Exponential curves.

Gauss Seidal iteration method to solve a system of equations –

Calculation of dominant Eigen value by iteration. Numerical solution of algebraic and transcendental equations by Regula-Falsi method Newton-Raphson's method.

Reading:

1. Miller and Freund, *Probability and Statistics for Engineers*, Pearson, 2005.
2. Jain, Iyengar and Jain, *Numerical methods for Scientific and Engineering Computation,* New Age International Publications, 2008.
3. Kantiswarup, Manmohan and P.K.Gupta, *Operations Research,* S.Chand & Co., 2006.

EE236	NETWORK ANALYSIS	ESC	3 – 0 – 0	3 Credits

Pre-requisites: None.

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

CO1	Apply the knowledge of basic circuital law and simplify the network using reduction techniques.
CO2	Analyze the circuits using Kirchhoff's law and network simplification theorems.
CO3	Determine the transient response and steady state response for given network.
CO4	Obtain the maximum power transfer to the load as well as analyze the series resonant and parallel resonant circuit.
CO5	Determine the parameters of a given Two-port network.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	2					1	2	
CO2	2	2					1	2	
CO3	2	2					1	2	
CO4	2	2					1	2	
CO5	2	2					1	2	

Detailed syllabus:

Circuit Elements And Relations: Types of sources and source transformations – Dot convention and formation of loop and node equations.

Network Graphs And Analysis: Graph of a network – incidence matrix Formation of equilibrium equations – Dual networks.

Time Domain Analysis: Solution of network equations in time domain classical differential equations – approach – initial conditions and their evaluation – Applications to simple RLC circuits only.

Applications Of Laplace Transforms In Circuit Theory: Laplace transformers of various signals of excitation – Waveform synthesis, Laplace transformed networks – Determination and representation of initial conditions – Response for impulse function only and its relation to network admittance – convolution integral and applications.

Steady State Analysis Of Circuits For Sinusoidal Excitations: 1-phase series, Parallel, series-parallel circuits – Solution of AC networks using mesh and nodal analysis.

Resonance: Series and parallel resonance – Selectivity – Bandwidth – Q factors

Network Theorems And Applications: Superposition theorem – Thevenin's and Norton's theorems –Millman's theorem – Maximum power transfer theorem – Tellegen's theorem – Their applications in analysis of networks.

Reading:

1. M.E.Van Valken Burg, *Network Analysis*, 3/e, PHI, 2002
2. Charles A Desoer and Ernest S Kuh, *Basic Circuit Theory*, Mc Graw Hill, 1969
3. M.L.Soni and J.C. Gupta, *A Course in Electrical Circuit Analysis*, Dhanpat Rai & Co. (P), 2001.
4. G.K.Mithal and Ravi Mittal, *Network Analysis*, Khanna Pub., 1998.

EC237	DIGITAL LOGIC DESIGN	ESC	3 – 0 – 0	3 Credits

Pre-requisites: None.

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

CO1	Design digital components including - decoders, multiplexers, arithmetic circuits
CO2	Design of synchronous sequential circuits
CO3	Analyze digital systems and improve the performance by reducing complexities.
CO4	Test digital systems and analyze faults.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	2						2	
CO2	2	2						2	
CO3	2	2						2	
CO4	2	2						2	

Detailed syllabus:

Digital Hardware, Design Process, Design of digital hardware.

Logic Circuits, Boolean Algebra, Logic Gates, Synthesis using AND, OR, NOT gates Design examples, Introduction to CAD tools and VHDL.

Implementation Technology – NMOS, CMOS gates, Standard chips, programmable logic devices. Custom chips, Standard cells and Gate Arrays.

Implementation of Logic functions, Minimization, Product-of-sums Form, Incompletely specified functions. Multiple output circuits. Cube representations – minimization

Number representations and Arithmetic circuits, Additions of unsigned and Signed number, Fast Address, Design of Arithmetic Circuits, Multiplication and other number representations.

Combinational Circuit Building blocks – Multiplexes, Decoders, encoders, Code converters, Arithmetic Comparison Circuits.

Flip-Flops, Registers and Counters – Basic Latch, SR and D latches, Master Slave edge triggered D Flip-flop, and KJ Flip Flops. Registers, Synchronous and Asynchronous Counters. Reset Synchronization

Synchronous Sequential circuits – State diagram, table and assignment choice of Flip-Flops. State Assignment problem. Moore and Mealy State models, Design of Finite State Machines

A Complete Digital System design Example (Ch. 10)

Reading:

1. Stephen Brown, Zvonko Vranesic, *Fundamentals of Digital Logic with VHDL Design*, McGrawHill, 2000. Chapters 1 to 8.
2. William I Fletcher, *An Engineering approach to Digital Design*, Eastern Economy edition, PHI Limited, 2000.

CS201	DISCRETE MATHEMATICS	PCC	4 – 0 – 0	4 Credits

Pre-requisites: None.

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

CO1	Understand sets, relations, functions and discrete structures
CO2	Apply Propositional logic and First order logic to solve problems
CO3	Understand discrete mathematical structures
CO4	Formulate and solve graph problems
CO5	Count discrete event occurrences
CO6	Formulate and solve recurrence relations

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2				2		2	
CO2	3	2				2		2	
CO3	3	2				2		2	
CO4	3	2	3			2		2	
CO5	3	2				2		2	
CO6	3	2				2		2	

Detailed syllabus:

Sets, Relations, Functions, Fundamentals of Logic, Quantified propositions, mathematical Induction, Combinations and Permutations, Enumerations, Recurrence Relations, Generating Functions, Binary

Relations, Lattices, Directed Graphs, Graphs, Spanning Trees, Planar Graphs, Euler Circuits, Hamiltonian Graphs.

Reading:

1. Mott, Kandel, Baker, *Discrete Mathematics for Computer Scientists and Mathematicians*, 2nd Edition, PHI, 2001.
2. Tremblay J.P. and Manohar R., *Discrete Mathematical Structures*, MGH, 1987.

CS202	DATA STRUCTURES AND ALGORITHMS	PCC	4 – 0 – 0	4 Credits

Pre-requisites: CS101-Problem Solving and Computer Programming

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

CO1	Understand the concept of ADT
CO2	Identify data structures suitable to solve problems
CO3	Develop and analyze algorithms for stacks, queues
CO4	Develop algorithms for binary trees and graphs
CO5	Implement sorting and searching algorithms
CO6	Implement symbol table using hashing techniques

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	3	3		3		2	2
CO2	3	3	3	3	2	3		2	2
CO3	3	3	3	3	2	3		2	2
CO4	3	3	3	3	2	3		2	2
CO5	3	3	3	3	2	3		2	2
CO6	3	3	3	3	2	3		2	2

Detailed syllabus:

Asymptotic Notations: Big-oh, Big-omega, Theta, Little-oh, Little-omega notations, Properties of Asymptotic Notations

Analysis of Algorithms: RAM Model, Analysis of Iterative and Recursive Algorithms

Abstract Data Types (ADTs), Implementation and Applications of Stacks, Operations and Applications of Queues, Array Implementation of Circular Queues, Implementation of Stacks using Queues, Implementation Queues using Stacks, Linked Lists, Search and Update Operations on Varieties of Linked Lists, Linked List Implementation of Stacks and Queues

Introduction to Trees, Implementation of Trees, Binary Trees, Tree Traversals with an Application, Binary Search Trees (BSTs), Query and Update Operations on BSTs, AVL Trees, Rotations, Search and Update Operations on Balanced BSTs, Splay Trees, B-trees

Hashing: Implementation of Dictionaries, Hash Function, Collisions in Hashing, Separate Chaining, Open Addressing, Analysis of Search Operations

Priority Queues: Priority Queue ADT, Binary Heap Implementation and Applications of Priority Queues

Sorting Algorithms: Stability and In Place Properties, Insertion Sort, Merge Sort, Quick Sort, Heap Sort, Lower Bound for Comparison Based Sorting Algorithms, Linear Sorting Algorithms: Counting Sort, Radix Sort, Bucket Sort

Graph Algorithms: Graphs and their Representations, Graph Traversal Techniques: Breadth First Search (BFS) and Depth First Search (DFS), Applications of BFS and DFS, Minimum Spanning Trees (MST), Prim's and Kruskal's algorithms for MST, Connected Components, Dijkstra's Algorithm for Single Source Shortest Paths, Warshall's Algorithm for finding Transitive Closure of a Graph, Floydd's Algorithm for All-Pairs Shortest Paths Problem

Reading:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, *Introduction to Algorithms*, Second Edition, PHI, 2009.
2. Mark Allen Weiss, *Data Structures and Algorithm Analysis in C++*, Third Edition, Pearson Education, 2006
3. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, *Fundamentals of Computer Algorithms*, Second Edition, Universities Press, 2011.
4. Michael T.Goodrich and Roberto Tamassia, *Algorithm Design: Foundations, Analysis and Internet Examples*, Second Edition, Wiley-India, 2006.

CS203	FILE STRUCTURES	PCC	2 – 0 – 3	4 Credits

Pre-requisites: CS101-Problem Solving and Computer Programming

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

CO1	Understand file structures including sequential, indexed, indexed sequential, hashed file structures
CO2	Apply object-oriented concepts to design file systems
CO3	Implement file operations including read, write, update and search
CO4	Develop and analyze external sorting methods

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	3	3	2	2		2	2
CO2	3	3	3	3	2	2		2	2
CO3	3	3	3	3	2	2		2	2
CO4	3	3	3	3	2	2		2	2

Detailed syllabus:

Fundamental File Structure Concepts: Field and Record Organization, Using Classes to Manipulate Buffers, Using Inheritance for Record Buffer Classes, Managing Fixed Length, Fixed Field Buffers, An Object-Oriented Class for Record Files.

Managing Files and Records: Record Access, More about Record Structures, Encapsulating Record Operations in a Single Class, File Access and File Organization, Object-Oriented Approach to File Access, Portability and Standardization.

Fundamental File Processing Operations: Physical Files and Logical Files, Opening Files, Closing Files, Reading and Writing, Seeking, Special Characters in Files, The UNIX Directory Structure, Physical and Logical Files in UNIX, File-related Header Files, UNIX File System Commands. Object Oriented Support for Entry-Sequenced

Indexed Files of Data Objects- Indexing: A Simple Index for Entry-Sequenced File, Template Classes in C++, Object-Oriented support for Indexed, Entry-Sequenced Files of Data Objects, Indexes That Are Too Large to Hold in Memory, Indexing to Provide Access by Multiple Keys, Retrieval Using Combinations of Secondary Keys, Improving the Secondary Index Structure: Inverted Lists, Selective Indexes, Binding.

Multilevel Indexing and B-Trees: Introduction: The Invention of the B-Tree, Statement of the Problem, Binary Search Trees are not a Solution, Multi-level Indexing, A Better Approach to Tree Indexes, B-Trees: Working up from the Bottom, Example of Creating a B-Tree, An Object-Oriented Representation of B-Trees, B-Tree Methods Search, Insert, and Others, B-Tree Nomenclature, Formal Definition of B-Tree Properties, Worst-case Search Depth, Deletion, Merging, and Redistribution, Redistribution during Insertion: A Way to Improve

Storage Utilization, B* Trees, Buffering of Pages: Virtual B-Trees, Variable-length Records and Keys.

Indexed Sequential File Access and B+ Trees : Indexed Sequential Access, Maintaining a Sequence Set, Adding a Simple Index to the Sequence Set, The Content of the Index: Separators Instead of Keys, The Simple Prefix B+ Tree, Simple Prefix B+ Tree Maintenance, Index Set Block Size, Internal Structure of Index Set Blocks: A Variable-order B-Tree., Loading a Simple Prefix B+ Tree, B+ Trees, B-Trees, B+ Trees, and Simple Prefix B+ Trees in Perspective.

Hashing: Introduction, A Simple Hashing Algorithm, Hashing Functions and Record Distributions, How Much Extra Memory Should Be Used, Collision Resolution by Progressive Overflow, Storing More Than One Record per Address: Buckets, Making Deletions, Other Collision Resolution Techniques, Patterns of Record Access.

Extendible Hashing: Introduction, How Extendible Hashing Works, Implementation, Deletion, Extendible Hashing Performance, Alternative Approaches, Multi list and Inverted Files, Sorting of Large Files,

External sorting: Secondary storage algorithms.

.

Reading:

1. Folk, Zoellick, Riccardi; *File Structures: An Object Oriented Approach with C++*, 2/e Pearson Publishers, 1997
2. Gio Wiederhold, *Database Design*, 2/e, MGH, 2001

EC238	BASIC ELECTRONICS LABORATORY	ESC	0 – 0 – 3	2 Credits

Pre-requisites: None.

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

CO1	Carryout the experiments and understand characteristics of Si, Ge, diodes & Common Emitter Transistor characteristics
CO2	Execute rectifiers & filters & study ripple factor & regulation performance.
CO3	Implement BJT amplifier(CE),RC phase shift oscillator experiment.
CO4	Implement Op-amp applications –inverse amplifier
CO5	Implement logic gates and test their functionality

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	1						2	
CO2	2	1						2	
CO3	2	1						2	
CO4	2	1						2	
CO5	2	1						2	

Detailed syllabus:

1. Characteristics of PN junction Diode
2. Load regulation characteristics of Zener diode
3. Rectifiers & Filters.
4. Characteristics of BJT
5. Characteristics of JFET
6. Single stage Amplifier.
7. R.C. Phase shift oscillator.
8. Clippers and Clampers.
9. Op-amp Frequency Response
10. Verification of Logic Gates.

Reading:

1. Salivahanan, *Electronic Devices and Circuits*, 3/e, Tata McGraw Hill
2. Neil Storey, *Electronics: A Systems Approach*, 4/e, Pearson Education
3. N.N.Bhargava, *Basic Electronics and Linear Circuits*, 56th reprint, Tata McGraw Hill
4. D.Roychowdhury, *Linear Integrated Circuits*
5. Molvino and Leach, *Principles of Digital Electronics*
6. William David Cooper, *Electronic Instrumentation And Measurement Techniques*
7. Georgy Kennedy, *Principles of Communication Systems*

CS204	DATA STRUCTURES LABORATORY	PCC	0 – 0 – 3	2 Credits

Pre-requisites: None

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

CO1	Develop ADT for stack and queue applications
CO2	Implement tree and graph algorithms
CO3	Implement and analyze internal and external sorting algorithms
CO4	Design and implement symbol table using hashing technique

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	3	3		3		2	2
CO2	3	3	3	3	2	3		2	2
CO3	3	3	3	3	2	3		2	2
CO4	3	3	3	3	2	3		2	2

Detailed syllabus:

1. Write a program to implement stack using arrays.

2. Write a program to evaluate a given postfix expression using stacks.

3. Write a program to convert a given infix expression to postfix form using stacks.

4. Write a program to implement circular queue using arrays.

5. Write a program to implement double ended queue (de queue) using arrays.

6. Write a program to implement a stack using two queues such that the *push* operation runs in constant time and the *pop* operation runs in linear time.

7. Write a program to implement a stack using two queues such that the *push* operation runs in linear time and the *pop* operation runs in constant time.

8. Write a program to implement a queue using two stacks such that the *enqueue* operation runs in constant time and the *dequeue* operation runs in linear time.

9. Write a program to implement a queue using two stacks such that the *enqueue* operation runs in linear time and the *dequeue* operation runs in constant time.

10. Write programs to implement the following data structures:

 (a) Single linked list

 (b) Double linked list

11. Write a program to implement a stack using a linked list such that the *push* and *pop* operations of stack still take O(1) time.

12. Write a program to implement a queue using a linked list such that the *enqueue* and *dequeue* operations of queue take O(1) time.

13 . Write a program to create a binary search tree(BST) by considering the keys in given order and perform the following operations on it.

(a) Minimum key

(b) Maximum key

(c) Search for a given key

(d) Find predecessor of a node

(e) Find successor of a node

(f) delete a node with given key

14. Write a program to construct an AVL tree for the given set of keys. Also write function for deleting a key from the given AVL tree.

15. Write a program to implement hashing with (a) Separate Chaining and (b) Open addressing methods.

16. Implement the following sorting algorithms:

  (a) Insertion sort

  (b) Merge sort

  (c) Quick sort

  (d) Heap sort

17. Write programs for implementation of graph traversals by applying: (a) BFS (b) DFS

18. Write programs to find out a minimum spanning tree of a simple connected undirected graph by applying: (a) Prim's algorithm (b) Kruskal's algorithm

19. Write a program to implement Dijkstra's algorithm for solving single source shortest path problem using priority queue.

20. Write a program to implement Floyd-Warshall algorithm for solving all pairs shortest path problem.

Reading:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, *Introduction to Algorithms*, Second Edition, PHI, 2009.
2. Mark Allen Weiss, *Data Structures and Algorithm Analysis in C++*, Third Edition, Pearson Education, 2006
3. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, *Fundamentals of Computer Algorithms*, Second Edition, Universities Press, 2011.
4. Michael T.Goodrich and Roberto Tamassia, *Algorithm Design: Foundations, Analysis and Internet Examples*, Second Edition, Wiley-India, 2006.

EC287	IC APPLICATIONS	ESC	3 – 0 – 0	3 Credits

Pre-requisites: None.

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

CO1	Apply the knowledge gained in developing and demonstrating op-amp circuits for the given design specifications
CO2	Elucidate and design the linear and non-linear applications of an op-amp and special application ICs.
CO3	Analyze and design circuits using functional ICs for various applications
CO4	Develop systematically analog signal processing systems as case study

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	1						2	
CO2	2	1						2	
CO3	2	1						2	
CO4	2	1						2	

Detailed syllabus:

Operational Amplifiers: Monolithic operational amplifiers, Characteristics, Specifications, Measurement of operational amplifier parameters.

Application Of Linear ICs:

Operational Amplifier Applications: Inverting and non-inverting amplifiers, comparators, sine wave oscillators, Astable and Monostable multivibrators, Logarithmic amplifier. Other ICs: 555 timer and its applications, uA 723 and its applications.

Digital Integrated Circuits And Applications: Study of Logic Families: TTL, CMOS circuits, Logic gate ICs. Combinational Logic: IC Versions of combinational logic circuits multiplexer, decoder, demultiplexer, tristate buffers, binary adders.

Sequential Logic: IC Versions of sequential logic circuits, flip-flops, synchronous and asynchronous counters, Registers.Design of modulus counters. Semiconductor memories: RAM, ROM (Cell structures and organization on chip). Data Conversion Circuits: specifications, Integrated D/A converters (DAC O80X), Integrated A/D converters (ADC 080X).

Reading:

1. J.Millman, *Microelectronics*, Mc grawhill, 1987.
2. Ramakant A. Gayakwad, *Operational amplifiers and Linear IC technology*, PHI, 1987.
3. Taub and Schilling, *Digital Electronics*, Mc grawhill, 1986.

CS251	OBJECT ORIENTED PROGRAMMING	PCC	4 – 0 – 0	4 Credits

Pre-requisites: None.

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

CO1	Apply Object oriented approach to design software.
CO2	Implement programs using classes and objects.
CO3	Specify the forms of inheritance and use them in programs.
CO4	Analyze polymorphic behavior of objects
CO5	Design and develop GUI programs.
CO6	Develop Applets for web applications

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	3	3	3		2		2	2
CO2	2	3	3	3				2	
CO3		2	3	3					2
CO4		2		2					
CO5		2	2	2				2	2
CO6		2	3	2		2			

Detailed syllabus:

Object Oriented Thinking – A way of Viewing the World, Computation as Simulation, Messages and Methods; - A Brief History Of Object - Oriented Programming - The History of Java, The White Paper Description; – Object - Oriented Design - Responsibility Implies Noninterference, Programming in the Small and in the Large, Why Begin with Behavior? A Case Study in RDD, CRC Cards – Recording Responsibility, Components and Behavior, Software Components, Formalizing the Interface; - A Paradigm - Program Structure, The Connection to the Java World, Types, Access Modifiers, Lifetime Modifiers; - Ball Worlds – Data Fields, Constructors, Inheritance, The Java Graphics Model, The Class Ball, Multiple Objects of the Same Class; - A Cannon Game – The Simple Cannon Game, Adding User Interaction; Pinball Game Construction Kit – First Version of Game, Adding Targets : Inheritance and Interfaces, Pinball Game Construction Kit : Mouse Events Reconsidered; - Understanding Inheritance – An Intuitive Description of Inheritance, The Base Class Object, Subclass, Subtype, and Substitutability – Forms of Inheritance, Modifiers and Inheritance, The Benefits of Inheritance, The Costs of Inheritance; - A Case Study : Solitaire – The Class Card, The Game – Card Piles- Inheritance in Action, The Application Class, Playing the Polymorphic Game, Building a More Complete Game; - Polymorphism - Varieties of

Polymorphism, Polymorphic Variables, Overloading, Overriding, Abstract Methods, Pure Polymorphism; - The AWT – The AWT Class Hierarchy, The Layout Manager, User Interface Components, Panels, Dialogs, The Menu Bar; - Input And Output Streams - Streams versus Readers and Writers, Input Streams, Stream Tokenizer, Output Streams, Object Serialization, Piped Input and Output; - Understanding Graphics - Colour, Rectangles, Fonts, Images, Graphic Contexts, A Simple Painting Program; - Applets And Web Programming – Applets and HTML, Security Issues, Applets and Applications, Obtaining Resources Using an Applet, Combining Applications and Applets.

Reading:

1. Timothy Budd , *Object Oriented Programming with JAVA*, Updated Edition, Pearson Education, 2009.
2. Herbert Schildt, *Java 2 Complete Reference*, TMH, 2010.

CS252	COMPUTER ARCHITECTURE	PCC	4 – 0 – 0	4 Credits

Pre-requisites: None.

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

CO1	Identify functional units, bus structure and addressing modes
CO2	Design the hardwired and micro-programmed control units.
CO3	Identify memory hierarchy and performance.
CO4	Design Arithmetic Logic Unit.
CO5	Interface I/O devices
CO6	Understand pipelined execution and instruction scheduling

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	2	2	1	1	2	2	2	1
CO2	3	1	1	1	1	1	2	1	1
CO3	3	2	3	2	3	2	2	2	1
CO4	3	2	3	1	2	1	2	2	1
CO5	3	2	2		1	1	2	1	2
CO6	2	2	3		3	2	2	2	1

Detailed syllabus:

Basic Structures of Computers : Computer Types, Functional Units, Basic Operational Concepts, Bus Structures, Software, Performance, Multiprocessors and Multicomputers, Historical Perspective

Machine instructions and Programs: Numbers, Arithmetic Operations and Characters, Memory Locations and Addresses, Memory Operations, Instructions and Instruction Sequencing, Addressing Modes, Assembly Language, Basic Input Output Operations, Stacks and Queues, Subroutines, Additional Instructions, Example Programs, Encoding of Machine Instructions

Input/output Organization: Accessing I/O Devices, Interrupts, Processor Examples, Direct Memory Access, Buses, Interface Circuits, Standard I/O Interfaces

The Memory System: Some Basic Concepts, Semiconductor RAM Memories, Read Only Memories, Speed Size and Cost, Cache Memories, Performance Considerations, Virtual Memories, Memory Management Requirements, Secondary Storage

Arithmetic: Addition and Subtraction of Signed Numbers, Design of Fast Adders, Multiplication of Positive Numbers, Signed-Operand Multiplication, Fast Multiplication, Integer Division, Floating Point Numbers and Operations, Implementing Floating Point Operations

Basic Processing Unit : Some Fundamental Concepts, Execution of a Complete Instruction, Multiple-Bus Organization, Hardwired Control, Microprogrammed Control

Pipelining: Basic Concepts, Data Hazards, Instruction Hazards, Influence on Instruction Sets, Data Path and Control Considerations, Super Scalar Operation, UltraSPARC 2 Example, Performance Consideration

Large Computer Systems: Forms of Parallel Processing, Array Processors, The Structure of General-Purpose Multiprocessors, Interconnection Networks

Reading:

1. Carl Hamacher, *Computer Organization*, 5th Edition, Mc Graw Hill Publishers, 2002.
2. Wiiliam Stallings, *Computer Organization and Architecture Designing for Performance*, 8th Edition, Pearson Education, 2010

CS253	DATABASE MANAGEMENT SYSTEMS	PCC	4 – 0 – 0	4 Credits

Pre-requisites: CS203: File Structures

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

CO1	Understand functional components of the DBMS.
CO2	Devise queries using Relational Algebra, Relational Calculus and SQL.
CO3	Design database schema.
CO4	Develop E-R model
CO5	Evaluate and optimize queries.
CO6	Understand transaction processing, concurrency control and recovery techniques.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1									
CO2		2	2				1		1
CO3	1	3	3		1		2	2	2
CO4	1	3	3		1		2	2	2
CO5	1								1
CO6			2			3			

Detailed syllabus:

Introduction to DBMS- Historical perspective, File Versus a DBMS, Advantages of DBMS, Describing and storing data in DBMS, Architecture of a DBMS, Different Data Models, Entity Relationship model- features of ER model, conceptual design using ER model, design for large enterprises, Relational model-structure and operations, Integrity constraints over relations, Query languages-Relational Algebra, Relational Calculus and SQL- Queries, Constraints, Form of SQL query, UNION, INTERSECT and EXCEPT, Nested queries, Aggregate Operators, Null values, Complex Integrity constraints in SQL, triggers and Embedded SQL., Database Design- Mapping ER model to Relational form, Functional Dependency-Closer of functional dependencies, closer of attributes, canonical cover and Properties of Decompositions, Normalization process- 1NF, 2NF, 3NF and BCNF, Multivalued dependency- Closer properties of Multivalued dependency and 4NF, Join dependency- PJNF, Decomposition Algorithms.

Transaction Management-ACID properties, transactions, schedules and concurrent execution of transactions, Concurrency control- lock based protocol, Serializability, recoverability, dealing with deadlocks and Concurrency control without locking. Query Processing-Overview of Query Evaluation, operator evaluation, Algorithms for relational operations- Selection operation, General selection condition, Projection operation, Join operation, set operation and aggregate operation, Evaluation of relational operations. Query optimization-Alternative plans, functions of query optimizer, translating SQL queries into relational algebra, estimating the cost of a plan, relational algebra equivalences, and other approaches to query optimization. Database Recovery- Failure classification, Recovery and atomicity, Log-based recovery shadow paging and Advanced Recovery Techniques. Security and Authorization- Access control, Direct access control and Mandatory access control, Role of DBA, Application development.

Reading:

1. Elamsri, Navathe, Somayajulu and Gupta, *Fundamentals of Database Systems*, 6th Edition, Pearson Education, 2011.
2. Raghu Ramakrishnan, Johannes Gehrke, *Database Management Systems*, 3nd Edition, McGraw Hill, 2003.
3. Silberschatz, Korth and Sudharshan, *Database System Concepts,* 6rd Edition, McGraw Hill, 2010.

CS254	SYSTEMS PROGRAMMING	PCC	4 – 0 – 0	4 Credits

Pre-requisites: None.

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

CO1	Understand BIOS and DOS interrupts
CO2	Apply debugging tools
CO3	Develop system level programs
CO4	Design assemblers and macro processors for a hypothetical system
CO5	Implement Terminate and Stay Resident(TSR) programs
CO6	Develop simple utilities including editor, device drivers

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	1		1	1				2	
CO2	1	2	2			2		2	
CO3	2	2		2		1			
CO4	3		2	1		3			
CO5	3	2		1					3
CO6	3	2		2		1		2	2

Detailed syllabus:

Fundamentals Of PC Hardware And Software: Basic Features of PC Hardware, Instruction Addressing and Execution, Examining Computer Memory and Executing Instructions.

Fundamentals of Assembly Language: Requirements for Coding in Assembly Language, Assembling, Linking, and Executing Programs, Symbolic Instructions and Addressing, Program Logic and Control.

Video and Keyboard Operations: Introduction to Video and Keyboard Processing, Video Systems, Keyboard Processing.

Data Manipulation: Processing String Data, Arithmetic I: Processing Binary Data, Arithmetic II: Processing ASCII and BCD Data, Defining and Processing Tables.

Advanced Input/output: Facilities for Using the Mouse, Disk Storage I: Organization, Disk Storage II: Writing and Reading Files, Disk Storage III: INT 21H Functions for Support Disks and Files, Disk Storage IV: INT 13H Disk Functions, Facilities for Printing.

Special Topics: Defining and Using Macros, Linking to Subprograms, Program Loading and Overlays, TSR Programming, Introduction to assemblers, Algorithms to built macro processors, Brief note on loaders

Reading:

1. Peter Abel, *Assembly Language Programming*, 5th Edition, Pearson Education, 2003
2. Sivarama P. Dandamudi, *Introduction to Assembly Language Programming*, Speinger 1st Edition 2003

EC288	IC APPLICATIONS LABORATORY	ESC	0 – 0 – 3	2 Credits

Pre-requisites: None.

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

CO1	Develop an in-depth understanding of the design principles and applications of integrated analogue and digital circuits.
CO2	Apply theory and realize analog filter circuits.
CO3	Understand the circuit operation of the 555 timer IC and regulator IC.
CO4	Identify faulty components within a circuit.
CO5	Design practical circuits by selecting proper IC chips needed for the application
CO6	Understand the issues in the design of digital integrated circuits

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	1	1					2	
CO2	2	1						2	
CO3	2	1						2	
CO4	2	1						2	
CO5	2	1						2	
CO6	2	1						2	

Detailed syllabus:

1. Study and Operation of IC testers, pulse generator and digital trainer.
2. Measurement of Op.amp parameters:
   (i) Offset voltage
   (ii) Offset current
   (iii) CMRR
   (iv) Slew rate
   (v) Open loop gain
   (vi) Input impedance.
3. Op.amp monostable and astable multivibrators.
4. 555 timer: Monostable and astable multivibrators.
5. Characteristics of TTL NAND gate:
   (i) Sourcing (ii) Sinking (iii) Transfer

6. Study of flip-flops: RS, JK, T and D.
7. Mod-N counter using 7490 and 74190.
8. Mod-N counter using 7492 and 74192.
9. MUX and decoder ICSs(IC 74153&74138).
10. Shift register IC 7495.

Reading:

1. J.Millman, *Microelectronics*, Mcgrawhill, 1987.
2. Ramakant A. Gayakwad, *Operational amplifiers and Linear IC technology*, PHI, 1987

CS255	DATABASE MANAGEMENT SYSTEMS LABORATORY	PCC	0 – 0 – 3	2 Credits

Pre-requisites: None.

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

CO1	Design and Implement a database schema
CO2	Devise queries using DDL, DML, DCL and TCL commands.
CO3	Develop application programs using PL/SQL
CO4	Design and implement a project using embedded SQL and GUI.
CO5	Apply modified components for performance tuning in open source software.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	3	3	2	3	2		2	2
CO2	2	1	2	2	3	2		2	2
CO3	2	1	2	3	2	2		2	2
CO4	2	3	3	3	2	2		2	2
CO5	2	1		1	1	2		1	2

Detailed syllabus:

Familiarization of Oracle RDBMS, SQL*Plus, SQL- query-structure, DDL-create, alter, drop, rename and Truncate DML-select, insert, update, delete and lock, set-operations, union, intersection and except, join, aggregate, group-by and having, nested sub-queries and views, DCL-grant and revoke, TCL-Commit, save point, rollback and set transaction. PL/SQL-Environment, block structure, variables, operators, data types, control structures, Cursors structures- Implicit and Explicit, Bulk statements- Bulk collect into and Forall, Exception handling- Compilation and Run-time, user-defined, Stored procedures- creation options, pass-by-value and pass-by-reference, functions-pass-by-value and pass-by-reference, packages-package specification, body, package creation and usage, and Triggers- Data definition language triggers, Data manipulation triggers, Compound triggers and trigger restrictions, Large objects-CLOB, NCLOB, BLOB and BFILE, Implementation of applications using GUI, group project.

Reading:

1. James, Paul and Weinberg, Andy Oppel, *SQL: The Complete Reference,* 3rd Edition, McGraw Hill, 2011.
2. Michael McLaughlin, *Oracle Database 11g PL/SQL Programming*, Oracle press.

CS256	PROGRAMMING LABORATORY	PCC	0 – 0 – 3	2 Credits

Pre-requisites: None.

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

CO1	Design and develop utilities for screen and key board processing.
CO2	Design and implement TSR programs
CO3	Develop programs using objects and inheritance in Java Language.
CO4	Design and implement GUI programs using components in Java Language

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	2	1	2		2	1	3	3
CO2	2	2	1	3		2	2	3	3
CO3	1	3	3	3	1	2		2	2
CO4	1	3	3	3	1	2		2	2

Detailed syllabus:

Assembly language programming :

1. Screen and keyboard processing programs
2. Number manipulation programs
3. String/text processing programs
4. Disk processing programs
5. Memory control blocks tracking programs
6. Terminate and Stay Resident (TSR) utility programs
7. Writing macros

Java Programming:

8. Ball games
9. Cannon game
10. Pinball game
11. Cards game
12. User interface dialogs related programs
13. I/O processing programs.

Reading:

1. Peter Abel, *Assembly Language Programming*, 5th Edition, Pearson Education, 2003
2. Sivarama P. Dandamudi, *Introduction to Assembly Language Programming*, Speinger 1st Edition 2003
3. Timothy Budd , *Object Oriented Programming with JAVA*, Updated Edition, Pearson Education, 2009.
4. Herbert Schildt, *Java 2 Complete Reference*, TMH, 2010.

SM335	ENGINEERING ECONOMICS AND ACCOUNTANCY	HSC	3 – 0 – 0	3 Credits

Prerequisites: None.

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

CO1	Prepare accounting records and summarize and interpret the accounting data for managerial decisions
CO2	Understand the macro-economic environment of the business and its impact on enterprise
CO3	Understand cost elements of the product and its effect on decision making
CO4	Understand the concepts of financial management and smart investment

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	1	2	3		2		2		
CO2	1	2	3		2		2		
CO3	1	2	3		2		2		
CO4	1	2	3		2		2		

Detailed Syllabus:

Engineering Economics: Introduction to Engineering Economics – Fundamental concepts – Time value of money – Cash flow and Time Diagrams – Choosing between alternative investment proposals – Methods of Economic analysis. The effect of borrowing on investment- Various concepts of National Income – Significance of National Income estimation and its limitations, Inflation –Definition – Process and Theories of Inflation and measures to control, New Economic Policy 1991 – Impact on industry.

Accountancy: Accounting Principles, Procedure – Double entry system – Journal – Ledger, Trail Balance – Cash Book – Preparation of Trading, Profit and Loss Account – Balance sheet.

Cost Accounting – Introduction – Classification of costs – Methods of costing – Techniques of costing – Cost sheet and preparation of cost sheet- Breakeven Analysis – Meaning and its application, Limitations.

Reading:

1. Henry Malcom Stenar, Engineering Economic Principles, McGraw Hill, 2005.
2. K K Dewett, Modern Economic Theory, Siltan Chand & Co., 2005.
3. Agrawal AN, Indian Economy, Wiley Eastern Ltd, New Delhi, 2012.
4. Jain and Narang, Accounting Part-I, Kalyani Publishers, 2012.
5. Arora, M.N., Cost Accounting, Vikas Publications, 2013.

CS301	THEORY OF COMPUTATION	PCC	4 – 0 – 0	4 Credits

Pre-requisites: None.

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

CO1	Understand formal machines, languages and computations
CO2	Design finite state machines for acceptance of strings
CO3	Design context free grammars for formal languages
CO4	Develop pushdown automata accepting strings
CO5	Design Turing machine
CO6	Distinguish between decidability and undecidability

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	2		1				2	
CO2	3	3		1				2	
CO3	3	3		1				2	
CO4	3	3		1				2	
CO5	3	3		1				2	
CO6	3	3		1				2	

Detailed syllabus:

Finite Automata - Structural Representations. Automata and Complexity, The Central Concepts of Automata Theory, Alphabets, Strings, Languages, Enabling the Automata to Ignore Actions, Deterministic, non-deterministic, Finite Automata with Epsilon-Transitions, Uses of e-Transitions.

Regular expressions - The Operators of Regular Expressions, Building Regular Expressions, Precedence of Regular-Expression Operators, Finite Automata and Regular Expressions, From DFA's to Regular Expressions, Converting DFA's to Regular Expressions by Eliminating States, Converting Regular Expressions to Automata, Applications of Regular Expressions, Regular Expressions in UNIX, Lexical Analysis, Finding Patterns in Text, Algebraic Laws for Regular Expressions, Associativity and Commutativity, Identities and Annihilators, Distributive Laws, The Idempotent Law, Laws Involving Closures, Pumping Lemma

Context Free Grammars - Derivations Using a Grammar, Leftmost and Rightmost Derivations, The Language of a Grammar, Sentential Forms, Parse Tress, Constructing Parse Trees, The Yield of a Parse Tree, Applications of Context-Free Grammars, Parsers, The YACC Parser-Generator, Ambiguity in Grammars and Languages, Ambiguous Grammars, Removing Ambiguity From Grammars

Push Down Automata - Definition of the Pushdown Automaton, A Graphical Notation for PDA's, Instantaneous Descriptions of a PDA, The Languages of a PDA, Acceptance by Final

State, Acceptance by Empty Stack, Equivalence of PDA's and CFG's, Context Free Languages - Properties, Normal Forms for Context-Free Grammars, Eliminating Useless Symbols.

Turing Machines - Introduction to Turing Machines, Problems That Computers Cannot Solve, Notation for the Turing Machine, Instantaneous Descriptions for the Turing Machines, Transition Diagrams for Turing Machines, The Language of a Turing Machine, Turing Machines and Halting, Programming Techniques for Turing Machines, Storage in the State, Multiple Tracks, Shifting Over, Subroutines, Extensions to the Basic Turing-Machines, Multiple Turing Machines, Computable Functions.

Undecidability - A Language That is Not Recursively Enumerable, Enumerating the Binary Strings, Codes for Turing Machines, The Diagonalization Language, An Undecidable Problem That is RE, Complements of Recursive and RE Languages, The Universal Language, Undecidability of the Universal Language

Reading:

1. John E. Hopcroft, Rajeev Motwani, Jeffrey D Ullman, *Introduction to Automata Theory, Languages and Computation*, 2nd Edition, Pearson, 2001
2. Michael Sipser, *Introduction to Theory of Computation*, 3rd Edition, Course Technology, 2012.

CS302	OPERATING SYSTEMS	PCC	4 – 0 – 0	4 Credits

Pre-requisites: CS252:Computer Architecture, CS254: Systems Programming

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

CO1	Understand functional architecture of an operating system
CO2	Develop algorithms for subsystem components
CO3	Design device drivers and multi threading libraries for a tiny OS
CO4	Develop application programs using UNIX system calls
CO5	Design and solve synchronization problems
CO6	Understand standard UNIX and FAT file systems

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1		3	1	3					
CO2	3	3	1	3		2		2	1
CO3	2	3	2	3		2		2	1
CO4		1	1	3				3	
CO5	3	3	3	2		2		2	
CO6	2	2	1	3		2			

Detailed syllabus:

Introduction: Batch, iterative, time sharing, multiprocessor, distributed, cluster and real-time systems, Unix system introduction and commands

Operating system structures : Computer system structure, Network structure, I/O Structure, Storage Structure, Dual mode operation, System components, Operating-System Services, System Calls, System Programs, System structure, Virtual Machines, System Design and Implementation, System Generation

Processes and Threads : Process Concept, Process Scheduling, Operations on Processes, Cooperating Processes, Interprocess Communication, Communication in Client – Server Systems, Multithreading Models, Threading Issues, Pthreads Basic Concepts,

CPU Scheduling : Scheduling Criteria, Scheduling Algorithms, Multiple-Processor Scheduling, Real-Time Scheduling, Algorithm Evaluation, Process Scheduling Models

Process Synchronization : Synchronization Background, The Critical-Section Problem, Synchronization Hardware, Semaphores, Classic Problems of Synchronization, Critical Regions, Monitors, OS Synchronization

Deadlocks : System Model, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock

Memory Management : Memory Management Background, Swapping, Contiguous Memory Allocation, Paging, Segmentation, Segmentation with Paging, Virtual Memory, Demand Paging, Process Creation, Page Replacement, Allocation of Frames, Thrashing, Operating-System Examples, Other Considerations

File System : File Concept, Access Methods, Directory Structure, File-System Mounting, File Sharing, Protection File-System Structure, File-System Implementation, Directory Implementation, Allocation Methods, Free-Space Management, Efficiency and Performance, Recovery, Log-Structured File System, NFS

I/O Systems : Hardware, Application I/O Interface, Kernel I/O Subsystem, Transforming I/O to Hardware Operations, STREAMS, Performance, Disk Structure , Disk Scheduling , Disk Management, Swap-Space Management, RAID Structure , Disk Attachment, Stable-Storage Implementation, Tertiary-Storage Structure

Protection : Goals of Protection, Domain of Protection, Access Matrix, Implementation of Access Matrix, Revocation of Access Rights, Language-Based Protection, Capability-Based Systems, The Security Problem , User Authentication , Program Threats, System Threats, Securing Systems and Facilities, Intrusion Detection, Cryptography, Computer-Security Classifications

Reading:

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, *Operating System Principles*, Wiley, 8/e
2. Richard Stevens, Stephen Rago, *Advanced Programming in the UNIX Environment*, Pearson Education, 2/e

CS303	DATA WAREHOUSING AND DATA MINING	PCC	4 – 0 – 0	4 Credits

Pre-requisites: CS255: Database Management Systems.

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

CO1	Understand stages in building a Data Warehouse
CO2	Apply preprocessing techniques for data cleansing
CO3	Analyze multi-dimensional modeling techniques
CO4	Analyze and evaluate performance of algorithms for Association Rules.
CO5	Analyze Classification and Clustering algorithms

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	1	1	1	2	3	2	1	1	1
CO2	2	1	1	1	3	1		1	1
CO3	2	1	1	1	3	1		2	1
CO4	3	2	2	1	3	1	1	2	1
CO5	2	3	2	1	3	1	1	2	1

Detailed syllabus:

KDD Process, Introduction to Data Warehouse, Data Preprocessing- Data Cleaning methods, Descriptive Data Summarization, Data Reduction, Data Discretization and Concept hierarchy generation, Overview of ETL and OLAP OLTP integration – comparison of OLAP with OLTP systems, ROLAP, MOLAP and DOLAP, Data Cube Computation methods, Advanced SQL support for OLAP, multi-dimensional modeling, Attribute-oriented Induction, Data Warehouse architecture and implementation - Parallel execution, Materialized views.

Data Mining Techniques: Basic concepts of Association Rule Mining, Frequent Item set mining, Mining various kinds of association rules, Classification by decision tree induction, Bayesian Classification, Rule-based Classification, Classification Back-propagation, Associative Classification, Lazy Learners, Rough set approach, Clustering methods, Data Objects and Attribute Types, Basic Statistical Descriptions of Data, Measuring Data Similarity and Dissimilarity Partition based Clustering, Hierarchical based clustering, Density based clustering.

Reading:

1. Jiawei Han and M Kamber, *Data Mining Concepts and techniques*, Third Edition, Elsevier Publications, 2011; chapters 1-8

Other Reference:

i) Data Warehouse Video Content

ii) NMIECT – Data Warehousing Video Content

CS304	SOFTWARE ENGINEERING	PCC	4 – 0 – 0	4 Credits

Pre-requisites: None.

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

CO1	Comprehend software development life cycle
CO2	Prepare SRS document for a project
CO3	Apply software design and development techniques
CO4	Identify verification and validation methods in a software engineering project
CO5	Implement testing methods at each phase of SDLC
CO6	Analyze and Apply project management techniques for a case study

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	1	3	3	3	1	3	1	2	2
CO2		3	3	3	2	2	1	2	2
CO3	2	3	3	3	3	3		2	1
CO4	1	2	3	2	2	2		2	1
CO5	1	2	3	3	2	2		2	1
CO6	3	2	3	2	2	1		2	1

Detailed syllabus:

Introduction – Evolving role of software – Software – Software a crisis on the Horizon – Software Myths

Software engineering layered technology – Software process – Software process models – The linear sequential model – The prototyping model – The RAD model – Evolutionary models – Component based development – The formal methods model – Fourth generation techniques

Project management concepts - The management spectrum – People- The problem –The process – The project – Critical approach

Software Process and project metrics – Measures, Metrics, and Indicators - Metrics in the Process and Project Domains - Software Measurement - Reconciling Different Metrics Approaches – Metrics for software quality – Managing validation –

Software project planning – Observations on estimating- Project planning objectives-Resources – Software project estimation – Empirical estimation models-Automated estimation tools

Risk management – Software risks – Risk identification – Risk projection – Risk refinement – safety risks and hazard – RMMM plans

Project scheduling and tracking – Defining task set-Defining task network – scheduling-earned value analysis-Eror tracking-project plan

Software quality assurance – Quality concepts – The quality movement-software quality assurance-Reviews-Relability

Software configuration management – Identification of objects in the software configuration-configuration audit-SCM standards

Analysis concepts and principles – Requirement analysis-software prototyping-Specification Review

Analysis modeling – Data modeling-functional modeling-Behavioral modeling – Data dictionary

Design concepts and principles – Effective modulare design – design heuristics – Design model – Documentation

Software design – Software architecture – Data designing – Architectural styles – Transform mapping –Ttransaction mapping – Refining architectural design

User interface design – Component level design

Software testing techniques – White box and black box testing – Testing for specialized environment, architectures and applications

Software testing strategies – Unit testing – Integrating testing – validation technique – System testing - debugging

.

Reading:

1. Roger S. Pressman, *Software Engineering - A Practitioner's Approach*, 6th Edition, MGH, 2005.
2. Ian Sommerville, *Software Engineering*, 9th Edition, Pearson Publishers, 2010.

CS305	OPERATING SYSTEMS LABORATORY	PCC	0 – 0 – 3	2 Credits

Pre-requisites: None.

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

CO1	Implement elementary UNIX system commands
CO2	Devise programs to test synchronization problems
CO3	Design and develop user level thread library
CO4	Design and implement file system.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1		3		2				2	
CO2	3	3		2		2		2	
CO3	3	3	2	3		3		2	
CO4	3	3	2	3		2		2	

Detailed syllabus:

1. Write Command Interpreter Programs which accepts some basic Unix commands and displays the appropriate result. Each student should write programs for at least six commands.
2. Study the concept of Signals and write a program for Context Switching between two processes using alarm signals.
3. Study pthreads and implement the following: Write a program which shows the performance improvement in using threads as compared with process.(Examples like Matrix Multiplication, Hyper quicksort, Merge sort, Traveling Sales Person problem)
4. Create your own thread library, which has the features of pthread library by using appropriate system calls (UContext related calls). Containing functionality for creation, termination of threads with simple round robin scheduling algorithm and synchronization features.
5. Implement all CPU Scheduling Algorithms using your thread library
6. Study the concept of Synchronization and implement the classical synchronization problems using Semaphores, Message queues and shared memory (minimum of 3 problems)
7. A complete file system implementation inside a disk image file.
8. Modification of Tiny OS to include new disk and NIC drivers and new file systems.

Reading:

1. Richard Stevens, Stephen Rago, *Advanced Programming in the UNIX Environment*, Pearson Education, 2/e

CS306	KNOWLEDGE ENGINEERING LABORATORY	PCC	0 – 0 – 3	2 Credits

Pre-requisites: None.

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

CO1	Build data cubes with SQL
CO2	Implement data preprocessing techniques on data.
CO3	Implement OLAP operations and multi-dimensional modeling
CO4	Implement data mining algorithms

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	2	2	3	2	1	1	2
CO2	2	3	3		3	2		1	
CO3	2	3	3		3	2		1	
CO4	3	2		2	3	2		1	

Detailed syllabus:

1. Advanced SQL Analytic functions
2. Implementation of OLAP operations
3. Data preprocessing techniques
4. Cube computation methods
5. Concept hierarchy method
6. Write a program in any programming language to generate at least 10,000 transactions in a text file with at least three items.
7. Write a program to implement the *APRIORI* algorithm and also test it thoroughly.
8. Write a program for each of the following to improve *APRIORI*
   A. Hash based Technique. B. Dynamic Item set Counting Algorithm. C. Partition Based Approach.
9. Write a program for *FPGROWTH* algorithm and also test it.
10. Write a program to construct an optimized DECISION TREE for a given training data and by using any attribute selection measure.
11. Write a program for NAÏVE BAYESIAN algorithm for classifying the data.
12. Implement the K-Means Clustering algorithm for clustering the given data.

Reading:

1. Jiawei Han and M Kamber, *Data Mining Concepts and techniques*, Third Edition, Elsevier Publications, 2011

CS307	CASE TOOLS LABORATORY	PCC	0 – 0 – 3	2 Credits

Pre-requisites: None.

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

CO1	Prepare Software Requirement Specification document
CO2	Prepare design document and compute effort estimates for a software project
CO3	Design UML diagram for a case study
CO4	Design and Develop test cases for a software

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	2	3	3	1	3		1	3
CO2		3	3	3	1	2		1	3
CO3		3	3	3	1	2		1	3
CO4		3	3	3	1	2		1	3

Detailed syllabus:

1. Develop a Software Project Plan Using Microsoft Project (Planning involves estimation – work break down structure – how much money- how much effort – how many resources – how much time it will take to a specific software –based system or product)
2. Develop a SRS Document using Rational Requisite Pro Tool. (This Lab is for mastering the software requirements in this regard the documents like Vision Document- Use Case Document – SRS Documents must be submitted for the Problem given to you)
3. Designing a Software using UML – Tool used is Rational Rose- In this lab, the student is supposed to solve the problem using OO analysis and design Methodology
4. Testing using tools Rational Robot, Rational Purify, Rational Quantify, Rational Pure Coverage etc., (Functional and Structural Testing techniques were discussed and necessary programs will be tested)
5. Writing a programs for the following : Quality Metrics and OO Metrics, Finding the coupling and cohesion intensity in java code, Reverse Engineering Problems
6. Web site Testing , Security Testing , System Testing

Reading:

1. Rational Online Documentation
2. Booch, Jackobson and Rambaugh, UML Guide , Pearson Edu, 1999
3. IEEE Standards for SRS Documents, IEEE Std. 830.
4. Fenton NE, Software Metrics: A Rigorous Approach, Chapman and Hall, 1991

CS351	LANGUAGE PROCESSORS	PCC	4 – 0 – 0	4 Credits

Pre-requisites: CS301:Theory of Computation

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

CO1	Understand phases in the design of compiler
CO2	Design top-down and bottom-up parsers
CO3	Identify synthesized and inherited attributes
CO4	Develop syntax directed translation schemes
CO5	Develop algorithms to generate code for a target machine

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	1	2		2				1	
CO2	1	2						1	
CO3	1	2						1	
CO4	2	2						1	
CO5	3	2				2		1	

Detailed syllabus:

Phases of Compilers - Compiler Construction Tools - Bootstrapping

Lexical analyzer - The Role of the Lexical Analyzer, Input Buffering, Specification of Tokens, Recognition of Tokens, A Language for Specifying Lexical Analyzers.

Parsing - The Role of the Parser, Context-Free Grammars, Top-Down Parsing, Bottom-Up Parsing, Operator-Precedence Parsing, LR Parsers, Using Ambiguous Grammars, Parser Generators.

Syntax-Directed Translation- Syntax-Directed Definitions, Construction of Syntax Trees, Bottom-Up Evaluation of S-Attributed Definitions, L-Attributed Definitions, Top Down Translation, Bottom-Up Evaluation of Inherited Attributes, Recursive Evaluators, Space for Attribute Values at Compile Time, Assigning Spaces at Compiler-Construction Time, Analysis of Syntax-Directed Definitions.

Type Checking- Type Systems, Specification of a Simple Type Checker, Equivalence of Type Expressions, Type Conversions, Overloading of Functions and Operators, Polymorphic Functions, An algorithm for Unification.

Run-Time Environments - Source Language Issues, Storage Organization, Storage-Allocation Strategies, Access to Nonlocal Names, Parameter Passing, Symbol Tables, Language Facilities for Dynamic Storage Allocation, Dynamic Storage Allocation Techniques, Storage Allocation in Fortran.

Intermediate Code Generation - Intermediate Languages, Declarations, Assignment Statements, Boolean Expressions, Case Statements, Backpatching, Procedure Calls.

Code Generation - Issues in the Design of a Code Generator, The Target Machine, Run-Time Storage Management, Basic Blocks and Flow Graphs, Next-Use Information, A Simple Code Generator, Register Allocation and Assignment, The Dag Representation of Basic Blocks, Peephole Optimization, Generating Code from DAGs, Dynamic Programming Code-Generation Algorithm, Code-Generator Generators

Reading:

1. Aho, Ravi Sethi, Monica S Lam, Ullman, *Compilers - Principles, Techniques and Tools*, 2nd Edition, Pearson, 2002.
2. Randy Allen, Ken Kennedy, *Optimizing Compilers for Modern Architectures*, Morgan Kauffmann, 2001.

CS352	COMPUTER NETWORKS	PCC	4 – 0 – 0	4 Credits

Pre-requisites: CS302: Operating Systems

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

CO1	Understand OSI and TCP/IP models
CO2	Analyze MAC layer protocols and LAN technologies
CO3	Design applications using internet protocols
CO4	Implement routing and congestion control algorithms
CO5	Develop application layer protocols

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1		2	2						2
CO2		2							2
CO3	2	2	2	2		2			2
CO4	2	2		2					2
CO5	3	3	3	3					2

Detailed syllabus:

Introduction – network architecture - protocol implementation issues - Quantitative performance metrics - network design. Reference models- The OSI Reference Model- The TCP/IP Reference Model - A Comparison of the OSI and TCP/IP Reference Models-

Low –level network technologies-Ethernet to token ring to wireless-Issues wit data link protocols-Encoding framing and error detection and correction-sliding window protocol-Medium access control sub layer-Basic models of switched networks-Datagrams versus virtual circuits-Switching technologies-Switched Ethernet and ATM- The design of hardware based switches

Network layer – network layer design issues-Touting algorithms-Congestion control algorithms-Internetworking- The network layer in the internet-Internet Protocol (IP).- Unicast, multicast, and inter domain routing

Transport layer-Elements of transport protocol-Congestion control – Performance issues-The Internet's Trans-mission Control Protocol (TCP)- Remote Procedure Call (RPC)- – Implementation semantics of RPC -client-server applications- The Real-time Transport Protocol(RTP) - Multimedia applications- Congestion control and resource allocation.- congestion control in TCP–UDP –Quality of service in IP.
Application layer-Domain name server-World wide web-Hyper text transfer protocol-Presentation formatting and data compression- Network security- crypto graphic tools- the problems of key distribution – Geveral authentication techniques - Pretty Good Privacy (PGP)- Secure Shell (SSH),- IP Security architecture(IPSEC).-Firewalls .

Network applications and the protocols- File transfer protocol - email and the Web, multimedia applications such as IP telephony and video streaming- Overlay networks like peer-to-peer file sharing and content distribution networks- Web Services architectures for developing new application protocols.

Reading:

1. Larry L Peterson, Bruce S Davis, *Computer Networks*, 5th Edition, Elsevier, 2012.
2. Andrew S. Tanenbaum, David J Wetherall, *Computer Networks*, 5th Edition, Pearson Edu, 2010.

CS353	LANGUAGE PROCESSORS LAB	PCC	0 – 0 – 3	2 Credits

Pre-requisites: None.

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

CO1	Implement simple lexical analyzers
CO2	Generate predictive parsing table for a CFG
CO3	Apply Lex and Yacc tools
CO4	Design and Implement LR parser
CO5	Implement Intermediate code generation for subset C language

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	2		2		1			
CO2	2	2		2		1			
CO3	2	2		2		1		1	2
CO4	2	2		2		1			
CO5	2	2		2		1			

Detailed syllabus:

1. Lex and Yacc - Generation of Intermediate Code for Expression Grammar - Construction of Predictive Parsing Table - LR Parsing Tables - Parsing Actions.
2. Implement CYK algorithm (from Motwani's book)
3. Using lex/yacc tools generate assembly language code for a block of assignment and arithmetic statements.
4. Implement elimination of left recursion and left factoring algorithms for any given grammar and generate predictive parsing table.
5. Write a program for generating a parser program using lex and yacc for a language with integer identifiers, binary arithmetic expressions and assignments. (Input is grammar and output is parser in C language)
6. Write a program for generating SLR Parsing table and also write a parser.
7. Write a program for generating derivation sequence for a given terminal string using parsing table.
8. Using back-patching method generate three address code for while, if and Boolean expressions.
9. Major assignment: Intermediate code generation for subset C language.

Reading:

1. Aho, Ravi Sethi, Monica S Lam, Ullman, *Compilers - Principles, Techniques and Tools*, 2nd Edition, Pearson, 2002.
2. John R Levine, Tony Mason, Doug Brown, *Lex and Yacc*, Orielly, 2nd Edition, 2009

CS354	COMPUTER NETWORKS LAB	PCC	0 – 0 – 3	2 Credits

Pre-requisites: None.

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

CO1	Develop programs for client-server applications
CO2	Perform packet sniffing and analyze packets in network traffic.
CO3	Implement error detecting and correcting codes

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	2	2	2					2
CO2	1	1	2	2		2			
CO3	2	2						2	

Detailed syllabus:

Assinment-1 Programs to implement error correction and detection

Assinment-2 Programs for IP address conversion function

Assignment-3 Client server applications using inter process communication and synchronous mechanisms

a)FIFO

b)Message queues

c)Shared memory

Assignment-4 Connection oriented Client server applications with TCP

Assignment-5 Connectionless Client server applications with UDP

Assignment-6 Programs using RPC remote procedure call

Assignment-7 client server applications using cocurrent server

Assignment-8 client server applications using Multi protocol server

Assignment-9 client server applications using super server

Assignment-10 Implement a chat and mail server

Reading:

1. W. Richard Stevens, *UNIX Network Programming, Volume 1, Second Edition: Networking APIs: Sockets and XTI*, Prentice Hall, 1998
2. W. Richard Stevens, *UNIX Network Programming, Volume 2, Second Edition: Interprocess Communications*, Prentice Hall, 1999
3. W. Richard Stevens, Stephen Rago, *Advanced Programming in the UNIX Environment*, Pearson Education, 2/e

CS401	DISTRIBUTED COMPUTING	PCC	4 – 0 – 0	4 Credits

Pre-requisites: CS302: Operating Systems, CS352: Computer Networks

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

CO1	Understand models of distributed computing
CO2	Analyze algorithms for coordination, communication, security and synchronization in distributed systems
CO3	Analyze distributed shared memory models
CO4	Design and Implement distributed file systems
CO5	Design distributed algorithms for handling deadlocks

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2		2	2			2	3
CO2	3	3	3	3	1	2	2	2	1
CO3	3	2	2	3	2	2		2	3
CO4	2	3	3	3	2	2		2	3
CO5	3	3	2	2	1	3		2	3

Detailed syllabus:

Distributed Computing Introduction : Definition, Relation to parallel systems, synchronous vs asynchronous execution, design issues and challenges

A Model of Distributed Computatioms : A Model of distributed executions, Models of communication networks, Global state of distributed system, Models of process communication.

Logical Time : Logical clocks, scalar time, vector time, Matrix time, vrtual time, Physicla clock synchronization - NTP

Global state and snapshot recording algorithms: System model, Snapshot algorithms for FIFO channels, Variations of Chandy-Lamport algorithm, Snapshot algorithms for non-FIFO channels, Snapshots in a causal deluvery system, Monitoring global state, Nececssary and sufficient conditions for consistent global snapshots, Finding consistent global snapshots in a distributed computation.

Message ordering and group communication : Mesage ordering paradigms, Group communication, Causal order (CO), Total order, Multicast, Propagation trees for multicast, Application-level multicast algorithms, Fault-tolerant group communication, Multicast algorithms at the network layer.

Termination detection : System model of a distributed computation, Termination detection using distributed snapshots, weight throwing and spanning-tree-based algorithms, Message-optimal termination detection, Termination detection in a very general distributed computing model, Termination detection in the atomic computation model, Termination detection in a faulty distributed system

Distributed mutual exclusion algorithms: Lamport's algorithm, Ricart–Agrawala algorithm, Singhal's dynamic information-structure algorithm, Lodha and Kshemkalyani's fair mutual exclusion algorithm, Quorum-based mutual exclusion algorithms, Maekawa's algorithm, Agarwal–El Abbadi quorum-based algorithm, Token-based algorithms, Suzuki–Kasami's broadcast algorithm, Raymond's tree-based algorithm,.

Deadlock detection in distributed systems: System model, Models of deadlocks, Knapp's classification of distributed deadlock detection algorithms, Mitchell and Merritt's algorithm for the single resource model, Chandy–Misra–Haas algorithm for the AND model, Chandy–Misra–Haas algorithm for the OR model, Kshemkalyani–Singhal algorithm for the P-out-of-Q model

Distribued shared memory : Abstraction and advantages, Memory consistency models, Shared memory mutual exclusion, Wait-freedom, Register hierarchy and wait-free simulations, Wait-free atomic snapshots of shared objects

Check pointing and rollback recovery : Introduction, Background and definitions, Issues in failure recovery, Checkpoint-based recovery, Log-based rollback recovery, Koo–Toueg coordinated checkpointing algorithm, Juang–Venkatesan algorithm for asynchronous checkpointing and recovery, Manivannan–Singhal quasi-synchronous checkpointing algorithm, Peterson–Kearns algorithm based on vector time, Helary–Mostefaoui–Netzer–Raynal communication-induced protocol

Consensus and agreement algorithms : Problem definition, Overview of results, Agreement in a failure-free system (synchronous or asynchronous), Agreement in (message-passing) synchronous systems with failures, Agreement in asynchronous message-passing systems with failures, Wait-free shared memory consensus in asynchronous systems

Failure detectors : Unreliable failure detectors, The consensus problem, Atomic broadcast, A solution to atomic broadcast, The weakest failure detectors to solve fundamental agreement problems, An implementation of a failure detector, An adaptive failure detection protocol

Reading:

1. Ajay D. Kshemakalyani, Mukesh Singhal, *Distributed Computing,*Cambridge University Press, 2008
2. Andrew S. Tanenbaum, Maarten Van Steen, *Distributed Systems - Principles and Paradigms,* PHI, 2004

CS402	CRYPTOGRAPHY AND NETWORK SECURITY	PCC	4 – 0 – 0	4 Credits

Pre-requisites: CS352: Computer Networks

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

CO1	Analyze encryption algorithms.
CO2	Perform packet sniffing and analyze packets for vulnerabilities
CO3	Identify system vulnerabilities of communication protocols
CO4	Design firewalls
CO5	Develop intrusion detection system

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	1	1	1		2			2	1
CO2	3	2	1	2	3	3		1	1
CO3	3	3	1		2	3		2	1
CO4	3	3	1	3	3	3	1	2	2
CO5	3	3	1	2	3	3	1	2	3

Detailed syllabus:

Need for Security – Attacks, Services and Mechanisms, Classical encryption Techniques, Block ciphers and data encryption, standard.

Advanced encryption standard, evaluation criteria of AES, Symmetric ciphers- multiple encryption and triple DES, Block cipher modes of operation, Stream ciphers and RC4, Stream ciphers – Blowfish, Modern Symmetric encryption - IDEA, Confidentiality using Symmetric Encryption, Placement of encryption function, traffic confidentiality, Random number generation.

Introduction to number theory- Prime numbers, Fermat's and Euler's theorems, Chinese Remainder Theorem, Discrete logarithms, Public key cryptography - Principles of public key cryptosystems and RSA, Key management, Diffie-Hellman key exchange, Elliptic curve arithmetic, Elliptic curve cryptography, Key Distribution, Message authentication and Hash functions-Authentication functions, Security and Hash functions and MACs, HMAC, CMAC, Digital signatures and authentication protocols, Authentication protocols, Digital signature standard.

Attacks- Denial-of-service/Distributed denial-of-service attacks, Back door, Spoofing, Man-in-the-middle, Replay, TCP/Hijacking, Fragmentation attacks, Weak keys, Mathematical attacks, Social engineering, Port scanning, Dumpster diving, Birthday attacks, Password guessing, Software exploitation, Inappropriate system use, Eavesdropping, War driving, TCP sequence number attacks, War dialing/demon dialing attacks.

Other public Key Cryptosystems –Public key algorithms using GMP, Introduction to packet sniffing tool, Architecture of SSL, Attacks on SSL, Introduction to Intruder detection System, Snort and stenographic tools.

Wireless and IP Security-IEEE 802.11 Wireless Security, WEP, WEP security upgrades, IEEE 802.11i, Wireless application protocol, IP Security architecture, Authentication header, Encapsulating security pay load, combining security associations.

Reading:

1. Eric Cole, Dr. Ronald Kurtz and James W. Conley, *Network Security Bible*, Wiley Publishers, 2009
2. Jason Albanese and Wes Sonnenreich, *Network Security Illustrated*, MGH Publishers, 2003
3. William Stallings, *Cryptography and Network Security*, Pearson Education, 2006

CS403	SECURITY LABORATORY	PCC	0 – 0 – 3	2 Credits

Pre-requisites: None.

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

CO1	Implement cryptographic algorithms
CO2	Analyze packets and simulate attacks
CO3	Build a mini firewall
CO4	Develop intrusion detection system using snort

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2		2	2	2		2	
CO2	3	2		2	3	3	1	2	2
CO3	3	1	2	2	2	2		1	1
CO4	3	1		1	2	3	1	2	2

Detailed syllabus:

1. Write programs using UNIX pipes and signals.
2. Write socket programs for group communications.
3. Write a socket program to implement TCP quiz
4. Write a program for a modified tic-tac-toe game using semaphore
5. Write socket programs for authentication problems
6. Implement a File Transfer Protocol.
7. Write a problem of secure communication between two groups:
8. Design a communication protocol to anonymous routing.
9. Design and code security association between computers in a network through shared access
10. Exercises on snort, wireshark, network simulator tools.

Reading:

1. Eric Cole, Dr. Ronald Kurtz and James W. Conley, *Network Security Bible*, Wiley Publishers, 2009
2. Jason Albanese and Wes Sonnenreich, *Network Security Illustrated*, MGH Publishers, 2003
3. Eric Maiwald, *Network Security: A Beginner's Guide*, 3rd Edition, MGH/Osborne, 2012

ME435	INDUSTRIAL MANAGEMENT	ESC	3 – 0 – 0	3 Credits

Pre-requisites: None.

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

CO1	Understand the basic principles, approaches and functions of management and apply concepts to specific situations.
CO2	Understand marketing management process and apply marketing mix in the formulation of marketing strategies during the life cycle of product.
CO3	Identify and utilize various techniques for improving productivity using work study.
CO4	Apply the concepts and tools of quality engineering in the design of products and process controls.
CO5	Understand and use appropriate methods/tools of inventory classification and control in industry.
CO6	Identify activities with their interdependency so as to optimize time vs costs utilizing the techniques of project management/CPM.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1		3					3	2	3
CO2	2	2	2				3	2	3
CO3		3					3	1	3
CO4		2				3	2	2	3
CO5	2	2					2	2	3
CO6		3				3	2	3	3

Detailed syllabus:

Introduction: Overview of the course, Examination and Evaluation patterns; Nature, significance and role of management in organizations.

Evolution of Industry and Principles of management: Evolution of industry and professional management; Functions of management; Organization structures; Hawthorne Experiments and informal organizational structures; Motivational theories and leadership styles.

Marketing Management: Marketing management process; 4P's of marketing mix; Target marketing; Product life cycle and marketing strategies.

Work Study: Productivity and its role in the economy; Techniques for improving productivity; Method study; Principles of motion economy; Stop watch time study; Work sampling.

Quality Management: Dimensions of quality; Process control charts; Acceptance sampling; Taguchi's Quality Philosophy; Quality function deployment; Introduction to TQM.

Inventory Management: Purpose of inventories; Inventory costs; ABC classification; Economic Order Quantity (EOQ); P and Q systems of inventory control.

Project Scheduling- PERT/CPM: Project activities; Network diagrams; Critical path method (CPM); Programme Evaluation and Review Technique (PERT).

Reading:

1. Koontz., H. et al., *Essentials of Management*, 7th Edition, MGH, New York, 2007.
2. Philip Kotler., *Marketing Management*, 13th Edition, Prentice Hall of India/Pearson, New Delhi, 2009.
3. Chase, Shankar, Jacobs and Aquilano, *Operations and Supply Management*, 12th Edition, Tata McGraw Hill, New Delhi, 2010.

CS451	WIRELESS AND MOBILE COMPUTING	PCC	3 – 0 – 0	3 Credits

Pre-requisites: None.

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

CO1	Understand algorithm/protocols, environments and communication systems in mobile computing.
CO2	Evaluate the efficiency of mobile IPv4 and IPv6 architectures with agents and proxies.
CO3	Analyze the performance of MAC protocols used for wired network and wireless networks.
CO4	Evaluate the performance of TCP protocols in Wireless Networks with mobile nodes.
CO5	Design and analyze the existing routing protocols for multi-hop wireless networks.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	1	3	3	2		2			2
CO2	1	2	2	2		3			2
CO3	1	2	2	3		2			2
CO4	1	2	3	2		1			2
CO5	2	2	3	2	2				2

Detailed syllabus:

Basic communication Technologies, Introduction to Mobile Networks, Introduction to different categories of Wireless networks (MANET: Mobile ad-hoc networks- Communication Architectures of a typical MANET, Applications of MANET, WSN: Wireless Sensor Networks- topologies in WSN-Linear, Grid and Cluster based topologies, communication architectures in a WSN, applications of WSNs, VANET: Vehicular Ad-hoc Networks- communication architectures in VANET, Applications of VANET, PAN: Personal Area Networks- the Bluetooth technology, the blue tooth specifications, DTN: Delay Tolerant Network-delay tolerant network architecture, applications of DTN), Wireless Communication Fundamentals, Cellular Wireless Networks.

Medium Access Control Layer- Hidden terminal problem, Exposed terminal problem, Collision avoidance, Congestion Avoidance, Congestion control, Energy Efficiency, MACA and MACAW protocols, Wireless LAN and IEEE 802.11- Network architecture, the physical layer, the MAC layer, security.

Detailed network layer functionalities in multi-hop wireless networks- Mobile Ad-hoc Networks- broadcasting in a MANET, Flooding generated broadcast storm problem, rebroadcasting schemes, Issues in providing multicasting in MANET, Multicast routing protocols, Geocasting- Geocast routing protocols. Mobile Network Layer (Mobile IP), DHCP (Dynamic host configuration protocol), Routing in Mobile Ad hoc Networks (MANET)- Topology-based versus position based approaches, Proactive routing protocols, Reactive routing protocols, Hybrid routing protocols, position based routing issues and forwarding strategies, AODV (Ad-hoc On-Demand Distance Vector Routing Protocol)- Analysis of AODV under mobility and Faults in a network, DSR (Dynamic Source Routing)-Analysis of DSR under mobility and Faults in a network, Secure routing protocols in MANET, Wireless Sensor Networks: (Routing protocols, Localization methods, Sensor Deployment Strategies), traffic flow pattern in WSN- one to many, many to one and many to many, Routing protocols for Delay Tolerant Networks, Routing protocols for Vehicular Ad-hoc Networks, Wireless Access Protocol, GPS (Global positioning system) and applications, RFID and its applications. **Reading:**

1. C D M Cordeiro, D. P. Agarwal, *Adhoc and Sensor Networks: Theory and applications*, World Scientific, 2006.
2. Jochen Schiller, *Mobile Communications*, Second Edition, Pearson Education, 2003.
3. Asoke K Talukder and Roopa R. Yavagal, *Mobile Computing – Technology, Applications and Service Creation*; TMH Pub., New Delhi, 2006

CS452	MACHINE LEARNING AND SOFT COMPUTING	PCC	3 – 0 – 0	3 Credits

Pre-requisites: None.

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

CO1	Understand instance based learning algorithms
CO2	Design neural network to solve classification and function approximation problems
CO3	Build optimal classifiers using genetic algorithms
CO4	Comprehend probabilistic methods for learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	3	1	3	1	2	2	1
CO2	3	2	3	2	3	1	2	2	2
CO3	2	1	3	2	3	1	2	1	2
CO4	3	2	3	2	3	2	2	2	2

Detailed syllabus:

Introduction – Well defined learning problems, Designing a Learning System, Issues in Machine Learning; - The Concept Learning Task - General-to-specific ordering of hypotheses, Find-S, List then eliminate algorithm, Candidate elimination algorithm, Inductive bias - Decision Tree Learning - Decision tree learning algorithm-

Inductive bias- Issues in Decision tree learning; - Artificial Neural Networks – Perceptrons,Gradient descent and the Delta rule, Adaline, Multilayer networks, Derivation of backpropagation rule-Backpropagation Algorithm- Convergence, Generalization; – Evaluating Hypotheses – Estimating Hypotheses Accuracy, Basics of sampling Theory, Comparing Learning Algorithms; - Bayesian Learning – Bayes theorem, Concept learning, Bayes Optimal Classifier, Naïve Bayes classifier, Bayesian belief networks, EM algorithm; - Computational Learning Theory – Sample Complexity for Finite Hypothesis spaces, Sample Complexity for Infinite Hypothesis spaces, The Mistake Bound Model of Learning; - Instance-Based Learning – *k*-Nearest Neighbor Learning, Locally Weighted Regression, Radial basis function networks, Case-based learning - Genetic Algorithms – an illustrative example, Hypothesis space search, Genetic Programming, Models of Evolution and Learning; Learning first order rules-sequential covering algorithms-General to specific beam search-Foil; Reinforcement Learning - The Learning Task, *Q* Learning.

Reading:

1. Tom.M.Mitchell, *Machine Learning*, McGraw Hill International Edition
2. Ethern Alpaydin, *Introduction to Machine Learning.* Eastern Economy Edition, Prentice Hall of India, 2005.

S491	**SEMINAR**	**PCC**	**0 – 0 – 3**	**1 Credits**

Pre-requisites: None.

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

CO1	Analyze the selected topic, organize the content and communicate to audience in an effective manner
CO2	Practice the learning by self study

Mapping of course outcomes with program outcomes

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	2	2	2	2	2	2	3	3	2
CO2	2	2	2	2	2	2	3	3	2

CS499	PROJECT WORK	PRC	0 – 0 – 6	4 Credits

Pre-requisites: None.

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

CO1	Synthesizing and applying prior knowledge to designing and implementing solutions to open-ended computational problems while considering multiple realistic constraints.
CO2	Design and Develop the software with SE practices and standards
CO3	Analyze Database, Network and Application Design methods
CO4	Evaluate the various validation and verification methods
CO5	Practice CASE tools for solving case studies
CO6	Analyzing professional issues, including ethical, legal and security issues, related to computing projects.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	3	3	3	3	3	2	3
CO2	3	2	2	3	2	3	3	2	3
CO3	3	2	3	3	2	2	3	2	3
CO4	3	2	3	3	3	3	3		3
CO5	2	2	3	3	3	3	3	3	3
CO6	3						3	1	3

DEPARTMENT ELECTIVE COURSES

CS361	DESIGN AND ANALYSIS OF ALGORITHMS	DEC	3 – 0 – 0	3 Credits

Pre-requisites: None

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

CO1	Analyze time and space complexity
CO2	Identify algorithm design methodology to solve problems.
CO3	Design algorithms for network flows
CO4	Distinguish between P and NP classes of problems
CO5	Analyze amortized time complexity

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	2	1	1	2		2	1
CO2	3	2	2	1	2	2		2	1
CO3	3	2	2	1	1	2		2	1
CO4	3	2	2	1	2	2		2	1
CO5	3	2	2	1	2	2		2	1

Detailed syllabus:

Introduction to Algorithm Analysis, Asymptotic Notations, Divide and Conquer Method, Binary Search, Merge Sort, Quick Sort, Master Theorem, Expected Running Time of Randomized Quick Sort, Strassen's Matrix Multiplication Algorithm, Large Integer Multiplication, Selection Problem, Elements of Greedy Method, Activity Selection Problem, Knapsack Problem, Prim's and Krukal's Algorithms for finding Minimum Spanning Tree, Dijkstra's Algorithm, Elements of Dynamic Programming, Matrix Chain Multiplication, Solution to 0-1 Knapsack Problem and TSP using Dynamic Programming, Floyd-Warshall Algorithm, Backtracking Algorithms for Enumerating Independent Sets of a Graph, Graph Coloring Problem and N-Queen's Problem, Complexity Classes, Example NP-complete problems, Approximation Algorithm for Vertex Cover Problem, Randomized Min-Cut Algorithm, Introduction to Network Flows, Max-Flow Min-Cut Theorem, Boyer-Moore String Matching Algorithm, Knuth-Morris-Pratt Algorithm for Pattern Matching and Amortized Analysis.

Reading:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, *Introduction to Algorithms*, Second Edition, PHI, 2009.
2. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, *Fundamentals of Computer Algorithms*, Second Edition, Universities Press, 2011.
3. Michael T.Goodrich and Roberto Tamassia, *Algorithm Design: Foundations, Analysis and Internet Examples*, Second Edition, Wiley-India, 2006.

CS362	COMPUTATIONAL NEUROSCIENCE	DEC	3 – 0 – 0	3 Credits

Pre-requisites: None

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

CO1	Simulate simple models of neurons, and their populations using computing languages.
CO2	Understand the working of neural networks to store and process information
CO3	Construct computational models for hypothesis testing
CO4	Perform literature surveys and evaluate evidence for the impact of neuroscience on specific computational and cognitive neuroscience theories.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3		2	1				
CO2	2	2		2	2				
CO3	2	2		2	2	1			
CO4	3	3	2	2	2	1	1	1	1

Detailed syllabus:

Analyzing And Modeling Neural Responses: Introduction-Properties of Neurons, Recording Neuronal Responses, From Stimulus to Response Spike Trains and Firing Rates-Measuring Firing Rates, Tuning Curves, Spike-Count Variability What Makes a Neuron Fire?-Describing the Stimulus, The Spike-Triggered Average, White-Noise Stimuli, Multiple-Spike-Triggered Averages and Spike-Triggered correlations, Spike Train Statistics-The Homogeneous Poisson Process, The Spike-Train Autocorrelation Function, The Inhomogeneous Poisson Process, The Poisson Spike Generator, Comparison with Data, The Neural Code-Independent-Spike, Independent Neuron and Correlation Codes, Temporal Codes

Information Theory : Entropy and Mutual Information, Entropy, Mutual Information, Entropy and Mutual Information for Continuous Variables Information and Entropy Maximization-Entropy Maximization for a Single Neuron, Populations of Neurons, The Whitening Filter, Filtering Input Noise, Temporal Processing in the LGN, Cortical Coding Entropy and Information for Spike Trains

Modeling Neurons And Networks : Levels of Neuron Modeling-Levels of Neuron Modeling, Single-Compartment Models-Integrate-and-Fire Models, Spike-Rate Adaptation and Refractoriness, Hodgkin-Huxley model, Firing-rate Models- Feed forward Networks-Neural Coordinate Transformations, Recurrent Networks, Network Stability, Associative Memory, Excitatory-Inhibitory Networks-Homogeneous Excitatory and Inhibitory Populations, Phase-Plane Methods and Stability Analysis, The Olfactory Bulb, Oscillatory Amplification, Stochastic Networks

Plasticity And Learning : Synaptic Plasticity Rules-The Basic Hebb Rule, The Covariance Rule, The BCM Rule, Synaptic Normalization, Subtractive Normalization, Multiplicative

Normalization and the Oja Rule, Timing-Based Rules, Unsupervised Learning, Supervised Learning-Supervised Hebbian Learning, Classification and the Perceptron, Function Approximation-Supervised Error-Correcting Rules, The Perceptron Learning Rule, The Delta Rule-Contrastive Hebbian Learning

Reading:

1. Peter Dayan and L F Abbott, *Theoretical Neuroscience*, MIT Press, 2001.
2. Christopher Koeli, *Electrophysics of Neuron*, 1st Edition, MIT Press, 2004.

CS363	WEB TECHNOLOGIES	DEC	3 – 0 – 0	3 Credits

Pre-requisites: None

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

CO1	Understand, analyze and build dynamic and interactive web sites
CO2	Install and manage server software and server side tools.
CO3	Understand current and evolving Web languages for integrating media and user interaction in both front end and back end elements of a Web site
CO4	Analysis and reporting of web data using web analytics
CO5	Applying different testing and debugging techniques and analyzing the web site effectiveness.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	3	3	3	1	2	1	2	1
CO2		2	2	2	1	1	2		
CO3	2	2	2	1	1	1		1	1
CO4		1	1	2	3	1	1	1	1
CO5	2	2	2	2	1	1			1

Detailed syllabus:

Creating home pages, Introduction to XHTML- Editing XHTML, First XHTML Example, W3C XHTML Validation Service, Headers, Linking, Images, Special Characters and More Line Breaks, Unordered Lists, Nested and Ordered Lists, Internet and World Wide Web Resources.

Dynamic HTML: Object Model and Collections- Introduction, Object Referencing, Collections all and children, Dynamic Styles, Dynamic Positioning, Using the frames Collection, navigator Object, Summary of the DHTML Object Model, Dynamic HTML: Event Model- Introduction- Event onclick, Event onload, Error Handling with onerror, Tracking the Mouse with Event onmousemove, Rollovers with onmouseover and onmouseout, Form Processing with onfocus and onblur, More Form Processing with onsubmit and onreset, Event Bubbling, More DHTML Events. Dynamic HTML Filters and transitions, Dynamic HTML Data binding with tabular data control, Structured graphics and active X control.

JavaScript: Functions- Introduction, Program Modules in JavaScript, Programmer-Defined Functions, Function Definitions, Random-Number Generation, Example: Game of Chance, Duration of Identifiers, Scope Rules, JavaScript Global Functions, Recursion, Example Using Recursion: Fibonacci Series, Recursion vs. Iteration, JavaScript Internet and World Wide Web Resources. JavaScript arrays, JavaScript objects.

Extensible Markup Language (XML)- Introduction, Structuring Data, XML Namespaces, Document Type Definitions (DTDs) and Schemas, Document Type Definitions, W3C XML Schema Documents, XML Vocabularies, Chemical Markup Language (CML), Other Markup

Languages, Document Object Model (DOM), DOM Methods, Simple API for XML (SAX), Extensible Style sheet Language (XSL), Simple Object Access Protocol (SOAP), Internet and World Wide Web Resources,

Web Servers (IIS, PWS and Apache)- Introduction, HTTP Request Types, System Architecture, Client-Side Scripting versus Server-Side Scripting, Accessing Web Servers, Microsoft Internet Information Services (IIS), Microsoft Personal Web.

Multimedia, PHP, String Processing and Regular Expressions, Form processing and Business logic, Dynamic content, Database connectivity, Applets and Servlets, JDBC connectivity, JSP and Web development Frameworks.

Reading:

1. Deitel, Deitel and Nieto, *Internet and Worldwide Web - How to Program*, 5th Edition, PHI, 2011.
2. Bai and Ekedhi, *The Web Warrior Guide to Web Programming*, 3rd Edition, Thomson, 2008.

CS371	SOFTWARE METRICS AND SOFTWARE PROJECT MANAGEMENT	DEC	3 – 0 – 0	3 Credits

Pre-requisites: None

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

CO1	Determine the software measurement attributes and metrics
CO2	Plan and evaluate software projects
CO3	Analyze factors involved in implementation of software projects.
CO4	Understand project monitoring and control techniques

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	2	2	3	2	2	1	1
CO2	1	2	2	2	2	1	1	1	1
CO3	2	2	2	2	3	2	1	2	1
CO4	1	2	2	3	2	2	1	1	1

Detailed syllabus:

The Basics of Measurement: Measurement in software engineering, The scope of software metrics, the representational theory of measurement, Measurement and models, Measurement scales and scale types, Meaningfulness' in measurement

Goal-based framework for software measurement: Classifying software measures, determining what to measure, applying the framework, Software measurement validation

Empirical investigation: Principles of investigation, planning formal experiments, planning case studies

Measuring internal product attributes: Aspects of software size, Length, reuse

Measuring internal product attributes; Types of structure measures, Control-flow structure, Modularity and information flow attributes, Object-oriented metrics

Measuring external product attributes: Modeling software quality, measuring aspects of quality

Making process predictions: Good estimates, Cost estimation - problems and approaches, Models of effort and cost, Problems with existing modeling methods, Dealing with problems of current estimation methods, Implications for process prediction

Software Project Management: General management, introduction to software project management, Conventional software management, project initiation, feasibility study, project planning, project evaluation, resource allocation, project monitoring, project control, case studies

Reading:

1. Norman E. Fenton, Shari Lawrence Pfleeger, *Software Metrics - A Rigorous and Practical Approach*, 2nd Edition, PWS Pub, 1996.
2. Walker Royce, *Software Project Management*, Addison Wesley, 1998.
3. Pankaj Jalote, *Software Project Management in Practice*, Pearson Education Inc. Delhi, 2002..

CS372	PROGRAMMING LANGUAGE CONCEPTS	DEC	3 – 0 – 0	3 Credits

Pre-requisites: None.

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

CO1	Understanding the concepts of evolution of programming languages.
CO2	Understanding the concepts of object oriented languages, functional and logical programming languages
CO3	Analyzing the methods and tools to define syntax and semantics of a languages
CO4	Analyzing the design issues involved in various constructs of programming languages
CO5	Apply the concepts and identify the issues involved in other advanced features of programming languages

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	2	2	2	1	2	1		
CO2	3	3	3	3	2	1		1	1
CO3	2	2	2	2	3	1		1	
CO4	3	3	3	3	2	1	1		1
CO5	1	2	2	1	1	2	1	1	1

Detailed syllabus:

Introduction- The Origins of Programming Languages- Abstractions in Programming Languages - Computational Paradigms -Language Definition - Language Translation

Language Design Criteria – Efficiency, regularity, security and extensibility - C++: An Object-Oriented Extension of C-Python: A General-Purpose Scripting Language –

Functional Programming - Programs as Functions - Scheme: A Dialect of Lisp - ML: Functional Programming with static typing -Delayed Evaluation- Haskell- Overloading .

Logic Programming-Logic and Logic Programs - Horn Clauses -Resolution and Unification-The Language Prolog - Problems with Logic Programming

Object-Oriented Programming- Software Reuse and Independence Smalltalk Java C++ - Design Issues in Object-Oriented Languages - Implementation Issues in Object-Oriented

Languages

Syntax-Lexical Structure of Programming Languages -Context-Free Grammars and BNFs - Parse Trees and Abstract Syntax Trees - EBNFs and Syntax Diagrams - Parsing Techniques and Tools-Lexics vs. Syntax vs. Semantics

Basic Semantics -Attributes, Binding, and Semantic Functions - Declarations, Blocks, and Scope - The Symbol Table - Name Resolution and Overloading - Allocation, Lifetimes, and the Environment Variables and Constants Aliases, Dangling References, and Garbage

Data Types-Data Types and Type Information - Simple Types - Type Constructors - Type Nomenclature in Sample Languages -Type Equivalence- Type Checking -Type Conversion-Polymorphic Type Checking- Explicit Polymorphism

Control Expressions and Statements –Expressions - Conditional Statements and Guards-Exception Handling- Procedure Definition and Activation-Procedure Semantics- Parameter-Passing Mechanisms- Procedure Environments, Activations, and Allocation-Dynamic Memory Management- Exception Handling and Environments

Abstract Data Types and Modules - The Algebraic Specification of Abstract Data Types-Abstract Data Type Mechanisms and Modules -Separate Compilation in C, C++ Namespaces, and Java Packages- Ada Packages -Modules in ML- Problems with Abstract Data Type Mechanisms

Formal Semantics- A Sample Small Language- Operational Semantics -Denotational Semantics- Axiomatic Semantics- Proofs of Program Correctness-

Parallel Programming- Introduction to Parallel Processing- Parallel Processing and Programming Languages- Threads – Semaphores- Monitors –Message Passing.

Reading:

1. Kenneth C. Louden, *Programming Language Principles and Practices*, 2nd Edition, Thomson 2003.
2. Carlo Ghezzi, Mehdi Jazayeri, *Programming Language Concepts*, 3rd Edition, John Wiley & Sons, 1997.

CS373	UNIX TOOLS AND PROGRAMMING	DEC	3 – 0 – 0	3 Credits

Pre-requisites: None

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

CO1	Develop text data processing applications using Unix commands and filters
CO2	Design and develop text based user interface components
CO3	Understand user management, network management and backup utilities
CO4	Apply SCCS/RCS utilities for Software version management
CO5	Design and implement lexical analyzer, syntax analyzer using Lex/Yacc tools

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	2	2		2	2			
CO2	2	2	3	2		2			
CO3		2	2	3			1		
CO4		2				2		3	2
CO5	3	3	3	3		3	1	2	2

Detailed syllabus:

Unix Introduction : Architecture, Features, Internal and External commands, Manual pages, startup, shutdown, login, logout

Unix Commands : at, banner, batch, bc, cal, cat, cd, cmp, comm, chmod, chown, chgrp, cp, cron, cut, date, dd, diff, echo, finger, find, ftp, head, kill, lock, ln, ls, lp, lpstat, man, mesg, mkdir, more, mv, nl, nice, passwd, pr, paste, ping, ps, pwd, rcp, rlogin, rmdir, rm, rsh, split, sort, tail, talk, tar, telnet, touch, tput, tr, tty, uname, uniq, wc, who, write

Shell Programming : Different types of shells, shell environment, Pattern matching - wild cards, Escaping, quoting, File I/O, Redirection, Pipes, Command substitution, shell variables, Aliases, Command history, interactive shell scripting, if, case, for, while constructs, terminal capabilities, Text based user interface development

Filters : Regular expressions, grep, pr, head, tail, cut, paste, sort, uniq, tr, introduction to sed and awk

Backup: Backup using tar and cpio

Program development tools : make, ar, SCCS, RCS, CVS, gdb, gnu compilers, rpm, memory leakage, autoconf, automake, indent.

Lex and Yacc : (flex, bison), Recognizing words with lex, Regular expressions, Parsing command line, Start states, Example lex programs, Grammars, Shift/Reduce parsing, Definitions, rules and Actions sections, Ambiguity, precedence rules, variables, typed tokens, Symbol tables, Functions and reserved words

Reading:

1. Sumitabha Das, *Unix Concepts and Applications*, TMH, 4/e, 2008
2. John R Levine, Tony Mason, Doug Brown, *Lex and Yacc*, Orielly, 2nd Edition, 2009

CS374	PARALLEL PROCESSING	DEC	3 – 0 – 0	3 Credits

Pre-requisites: None

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

CO1	Design and analyze the parallel algorithms for real world problems and implement them on available parallel computer systems.
CO2	Optimize the performance of a parallel program to suit a particular hardware and software environment.
CO3	Design algorithms suited for Multicore processor systems using OpenCL, OpenMP, Threading techniques.
CO4	Analyze the communication overhead of interconnection networks and modify the algorithms to meet the requirements.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	2	2		2			2
CO2	2	2	2	2		3			2
CO3	3	3		2		3			
CO4	3	2				3			

Detailed syllabus:

Introduction: Implicit parallelism, Limitations of memory system performance, control structure, communication model, physical organization, communication costs of parallel platforms, Routing mechanisms for interconnection networks, Mapping techniques.

Parallel algorithm design: Preliminaries, decomposition techniques, tasks and interactions, mapping techniques for load balancing, methods for reducing interaction overheads, parallel algorithm models.

Basic communication operations: Meaning of all-to-all, all-reduce, scatter, gather, circular shift and splitting routing messages in parts. Analytical modeling of parallel programs: sources of overhead, performance metrics, the effect of granularity on performance, scalability of parallel systems, minimum execution time, minimum cost-optimal execution time, asymptotic analysis of parallel programs.

Programming using message passing paradigm: Principles, building blocks, MPI, Topologies and embedding, Overlapping communication and computation, collective communication operations, Groups and communicators

Programming shared address space platforms: Threads, POSIX threads, Synchronization primitives, attributes of threads, mutex and condition variables, Composite synchronization constructs, OpenMP Threading Building blocks; An Overview of Memory Allocators, An overview of Intel Threading building blocks.

Dense Matrix Algorithms: matrix vector multiplication, matrix-matrix multiplication, solving system of linear equations, Sorting: Sorting networks, Bubble sort, Quick sort, Bucket sort and other sorting algorithms Graph algorithms: Minimum spanning tree, single source shortest paths, all-pairs shortest paths, Transitive closure, connected components, algorithms for sparse graphs.

Reading:

1. Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar : Introduction to Parallel Computing, Second Edition Pearson Education – 2007
2. *Michael J. Quinn (2004),* Parallel Programming in C with MPI and OpenMP McGraw-Hill International Editions, Computer Science Series,

CS381	ADVANCED DATA STRUCTURES	DEC	3 – 0 – 0	3 Credits

Pre-requisites: None

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

CO1	Understand implementation of symbol table using hashing techniques
CO2	Develop and analyze algorithms for red-black trees, B-trees and Splay trees
CO3	Develop algorithms for text processing applications
CO4	Identity suitable data structures and develop algorithms for computational geometry problems

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	2	2	2	1	2	1		1
CO2	3	2	2	1	2	1		1	
CO3	3	3	3	3	2	1			
CO4	2	2	2	2	2	1	1	1	1

Detailed syllabus:

Dictionaries: Definition, Dictionary Abstract Data Type, Implementation of Dictionaries.

Hashing: Review of Hashing, Hash Function, Collision Resolution Techniques in Hashing, Separate Chaining, Open Addressing, Linear Probing, Quadratic Probing, Double Hashing, Rehashing, Extendible Hashing.

Skip Lists: Need for Randomizing Data Structures and Algorithms, Search and Update Operations on Skip Lists, Probabilistic Analysis of Skip Lists, Deterministic Skip Lists

Trees: Binary Search Trees (BST), AVL Trees

Red Black Trees: Height of a Red Black Tree, Red Black Trees Bottom-Up Insertion, Top-Down Red Black Trees, Top-Down Deletion in Red Black Trees, Analysis of Operations.

2-3 Trees: Advantage of 2-3 trees over Binary Search Trees, Search and Update Operations on 2-3 Trees, Analysis of Operations.

B-Trees: Advantage of B- trees over BSTs, Height of B-Tree, Search and Update Operations on 2-3 Trees, Analysis of Operations.

Splay Trees: Splaying, Search and Update Operations on Splay Trees, Amortized Analysis of Splaying.

Text Processing: Sting Operations, Brute-Force Pattern Matching, The Boyer-Moore Algorithm, The Knuth-Morris-Pratt Algorithm, Standard Tries, Compressed Tries, Suffix Tries, The Huffman Coding Algorithm, The Longest Common Subsequence Problem (LCS), Applying Dynamic Programming to the LCS Problem.

Computational Geometry: One Dimensional Range Searching, Two Dimensional Range Searching, Constructing a Priority Search Tree, Searching a Priority Search Tree, Priority Range Trees,Quadtrees, k-D Trees.

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Reading:

1. Mark Allen Weiss, Data *Structures and Algorithm Analysis in C++*, 2nd Edition, Pearson, 2004.
2. M T Goodrich, *Roberto Tamassia, Algorithm Design*, John Wiley, 2002.

CS382	ADVANCED DATABASES	DEC	3 – 0 – 0	3 Credits

Pre-requisites: None

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

CO1	Understand issues related to Distributed database Design.
CO2	Apply Partitioning techniques to databases.
CO3	Design and develop query processing strategies.
CO4	Understand transaction processing and concurrency control in distributed databases.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	2	2		3	2	1	1	2
CO2	2		3	2	3	2	1	1	
CO3	2	2	3	2	3	2	1	1	
CO4	2	2	1	1	3		1	2	

Detailed syllabus:

Features of Distributed versus Centralized Databases, Principles Of Distributed Databases, Levels Of Distribution Transparency, Reference Architecture for Distributed Databases, Types of Data Fragmentation, Integrity Constraints in Distributed Databases.

Translation of Global Queries to Fragment Queries, Equivalence Transformations for Queries, Transforming Global Queries into Fragment Queries, Distributed Grouping and Aggregate Functions, Evaluation of Parametric Queries.

Optimization of Access Strategies, A Framework for Query Optimization, Join Queries, General Queries.

The Management of Distributed Transactions, A Framework for Transaction Management , Supporting Atomicity of Distributed Transactions, Concurrency Control for Distributed Transactions, Architectural Aspects of Distributed Transactions.

Concurrency Control, Foundation of Distributed Concurrency Control, Distributed Deadlocks, Concurrency Control based on Timestamps, Optimistic Methods for Distributed Concurrency Control.

Reliability, Basic Concepts, Non-blocking Commitment Protocols, Reliability and concurrency Control, Determining a Consistent View of the Network, Detection and Resolution of Inconsistency, Checkpoints and Cold Restart, Distributed Database Administration, Catalogue Management in Distributed Databases, Authorization and Protection

Architectural Issues, Alternative Client/Server Architectures, Cache Consistency Object Management, Object Identifier Management, Pointer Swizzling, Object Migration, Distributed Object Storage, Object Query Processing, Object Query Processor Architectures, Query

Processing Issues, Query Execution , Transaction Management, Transaction Management in Object DBMSs , Transactions as Objects.

Database Integration, Scheme Translation, Scheme Integration, Query Processing Query Processing Layers in Distributed Multi-DBMSs, Query Optimization Issues. Transaction Management Transaction and Computation Model Multi-database Concurrency Control, Multi-database Recovery, Object Orientation And Interoperability Object Management Architecture CORBA and Database Interoperability Distributed Component Model COM/OLE and Database Interoperability, PUSH-Based Technologies.

Current trends in No SQL and New SQL data management issues on the cloud, Stream data management

Reading:

1. M. Stonebraker, *Readings in Database Systems*, 2nd Edition, Morgan Kauffman, 1993.
2. M T Ozsu, Patrick Valduriez, *Principles of Distributed Database Systems*, Prentice Hall, 1999
3. S. Ceri and G. Pelaggati, *Distributed Database System Principles and Systems*, MGH, 1985.

CS383	ADVANCED DATA MINING	DEC	3 – 0 – 0	3 Credits

Pre-requisites: None

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

CO1	Analyze Algorithms for sequential patterns
CO2	Determine patterns from time series data
CO3	Develop algorithms for Temporal Patterns
CO4	Distinguish computing frameworks for Big Data analytics.
CO5	Apply Graph mining algorithms to Web Mining.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	1	2		3	2	1	2	2
CO2	3	2	3		3	2	1	2	2
CO3	3	2	3		3	1	1	1	2
CO4	2	2	3	2	3	1	1	2	1
CO5	3	3	3	2	3	1	1	1	2

Detailed syllabus:

Sequential Pattern Mining concepts, primitives, scalable methods; Transactional Patterns and other temporal based frequent patterns, Mining Time series Data, Periodicity Analysis for time related sequence data, Trend analysis, Similarity search in Time-series analysis; Mining Data Streams, Methodologies for stream data processing and stream data systems, Frequent pattern mining in stream data, Sequential Pattern Mining in Data Streams, Classification of dynamic data streams, Class Imbalance Problem; Graph Mining, Mining frequent subgraphs, finding clusters, hub and outliers in large graphs, Graph Partitioning; Web Mining, Mining the web page layout structure, mining web link structure, mining multimedia data on the web, Automatic classification of web documents and web usage mining; Distributed Data Mining, Distribute data mining framework, Distributed data source, Distributed data mining techniques, Distributed classifier learning, distributed clustering, distributed association rule mining and Challenges of distributed data mining; Social Network Analysis, characteristics of social Networks.

Reading:

1. J Han and M Kamber, *Data Mining Concepts and Techniques*, 2nd Edition, Elsevier, 2011
2. Pang Ning Tan, M Steinbach, Vipin Kumar, *Introduction to Data Mining*, Addision Wesley, 2006
3. G Dong and J Pei, *Sequence Data Mining*, Springer, 2007.

CS411	BUSINESS INTELLIGENCE	DEC	3 – 0 – 0	3 Credits

Pre-requisites: None

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

CO1	Demonstrate the need for data warehouse for large organizations.
CO2	Determine the data sources to populate data warehouse.
CO3	Design data warehouse models using appropriate schemas.
CO4	Develop data warehouse for a domain using Data warehouse tools.
CO5	Operate data warehouse to meet business objectives.
CO6	Apply data analysis techniques for building Decision support system.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	1	1	2	3	2		1	
CO2	2	2	2	3	3	2		2	1
CO3	1	2	2	3	2	2		1	
CO4		1		1	2	1		3	1
CO5	1	1	1	1	1		1		
CO6	1	2	1		3	2			2

Detailed syllabus:

Business Intelligence Introduction – Definition, Leveraging Data and Knowledge for BI, BI Components, BI Dimensions, Information Hierarchy, Business Intelligence and Business Analytics. BI Life Cycle. Data for BI - Data Issues and Data Quality for BI.

BI Implementation - Key Drivers, Key Performance Indicators and operational metrics, BI Architecture/Framework, Best Practices, Business Decision Making.

Business Analytics – Objective Curve, Web Analytics and Web Intelligence, Customer Relationship Management.

Business/Corporate Performance Management - Dash Boards and Scorecards, Business Activity Monitoring, Six Sigma.

Advanced BI – Big Data and BI, Social Networks, Mobile BI, emerging trends.

Working with BI Tools – Pentaho etc.

Overview of managerial, strategic and technical issues associated with Business Intelligence and Data Warehouse design, implementation, and utilization. Critical issues in planning, physical design process, deployment and ongoing maintenance.

Data Warehousing (DW): Introduction & Overview; Data Marts, DW architecture – DW components, Implementation options; Meta Data, Information delivery.

ETL - Data Extraction, Data Transformation – Conditioning, Scrubbing, Merging, etc., Data Loading, Data Staging, Data Quality.

Dimensional Modeling - Facts, dimensions, measures, examples; Schema Design – Star and Snowflake, Fact constellation, Slow changing Dimensions.

OLAP - OLAP Vs OLTP, Multi-Dimensional Databases (MDD); OLAP – ROLAP, MOLAP, HOLAP;

Data Warehouse Project Management - Critical issues in planning, physical design process, deployment and ongoing maintenance.

Reading:

1. Efraim Turban, Ramesh Sharda, Jay Aronson, David King, *Decision Support and Business Intelligence Systems*, 9th Edition, Pearson Education, 2009.
2. David Loshin, *Business Intelligence - The Savy Manager's Guide Getting Onboard with Emerging IT*, Morgan Kaufmann Publishers, 2009.

CS412	GAME THEORY	DEC	3 – 0 – 0	3 Credits

Pre-requisites: None

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

CO1	Analyze games based on complete and incomplete information about the players
CO2	Analyze games where players cooperate
CO3	Compute Nash equilibrium
CO4	Apply game theory to model network traffic
CO5	Analyze auctions using game theory

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	2	1	1				
CO2	2	2	2	2	1			1	
CO3	2	1	3	2	2	1			1
CO4	2	2	2	1	2	1			1
CO5	2	3	3	2	1			1	1

Detailed syllabus:

Non-cooperative Game Theory: Games in Normal Form - Preferences and utility, examples of normal-form, Analyzing games: Pareto optimality, Nash equilibrium, Maxmin and minmax strategies, dominated strategies, Rationalizability, Correlated equilibrium

Computing Solution Concepts of Normal-Form Games: Computing Nash equilibria of two-player, zero-sum games, Computing Nash equilibria of two-player, general-sum games, Complexity of computing Nash equilibrium, Lemke–Howson algorithm, Searching the space of supports, Computing Nash equilibria of n-player, general-sum games, Computing maxmin and minmax strategies for two-player, general-sum games, Computing correlated equilibria

Games with the Extensive Form: Perfect-information extensive-form games, Subgame-perfect equilibrium, Computing equilibria, Imperfect-information extensive-form games, Sequential equilibrium

Other Representations: Repeated games: Finitely repeated games, Infinitely repeated games, automata, Stochastic games Bayesian games: Computing equilibria

Coalitional Game Theory: Transferable Utility, Analyzing Coalitional Games, The Shapley Value, The Core

Mechanism Design: Strategic voting, unrestricted preferences, Implementation, quasi linear setting, Efficient mechanisms, Computational applications of mechanism design, Task scheduling, Bandwidth allocation in computer networks

Auctions: Single-good auctions, Canonical auction families, Bayesian mechanisms, Multiunit auctions, Combinatorial auctions.

Reading:

1. Nisan, N., T. Roughgarden, ´ E. Tardos, and V. Vazirani (Eds.). *Algorithmic Game Theory*. Cambridge University Press, 2007.
2. Shoham, Y. and Leyton–Brown, K. *Multiagent Systems: Algorithmic, Game Theoretic, and Logical Foundations*. Cambridge University Press, 2008.
3. Osborne, M. J., and Rubinstein, A. *A Course in Game Theory. Cambridge*, MA: MIT Press, 1994.

CS413	PATTERN RECOGNITION	DEC	3 – 0 – 0	3 Credits

Pre-requisites: None

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

CO1	Determine classifiers for pattern recognition
CO2	Analyze feature selection and dimensionality reduction techniques
CO3	Apply MC and HMM models
CO4	Classify the data objects and develop template matching module to recognize the patterns.
CO5	Apply unsupervised learning algorithms to data objects.
CO6	Analyze clustering algorithms.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	2	1	1	3	1			
CO2	1	2	1	1	3	2		1	
CO3	2	2			3	1		1	
CO4	2	1		1	3	1			
CO5	2	2	1	1	3	1		1	
CO6	2	1	2	1	3	2		1	

Detailed syllabus:

Classifiers Based on Bayes Decision Theory: Introduction , Bayes Decision Theory, Discriminant Functions and Decision Surfaces , Bayesian Classification for Normal Distributions , Estimation of Unknown Probability Density Functions: Maximum Likelihood Parameter Estimation , Maximum a Posteriori Probability Estimation, Bayesian Inference , Maximum Entropy Estimation , Mixture Models , Nonparametric Estimation ,The Naive-Bayes Classifier , The Nearest Neighbor Rule, Bayesian Networks

Linear Classifiers: Linear Discriminant Functions and Decision Hyperplanes, The Perceptron Algorithm , Least Squares Methods, Mean Square Estimation Revisited: , Logistic Discrimination, Support Vector Machines

Non Linear Classifiers: The XOR Problem , The Two-Layer Perceptron , Three Layer Perceptrons, Algorithms Based on Exact Classification of the Training Set , The Backpropagation Algorithm , Variations on the Backpropagation Theme, The Cost Function Choice, Choice of the Network Size, A Simulation Example , Networks with Weight Sharing, Generalized Linear Classifiers, Capacity of the *l*-Dimensional Space in Linear Dichotomies, Polynomial Classifiers, Radial Basis Function Networks, Universal Approximators, Support Vector Machines: The nonlinear Case, Decision Trees, Combining Classifiers , The Boosting Aprroach to Combine Classifiers

Feature Selection: Preprocessing, Feature Selection Based on Statistical Hypothesis Testing, The Receiver Operating Characterisitcs (ROC) Curve , Class Separability Measures , Feature Subset selection , Optimal Feature Generation , Neural Networks and Feature Generation / Selection, The Bayesian Information Criterion

Feature Generation: Linear Transforms, Regional Features, Features for Shape and Size Characterization, Typical Features for Speech and Audio Classification
Template Matching: Introduction, Similarity Measures Based on Optimal Path Searching Techniques, Measures Based on Correlations, Deformable Template Models

Context Dependent Classification: Markov Chain Models, Hidden Markov Models

Clustering Algorithms: Clustering Algorithms Based on Graph Theory, Competitive Learning Algorithms: Supervised Learning Vector Quantization

Reading:

1. S Theodoridis and K Koutroumbas – Pattern Recognition, 4th Edition, Academic Press, 2009.
2. C Bishop – Pattern Recognition and Machine Learning – Springer , 2006.

CS414	SEMANTIC WEB	DEC	3 – 0 – 0	3 Credits

Pre-requisites: None

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

CO1	Understand the standards and data formats used in the Semantic Web
CO2	Comprehend technologies including XML and XSLT
CO3	Design semantic web meta data and RDF schema
CO4	Develop ontology programming with Jena API

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1		1	3	2	2	1		1	
CO2		2	3	2	1	1		1	
CO3	1	2	3	3	3	2		1	
CO4		2	3	2	1	2		1	

Detailed syllabus:

The Semantic Web Vision, overview of techniques and standards, Semantic Web Architecture, XML with Document Type Definitions and Schemas, Transformation/Inference rules in XSLT, RuleML and RIF, metadata with RDF (Resource Description Framework); metadata taxonomies with RDF Schema; Ontology languages, Ontology Development using Protege editor, Ontology Querying, Ontology Reasoning and Description Logic (DL), Semantic Web Application Areas, Ontology programming with Jena API, Ontology Engineering.

Reading:

1. Grigoris Antoniou and Frank van Harmelen, A Semantic Web Primer, 1st Edition, MIT Press, 2004.
2. John Hebeler, Matthew Fisher, Ryan Blace and Andrew Perez-Lopez, Semantic Web Programming, 1st Edition, Wiley, 2009.

CS421	SECURE SOFTWARE ENGINEERING	DEC	3 – 0 – 0	3 Credits

Pre-requisites: None

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

CO1	Evaluate secure software engineering problems, including the specification, design, implementation, and testing of software systems
CO2	Elicit, analyze and specify security requirements through SRS
CO3	Design and Plan software solutions to security problems using various paradigms
CO4	Model the secure software systems using Unified Modeling Language Sec(UMLSec)
CO5	Develop and apply testing strategies for Secure software applications

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	3	3	2	2	1	1	1
CO2	3	2	2	3	2	2	1	1	1
CO3	3	3	3	2	3	2	2	1	1
CO4	3	3	3	2	3	2	2	2	1
CO5	2	3	3	2	3	3	2	1	1

Detailed syllabus:

Software assurance and software security, threats to software security, sources of software insecurity, benefits of detecting software security, managing secure software development

Defining properties of secure software, how to influence the security properties of software, how to assert and specify desired security properties

Secure software Architecture and Design: Software security practices for architecture and design: Architectural risk analysis, software security knowledge for Architecture and Design: security principles, security guidelines, and attack pattens, secure design through threat modeling

Writing secure software code: Secure coding techniques, Secure Programming: Data validation, Secure Programming: Using Cryptography Securely, Creating a Software Security Programs.

Secure Coding and Testing: code analysis- source code review, coding practices, static analysis, software security testing, security testing consideration through SDLC

Reading:

1. Julia H Allen, Sean J Barnum, Robert J Ellison, Gary McGraw, Nancy R Mead, Software Security
   Engineering: A Guide for Project Managers, Addison Wesley, 2008
2. Ross J Anderson, Security Engineering: A Guide to Building Dependable Distributed Systems, 2nd Edition, Wiley, 2008.
3. Howard, M. and LeBlanc, D., Writing Secure Code, 2nd Edition, Microsoft Press, 2003.

CS422	DISTRIBUTED OBJECT TECHNOLOGIES	DEC	3 – 0 – 0	3 Credits

Pre-requisites: None

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

CO1	Understand the basic concepts of distributed systems and objects.
CO2	Design distributed systems using CORBA-based platforms, Java RMI and Web services.
CO3	Understand the principles of object oriented middleware and common design problems
CO4	Implement distributed multi-tier application using distributed objects
CO5	Evaluate management methods for distributed systems

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1		1	3	2		2		1	
CO2	1	2	3	3		2		1	
CO3	1	2	3	3	1	2		1	
CO4	2	2	3	3	1	2		1	
CO5	1	1	3	3	1	2		1	

Detailed syllabus:

Introduction: Evolution of corporate computing models from centralized to distributed computing, client server models. Benefits of client server computing, pitfalls of client server programming, Benefits of Java Programming with CORBA

CORBA with Java: Review of Java concept like RMI, RMI API, JDBC , applets. CORBA overview Client/Server. Overview of Java ORB

DCOM: DCOM and Java, DCOM Java count .

Introducing C# and the .NET Platform: Understanding .NET Assemblies; Object –Oriented Programming with C#; Callback Interfaces, Delegates, and Events.

Building C# applications: Type Reflection, Late Binding, and Attribute-Based Programming; Object Serialization and the .NET Remoting Layer; Data Access with ADO.NET; XML Web Services.

Core CORBA / Java: Two types of Client/Server invocations-static, dynamic. The static CORBA, first CORBA program, ORBlets with Applets, Dynamic CORBA- portable count, the dynamic count , multi count.

Existential CORBA: CORBA initialization protocol, CORBA activation services, CORBA IDL mapping to Java, CORBA Java- to- IDL mapping, the introspective CORBA/Java object.

Java Bean Component Model: Events, properties, persistency, Introspection of beans, CORBA Beans.

EJBs and CORBA: Object transaction monitors CORBA OTM's, EJB and CORBA OTM's, EJB container frame work, Session and Entity Beans, The EJB client/server development Process The EJB container protocol, support for transaction EJB packaging EJB design Guidelines.

Reading:

1. Robert Orfali and Dan Harkey, *Client/Server Programming with Java and CORBA*, 2nd Edition, John Wiley & Sons, 1998.
2. Robert J. Oberg, *Introduction to C# Using .NET*, Prentice Hall, 2002
3. G. Brose, A Vogel, K Duddy, *Java Programming with CORBA*, 3rd Edition, Wiley, 1998.

CS423	DESIGN PATTERNS	DEC	3 – 0 – 0	3 Credits

Pre-requisites: None

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

CO1	Understand common design patterns in the context of incremental/iterative development
CO2	Evaluate and retractor software source code using patterns
CO3	Analyze and combine design patterns to work together in software design
CO4	Implement the design patterns in an object oriented language.
CO5	Understand the benefits of a pattern approach over program in a software application.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	3	3	2	2	2	1	1
CO2	3	3	3	3	3	2	2	2	1
CO3	2	3	3	3	2	3	2	3	1
CO4	3	3	2	3	3	2	2	2	1
CO5	3	2	3	2	3	2	2	1	1

Detailed syllabus:

Introduction: What Is a Design Pattern, Design Patterns in Smalltalk MVC, Describing Design Patterns, the Catalog of Design Patterns, Organizing the Catalog, How Design Patterns Solve Design Problems, How to Select a Design Pattern, How to Use a Design Pattern.

A Case Study: Designing a Document Editor: Design Problems, Document Structure, Formatting, Embellishing the User Interface, and Supporting Multiple Look-and-Feel Standards, Supporting Multiple Window Systems, User Operations, Spelling Checking and Hyphenation.

Creational Patterns: Abstract Factory, Builder, Factory Method, Prototype, Singleton.

Structural Pattern: Adapter, Bridge, Composite, Decorator, Façade, Flyweight, Proxy.

Behavioral Patterns: Chain of Responsibility, Command, Interpreter, Iterator, Mediator, Memento, Observer, State, Strategy, Template Method, Visitor, a Brief History, and the Pattern Community

Reading:

1. Erich Gamma, *Design Patterns*, Addison-Wesley, 1994.
2. Frank Buschmann, RegineMeunier, Hans Rohnert, Peter Sommerlad, Michael Stal, *Pattern-Oriented Software Architecture: A System of Pattern*, John Wiley & Sons; 1996.

CS424	ADVANCED COMPILER DESIGN	DEC	3 – 0 – 0	3 Credits

Pre-requisites: None

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

CO1	Understand code generation methods
CO2	Apply scalar variable optimizations and procedural optimizations on intermediate code.
CO3	Apply machine level optimizations on the low level intermediate code.
CO4	Perform loop restructuring transformations

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2			2				1	
CO2	2	2		2		3		1	
CO3		2				3		1	
CO4	2	3		2		3		1	

Detailed syllabus:

Introduction : Interpreters - Recursive and iterative interpreters

Code generation: Arithmetic statement translation, acyclic graph representation, pattern matching in the acyclic graph, graph rewriting, linearization following the dependencies, code generation for purely register machine, purely stack machine and with memory addressing. Code generation for a basic block.

Simple optimizations : Constant folding, Scalar replacement of aggregates and Algebraic simplifications, Value numbering, Loop invariants identification, loop invariant code motion, partial redundancy elimination, procedure optimizations - call and return optimizations, Code hoisting, Induction variable identification and optimizations, Unnecessary bounds checking elimination

Register Allocation and Code scheduling : Local methods and global methods, representation of the register allocation problem as graph colouring problem, heuristics, register tracking and spilling, Pipeline and Code scheduling effect on performance of the program, Software pipelining, speculative scheduling, boosting

Inter-procedural data flow analysis - static and dynamic, optimizations, Optimizing for memory hierarchies

High performance systems – Scalar, vector, multiprocessor, SIMD, Message Passing Architectures. Sequential and parallel loops. Data dependence Use-Def chains. Dependence system, GCD test, Banerjee's Inequality, Exact algorithm, Exact algorithm, Vectorization, Concurrentization, Array region analysis, Loop restructuring transformations.

Reading:

1. Steven S. Muchnick, *Advanced Compiler Design & Implementation,* Morgan Kaufmann, Elsevier Science, 2003.
2. Michael Wolfe, *High Performance Compilers for Parallel Computing,* Addison Wesley, 1995.

CS461	MODEL-DRIVEN FRAMEWORKS	DEC	3 – 0 – 0	3 Credits

Pre-requisites: None

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

CO1	Construct domain specific languages
CO2	Construct model transformations
CO3	Synthesize model metrics
CO4	Understand contemporary approaches to model driven engineering
CO5	Apply domain specific modeling approach to authentic cases

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	1	1	1	3		2			
CO2	1	1	1	3		2			
CO3	1	1	1	3		2			
CO4	1	1	1	3		2			
CO5	1	1	1	3		2			

Detailed syllabus:

Traditional software engineering approach: Drawbacks, Software processes, modular-based software design

Model Driven Software Engineering (MDSE) Principles: MDSE basis, Overview of MDSE Technology, Criticism of MDSE, MDSE use cases

Model driven Architecture (MDA): MDA Definitions and Assumptions, The modeling levels-CIM,PIM,PSM ,mapping, general purpose and domain specific language in MDA,architecture Driven modernization

Integration of MDSE in your development process: introducing MDSE in your software development process, traditional development process and MDSE, Domain driven design and MDSE,Test driven Development and MDSE

Modeling Language at a glance: Anatomy of modeling language, general purpose vs. domain specific modeling language, General purpose modeling-the case of UML,UML profile platforms, software artifacts using UML standard modeling language, defining modeling constraints, automated GUI generation

Transformations: Model to model transformations, model to text transformations

MDA Practice, Usage of QVT, Kermeta, etc., MDA Transformation Languages, model editors, model valuators, model metrics, modeling framework, middleware to support transformations, MDA applications

Reading:

1. Thomas Stahl, Markus Voelter, *Model-Driven Software Development: Technology, Engineering, Management*, Wiley, 2006.
2. Anne Kleppe, Jos Warmer, and Wim Bast, *MDA Explained - The Model Driven Architecture: Practice and Promise*, Pearson Education, Boston, USA, 2003.

CS462	SERVICE ORIENTED ARCHITECTURE	DEC	3 – 0 – 0	3 Credits

Pre-requisites: None

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

CO1	Understand software oriented architectures
CO2	Design medium scale software project development using SOA principles
CO3	Develop SOA messages from business use cases
CO4	Design and implementation of modern SOA and SOA-specific methodologies, technologies and standards
CO5	Create composite services by applying composition style

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	1	2	1	1		2	1	1	
CO2	1	3	1	1		2		1	
CO3	1	2	1	1		2	1	1	
CO4	1	3	1	1		2	1	1	
CO5	1	2	1	1		1		1	

Detailed syllabus:

Introduction To SOA, Evolution Of SOA: Fundamental SOA; Common Characteristics of contemporary SOA; Common tangible benefits of SOA; An SOA timeline (from XML to Web services to SOA); The continuing evolution of SOA (Standards organizations and Contributing vendors); The roots of SOA (comparing SOA to Past architectures).

Web Services and Primitive SOA: The Web services framework· Services (as Web services); Service descriptions (with WSDL); Messaging (with SOAP).

Web Services And Contemporary SOA – I Message exchange patterns; Service activity; Coordination; Atomic Transactions; Business activities; Orchestration; Choreography.

Web Services And Contemporary SOA-2: Addressing; Reliable messaging; Correlation; Polices; Metadata exchange; Security; Notification and eventing.

Principles Of Service - Orientation: Services orientation and the enterprise; Anatomy of a service oriented architecture; Common Principles of Service orientation; How service orientation principles interrelate; Service orientation and object orientation; Native Web service support for service orientation principles.

Service Layers: Service orientation and contemporary SOA; Service layer abstraction; Application service layer, Business service layer, Orchestration service layer; Agnostic services; Service layer configuration scenarios.

Business Process Design: WS-BPEL language basics; WS Coordination overview; Service oriented business process design; WS addressing language basics; WS Reliable Messaging language basics.

SOA Platforms: SOA platform basics; SOA support in J2EE; SOA support in. ET; Integration considerations.

Reading:

1. Thomas Erl, *Service-Oriented Architecture: Concepts, Technology and Design*, Prentice Hall Publication, 2005.
2. Michael Rosen, Boris Lublinsky, *Applied SOA Service Oriented Architecture and Design Strategies*, Wiely India Edition, 2008.

CS463	HETEROGENEOUS COMPUTING	DEC	3 – 0 – 0	3 Credits

Pre-requisites: None

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

CO1	Analyze for the performance of GPU memory hierarchy
CO2	Develop parallel programs using OpenCL library
CO3	Generate parallel programs for matrix, graph and sorting problems using Cuda library
CO4	Develop mixed mode programs for Multicore and GPGPU systems

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1		2		2		2			2
CO2	3	2	2	2		3			2
CO3	3	3		3		3			2
CO4	3	3		3		3			2

Detailed syllabus:

GPU Computing - Introduction : Introduction to General Purpose Computing on Graphic Processing Units (GPGPU); GPU as parallel computers – CUDA enabled NVIDIA GPUs; AMD-ATI-OpenCL, GPGPU Architecture of a Modern GPU – Threaded Streaming Multi-processors; communication bandwidth;, Unified Graphics and Computing Processors; GPGPU- GPU computing – Scalable GPUs; Speed-up & Parallelism; CPU/GPU programing; SPMD programming model

CUDA APIs & CUDA Threads - GPUs-Data Parallelism; GPU-CUDA Program Structure; GPU device memories & Data transfer; Kernel functions and threading; CUDA Runtime API; CUDA Thread Execution; CUDA Thread organization; Synchronization; Thread Scheduling;

CUDA Memory and Performance Considerations : GPUs-Memory Access Efficiency; CUDA Device Memory types; CUDA memory model – constant memory; shared memory; local memory; global memory – Performance Issues; Unified Address space- NVIDIA GPUS; Global Memory Bandwidth; Thread Granularity; Memory Coalescing; Using Multiple GPUs; CUDA – matrix into matrix multiplication using shared memory without shared memory

Performance Issues - Matrix Computations : Performance Considerations; Date Prefetching; Shared memory resources; Programming on Dense Matrix computations (Vector-Vector Multiplication; Matrix-Vector Multiplication; Matrix-Matrix Multiplication

OpenCL (Open Computing Language) : Heterogeneous Computing – Programming; Data Parallelism Model – OpenCL; OpenCL, Device Architecture; OpenCL Kernel Functions; OpenCL APIs – Matrix-Matrix, Computations using different partitioning techniques– OpenCL; OpenCL – Device Management and Kernel launch; Compilation Model and programming features of OpenCL – Device query; Object Query, and task parallelism model

Mixed Programming - Multi-Core Processors & GPUs : Heterogeneous computing – mixed programming (Message Passing-MPI and Shared Memory Programming (Pthreads, OpenMP); Heterogeneous computing - mixed programming – CPU (Pthreads, OpenMP) & GPU (CUDA, OpenCL); MPI-OpenCL & MPI-CUDA ; Programming for Dense Matrix Computations

Reading:

1. Benedict R Gaster, Lee Howes, David R Kaeli Perhaad Mistry Dana Schaa, *Heterogeneous Computing with OpenCL,* MGH, 2011
2. Jason Sanders, Edward Kandrot, *CUDA By Example – An Introduction to General-Purpose GPU Programming,* Addison Wesley, 2011

CS464	BIO-INFORMATICS	DEC	3 – 0 – 0	3 Credits

Pre-requisites: None

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

CO1	Understand the theoretical basis behind bioinformatics.
CO2	Compute homologues, analyse sequences, construct and interpret evolutionary trees.
CO3	Analyse protein sequences, identify proteins, and retrieve protein structures from databases.
CO4	Understand homology modelling and computational drug design.
CO5	Determine and model biological information and apply this to the solution of biological problems in any arena involving molecular data.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	1	2	1	1	2				
CO2	1	2	2	1	3	1			
CO3		2	2	2	3	1		1	
CO4	1	2	1	1	3	1		1	
CO5	1	2	2	2	2			1	

Detailed syllabus:

Introduction to Bioinformatics: What is a Data Base, Types of Databases, Biological Databases, Pitfalls of Biological Databases, Information Retrieval from Biological Databases, Pair wise Sequence Alignment: Evolutionary Basics, Sequence homology versus similarity, Sequence similarity versus Identity, Scoring Matrices, Statistical Significance of Sequence alignment, Database similarity searching: Unique requirement of Database searching, Heuristic Database searching, Basic alignment search tool: Comparison of FASTA and BLAST, Multiple Sequence Alignment, Scoring Function, Exhaustive Algorithms, Heuristic Algorithms, Gene Prediction, Categories of gene prediction programs, Gene prediction in prokaryotes and Eukaryotes, Phylogenetics Basics Molecular phylogenetics and molecular basics Gene phylogeny versus species phylogeny, Forms of tree representation, Why finding a true tree is difficult, Phylogenetic tree construction methods and programs Protein structure basics: Amino acid, peptide formation, Dihedral Angles, Hierarchy, Secondary structures, Tertiary structure, Determination of protein 3-D structure, Protein structure data base, Genome mapping, assembly and comparison, Genome mapping, Genome sequencing, Genome sequence assembly, Genome Annotation, Comparative genomics, Functional

Genomics, Sequence based approaches, Microarray based approaches, Comparisons of SAGE and DNA microarray.

Reading:

1. Jin Xiong, *Essential Bioinformatics*, 1th Edition, Cambridge University Press, 2011.
2. Arthur M Lesk, *Introduction to Bioinformatics*, 2nd Edition, Oxford University Press, 2007.

CS465	DNA COMPUTING	DEC	3 – 0 – 0	3 Credits

Pre-requisites: None

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

CO1	Understand computations with DNA, gene rearrangements, and membrane systems.
CO2	Analyze and determine the power and limitations of molecular computing
CO3	Design and develop molecular computing methods
CO4	Analyze genetic code for determining the biological diversity.
CO5	Model genetic codes using computational methods and genome biology.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	1	1		1	2	1		1	
CO2	2	2	1	1	3	1		1	
CO3	3	3	2	2	3	1		1	1
CO4	1	2	1	1	3	1		1	1
CO5	2	2	1	1	2	1		1	

Detailed syllabus:

Introduction to DNA Computing: Molecular Biology, Molecular Structure, Genes, Structure and Biosynthesis, DNA Recombination, Genomes, Gene Expression, Protein Biosynthesis, Proteins–Molecular Structure, Cells and Organisms, Eukaryotes and Prokaryotes, Viruses

Word Design for DN A Computing: Distance, Similarity, DNA Languages, Bond-Free Languages, Hybridization Properties, Small DNA Languages, DNA Code Constructions and Bounds, Reverse and Reverse-Complement Codes, Constant GC-Content Codes, Similarity-Based Codes, General Selection Model

Autonomous DNA Models: Algorithmic Self-Assembly, Self-Assembly, DNA Graphs, Linear Self-Assembly, Tile Assembly, Finite State Automaton Models, Two-State Two-Symbol Automata, Length-Encoding Automata, Sticker Automata, Stochastic Automata, DNA Hairpin Model, Whiplash PCR, Satisfiability, Hamiltonian Paths, Maximum Cliques, Hairpin Structures, Computational Models, Neural Networks, Tic-Tac-Toe Networks, Turing Machines

Cellular DNA Computing: Models of Gene Assembly, Intramolecular String Model, Intramolecular Graph Model, Intermolecular String Model, Biomolecular Computing, Gene Therapy, Anti-Sense Technology, Cell-Based Finite State Automata, Anti-Sense Finite State Automata, Diagnostic Rules, Diagnosis and Therapy, Computational Genes, Diagnostic Rules, Diagnosis and Therapy

Reading:

1. Zoya Ignatova, Israel Martınez-Perez, Karl-Heinz Zimmermann, DNA Computing Models,1st edition, Springer 2008
2. Jin Xiong, Essential Bioinformatics, 1^{th} Edition, Cambridge University Press,2011
3. Arthur M Lesk, Introduction to Bioinformatics, 1^{nd} Edition, Oxford University Press2011

CS471	ADVANCED COMPUTER NETWORKS	DEC	3 – 0 – 0	3 Credits

Pre-requisites: None

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

CO1	Analyze wireless LAN technologies including IEEE 802.11.
CO2	Understand internet traffic and plan traffic engineering including IP over ATM and multimedia over internet.
CO3	Design of routing and transport layer protocols for advanced multi hop networks.
CO4	Design of cryptographic algorithms for Enterprise networks.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	1	3	2	1		1			
CO2	2	3	2	2	1	2	1	1	
CO3	2	2	2	2		2			1
CO4	2	3	2	1		3	1	1	1

Detailed syllabus:

Wireless LAN - Introduction to wireless LANs, IEEE 802.11 WAN-Architecture and Services, Physical Layer - MAC sublayer - MAC management sublayer - Other IEEE 802.11 standards,

DHCP-Outing in the Internet-MOSTF DVMRP, IP Over ATM,

Storage Area Networks- Introduction to Storage Technology, Storage System Architecture, Introduction to Networked Storage, Direct-Attached Storage, SCSI, NAS, IP SAN, Information Availability & Monitoring & Managing Datacenter, Securing Storage and Storage Virtualization.

Traffic Engineering Planning, WAP-WAP architecture-WAE-WTA Framework-WAP push services- WAP protocol stack, Tiny OS, NEST Cellular Network.

Tuning RED for Web Traffic - Introduction, Background Work, Experimental Methods, Experimental Network, Web-like Traffic Generation, Analysis of RED Response Times, Comparing FIFO and RED.

XCP - Implementation, Experimental study- Multimedia Over Internet- RSVP, RTP, RTCP, RTSP-Skype.

Internet Telephony- 1st Generation Protocols, Compression Techniques, 2nd Generation Systems, H.320 Standards, Directory Systems, IRC..LDAP, Integration with the PSTN, Gateways, VoIP Consortium, ETSI TIPHON-Skype-Enterprise Network Security, SNAT, DNAT.

Reading:

1. J. Walrend, *High Performance Communication Networks*, 2nd Edition, Maurgan Kauffmann, 1999.
2. D.E. Comer, *TCP/IP - Vol : I, II and III*, Pearson Education, 2008.

CS472	COMPUTER VISION	DEC	3 – 0 – 0	3 Credits

Pre-requisites: None.

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

CO1	Understand Image representation and modeling
CO2	Apply Image transformation methods
CO3	Implement image processing algorithms
CO4	Design of face detection and recognition algorithms

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	3		3	2			1	
CO2	3	3	3	2	2	2		2	
CO3	3	3	3	3	3				2
CO4	2	3	2	2	2	2		2	2

Detailed syllabus:

The image model and acquisition, image shape, sampling, intensity images, color images, range images, image capture, scanners. Statistical and spatial operations, Gray level transformations, histogram equalization, multi image operations. Spatially dependent transformations, templates and convolution, window operations, directional smoothing, other smoothing techniques. Segmentation and Edge detection, region operations, Basic edge detection, second order detection, crack edge detection, edge following, gradient operators, compass & Laplace operators. Morphological and other area operations, basic morphological operations, opening and closing operations, area operations, morphological transformations. Image compression: Types and requirements, statistical compression, spatial compression, contour coding, quantizing compression. Representation and Description, Object Recognition, 3-D vision and Geometry, Digital Watermarking. Texture Analysis.

Reading:

1. D. A. Forsyth, J. Ponce, *Computer Vision: A Modern Approach*, PHI Learning 2009.
2. Milan Soanka, Vaclav Hlavac and Roger Boyle, *Digital Image Processing and Computer Vision*, Cengage Learning.
3. R.C. Gonzalez and R.E. Woods, *Digital Image Processing*, Pearson Education.

CS473	SECURITY AND PRIVACY	DEC	3 – 0 – 0	3 Credits

Pre-requisites: None

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

CO1	Analysis and design of algorithms to implement secure protocols.
CO2	Evaluate computational techniques used in privacy preserving data mining techniques.
CO3	Analyze the universe of security and privacy metrics.
CO4	Evaluate compliance with security and privacy regulations and standards.
CO5	Optimize privacy regulations and noiseless differential privacy approaches.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	2	1	2	1	3		1	
CO2	2	2	1	2	1	3		1	
CO3	2	1	1	2	1	3		1	
CO4	2	1	1	2	1	3		1	
CO5	2	1	1	2	1	3		1	

Detailed syllabus:

Introduction to security and privacy, Number theory, Formal analysis and design of algorithms and protocols, Provably security, Cryptosystems.
Privacy, Foundations of privacy, Differential privacy, Definitions and early uses, Privacy regulations, Noiseless differential privacy, Privacy preserving, Data mining techniques.
Measuring compliance with security and privacy regulations and standards, Security and Privacy Metrics.
Physical security, IT security, Personal Security, Operational security.
Security and privacy in social networks, Measurement of user behavior in social networks, An effective user user-driven framework for selection of social networks, Providing group anonymity in social networks.

Reading:

1. J. Thomas Shaw, "*Information Security Privacy*", ABA, 2012.
2. Matthew Bailey, "*Complete Guide to Internet Privacy, Anonymity and Security*", Nerel Online, 2011.
3. D. S. Herrmann, "*A complete guide to security and privacy metrics*", Auerbach Publisher (Taylor and Francis Group), 2007
4. A. Abraham, "*Computational Social Networks: security and privacy*", Springer, 2012

CS474	INFORMATION SECURITY AND AUDITING	DEC	3 – 0 – 0	3 Credits

Pre-requisites: None.

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

CO1	Recognize propensity of errors and remedies in processes involving information technology
CO2	Consummate knowledge of risk and controls in IT opetation in industry
CO3	Determine IT security guidelines for various type of industries
CO4	Evaluate asset safeguarding, data integrity, system effectiveness and system efficiency.
CO5	Understand software security auditing including database security audit, network security audit and micro-computer security audit.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1		2				3	1	2	
CO2		2				3	1	2	
CO3		2				3	1	2	
CO4		2				3	1	2	
CO5		2				3	1	2	

Detailed syllabus:

Computer Auditing- System Access control, Data Access Control, Security Administration, System Design.

Hardware Security Controls - The Total System Needs Securing, Levels of Hardware Controls, Operating System Controls , Access Controls, General-Purpose Operating Systems Security , Sources of Additional Information

Software Controls - Software Security and Controls, Types of Software Intrusions, Configuration Management , Modularity and Encapsulation, Protecting Information, Selecting Security Software, Analysis of Software Products
Database Security - Introduction to Databases, Security Requirements of Databases, Designing Database Security, Methods of Protection, Security of Multilevel Databases,The Future of Databases.
Network and Telecommunication Security - Telecommunications and Networks, Security Considerations, Cases in Point, Special Communications, Security Considerations.

Microcomputer Security - Microcomputer Problems and Solutions , The Microcomputer Environment , Security of Microcomputers, Internal Data Security, The Threats to Micros, Developing a Micro Security Plan, Establishing a Micro-to-Mainframe Link , Portable Microcomputer Security , Password Protection, Security of Special Micro Applications.

Reading:

1. Deborah Russell, *Computer Security Basics*, O'Reilly & Associate, 1991.
2. Karen A. Forcht, *Computer Security Management*, Boyd & Fraser Publishing Co., 1994.
3. Donald A. Watne, Peter B.B. Turney, *Auditing EDP Systems*, 2nd Edition, PH 1990

CS475	REAL TIME SYSTEMS	DEC	3 – 0 – 0	3 Credits

Pre-requisites: None

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

CO1	Understand the use of multi tasking techniques in real time systems.
CO2	Evaluate the performance of soft and hard real time systems.
CO3	Analyze multi task scheduling algorithms for periodic, aperiodic and sporadic tasks.
CO4	Design real time operating systems.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	2		2					
CO2	3	3	3			3		2	
CO3	2	2	3	2		3			
CO4	3	3	3	3		3		2	2

Detailed syllabus:

Real-Time Systems, Typical Real-Time Applications, Hard Versus Soft Real-Time Systems, A Reference Model of Real-Time Systems.

Commonly Used Approaches to Hard Real-Time Scheduling, Clock-Driven Scheduling, Priority-Driven Scheduling of Periodic Tasks, Scheduling Aperiodic and Sporadic Jobs in Priority- Driven Systems.

Resources and Resource Access Control, Multiprocessor Scheduling and Resource Access Control.

Scheduling Flexible Computations and Tasks with Temporal Distance Constraints.

Real-Time Communications, Operating Systems.

Reading:

1. Jane Liu, *Real-Time Systems*, Prentice Hall, 2000.
2. Philip.A.Laplante, *Real Time System Design and Analysis*, 3rd Edition, PHI, 2004.

CS481	CLOUD COMPUTING	DEC	3 – 0 – 0	3 Credits

Pre-requisites: None

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

CO1	Identify the appropriate cloud services for a given application
CO2	Analyze Cloud infrastructure including Google Cloud and Amazon Cloud.
CO3	Analyze authentication, confidentiality and privacy issues in Cloud computing environment.
CO4	Determine financial and technological implications for selecting cloud computing platforms

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	3	2	2	1	2	2	2	1
CO2	2	3	2	2	3	2	1	2	1
CO3	2	3	2	2	1	2	3	2	1
CO4	2	2	3	3	3	3	2	2	1

Detailed syllabus:

Introduction - Cloud Computing Architecture, Cloud Delivery Models, The SPI Framework, SPI Evolution, The SPI Framework vs. the Traditional IT Model, Cloud Software as a Service (SaaS), Cloud Platform as a Service (PaaS), Cloud Infrastructure as a Service (IaaS) Google Cloud Infrastructure - Google File System – Search engine – MapReduce - Amazon Web Services - REST APIs - SOAP API - Defining Service Oriented Architecture, Combining the cloud and SOA, Characterizing SOA, Loosening Up on Coupling, Making SOA Happen, Catching the Enterprise Service Bus, Telling your registry from your repository, Cataloging services, Understanding Services in the Cloud.

Serving the Business with SOA and Cloud Computing, Query API - User Authentication- Connecting to the Cloud - OpenSSH Keys - Tunneling / Port Forwarding - Simple Storage Service - S3, EC2 - EC2 Compute Units, Platforms and storage, EC2 pricing, EC2 customers Amazon Elastic Block Storage - EBS - Ubuntu in the Cloud - Apache Instances in EC2 – Amazon Cloud Services- Amazon Elastic Compute Cloud (Amazon EC2), Amazon SimpleDB, Amazon Simple Storage Service (Amazon S3), Amazon CloudFront, Amazon Simple Queue Service (Amazon SQS), Amazon Elastic MapReduce, Amazon Relational Database Service (Amazon RDS) , EC2 Applications - Web application design - AWS EC2 Capacity Planning – Apache Servers - Mysql Servers - Amazon Cloud Watch - Monitoring Tools.

Reading:

1. Anothony T Velte, Toby J Velte, Robert Elsenpeter, *Cloud Computing: A Practical Approach*, MGH, 2010.
2. Gautam Shroff, *Enterprise Cloud Computing*, Cambridge, 2010.
3. Ronald Krutz and Russell Dean Vines, *Cloud Security*, 1st Edition, Wiley, 2010.

CS482	SOCIAL NETWORK ANALYSIS	DEC	3 – 0 – 0	3 Credits

Pre-requisites: None

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

CO1	Understand the importance of social media and networks
CO2	Enhance analytical skills for analyzing social media and networking data
CO3	Develop skills to leverage extended enterprise data
CO4	Create real-life case studies using social media data

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	1					1	2		
CO2	2	2	1	1		1	2		
CO3	2	2	1	1	2	1	2		
CO4	3	2	1	1		1	2		

Detailed syllabus:

Social Media- Descriptions and Definitions-social media networks-introduction, rise of social media for consumer applications, applying social media to national priorities Social Media Marketing - Theory and Practice, Social Media Marketing (including Viral Marketing), Mobile Marketing, Web Analytics, Social Media Analytics - Criteria of Effectiveness, Metrics, Techniques (e.g., Social Network Analysis, Semantic Analysis, Online Sentiment Analysis), Tools, Social Media Management, Centrality Measures-opinion mining, feature based sentiment analysis,

Community Detection-communities in social media, community detection, taxonomy of community criteria, nodes-centric community detection, complete mutuality: cliques, group-centric community detection, latent space models, spectral clustering, hierarchy-centric community detection. Community evaluation- measuring a clustering result, normalized mutual information, evaluation using semantics, Mining Social Network Data, Network Topology Discovery, Link Prediction- definition of link prediction problem, challenges, methods for link prediction-shortest path, neighborhood based preferential attachment, ensemble of all paths, hitting and commute times, rooted page rank. Comparison of different methods.

Managing Big Data, Case Studies-semantic analysi-handling internet slang

Reading:

1. Hansen, Derek, Ben Sheiderman, Marc Smith., *Analyzing Social Media Networks with NodeXL*: Insights from a Connected World, Morgan Kaufmann, 2011.
2. Avinash Kaushik., *Web Analytics 2.0: The Art of Online Accounta-bility*, Sybex, 2009.

CS483	INTELLIGENT AGENTS	DEC	3 – 0 – 0	3 Credits

Pre-requisites: None

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

CO1	Solve searching problems using A*, Mini-Max algorithms.
CO2	Create logical agents to do inference using first order logic.
CO3	Understand Bayesian Networks to do probabilistic reasoning.
CO4	Perform Statistical learning using EM algorithm.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	2			2				
CO2	2	2			2				
CO3	2	2			3				
CO4	2	2			3				

Detailed syllabus:

INTRODUCTION – Agents and Objects – Evaluation of Agents – Agent Design Philosophies - Multi-agent System – Mobile Agents – Agent Communication – Knowledge query and Manipulation Language – Case Study.

INTRODUCTION – What is AI? , The Foundations of Artificial Intelligence; - INTELLIGENT AGENTS – Agents and Environments, Good Behavior: The Concept of Rationality, The Nature of Environments, The Structure of Agents; - SOLVING PROBLEMS BY SEARCH – Problem-Solving Agents, Formulating problems, Searching for Solutions, Uninformed Search Strategies, Breadth-first search, Depth-first search, Searching with Partial Information, Informed (Heuristic) Search Strategies, Greedy best-first search, A* Search: Minimizing the total estimated solution cost, Heuristic Functions, Local Search Algorithms and Optimization Problems, Online Search Agents and Unknown Environments; –ADVERSARIAL SEARCH – Games, The minimax algorithm, Optimal decisions in multiplayer games, Alpha-Beta Pruning, Evaluation functions, Cutting off search, Games that Include an Element of Chance; - LOGICAL AGENTS – Knowledge-Based agents, The Wumpus World, Logic, Propositional Logic: A Very Simple Logic, Reasoning Patterns in Propositional Logic, Resolution, Forward and Backward chaining; - FIRST ORDER LOGIC – Syntax and Semantics of First-Order Logic, Using First-Order Logic , Knowledge Engineering in First-Order Logic; - INFERENCE IN FIRST ORDER LOGIC – Propositional vs. First-Order Inference, Unification and Lifting, Forward Chaining, Backward Chaining, Resolution ; - UNCERTAINTY – Acting under Uncertainty, Basic Probability Notation, The Axioms of Probability, Inference Using Full Joint Distributions, Independence, Bayes' Rule and its Use, The Wumpus World Revisited; - PROBABILISTIC REASONING – Representing Knowledge in an Uncertain Domain, The Semantics of Bayesian Networks, Efficient Representation of Conditional Distribution, Exact Inference in Bayesian Networks, Approximate Inference in Bayesian Networks; -

STATISTICAL LEARNING METHODS – Statistical Learning, Learning with Complete Data, Learning with Hidden Variables: EM Algorithm.

Reading:

1. Stuart Russell, Peter Norvig, *Artificial Intelligence -A Modern Approach*, 2/e, Pearson, 2003.
2. Nils J Nilsson, *Artificial Intelligence: A New Synthesis*, Morgan Kaufmann Publications,2000.

CS484	BIG DATA ANALYTICS	DEC	3 – 0 – 0	3 Credits

Pre-requisites: None

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

CO1	Understand big data challenges in different domains including social media, transportation, finance and medicine
CO2	Analyze scalability and performance of relational model, SQL and emergent systems.
CO3	Comprehend machine learning and algorithms for data analytics.
CO4	Understand the capability of No-SQL systems
CO5	Build secure big data systems
CO6	Analyze Map-Reduce programming model for better optimization

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	2	2		3		2		
CO2	2	2	2	2	3				
CO3		2	2	1	3				
CO4		2	2	2	3				
CO5	2	2	2	2	3				
CO6	2	2	2	2	3				

Detailed syllabus:

Overview of Big Data, Stages of analytical evolution, State of the Practice in Analytics, The Data Scientist, Big Data Analytics in Industry Verticals, Data Analytics Lifecycle, Operationalizing Basic Data Analytic Methods Using R, Advanced Analytics - Analytics for Unstructured Data - Map Reduce and Hadoop, The Hadoop Ecosystem, In-database Analytics, Data Visualization Techniques, Stream Computing Challenges, Systems architecture, Main memory data management techniques, energy-efficient data processing, Benchmarking, Security and Privacy, Failover and reliability.

Reading:

1. Bill Franks, Taming *The Big Data Tidal Wave*, 1st Edition, Wiley, 2012.
2. Frank J. Ohlhorst, *Big Data Analytics*,1st Edition, Wiley, 2012.

OPEN ELECTIVES

CE390	ENVIRONMENTAL IMPACT ANALYSIS	OPC	3 – 0 – 0	3 Credits

Pre-requisites: None.

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

CO1	Identify the environmental attributes to be considered for the EIA study.
CO2	Formulate objectives of the EIA studies.
CO3	Identify the suitable methodology and prepare Rapid EIA.
CO4	Prepare EIA reports and environmental management plans.
CO5	Plan the methodology to monitor and review the relief and rehabilitation works.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	1					1	2	
CO2	2	1					1	2	
CO3	2	1					1	2	
CO4	2	1					1	2	
CO5	2	1					1	2	

Detailed Syllabus:

Introduction: The Need for EIA, Indian Policies Requiring EIA , The EIA Cycle and Procedures, Screening, Scoping, Baseline Data, Impact Prediction, Assessment of Alternatives, Delineation of Mitigation Measure and EIA Report, Public Hearing, Decision Making, Monitoring the Clearance Conditions, Components of EIA, Roles in the EIA Process. Government of India Ministry of Environment and Forest Notification (2000), List of projects requiring Environmental clearance, Application form, Composition of Expert Committee, Ecological sensitive places, International agreements.

Identifying the Key Issues: Key Elements of an Initial Project Description and Scoping, Project Location(s), Land Use Impacts, Consideration of Alternatives, Process selection: Construction Phase, Input Requirements, Wastes and Emissions, Air Emissions, Liquid Effluents, Solid Wastes, Risks to Environment and Human, Health, Socio-Economic Impacts, Ecological Impacts, Global Environmental Issues.

EIA Methodologies**:** Criteria for the selection of EIA methodology, impact identification, impact measurement, impact interpretation & Evaluation, impact communication, Methods-Adhoc methods, Checklists methods, Matrices methods, Networks methods, Overlays methods, Environmental index using factor analysis, Cost/benefit analysis, Predictive or Simulation methods. Rapid assessment of Pollution sources method, predictive models for impact assessment, Applications for RS and GIS.

Reviewing the EIA Report: Scope, Baseline Conditions, Site and Process alternatives, Public hearing. Construction Stage Impacts, Project Resource Requirements and Related Impacts, Prediction of Environmental Media Quality, Socio-economic Impacts, Ecological Impacts, Occupational Health Impact, Major Hazard/ Risk Assessment, Impact on Transport System,Integrated Impact Assessment.

Review of EMP and Monitoring: Environmental Management Plan, Identification of Significant or Unacceptable Impacts Requiring Mitigation, Mitigation Plans and Relief & Rehabilitation, Stipulating the Conditions, What should be monitored? Monitoring Methods, Who should monitor? Pre-Appraisal and Appraisal.

Case Studies: Preparation of EIA for developmental projects- Factors to be considered in making assessment decisions, Water Resources Project, Pharmaceutical industry, thermal plant, Nuclear fuel complex, Highway project, Sewage treatment plant, Municipal Solid waste processing plant, Tannery industry.

Reading:

1. Jain, R.K., Urban, L.V., Stracy, G.S., *Environmental Impact Analysis*, Van Nostrand Reinhold Co., New York, 1991.
2. Barthwal, R. R., *Environmental Impact Assessment*, New Age International Publishers, 2002
3. Rau, J.G. and Wooten, D.C., *Environmental Impact Assessment,* McGraw Hill Pub. Co., New York, 1996.
4. Anjaneyulu.Y., and Manickam. V., Environmental Imapact Assessment Methodologies, B.S. Publications, Hyderabad, 2007.
5. Wathern.P., Environmental Impact Assessment- Theory and Practice, Routledge Publishers, London, 2004.

EE390	LINEAR CONTROL SYSTEMS	OPC	3 – 0 – 0	3 Credits

Pre-requisites: None.

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

CO1	Analyze electromechanical systems using mathematical modelling
CO2	Determine Transient and Steady State behavior of systems using standard test signals
CO3	Analyze linear and non-linear systems for steady state errors, absolute stability and relative stability
CO4	Design a stable control system satisfying requirements of stability and reduced steady state error

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	2					1	2	
CO2	2	2					1	2	
CO3	2	2					1	2	
CO4	2	2					1	2	

Detailed syllabus:

Introduction - control system, types, feedback and its effects-linearization

Mathematical Modelling of Physical Systems. Block diagram Concept and use of Transfer function. Signal Flow Graphs- signal flow graph, Mason's gain formula.

Time Domain Analysis of Control Systems - BIBO stability, absolute stability, Routh-Hurwitz Criterion.

P, PI and PID controllers. Root Locus Techniques - Root loci theory, Application to system stability studies.

Frequency Domain Analysis of Control Systems - polar plots, Nyquist stability criterion, Bode plots, application of Bode plots.

Reading:

1. B.C. Kuo, Automatic Control Systems, 7th Edition, Prentice Hall of India, 2009.
2. I.J. Nagarath and M. Gopal: Control Systems Engineering, 2nd Edition, New Age Pub. Co. 2008.

ME390	AUTOMOTIVE MECHANICS	OPC	3 – 0 – 0	3 Credits

Pre-requisites: None.

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

CO1	Analyze operation and performance indicators of transmission systems, internal combustion engines and after treatment devices.
CO2	Understand operation of engine cooling system, lubrication system, electrical system and ignition system.
CO3	Understand fuel supply systems in an diesel and petrol vehicles
CO4	Analyze current and projected future environmental legislation and its impact on design, operation and performance of automotive power train systems.
CO5	Understand operation and performance of suspension, steering and braking system.
CO6	Understand layout of automotive electrical system and importance of electronic controls

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1		2					1	2	
CO2		2					1	2	
CO3		2					1	2	
CO4		2					1	2	
CO5		2					1	2	
CO6		2					1	2	

Detailed syllabus

Introduction: Layout of an automotive chassis, engine classification.

Cooling Systems: Air cooling, air cleaners, Water cooling: Thermosyphon and pump circulation systems, Components of water cooling systems- Radiator, thermostat etc.

Engine Lubrication: Petroils system, Splash system, Pressure lubrication and dry sump system

Ignition System: Battery, Magneto and Electronic, Engine Starting drives

Fuel supply system: Components in fuel supply system, types of feed pumps, air cleaners, fuel and oil filters, pressure and dry sump systems.

Engine testing and Performance: Performance parameters, constant and variable speed test, heat balance test, performance characteristics. Engine Emissions: SI and CI engine emissions, emission control methods

Automotive electrical and electronics: Electrical layout of an automobile, ECU, sensors, windscreen wiper, Electric horn.

Transmission: Clutch**-** Single and multiplate clutch, semi & centrifugal clutch and fluid flywheel, Gear box: Sliding mesh, constant mesh and synchromesh gear box, selector mechanism, over drive, Propeller shaft and Differential.

Suspension System: Front and rear suspension, shock absorbers, Rear Axles mountings, Front Axle. Steering Mechanism: Manual and power steering systems, Braking System: Mechanical, Hydraulic and Air braking systems.

Engine service: Engine service procedure.

Reading:

1. S. Srinivasan, Automotive Mechanics, Tata McGraw-Hill, 2004.
2. K.M.Gupta, Automobile Engineering, Vol.1 and Vol.2, Umesh Publications, 2002
3. Kirpal Singh, Automobile Engineering, Vol.1 and Vol.2, Standard Publishers, 2003.
4. William H.Crouse and Donald L. Anglin, Automotive Mechanics, Tata McGraw-Hill, 2004
5. Joseph Heitner, Automotive Mechanics, East-West Press, 2000.

ME391	ROBUST DESIGN	OPC	3 – 0 – 0	3 Credits

Pre-requisites: None.

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

CO1	Understand stages in engineering design and concept of robust design.
CO2	Develop quality loss functions and S/N ratios for S, N and L type objective functions.
CO3	Identify control and noise factors for a given product or process.
CO4	Conduct experiments using DOE concepts to decide the optimal setting of parameters
CO5	Apply quality loss function approach for fixing the component tolerances.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	1	1					1	2	
CO2	1	1					1	2	
CO3	1	1					1	2	
CO4	1	1					1	2	
CO5	1	1					1	2	

Detailed syllabus

Introduction: Taguchi's quality philosophy, causes of performance variation, concept of robust design, stages in product/process design, need for experimentation, QFD, process flow analysis, cause and effect diagram.

Design of Experiments**:** Principles of experimentation, Basic concepts of probability and statistics, Comparison of two means and two variances, Comparison of multiple (more than two) means & Anova, Factorial designs, fractional factorial designs, orthogonal arrays, standard orthogonal arrays & interaction tables, modifying the orthogonal arrays, selection of suitable orthogonal array design, analysis of experimental data.

Parameter Design**:** Loss function, average quality loss, S/N ratios, objective functions, selection of control & noise factors and their levels, strategy for systematic sampling of noise, classification of control factors, inner-array and outer-array design, data analysis, selection of optimum levels/values for parameters.

Tolerance Design: Experiments, selection of tolerances to be tightened, fixing the final tolerances.

Reading:

1. Taguchi G, Chowdhury S and Taguchi S, Robust Engineering, TMH, 2000.
2. Ross PJ, Taguchi Techniques for Quality Engineering, TMH, 2005.

ME392	ENTREPRENEURSHIP DEVELOPMENT	OPC	3 – 0 – 0	3 Credits

Pre-requisites: None.

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

CO1	Understand entrepreneurship and entrepreneurial process and its significance in economic development.
CO2	Develop an idea of the support structure and promotional agencies assisting ethical entrepreneurship.
CO3	Identify entrepreneurial opportunities, support and resource requirements to launch a new venture within legal and formal frame work.
CO4	Develop a framework for technical, economic and financial feasibility.
CO5	Evaluate an opportunity and prepare a written business plan to communicate business ideas effectively.
CO6	Understand the stages of establishment, growth, barriers, and causes of sickness in industry to initiate appropriate strategies for operation, stabilization and growth.

Mapping of course outcomes with program outcomes

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1		2					2	2	
CO2		2					2	2	
CO3		2					2	2	
CO4		2					2	2	
CO5		2					2	2	
CO6		2					2	2	

Detailed syllabus

Entrepreneur and Entrepreneurship: Introduction; Entrepreneur and Entrepreneurship; Role of entrepreneurship in economic development; Entrepreneurial competencies and motivation; Institutional Interface for Small Scale Industry/Enterprises.

Establishing Small Scale Enterprise: Opportunity Scanning and Identification; Creativity and product development process; Market survey and assessment; choice of technology and selection of site.

Planning a Small Scale Enterprsies**:** Financing new/small enterprises; Techno Economic Feasibility Assessment; Preparation of Business Plan; Forms of business organization/ownership.

Operational Issues in SSE**:** Financial management issues; Operational/project management issues in SSE; Marketing management issues in SSE; Relevant business and industrial Laws.

Performance appraisal and growth strategies**:** Management performance assessment and control; Causes of Sickness in SSI, Strategies for Stabilization and Growth.

Reading:

1. G.G. Meredith, R.E.Nelson and P.A. Neek, The Practice of Entrepreneurship, ILO, 1982.
2. Dr. Vasant Desai, Management of Small Scale Enterprises, Himalaya Publishing House, 2004.
3. A Handbook for New Entrepreneurs, Entrepreneurship Development Institute of India, Ahmedabad, 1988.
4. Bruce R Barringer and R Duane Ireland, Entrepreneurship: Successfully Launching New Ventures, 3rd ed., Pearson Edu., 2013.

EC390	COMMUNICATION SYSTEMS	OPC	3 – 0 – 0	3 Credits

Pre-requisites: None

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

CO1	Understand different modulation and demodulation schemes for analog communications.
CO2	Design analog communication systems to meet desired application requirements
CO3	Evaluate fundamental communication system parameters, such as bandwidth, power, signal to quantization noise ratio etc.
CO4	Elucidate design tradeoffs and performance of communications systems.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1		1						2	
CO2		1						2	
CO3		1						2	
CO4		1						2	

Detailed syllabus

Signal Analysis**:** Communication Process, Sources of Information, Communication Channels, Modulation Process, Types of Communication, Random Process, Gaussian Process, Correlation Function, Power Spectral Density, Transmission of Random Process through an LTI Filter.

Noise Analysis: External Noise, Internal Noise, White Noise, Narrow Band Noise, Representation of Narrow Band noise In phase and Quadrature Components, Noise Figure, Noise Bandwidth, Noise Temperature.

Amplitude (Linear) Modulation: Linear Modulation Schemes, Generation of AM, Envelope Detector, DSB-SC Product Modulator, Switching Modulator, Ring Modulator, Coherent Detection, Costas receiver, SSB Signal Representation, Filtering Method, Phase Shift Method, Coherent Demodulation, VSB Modulator and Demodulator, Carrier Acquisition using Squaring Loop and Costas Loop, Receiver Model, SNR, Noise in SSB and DSB receivers using coherent detection, Noise in AM Receiver using Envelope detection, Threshold Effect.

Angle (Exponential) Modulation: Types of Angle Modulation, Relation between FM and PM, Narrow Band FM, Wideband FM, Transmission Bandwidth of FM Signals, Generation of FM using Direct and Indirect methods, FM Demodulation using Slope Circuit, Frequency Discriminator, Interference in Angle Modulation, Noise in FM Receiver, FM Threshold Effect, Pre-emphasis and De-emphasis in FM, Model of PLL for FM Demodulation.

Pulse Modulation: Sampling Process, PAM, PWM, PPM, Quantization, PCM, TDM, Digital Multiplexer Hierarchy, DM, DSM, Linear Prediction, DPCM, ADPCM, Noise in PCM System, Companding, Comparison of the Noise Performance of AM,FM,PCM and DM.

Information Theory: Uncertainty, Information, Entropy, Source Coding Theorem, Data Compaction, Mutual information, Channel Capacity, BSC Channel, Information Capacity Theorem, Bandwidth - Power Tradeoff, Huffman Coding.

Reading:

1. S. Haykin, Communication Systems, 4th Edn, John Wiley & Sons, Singapore, 2001.
2. B.P. Lathi, Modern Digital & Analog Communication Systems, 3rd Edn, Oxford University Press, Chennai, 1998.
3. Leon W.Couch II., Digital and Analog Communication Systems, 6th Edn, Pearson Education inc., New Delhi, 2001.
4. A Bruce Carlson, PB Crilly, JC Rutledge, Communication Systems – 4th Edn, MGH, New York, 2002.

EC391	MICROPROCESSOR SYSTEMS	OPC	3 – 0 – 0	3 Credits

Pre-requisites: None

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

CO1	Develop basic understanding of microprocessor architecture.
CO2	Design Microprocessor and Microcontroller based systems.
CO3	Understand C, C++ and assembly language programming
CO4	Understand concept of interfacing of peripheral devices and their applications

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	3		1					1
CO2	2	3		2					1
CO3	2	3		2					3
CO4	2	3		3					1

Detailed syllabus

Microcomputer Organization: CPU, Memory, I/O, Operating System, Multiprogramming, Multithreading, MS Windows

80386 Micro Processors : Review of 8086,salient features of 80386,Architecture and Signal Description of 80386,Register Organization of 80386,Addressing Modes,80386 Memory management, Protected mode, Segmentation, Paging, Virtual 8086 Mode, Enhanced Instruction set of 80386, the Co- Processor 80387

Pentium & Pentium-pro Microprocessor: Salient features of Pentium microprocessor, Pentium architecture, Special Pentium registers, Instruction Translation look aside buffer and branch Prediction, Rapid Execution module, Memory management, hyper-threading technology, Extended Instruction set in advanced Pentium Processors

Microcontrollers: Overview of micro controllers-8051 family microcontrollers, 80196 microcontrollers family architecture, instruction set, pin out, memory interfacing.

ARM Processor Fundamentals: Registers, current Program Status Registers, Pipeline Exceptions, Interrupts and Vector Table, Architecture Revisions, ARM Processor families, ARM instruction set, Thumb Instruction set-Exceptions Handing, Interrupts, Interrupt Handling schemes, firmware, Embedded operating systems, Caches-cache architecture, Cache policy, Introduction to DSP on the ARM, DSP on the ARM7TDMI,ARM9TDMI.

Case study-Industry Application of Microcontrollers

Reading:

1. Barry B.Brey: Intel Microprocessor Architecture, Programming and Interfacing-8086/8088,80186,80286,80386 and 80486, PHI,1995.
2. Muhammad Ali Mazidi and Mazidi: The 8051 Microcontrollers and Embedded systems, PHI, 2008

3. Intel and ARM Data Books on Microcontrollers.

MM390	METALLURGY FOR NON-METALLURGISTS	OPC	3 – 0 – 0	3 Credits

Pre-requisites: None

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

CO1	Understand the characteristics and usefulness of metals and alloys.
CO2	Differentiate metals and alloys and their fabrication techniques.
CO3	Correlate the microstructure, properties, processing and performance of materials.
CO4	Select metal/alloy for engineering applications.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1								2	1
CO2								2	1
CO3								2	1
CO4								2	1

Detailed Syllabus:

Introduction to Metallurgy:

Structure of Metals and Alloys: Nature of Metallic Bonding, Crystal Structures of Metals, Structure of Alloys, Imperfections in Crystals

Mechanical Properties: Plastic Deformation Mechanisms, Tensile, Creep, Fatigue, Fracture

Strengthening Mechanisms: Strain Hardening, Grain Size Refinement, Solid Solution Strengthening, Precipitation Hardening

Discovering Metals: Overview of Metals, Modern Alloy Production

Fabrication and Finishing of metal products: Metal Working and Machining

Testing of Metals: Both Destructive and Non-Destructive, Inspection and Quality Control of Metals

Engineering Alloys: Steel Products and Properties, Cast Irons, Tool Steels and High Speed Steels, Stainless Steels, Nonferrous Metals

Heat Treatment: Annealing, Normalizing, Hardening, Tempering

Corrosion and its Prevention: Electro chemical considerations, Corrosion Rates, Passivity, Environmental Effects, Forms of Corrosion, Corrosion Environments, Oxidation; Durability of Metals and Alloys

The material selection processes: Case studies

Reading:

1. M. F. Ashby: Engineering Metals, 4th Edition, Elsevier, 2005.
2. R. Balasubramaniam (Adapted): Calister's Materials Science and Engineering, 7th Edition,

Wiley India (P) Ltd, 2007.
3. Reza Abbaschian, Lara Abbaschian, R E Reed-Hill: Physical Metallurgy Principles, Affiliated East-West Press, 2009.
4. V Raghavan: Elements of Materials Science and Engineering- A First Course, 5th Edition, PHI, 2006

CH390	NANOTECHNOLOGY AND APPLICATIONS	OPC	3 – 0 – 0	3 Credits

Prerequisites: None

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

CO1	Understand the properties of Nano-materials and applications
CO2	Apply chemical engineering principles to Nano-particle production
CO3	Solve the quantum confinement equations.
CO4	Characterize Nano-materials.
CO5	Scale up the production Nanoparticles for Electronics and Chemical industries.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1		1						2	
CO2	2	1						2	
CO3	2	1						2	
CO4	2	1						2	
CO5	2	1						2	

Detailed Syllabus:

Introduction to Nanotechnology: Introduction to nanotechnology and materials, Nanomaterials, Introduction to nano-sizes and properties comparison with the bulk materials, Different shapes and sizes and morphology.

Fabrication of Nanomaterials: Top Down Approach Grinding, Planetory milling and Comparison of particles, Bottom Up Approach, Wet Chemical Synthesis Methods, Microemulsion Approach, Colloidal Nanoparticles Production, Sol Gel Methods, Sonochemical Approach, Microwave and Atomization, Gas phase Production Methods : Chemical Vapour Depositions.

Kinetics at Nanoscale: Nucleation and growth of particles, Issues of Aggregation of Particles, Oswald Ripening, Stearic hindrance, Layers of surface charges, Zeta Potential and pH.

Carbon Nanomaterials: Synthesis of carbon bucky-balls, List of stable carbon allotropes extended, fullerenes, metallofullerenes, solid C_{60}, bucky onions, nanotubes, nanocones

Quantum mechanics: Quantum dots and its Importance, Pauli exclusion principle, Schrödinger's equation, Application of quantum Dots: quantum well, wire, dot, characteristics of quantum dots, Synthesis of quantum dots Semi-conductor quantum dots

Nanomaterials characterization: Fractionation principles of Particle size measurements, Particle size and its distribution, XRD, Zeta potential, Electronic band structure Electron statistics Application: Optical transitions in solids, photonic crystals, Microscopies SEM, TEM, Atomic Forced Microscopy, Scanning and Tunneling Microscopy.

Applications: Self-assembly and molecular manufacturing, Surfactant based system Colloidal system applications, Functional materials Applications, commercial processes of synthesis of nanomaterials.

Nano inroganic materials of $CaCO_3$ synthesis, Hybrid Waste Water Treatments systems, Electronic Nanodevices,

Nanobiology: Biological synthesis of nanoparticles and applications in drug delivery, Nanocontainers and Responsive Release of active agents, Layer by Layer assembly for nanospheres, Safety and health Issues of nano materials, Environmental Impacts, Case Study for Environmental and Societal Impacts

Reading:

1. Kulkarni Sulabha K, Nanotechnology: Principles and Practices, Capital Publishing Company, 2007
2. Stuart M. Lindsay, Introduction to Nanoscience, Oxford University Press, 2009.
3. Robert Kelsall, Ian Hamley, Mark Geoghegan, Nanoscale Science and Technology, John Wiley & Sons, 2005.
4. Gabor L. Hornyak , H.F. Tibbals , Joydeep Dutta , John J. Moore Introduction to Nanoscience and Nanotechnology CRC Press
5. Davies, J.H. 'The Physics of Low Dimensional Semiconductors: An Introduction', Cambridge University Press, 1998.

CH391	INDUSTRIAL SAFETY AND HAZARDS	OPC	3 – 0 – 0	3 Credits

Prerequisites: None.

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

CO1	Analyze the effects of release of toxic substances.
CO2	Select the methods of prevention of fires and explosions.
CO3	Understand the methods of hazard identification and preventive measures.
CO4	Assess the risks using fault tree diagram.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	1				1		2	
CO2	2	1				1		2	
CO3	2	1				1		2	
CO4	2	1				1		2	

Detailed syllabus:

Introduction-Safety Programs, Engineering Ethics, Accident and Loss Statistics, Acceptable Risk , Public Perceptions ,The Nature of the Accident Process ,Inherent Safety.

Industrial Hygiene- Anticipation and Identification, Hygiene Evaluation, Hygiene Control.

Toxic Release and Dispersion Models- Parameters Affecting Dispersion, Neutrally Buoyant Dispersion Models, Dense Gas Dispersion, Toxic Effect Criteria, Effect of Release Momentum and Buoyancy, Release Mitigation.

Fires and Explosions- The Fire Triangle, Distinction between Fires and Explosions, Flammability Characteristics of Liquids and Vapors, Limiting Oxygen Concentration and Inerting, Flammability Diagram

Hazards Identification- Process Hazards Checklists, Hazards Surveys, Hazards and Operability Studies, Safety Reviews.

Risk Assessment- Review of Probability Theory, Event Trees, Fault Trees.

Safety Procedures: Process Safety Hierarchy, Managing Safety, Best Practices, Procedures—Operating, Procedures—Permits, Procedures—Safety Reviews and Accident Investigations.

Reading:

1. D. A. Crowl and J.F. Louvar, Chemical Process Safety (Fundamentals with Applications), Prentice Hall,2011.
2. R.K. Sinnott, Coulson & Richardson's Chemical Engineering, Vol. 6, Elsevier India, 2006.

CS390	OBJECT ORIENTED PROGRAMMING	OPC	3 – 0 – 0	3 Credits

This course is not available to B.Tech Computer Science & Engineering Students

Pre-requisites: None

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

CO1	Understand fundamental concepts in object oriented approach.
CO2	Analyze design issues in developing OOP applications.
CO3	Write computer programs to solve real world problems in Java.
CO4	Analyze source code API documentations.
CO4	Create GUI based applications.

Mapping of course outcomes with program outcomes

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	2	3	3	3		2		2	2
CO2	2	3	3	3				2	
CO3		2	3	3					2
CO4		2		2					
CO5		2	2	2				2	2

Detailed Syllabus:

Object- oriented thinking, History of object-oriented programming, overview of java, Object-oriented design, Structure of java program. Types and modifiers, Classes, declaring objects in classes, Methods, constructors, garbage collection, Method overloading, passing objects as parameters, Inheritance, various forms and types of inheritance, Multilevel hierarchy, use of super, method overriding, Applications of method overriding, abstract classes, Packages with examples

Interfaces and implementation, Exception handling, types, throwing, creating own exceptions, Multithreading and concepts, its usage and examples, Input/output streams, String operations and examples, Collection classes-array, stack collection, bitset collection, Utility classes-string tokenizer, bitset, date, Applets- methods, creation, designing and examples, Event handling-event classes, Event listener interfaces, AWT classes, working with frames, AWT controls-layout manager, user interface components, Graphics programming

Reading:

1. Timothy Budd, Understanding object-oriented programming with Java, 2nd ed., Pearson, 2001
2. Herbert Schildt, The complete reference Java 2, TMH, 8th ed., 2011

BT390	GREEN TECHNOLOGY	OPC	3 – 0 – 0	3 Credits

Pre-requisites: None

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

CO1	Address smart energy and green infrastructure
CO2	Build models that simulate sustainable and renewable green technology systems
CO3	Understand the history, global, environmental and economical impacts of green technology
CO4	Address non-renewable energy challenges

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1							1	2	2
CO2							1	2	2
CO3							1	2	2
CO4							1	2	2

Detailed Syllabus:

Biomass Energy, basic concepts, sources of biomass energy, uses of biomass energy, science and engineering aspects of biomass energy, production of biomass electricity, transmission of biomass electricity, storage of biomass electricity.

Energy transformation from source to services; Energy sources, sun as the source of energy; biological processes; photosynthesis; food chains, classification of energy sources, quality and concentration of energy sources; fossil fuel reserves - estimates, duration; theory of renewability, renewable resources; overview of global/ India's energy scenario.

Environmental effects of energy extraction, conversion and use; sources of pollution from energy technologies, Criteria for choosing appropriate green energy technologies, life cycle cost; the emerging trends – process/product innovation-, technological/ environmental leap-frogging; Eco/green technologies for addressing the problems of Water, Energy, Health, Agriculture and Biodiversity.

First and second laws of thermodynamics and their applications – Thermodynamic processes - Irreversibility of energy – Entropy. Properties of steam and classification of steam engines. Carnot cycle - Rankine cycle, Current energy requirements, growth in future energy requirements, Review of conventional energy resources- Coal, gas and oil reserves and resources, Tar sands and Oil, Shale, Nuclear energy Option.

Biomass fuels, market barriers of biomass fuels, biomass fuel standerdization, biomass fuel life cycle, Sustainability of biomass fuels, economics of biomass fuels, Fuel stoichiometry and analysis: Fuel stoichiometry relations; Estimation of air required for complete combustion; Estimation of minimum amount of air required for a fuel of known composition; Estimation of dry flue gases for known fuel composition; Calculation of the composition of fuel & excess air supplied, from exhaust gas analysis; Dew point of products; Flue gas analysis (O_2, CO_2, CO, NOx, SOx).

Biomass as a major source of energy in India: Fuel-wood use in rural households. Consequences for ecosystems. Future energy scenario in rural areas. Utilization of biomass in industrial and semi-industrial settings. Future utilization of biomass in India. Future of landscape management: optimal management.

Reading:

1. Ayhan Demirbas, Green Energy and Technology, Biofuels, Securing the Planet's Future Energy Needs, 1^{st} Edition, Springer, 2009.
2. Jay Cheng, Biomass to Renewable Energy Processes, 1^{st} Edition, CRC press, 2009.
3. Samir K. Khanal, Rao Y. Surampally, 1^{st} edition, American Society of Civil Engineers, 2010.

SM390	MARKETING MANAGEMENT	OPC	3 – 0 – 0	3 Credits

Pre-requisites: None

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

CO1	Understand concepts and scope of marketing and market oriented strategic planning
CO2	Analyze macro level environment
CO3	Identify factors influencing consumer behavior in competitive global business environment
CO4	Identify tools and techniques for marketing management through integrated marketing communication systems.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1		2					3	2	
CO2		2					3	2	
CO3		2					3	2	
CO4		2					3	2	

Detailed Syllabus:

Importance of Marketing, Scope of Marketing, Core Marketing concepts company orientation towards market place-production concept, Product concept, selling concept and Marketing concept.

Market oriented Strategic planning – Defining corporate Mission and Vision Statement at Corporate level and at Business unit level. Assigning resources to Strategic Business units through B.C.G Matrix and G.E Model.

Analyzing Macro environment-Demographic environment. Economic Environment, Technical Environment, Social-Cultural Environment and political – Legal Environment.

Components of Marketing information systems- Internal Records, Marketing intelligence, Marketing research and Marketing Decision support system.

Consumer Behavior- Buying Decision process and the factors influencing consumer Behavior-Psychological factors, social factors, cultural factors and personal factors.

Importance of Market segmentation, Target market selection and positioning.

Importance of new product development process and the various stages involved.

The concept of product lifecycle and the various strategies used by the marketer in each stage.

Product characteristics and classification, Product mix and product line decisions Branding Decisions, Building Brand Equity.

Importance of Pricing, Factors influencing pricing decisions. Various pricing methods-cost based and demand based methods.

Role of Marketing channels-Channel functions and channel levels channel Design and channel Management Decisions, Managing Retailing. Wholesaling and logistics. Importance of Electronic channels.

Importance of integrated Marketing communication. Advantages and Disadvantages of Various promotional tools- Advertising, Sales promotion, personal selling, publicity and public Relations and Direct marketing.

Reading:

1. Philip Kotler, Marketing Management, PHI, 14th Edition, 2013.
2. William Stonton & Etzel, Marketing Management, TMH, 13th Edition, 2013.
3. Rama Swamy & Namakumari, Marketing Management, McMillan, 2013.

MA390	NUMERICAL SOLUTION OF DIFFERENTIAL EQUATIONS	OPC	3 – 0 – 0	3 Credits

Pre-requisites: None

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

CO1	Solve nonlinear differential equations by numerical methods.
CO2	Determine the convergence region for a finite difference method.
CO3	Solve elliptic PDE by finite difference method
CO4	Solve a parabolic PDE by finite difference method
CO5	Solve a hyperbolic PDE by finite difference method

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1		3						2	
CO2		3						2	
CO3		3						2	
CO4		3						2	
CO5		3						2	

Detailed Syllabus:

Ordinary Differential Equations: Multistep (explicit and implicit) methods for initial value problems, Stability and Convergence analysis, Linear and nonlinear boundary value problems, Quasi-linearization, Shooting methods

Finite difference methods: Finite difference approximations for derivatives, boundary value problems with explicit boundary conditions, implicit boundary conditions, error analysis, stability analysis, convergence analysis.

Partial Differential Equations: Classification of partial differential equations, finite difference approximations for partial derivatives and finite difference schemes for Parabolic equations, Schmidt's two level, multilevel explicit methods, Crank-Nicolson's two level, multilevel implicit methods, Dirichlet's problem, Neumann problem, mixed boundary value problem, stability analysis.

Hyperbolic Equations: Explicit methods, implicit methods, one space dimension, two space dimensions, ADI methods.

Elliptic equations: Laplace equation, Poisson equation, iterative schemes, Dirichlet's problem, Neumann problem, mixed boundary value problem, ADI methods.

Reading:

1. M.K. Jain, Numerical Solution of Differential Equations, Wiley Eastern, 1984.
2. G.D. Smith, Numerical Solution of Partial Differential Equations, Oxford Univ. Press, 2004.
3. M.K.Jain, S.R.K. Iyengar and R.K. Jain, Computational Methods for Partial Differential Equations, Wiley Eastern, 2005.

MA391	**FUZZY MATHEMATICS AND APPLICATIONS**	**OPC**	**3 – 0 – 0**	**3 Credits**

Pre-requisites: None.

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

CO1	Apply operations on Fuzzy sets
CO2	Solve problems related to Propositional Logic.
CO3	Apply Fuzzy relations to cylindric extensions.
CO4	Apply logic of Boolean Algebra to switching circuits.
CO5	Develop Fuzzy logic controllers

Mapping of course outcomes with program outcomes

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1		3						2	
CO2		3						2	
CO3		3						2	
CO4		3						2	
CO5		3						2	

Detailed Syllabus:

Crisp set theory (CST): Introduction, Relations between sets, Operations on sets, Characteristic functions, Cartesian products of crisp sets, crisp relations on sets.

Fuzzy set theory (FST): Introduction, concept of fuzzy set (FS), Relation between FS, operations on FS, properties of standard operations, certain numbers associated with a FS, certain crisp sets associated with FS, Certain FS associated with given FS, Extension principle.

Propositional Logic (PL1): Introduction, Syntax of PL1, Semantics of PL1, certain properties satisfied by connectives, inference rules, Derivation, Resolution.

Predicate Logic (PL2): Introduction, Syntax of PL2, Semantics of PL2, certain properties satisfied by connectives and quantifiers, inference rules, Derivation, Resolution

Fuzzy Relations (FR): Introduction, Operations on FR, □-cuts of FR, Composition of FR, Projections of FR, Cylindric extensions, Cylindric closure, FR on a domain.

Fuzzy Logic (FL): Introduction, Three-valued logics, N-valued logics and infinite valued logics, Fuzzy logics, Fuzzy propositions and their interpretations in terms of fuzzy sets, Fuzzy rules and their interpretations in terms of FR, fuzzy inference, More on fuzzy inference, Generalizations of FL.

Switching functions (SF) and Switching circuits (SC): Introduction, SF, Disjunctive normal form, SC, Relation between SF and SC, Equivalence and simplification of circuits, Introduction of Boolean Algebra BA, Identification, Complete Disjunctive normal form.

Applications: Introduction to fuzzy logic controller (FLC), Fuzzy expert systems, classical control theory versus fuzzy control, examples, working of FLC through examples, Details of FLC, Mathematical formulation of FLC, Introduction of fuzzy methods in decision making.

Reading:

1. M. Ganesh, Introduction to Fuzzy Sets and Fuzzy Logic, PHI, 2001.
2. G.J. Klir and B.Yuan, Fuzzy sets and Fuzzy Logic–Theory and Applications, PHI, 1997.
3. T. J. Ross, Fuzzy Logic with Engineering Applications, McGraw-Hill, 1995.

PH390	MEDICAL INSTRUMENTATION	OPC	3 – 0 – 0	3 Credits

Pre-requisites: None.

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

CO1	Understand the origin of bio-potentials and their physical significance.
CO2	Understand anatomy and functioning of human heart and its common problems.
CO3	Analyze ECG, ENG and EMG signals and instrumentation.
CO4	Compare different techniques of measuring blood pressure, blood flow and volume.
CO5	Interpret the principle and operation of therapeutic and prosthetic devices.
CO6	Differentiate between the various techniques for measurement of parameters.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	2		2			3	2	1
CO2	2	2		2			3	2	1
CO3	2	2		2			3	2	1
CO4	2	2		2			3	2	1
CO5	2	2		2			3	2	1
CO6	2	2		2			3	2	1

Detailed Syllabus:

General Introduction: The cell, body fluids, Musculoskeletal system, respiratory system, gastrointestinal system, Nervous system, endocrine system and circulatory system.

Origin of Bio potentials: electrical activity of Excitable cells: the resting state, The active state, Volume conductor fields, Functional organization of the peripheral nervous system: Reflex are & Junctional transmission.

The Electroneurogram (ENG): The H-Reflex, The Electromyogram (EMG), The Electrocardiogram (ECG), heart and the circulatory system, Electro conduction system of the heart and heart problems, ECG waveform and Physical significance of its wave features, Electrical behavior of cardiac cells, The standard lead system, The ECG preamplifier, DC ECG Amplier, Defibrillator protection circuit, Electro surgery Unit filtering, Functional blocks of ECG system, Multichannel physiological monitoring system, Common problems encountered and remedial techniques.

Blood Pressure: indirect measurement of blood pressure, korotkoff sounds, auscultatory method using sphygmo manometer, Oscillometric and ultrasonic non invasive pressure measurement, Direct measurement of blood pressure H2O manometers, electronic manometry, Pressure transducers,. Pressure amplifier designs, Systolic, diastolic mean detector circuits

Blood flow and Volume Measurement: indicator dilution methods, Transit time flow meter, DC flow meter, Electromagnetic flow meter AC electromagnetic flow meter, Quadrature suppression flow meter, Ultrasonic flow meter, Continuous-wave Doppler flow meter, Electric impedance plethysmography, chamber plethysmography, Photo plethysmography.

Pulse Oximetr: Principles of Operation, Absorption Spectrum, Sensor design, Pulse oximeter, Therapeutic and Prosthetic Devices.

Cardiac Pacemakers: Lead wires and electrodes, Synchronous Pacemakers, rate responsive pacemaking, Defibrillators, cardioverters, Electrosurgical unit, Therapeutic applications of laser, Lithotripsy Haemodialysis.

Reading:

1. John G Webster, Medical Instrumentation: Application and Design , John Wiley,3rd Ed. 2012.
2. Joseph J. Carr & John M. Brown , Introduction to biomedical Equipment Technology, 4th Ed., Prentice Hall India, 2001

PH391	ADVANCED MATERIALS	OPC	3 – 0 – 0	3 Credits

Pre-requisites: None.

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

CO1	Understand the synthesis and properties of nanomaterials
CO2	Evaluate the usefulness of nanomaterials in medicine, biology and sensing
CO3	Understand modeling of composite materials by finite element analysis
CO4	Differentiate superconducting materials
CO5	Understand the characteristics and uses of functional materials

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1								2	1
CO2								2	1
CO3								2	1
CO4								2	1
CO5								2	1

Detailed Syllabus:

Nano Materials: Origin of nano technology, Classification of nano materials, Physical, chemical, electrical, mechanical properties of nano materials. Preparation of nano materials by plasma arcing, physical vapour deposition, chemical vapour deposition (CVD), Sol-Gel, electro deposition, ball milling, carbon nano tubes(CNT).Synthesis, preparation of nanotubes, nano sensors, Quantum dots, nano wires,nano biology, nano medidcines.

Biomaterials: Overview of biomaterials. Biomaterials, bioceramics, biopolymers, tissue grafts, soft tissue applications, cardiovascular implants, biomaterials in ophthalmology, orthopeadiac implants, dental materials.

Composites: General characteristics of composites , composites classes, PMCs, MMCs, CMCs, CCCs, IMCs, hybrid composites, fibers and matrices, different types of fibers, whiskers, different matrices materials, polymers, metal, ceramic matrices, toughening mechanism, interfaces, blending and adhesion, composite modeling, finite element analysis and design.

Optical materials: Mechanisms of optical absorption in metals, semiconductors and insulators. Nonlinear optical materials, optical modulators, optical fibers. Display devices and materials photo-emissive, photovoltaic cells, charge coupled devices(CCD), laser materials.

Super conducting materials: Types of super conductors, an account of mechanism of superconductors, effects of magnetic field currents, thermal energy, energy gap, acoustic attenuation, penetration depth, BCS theory, DC and AC Josephson effects, high Tc superconductors, potential applications of superconductivity, electrical switching element, superconductor power transmission and transformers, magnetic mirror, bearings, superconductor motors, generators, SQUIDS etc.

Smart materials: An introduction, principles of smart materials, input – output decision ability, devices based on conductivity changes, devices based on changes in optical response, biological systems smart materials. Devices based on magnetization, artificial structures, surfaces, hetero structures, polycrystalline, amorphous, liquid crystalline materials.

Surface Acoustic Wave (SAW) Materials and Electrets: Delay lines, frequency filters, resonators, Pressure and temperature sensors, Sonar transducers. Comparison of electrets with permanent magnets, Preparation of electrets, Application of electrets..

Reading:

1. T.Pradeep, Nano: The Essentials; TaTa McGraw-Hill,2008.
2. B.S. Murthy et al., Textbook of Nano science and Nanotechnology, University press
3. Krishan K Chawla, Composite Materials; 2nd Ed., Springer 2006.

CY390	**INSTRUMENTAL METHODS IN CHEMICAL ANALYSIS**	**OPC**	**3 – 0 – 0**	**3 Credits**

Pre-requisites: None.

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

CO1	Characterize materials using ultraviolet and visible absorption and fluorescence techniques
CO2	Analyze materials, minerals and trace samples using atomic absorption, emission and X-ray fluorescence techniques
CO3	Analyze environmental, industrial, production-line materials by liquid, gas and size-exclusion chromatographic techniques.
CO4	Characterize interfaces and traces of surface adsorbed materials using electro-analytical techniques
CO5	Understand principles of thermogravimetry and differential thermal analyses.
CO6	Characterize chemical, inorganic and engineering materials using analytical techniques

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1							1	2	
CO2							2	2	
CO3							2	2	
CO4							2	2	
CO5							2	2	
CO6							2	2	

Detailed Syllabus:

UV-Visible Spectrophotometry and Fluorescence Beer-Lambert's law, limitations, Molecular fluorescence, influencing factors, basic instruments, standardization, quantitative methods, applications.

Atomic spectrometry, atomic absorption, X-ray fluorescence methods Flame atomic emission and absorption, flame emission photometer, flame absorption spectrometer, spectral interferences, quantitative aspects, X-ray fluorescence principle, Instrumentation, quantitative analysis.

Separation techniques Solvent extraction, Principle, Extraction of solutes, Soxhlet extraction

Chromatography methods Gas chromatography, High performance liquid chromatography, Size exclusion chromatography, Principle, Basic instrumentation, Capillary Electrophoresis: Principle and application.

Thermoanalytical methods Thermogravimetry, Differential thermal analysis, differential scanning calorimetry, Principle, Block diagram, Applications, Quantitative determinations.

Electroanalytical methods Coulometric methods, Polarography, Pulse voltammetric methods, Amperometry, Principles, Applications, Electrochemical sensors, Ion selective, Potentiometric and amperometric sensors, Applications.

Spectroscopic methods Molecular absorption, Woodward rules, applications, Infra red absorption, functional group analysis, qualitative analysis, 1H- and 13C-NMR spectroscopy, Principle, Basic instrumentation, terminology, Interpretation of data, Quantitative applications.

Mass spectrometry Principles, Instrumentation, Ionization techniques, Characterization and applications.

Reading:

1. Mendham, Denny, Barnesand Thomas, Vogel: Text book of Quantitative Chemical Analysis, Pearson Education, 6th Edition, 2007.
2. Skoog, Holler and Kouch, Thomson, Instrumental methods of chemical analysis, 2007.
3. Willard, Meritt and Dean, Instrumental methods of chemical analysis, PHI, 2005.

CY391	CHEMICAL ASPECTS OF ENERGY SYSTEMS	OPC	3 – 0 – 0	3 Credits

Pre-requisites: None.

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

CO1	Understand traditional and alternative forms of energy
CO2	Understand energy production, storage, distribution and utilization.
CO3	Model environmental impacts of energy generation and conservation
CO4	Apply concepts of engineering design to energy challenges

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1						1		2	
CO2						2		2	
CO3						3		2	
CO5						3		2	

Detailed Syllabus:

THERMOCHEMISTRY AND CHEMICAL KINETICS OF ENERGY SOURCES:

Chemistry of Fuels and Characteristics of a Good Fuel; Heats of Combustion of Fuels; Determination of Heats of Combustion by Bomb Calorimetry and Differential Scanning Calorimetry; Thermodynamics of Electrochemical Cells; Determination of Various Thermochemical Functions of Energy Materials by Electroanalytical Methods (Potentiometry, Coulometry and Voltammetry)

Rates of Combustion Processes; Determination of Ignition Point, Flash Point and Other Kinetic Parameters of Chemical Energy Sources

CHEMISTRY OF CONVENTIONAL AND NON-CONVENTIONAL ENERGY MATERIALS:

Chemical Composition of Finite Energy materials (Petroleum Products, Petroleum Refinery, Fractional Distillation and Petroleum Cracking; Natural Gas, Water Gas, Biomass and Goober Gas; Hydrogen as a Fuel and Its Controlled Combustion; Coal Carbonization and Gasification; Pulverization of Cellulose and Firewood

ELECTROCHEMICAL ENERGY SYSTEMS:

Primary and Secondary batteries, Reserve batteries, Solid state and molten solvent batteries, Recent technological trends, Lithium ion batteries, Nanostructured electrode materials, Lithium and carbon based nanomaterials and nanocomposites, Solid-state Lithium ion batteries, Energy storage and backup. Fuel cells, Scientific prospects of fuel cells, Electrochemistry, In-situ and ex-situ electrochemical characterizations, Current-Voltage measurement, Current Interrupt measurements, Porosity, BET surface area analysis, Gas permeability, Hydrogen as future fuel, Alkaline-, acid- and molten carbonate-fuel cells, Solid oxide fuel cells.

SOLAR ENERGY HARNESSING:

Fundamentals, Conversion into electrical energy, Photovoltaic and Photogalvanic energy storage, Semiconductor photoelectrochemical cells, Photoelectrochemical reactions, Regenerative photoelectrochemical cells, Basic problems, Photocorrosion and protection of semiconductor electrodes, Protective coatings, Coatings of metals and electrically conductive polymers, Electrodes with chemically modified surfaces.

PHOTOCHEMICAL AND PHOTOELECTROCHEMICAL CLEAVAGE OF WATER:

Photochemistry and Photocatalysis of Splitting of Water Molecule; Chemically Modified Electrodes for Water Cleavage; Coordination Chemistry of Water Cleavage

ENVIRONMENTAL CONCERNS AND GREEN METHODS OF ENERGY SOURCES:

Quality of Chemical Energy Sources; Pollution Control and Monitoring of Energy Extraction from Materials; Nanochemical Methods in Energy Extraction; Modeling of Combustion and Other Energy Tapping from Materials

Reading:

1. Francis Vanek, Louis Albright, Largus Argenent, Energy systems Engineering – Evaluation and Implementation, Mc Graw-Hill, 2012.
2. Bob Everett, Godfrey Boyle, Stephen Peake and Janet Ramage, Energy Systems and Sustainability: Power for a Sustainable Future, Oxford Uni Press, 2012.
3. Gianfranco Pistoria, Lithium ion batteries – Advances and applications, Elsevier 2014.
4. Peter Hoffmann, Byron Dorgan, Tomorrow's Energy: Hydrogen, Fuel cells, and the prospects for a cleaner planet, MIT Press, 2012.
5. Yuri V Pleskov, Solar energy conversion, Springer-Verlag, 1990.
6. Piotrowiak, Laurie Peter, Heinz Frei and Tim Zhao, Solar energy conversion – Dynamics of interfacidal electron and excitation transfer, RSC 2013.

HS390	SOFT SKILLS	OPC	3 – 0 – 0	3 Credits

Pre-requisites: None.

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

CO1	Understand corporate communication culture
CO2	Prepare business reports and proposals expected of a corporate professional
CO3	Employ appropriate speech in formal business situations
CO4	Exhibit corporate social responsibility and ethics
CO5	Acquire corporate email, mobile and telephone etiquette

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1							2	1	
CO2							2	1	
CO3							2	1	
CO4							3	1	
CO5							3	1	

Detailed Syllabus:

English Language Enhancement: Verbs and tenses, Phrasal verbs, Synonyms, Antonyms, Homonyms - Descriptive Words, Combining Sentences, Business Idioms, Indianisms in English.

Art of Communication, Communication process- Non-verbal Communication- Effective Listening.

Interpersonal and Intra Personal Communication Skills- Self-Awareness- Self-Esteem and Confidence- Assertiveness and Confidence- Dealing with Emotions-Team Concept- Elements of Teamwork- Stages of Team Formation- Effective Team-Team Player Styles- Leadership.

Campus to Company- Dressing and Grooming- The Corporate Fit- Business Etiquette- Communication; media etiquette- Group Discussions, Interviews, and Presentation Skills.

Interview Handling skills- Effective Resume-- Common Interview Mistakes- Body-language- Content Aid, Visual Aids- Entrepreneurial Skills Development.

Reading:

1. Robert M. Sherfield, Developing Soft Skills, Montgomery and Moody Fourth Edn. Pearson, 2009.
2. K.Alex, Soft Skills: Know Yourself & Know The world, S. Chand; 2009.
3. Robert Bramson, Coping with Difficult People, Dell, 2009

CE440	BUILDING TECHNOLOGY	OPC	3 – 0 – 0	3 Credits

Pre-requisites: None.

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

CO1	Apply basic principles to develop stable, sustainable and cost-effective building plans.
CO2	Identify effective measures for fire proofing, damp proofing, and thermal insulation.
CO3	Adopt standard building provisions for natural ventilation and lighting.
CO4	Identify different materials, quality and methods of fabrication & construction.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	1	2						2	
CO2	1	2						2	
CO3	1	2						2	
CO4	1	2						2	

Detailed Syllabus:

Overview of the course, basic definitions, Buildings – Types, components, economy and design, Principles of planning of buildings and their importance.

Definitions and importance of Grouping and circulation; Lighting and ventilation; How to consider these aspects during planning of building

Termite proofing: Inspection, control measures and precautions, Lighting protection of buildings: General principles of design of openings, Various types of fire protection measures to be considered while planning a building.

General requirements and extra requirements for safety against fire, special precautions, Vertical transportation in building – types of vertical transportation, Stairs, different forms of stairs, planning of stair cases, Other modes of vertical transportation – lifts, ramps, escalators.

Prefabrication systems in residential buildings – walls, openings, cupboards, shelves etc., planning and modules and sizes of components in prefabrication.

Planning and designing of residential buildings against the earthquake forces, Principles, Seismic forces and their effect on buildings.

Air conditioning – process and classification of air conditioning, Dehumidification. Systems of air-conditioning, ventilation, functional requirements of ventilation.

Acoustics, effect of noise, properties of noise and its measurements, Principles of acoustics of building. Sound insulation – importance and measures.

Plumbing services – water supply system, maintenance of building pipe line, Sanitary fittings, principles governing design of building drainage.

Reading:

1. Building Construction - Varghese, PHI Learning Private Limited, 2008
2. Building Construction - Punmia, B C, Jain, A J and Jain A J, Laxmi Publications, 2005.
3. Building Construction by S.P. Arora and S.P. Bindra – Dhanpatrai and Sons, New Delhi, 1996.
4. Building Construction – Technical Teachers Training Institute, Madras, Tata McGraw Hill, 1992.
5. National Building code of India, Bureau of Indian Standards, 2005.

EE440	NEW VENTURE CREATION	OPC	3–0– 0	3 Credits

Pre-requisites: None

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

CO1	Understand the process and practice of entrepreneurship and new venture creation
CO2	Understand conceptual frameworks for identifying entrepreneurial opportunities and for preparation of business plan
CO3	Explore opportunities for launching a new venture
CO4	Identify functional management issues of running a new venture

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1							3	2	
CO2							3	2	
CO3							3	2	
CO4							3	2	

Detailed syllabus:

ENTREPRENEUR AND ENTREPRENEURSHIP:

Entrepreneurship and Small Scale Enterprises (SSE) – Role in Economic Development, Entrepreneurial Competencies, Institution Interface for SSE.

ESTABLISHING THE SMALL SCALE ENTERPRISE:

Opportunity Scanning and Identification, Market Assessment for SSE, Choice of Technology and Selection of Site, Financing the New/Small Enterprises, Preparation of the Business Plan, Ownership Structures and Organizational Framework.

OPERATING THE SMALL SCALE ENTERPRISES:

Financial Management Issues in SSE, Operational Management Issues in SSE, Marketing Management Issues in SSE, Organizational Relations in SSE.

Reading:

1. Kuratko: New Venture Management : The Entrepreneur's Roadmap, Pearson Education India, 2008.
2. Holt, "Entrepreneurship: New Venture Creation", PHI(P), Ltd.,2001.
3. Lisa K. Gundry, Jill R. Kickul: Entrepreneurship Strategy: Changing Patterns in New Venture Creation, Growth, and Reinvention, Sage Publications, 2007.

ME440	ALTERNATIVE SOURCES OF ENERGY	OPC	3 – 0 – 0	3 Credits

Pre-requisites: None

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

CO1	Identify renewable energy sources and their utilization.
CO2	Understand basic concepts of solar radiation and analyze solar thermal systems for its utilization.
CO3	Understand working of solar cells and its modern manufacturing technologies.
CO4	Understand concepts of Fuel cells and their applications
CO5	Identify methods of energy storage.
CO6	Compare energy utilization from wind energy, geothermal energy, biomass, biogas and hydrogen.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1						1	2	2	
CO2						1	2	2	
CO3						1	2	2	
CO4						1	2	2	
CO5						1	2	2	
CO6						1	2	2	

Detailed Syllabus:

Introduction: Overview of the course; Examination and Evaluation patterns; Global warming; Introduction to Renewable Energy Technologies

Energy Storage: Introduction; Necessity of Energy Storage; Energy Storage Methods

Solar Energy: Fundamentals; Solar Radiation; Estimation of solar radiation on horizontal and inclined surfaces; Measurement of solar radiation data

Solar Thermal systems: Introduction; Basics of thermodynamics and heat transfer; Flat plate collector; Evacuated Tubular Collector; Solar air collector; Solar concentrator; Solar distillation; Solar cooker; Solar refrigeration and air conditioning; Thermal energy storage systems

Solar Photovoltaic systems: Introduction; Solar cell Fundamentals; Characteristics and classification; Solar cell: Module, panel and Array construction; Photovoltaic thermal systems.

Wind Energy: Introduction; Origin and nature of winds; Wind turbine siting; Basics of fluid mechanics; Wind turbine aerodynamics; wind turbine types and their construction; Wind energy conversion systems

Fuel cells: Overview; Classification of fuel cells; operating principles; Fuel cell thermodynamics

Biomass Energy: Introduction; Photosynthesis Process; Biofuels; Biomass Resources; Biomass conversion technologies; Urban waste to energy conversion; Biomass gasification.

Other forms of Energy: Introduction: Nuclear, ocean and geothermal energy applications; Origin and their types; Working principles

Reading:

1. Sukhatme S.P. and J.K.Nayak, Solar Energy - Principles of Thermal Collection and Storage, Tata McGraw Hill, New Delhi, 2008.
2. Khan B.H., Non-Conventional Energy Resources,Tata McGraw Hill, New Delhi, 2006.
3. J.A. Duffie and W.A. Beckman, Solar Energy - Thermal Pro

EC440	ELECTRONIC MEASUREMENTS AND INSTRUMENTAION	OPC	3 – 0 – 0	3 Credits

Pre-requisites: None

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

CO1	Apply knowledge of instruments for effective use
CO2	Select suitable instruments for typical measurements.
CO3	Identify various transducers to measure strain, temperature and displacement.
CO4	Understand data acquisition system and general purpose interfacing bus.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1		1						2	
CO2		1						2	
CO3		1						2	
CO4		1						2	

Detailed syllabus

Measurement And Error: Sensitivity, Resolution, Accuracy and precision, Absolute and Relative types of errors, Statistical analysis, Probability of and Limiting errors, Linearity.

Instruments: D'Arsonval movement and basic principles of Measurement of Voltage, Current and Resistance in instruments. Analog and Digital Multimeters, Measurement of time and Frequency – Digital Frequency Meter and applications.

Impedance Measurement: Kelvin Bridge; Megger; Maxwell, Hay and Shering Bridges. Q-meter; Noise and Interference reduction techniques in Measurement Systems.

Oscilloscopes: Block diagram, probes, Deflection amplifier and delay line, Trigger Generator, Coupling, Automatic Time Base and Dual Trace Oscilloscopes, Pulse Measurements, Delayed Time Base, Analog Storage, Sampling and Digital Storage Oscilloscopes.

Special instruments: Wave Analyzer, Harmonic Distortion Analyzer, Spectrum Analyzer, FFT Analyzer.

Transducers (Qualitative Treatment Only): Classification and selection of Transducers, Introduction to strain, Load, force, Displacement, Velocity, Acceleration, Pressure and Temperature Measurements.

Introduction to Data Acquisition Systems (DAS): Block Diagram, Specifications and various components of DAS.

General purpose Instrumentation Bus (GP-IB): Protocol, SCPI Commands and Applications to DSO and DMM.

Reading:

1. Oliver and Cage, Electronic Measurements and Instrumentation, McGraw Hill, 2009
2. Helfrick Albert D. and Cooper William D., Electronic Instrumentation & Measurement Techniques, PHI, 2008.
3. D.A. Bell, Electronic Instrumentation and Measurements, 3/e, Oxford, 2013.

MM440	MATERIALS FOR ENGINEERING APPLICATIONS	OPC	3 – 0 – 0	3 Credits

Pre-requisites: None

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

CO1	Correlate processing, microstructure and properties of materials.
CO2	Understand behaviour of materials under various conditions.
CO3	Characterize modes of failure of engineering materials and design new materials with better properties and cost effective processes.
CO4	Identify suitable materials for engineering applications.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	1	1						2	1
CO2	1	1						2	1
CO3	1	1						2	1
CO4	1	1						2	1

Detailed Syllabus:

Materials Science and Engineering Materials, Classification of Materials and Properties: Mechanical, Dielectric, Magnetic and Thermal

Metallurgical Aspects of Materials: Structure of Metals and Alloys, Nature of Metallic Bonding, Crystal Structures of Metals, Structure of Alloys, Imperfections in Crystals, Significance of microstructural features

Heat Treatment: effect of cooling and heating rates and ageing materials for mechanical load bearing applications

Corrosion Resistant Materials: Some important Metals, Alloys, Ceramics and Polymers

Materials for Electrical Applications: Conductors, Dielectrics, insulators

Materials for Civil Engineering Applications

Materials for Biomedical applications: Steels, Ti and its alloys, Ni-Ti alloys, bioceramics, porous ceramics, bioactive glasses, calcium phosphates, collagen, thin films, grafts and coatings, biological functional materials Latex products

Reading:

1. M.F. Ashby: Engineering Materials, 4th Edition, Elsevier, 2005.
2. M.F. Ashby: Materials Selection in Mechanical Design, B H, 2005.
3. ASM Publication Vol. 20, Materials Selection and Design, ASM, 1997
4. Pat L. Mangonon: The Principles of Materials Selection and Design, PHI, 1999.

CH440	INDUSTRIAL POLLUTION CONTROL	OPC	3 – 0 – 0	3 Credits

Pre-requisites: None

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

CO1	Analyze the effects of pollutants on the environment.
CO2	Understand meteorological aspects of air pollution
CO3	Understand air pollution control methods
CO4	Select treatment technologies for water/wastewater/solid waste.
CO5	Design unit operations for pollution control.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1		1					3	2	
CO2		2					3	2	
CO3		2					3	2	
CO4		2					3	2	
CO5		2					3	2	

Detailed Syllabus:

Introduction: Biosphere, hydrological cycle, nutrient cycle, consequences of population growth, pollution of air, water and soil.

Air pollution sources & effects: Classification and properties of air pollutants, emission sources, behavior and fate of air pollutants, effect of air pollution.

Meteorological aspects of air pollutant dispersion: Temperature lapse rates and stability, wind velocity and turbulence, plume behavior, dispersion of air pollutants, estimation of plume rise.

Air pollution sampling and measurement: Types of pollutant sampling and measurement, ambient air sampling, stack sampling, analysis of air pollutants.

Air pollution control methods & equipment: Control methods, source correction methods, cleaning of gaseous effluents, particulate emission control, selection of a particulate collector, control of gaseous emissions, design methods for control equipment.

Water pollution: Water resources, origin of wastewater, types of water pollutants and there effects.

Waste water sampling, Analysis and Treatment: Sampling, methods of analysis, determination of organic matter, determination of inorganic substances, physical characteristics, bacteriological measurement, basic processes of water treatment, primary treatment, secondary treatment, advanced wastewater treatment, recovery of materials from process effluents.

Solid Waste Management: Sources and classification, public health aspects, methods of collection, disposal Methods, potential methods of disposal.

Hazardous Waste Management: Definition and sources, hazardous waste classification, treatment methods, disposal methods.

Reading:

1. Rao C.S. – Environmental Pollution Control Engineering- Wiley Eastern Limited, India, 1993.
2. Noel de Nevers- Air Pollution and Control Engineering- McGraw Hill, 2000.
3. Glynn Henry J. and Gary W. Heinke - Environmental Science and Engineering, 2nd Edition, Prentice Hall of India, 2004.
4. Rao M.N. and Rao H.V.N - Air Pollution, Tata – McGraw Hill Publishing Ltd., 1993.
5. De A.K - Environmental Chemistry, Tata – McGraw Hill Publishing Ltd., 1999.

CH441	FUEL CELL TECHNOLOGY	OPC	3 – 0 – 0	3 Credits

Pre-requisites: None.

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

CO1	Understand fuel cell fundamentals.
CO2	Analyze the performance of fuel cell systems.
CO3	Understand construction and operation of fuel cell stack and fuel cell system.
CO4	Apply the modeling techniques for fuel cell systems

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1							3	2	
CO2							3	2	
CO3							3	2	
CO4							3	2	

Detailed syllabus

Overview of Fuel Cells: What is a fuel cell, brief history, classification, how does it work, why do we need fuel cells, Fuel cell basic chemistry and thermodynamics, heat of reaction, theoretical electrical work and potential, theoretical fuel cell efficiency.

Fuels for Fuel Cells: Hydrogen, Hydrocarbon fuels, effect of impurities such as CO, S and others.

Fuel cell electrochemistry: electrode kinetics, types of voltage losses, polarization curve, fuel cell efficiency, Tafel equation, exchange currents.

Fuel cell process design: Main PEM fuel cell components, materials, properties and processes: membrane, electrode, gas diffusion layer, bi-polar plates, Fuel cell operating conditions: pressure, temperature, flow rates, humidity.

Main components of solid-oxide fuel cells, Cell stack and designs, Electrode polarization, testing of electrodes, cells and short stacks, Cell, stack and system modeling

Fuel processing: Direct and in-direct internal reforming, Reformation of hydrocarbons by steam, CO_2 and partial oxidation, Direct electro-catalytic oxidation of hydrocarbons, carbon decomposition, Sulphur tolerance and removal , Using renewable fuels for SOFCs

Reading:

1. Gregor Hoogers, Fuel Cell Technology Hand Book, CRC Press, 2003.
2. Karl Kordesch& Gunter Simader, Fuel Cells and Their Applications, VCH Publishers, NY, 2001.
3. F. Barbir, PEM Fuel Cells: Theory and Practice (2nd Ed.) Elsevier/Academic Press, 2013.
4. Subhash C. Singal and Kevin Kendall, High Temperature Fuel Cells: Fundamentals, Design and Applications

CS440	MANAGEMENT INFORMATION SYSTEMS	OPC	3 – 0 – 0	3 Credits

This course is not available to B.Tech Computer Science & Engineering Students

Pre-requisites: None

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

CO1	Determine key terminologies and concepts including IT, marketing, management, economics, accounting, finance in the major areas of business.
CO2	Design, develop and implement Information Technology solutions for business problems.
CO3	Analysis of computing systems and telecommunication networks for business information systems.
CO4	Understand ethical issues that occur in business, evaluate alternative courses of actions and evaluate the implications of those actions.
CO5	Plan projects, work in team settings and deliver project outcomes in time.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1		3	2					2	
CO2		3	2					2	
CO3		3	2					2	
CO4							3	2	
CO5								2	3

Detailed syllabus

Organization and Information Systems, Foundation Concepts, Information Systems in Business, The Components of Information Systems, Competing with Information Technology, Fundamentals of Strategic Advantage, Using Information Technology for Strategic Advantage.

Changing Environment and its impact on Business, Kinds of Information Systems.

Computer Fundamentals, Computer Hardware, Computer Systems: End User and Enterprise Computing, Computer Peripherals: Input, Output, and Storage Technologies, Computer Software, Application Software, System Software, Computer System Management, Data Resource Management, Technical Foundations of Database Management, Managing Data Resources

Telecommunication and Networks, Telecommunications and Networks, The Networked Enterprise, Telecommunications Network Alternatives

System Analysis and Development and Models, Developing Business/IT Strategies, Planning Fundamentals, Implementation Challenges, Developing Business/IT Solutions, Developing Business Systems, Implementing Business Systems

Manufacturing and Service Systems Information systems for Accounting, Finance, Production and Manufacturing, Marketing and HRM functions, Enterprise Resources Planning (ERP), Choice of IT, Nature of IT decision, Managing Information Technology, Managing Global IT,

Security and Ethical Challenges, Security and Ethical Challenges, Security and Ethical, and Societal Challenges of IT, Security Management of Information Technology, Enterprise and Global Management of Information Technology

Reading:

1. Kenneth J Laudon, Jane P. Laudon, *Management Information Systems*, 10th Edition, Pearson/PHI, 2007.
2. W. S. Jawadekar, *Management Information Systems*, 3rd Edition, TMH, 2004.

BT440	BIOSENSORS	OPC	3 – 0 – 0	3 Credits

Pre-requisites: None.

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

CO1	Understand biosensing and transducing techniques
CO2	Understand principles of linking cell components and biological pathways with energy transduction, sensing and detection
CO3	Demonstrate appreciation for the technical limits of performance of biosensor
CO4	Apply principles of engineering to develop bioanalytical devices and design of biosensors

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1		1					3	2	
CO2		1					3	2	
CO3		1					3	2	
CO4		3					3	2	

Detailed Syllabus:

General principles: A historical perspective; Signal transduction; Physico-chemical and biological transducers; Sensor types and technologies, Definitions and Concepts Terminology and working vocabulary; Main technical definitions: calibration, selectivity, sensitivity, reproducibility, detection limits, response time.

Physico-chemical transducers: Electrochemical transducers (amperometric, potentiometric, conductimetric); optical transducers (absorption, fluorescence, SPR); Thermal transducers; Piezoelectric transducers.

Biorecognition systems: Enzymes; Oligonucleotides and Nucleic Acids; Lipids (Langmuir-Blodgett bilayers, Phospholipids, Liposomes); Membrane receptors and transporters; Tissue and organelles (animal and plant tissue); Cell culture; Immunoreceptors; Chemoreceptors; Limitations & problems. Immobilization of biomolecules.

Biosensor Engineering: Methods for biosensors fabrication: self-assembled monolayers, screen printing, photolithography, micro-contact printing, MEMS. Engineering concepts for mass production.

Application of modern sensor technologies: Clinical chemistry; Test-strips for glucose monitoring; Urea determination; Implantable sensors for long-term monitoring; Environmental monitoring; Technological process control; Food quality control; Forensic science benefits; Problems & limitations.

Reading:

1. Donald G. Buerk, Biosensors: Theory and Applications, 1st Edition, CRC Press, 2009.
2. Alice Cunningham, Introduction to Bioanalytical Sensors, John Wiley& Sons, 1998.
3. Brian R. Eggins, Chemical Sensors and Biosensors, John Wiley& Sons, 2003.

SM440	HUMAN RESOURCE MANAGEMENT	OPC	3 – 0 – 0	3 Credits

Pre-requisites: None

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

CO1	Understand principles, processes and practices of human resource management.
CO2	Apply HR concepts and techniques in strategic planning to improve organizational performance.
CO3	Understand tools to manage HR systems and procedures.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1		2					3	2	3
CO2		2					3	2	3
CO3		2					3	2	3

Detailed Syllabus:

Introduction to Human Resource Management, Objectives, Scope and Significance of HRM, Functions of HRM, Problems and Prospects in HRM, Environmental scanning.

Human Resource Planning, Demand Forecasting Techniques, Supply Forecasting Techniques,

Analyzing work and designing jobs, Recruitment and Selection, Interviewing Candidates.

Human Resource Development, Orientation, Training and Development, Management

Development, Performance Appraisal and Employee Compensation, Factors Influencing

Employee Remuneration and Challenges of Remuneration.

Industrial Relations, Industrial Disputes and Discipline, Managing Ethical Issues in Human Resource Management, Workers Participation in Management, Employee safety and health,

Managing Global Human Resources and Trade Unions

International HRM, Future of HRM and Human Resource Information Systems

Reading:

1. Aswathappa, Human Resource Management — TMH., 2010.
2. Garry Dessler and Biju Varkkey ,Human Resource Management, PEA., 2011.
3. Noe & Raymond ,HRM: Gaining a Competitive Advantage, TMH, 2008.
4. Bohlander George W, Snell Scott A, Human Resource Management, Cengage Learning, 2009.

MA440	OPTIMIZATION TECHNIQUES	OPC	3 – 0 – 0	3 Credits

Pre-requisites: None

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

CO1	Formulate and solve linear Programming Problems
CO2	Determine the optimum solution to constrained and unconstrained
CO3	Apply dynamic programming principle to Linear programming problems.
CO4	Determine the integer solutions to Linear Programming Problems.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	2	2	2	2			2	2
CO2	3	2	2	2	2			2	2
CO3	3	2	2	2	2			2	2
CO4	3	2	2	2	2			2	2

Detailed Syllabus:

Linear Programming: Introduction and formulation of models, Convexity, Simplex method, Big-M method, Two-phase method, Degeneracy, non-existent and unbounded solutions, revised simplex method, duality in LPP, dual simplex method, sensitivity analysis, transportation and assignment problems, traveling salesman problem .

Nonlinear Programming: Introduction and formulation of models, Classical optimization methods, equality and inequality constraints, Lagrange multipliers and Kuhn-Tucker conditions, quadratic forms, quadratic programming problem, Wolfe's method.

Dynamic Programming: Principle of optimality, recursive relations, solution of LPP.

Integer Linear Programming: Gomory's cutting plane method, Branch and bound algorithm, Knapsack problem, linear 0-1 problem.

Reading:

1. Kanti Swarup, Man Mohan and P.K.Gupta, Introduction to Operations Research, S.Chand & Co., 2006
2. J.C. Pant, Introduction to Operations Research, Jain Brothers, New Delhi, 2008.
3. N.S.Kambo, Mathematical Programming Techniques, East-West Pub., Delhi, 1991.

MA441	OPERATIONS RESEARCH	OPC	3 – 0 – 0	3 Credits

Prerequisites: None

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

CO1	Formulate and solve linear programming problems
CO2	Determine optimum solution to transportation problem
CO3	Determine average queue length and waiting times of queuing models.
CO4	Determine optimum inventory and cost in inventory models.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	2	2	2	2			2	2
CO2	2	2	2	2	2			2	2
CO3	2	2	2	2	2			2	2
CO4	2	2	2	2	2			2	2

Detailed Syllabus:

Linear Programming: Formulation and graphical solution of LPP's. The general LPP, slack, surplus and artificial variables. Reduction of a LPP to the standard form. Simplex computational procedure, Big-M method, Two-phase method. Solution in case of unrestricted variables. Dual linear programming problem. Solution of the primal problem from the solution of the dual problems.

Transportation Problems : Balanced and unbalanced Transportation problems. Initial basic feasible solution using N-W corner rule, row minimum method, column minimum, least cost entry method and Vogel's approximation method. Optimal solutions. Degenracy in Transportation problems.

Queueing Theory : Poisson process and exponential distribution. Poisson queues - Model (M/M/1):(∞/FIFO) and its characteristics.

Elements of Inventory Control : Economic lot size problems - Fundamental problems of EOQ. The problem of EOQ with finite rate of replenishment. Problems of EOQ with shortages - production instantaneous, replenishment of the inventory with finite rate. Stochastic problems with uniform demand (discrete case only).

Reading:

1. Kanti Swarup, Man Mohan and P.K.Gupta, Introduction to Operations Research, S. Chand & Co., 2006
2. J.C. Pant, Introduction to Operations Research, Jain Brothers, New Delhi, 2008.
3. N.S.Kambo : Mathematical Programming Techniques, East-West Pub., Delhi, 1991.

PH440	NANOMATERIALS AND TECHNOLOGY	OPC	3 – 0 – 0	3 Credits

Prerequisites: None

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

CO1	Understand synthesis and properties of nanostructured materials.
CO2	Analyze magnetic and electronic properties of quantum dots
CO3	Understand structure, properties and applications of Fullerenes and Carbon nanotubes.
CO4	Understand applications of nanoparticles in nanobiology and nanomedicine

Mapping of course outcomes with program outcomes

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1		1					1	2	
CO2		1					1	2	
CO3		1					1	2	
CO4		1					1	2	

Detailed Syllabus:

General properties of Nano materials : Origin of nanotechnology. Classification of nanomaterials. Fullerene,carbon, Nanotubes (CNT's), Nanoparticles. Physical, Chemical, Electrical, Optical, Magnetic and mechanical properties of nanomaterials.

Fullerenes and Carbon Nanotubes (CNT's): Introduction: Synthesis and purification. Preparation of fullerenes in the condensed phase,Transport, mechanical, physical properties of CNT's.

Investigation and manipulating materials in the Nanoscale: Electron microscope, scanning probe microscopes, optical microscopes for Nanoscience and Technology, X-Ray Diffraction.

SAMs and clusters: Growth process. Patterning monolayers. Types of clusters. Bonding and properties of clusters.

Semi conducting Quantum Dots: Introduction: Synthesis of Quantum Dots. Electronic structure of Nanocrystals, properties.

Nanobiology: Interaction between Biomolecules and Nanoparticle surgaces. Different types of Inorganic materials used for the synthesis of Hybrid Nano-bio assemblies. Nanoprobes for Analytical Applications.

Nanosensors: Nanosensors based on optical properties. Nanosensors based on quantum size effects. Nanobiosensors.

Nanomedicines: Developments of nanomedicines. Nanotechnology in Diagnostic Applications, materials for use in Diagnostic and therapeutic Applications.

Reading:

1. T. Pradeep, Nano: The Essentials; Tata McGraw-Hill, 2008.

2. W.R. Fahrner, Nanotechnology and Nanoelectronics; Springer,2006.
3. Rechard Booker and Earl Boysen, Nanotechnology, Willey, 2006.

PH441	BIOMATERIALS AND TECHNOLOGY	OPC	3 – 0 – 0	3 Credits

Prerequisites: None

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

CO1	Understand the structure and properties of biomaterials
CO2	Classify implant biomaterials
CO3	Evaluate biocompatibility of implants
CO4	Identify appropriate biomaterials for specific medical applications

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1							2	2	
CO2							3	2	
CO3							3	2	
CO4							2	2	

Detailed Syllabus:

Overview of biomaterials: Historical developments, impact of biomaterials, interfacial phenomena, tissue responses to implants.

Structure and properties of biomaterials: Crystal structure of solids, phase changes, imperfections in solids, non-crystalline solids, surface properties of solids, mechanical properties, surface improvements.

Types of biomaterials: Metallic implant materials, ceramic implant materials, polymeric implant materials composites as biomaterials.

Characterization of materials: Electric properties, optical properties, X-ray absorption, acoustic and ultrasonic properties.

Bio implantation materials: Materials in ophthalmology, orthopedic implants, dental materials and cardiovascular implant materials.

Tissue response to implants : Normal wound healing processes, body response to implants, blood compatibility, structure – property relationship of tissues.

Reading:

1. Joon Park, R.S. Lakes , Biomaterials an introduction; 3rd Ed., Springer, 2007
2. Sujatha V Bhat , Biomaterials; 2nd Ed., Narosa Publishing House, 2006.

CY440	CORROSION SCIENCE	OPC	3 – 0 – 0	3 Credits

Pre-requisites: None

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

CO1	Understand the electrochemical Principles of Corrosion.
CO2	Apply eight forms of corrosion to industrial problems.
CO3	Evaluate corrosion rates for industrial problems
CO4	Evaluate the corrosion rates of steel in RCC under corrosive environments.
CO5	Perform case studies using microbially induced corrosion of metals.
CO6	Perform case studies using appropriate methods of corrosion control of metals and alloys

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1							1	2	
CO2							1	2	
CO3							1	2	
CO4							1	2	
CO5							1	2	
CO6							1	2	

Detailed Syllabus:

Understanding Corrosion:

Types of corrosion: uniform corrosion, Galvanic corrosion, pitting corrosion, stress corrosion cracking, corrosion fatigue, stray current corrosion, selective leaching, microbial corrosion Pourbaix potential-pH diagrams for iron, for aluminium, limitations of Pourbaix diagram Passivity- characteristics of passivation and the Flade potential, Theories of passivity, passive-active cells, critical pitting potential, Anodic protection and transpassivity.

Methods of corrosion monitoring:

Polarisation and corrosion rates, polarisation diagrams of corroding metals, calculation of corrosion rates from polarization data. Electrochemical impedance spectroscopy: Nyquist plots, Bode plots, simple equivalent circuits for fitting the impedance data, calculation of corrosion parameters from impedance measurements. Electrochemical cell assembly for polarization and impedance studies. Gravimetric method of determination of corrosion rates.

Measurement of corrosion rates of carbon steel in reinforced cement concrete, Corrosion rates of metals due to micriobially induced corrosion .

Methods of corrosion prevention and control:

Cathodic protection; By impressed current, By the use of sacrificial anodes, combined use with coatings, Advances in cathodic protection.

Metallic coatings: Methods of application, Electroplating, Electroless plating, specific metal platings like Cu, Ni and Cr.

Inhibitors and passivators: Picking inhibitors, vapour phase inhibitors, Inhibitors for cooling water systems, understanding of action of inhibitors through polarization and impedance.

Corrosion prevention and control strategies in different industries – case studies

Reading:

1. R. Winston Revie, Herbert H. Uhlig, Corrosion and Corrosion control, 4th edition, Wiley-Interscience, 2007
2. Mc Cafferty and Edward, Introduction to Corrosion Science, 1st Edition, Springer, 2010.
3. Mars G. Fontana, Corrosion Engineering, 3rd edition, Tata McGraw- Hill, New Delhi, 2008.

CY441	CHEMISTRY OF NANOMATERIALS	OPC	3 – 0 – 0	3 Credits

Pre-requisites: None

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

CO1	Understand the state of art synthesis of nano materials
CO2	Characterize nano materials using ion beam, scanning probe methodologies, position sensitive atom probe and spectroscopic ellipsometry.
CO3	Analyze nanoscale structure in metals, polymers and ceramics
CO4	Analyze structure-property relationship in coarser scale structures
CO5	Understand structures of carbon nano tubes.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1		1					2	2	
CO2		1					2	2	
CO3		1					2	2	
CO4		1					3	2	
CO5		1					3	2	

Detailed Syllabus:

Introduction: Scope of Nano science and nanotechnology, Nano science in nature, classification of nanostructured materials, importance of nano materials.

Synthetic Methods: Chemical Routes (Bottom-Up approach):- Sol-gel synthesis, micro emulsions or reverse micelles, solvothermal synthesis, microwave heating synthesis and sonochemical synthesis. Physical methods (Top-Down approach):- Inert gas condensation, plasma arc technique, ion sputtering, Laser ablation, laser pyrolysis, and chemical vapour deposition method.

Techniques for characterization:

Diffraction Technique: - Powder X-ray diffraction for particle size analysis.

Spectroscopy Techniques: - Operational principle and applications of spectroscopy techniques for the analysis of nanomaterials, UV-VIS spectrophotometers and its application for band gap measurement.

Electron Microscopy Techniques:- Scanning electron microscopy (SEM) and EDAX analysis, transmission electron microscopy (TEM), scanning probe microscopy (SPM).

BET method for surface area determination.

Dynamic light scattering technique for particle size analysis.

Reading:

1. T. Pradeep, NANO: The Essentials: McGraw-Hill, 2007.

2. B. S. Murty, P. Shankar, Baldev Rai, BB Rath and James Murday, Textbook of Nanoscience and nanotechnology: Univ. Press, 2012.
3. Guozhong Cao, Nanostructures & Nanomaterials; Synthesis, Properties & Applications: Imperial College Press, 2007.
4. M.A. Shah and Tokeer Ahmad, Principles of Nanoscience and Nanotechnology: Narosa Pub., 2010.
5. Manasi Karkare, Nanotechnology: Fundamentals and Applications: IK International, 2008.
6. C. N. R. Rao, Achim Muller, K.Cheetham, Nanomaterials Chemistry, Wiley-VCH, 2007

HS440	CORPORATE COMMUNICATION	OPC	3 – 0 – 0	3 Credits

Pre-requisites: None

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

CO1	Understand corporate communication culture
CO2	Prepare business letters, memos and reports
CO3	Communicate effectively in formal business situations
CO4	Exhibit corporate social responsibility and ethics
CO5	Practice corporate email, mobile and telephone etiquette
CO6	Develop good listening skills and leadership qualities

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1							3	2	2
CO2							3	2	2
CO3							3	2	2
CO4							3	2	2
CO5							3	2	2
CO6							3	2	2

Detailed Syllabus:

Importance of Corporate communication - Introduction to and definition of corporates – Communication, process, patterns and channels of communication- Barriers to communication and strategies to overcome them- Evolution of corporate culture- Role and contribution of individual group and organization - Role of psychology in communication.

Oral Communication- Techniques for improving oral fluency-Speech mechanics-Group Dynamics and Group Discussion – Debate and oral presentations.

Written Communication- Types and purposes- Writing business reports, and business proposals- Memos, minutes of meetings- Circulars, persuasive letters- Letters of complaint- ; language and formats used for drafting different forms of communication. Internal and external communication.

Corporate responsibility- Circulating to employees vision and mission statements- ethical practices- Human rights -Labour rights-Environment- governance- Moral and ethical debates surrounding -Public Relations - Building trust with stakeholders.

Corporate Ethics and Business Etiquette- Integrity in communication-Harmful practices and communication breakdown- Teaching how to deal with tough clients through soft skills. Body language- Grooming- Introducing oneself- Use of polite language- Avoiding grapevine and card pushing – Etiquette in e-mail, mobile and telephone.

Listening Skills - Listening- for information and content- Kinds of listening- Factors affecting listening and techniques to overcome them- retention of facts, data and figures- Role of speaker in listening.

Leadership Communication Styles - Business leadership -Aspects of leadership-qualities of leader- training for leadership-delegation of powers and ways to do it-humour-commitment.

Reading:

1. Raymond V. Lesikar, John D. Pettit, Marie E. Flatley Lesikar's Basic Business Communication - 7th Edition: Irwin, 1993
2. Krishna Mohanand Meera Banerji, Developing Communication Skills: Macmillan Publishers India, 2000
3. R.C. Sharma & Krishna Mohan Business Correspondence and Report Writing: – 3rd Edition Tata McGraw-Hill, 2008
4. Antony Jay & Ross Jay, Effective Presentation, University Press, 1999.
5. Shirley Taylor, Communication for Business, Longman, 1999