INDIAN INSTITUTE OF INFORMATION TECHNOLOGY, DESIGN & MANUFACTURING JABALPUR

UG CURRICULUM

The CRC takes its guiding principles from the ethos and vision of the Institute. In particular its belief in the following philosophies:

1. The curriculum is based on the choice based credit systems through electives (Open elective across the disciplines and professional electives within the disciplines).

2. The CRC takes care of the project based learning beginning from Semester 1 to encourage the students for new products and integrated solution methodology.

3. It is also taken care about the industrial experience of students through project in higher semester that enhances the Industry relationship.

4. Inter-discipline courses have been proposed for broad knowledge of students in inter discipline subjects (through core courses and core electives)

5. The committee has taken care of Design and manufacturing projects for hands on experience.

6. The committee balance the load for different types of courses in the curriculum (About 50 % from own discipline and 50 % from other disciplines).

UG CURRICULUM GUIDELIENS

Total Credit in BTech	**160**	
Professional courses	**81**	
	Professional core: 33	courses from Engineering disciplines (EC,CS,ME)
	Professional Ele: 34 -38	courses from Engineering disciplines (EC,CS,ME)
	Project: up to 04-08	Project from all disciplines (EC,CS,ME, NS, DS)
	Professional Lab: 6	courses from Engineering disciplines (EC,CS,ME)
Core courses (ES+NS+DS+MN+HS)	79	
	Engineering Science (ES): 30	courses from different disciplines (core+elective)
	Natural Science(NS): 21	Courses from natural Science(core+elective)
	Humanities (HS): 12	Courses from English, Environmental Science and others (core+elective)
	Design (DS): 8	Courses of Design in nature (core)
	Manufacturing (MN):4	Courses of Manufacturing in nature (core)
	Management Science (MS):4	Courses of Management in nature (core)
External PBI	12 credit (against 3 prof. Electives) in 7th Sem. 8 credits to be earned from other semester where atleast 4 credits should be before PBI. Coordination of PBI will be done by Discipline.	
Optional Project	A student can choose project starting from first semester and can register at any time in a year after discussing with faculty mentor. The project will be of two credits in a year. A student can earn maximum of 6 credits within 3 years and he/she may get relaxation of 6 credits in the curriculum (Including PBI/Project) as per his/her choice. The evaluation of this optional project will be in the summer by an approved committee at the discipline level. The weightage of grading will be: Faculty menter-70%, committee-30%. The faculty mentor will be convener of the process of evaluation of his student.	
Academic load and the credit for a given course	Academic Load: AL = 3.0 x L + 1.0 x T + 1.5 x P + 0.0 x D+1.5 x PR (L: Lecture Hours, T: Tutorial Hours, P: Practice or Lab Hours, D: Discussion Hours and Pr =Project hour)	

Academic Load AL		**Course Weightage or Units**
Course Credits or Units	≤ 06	2
	> 06 - ≤ 08 / (06, 08]	3
	(08, 11]	4
	(11, 13]	5
	>13	6

Grading

A+	10	C+	6	F	2
A	9	C	5	S	Satisfactory
B+	8	D+	4	X	Unsatisfactory
B	7	D	3	CD	Course Drop

UG Curriculum Structure

Sem1	Sem2	Sem3	Sem4
NS1, (3L+1T, 4C) NS101: Mathematics-I	NS3,(3L+1T, 4C) NS103: Mathematics-II	NS5 (Elect), (3L+1T , 4C) Course of NS nature and can be floated by any discipline NS205a,b…..	ES5 (3L, 4C) Core courses(Engg Discipline) ES205:Fundamentals of Robotics
NS2, (2L+1T+2P, 4C) NS102: Engineering Mechanics	NS4, (3L+1T+2P, 5C) NS104: Electrodynamics and Optics	ES4, (3L, 4C) Core courses(Engg Discipline) ES204: Digital Electronics	MS1 (3L, 4C) Core course, Management MS201: Management Concepts and Technology
HS1, (2L+1D, 2C) HS101: Effective Communication Skills	HS2, (2L+1GD, 2C) HS102: Culture and Human values	MN1, (2L+2P, 4C) MN201: Manufacturing process	Prof C3(3L+1T,4C) EC203: Network Analysis and synthesis ME203: Thermodynamics CS203: Computer Organization and Architecture
ES1, (3L+2P, 5C) ES101: Fundamental of Electrical & Electronics Engg.	DS1, (1L+3P, 3C) DS101: Engineering Graphics	Prof C1, (3L+2P, 5C) EC201: Electronics Devices and Circuits ME201: Kinematics and Dynamics of Machines CS201: DBMS	Prof C4(3L,4C) EC204: Signals and Systems ME204:Solid Mechanics CS204:Design & Analysis of Algorithm
ES2, (2L+2P, 4C) ES102: Fundamental of Computing	ES3, (3L+2P, 5C) ES103: Data structure and Algorithm	Prof C2, (2L, 2C) EC202: Instrumentation and Measurement ME202: IT Workshop (3P) CS202: OOPs with Java (1L+2P, 2C)	Prof C5 (2L,2C) EC205: Microprocessor and interfacing ME205: Engg Material CS205: Data Communication
			Prof Lab1(3P,2C) EC206L: Microprocessor +Electronics ME206L: Thermodynamics + Solid Mechanics CS206L: Lab based Project 1 (CSE)
PR101: Project (Optional), 2C		**PR201: Project (Optional), 2C**	

Sem5	Sem6	Sem7	Sem8
DS2 (2L+4P, 5C) DS302: Engineering design (incl design & Fabrication project)	HS3(3L,4C) Open elective2 from HS HS303a,b…	ES6 (3L, 4C) Core Elective from an Enggineering Discipline floated for other disciplines ES406a,b…	ES7/HS5/NS6/DS3/ MN2 (3L,4C) Open elective3 All streams ES407a,b… HS405a,b… NS406a,b… DS403a,b… MN402a,b…
Prof C6(3L,4C) EC307: Fundamental of Electromagnetic Theory ME307:Manufacturing Technology CS307:Computer Network	HS4(3L, 4C), (Core course) HS304: Environmental Science	Prof El 4(3L,4C) EC416a,b… ME416a,b… CS416a,b…	Prof El 7(3L,4C) EC419a,b… ME419a,b… CS419a,b…
Prof C 7(3L+1T,4C) EC308:Control Systems ME308:Fluid Mechanics CS308:Operating System	Prof C9(3L,4C) EC312: Linear Integrated Circuit Design ME312: HMT CS312: Software Engineering	Prof El 5(3L,4C) EC417a,b… ME417a,b… CS417a,b…	Prof El 8(3L,4C) EC420a,b… ME420a,b… CS420a,b…
Prof C 8(3L,4C) EC309: Principle of Communication ME309:Design of Mechanical Components CS309:Language Theory	Prof El 2(3L,4C) EC313a,b… ME313a,b… CS313a,b…	Prof El 6(3L,4C) EC418a,b… ME418a,b… CS418a,b…	Prof El 9(3L,4C) EC421a,b… ME421a,b… CS421a,b…
ProfEl 1(2L,2C) EC310a,b… ME310a,b… CS310a,b…	Prof El3(3L,4C) EC314a,b… ME314a,b… CS314a,b…	Project(4C) PR499 PR499 PR499	Project(4C) or Prof El 10(3L,4C) PR499,PR499,PR499 or EC422a,b… ME422a,b… CS422a,b…
Prof Lab 2(3P,2C) EC311L: Control systems+Communication ME311L: FM&ST CS311L:Lab based Project 2	Prof Lab 3(3P,2C) EC315L:DSP+Microwave ME315L:Adv. Manufacturing + NCCNC CS315L:Lab based Project 3		
PR301: Project (Optional), 2C			

Electives

Course Type	Course Code	Course Name	Credits	Semester
Engineering Science(ES)-6	ES406a	Communication Systems	3L, 4C	VII
	ES406b	Electrical Drives and Control	3L, 4C	
	ES406c	Sensors and Actuators	3L, 4C	
	ES406d	Geometric Modelling	3L, 4C	
	ES406e	Computer Graphics	3L, 4C	
	ES406f	Multimedia Processing	3L, 4C	
Engineering Science(ES)-7	ES407a	Fundamentals of RF & Microwave Electronics	3L, 4C	VIII
	ES407b	Internet of things	3L, 4C	
	ES407c	Applied Photonics	3L, 4C	
	ES407d	Operations Research	3L, 4C	
	ES407e	IoT	3L, 4C	
	ES407f	Social network Analysis	3L, 4C	
	HS405a	Culture and Technology	3L, 4C	
Natural Science(NS)-5	NS205a	Advanced Engineering Mathematics	3L, 4C	III
	NS205b	Analytical Methods in Engineering	3L, 4C	
	NS205c	Discrete Mathematics	3L, 4C	
	NS205d	Applied Probability and Statistics	3L, 4C	
	NS205e	Numerical Methods	3L, 4C	
	NS205f	Optimization	3L, 4C	
	NS205g	Modern Physics	3L, 4C	
	NS205h	Material Science	3L, 4C	
	NS205i	Culture and Science-a comparison	3L, 4C	
Humanity Science(HS)-3	HS303a	Soft Skills and use of English Language	3L, 4C	VI
	HS303b	Literature in Social Cultural Panorama	3L, 4C	
	HS303c	Indian Philosophy and Literature in English	3L, 4C	
Prof Elective-1	EC310a	Computer Networks	2L, 2C	V
	EC310b	Digital System Design	2L, 2C	
	EC310c	Intelligent Control	2L, 2C	
	ME310a	Steam Turbine	2L, 2C	
	ME310b	Steam Generators	2L, 2C	
	ME310c	Gas Dynamics	2L, 2C	
	CS310a	Soft Computing	2L, 2C	
	CS310b	Parallel Computing	2L, 2C	
	CS310c	Coding Theory	2L, 2C	
Prof Elective-2	EC313a	Digital Communication	3L, 4C	VI
	EC313b	Digital Signal Processing	3L, 4C	
	EC313c	IC Fabrication	3L, 4C	
	ME313a	Finite Element Methods	3L, 4C	
	ME313b	CNC Machine Tools and Programming	3L, 4C	
	ME313c	Computer Aided Design	3L, 4C	
	CS313a	S/W testing and Quality Assurance	3L, 4C	
	CS313b	Network Security & Cryptography	3L, 4C	
	CS313c	Artificial Intelligence	3L, 4C	

Prof Elective-3	EC314a	Antenna Theory & Design	3L, 4C	VI
	EC314b	Wavelet and Filter Bank	3L, 4C	
	EC314c	Biomedical Instrumentation	3L, 4C	
	ME314a	Vibration of Mechanical Systems	3L, 4C	
	ME314b	Computer Aided Design	3L, 4C	
	ME314c	Computational Fluid Dynamics	3L, 4C	
	CS314a	Wireless and Mobile networks	3L, 4C	
	CS314b	Machine Learning	3L, 4C	
	CS314c	Human Computer Interactions	3L, 4C	
	CS314d	Compiler Design	3L, 4C	
Prof Elective-4	EC416a	Advanced Analog Circuits Design	3L, 4C	VII
	EC416b	Detection and Estimation Theory	3L, 4C	
	EC416c	Industrial Microwave and Communication	3L, 4C	
	ME416a	Energy Conversion Device	3L, 4C	
	ME416b	Industrial Instrumentation & Metrology	3L, 4C	
	ME416c	Rapid Product Development Technologies	3L, 4C	
	CS416a	Pattern Recognition	3L, 4C	
	CS416b	Internet Technology	3L, 4C	
	CS416c	Cyber Security	3L, 4C	
	CS416d	Computational Geometry	3L, 4C	
Prof Elective-5	EC417a	Satellite Communication	3L, 4C	VII
	EC417b	Mixed-Mode Circuit Design	3L, 4C	
	EC417c	Power System Engineering	3L, 4C	
	ME417a	Mechanical Vibration and Condition Monitoring	3L, 4C	
	ME417b	Advance Manufacturing Processes	3L, 4C	
	ME417c	Automobile Engineering	3L, 4C	
	CS417a	Advanced Computer Architecture	3L, 4C	
	CS417b	Cloud Computing	3L, 4C	
	CS417c	Object Oriented Analysis and Design	3L, 4C	
Prof Elective-6	EC418a	Time Frequency Analysis	3L, 4C	VII
	EC418b	Radio Frequency Integrated Circuits Design	3L, 4C	
	EC418c	Physics of Semiconductor Devices	3L, 4C	
	ME418a	Advance Solid Mechanics	3L, 4C	
	ME418b	Management of Production System	3L, 4C	
	ME418c	Design of Mechanical Systems	3L, 4C	
	CS418a	Complex Networks	3L, 4C	
	CS418b	Data Mining and Data Warehousing	3L, 4C	
	CS418c	Advanced Algorithms	3L, 4C	
	CS318d	Mesh Free Computations	3L, 4C	
Prof Elective-7	EC419a	RF and Microwave Engineering	3L, 4C	VIII
	EC419b	Power Electronics	3L, 4C	
	EC419c	Advanced Filter Design	3L, 4C	
	ME419a	Computer Integrated Manufacturing	3L, 4C	
	ME419b	Fracture and Fatigue	3L, 4C	
	ME419c	Refrigeration and Air Conditioning	3L, 4C	
	CS419a	Computer Vision	3L, 4C	
	CS419b	Distributed Systems	3L, 4C	
	CS419c	Quantitative Methods in Software Engineering	3L, 4C	

Prof Elective-8	EC420a	Advanced Control Systems	3L, 4C	VIII
	EC420b	VLSI Test and Testability	3L, 4C	
	EC420c	Information Theory and Coding	3L, 4C	
	ME420a	Optimization Techniques	3L, 4C	
	ME420b	Mechanics of Composite Materials	3L, 4C	
	ME420c	Metal Forming	3L, 4C	
	CS420a	Big Data Analytics	3L, 4C	
	CS420b	Principles of Programming Languages	3L, 4C	
	CS420c	Approximation Algorithms	3L, 4C	
	CS420d	Randomized Algorithms	3L, 4C	
Prof Elective-9	EC421a	CMOS Memory Design	3L, 4C	VIII
	EC421b/CS421b	Image Processing	3L, 4C	
	EC421c	Optical Communication	3L, 4C	
	ME421a	IC Engine	3L, 4C	
	ME421b	Gas Turbine and Propulsion	3L, 4C	
	ME421c	Quality, Reliability and Maintenance Engineering	3L, 4C	
	CS421a	Image Reconstruction	3L, 4C	
	CS421b/EC421b	Image Processing	3L, 4C	
	CS421c	Statistical Methods in Computer Science	3L, 4C	
Prof Elective-10	EC422a	Nanophotonics and Plasmonics	3L, 4C	VIII
	EC422b	Application of Signal and Image Processing	3L, 4C	
	EC422c	Renewal Energy System	3L, 4C	
	ME422a	Smart Materials and Structures	3L, 4C	
	ME422b	Fault Diagnosis and Prognosis for Engineering Systems	3L, 4C	
	ME422c	Robot Kinematics and Dynamics	3L, 4C	
	CS422a	Natural Language Processing	3L, 4C	
	CS422b	Visual Cryptography & Data Hiding	3L, 4C	
	CS422c	Model Thinking	3L, 4C	

Course Details
Semester-1

Subject Code:	NS101	**Course Title**	Mathematics -I
Contact Hours	L-3, T-1	**Credit**	4
Programme	B.Tech	**Semester**	I
Pre-requisites	NIL		
Evaluation scheme	Quiz I (15%), Mid term (30%), Quiz II (15%), End term (40%)		

Calculus of Functions of One Variable: Real Numbers, Functions, Sequences, Limit and Continuity, Differentiation : Review, Successive differentiation, Chain rule and Libnitz Theorem, Rolle‟s and Mean Value Theorems, Maxima/ Minima, Linear and Quadratic approximations, Error estimates, Taylor‟s Theorem, The Riemann Integral, Approximate Integration, Natural Logarithm, Exponential function, Relative growth rates, L‟Hospital‟s rule, Geometric applications of Integrals, Infinite series, Tests of convergence, Absolute and Conditional convergence, Taylor and Maclaurin series. **[21 H]**

Calculus of Functions of Several Variables: Scalar fields, Limit and Continuity, Partial derivatives, Chain rules, Implicit differentiation, Web gradient, Directional derivatives, Total differential, Tangent planes and Normals, Maxima, Minima and Saddle points, Constrained maxima and minima, Double Integrals, Applications to areas and volumes, Change of variables. **[14 H]**

Vector Calculus: Vector fields, Divergence and Curl, Line Integrals, Green‟s Theorem, Surface Integrals, Divergence Theorem, Stoke‟s Theorem and applications. Evaluvation Schedules. **[7 H]**

Text/Reference books:

1. Calculus and Analytic Geometry by Thomas & Finney
2. Introduction to Real Analysis, Bartle R.G. & Sherbert D.R.

Subject Code:	NS102	**Course Title**	Engineering Mechanics
Contact Hours	L-2, T-1, P-2	**Credit**	4
Programme	B.Tech	**Semester**	I
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Mid term (20%), Quiz II (10%),Lab (20%) End term (40%)		

Scalars and Vectors, Cartesian and curvilinear coordinate system, Newtons law: statics and dynamics, centre of mass and variable mass problem, work and energy, stable and unstable equilibrium, collisions in two dimension: Laboratory and COM frame **[7 H]**

Double and triple integrals, Line, surface & volume integrals, Gradient, Divergence & Curl (in Cartesian and curvilinear coordinates), Line, surface, volume integrals, Guass's and Stoke's theorem (problems and physical significance) **[7 H]**

Rotational motion, Torque, Angular momentum, Moments of Inertia, pure rotation and center of percussion (example), combined translation and rotation & the role of centre of mass, Chasles' Theorem, Moments of Inertia. **[7 H]**

Moment of inertia tensor, Principal Axes of Inertia, Finding the Principal Axes; Eigenvalue Equations, Precession of a Top due to a Weak Torque & gyroscopic motion **[7 H]**

Lab experiments:

1. Introduction to error analysis
2. Spring oscillation apparatus
3. Simple pendulum
4. Moment of inertia of a flywheel
5. Determine g by Bar pendulum
6. Tortional pendulum
7. Sonometer
8. Stoke's law
9. Newton's law of cooling

Text/Reference books:

1. Introduction to mechanics: Daniel Kleppner , Robert J. Kolenkow
2. Mathematical Methods in the Physical Sciences: Mary L. Boas

Subject Code:	HS101	**Course Title**	Effective Communication Skills
Contact Hours	L-2, T-0, P-0, GD-1	**Credit**	2
Programme	B.Tech	**Semester**	I
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Mid term (30%), Quiz II (10%), End term (50%)		

Why English? ,Effective Communication Skills-2l, Technical English-2l, Technical Reports -5 L, Tender Notices-2l, Holding Meetings-3l, Good Presentation-3l, Group Discussion-2l, Curriculum Vitae (Cv), Or Resume, Bio-Data, Job Application Letter-3l, Interview-2l, Phonetics.-2l, Grammar-1l

Text/Reference books:

1. Developing Communication Skills- Krishna Menon- Macmillan Publication House.
2. Remedial Grammar- F.T. Wood- Macmillan
3. Personality Development and Soft Skills- BarunMitra- Oxford Publication House.
4. The Ace of Soft Skills: Attitude, Communication and Etiquette for Success- Pearson Education

Subject Code:	ES101	**Course Title**	Fundamentals of Electrical and Electronics Engineering
Contact Hours	L-3, T-0, P-2	**Credit**	5
Programme	B.Tech	**Semester**	I
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Mid-Term (25%), Quiz II (10%), End-Term (35%), Lab (20%)		

D.C. Circuits

Ohm's law, Kirchoff's laws, Nodal Analysis, Mesh Analysis, Superposition Theorem, Source Transformations, Thevnin's and Norton's Theorems, star/delta transformation, maximum power transfer theorem, Transients. **[10H]**

A.C. Fundamentals

Single phase EMF generation, average and effective values of sinusoids, Solution of series and Parallel Circuits, power and power factor, Resonance in series and parallel circuits, steady state analysis for sinusoidal excitation: Sinusoids, Three phase connections: star and delta. **[10H]**

Magnetic Circuit

MMF, Magnetising force, Magnetic flux and flux density, permeability, Reluctance and permeance, B-H curve, Simple magnetic circuits, Hysteresis and eddy current loss. **[2H]**

Transformers

Single-phase transformer Construction, principle of operation, EMF equation, phase diagram on no-load and full-load, losses and efficiency, open and short circuit test, auto transformer. **[5H]**

D. C. Machines

Construction, EMF equation, various types and characteristics D. C. Generator Principle, torque and speed formula, types and their characteristics, Speed control. **[5H]**

Semiconductor Devices

Semiconductor Diode and its V-I characteristics, Rectifier circuit, Various types of diodes, Zener diode, PIN Diode, Light emitting diode, gun diode Semiconductor BJT, Working principle, Transistors in CC, CE, and CB configurations, transistor biasing, V-I characteristics and load line concept with Quiescent point, Transistor H parameter. **[10H]**

Laboratory Experiments **[16H]**

Introduction and familiarization to the lab equipments and common components:

a) Study of CRO
b) Study of Function genertaor
c) Study of Multimeter
d) Familirization with Breadboard, resistances, capacitances, diodes, transistors, etc.

Study of PN-Junction Diode Characteristics: To study and plot the forward and reverse bias characteristics of a general purpose pn junction diode.

Study of half-wave rectifier circuit: To construct a half-wave rectifier circuit, and observe waveforms and find average output.

Study of center-tapped full-wave rectifier circuit: To construct a full-wave rectifier circuit, and observe waveforms and find average output.

Study of Zener Diode as a Voltage Regulator: To study and analyze use of a zener diode as a voltage regulator.

Study of Bipolar Junction Transistor Characteristics in CE mode: To study the input and output characteristics of a BJT in Common Emitter mode.

Study of Bipolar Junction Transistor Characteristics in CB mode: To study the input and output characteristics of a BJT in Common Base mode.

Study of Common Emitter Transistor as an Amplifier: To design a common emitter transistor amplifier circuit and observe the frequency response of the amplifier

Study of a Series Resonant Circuit: To study the behavior of a series LCR resonant circuit and to estimate the resonant frequency and Q-factor.

Text/Reference books:

1. V. Del Toro, "*Electrical Engineering Fundamentals*," 2e, Printice Hall of India 1994.
2. Millman Jacob and Christos C. Halkias, "*Integrated Electronics: Analog and Digital Circuits and Systems,*" McGraw Hill, 2004.
3. Robert L. Boylestad and Louis Nashelsky, "*Electronics Device and Circuit Theory*," 9e, Pearson Education India, 2005.

Subject Code:	ES102	**Course Title**	Fundamentals of Computing
Contact Hours	L-2, T-0, P-3	**Credit**	4
Programme	B.Tech	**Semester**	I
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Midterm (20%), Quiz II (10%), End term (30%), lab (30%)		

Introduction: Basics of operating system, Components of Computer, Memory hierarchy, Number System **[4H]**

Overview of C: Constants, Variables, and Data Types, Operators and Expressions **[4H]**

Input/ Output: Managing Input and Output Operations, Formatted Input / Output **[2H]**

Decision making & Iterations: Decision Making and Branching, Decision Making and Looping **[2H]**

Advanced topics: Arrays, Character Arrays and Strings, User-Defined Functions **[4H]**

Structures and Unions, Pointers, Dynamic Memory Allocation and Linked Lists **[8H]**

File Management in C, The Preprocessor directives and Header Files, Developing a C Program: Some Guidelines. **[4H]**

Text/Reference books:

1. E. Balaguruswamy, Programming in ANSI C, 5th Edition, Tata McGraw-Hill Education, 2011
2. B. W. Kernighan and D. Ritchie, The C Programming Language, 2nd edition, Prentice Hall, 1990
3. Y. Kanitkar, Let Us C, 8th Edition, Infinity Science Press, 2008
4. H. Schildt, The Complete reference C, 2nd Edition, Tata McGraw-Hill Education, 1987

Semester-II

Subject Code:	NS103	**Course Title**	Mathematics-II
Contact Hours	L-3, T-1, P-0	**Credit**	4
Programme	B.Tech	**Semester**	II
Pre-requisites	NIL		
Evaluation scheme	Quiz I (15%), Mid term (30%), Quiz II (15%), End term (40%)		

Ordinary Differential Equation **[28 H]**

Introduction to Differential equations, 1st order ODE, Geometrical interpretation, Variable separable forms, Exact equations, Integrating factors, Linear ODE's, Orthogonal Trajectories, Higher order linear differential equations, general solution of ODEs, Method of using known solutions, Method of removal first derivative, Existence & uniqueness, Wronskian, Series solution method & Special function , ODE's with constant & variable co-efficient, Laplace Transform,

Partial Differential Equation **[14 H]**

Classification of PDE, First and Second order PDE, Fourier series and Fourier Transform, Introduction to parabolic(Heat Equation), elliptic(Laplace Equation) and hyperbolic equations(Wave Equation).

Text/Reference books:

1. Advanced Engineering Mathematics by Erwin O. Kreyszig,

2. An elementary Course in PDE by T. Amarnath.

3. E. A. Coddington and N. Levinson, Theory of Ordinary Differential Equations

Subject Code:	NS104	**Course Title**	Electrodynamics and Optics
Contact Hours	L-3, T-1, P-2	**Credit**	5
Programme	B.Tech	**Semester**	II
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Mid term (20%), Quiz II (10%),Lab (20%) End term (40%)		

The Electric Field, Divergence and curl of electrostatic fields, potential and its relation with electrostatic Field, The energy of a continuous charge distribution, conductors and induced charges, Laplace's Equation, theorems regarding boundary conditions, Separation of Variables, The Method of Images. **[6H]**

Dielectrics, The field of a polarized object, bound charges, Gauss's Law in the Presence of Dielectrics, Energy in Dielectric Systems **[3 H]**

The Lorentz Force Law, magnetostatics and The Biot-Savart Law, The Divergence and Curl of magnetic field, The Vector Potential, Magnetization, Effect of a Magnetic Field on Atomic Orbits: diamagnetism, Bound Currents, Ampere's law in Magnetized Materials, Brief idea of ferromagnetism **[6H]**

Electromotive Force, Motional emf, Electromagnetic Induction, energy in magnetic fields, Maxwell's modification of Ampere's law, Maxwell's equations, Boundary condition **[6 H]**

Poynting theorem, Electromagnetic Waves, Reflection and Transmission of a wave, Electromagnetic Waves in Vacuum and dielectric, Energy and Momentum & intensity in Electromagnetic Waves, Reflection and Transmission of light at Normal Incidence, Reflection and Transmission of light at oblique Incidence and Snell's law **[9 H]**

Superposition of light having same frequency, Coherent and random sources, Yong's double slit experiment: superposition by splitting of wavefront, parallel film and Newton's ring: superposition by splitting of amplitude, Michelsons and Febry perot interferrometre, spatial and temporal coherence **[6H]**

Fraunhoffer's and Fresnel's diffraction, diffraction from single slit, double slit and grating, resolution, dispersive power and resolution of a grating, Basics of a Laser **[6 H]**

Lab Experiments:

1. Single slit diffraction of Laser light
2. Diffraction due to grating
3. Newton's ring
4. Dispersive power of a grating using spectrometer
5. e/m by millikan oil drop experiment
6. e/m by Thomson method method
7. Balmer series
8. Charging and discharging of a capacitor
9. Frank hertz Experiment

Text/Reference books:

1. Introduction to Electrodynamics: David J Griffiths
2. Introduction to optics: Frank L. Pedrotti, Leno M. Pedrotti, Leno S. Pedrotti
3. Principles of electromagnetic: Matthew N. O. Sadiku
4. Optics: Eugene Hecht

Subject Code:	HS102	**Course Title**	Culture and Human Values
Contact Hours	L-2, T-0, P-0, GD-1	**Credit**	2
Programme	B.Tech	**Semester**	II
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Mid term (30%), Quiz II (10%), End term (50%)		

A collection of Shlokas from Gita and Upanishads- **[2H]**
Pearls of Confucius- **[2H]**
Excerpts from the *Arthashastra* of Chanakya- **[2H]**
Poems from Tagore's *Gitanjali*- **[1H]**
Speech of Swami Vivekananda- **[2H]**
Excerpt from the book of APJ Abdul Kalam, '*Ignited Minds'*.- **[2H]**
Speech 'Tryst with Destiny' of JawaharLal Nehru- **[1H]**
Excerpts from *Hamlet* of William Shakespeare- **[2H]**
Excerpts from Bacon's '*Of Studies'*.- **[2H]**
Excerpts from Mahatma Gandhi's *' Simple Life'*.- **[1H]**
The Gold Frame.- **[2H]**
Death is a Reality- **[1H]**
Company You Keep- **[1H]**
The Temptation of Possession- **[1H]**
Discretion is the Best Weapon- **[1H]**
Akbar and Tansen- **[1H]**
Gender Studies- Woman and Home- Rabindranath Tagore.- **[2H]**
Excerpts from Male Brain and Female brain of Dr.Brizendine.- **[2H]**

Text/Reference books:

1. "Wisdom Through the Ages- A Reader" Edited and compiled by Prof. Adhikari, Part compilation on Gender Studies by Dr.MamtaAnand.
2. Gitanjali- Rabindranath Tagore- Macmillian
3. Complete Works – William Shakespeare- Oxford Edition
4. Complete Works – Swami Vivekananda- Advaita Trust

Subject Code:	DS101	**Course Title**	Engineering Graphics
Contact Hours	L-1, T-0, P-3	**Credit**	3
Programme	B.Tech	**Semester**	II
Pre-requisites	NIL		
Evaluation scheme	Quiz I (5%), Midterm (30%), Quiz II (5%), Lab (20%) End term (40%)		

Introduction **[2 H]**

Lines, Lettering, Sketching, Principle of Dimensioning, Basic geometrical constructions, Scales, Engineering Curves.

Orthographic Projections **[3 H]**

Pictorial view, Multi-view, Multi-view Drawing, Terminology, First angle projection and its features, Third angle projections and its features, Symbols, Section lines or hatching, Conversion of pictorial view into orthographic view.

Projections of Points **[2 H]**

Location of a point, Conventional representations, Projections of a point located at different locations.

Projections of Lines **[3 H]**

Introduction, Orientation of a line, Projections of a line located at different locations, Projections of a line in different angles.

Projections Planes **[3 H]**

Introduction, Orientation of a plane, Projections of a plane located at different locations, Trace of a plane, Plane inclined to both the reference planes.

Projection of Solids **[3 H]**

Introduction, Classification of solids, Recommended method of labelling, Orientation of solids, Drawing projections of a solid at different orientation of its axis, Identify visible and hidden lines.

Sections of Solids **[2 H]**

Introduction, Terminology, Types of section planes, Section by a plane perpendicular to VP, HP and both.

Development of Surfaces **[2 H]**

Introduction, Classification of surfaces, Methods of development, Development of prism, pyramid, cylinders, cone, trays, Applications.

Intersection of Surfaces **[4 H]**

Introduction, Engineering Applications, Method of determining the curves of intersection, Types of interpenetrating solids, Intersection by prism, cylinder, pyramid and cone by another solid.

Axonometric Projection **[4 H]**

Introduction, Principles of isometric projections, Terminology, Isometric scales, Four centre method to draw ellipse, Dimensioning of isometric projection, Isometric view of right solids, solid containing non-isometric lines, truncated solids, composite solids, Conversion of orthographic view into isometric views, Oblique projections, Perspective projections.

Text/Reference books:

1. N D Bhatt Engineering Drawing, 49th edition Charoter, Publishing House, 2006.
2. B Agrawal and C M Agrawal, Engineering Drawing (2nd Ed), McGraw Hill, New Deli, 2014.
3. Dhananjay A Jolhe, Engineering drawing, TMH, 2008.
4. T E French, C J Vierck and R J Foster, Graphic Science and Design, 4th edition, McGraw Hill, 1984.
5. W J Luzadder and J M Duff, Fundamentals of Engineering Drawing, 11th edition, Prentice-Hall of India, 1995.
6. K Venugpoal, Engineering Drawing and Graphics, 3rd edition, New Age International, 1998.
7. K. Venkata Reddy, Engineering Drawing, 2nd edition, BS Publications, 2008.

Subject Code:	ES103	**Course Title**	Data Structures and Algorithms
Contact Hours	L-3, T-0, P-2	**Credit**	4
Programme	B.Tech	**Semester**	II
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Mid term (20%), Quiz II (10%), End term (40%), lab (20%)		

Notion of Algorithm, Space and Time Complexity, Analyzing algorithms
Static & Dynamic Memory Management, Arrays, Stacks, Queues, Linked Lists
Trees, Binary Trees, Tree Traversals, Applications of Binary Trees, Binary Search Tree, Balanced Tree, AVL Tree
Graphs and their representations, Graph Traversal Algorithms, Minimum Spanning Tree, Shortest Paths
Searching Algorithms: Sequential Search, Binary Search
Sorting Algorithms: Quick sort, Merge sort, Insertion sort, Selection sort, Heap & Heap sort
Files, Indexing: Hashing, Tree Indexing: B-tree

Text/Reference books:

1. E. Horowitz, S. Sahni, and S. Anderson-Frees, "Fundamentals of Data Structures in C," 2nd edition, Silicon Press, 2008.
2. T. H. Cormen, C Leiserson, R. Rivest, and C. Stein, "Introduction to Algorithms," 3rd edition, MIT Press/McGraw-Hill, Cambridge, 2009.
3. S. Lipschutz, "Data Structures with C," Schaum's Outlines, TMH, 2011.
4. (Programming) B. W. Kernigham and D. M. Ritchie, "The C Programming language," 2nd edition, Pearson, 1988 or any other book on C programming.

Semester-III

Subject Code:	NS205a	**Course Title**	Advance Engineering Mathematics
Contact Hours	L-3, T-0, P-2	**Credit**	4
Programme	B.Tech	**Semester**	III
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Mid term (20%), Quiz II (10%), End term (40%), lab (20%)		

Complex Analysis: Complex numbers, powers and roots of complex numbers. Complex variables: Continuity, and Differentiability, Analytic functions, Cauchy-Riemann equations, Laplace equation, Harmonic functions, Complex logarithmic function, Cauchy's integral theorem, Liouville's Theorem, Taylor series and Laurent series. Zeros, Singularities and its classifications, Residues, Residue theorem and its applications to evaluating real integrals and improper integrals. Conformal mappings, , Schwarz-Christoffel transformation. **[10H]**

Fourier series and transforms: Fourier Integral, Fourier series of periodic functions, Convergence of Fourier series, Differentiation and Integration of Fourier series, Complex form of Fourier series. Fourier Transforms and Properties, Convolution theorems, Inversion theorem, Application in engineering. **[8H]**

Ordinary Differential Equations: Classification of ODEs, Ordinary linear differential equations of first and n-th orders and their solutions, homogeneous and non-homogeneous equations. Operator method. Method of undetermined coefficients and variation of parameters. Power series methods for solutions of ordinary differential equations. Legendre equation and Legendre polynomials, Bessel equations. **[7H]**

Partial Differential Equations: Introduction to PDEs, basic concepts, Linear and quasi-linear first order PDE, Second order PDE and classification of second order semi-linear PDE, Canonical form.. Cauchy problems. D' Alemberts formula, Wave equations, Laplace and Poisson equations, Fourier method for IBV problem for wave and heat equation, rectangular region. **[10H]**

Special Functions in Engineering: Introduction to Some Special Functions: Gamma function, Beta function, Bessel function, Henkel Functions, Legendre and Hermite polynomial. Error function, Heaviside's function, Sinusoidal Pulse function, Rectangle function, Gate function, Dirac's Delta function, Signum function, Saw tooth wave function, Triangular wave function, Half wave rectified sinusoidal function, Full rectified sine wave, Square wave function. Applications of special functions in engineering. **[10H]**

Text/Reference books:

1. Advanced Engineering Mathematics (8th Edition), by E. Kreyszig, Wiley-India (2007).
2. Advance Engineering Mathematics, by R. K Jain and SRK Iyengar, Narosa Publication.
3. W. E. Boyce and R. DiPrima, Elementary Differential Equations (8th Edition), John Wiley (2005)
4. R. V. Churchill and J. W. Brown, Fourier series and boundary value problems (7th Edition), McGraw-Hill (2006).
5. T.M.Apostol, Calculus , Volume-2 (2nd Edition), Wiley Eastern , 1980

Subject Code:	NS205b	**Course Title**	Analytical Method in Engineering
Contact Hours	L-3, T-0, P-2	**Credit**	4
Programme	B.Tech	**Semester**	III
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Mid term (20%), Quiz II (10%), End term (40%), lab (20%)		

Introduction **[1 H]**

Solution methods for ordinary differential equations (odes) **[3 H]**

First order differential equations, nth order differential equations

First order partial differential equations (pdes) **[2 H]**

Classification, Analytical Solutions for Linear and Semilinear equations

Second order pdes **[2 H]**

Classification, Transformations to Canonical forms for Hyperbolic, Elliptic and parabolic Equations

Concepts in approximate solutions of differential equations **[4 H]**

Space of Functions: Inner product, Orthogonal functions, Norm, Projection of a Function onto an

Orthogonal set, GramSchmidt Orthogonalization and Orthonormal set, Parseval's theorem

Fourier series **[3 H]**

Series of Trigonometric functions, Convergence of Fourier Series: Piecewise Continuous and Smooth function, Evaluation of Fourier Coefficients: Even and Odd functions, Even and odd extensions of a function, Uniform Convergence of a Fourier Series, Parseval's theorem for Fourier Series, Application of Parseval's theorem to estimate the Mean Square Error

Analytical Series Solutions of Pdes **[20 H]**

Separation of Variables, Extension of Separation of Variables methodology by Method of Superposition, Rectangular coordinate system, Cylindrical coordinate system (Bessel function), Spherical coordinate system (Legendre function), Hyperbolic Equations, Elliptic Equations, Parabolic Equations

Fourier transform and its applications **[3 H]**

Fourier Series to Fourier Integral, Properties of Fourier Transformation, Problems in Infinite and Semi-infinite Media, Solution of PDEs in Infinite and Semiinfinite Media, Dirac Delta Function

Laplace transform and its applications **[4 H]**

Fourier Transform to Laplace Transform, Review of Laplace Transform, Laplace Inverse Transform by Complex Number Residue theory, Solution of PDEs by Laplace Transform

Text/Reference books:

[1] J B Doshi, "Differential Equations for Scientists and Engineers," Narosa Publishing House, 2010.

[2] Erwin Kreyszig, "Advanced Engineering Mathematics," Wiley India, 1999.

[3] M K Jain, S R K Iyengar and R K Jain, "Numerical Methods for Scientific and Engineering Computation," New Age International Publisher, 2007.

Subject Code:	NS205c	**Course Title**	Discrete Mathematics
Contact Hours	L-3, T-0, P-2	**Credit**	4
Programme	B.Tech	**Semester**	III
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Mid term (20%), Quiz II (10%), End term (40%), lab (20%)		

Preliminaries: Sets, relations, partial ordering, total orders, equivalence relations, functions and sequences.

Logic and proofs: propositional logic and equivalences, predicates, quantifiers, rules of inferences, proof methods, mathematical induction. **[7H]**

Number Theory: Division algorithm, Euclid's algorithm, fundamental theorem of arithmetic, Chinese remainder theorem. **[7H]**

Basics of Combinatorics: Counting principles, Permutations, combinations, generalized permutations and combinations, recurrence relations and generating function. **[7H]**

Algebra: Groups and normal subgroups, homomorphism and isomorphism, rings, integral domains, fields, lattices and Boolean Algebra. **[7H]**

Graphs: Graphs. Graph representations, special types of graphs, graph isomorphism, connectivity, Euler and Hamiltonion paths, planar graphs, graph coloring. **[7H]**

Probability and Statistics: Basic probability, conditional probability, random variables, probability distribution, variance, central limit theorem, confidence interval and hypothesis testing. **[7H]**

Text/Reference books:

1. K. H. Rosen, Discrete Mathematics and Its Applications, 6th Edition / International Students Edition, Tata McGraw Hill, 2007.
2. C.L. Liu, Elements of Discrete Mathematics, 2nd Edition, Tata McGraw Hill, 2000.
3. L. Lovász, J. Pelikán, K. Vesztergombi, Discrete Mathematics: Elementary and Beyond (Undergraduate Texts in Mathematics), Springer, 2003.
4. S. M. Ross, Introduction to Probability and Statistics for Engineers and Scientists, Elsevier, 2014.

Subject Code:	NS205d	**Course Title**	Applied Probability and Statistics
Contact Hours	L-3, T-0, P-2	**Credit**	4
Programme	B.Tech	**Semester**	III
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Mid term (20%), Quiz II (10%), End term (40%), lab (20%)		

Probability Module: Basic Set Operations, Algebra and Sigma algebra, Measurable Space, Measure, Measurable Function, Probability Measure, **[4 H]**

Random Variable, Function of Random Variable, Probability Mass Function, Probability Density Function, Cumulative Probability Distribution Function, Independent Event, Expectation, Variance, Covariance, Correlation. **[5 H]**

Conditional Probability Measure, Law of Total Probability, Baye‟s Formula, Baye‟s Theorem, Function of Several Variables, Joint and Marginal Distribution Function **[4 H]**

Moments, Moments Generating Function, Characteristic Function, Inversion Theorem, Uniqueness Theorem, Important Statistical Inequalities **[4 H]**

Mode of Convergence, Convergence in Law, Convergence in Measure, Convergence in rth Mean, Almost Sure Convergence, Weak Law of Large Numbers, Strong Law of Large Numbers, Center Limit Theorem. **[9 H]**

Statistics Module: Estimation-Point Estimation, Properties of Estimation: Unbaisedness, Consistency, Sufficiency, Efficiency. Method of Estimation: Method of moments, Maximum Likelihood Estimation. **[6 H]**

Interval Estimation, Confidence Interval. Inference-Testing of Hypothesis: Different type of Hypothesis, Acceptance Region, Critical Region, Test function, Type-I and Type-II Errors, Level of Significance, Power of the Test, Uniformly Most Powerful Test ,Neyman-Person‟s Lemma. **[6H]**

Exact Sampling DistributionChi-Square Distribution, Chi-Square test for goodness of fit,Student‟s t−Distribution, t−test for single mean, t−test for difference of means, Paired t−test for difference of means, F-distribution, F−test for equality of population variance. **[4 H]**

Text/Reference books:

Introduction to Probability and Statistics, V.K.Rohatgi, A.M.E.Saleh

Subject Code:	NS205e	**Course Title**	Numerical Method
Contact Hours	L-3, T-0, P-2	**Credit**	4
Programme	B.Tech	**Semester**	III
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Mid term (20%), Quiz II (10%), End term (40%), lab (20%)		

Approximation and round off errors(Truncation error, absolute error), Root finding method for non-linear equation i.e. Bi-section method, Secant method, Newton raphson method (for higher dimensions also). **[7 H]**

System of Linear Equation: **[7 H]**

Direct method i.e Gauss Elimination, Pivoting etc. LU Factorization, Cholesky method with order of Convergence and error analysis

Iterative method: Gauss Jacobi Method, Gauss Siedel with order of Convergence and error analysis.

Interpolation Theory: Langrage Interpolation with Error Analysis, Newton Divided difference interpolation, backward and forward interpolation, Central interpolation, errro estimate, Hermite interpolation, Piecewise interpolation. **[8 H]**

Spline: Quadratic spline, Cubic spline with error analysis. **[3 H]**

Least Squares method, Weirstrass Theorme, Gram Schmit process, Lengendre and Chebyshev Polynomials. **[3 H]**

Numerical Integration: Trapezoidal method(for single and double integration), Simpson Method, Gaussian Quadrature Method with error estimates. **[7 H]**

Numerical Method for ODE: Existence, Uniqueness, Euler, Modified Euler, Runge-Kutta and Predictor-Corrector methods. Stability of numerical methods. **[7 H]**

Text/Reference books:

1. Numerical Methods for Scientific and Engineering by Jain, Iyengar, Jain
2. An Introduction to Numerical Analysis by Atkinson.

Subject Code:	NS205f	**Course Title**	Optimization
Contact Hours	L-3, T-0, P-2	**Credit**	4
Programme	B.Tech	**Semester**	III
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Mid term (20%), Quiz II (10%), End term (40%), lab (20%)		

Introduction to optimization, Minimization and maximization, Convex set, Convex function, Differentiable convex functions, Sub differential of a convex function, Saddle point Conditions.

[12H]

Fritz John and Karush-kuhn-Tucker Conditions, duality , Convex programming problems, Linear programming problems, Simplex method. **[12H]**

Quadratic programming, Separable programming. Constrained Optimization: One dimensional search methods, Multi-dimensional search methods. Unconstrained optimization: Conjugate gradient method, Generalized reduced gradient methods, Method of feasible direction.

[18H]

Text/Reference books:

1. Bazarra M.S., Sherali H.D. & Shetty C.M., Nonlinear Programming Theory and Algorithms, John Wiley, New York, 1979.
2. Convex Analysis By R.T.Rockafellar, New Jersey, Princeton University Press.

Subject Code:	NS205g	**Course Title**	Modern Physics
Contact Hours	L-3, T-0, P-2	**Credit**	4
Programme	B.Tech	**Semester**	III
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Mid term (20%), Quiz II (10%), End term (40%), lab (20%)		

Special theory of relativity**,** Length contraction, time dilation, dopper effect, velocity addition, relativistic energy and momentum, concept of four vector **[6 H]**

Early development of quantum theory, Blackbody radiation, Photoelecctric effect, Compton scattering **[3 H]**

Modern development, De Broglie's hypothesis and Schrodinger's equation, The Statistical Interpretation, Normalization and expectation values, The Uncertainty Principle **[4 H]**

Stationary States, Particle in a box, The Harmonic Oscillator, The Free Particle, potential step and barrier **[6 H]**

Series Solutions to Legendre's Equation, Associated Legendre's Equation, Bessel equation and Hermite equations, Generating function and orthogonality, Laguerre Functions and associated Laguerre Functions **[14 H]**

Schrodinger Equations in Spherical Coordinates, The Hydrogen Atom, Angular Momentum, addition of angular momentum, Spin, identical particles and quantum statistics **[9 H]**

Text/Reference books:

1. Introduction to quantum Mechanics: David J Griffiths
2. Concepts of Modern physics: Arthur Beiser
3. Introductory quantum mechanics: Richard L Liboff
4. Modern physics: Kenneth S. Krane

Subject Code:	NS205h	**Course Title**	Material Science
Contact Hours	L-3, T-0, P-2	**Credit**	4
Programme	B.Tech	**Semester**	III
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Mid term (20%), Quiz II (10%), End term (40%), lab (20%)		

Overview of Materials and their applications. Bonding in materials. Crystal systems, packing fraction, nearest neighbour, concept of Bravais Lattice and unit cell. Miller indices in crystalline materials. Defects in crystalline materials, single crystals, poly-crystals and amorphous materials. **[12 H]**

Band theory of solids, conductors, semiconductors and insulators, intrinsic and extrinsic semiconductors, electrical conduction, effect of temperature on conductivity. Heat capacity and thermal conductivity. Stress-strain diagram, elastic and plastic deformation, yield strength, tensile strength, elongation, modulus of elasticity, ductile and brittle fracture. **[10 H]**

Diffusion in solids, Fick's laws and technological application of diffusion. Phase Diagrams of engineering materials; Solidification; Diffusion assisted and diffusion less solid-state phase transformations, Applications and Properties of Ceramic, Polymers and also of their Composite Materials. **[10 Lectures]**

Magnetic materials and their properties, magnetic hysterisis. Elements of superconductivity, Meissener's effect, type-I, type-II semiconductors, BCS Theory. Introduction to nanotechnology, 0D, 1D and 2-D materials, nanoribbons. Advance applications of nanomaterials including spintronics. **[10 H]**

Text/Reference books:

1. Callister, “Materials Science and Engineering” Wiley.
2. Smith,William, “Foundations of Materials Science And Engineering”, Mc Graw Hill. 3. V. Raghvan, “Materials Science and Engineering”.
3. Poole and Owens "Introduction to nanotechnology", Wiley.

Subject Code:	NS205i	**Course Title**	Culture and Science-a comparison
Contact Hours	L-3, T-0, P-0, GD-1	**Credit**	4
Programme	B.Tech	**Semester**	III
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Mid term (30%), Quiz II (10%), End term (50%)		

Science and Humanities. **[11L]**

Magnifying and Classifying in Science, Linear approach to thought in Science, Hierarchical and Horizontal linkages to development through Science **[11L]**

Synthesis and Transformation in Cultural Progress, Concentric approach to thought in Humanities, Concentric Context to development and Culture

Indian Intellectual Traditions **[20 L]**

Unity in Diversity- From Unity to Multiplicity, Upanishads and 21st Century- Vision and Pluralism, Concept of holiness in a World of Conflict, The Spirit in Human Being, Progress in Science, Progress in Humanities.

Text/Reference books:

1. Progress and Values in the Humanities- Volney Gay- Columbia University, New York.
2. A Cultural History of India- A.L.Basham
3. India’s Intellectual Traditions- World Association for Vedic Studies

Subject Code:	ES204	**Course Title**	Digital Electronics
Contact Hours	L-3, T-0, P-2	**Credit**	4
Programme	B.Tech	**Semester**	III
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Mid term (20%), Quiz II (10%), End term (40%), lab (20%)		

Module 1

Number Systems and Boolean Algebra, Simplification of functions using Karnaugh map and QuineMcCluskey Method, Boolean Function Implementation, Minimization and Combinational Design, Examples of Combinational Digital Circuits, Hazards in Combinational Circuits, Hazard free realization. **[12H]**

Module2

Introduction to Sequential circuits: Latches and Flip-Flops (RS, JK, D, T and Master Slave), Design of a Clocked Flip-Flop, Flip-Flop conversion, Practical Clocking aspects concerning Flip-Flops. Counters: Design of Single Mode and Multimode Counters, Ripple Counters, Synchronous Counters, Shift Registers, Shift Register Counters and Random Sequence Generators. **[12H]**

Module 3

Design and Analysis of Sequential Circuits: General model of Sequential Networks, State Diagram, Analysis and Design of Synchronous Sequential Circuits; Finite Sate Machine, State Reduction, Minimization and Design of the Next State Decoder. Asynchronous Sequential Logic: Analysis and Design, Race conditions and Cycles. Practical Design Aspects: Timing and Triggering considerations in the Design of Synchronous Circuits, Set up time, Hold time, Clock skew. **[10H]**

Modul 4

Logic Families: Fundamentals of ECL, TTL, CMOS Logic family, Transfer Characteristics, Input and Output Characteristics, Tristate Logic, Wired Logic and Bus Oriented structure, Practical Aspects, MOS gates, MOS Inverter, CMOS inverter, Rise and fall time in MOS and CMOS gates, Speed Power Product, Interfacing BJT and CMOS gates. **[8H]**

Text/Reference books:

1. Wakerly J. F., "Digital Design: Principles and Practices," 2e, Prentice-Hall, 2002.
2. Mano M. M., "Digital Logic Design," Prentice Hall, 1993.

Subject Code:	MN201	**Course Title**	Manufacturing process
Contact Hours	L-3, T-0, P-2	**Credit**	4
Programme	B.Tech	**Semester**	III
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Mid term (20%), Quiz II (10%), End term (40%), lab (20%)		

Introduction: Introduction to Manufacturing, Historical Perspective, Importance, etc Mechanical Properties In Design & Manufacturing. **[2H]**

Casting: Fundamentals of casting process, features of casting, Casting Processes, Classification, Significances. **[3H]**

Metal Forming: Hot & Cold Working, Bulk Deformation processes like Rolling, Forging, Extrusion and Drawing, Sheet metal forming (Shearing & Drawing operation). **[3H]**

Machining: Machining, Mechanism of machining, Chip Formation, Temperature, Tool Wear, Tool Life, Machining Processes, Brief introduction to Single point and multi-point cutting operations. Introduction to Grinding & Finishing. **[3H]**

Metal Joining: Fundamentals of Welding, Classification of welding, processes, Introduction to Gas &Are Welding, Ultrasonic Welding, Friction Welding, Resistance welding, Brazing, Soldering and Adhesive bonding. **[3H]**

Polymers: Polymer products manufacturing, Extrusion, Injection molding, Blow molding , Thermoforming, Compression molding and Transfer Molding. **[3H]**

Modern Manufacturing Processes: Introduction to rapid prototyping, classification and various RP processes. Introduction to various unconventional machining processes and their classification. Introduction to automation, Flexible manufacturing systems and CNC. **[6H]**

Manufacturing of Electronic Device: Manufacturing of semiconductor devices and silicon wafers. Devices fabrication Techniques, Surface Films Depositions, Lithography, Etching, Processes Integration and Packaging. Printed circuit boards and Techniques for micro / nano fabrication. **[5H]**

Lab Experiments:

1. Practice on various Measuring instruments
2. To performed joining of two thick MS plates by V groove Butt Joint using arc welding (MMAW)
3. To performed joining of two thin MS plates by Lap Joint using oxy acetylene gas welding
4. To learn and practice turning, parting operation on lathe machine
5. To perform grooving, threading and knurling operations on lathe machine
6. To perform step and taper turning operation on lathe machine
7. To learn operations of Vertical Milling M/C and perform a practice job like T Slot Cutting.
8. To learn operations on horizontal milling machine and prepare a Spur Gear
9. To learn various fitting operations like Drilling, Taping, Radios, Square Cut in MS metal working.
10. To learn various sheet metal operations of GI Sheet and prepare a funnel cone by using GI Sheet.
11. Process demonstration of Ultrasonic Plastic & Metal Welding
12. Process demonstration of Tool Wear Measurement

Text/Reference books:

1. SeropeKalpakjian, Steven R Schmid, "Manufacturing Engineering and Technology", Pearson Education.
2. Callister, "Materials Science and Engineering" John Wiley & Sons Inc.
3. Smith William. "Foundation of Materials Science and Engineering", McGrwa Hill, 4th Edition.
4. V. Raghwan,"Materials Science and Engineering" 5th Edition.
5. Mikel P. Groover, "Fundamentals of Modern Manufacturing", John Wiley & Sons inc.
6. John A Schey, "Introduction to Manufacturing Processes", McGraw Hill 3rd Edition.

Subject Code:	EC201	**Course Title**	Electronics Devices and Circuits
Contact Hours	L-3, T-0, P-2	**Credit**	5
Programme	B.Tech	**Semester**	III
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Mid term (20%), Quiz II (10%), End term (40%), lab (20%)		

Review of theory of semiconductor, PN junction diode theory, contact potential and current components, energy band diagram for PN Junction, Diode I-V Characteristics, breakdown voltage and leakage current Diode applications rectifier half wave and full wave with filter design, clipping and clamping circuit analysis and design, Special purpose diodes zener diode and its application for regulator, varactor diode, PIN diode, tunnel diode, photodiode, Schottkey barrier diode and LED. **[10H]**

Junction field effect transistor (JFET), device structure and physical operation, IV characteristics, n-channel and p-channel JFET, Biasing and small signal analysis and JEFT applications as voltage amplifier. MOSFET basics, the inversion cannel formation, the derivation of the IV characterises, triode region and saturation region operation, body effect and channel length modulation, Modeling of the MOSFET, Basing, Common source, common drain, and common gate configurations. MOSFET as an amplifier and as a Switch, Single stage MOS Amplifier, MOSFET small signal model for analysis of single stage amplifier, high frequency MOSFET model and frequency response, Current mirror, differential amplifier using MOSFET. **[15H]**

Operation of BJT, Current Components, currents gains α and β, BJT Biasing and Q point & Regions of Operation, Bias Stability, Transistor in CB, CE, CC configuration, Transistor leakage current I_{CBO} and I_{CEO} and breakdowns. Introduction to amplifiers, RC Coupled amplifiers, frequency response, Transistor re Model, Transistor H parameter, BJT Small Signal Analysis, BJT and FET High frequency modelling, Transistor as a switch and power dissipation in the transistor. **[10H]**

Feedback Amplifiers, Oscillators (Different types), Differential Amplifiers, power amplifier, Operational Amplifiers and its Applications. Logic Families using BJT and MOSFET for Digital Applications. **[7H]**

Laboratory Experiments

1. Introduction to laboratory equipment
2. Clipping and Clamping Circuits Design and analysis
3. Rectifier full wave with filter design
4. Zerner regulator design and analysis
5. JFET characteristics and Baising
6. BJT as switch performance and measurments and verification by simulations tools (pSpice)
7. RC coupled amplifier design and analysis small sigal and high frequency Lab and pSpice
8. MOSFET characterstics and various baising
9. Single stage MOS Amplifier CS, CD and CG and Cascode stages
10. Current mirror using BJT and MOSFET

Text/Reference books:

1. Electronic Circuits Analysis and Design, Donald Neamen.
2. Microelectronics Circuits 5th Edition BySedra and Smith Oxford Publication
3. Electronic Devices and Circuits David A Bell. Oxford Publication
4. Integrated Electronics: Analog and Digital Circuits and Systems, Millman Jacob and Halkias, Christos C. ,McGraw Hill 2004
5. Electronics Device and Circuit TheoryBoylestad,Robert L. and NashelskyLouis,Ninth Edition, Printice Hall of India 2005

Subject Code:	ME201	**Course Title**	Kinematics and Dynamics of Machines
Contact Hours	L-3, T-0, P-2	**Credit**	4
Programme	B.Tech	**Semester**	III
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Mid term (20%), Quiz II (10%), End term (40%), lab (20%)		

1. **KINEMATICS:** Plain motion, kinematic concepts of links; basic terminology and definitions; inversion of kinematic chains, absolute and relative motion, kinematics and structure diagrams, equivalent linkages, vector diagram, displacement, velocity and acceleration polygons, analysis, instantaneous centres, special graphical methods for slider crank mechanism. **[08 H]**

2. **KINEMATIC SYNTHESIS OF MECHANISMS:** Introduction, Movability of four bar linkage, Function Generation, path generation, motion generation, Errors in synthesis problems, Chebyshev spacing of precision points. **[6 H]**

3. **GEARS:** Fundamental law of gearing, classification and basic terminology, involute tooth profile and its kinematic considerations, type of gears, standards in tooth forms, gear trains, simple, compound, reverted and epicyclic gear trains. **[8 H]**

4. **CAMS:** Classification of Followers and Cams, Terms used in Radial Cams, Cam Mechanism and its Uses, Displacement,Velocity and Acceleration Diagrams, When the Follower Moves With Uniform Velocity, Simple Harmonic Motion, Uniform Acceleration and Retardation and Cycloid Motion, Construction of Cam Profile for a Radial Cam, Operating a Knife Edge, Roller and Flat Faced Follower. **[5 H]**

5. **GOVERNORS:** Functions, Difference between Governor and Flywheel, Various Terms Used, Types of Governor-Watt, Porter,Proell&Hartnell; Inertia Governor, Sensitiveness and Stability of Governor; Isochronous Governor, Hunting, Effort and Power ofa Porter Governor, Controlling Force Diagrams For Porter and Spring Controlled Governor, Coefficient of Insensitiveness. **[4 H]**

6. **TURNING MOMENT AND FLYWHEEL:** Turning Moment Diagram for a Four Stroke Cycle I.C. Engine and Multi Cylinder Engine, Fluctuation of Energy and Production of Energy and Co-Efficient of Fluctuation of Energy, Co-Efficient of Fluctuation of Speed, Energy Stored in a Flywheel, Dimensions of the Flywheel Rim, Fly Wheel in Punching Press. **[5 H]**

7. **BALANCING OF MACHINERY:** Necessity of Balancing, Static and Dynamic Balancing, Balancing of Rotating Masses in one Plane, In Different Planes - Analytical and Graphical Methods, Partial Unbalanced Primary Force in an Engine, Balancing of Reciprocating Masses, Condition of Balance in Multi Cylinder in Line Engines. Balancing of V Engine. **[6 H]**

8. STAIC AND DYNAMIC FORCE ANALYSIS: 2 and 3 force members, torque addition, free body diagram, Inertia forces, D'alembert's Principle, offset inertia forces, equivalent force analysis for various mechanisms, matrix method. **[6H]**

Experiments:

Experiment No. 1

1. To study inversions of 4-bar mechanisms, single and double slider crank mechanisms.
2. To study various types of gears and gear trains.
3. To study various types of steering mechanisms.
4. Study jump phenomenon in the cam-follower system.
5. Study of Gyroscopic effect and determination of gyroscopic couple on motorized gyroscope.
6. To perform the experiment for static balancing on static balancing machine.
7. To perform the experiment for dynamic balancing on dynamic balancing machine.
8. To understand the balancing of reciprocating masses.
9. Determine the moment of inertia of connecting rod by compound pendulum method and tri-flair suspension pendulum.
10. To verify the relation $T = 2\pi\sqrt{\frac{l}{g}}$ for a simple pendulum.
11. To determine whirling speed of the shaft and study effect of shaft diameter and end conditions on the same.
12. To study the performance characteristics curves, stability and sensitivity of the Governors: Porter, Proell and Hartnell.
13. To study various types of dynamometers.

Text/Reference books:

[1] Rattan S.S., .Theory of Machines., TMH

[2] Thomas Bevan, .Theory of Machines., CBS

[3] Theory of Mechanisms & Machines by Ghosh & Mallick, EWP

[4] John J. Uicker, Jr., Gordon R. Pennock and Joseph E. Sigley (2005), "Theory of Machines and Mechanisms (3rd Ed)," Oxford University Press, Indian Edition.

[5] K J Waldron and G L Kinzel (2004), "Kinematics, Dynamics and Design of Machinery (2nd Ed)," Wiley.

Subject Code:	CS201	**Course Title**	DBMS
Contact Hours	L-3, T-0, P-2	**Credit**	4
Programme	B.Tech	**Semester**	III
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Mid term (20%), Quiz II (10%), End term (40%), lab (20%)		

Introduction of DBMS: Evolution of Database Management Systems, Concept of data models, database system architecture. [5H]

Data Models: ER Model: ER Schema, entity-sets, ER diagram, Specialization & generalization, Aggregation; Relational Model: Relations, Keys, Constraints; ER Schema to Relational model; Relational algebra; tuple and domain relational calculus. [10H]

Structured Query Language: SQL data types, Types of SQL commands, SQL operators, Tables, views and indexes, Queries and sub queries, Aggregate functions, assertion, trigger, integrity & SQL, security implementation with SQL, Embedded SQL. (Will be covered in the Lab hours. Lab will also include exercises on development of a complete database based application) [10H]

Database Design: Functional Dependencies, decomposition, canonical cover, Normalization (1NF-5NF), Dependency preservation, multivalued dependencies, Join dependencies. [7H]

Transaction Management: Transaction concept, ACID properties, Serializability, Concurrency control techniques, Recovery concepts and techniques. [5H]

Storage Structure & File Organization: Indexing, ordered indices: B+ tree and B tree index files, Introduction to Client Server and Distributed Databases [5H]

ext/Reference books:

1. R. Elmasri, S. B. Navathe, D. V.L.N. Somayajulu, S. K. Gupta, "Fundamentals of Database Systems," 7th edition, Pearson Education, 2015.

2. A. Silberschatz, H. F. Korth, S. Sudarshan, "Database System Concepts," 6th edition, McGraw-Hill, 2010.
3. H. Garcia-Molina, J. D. Ullman, and J. Widom, "Database Systems: The Complete Book," 2nd edition, Pearson Education, 2008.
4. D. M. Kroenke, "Database Processing Fundamentals, Design, and Implementation," 13th edition, Pearson Education, 2014.
5. C. J. Date, A. Kannan, S. Swamynathan, "An Introduction to Database Systems," 8th edition, Pearson Education, 2006.

Subject Code:	EC202	**Course Title**	Instrumentation and Measurement
Contact Hours	L-2, T-0, P-0	**Credit**	2
Programme	B.Tech	**Semester**	III
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Mid term (20%), Quiz II (10%), End term (40%), lab (20%)		

Basic terminologies (range, span, settling time dead zone, input impedance), Static and Dynamic characteristics, first order and second order instruments with step, ramp and sinusoidal input, output characteristics. **[5H]**

Strain gauge, derivation of gauge factor, strain gauge rosette, unbalanced wheatstone bridge, AC bridges for capacitance, inductance, phase and frequency measurement. Ultrasonic and its applications for measurement of flow, displacement and non-destructive testing. **[5H]**

LVDT, phase compensation, phase sensitive demodulation, thermistor and its linearization, RTD, its construction, three wire and four wire method Muller bridge, Thermocouple, their relative comparison, cold junction compensation using AD590, grounded thermocouple, potentiometer as displacement sensor, Capacitance as displacement and level transducer, push pull arrangement, Pressure transducer [Bourdon gauge, diaphragm gauge (metal and semiconductor) etc]. **[8H]**

Signal Conditioning Circuits, Quantization, Resolution, Sample and Hold Circuits, Analog (Successive Approximation, Ramp, and Flash) and Digital (R-2R, Binary weighted) Converters. **[4H]**

Text/Reference books:

1. Measurement Systems Application and Design, Ernest O. Doebelin, McGraw-Hill
2. Principles of Industrial Instrumentation,2e. Front Cover. Patranabis. Tata McGraw-Hill
3. Clarence W de Silva, MECHATRONICS - An Integrated Approach, CRC Press
4. Alan S Morris, Measurement and Instrumentation Principles, Butterworth-Heinemann

Subject Code:	ME202	**Course Title**	IT Workshop
Contact Hours	L-0, T-0, P-3	**Credit**	2
Programme	B.Tech	**Semester**	III
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Mid term (20%), Quiz II (10%), End term (40%), lab (20%)		

Programming **[6 H]**

Using C++/MATLAB

Geometric Modelling **[6 H]**

Catia/Solidworks

[1] Part Design - Pad / Pocket
[2] Part Design - Shaft / Groove
[3] Part Design - Rib / Slot
[4] Part Design - Multi-Sections Solids / Removed Multi-Sections Solids
[5] Assembly Design - 1
[6] Assembly Design - 2

Text/Reference books:

[1] Software Manuals
[2] Web sources

Subject Code:	CS202	**Course Title**	Oops With Java
Contact Hours	L-2, T-0, P-0	**Credit**	2
Programme	B.Tech	**Semester**	III
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Mid term (20%), Quiz II (10%), End term (40%), lab (20%)		

Introduction to Java, Program structure, Class Libraries, Using Java class libraries, data types, control structures in Java, simple Java programs, [5H]

Java applications and Applets, Drawing graphical shapes, [5H]

Objects and Classes, Attributes, Methods, Visibility, Class Diagram
Class Relationships, Association, Aggregation, Composition [5H]

Inheritance and Polymorphism, Base class, Derived class, Redefined methods, Abstract methods and classes [5H]

Java Interfaces [5H]

Exception Handling, try, catch, and finally blocks, Types of Exceptions, Creating exception classes
I/O streams, Character streams, Byte Streams, File Streams, Reading and writing to a file, Persistent objects, Object streams, Reading and writing objects to a file [10H]

GUI Programming-1: Components, containers, events, listeners, dialog boxes, menu items
GUI Programming-2: Frames, Layouts, Swing components and Hierarchies [7H]

Text/Reference books:

1. H. M. Deitel & P. J. Deitel, Java How to Program, 7th Ed., Pearson Education, 2007
2. Thinking in Java, Bruce Eckel's Free e-book http://www.codeguru.com/java/tij/
3. K. Sierra and B. Bates, Head First Java, 2nd Edition, O'Reilly Media, 2005.
4. H. Shield, Java: A beginner's guide, 6th Edition, McGraw-Hill Education, 2014

Semester-IV

Subject Code:	ES205	**Course Title**	Fundamental of Robotics
Contact Hours	L-2, P-2	**Credit**	4
Programme	B.Tech	**Semester**	IV
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Mid term (20%), Quiz II (10%), End term (30%), Lab (30%)		

Module 1: Introduction **[2 H]**

1. Introduction and Classification of robots
2. Introduction to Mechanical, Electrical and Electronics Elements of robots such as joints, links

Module 2: Robot Kinematics **[11 H]**

3. Robot as Mechanism
4. Joints and degrees of freedom
5. Position and orientation of a rigid body
6. Homogeneous transformations, Euler Angle
7. Direct kinematics of serial robots, Introduction to D-H parameters and its physical significance
8. Inverse kinematics of serial robots
9. Kinematics of mobile robot, Non-holonomic and holonomic robots

Module 3: Sensors and Actuators **[5 H]**

10. Sensors for robots: Introduction and their characteristics:
    a. Position, Velocity and Acceleration sensors
    b. Force, pressure and Torque sensors
    c. Light, infrared, proximity and range finder sensors
11. Actuators for robots: Introduction to servo and stepper motors, pneumatic and hydraulic actuators

Module 4: Robot Motion and Control **[8 H]**

12. Brief introduction to trajectory planning for serial robots
13. Reactive navigation for mobile robot
14. Global navigation
15. Trajectory-following control – basics of feedback and motion control

Module 5: Intelligent robots **[2H]**

16. Intelligent robots: Programmable and autonomous

Lab:

1. Demonstration of components of a robot
2. Practice on joints, links and degrees of freedom
3. Simulation of position and orientation of a robot
4. Simulation for forward kinematics of puma or similar robot
5. Simulation for kinematics of mobile robot
6. Inverse kinematics analysis of puma or similar robot
7. Practice on Sensors and actuators (2 labs)
8. Simulation and hardware implementation of Trajectory following robot (4 labs)

Text/Reference books:

1. Introduction to Robotics by Saeed B. Niku
2. Robot Motion and Planning by Choset
3. Introduction to Robotics: Mechanics and Control by Craig
4. Robot Modeling and Control by M. Spong, S. Hutchinson, and M. Vidyasagar

Subject Code:	MS1	**Course Title**	Management Concepts and Techniques
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	IV
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Midterm (20%), Quiz II (10%), End term (60%)		

Introduction to Operations Management:
Functional Subsystems of Organization, Definition, Systems Concept of Production, Types of Production Systems – Flow Shop, Job Shop, Batch Manufacturing, The Project, Productivity, Strategic Management – Corporate Strategic, Generic competitive Strategies, Functional Strategies, Gross Domestic Product and its impact, World Class Manufacturing. **[6 H]**

Product & Process Design and Analysis:
Product Design and Analysis is (Definition), new product development - its concepts, Steps of Product Design, Process Planning and Design -Selection of Process, Process Selection Decision, Process Planning Design, Responsibilities of Process Planning Engineer, Steps in Process Planning. Process Design - Process Research, Pilot Development, Capacity Consideration, Commercial Plan Transfer, Enhanced Capacity Using Optimization. Value Analysis/Value Engineering – History of Value Analysis/Value Engineering, When to Apply Value Analyses is, Function, Aims, Value Engineering Procedure, Advantages and Application Areas. Standardization: Standardization Procedure, Advantages of Standardization, Application of Standardization. Ergonomic Considerations in Product Design. **[9 H]**

Statistical quality control: Quality Improvement in the Modern Business Environment, the DMAIC Process Methods and Philosophy of Statistical Process, Control Charts for Variables, Control Charts for Attributes Process and Measurement System Capability Analysis **[7 H]**

Plant Location & Plant Layout:
Factors Influencing Plant Location, Break -even Analysis. Single Facility Location Problem, Multi-facility Location Problems –Model for Multi -facility Location Problem, Method of Transformation, Model to Determine X - Coordinates of New Facilities, Model to Determine Y - Coordinate, Plant Layout - Plant layout introduction, Classification of Layout, Advantages and limitations of Product Layout, Advantages and limitations of Group Technology Layout, Layout Design Procedures. **[6 H]**

Scheduling:
Introduction, Johnson's Problem, Extension of Johnson's rule. Job Shop Scheduling: Introduction, Types of Schedules, Schedule Generation, heuristic Procedures, Priority Dispatching Rules. Two Jobs and Machines Scheduling. **[4 H]**

Materials Management:
Integrated Materials Management, Components of Integrated Materials Management - Materials Planning, Inventory Control, Purchase Management, Stores Management. Inventory Control - Inventory Decisions, Costs Trade Off. Models of Inventory, Operation of Inventory Systems, Quantity Discount, Implementation of Purchase Inventory Model, Purchasing Management, Stores Management – Incoming Materials Control, Store Accounting, Obsolete Surplus and Scrap Management, ABC Analysis, XYZ Analysis, VED Analysis is, FSN Analysis, SDE Analysis. **[8 H]**

Text/Reference books:

1. Panneerselvam " Production and Operations Management" PHI,2012
2. H.Kaushal, Production / Operations Management, Case Study Solutions, MacMillan, 2012.
3. Ajay K Garg, Production and Operations Management, TMH, 2012
4. B. Mahadevan, Operations Management: Theory and Practice, Second Edition, Pearson, 2010.
5. Danny Samson "Operations Management: Integrated Approach" Cambridge, 2012.
6. Kenneth K. Boyer, Rohit Verma, Operations Management: Cengage Learning, 2011.
7. Dipak Kumar Bhattacharyya, Production and Operations Management, Universities Press, 2012.
8. Prof. L.C. Jhamb: Production Operations Management, 18th ed ition, Everest Publishing House,2013.
9. J.K, Sharma: Operations Research, Macmillian, 2013.

Subject Code:	EC203	**Course Title**	Network Analysis and Synthesis
Contact Hours	L-3, T-1, P-0	**Credit**	4
Programme	B.Tech	**Semester**	IV
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Mid-Term (25%), Quiz II (10%), End-Term (45%), Assignment (10%)		

Introduction: Formulation of network equation, KCL, KVL and Tellegens theorem. Network representations and transform methods of network analysis (Transient study in RL, RC, and RLC networks by Laplace transform method with DC and AC excitation. Response to step, impulse and ramp inputs.). Coupled Circuits: Self-inductance and Mutual inductance, Coefficient of coupling, dot convention. **[10H]**

Two-Port Networks: Characteristics of linear time-invariant networks, relationships among different network parameters (short circuit admittance parameter, open circuit impedance parameters, Transmission parameters, Image parameters and Hybrid parameters), interconnections of networks (Tee and Pie circuit representation, Cascade and Parallel Connections). Two port devices (Ideal two port devices, ideal transformer). **[10H]**

Graph theory: Introduction, Linear graph of a network, Tie-set and cut-set schedule, incidence matrix, Analysis of resistive network using cut-set and tie-set, Dual of a network. **[5H]**

Network Functions: Poles and zeros, restrictions on pole and zero locations for driving point functions and transfer functions. **[5H]**

Network Synthesis: Positive real function physical realizabilty conditions, Hurwitz property, positive realness, properties of positive real functions, Synthesis of R-L, R-C and L-C driving point functions, Foster and Cauer forms. Introduction to two-port network synthesis. **[10H]**

Filters: Classification of filters, Characteristics of ideal filters. **[2H]**

Text/Reference books:

1. M.E Van Valkenburg, "Network Analysis"
2. M.E Van Valkenburg, "Network Synthesiss"
3. Joseph A. Edminister, Mahmood Maqvi, "Theory and Problems of Electric Circuits," Schaum's Outline Series, TMH.

Subject Code:	ME203	**Course Title**	Thermodynamics
Contact Hours	L-3, T-0, P-2	**Credit**	4
Programme	B.Tech	**Semester**	IV
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Quiz II (10%), Midterm (20%), Quiz III (10%), Assignment (10%), End term (40%)		

Introduction to Thermodynamics, Systems, Properties, State of a system. Thermodynamic Equilibrium, Processes; Zeroth law of thermodynamics, Ideal Gas, Work and Heat Transfer, Principles of Energy Conversion, Energy Interactions, First Law, Energy Transport Mechanisms, Point and Path Function, Internal Energy. **[12 H]**

First Law applied to various Processes; Constant Volume, Constant Pressure, Isothermal, Reversible- adiabatic, etc.; Applications of First Law to Flow and Non-flow Processes. **[12 H]**

Second Law of Thermodynamics, Kelvin-Planck and Clausius statements; Carnot theorem; Available Energy, Entropy, Heat Engine, Heat Pump. **[12 H]**

Applications: Gas Power Cycles, Otto, Diesel and Brayton; Vapour Power Cycles, Rankine Cycle, Power Plant Operation; Refrigeration Cycles. **[12 H]**

Text/Reference books:

1. Fundamentals of Thermodynamics by Sonntag (Wiley)
2. Fundamentals of Engineering Thermodynamics by Moran and Shapiro (Wiley)
3. Thermodynamics: An Engineering Approach by Cengel and Boles (TMH)
4. Engineering Thermodynamics by P K Nag (TMH)

Subject Code:	CS203	**Course Title**	Computer Organization and Architecture
Contact Hours	L-3, T-0, P-2	**Credit**	4
Programme	B.Tech	**Semester**	IV
Pre-requisites	NIL		

Evaluation scheme

Introduction: Functional components and operational concepts of a computer, Performance of a computer. [4H]

Memory Subsystem: Semiconductor memories: SRAM and DRAM cells, Internal organization of a memory chip, Organization of a memory unit, Error correction, Read-Only Memories, Interleaved Memories, Cache Memories: Concept, Mapping methods, Caches in commercial processors, Memory management unit: Concept of virtual memory, Address translation, Hardware support for memory management, Secondary storage: Hard Disks, RAID, Optical Disks, Magnetic Tape Systems. [10H]

Input/Output Subsystem: Access of I/O devices, I/O ports, I/O control mechanisms: Program controlled I/O, Interrupt controlled I/O, and DMA controlled I/O, I/O Interfaces: Serial port, Parallel port, PCI bus, SCSI bus, USB bus, FireWire and InfiniBand. [10H]

Representation of Instructions: Computer Arithmetic, Machine Instructions, Operands, Instruction Sets: Addressing Modes, Instruction Formats, Instruction set architectures: CISC and RISC architectures. [5H]

Processing Unit: Organization of a processor: Registers, ALU and Control Unit, Data path in a CPU, Instruction cycle, Instruction Pipelining, Organization of a control unit: Control Unit Operations, Hardwired control unit, Microprogrammed control unit. [10H]

Introduction to Multiprogramming and Multiprocessing. [3H]

Text/Reference books:

1. C. Hamacher, Z. Vranesic and S. Zaky, "Computer Organization", Fifth Edition, McGraw-Hill, 2002.
2. M. Morris Mano, Computer System Architecture, Third Edition, Prentice Hall of India, 2007.
3. W. Stallings , "Computer Organization and Architecture – Designing for Performance", Tenth Edition, Prentice Hall of India, 2015.
4. D. A. Patterson and J. L. Hennessy, "Computer Organization and Design – The Hardware/Software Interface", Fifth Edition, Morgan Kaufmann, 2013.
5. J. P. Hayes, "Computer Architecture and Organization", Third Edition, McGraw-Hill, 2002.

Subject Code:	EC204	**Course Title**	Signals and Systems
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	IV
Pre-requisites	NIL		
Evaluation scheme	Quiz I (15%), Mid-Term (30%), Quiz II (15%), End-Term (40%)		

Module1: Classification of Signals & Systems

Continuous and discrete time signals: Classification of Signals: Periodic aperiodic, even / odd, energy and power signals, Deterministic and random signals, complex exponential and sinusoidal signals, periodicity: properties of discrete time complex exponential unit impulse - unit step impulse functions, Transformation in independent variable of signals: time scaling, time shifting. Systems: Definition, Classification: linear and nonlinear, time variant and invariant, causal and non-causal, static and dynamic, stable and unstable, invertible. **[9H]**

Module2: Linear Time Invariant (LTI) Systems

Time-Domain representation & Characterization of LTI systems, Impulse response representation, Convolution integral & Convolution sum, properties of LTI systems, Stability criteria for LTI systems, Elements of Continuous time & Discrete-time LTI systems.Classification of LTI system: FIR and IIR, Recursive & nonrecursive system, LTI-DT systems -Characterization using difference equation, modelling of difference equation: AR System, MA system & ARMA system, implementation of LTI system: Direct form-I, Correlation, properties and classification of correlation, input/output relation of LTI system in term correlation. **[9H]**

Module3: Frequency Analysis of Signals and Systems

Fourier representation of Signals, Continuous -time Fourier series and their properties, Application of Fourier series to LTI systems, Fourier Transform & its properties, Applications of Fourier Transform to LTI systems, Discrete-time Fourier Transform & its properties. Circular Convolution, Relationship to other transforms. **[9H]**

Module 4: Laplace Transform

Introduction & Definition, Region-of- convergence, Properties of Laplace transform, Inverse Laplace Transform, Applications of Laplace Transform in analysis of LTI systems, Unilateral Laplace Transform & its applications to solve differential equations, Analysis of Electric circuits. **[7H]**

Module 5: Z-Transform

The Z-Transform, Region-of-convergence, properties of Z-Transform, Inverse Z-Transform, Transform Analysis of Discrete-time LTI systems, Unilateral Z-Transform & its applications to LTI systems described by difference equations. **[8H]**

Text/Reference books:

1. Signals and Systems by Alan V. Oppenheim, Alan V. Willsky, S.Hamid Nawab, Prentice Hall
2. Linear Systems and Signals by B.P. Lathi, Oxford University Press
3. Digital Signal Processing: A Computer Based Approach by S. K. Mitra Tata McGraw Hill, 2006.

Subject Code:	ME204	**Course Title**	Solid Mechanics
Contact Hours	L-3, T-0, P-2	**Credit**	4
Programme	B.Tech	**Semester**	IV
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Midterm (25%), Quiz II (15%), Assignment (10%), End term (40%)		

Stress & strain:
Tension, compression, shearing stress & strain; Poisson's ratio: stress-strain relationship, Hooke's law; elastic constants and their relations, stress-strain curves, anisotropy & orthotropy, thermal stresses, composite bars. **[8 H]**

Members subjected to flexural loads:
Theory of simple bending, bending moment and shear force diagrams, relationship between bending moment, shear force and load, flexural relation, bending stresses, section modulus and transverse shear stress distribution. **[8 H]**

Deflection of Beams:
Differential Equations of the Deflection Curve, Deflections by Integration of the Bending-Moment Equation, Deflections by Integration of the Shear-Force and Load Equations, Method of Superposition, Moment-Area Method, Discontinuity Functions, Use of Discontinuity Functions in Determining Beam Deflections. **[8 H]**

Principal Stress and Strain:
Principal planes, stresses & strains, maximum normal &shear stresses, Mohr's circle of stress & strain. **[5 H]**

Torsion:
Torsional shear stress in solid, hollow and stepped circular shafts, angulardeflection and power transmission capacity. **[5 H]**

Theories of Elastic Failures:
The necessity for a theory, different theories,significance and comparison. **[4 H]**

Buckling:
Buckling and Stability, Columns with Pinned Ends, Columns with Other Support Conditions. **[4 H]**

Text/Reference books:

1. Beer and Johnston , "Mechanics of Materials", 5th Edition, McGraw Hill
2. James M. Gere, "Mechanics of Materials", 6th Edition, Thomson Learning Inc.
3. Shames and Pitarresi, Introduction to Solid Mechanics, PHI

Subject Code:	CS204	**Course Title**	Design & Analysis of Algorithm
Contact Hours	L-3, T-1, P-0	**Credit**	4
Programme	B.Tech	**Semester**	IV
Pre-requisites	NIL		
Evaluation scheme	Quiz/Assignment/Project (25%), Midterm (30%), End term (45%)		

Models of Computation: space and time complexity measures, lower and upper bounds; Search Trees: TRIE; B+ Trees, Binomial Trees; [10H]

Design techniques: the greedy method, divide-and-conquer, dynamic programming, backtracking, branch and bound; examples [10H]

Lower bound for sorting; Selection; [2H]

Graph Algorithms: connectivity, strong connectivity, bi-connectivity, topological sort, shortest paths, minimum spanning trees, The disjoint set union problem; [10H]

String matching; [2H]

NP-completeness; Introduction to approximate algorithms and Randomized algorithms. [8H]

Text/Reference books:

1. T. H. Cormen, C E Leiserson, R L Rivest and C Stein, Introduction to Algorithms, MIT Press.
2. J. Kleinberg and E. Tardos, Algorithm Design, Addison Wesley

3. A. Aho, J. E. Hopcroft and J. D. Ullman, The Design and Analysis of Computer Algorithms, Addison-Wesley.
4. S. Sahni, Data Structures, Algorithms and Applications *in C++*, McGraw-Hill.
5. M. T. Goodrich and R. Tamassia, Algorithm Design: Foundations, Analysis and Internet Examples, John Wiley & Sons, 2001.

Subject Code:	EC205	**Course Title**	Microprocessor and Interfacing
Contact Hours	L-2, T-0, P-0	**Credit**	
Programme	B.Tech	**Semester**	IV
Pre-requisites	NIL		
Evaluation scheme	Quiz I (15%), Mid-Term (30%), Quiz II (15%), End-Term (40%)		

Introduction to Microprocessor: Microprocessor based design, design constraints, microprocessor selection, hardware implementation, software implementation, hardware debugging, software debugging. **[6H]**

8085: Introduction to 4044, 8085, 8086 and other latest chips of Intel, Motorola microprocessors. 8085 internal architecture, register structure, bus architecture, cycle timings to execute instruction, Introduction to Assembly language, basic instruction set, STACK and Memory Architecture, Implementation of Subroutines with CALL, Interrupt handling with ISR (Interrupt Subroutines)**[8]**

Interfacing of 8085: Handling of I/O ports and port programming using IN/OUT instruction, STACK handling and Signed Number Arithmetic, Interfacing instructions and control word strcuture for various pins like 8255, 8155, 8279,8259, etc. **[8H]**

8086: Differences between 8085 and 8086, 8086 internal architecture, introduction to programmable parallel ports and hand shake, input – output, DMA transfer interfacing and refreshing dynamic RAM, interfacing the 8086 with keyboard, alphanumeric displays, etc. **[8H]**

Text/Reference books:

1. Microprocessor Architecture, Programming and Applications with the 8085, Ramesh Gaonkar, Penram International.
2. 8086 Programming and Advanced Processor Architecture, M. T. Savaliya, Wiley.
3. Microprocessor 8085 by Dr. Anil Swarnakar, PHI

Subject Code:	ME205	**Course Title**	Engineering Materials
Contact Hours	L-2, T-0, P-0	**Credit**	
Programme	B.Tech	**Semester**	IV
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Midterm (20%), Quiz II (10%), End term (60%)		

Overview of Mechanical Behavior **[4 H]**

Introduction / Elastic Deformation / Permanent Deformation / Fracture / Summary

Elastic Behavior **[6 H]**

Introduction / Range of Elastic Moduli / Additional Elastic Properties / Basis for Linear Elasticity / Anisotropic Linear Elasticity / Rubber Elasticity / Polymer Elasticity and Viscoelasticity / Mechanical Damping / Summary

Strengthening of Crystalline Materials **[6 H]**

Introduction / General Description of Strengthening / Work Hardening / Boundary Strengthening / Solid-Solution Strengthening / Particle Hardening / Strain-Gradient Hardening / Deformation of Two-Phase Aggregates / Strength, Microstructure, and Processing: Case Studies / Summary

High-Temperature Deformation of Crystalline Materials **[6 H]**

Introduction / Phenomenological Description of Creep / Creep Mechanisms / Deformation Mechanism Maps / Materials Aspects of Creep Design / Engineering Estimates of Creep Behavior / Superplasticity / Hot Working of Metals / Summary

Deformation of Noncrystalline Materials **[3 H]**

Introduction/Crystalline versus Noncrystalline Structures / Viscosity / Deformation Behavior of Inorganic Glasses/Deformation of Metallic Glasses/Deformation of Polymeric Materials / Summary

Cellular Solids **[3 H]**

Introduction / The Geometries and Densities of Cellular Solids / Compressive Behavior of Cellular

Solids / Energy Absorption in Cellular Solids / Sandwich Panels / Summary

Text/Reference books:

1. Mechanical Behavior of Materials, Second Edition by Thomas H. Courtney
2. Norman E. Dowling " Mechanical Behavior of Materials: Engineering Methods for Deformation, Fracture, and Fatigue"
3. Callister, "Materials Science and Engineering" John Wiley & Sons Inc.

Subject Code:	CS205	**Course Title**	Data Communication
Contact Hours	L-2, T-0, P-3	**Credit**	4
Programme	B.Tech	**Semester**	IV
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Mid term (20%), Quiz II (10%), End term (30%), lab (30%)		

Introduction History and Development of Computer Networks, Networks Topologies.
Physical Layer: Theoretical Basis, Transmission Media, Wireless Transmission, Digital Transmission, Switching.
Data link layer: Error Control, Flow Control, Sliding Window Protocols, HDLC, PPP

Text/Reference books:

1. Andrew S Tanenbaum, "Computer Networks" Pearson Education
2. Ajit Pal, "Data Communications and Computer Networks " PHI

Subject Code:	EC206L	**Course Title**	Microprocessor+Electronics
Contact Hours	L-0, T-0, P-3	**Credit**	2
Programme	B.Tech	**Semester**	IV
Pre-requisites	NIL		
Evaluation scheme	Quiz I (15%), Mid-Term (30%), Quiz II (15%), End-Term (40%)		

A. Microprocessor **[18H]**

1. Experiments based on general register content transfer instructions
2. Experiments based on some advanced instructions set
3. Experiments based on 1's and 2's complements, Masking, Left and Right shift of the binary numbers in Registers, Look up table, square of a number
4. Largest and smallest numbers in an array, BCD addition and subtraction, Subroutines, programs based on subroutine implementation.
5. Stack implementation and creation, analysis of prefix, postfix and infix expressions in 8085.
6. Interrupt handling, Priority of interrupts, RST 5.5, 6.5, 7.5, etc.

B. Electronics **[24H]**

1. Study of Normal and Zener Diode Characteristics
2. Study of Rectifier Circuits with and without Filters
3. Setting up a Power Supply using a Zener Diode as Voltage Regulator
4. Study of LCR Resonant Circuit
5. Rc Circuit as Filtering and Phase Shifting Network
6. Bipolar Junction Transistor Static Characteristics.
7. Study of Common Emitter Transistor Amplifier circuit
8. Two Stage RC Coupled Transistor Amplifier

Text/Reference books:

1. *Microprocessor Architecture, Programming and Applications with the 8085*, Ramesh Gaonkar, Penram International
2. Jacob Millman and Christos C. Halkias, Electronic Devices and Circuits
3. Robert L. Boylestad Electronic Devices and Circuit Theory

Subject Code:	ME206L	**Course Title**	Thermodynamics+Solid Mechanics
Contact Hours	L-0, T-0, P-3	**Credit**	2
Programme	B.Tech	**Semester**	IV
Pre-requisites	NIL		
Evaluation scheme	Lab Work (40%), Midterm (20%), End term (40%)		

1. To perform compression, shear and bending test on steel bar and determine compressive strength, shear strength and bending strength of the bar.
2. To determine the Brinell Hardness/ Rockwell Hardness number for the given specimen.
3. To determine the energy absorbed by the given specimen by Izod Impact Test and Charpy Impact Test.
4. To determine the bending stress and strain in a cantilever beam, using resistance strain gauges.
5. The fundamental objectives of this study are: (a) Calculate and experimentally observe the angular velocity ratios of gear trains, and (b) Compute the efficiency of gear train.
6. To verify the relation T=I.W.Wp. for gyroscope and stability of vehicles.
7. Compare the measured natural frequency to that obtained theoretically for Whirling of shaft.
8. To find out the corrected performances parameters (compression ratio, valve timing, etc) on petrol engine and to plot the heat balance sheet.
9. To study the effect of cantilever loading on standard rotating bending specimen, also study the characteristics of S-N curve for ferrous materials.
10. To study dynamometer & conduct load test on diesel engine.
11. To perform torsion test on a wire.

Text/Reference books:

1. Beer and Johnston , “Mechanics of Materials”, 5th Edition, McGraw Hill
2. Mechanical Behavior of Materials, Second Edition by Thomas H. Courtney
3. Theory of Mechanisms & Machines by Ghosh & Mallick, EWP
4. Rattan S.S., .Theory of Machines.
5. Norman E. Dowling " Mechanical Behavior of Materials: Engineering Methods for Deformation, Fracture, and Fatigue"
6. Callister, “Materials Science and Engineering” John Wiley & Sons Inc

Subject Code:	CS206L	**Course Title**	Lab based Project 1
Contact Hours	L-3, T-0, P-2	**Credit**	4
Programme	B.Tech	**Semester**	IV
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Mid term (20%), Quiz II (10%), End term (40%), lab (20%)		

Lab based Project 1

Semester V

Subject Code:	DS302	**Course Title**	Engineering design
Contact Hours	L-2, T-0, P-4	**Credit**	4
Programme	B.Tech	**Semester**	V
Pre-requisites	NIL		
Evaluation scheme	Quizzes (15%); Mid-sem (35%) and End-sem (45%)		

Introduction to Engineering Design: **[6 H]**
Importance of Design, Design Philosophy, History of Design,Design Paradigm, the Design Process, Good Design, Engineering Analysis, Design phases, Productand Process Cycle.

Need Identification and Problem Definition: **[6 H]**
Identifying customer needs, Benchmarking,QualityFunction Deployment, Engineering Design Specification

Concept Design: **[6 H]**
Creativity and Problem Solving, Functional requirements, Product ComponentDecomposition, Product Function Decomposition, Conceptual Decomposition, Generating DesignConcepts, Product Form and Geometry, Product Aesthetics, Evaluating alternative Concepts, Theoryof Inventive Problem Solving, Axiomatic Design, Concept Evaluation Methods, Decision Making.

Embodiment Design: **[6 H]**
Introduction, Product Architecture, Configuration Design, Parametric Design,Best Practices, Industrial Design, Human Factors Design, Design For X (DFX) - Function, Assembly,Manufacture, Environment, Robustness, Reliability, Recyclability, etc.

Materials Selection: **[8 H]**
Performance Characteristics of Materials, the Material Selection Process,Economics of Materials, Material Selection Methods.

Selection of Manufacturing Processes: **[4 H]**
Manufacturing Processes, Costs of Manufacturing, ProcessSelection.

Building and Testing Prototypes: **[3 H]**
Building Traditional Prototypes, Building Rapid Prototypes, Testing Prototypes, Testing Product Usability.

Design for Failure, Safety and Tolerance: **[3 H]**
Failure Modes and Effects Analysis, Design for Safety,Tolerance Design.

Text/Reference books:

[1] Karl T. Ulrich and Steven D. Eppinger, Product Design and Development, McGraw-Hill
[2] Dennis M. Buede, The Engineering Design of Systems: Models and Methods, John Wiley & Sons inc.

Subject Code:	EC307	**Course Title**	Fundamental of Electromagnetic Theory
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	V
Pre-requisites	NIL		
Evaluation scheme	Quiz I (15%), Mid-Term (30%), Quiz II (15%), End-Term (40%)		

EMWAVES: Review of vector and coordinate systems, review Electrostatic and Magneto-statics, Maxwell's equations for static and time varying fields, Boundary conditions, Propagation of uniform plane waves in perfect dielectric and lossy medium, Wave velocity and impedance, Reflection and refraction. **[10H]**

Transmission Lines: Introduction of Transmission lines, Transmission line parameters and equations, Solution for lossless lines, Reflection and Transmission coefficients at junctions, VSWR, Introduction to Smith Chart. **[10H]**

Waveguides: Introduction of Waveguides, Waveguides Modes, Solution of Wave Equations in Rectangular and Cylindrical waveguides for TM and TE, Wave propagation in Waveguide, Power Transmission and losses. **[12H]**

Antenna and Radiation: Radiation fundamentals, the half-wave dipole antenna. Antenna performance parameters, two element array, linear arrays, multiplication of patterns, antennas for various applications, Propagation of radio waves (introduction). **[10H]**

Text/Reference books:

[1] Electromagnetic Waves and Radiating Systems, E.C.Jordan and K.G.Balmain, PHI.
[2] Elements of Electromagnetics, Mathew N.O.Sadiku, Oxford University Press.
[3] Theory and Problems of Electromagnetics by J.A. Administer

Subject Code:	ME307	**Course Title**	Manufacturing Technology
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	V
Pre-requisites	NIL		
Evaluation scheme	Quizzes (15%); Mid-sem (35%) and End-sem (45%)		

Machining and Mechanics of Metal Cutting: **[14 H]**

Introduction to orthogonal & oblique cutting; Chip information mechanism; heat generation and cutting tool temperature, tool geometry – ASA, ORS, NRS and relationships, selection of tool angles. Cutting tool material; tool wear; tool life and machinability; surface finish; cutting fluids. Merchant's circle diagram, coefficient of friction, stress, strain and strain rate, shear angle. Leee and Shaffer's Relationship: Friction in Metal cutting-sticking & sliding.

Material Removal Processes: **[8 H]**

Basic operations of turning, shaping, slotting and planning, drilling and boring, milling.Introduction multi-point cutting tools; twist drill, helical milling cutter. Practical machining operations with machining parameters, force magnituds, power consumption, material removal rate, time per pass.

Cutting Force Measurement: **[2 H]**

Basic methods of measurement, axially loaded members, cantilever beam, rings and octagon, dynamometer requirements machine tool dynamometers.

Economics of Machining: **[4 H]**

Cutting parameters for minimum production cost criteria; maximum production and profit rate criterion. Restrictions on cutting conditions (power, speed, force and vibration, surface finish).

Metal Forming: **[10 H]**

Plasticity: Introduction to stress, strain, stress-strain relationships, Mechanics of Forming Processes: Rolling, Forging, Drawing, Deep Drawing Extrusion, Punching and Blanking.

Casting: **[4 H]**

Design of riser, runner and gating system, mechanism and analysis of solidification.

Text/Reference books:

1. M.C. Shaw, Metal Cutting Principles, 2nd Edition Oxford University Press, England 2005.
2. A. Ghosh and A.K. Malik, Manufacturing Science. Affilated East West press 1985.
3. Mikel P. Groover, "Fundamentals of Modern Manufacturing", John Wiley & Sons inc.

Subject Code:	CS307	**Course Title**	Computer Network
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	V
Pre-requisites	NIL		
Evaluation scheme	Quiz I (15%), Mid term (30%), Quiz II (15%), End term (40%).		

- Introduction: History and Development of Computer Networks, Review of Data communication concepts and techniques, Networks Topologies, Network model components, layered network models (OSI reference model, TCP/IP networking architecture) [10H]
- Data Link and MAC sublayer:
  - Preliminaries of Error Control, Flow Control and Sliding Window Protocols.
  - Aloha Protocols, CSMA Protocols, Collision Free Protocols, Local Area Networks -- Ethernet, Wireless LAN, Broadband Wireless. [10H]
- Network Layer: Routing Algorithms, Subnets, Congestion Control Algorithms, Internetworking -- Bridges and Routers. [10H]
- Transport Layer: Connection Establishment, and release, TCP, UDP, Flow Control and Congestion Control, Quality of Services. [10H]

Application Layer Potocols and Introduction to Network Security. [2H]

Text/Reference books:

[1] Andrew S. Tanenbaum, David J. Wetherall , Computer Networks, 5th Edition, Pearson Publications, 2010.

[2] W. Stallings, Data and Computer Communication, 10th Edition, Pearson Publication, 2013.

[3] B. A. Forouzan, Data Communications and Networking, 5th Edition, McGraw Hill Publication, 2012.

[4] B. S. Davie and L. L. Peterson, Computer Networks: A Systems Approach, 5th Edition, Morgan Kaufmann Publication, 2011.

Subject Code:	EC308	**Course Title**	Control Systems
Contact Hours	L-3, T-1, P-0	**Credit**	4
Programme	B.Tech	**Semester**	V
Pre-requisites	NIL		

Evaluation scheme	Quiz I (15%), Mid-Term (30%), Quiz II (15%), End-Term (40%)

Terminology and basic structure, feedback control theory, multivariable systems, **[1 H]**
Modelling of physical systems, state- variable models; block diagram, signal flow graph and Masons gain formula. **[6 H]**
Time and frequency response of first and second order systems. **[4 H]**
Control system characteristics: stability, sensitivity, disturbance rejection and steady-state accuracy; stability analysis: Routh-Hurwitz test, relative stability. **[4 H]**
Root locus, Bode and Nyquist plots. **[6 H]**
Concepts of state variables and state model - state models for linear continuous-time systems, solution of state equations, concepts of controllability and observability, Pole placement by State Feedback. **[10 H]**
The z-transform and Inverse z-transform, Pulse Transfer Function, z- and s-domain Relationship, Stability. **[10 H]**

Text/Reference books:

[1] K. Ogata, Modern Control Engineering, Prentice Hall India, 2006.
[2] I. J. Nagrath and M. Gopal, Control System Engineering, New age International, 5th edition, 2008.
[3] B. C. Kuo, Automatic Control Systems, Prentice-hall of India, 7th edition, 2000.

Subject Code:	ME308	**Course Title**	Fluid Mechanics
Contact Hours	L-3, T-1, P-0	**Credit**	4
Programme	B.Tech	**Semester**	V
Pre-requisites	NIL		

Evaluation scheme	Quizzes (15%); Mid-sem (35%) and End-sem (45%)

1.Fundamental concepts: Continuum models, characteristics of fluids. **[1 H]**
2.Fluid Statics: Hydrostatic pressure, forces on submerged surfaces, pressure measurement. **[6 H]**
3.Integral Analysis: Fundamental laws, systems and control volumes, Reynold's Transport Theorem, conservation of mass, momentum and energy equation, Applications to various fluidic systems. **[12 H]**
4. Differential Analysis of fluid flow: Flow Kinematics, Types of flow, Flow field, velocity, acceleration, stream function, vorticity. Incompressible- inviscid flow, Euler's and Bernoulli's equation. **[10 H]**
5. Dimensional analysis and similitude, dimensionless numbers, kinematic and dynamic similarity. **[3 H]**
6.Flow in conduits and pipes – Incompressible viscous flow, fully developed flow in pipes, velocity distribution, laminar and turbulent flow, head loss, major and minor losses, Flow measurement, pipeline networks, bends, fittings, series and parallel pipes. **[8 H]**
7. Boundary layers and flow over objects, separation, lift and drag, applications for flat plate like objects. **[5 H]**
8. Introduction to Compressible Flow - speed of sound, stagnation properties. Steady state-one-dimensional compressible flow - basic equations for isentropic flow, adiabatic flow with friction. **[3 H]**

Text/Reference books:

[1] Fluid Mechanics by Frank M. White (MGH)
[2] Introduction to Fluid Mechanics by Fox and McDonald (Wiley)

Subject Code:	**CS308**	**Course Title**	**Operating System**
Contact Hours	L-3, T-1, P-0	**Credit**	4
Programme	B.Tech	**Semester**	V
Pre-requisites	NIL		
Evaluation scheme	Quiz I (15%), Mid term (30%), Quiz II (15%), End term (40%)		

Operating systems for mainframe and desktops: A Historical Overview, Batch OS, Multiprogramming OS, Time sharing OS, Multiprocessor and Distributed systems, Clustered systems, Real Time Systems. [2H]

Operating system structure: OS services, system calls, System programs, System structure, Virtual machines. [4H]

Process Management: Process concept, Process scheduling, Operations on processes, Threads. [3H]

CPU Scheduling: Scheduling Criteria, Scheduling algorithms, Multiprocessor scheduling, Real time scheduling, Thread scheduling. [4H]

Inter process communication: Cooperating processes, The Critical Section problem, Two tasks solutions, Semaphores, Classical synchronization. [4H]

Deadlocks: Characterization, Methods for handling deadlocks, Prevention, avoidance and detection, Recovery. [3H]

Memory management: Background, swapping, Contiguous memory allocation, Paging and segmentation, Virtual memory, Demand paging, Page replacement, thrashing. [10H]

File system management: File concept, Access method, Directory structure, File System mounting, File sharing, Allocation methods, Protection. [4H]

Mass storage structure and management: Disk structure, Disk scheduling and Management, Swap space management, RAID structure. [4H]

Protection and Security: Goals, Domain of protection, Access matrix, Capability based systems, Security problems, User authentication, Program threats and system threats [4H]

Text/Reference books:

1. A. Silberschatz, B. P. Galvin, G. Gagne, Operating System, 6th Edition, John Wiley & Sons Inc., 2004

2. W. Stalling, Operating System, 6th edition, Pearson Education, 2009

Subject Code:	EC309	**Course Title**	Principle of Communication
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	V
Pre-requisites	NIL		
Evaluation scheme	Quiz I (15%), Mid-Term (30%), Quiz II (15%), End-Term (40%)		

Introduction to Communication Systems:
Communication network and channel, Difference between Analog and Digital type of signal and Communication, Classification of Signals and systems, Fourier series, Fourier transform and its Properties and examples, Impulse Response, and Transfer Function. **[5H]**

Amplitude modulation (Linear modulation):
Modulation, Amplitude Modulation, and Double Sideband Modulation. Single-Sideband and Vestigial-Sideband Modulations. Implementation of AM Modulators and demodulators. **[8H]**

Angle Modulation:
Basic definition, Phase modulation, frequency modulation, relationship between frequency and phase modulation, bandwidth of FM signal, Narrowband and wideband frequency modulation, Transmission bandwidth of FM signal, Generation and detection of angle modulation. **[8H]**

Effect of Noise on Amplitude Modulation System:
Effect of noise on linear modulation systems (Base-band systems, DSB-SC AM, SSB AM, Conventional AM). **[7H]**

Effect of Noise on Angle Modulation System:
Noise in frequency modulation systems, threshold effect in FM system performance, threshold improvement in FM Discriminators, Noise in phase-modulated system, comparison of analog modulation system. **[7H]**

Pulse Modulation:
Sampling of band-limited signals and band pass signals, quantization, PCM system, Analog pulse modulation. **[7H]**

Text/Reference books:

1. Communication System, Haykin, S., Fourth Edition, Wiley and Sons, 2005.
2. Modern Digital and Analog Communication System, Lathi, B.P., Oxford University Press.
3. Communication System Engineering, John G. Proakis and Masoud Salehi, Prentice Hall,2006.

Subject Code:	ME309	**Course Title**	Design of Mechanical Components
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	V
Pre-requisites	NIL		
Evaluation scheme	Quizzes (20%); Mid-sem (35%) and End-sem (45%)		

Introduction:
Engineering Design, Basic requirements for machine elements and machines, Properties of materials. **[2H]**

Design of Cotter and Knuckle Joint:
Design of Cotter Joint with consideration of tensile failure of rod, spigot and socket; shear failure; crushing failure.
Design of Knuckle Joint considering failure of rod, pin, eye, fork end. **[4H]**

Design of Thick and Thin cylinders:
Cylinders, Cylinders subjected to internal pressure, Vessels subjected to external pressure, Pipes and Tubes. **[4H]**

Design of Shafts, Keys and Coupling:
Causes of Failures in shafts, Shaft subjected to pure torsional load and combined load, Design of Keys and Coupling. **[4H]**

Design of Bolted and Welded Joints:
Thread forms, Terminology, and Standards, Joint subjected to external load, Bolt tightening and initial tension,Joint-Fastener Stiffness.

Welded joints subjected to static axial and direct shearloading, Welded joints subjected to static torsional and bendingloading. **[8H]**

Design of Springs:

Terminology, Stress in the spring, Curvature effect, Deflection of helical springs.

[4H]

Selection of Bearings:

Bearingtypes and applications, Bearing designation, Selection of bearing type.

[4H]

Design and Selection of Gears and Belts:

Classification of Gears, Terminology, Tooth systems, Force analysis of Spur Gear, Lewis Bending equation, Velocity consideration in Lewis equation, Dynamic Tooth Load, Static Tooth Load, Wear Tooth Load, Design Procedure for Spur Gears.

Types of Belt Drives, Selection of a Belt Drive, Velocity ratio and length of a Belt Drive.

[6H]

Design of Clutches and Brakes:

Functions of Clutch, Single and Multi plate clutches, Distinction between brake and clutch, shoe brake, band brakes. **[2H]**

Design for variable loading:

Stress Concentration, Fatigue, Fatigue-Life Methods, Endurance limit, Endurance limit modifying factors, Fatigue Failure Criteria for Fluctuating Stress. **[4H]**

Text/Reference books:

1. Shigley, J., Mechanical Engineering Design, Sixth Edition, Tata McGraw Hill, 2003.
2. Bhandari, V., Design of Machine Elements, Second Edition, Tata Mc-Graw Hill, 2007.
3. Design Data Book, PSG College of Technology, Coimbatore.
4. Juvinall, R. C. and Marshek, K.M., Fundamentals of Machine Component Design, Wiley, 2005.

Subject Code:	**CS309**	**Course Title**	**Language Theory**
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	V
Pre-requisites	NIL		
Evaluation scheme	Quiz /Assignments (25%), Midterm (30%), End term (45%)		

Introduction of Automata, Computability, and Complexity; Mathematical notations and terminology; Finding proofs and types of proofs. [4H]

Finite Automata and regular languages: Formal definitions, Designing finite automata, Deterministic finite automata, Non-deterministic finite automata, Equivalence of NFAs and DFAs, finite automata with epsilon-transition; regular expressions and languages, Properties of Regular languages, conversion of RE to FA and vice versa. Pumping Lemma. [10H]

Push down Automata and Context free languages: Context free grammars, Designing context free grammar, Ambiguity in CFG and its removal, Chomsky normal form. Push down Automata: formal definition, graphical notations, Languages accepted by PDA, Equivalence of PDA and CFG, Non-context free languages, Pumping Lemma for CFGs. [10H]

Turing Machines and Computability: Formal definition of Turing machines with examples, Variants of Turing machines, [6H]

Decidability, un-decidability and reducibility: Decidable languages; Decidable problems concerning regular languages and context free languages, The halting problem, Post correspondence problems, Undecidable problems. [8H]

Computational Complexity & NP-Completeness: The class P, The class NP, Reductions, The class NP-Complete, Dealing with NP-Completeness. [4H]

Text/Reference books:

1. J. H. Hopcroft, R, Motwani, J. D. Ullman, Introduction to Automata Theory, Languages, and Computation, Third Edition, Pearson Education Inc., New Delhi
2. M. Sipser, Introduction to the Theory of Computation, Third Edition, Cengage Learning India Pvt. Ltd.

Subject Code:	EC310a	**Course Title**	Computer Networks
Contact Hours	L-2, T-0, P-0	**Credit**	2
Programme	B.Tech	**Semester**	V
Pre-requisites	NIL		
Evaluation scheme	Quiz I (15%), Mid term (30%), Quiz II (15%), End term (40%).		

- Introduction: History and Development of Computer Networks, Review of Data communication concepts and techniques, Networks Topologies, Network model components, layered network models (OSI reference model, TCP/IP networking architecture) **[10H]**
- Data Link and MAC sublayer: **[10H]**
  - Preliminaries of Error Control, Flow Control and Sliding Window Protocols.
  - Aloha Protocols, CSMA Protocols, Collision Free Protocols, Local Area Networks -- Ethernet, Wireless LAN, Broadband Wireless.
- Network Layer: Routing Algorithms, Subnets, Congestion Control Algorithms, Internetworking -- Bridges and Routers. **[10H]**
- Transport Layer: Connection Establishment, and release, TCP, UDP, Flow Control and Congestion Control, Quality of Services. **[10H]**

Application Layer Potocols and Introduction to Network Security. **[2H]**

Text/Reference books:

1. Andrew S. Tanenbaum, David J. Wetherall , Computer Networks, 5th Edition, Pearson Publications, 2010.
2. W. Stallings, Data and Computer Communication, 10th Edition, Pearson Publication, 2013.
3. B. A. Forouzan, Data Communications and Networking, 5th Edition, McGraw Hill Publication, 2012.
4. B. S. Davie and L. L. Peterson, Computer Networks: A Systems Approach, 5th Edition, Morgan Kaufmann Publication, 2011.

Subject Code:	EC310b	**Course Title**	Digital System Design
Contact Hours	L-2, T-0, P-0	**Credit**	2
Programme	B.Tech	**Semester**	V
Pre-requisites	NIL		
Evaluation scheme	Quiz I (15%), Mid-Term (30%), Quiz II (15%), End-Term (40%)		

Introduction to Digital Design and Digital Logic: What is Digital? Specification and Implementation of digital design, Structured and Trial-Error methods in design, Digital Computer Aided Design (CAD) tools. Binary Number System, Octal, Hexa-decimal and BCD Codes, Number System Conversion, Use of different number systems in digital design, Logic gates – AND, OR, NOT, NAND, NOR etc., NAND and NOR implementation of real life digital circuits, Digital Circuit Characterization – Fan-in/Fan-out, Switching functions, Switching times, Noise margin etc. **[6H]**

Boolean Algebra: AND, OR and other relations, DeMorgan's law, Karnaugh Maps, Minimization of Sum of Products and Product of Sums, Design of minimal two-level gate networks, Design of multiple output two level gate networks. **[5H]**

Combinational Circuit Design: Design Procedure, Design of Multiplexer, Decoder, Encoder, Comparator, Design of Seven-segment display, Parity generator, Design of large circuits using the above modules. **[5H]**

Synchronous Sequential Circuit Design: Design of sequential modules – SR, D, T and J-K Flip-flops, Flip-flop applications – Clock generation, Counters, Registers, Basic State machine concepts. **[6H]**

Text/Reference books:

1. Fundamentals of Logic Design – Charles H. Roth, 5th Ed., Cengage Learning.
2. Digital Systems Testing and Testable Design – Miron Abramovici, Melvin A. Breuer and Arthur D. Friedman- John Wiley & Sons Inc.
3. Logic Design Theory – N. N. Biswas, PHI
4. Switching and Finite Automata Theory – Z. Kohavi , 2nd Ed., 2001, TMH
5. Digital Design – Morris Mano, M.D.Ciletti, 4th Edition, PHI
6. Digital Circuits and Logic Design – Samuel C. Lee, PHI

Subject Code:	EC310c	**Course Title**	Intelligent Control
Contact Hours	L-2, T-0, P-0	**Credit**	2
Programme	B.Tech	**Semester**	V
Pre-requisites	NIL		

Evaluation scheme	Quiz I (15%), Mid-Term (30%), Quiz II (15%), End-Term (40%)

Biological foundations to intelligent systems I: Artificial neural networks, Back-propagation networks, Radial basis function networks, and recurrent networks. **[6H]**

Biological foundations to intelligent systems II: Fuzzy logic, knowledge representation and inference mechanism, genetic algorithm, and fuzzy neural networks. **[6H]**

Fuzzy and expert control (standard, Takagi-Sugeno, mathematical characterizations, design example), Parametric optimization of fuzzy logic controller using genetic algorithm. **[6H]**

System identification using neural and fuzzy neural networks. **[5H]**

Stability analysis: Lyapunov stability theory and Passivity Theory. **[5H]**

Text/Reference books:

1. Stanislaw H. Zak, Systems and Control, Oxford University Press, 2003
2. A.S. Poznyak, E. N. Sanchez and Wen Yu, Differential Neural Networks for Robust Nonlinear Control, World Scientific, 2001.
3. Kevin M. Passino and Stephen Yurkovich, Fuzzy Control, Addison Wesley Longman, Menlo Park, CA, 1998

Subject Code:	ME310a	**Course Title**	Steam Turbine
Contact Hours	L-2, T-0, P-0	**Credit**	2
Programme	B.Tech	**Semester**	V
Pre-requisites	NIL		

Evaluation scheme	Quizzes (20%); Mid-sem (35%) and End-sem (45%)

Flow through nozzles:

Flow in Steam Nozzles, Nozzle types, Flow area of nozzle, Nozzles operating in the off design condition, super saturated flow. **[3H]**

Steam Turbine:

Classification of Turbines, Metallurgical Consideration, Working Principles, Description of main components i.e. Turbine Casing, Rotor, Blades, Steam admission Valves, Couplings, Bearing, Barring Gear, Turbine Velocity Diagrams, Diagram work and diagram efficiency. **[7H]**

Cooling Water System & Cooling Towers: CW Open and Closed System, CW pumps, Cooling Towers, CT Fans, Calculation. **[6H]**

Regenerative Feed Heating System: Description and Layout system, Working Principles and constructional details of L P Heaters, HP Heaters, Deaerator, GSC, Ejector. Drip drain system, Regenerative Rankine Cyle with calculations. **[8H]**

Turbine House Pumps & Compressor: Constructional details and working principles of condensate extraction pump, Boiler feed pump, clarified water pump, HP & LP Dozing pump, PA & IA Compressors with drier. **[4H]**

Text/Reference books:

1. Rajmohan Gupta, "Steam Turbine", Oxford & IBH Publishing Co. Pvt. Ltd.
2. P. K. Nag, "Power Plant Engineering", Tata McGraw Hill Publications.
3. R. Yadav, "Steam Turbine", Khanna Publishers.
4. "Modern Power Station Practice" Volume C, British Electricity International Ltd., Central Electricity Generating Board, Pergamon Press, Oxford, 1991.
5. "Steam Turbine and its Auxiliaries", Manufacturer's Power Plant Manual.
6. Power Plant Familiarisation – Vol. III, NPTI Publication.
7. M. M. Vakil, " Power Plant Technology"

Subject Code:	ME310b	**Course Title**	Steam Generators
Contact Hours	L-2, T-0, P-0	**Credit**	2
Programme	B.Tech	**Semester**	I
Pre-requisites	NIL		
Evaluation scheme	Quizzes (20%); Mid-sem (35%) and End-sem (45%)		

Description of Main Boiler:
Classification and Types of Steam Generators, Fundamentals of Boilers design. Constructional details including steam water circuit of high pressure and high capacity water tube boilers, Economizers, Super-heaters, De-Superheater, Re-heaters. **[8H]**

Boiler Circulation Theory:
Boiler Drum & its Internals, Boiler Mountings, Feed water treatment. **[4H]**

Air Pre-heater:
Types and functions, Constructional details, SCAPH, Soot Blower. **[4H]**

Draft System:
Theory of Natural, Induced, Forced and Balance Draft, Constructional details /Lubricating Oil System for PA Fan, FD Fan, ID Fan, Layout etc. **[4H]**

Electrostatic Precipitator:
Basic working principle and constructional details of Electrostatic Precipitator, Corona effect, Rapping Mechanism. **[4H]**

Ash handling system:
Bottom ash, Fly ash, System Layout, equipment description, Ash disposal and utilization. **[4H]**

Text/Reference books:

1. P. K. Nag, "Power Plant Engineering", Tata McGraw Hill Publication
2. 'Modern Power Station Practice", Volume B, British Electricity International Ltd., Central Electricity Generating Board, Pergamon Press, Oxford, 1991.
3. "Steam Generator and its Auxiliaries", Manufacturer's Power Plant Manual.
4. Power Plant Familiarisation – Vol. II, NPTI Publication

Subject Code:	ME310c	**Course Title**	Gas Dynamics
Contact Hours	L-2, T-0, P-0	**Credit**	2
Programme	B.Tech	**Semester**	I
Pre-requisites	NIL		
Evaluation scheme	Quizzes (20%); Mid-sem (35%) and End-sem (45%)		

Introduction:
Governing equations of compressible flow. **[2H]**

1 D Flow:
Introduction - Normal Shock Relations - Hugoniot Equations. **[4H]**

Oblique Shocks:
Supersonic flow over wedges and cones - Interaction of shocks of opposite families - Intersection of shocks of same family. **[6H]**

3D Shock Waves:
Prandtl-Meyer Expansion waves - Shock expansion theory - Crocco's Theorem. **[6H]**

Linearized Flow:
Linearized velocity potential equation - Linearized pressure coefficient - Linearized Subsonic flow - Improved compressibility corrections - Linearized supersonic flow - Critical Mach Number. **[4H]**

Unsteady wave motion:
Moving normal shock wave - Reflected shock waves - Incident and reflected expansion waves - Shock tube relations - Finite compression waves. **[6H]**

Text/Reference books:

1. H. W. Liepmann and A. Roshko, Elements of Gas Dynamics
2. John D. Anderson, Jr., Modern Compressible Flow: With Historical Perspective, Third Edition,

Subject Code:	CS310a	**Course Title**	Soft Computing
Contact Hours	L-2, T-0, P-0	**Credit**	2
Programme	B.Tech	**Semester**	V
Pre-requisites	NIL		
Evaluation scheme	Quiz I (15%), Mid term (30%), Quiz II (15%), End term (40%)		

Introduction to Computing: Evolution of Computing, Basics of Soft Computing. Conventional AI and Computational Intelligence, Machine Learning Basics. **[8H]**

Neural Networks: Introduction to neural networks, Neural network architecture, Learning methods, Architecture of a back propagation network, Applications. **[8H]**

Fuzzy Logic: Crisp and Fuzzy sets, membership functions, Basic operations on fuzzy sets, Properties of fuzzy sets, Fuzzy relations, Propositional and predicate logic, fuzzy mapping rules and implications, Applications. **[8H]**

Nature Inspired Algorithms: Introduction, Genetic algorithms, Differential evolution, Particle swarm optimization, Cuckoo search. **[12H]**

Hybrid Systems: Integration of neural networks, fuzzy logic and genetic algorithms. **[6H]**

Text/Reference books:

1. N.P. Padhy and S.P. Simon, Soft Computing: With Matlab Programming, Oxford University Press, 2015.
2. K.H.Lee, First Course on Fuzzy Theory and Applications, Springer-Verlag, 2004.
3. D. E. Goldberg, Genetic Algorithms: Search, Optimization and Machine Learning , Addison Wesley, 1989.
4. S. Rajasekaran and G.A.Vijaylakshmi Pai, Neural Networks Fuzzy Logic, and Genetic Algorithms, Prentice Hall of India, 2003.
5. J.S.R. Jang, C.T. Sun and E. Mizutani, Neuro-Fuzzy and Soft Computing, Prentice Hall of India, 2004.

Subject Code:	CS310b	**Course Title**	Parallel Computing
Contact Hours	L-2, T-0, P-0	**Credit**	2
Programme	B.Tech	**Semester**	V
Pre-requisites	NIL		
Evaluation scheme	Quiz I (15%), Mid term (30%), Quiz II (15%), End term (40%)		

Paradigm of Parallel Computing: Flynn's taxonomy, Pipelining, SIMD, MIMD, Classification of parallel computers **[05 H]**

Programming Parallel Computers: Parallel Programming, Parallel Languages, Cognitive Training **[04 H]**

Connectivity: Synchronizing Communications, role of Memory, Network design, System Interconnections **[04 H]**

Data Flow Computer: dataflow graphs, elements of dataflow computers **[04 H]**

Software Issues in Parallel Computing: ideal Situation, using existing serial programs [**[04 H]**

Text/Reference books:

1. Elements of Parallel Computing, V Rajaraman, Prentice Hall, 2006
2. Parallel Computing: Principles and Practice, T. J. Fountain, Cambridge University press, 2006

Subject Code:	CS310c	**Course Title**	Coding Theory
Contact Hours	L-2, T-0, P-0	**Credit**	2
Programme	B.Tech	**Semester**	V
Pre-requisites	NIL		
Evaluation scheme	Project/Quiz I (30%), Mid term (30%), End term (40%)		

Review of basic concepts: probability including Bayesian analysis, Introduction to entropy and information content **[6L]**

Basics of coding theory: Finite fields, linear codes, generator and parity check matrices **[6L]**

General theory of data compressions: Overview of specific data compression techniques

Channel capacity theory, Shannon's Noisy Channel Coding Theorem **[10L]**

Some Interesting Codes: Repetition Codes, Hamming Codes, Hadamard Codes Cyclic Codes, BCH Codes, Reed-Solomon Codes, The Golay Codes **[10L]**

Bounds on Codes: Krawtchouk Polynomials and the Linear Programming Bound, Asymptotic Bounds, Evaluation of different coding techniques in specific situations **[10L]**

Text/Reference books:

1. van Lint, J. H. Introduction to coding theory, Third edition. Graduate Texts in Mathematics, Springer-Verlag, Berlin, 1999.
2. Huffman, W. C. and Pless, V. Fundamentals of error-correcting codes. Cambridge University Press, Cambridge, 2003.
3. D. R. Hankerson, D. G. Hoffman, D. A. Leonard, C. C. Lindner, K. T. Phelps, C. A. Rodger , J. R. Wall, Coding theory and cryptography: The essentials, 2nd edition, New York: Marcel Dekker, 1991.

Subject Code:	EC311L	**Course Title**	Control systems + Communication
Contact Hours	L-0, T-0, P-3	**Credit**	2
Programme	B.Tech	**Semester**	V
Pre-requisites	NIL		
Evaluation scheme	Quiz I (15%), Mid-Term (30%), Quiz II (15%), End-Term (40%)		

A. Control System **[18H]**

1. Relay Control System
2. AC/DC Motor Driver
3. Process Control Simulator
4. Lead/Lag Network
5. AC/DC servo Control
6. Frequency Response Analysis

B. Communication **[15H]**

1. Study of AM, SSB-SC and DSB-SC modulation techniques.
2. Study of frequency modulation techniques and observe the spectrum in spectrum analyser.
3. Study the time division multiplexing techniques and observe time domain signal on CRO.
4. Study of frequency division multiplexing techniques and observe the frequency spectrum in spectrum analyser.
5. Study of PAM, PPM, and PWM techniques.

Text/Reference books:

1. Digital Control and State Variable Methods by M Gopal, McGraw-Hill, 2003
2. Control Systems Engineering by I. J. Nagrath and M. Gopal, New age International, 2007
3. Lab Manuel: Communication lab
4. Communication System, Haykin, S., Fourth Edition, Wiley and Sons, 2005.
5. Modern Digital and Analog Communication System, Lathi, B.P., Oxford University Press, 2006.

Subject Code:	ME311L	**Course Title**	FM&ST
Contact Hours	L-0, T-0, P-3	**Credit**	2
Programme	B.Tech	**Semester**	V
Pre-requisites	NIL		
Evaluation scheme			

[1] To determine Coriolli's Component of Acceleration at various speeds of rotation.

[2] To calculate the Coefficient of Discharge Cd, Coefficient of Velocity Cv, and Coefficient of Contraction Cc for various heads over orifice fitted in the side of a tank. And to draw a relationship between these coefficients and the size of the orifice

[3] To compute Piezo-metric head and draw Hydraulic Gradient Line for the given flow passage

[4] To determine friction factor for the given pipes and also plot friction factor vs Reynold's number for all the pipes and compare it with the Moody's chart.

[5] To calculate the coefficient of discharge for the given Venturimeter and Orificemeter.

[6] To study journal bearing test rig system. Perform the pressure profile of lubricating oil at various conditions of load and speed and the frictional torque & power transmitted.

[7] To study the heat transfer phenomena in Parallel/ Counter flow arrangements.

[8] To the obtain performance characteristics of a centrifugal pump.

[9] To determine head loss coefficient for the given bend in pipes and To determine Bernoullis Theorem.

[10] To the obtain performance characteristics of a Francis turbine and determine its specific speed.

[11] To conduct load test on diesel engine. (a). Determine the Willien's line by graphical and regression method.; (b) To find out brake power, brake and indicated thermal efficiency, mechanical efficiency, bsfc, isfc, IMEP. BMEP, Air fuel ratio, specific brake output, mean piston speed, clearance volume and (c) Plot-Load v/s above parameter

[12] To determine COP for a given refrigeration system.

Text/Reference books:

1. Rattan S.S., .Theory of Machines., TMH
2. Thomas Bevan, .Theory of Machines., CBS
3. Theory of Mechanisms & Machines by Ghosh & Mallick, EWP
4. John J. Uicker, Jr., Gordon R. Pennock and Joseph E. Sigley (2005), "Theory of Machines and Mechanisms (3rd Ed)," Oxford University Press, Indian Edition.
5. K J Waldron and G L Kinzel (2004), "Kinematics, Dynamics and Design of Machinery (2nd Ed)," Wiley.

Subject Code:	CS311L	**Course Title**	Lab based Project 2
Contact Hours	L-0, T-0, P-3	**Credit**	2
Programme	B.Tech	**Semester**	V
Pre-requisites	NIL		
Evaluation scheme			
Lab based Project 2			

Semester-VI

Subject Code:	HS303a	**Course Title**	Soft Skills and use of English Language
Contact Hours	L-3, T-0, P-2,GD-1	**Credit**	4
Programme	B.Tech	**Semester**	VI
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Mid term (30%), Quiz II (10%), End term (50%)		

Personality Development and Soft Skills

1. **Personality Development and Career Growth.** **[3H]**
   - Why EQ matters more than IQ
2. **Soft Skills – A Dire Need** **[5L]**
   - Development of Qualities
3. **Body Language** **[5L]**
   - A learning or Training?
4. **Master Mind Technique** **[7L]**
   - Definite chief Aim
   - First- checking Self
   - Art of Co-operation
   - Walking an extra mile
   - Limitations – a dead end

Use of English and Soft Skills

1. **Communication Skills** **[5L]**
   - Matter
   - Phonetics (English LAB)
   - Structure (Grammar)
2. **Functional Dynamics of Language** **[6L]**
   - Improving Presentations (Presentation Assignments)
3. **Proper Writing Skills** **[5L]**
   - Systematic Errors (Writing Assignments)
4. **The Remedial Language** **[4L]**
   - Removing errors Specific to Indians (Writing Assignments)

Text/Reference books:

Reference

- Personality Development and Soft Skills - Barun K. Mitra
-Communication Skills and Personality Development - Dr. Seema Biji, Margaret Singh Punj
-*Managing Soft Skills for Personality Development- B.N. Ghosh*
-The Laws of Success- Napoleon Hill.

Subject Code:	HS303b	**Course Title**	Literature in Social Cultural Panorama
Contact Hours	L-3, T-0, P-0, GD -1	**Credit**	4
Programme	B.Tech	**Semester**	VI
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Mid term (30%), Quiz II (10%), End term (50%)		

Values in Literature and Human Personality.

1. Shakespeare **[8H]**
   - Merchant of Venice
   - Hamlet
2. John Ruskin **[5H]**
   - King's Treasuries
   - Queen's Garden
3. Wordsworth **[3H]**

- Daffodils

4. C. Rajagopalchari **[4H]**
   - Ramayan (2 chapters)

Literature edifice of Society and Culture

1. Rabindranath Tagore **[5H]**
   - The Wife's Letter

2. Sri Aurobindo- On Rebirth of India **[5H]**
   (Some excerpts)
3. Jawahar Lal Nehru **[5H]**
   - Gandhi Comes. (Discovery of India)

4. Premchand **[5H]**
   - The Aim of Literature.

Text/Reference books:

Abrams, M.H. Wordsworth: A Collection of Critical Essays. 1992

Bradley, John. An Introduction to Ruskin. 1971

Cook, E.T. The Works of John Ruskin. 1996

Nehru, Jawaharlal. The Discovery of India. 1994

Rajagopalchari, C. The Story of Ramayan. 2007

The Oxford India Premchand

(New Delhi: Oxford University Press, 2004

Scott, David. Shakespeare and the Shapes of Time. 1982

Wells, Stanley. Shakespeare a Life in Drama. 1995

Wordsworth, Jonathan. William Wordsworth: The Borders of Vision. 1982

The Oxford Tagore.

Subject Code:	HS303c	**Course Title**	Indian Philosophy and Literature in Engilish
Contact Hours	L-3, T-0, P-2, GD-1	**Credit**	4
Programme	B.Tech	**Semester**	VI
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Mid term (30%), Quiz II (10%), End term (50%)		

<u>Indian Writing in English</u>

1. Rabindranath Tagore [**3H]**
   - Gitanjali (song no. 1-7, 13, 18, 57)
2. Dr. S.Radhakrishnan- [**7H]**
   - The Hindu View of Life. (1 chapter)
   - An Idealist View of Life. (selected readings- 1 chapter)
3. Mahatma Gandhi- **[3H]**
   - The story of my Experiments with truth. (selected readings- 2 chapters)
4. Swami Vivekananda- **[5H]**
   - Microcosm
   - Macrocosm
5. Kabir – **[4H]**
   - Some songs

<u>American Literature</u>

1. Ralph Waldo Emerson- [**8H]**
   - The America Scholar
   - Self Reliance
2. Henry David Thoreau- [**8H]**
   - Christianity and Hinduism compared
   - Resistance to Civil Government

3. Some Poems- **[2H]**
   - Ralph Waldo Emerson
     i. Brahma
     ii. Hamatreya
4. Henry David Thoreau **[2H]**

- Walden (book –some readings)

Text/Reference books:

1. Basham, A.L. *The Wonder that was India*, New Delhi: Rupa and Co., 1997
2. Buell, Lawrence, *The American Transcendentalists Essential Writings*, New York: Random House, 2006.
3. Gopal, Sarvepalli, Radhakrishnan: *A Biography*, New Delhi: Oxford University Press, 2003.
4. Iyengar, Srinivas K.R., *Indian Writing in English*, New Delhi: Sterling Publishers, 2002.
5. Mcdermott, Robert A., *Basic Writings of S. Radhakrishnan*, Mumbai:Jaico Publishing House, 2002.
6. Mumukshananda, Swami, *The Complete works of Swami Vivekananada*, Calcutta: Swami Mumukshananda, 1994.
7. Narayan, Shriman, *The Selected works of Mahatma Gandhi*, Ahmedabad: Navjivan Trust, 1997.
8. Radhakrishnan, S., *An Idealist View of Life*, New Delhi: Indus Publishers, 1994.
9. Radhakrishnan, S., *The Hindu View of Life*, Mumbai: Blackie and Son Publishers, 1983.
10. Tagore, Rabindranath, *Gitanjali*, New Delhi: Macmillan India Limited, 1997.

Subject Code:	HS304	**Course Title**	Environmental Science
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	VI
Pre-requisites	NIL		
Evaluation scheme	Quiz I (15%), Midterm (25%), Quiz II (15%), End term (45%)		

Unit 1 : Multidisciplinary nature of environmental studies **[2H]**

Definition, scope and importance

Need for public awareness.

Unit 2 : Natural Resources :

Renewable and non-renewable resources :

Natural resources and associated problems.

a) Forest resources : Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people.

b) Water resources : Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.

c) Mineral resources : Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

d) Food resources : World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.

e) Energy resources : Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Case studies.

f) Land resources : Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

- Role of an individual in conservation of natural resources.
- Equitable use of resoureces for sustainable lifestyles.

[8 H]

Unit 3 : Ecosystems

Concept of an ecosystem.

- Structure and function of an ecosystem.
- Producers, consumers and decomposers.
- Energy flow in the ecosystem.
- Ecological succession.
- Food chains, food webs and ecological pyramids.

- Introduction, types, characteristic features, structure and function of the following ecosystem:-
  a. Forest ecosystem
  b. Grassland ecosystem
  c. Desert ecosystem
  d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

(6 H)

Unit 4 : Biodiversity and its conservation

- Introduction – Definition : genetic, species and ecosystem diversity.
- Biogeographical classification of India
- Value of biodiversity : consumptive use, productive use, social, ethical, aesthetic and option values
- Biodiversity at global, National and local levels.

Inida as a mega-diversity nation.

- Hot-sports 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.

(8 H)

Unit 5 : Environmental Pollution

Definition

- Cause, effects and control measures of :-

  a. Air pollution
  b. Water pollution
  c. Soil pollution
  d. Marine pollution
  e. Noise pollution
  f. Thermal pollution
  g. Nuclear hazards

- Solid waste Management : Causes, effects and control measures of urban and industrial wastes.
- Role of an individual in prevention of pollution.
- Pollution case studies.
- Diaster management : floods, earthquake, cyclone and landslides.

(8 H)

Unit 6 : Social Issues and the Environment

- From Unsustainable to Sustainable development
- Urban problems related to energy
- Water conservation, rain water harvesting, watershed management
- Resettlement and rahabilitation of people; its problems and concerns. Case Studies
- Environmental ethics : Issues and possible solutions.
- Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies.
- Wasteland reclamation.
- Consumerism and waste products.
- Environment Protection Act.
- Air (Prevention and Control of Pollution) Act.
- Water (Prevention and control of Pollution) Act
- Wildlife Protection Act
- Forest Conservation Act
- Issues involved in enforcement of environmental legislation.
- Public awareness.

(7 H)

Unit 7 : Human Population and the Environment

- Population growth, variation among nations.

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

(6 H)

Unit 8 : Field work

- Visit to a local area to document environmental assets-river/forest/grassland/hill/mountain
- Visit to a local polluted site-Urban/Rural/Industrial/Agricultural
- Study of common plants, insects, birds.
- Study of simple ecosystems-pond, river, hill slopes, etc. (Field work Equal to 5 lecture hours)

Unit 9: Hazard of Fireworks and ways of reducing them: (5 H)

Text/Reference books:

1. Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
2. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad – 380 013, India, Email:mapin@icenet.net (R)
3. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p
4. Clark R.S., Marine Pollution, Clanderson Press Oxford (TB)
5. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumabai, 1196p
6. De A.K., Environmental Chemistry, Wiley Eastern Ltd.
7. Down to Earth, Centre for Science and Environment (R)
8. Gleick, H.P. 1993. Water in crisis, Pacific Institute for Studies in Dev.,Environment & Security. Stockholm Env. Institute Oxford Univ. Press. 473p
9. Hawkins R.E., Encyclopedia of Indian Natural History, Bombay NaturalHistory Society, Bombay (R)
10. Heywood, V.H & Waston, R.T. 1995. Global Biodiversity Assessment.Cambridge Univ. Press 1140p.
11. Jadhav, H & Bhosale, V.M. 1995. Environmental Protection and Laws.Himalaya Pub. House, Delhi 284 p.
12. Mckinney, M.L. & School, R.M. 1996. Environmental Science systems &Solutions, Web enhanced edition. 639p.
13. Mhaskar A.K., Matter Hazardous, Techno-Science Publication (TB)
14. Miller T.G. Jr. Environmental Science, Wadsworth Publishing Co. (TB)
15. Odum, E.P. 1971. Fundamentals of Ecology. W.B. Saunders Co. USA, 574p
16. Rao M N. & Datta, A.K. 1987. Waste Water treatment. Oxford & IBH Publ.Co. Pvt. Ltd. 345p.
17. Sharma B.K., 2001. Environmental Chemistry. Geol Publ. House, Meerut
18. Survey of the Environment, The Hindu (M)
19. Townsend C., Harper J, and Michael Begon, Essentials of Ecology, Blackwell Science (TB)

Subject Code:	EC312	**Course Title**	Linear Integrated Circuit Design
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	VI
Pre-requisites	NIL		
Evaluation scheme	Quiz I (15%), Mid-Term (30%), Quiz II (15%), End-Term (40%)		

Basic Information of Op-Amp: Ideal Op-Amp Characteristics of OP-Amp, Practical Op-Amp, offset voltages and bias current, Internal structure and its analysis using BJT/MOSFET, Input stage, level shifter, and power stage Op-Amp data sheet and various parameters specifications of OpAmp, the error budget of Op-Amp circuits using temperature sensitive drift parameters. concept of virtual ground, Slew rate, CMRR, PSRR, Temperature drift of offset voltage and bias current.

[10H]

Application of Op-Amp: Voltage series shunt feedback to use Op-Amp as an Amplifier, Inverting and non-Inverting, Summing amplifiers, Integrator and differentiator Differential Circuit using Op-Amp, Common Mode and differential mode signal analysis, V/I and I/V convertors, Instrumentation Amplifiers, applications as weight measurement, temperature measurement etc. Frequency compensation, slew rate and methods of improving slew rate. Application of Operational Amplifiers, Analysis of four quadrant and variable trans conductance multipliers, Voltage controlled Oscillator. Active filter design, high pass, low pass Butterworth and Chebyshev filter designs, higher order filter design Closed loop analysis of PLL, AM, PM and FSK modulators and demodulator. **[12H]**

Non Linear Application: Comparators, Schmitt trigger with hysteresis and various application, Multi vibrators using Op-Amps, Waveform generators, clipper and clamper circuits, peak detector, sample and hold circuits, D/A convertors R-2R ladder and weighted resistor type, A/D convertors: dual slope, successive approximation and flash type. **[10H]**

Special purpose ICs: 555 timer IC, functional block diagram and various applications of 555 IC, 566 Volatge controlled Oscillator circuit, 565 PLL, Analog Multiplier circuits, LM317 and 732 IC regulators circuit design, Switching regulator, MA 7840, LM380 Power Amplifier, Isolation Amplifier, Opto-couplers and optoelectronic ICs ICL 8038 Function generator. **[10H]**

Text/Reference books:

1. Op-Amps and Linear Integrated CircuitsRamGayakwadPrentice Hall, Fourth edition.
2. Linear Integrated Circuit Roy D. Choudhury (1992-06), John Wiley & Sons.
3. Basic Operational Amplifiers and Linear Integrated CircuitsThomas L. Floyd Buchla(1998),Prentice Hall.
4. Op-Amps and Linear Integrated Circuit,WillamD.Stanley ,Merrill,Third edition
5. Linear Integrated Circuits, JackWinzerSaunders College Publishing, First Edition
6. Operational Amplifiers and Linear Integrated Circuits, Robert F. Coughlin, Prentice Hall, Sixth Edition.

Subject Code:	ME312	**Course Title**	Heat and Mass Transfer
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	VI
Pre-requisites	NIL		
Evaluation scheme			

1. Introduction to heat transfer **[06H]**
2. Conduction: Fourier's Law, One dimensional heat transfer, with and without heat generation, Transient conduction, Through Composite walls. **[10 H]**
3. Extended Surfaces: Heat transfer from finned surfaces, Fin Efficiency, Effectiveness. **[08 H]**
4. Convection: Free and forced convection, Flow and thermal boundary layer equations, laminar flow through circular pipe, constant heat flux and constant wall temperature conditions, Overall heat transfer coefficient. Heat exchangers. **[10 H]**
5. Thermal Radiation: Radiation properties, Plank's Law, Kirchoff's law, Heat exchange between two surfaces. **[08 H]**

Text/Reference books:

1. Fundamentals of Heat and Mass Transfer, F. P. Incropera and D.P. Dewitt (Wiley)..
2. Heat and Mass Transfer, JP Holman

Subject Code:	CS312	**Course Title**	Software Engineering
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	VI
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Midterm (20%), Quiz II (10%), End term (40%), course project (20%)		

The Software Problem: Software Process, SDLC, 3Ps of Software problem, Software characteristics, Software Life Cycle Models, CMM, SPI [5H]

Requirement Engineering: , Software Requirements – FRs and NFRs, Use case modelling, Software Requirement Specification, Object-Oriented Domain Modelling, Identifying domain objects, Domain models [10H]

Software Design System and Sub-System Design, Architectural Styles, Object Design, Interface Design, Design Principles, Design Patterns, Refactoring [10H]

Software Testing, Testing Levels, Unit Testing, Integration Testing, System Testing, User acceptance testing, specialized testing for NFRs, Testing Techniques: Black-box, White-box, Model based testing [10H]

Software Project Planning and Estimation, Efforts and Time Estimation, Scheduling and Tracking, Software Configuration Management and Software Quality Assurance, Software re-engineering, reverse engineering, Model based Software Development. [7H]

Text/Reference books:

1. Pankaj Jalote. "An Integrated Approach to Software Engineering", 3rd Edition, Narosa, 2005
2. B. Bruegge, A. Dutoit: “Object-Oriented Software Engineering: Using UML, Patterns, and Java”, Prentice Hall, 2003.
3. E. Freeman, Elisabeth Robson, Bert Bates, Kathy Sierra, "Head First Design Pattern" O'Reilly Media, 2004
4. M. R. Blaha and J. Rumbaugh. "Object-Oriented Analysis and Modeling using UML, 2nd Edition, TMH, 2005.

Subject Code:	EC313a	**Course Title**	Digital Communication
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	VI
Pre-requisites	NIL		
Evaluation scheme	Quiz I (15%), Mid-Term (30%), Quiz II (15%), End-Term (40%)		

Review of Random Variables and Random Processes. **[3H]**

Optimum Receivers for the AWGN channel, Signal Design for bandlimited channels. [10H]

Digital Pass Band Transmission and Reception: Introduction to Pass band Transmission model: Generation, Detection, Signal space diagram, Error performance - Coherent and Non-coherent detection systems, bit error probability and Power spectra of BPSK, QPSK, FSK and MSK schemes, Differential phase shift keying, Comparison of Digital modulation systems using a single carrier - Carrier and symbol synchronization. **[12H]**

Information theory and error control coding: Communication channel, Channel matrix, Channel capacity, Discrete memory less channels, Linear block codes - Cyclic codes - Convolutional codes - Maximum likelihood decoding of convolution codes-Viterbi Algorithm, Trellis coded Modulation. **[7H]**

Overview of spread spectrum: Pseudo-noise sequences: a notion of spread spectrum: Direct sequence spread spectrum, Frequency hop spread spectrum, Maximum length and Gold codes. **[10H]**

Text/Reference books:

1. John G. Proakis, Masoud Salehi, "*Fundamentals of Communication Systems*" Pearson, 2005.
2. H. P. Hsu, "*Analog and Digital Communications,*" Schaum's Series, Tata McGrawHill, 2e, 2006
3. Simon Haykins, "Communication Systems" John Wiley, 4th Edition, 2001
4. H. Taub, D. Schilling, and G. Saha, "*Principles of Communication Systems,* " McGraw-Hill" 2013.
5. B. P. Lathi and Z. Ding, "*Modern Digital and Analog Communication Systems*," Oxford Univ. Press, January 2009, 4/e.
6. S. Haykin and M. Moher, "*An Introduction to Analog and Digital Communications*," Wiley, January 2006, 2/e.

Subject Code:	EC313b	**Course Title**	Digital Signal Processing
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	VI
Pre-requisites	NIL		
Evaluation scheme	Quiz I (15%), Mid-Term (30%), Quiz II (15%), End-Term (40%)		

Module 1

Frequency Analysis of LTI Systems Frequency domain Characteristics of LTI Systems, Correlation functions and spectra at output of LTI systems, LTI Systems as frequency selective filters: ideal filters, all pass filters, comb filters, inverse system, classification based on phase response: minimum phase, maximum phase, and mixed phase system, Finite Impulse Response (FIR) Filters: Linear phase FIR filters- Frequency response of linear phase FIR filters - Location of the zeros of linear phase FIR filters. **[10H]**

Module 2

Discrete Fourier Transform and Computation DFT and its properties, Relation between DTFT and DFT, Linear filtering methods using DFT: Linear filtering as DFT, Filtering of long sequences: Overlap-add and save methods Frequency analysis of signals using DFT, FFT computations using Decimation in time and Decimation in frequency algorithms, radix 2-Butterfly structure, implementation of DFT as linear filtering: Goertzel algorithm, and Chirp algorithm.

[10H]

Module 3

Design of Digital Filters FIR design: Windowing Techniques -Need and choice of windows -Linear phase characteristics. IIR design: Analog filter design -Butterworth and Chebyshev approximations; digital design using impulse invariant and bilinear transformation Warping, prewarping - Frequency transformation. **[10H]**

Module 4

Realization of Digital Filters & IIR filter realization: Direct form-I, direct form-II, and Parallel & cascade forms. Finite word length effects in FIR and IIR digital filters: Quantization, round off errors and overflow errors, Overview of DSP processors. **[7H]**

Module 5

Application of signal processing Applications of digital signal processing: Speech Processing: speech analysis, speech coding, subband coding, ECG processing. **[5H]**

Text/Reference books:

1. John G.Proakis, Dimitris G. Manobakis, Digital Signal Processing, Principles, Algorithms and Applications, Third edition, (2000) PHI
2. S. K. Mitra, Digital Signal Processing: A Computer Based Approach, Tata McGraw Hill, 2006.
3. P. P. Vaidyanathan, Multirate systems and filter banks, Prentice Hall, 1993.
4. A. V. Oppenheim and R. W. Sehafer, Discrete Time Signal Processing, Prentice Hall, (1989).
5. Emmanuel C Ifeachor, Barrie W Jrevis, Digital Signal Processing, Pearson Education.

Subject Code:	EC313c	**Course Title**	IC Fabrication
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	VI
Pre-requisites	NIL		
Evaluation scheme	Quiz I (15%), Mid-Term (30%), Quiz II (15%), End-Term (40%)		

The Science of Miniaturization: Moore's Laws (1,2,&3) and technology' Roadmap–clean rooms Processing Methods: - Cleaning, oxidation, lithography, etching, CVD, diffusion, ion implantation, metallization, state of the art CMOS architectures photolithography overview ,critical dimension, overall resolution, line-width, lithographic sensitivity and intrinsic resist sensitivity (photochemical quantum efficiency), resist profiles, contrast and experimental determination of lithographic sensitivity, resolution in photolithography, photolithography resolution enhancement technology. **[12H]**

Nanostructuring by Physical Techniques: Next-generation technologies: state-of-the-art (including principles, capabilities, limits, applications) EUV lithography, phase-shifting photolithography, x-ray lithography, electron beam direct writing system, focused ion beam (FIB) lithography, neutral atomic beam lithography, plasma-aided nanofabrication, soft lithography, nanosphere lithography, nanoimprint, dip-pen nanolithography, key consequences of adopted techniques. **[12H]**

Nanomanipulation and Processing: Conventional techniques: scanning tunneling microscopy (STM), atomic force microscopy (AFM), near-field scanning optical microscopy (NSOM), advanced techniques: embossing and surface passivation, dimensional subtraction and addition, multistep Processing, of microcontact printing, Molding, implications and applications of the conventional and advanced techniques. **[10H]**

Nanometer Devices: Material Wave Nanotechnology: Nanofabrication using a de broglie wave-electron beam holography, atomic beam holography, nanometer lithography using organic positive/negative resists – sub-10 nm lithography using inorganic resist – 40 nm-gate-length metal-oxide-semiconductor field-emitter-transistors-14 nm gate-length electrically variable shallow junction MOSFETs-operation of aluminum-based single-electron transistors at 100 kelvins- room temperature operation of a silicon single-electron transistor. **[8H]**

Text/Reference books:

1. VLSI Technology,S. M. Sze, McGraw Hill, II , 1988
2. VLSI fabrication principles, S. K. Gandhi,,"John Wiley, New York",1983
3. ULSI Technology,C. Y. Chang. S. M. Sze,McGraw Hill companies,1996
4. Silicon VLSI Technology Fundamentals, Practice and Modeling James D. Plummer Michael, D. Deal Peter B. Griffin Department of Electrical Engineering Stanford University
5. Guozhong Cao, Nanostructures & Nanomaterials Synthesis, Properties G; Z: Applications, World Scientific Publishing Private, Ltd., Singapore (2004).
6. W.R.Fahrner, Nanotechnology and Nanoelectronics – Materials, Devices, Measurement Techniques, Springer-Verlag Berlin, Germany (2006).

Subject Code:	ME313a	**Course Title**	Finite Element Methods
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	VI
Pre-requisites	NIL		
Evaluation scheme	Assignments (10%), Quiz (15%), Project (20%) Mid-sem(15%) and End-sem(40%)		

1. Objective of the Course, Basic Steps in FEM Formulation, General Applicability of the method. **[4 H]**
2. 1-D Elements, Basis Functions and Shape Functions. **[4 H]**
3. Convergence Criteria, assembly, imposition of boundary conditions. **[4 H]**
4. Variational Functional, Ritz Method. **[7 H]**
5. Natural Coordinates, Numerical Integration, Solvers. **[3 H]**
6. Alternate Formulation: Weighted residual Method, Galerkin Method. **[4 H]**

7. Problems with CI continuity: Beam Bending, Connectivity and Assembly of CI Continuity Elements. **[4 H]**
8. 2-D elements (Triangles and Quadrilaterals) and Shape Functions. **[4 H]**
9. Sub-parametric, Iso-parametric and Super-parametric Elements. **[4 H]**
10. Free Vibration Problems, Formulation and solution of Eigen Value Problem. **[4 H]**

Text/Reference books:

COURSE TEXT:

1. Seshu P. Text Book of Finite Element Analysis, PHI, 1st Edition, 2003.
2. Cook, Malkus and Plesha, Concepts and Applications of Finite Element Analysis, John Wiley and Sons

Subject Code:	ME313b	**Course Title**	CNC Machine Tools and Programming
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	VI
Pre-requisites	NIL		
Evaluation scheme	Mid Sem Exam (25%), End Sem Exam (40%), Quizzes/Programming Assignment (15%) and Programming/Automation Project (20%)		

Automation

Types of automation, Programmed Automation, History of Numerical Control, Components of NC: Punched Tape, MCU, Processing Unit, Axis Designation, NC Motion Control: PTP, Straight cut, Contouring NC Coding System: EIA & ISO format, ApplicationNumerical Control, Advantages, & Disadvantages, Adoptive Control System **[5H]**

Computer Numerical Control

Block Diagram of CNC operations, Positioning System: Open loop and Closed loop System, Precision in NC Positioning: Control resolution, Accuracy, Repeatability **[8H]**

Part Programming

Procedures Associated with part programming, Cutting process parameter selection, Process planning issues and path planning, Part programming formats, G & M Codes, Interpolations, Canned Cycles and Subprograms,Tool Compensations **[12H]**

CNC Hardware Basics

Machines Structure, Guidways: Requirements, types and design features, Actuation systems: Ball Screws, Introduction of Servo and Stepper Motors, Feedback devices: Encoder, Optical grating, Resolvers, Inductosyn **[5H]**

Modern CNC Systems

Indexable carbide tools,Modular Tooling & Tool Presetting, Machining Centers, Automatic tool changers **[2H]**

Computer Aided Part Programming

APT Programming, Part Program Generation through ProE/DelCAM, Post Processors **[5H]**

Computations for part programming

Segmentations of free form curves, Consideration for INTOL and OUTTOL, Part programming for Bezier and B-spline Curves, Generating part program from CAD drawings **[5H]**

Text/Reference books:

1. Rao P N.,"CAD/CAM Principles and Practice", Tata McGraw-Hill
2. Robert Quesada, T. Jeyapoovan, "Computer Numerical Control : Machining Center and Turning Centers" , Tata McGraw-Hill
3. S K SINHA,"CNC Programming", Galgotia Pubs.
4. CNC Machine Manuals
5. Chang, Wysk and Wang, Computer Aided Manufacturing, Prentice Hall International. 3rd Edition
6. Kochan D., CAM: Developments in Computer Integrated Manufacturing System, Springer Verlag.
7. Chang, T.C., An Introduction to Automated Process Planning Systems, Prentice Hall

International.
8. Kundra, Rao and Tiwari, Numerical Control and CAM, TMH.
9. Koren, Computer Control of Manufacturing Systems, TMH.
10. Kochan D., Integration of CAD/CAM, North Holland.

Subject Code:	ME313c	**Course Title**	Computer Aided Design
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	VI
Pre-requisites	NIL		
Evaluation scheme	Quizzes (20%); Mid-sem (20%) Programming Project (20%) and End-sem (40%)		

Introduction:
Objective, scope, overview, CAD software, mathematical background, applications **[4H]**

Transformations:
Rotation, translation, scaling, reflection, shear and combined transformations in 2D and 3D, computer-aided assembly **[6H]**

Projections:
Orthographic, axonometric, oblique and perspective projections **[4H]**

Curves:
Parametric representation of analytic curves, representation of synthetic curves- Hermite/ Ferguson, Bezier, B-spline, rational curves, NURBS/NUBS, curve manipulations, Analytical properties **[10H]**

Surfaces:
Surface representation, parametric representation of analytic surfaces- plane, ruled, surface of revolution etc., representation of synthetic surfaces- Hermite, Bezier, B-spline, coons, sculptured etc., surface manipulations, curves on surfaces, surface with irregular boundaries, analytic properties, application in reverse engineering, design of turbine blades etc. **[8H]**

Solids:
Introduction, representation of solids, fundamentals of solid modeling, solid representation schemas (B-rep, CSG, Sweep, ASM etc), solid manipulations, solid modeling-based applications in manufacturing and assembly (CNC machining, Rapid prototyping). **[8H]**

Advanced Topics:
Geometric modeling using point clouds, CAD/CAM data exchange **[2H]**

Text/Reference books:

1. Zeid, Ibraheim, CAD/CAM: Theory and Practice, Revised First Edition, Tata McGraw Hill, 2007.
2. Rogers, D.F and Adams, J.A., Mathematical Elements for Computer Graphics, Tata McGraw Hill, 2002.
3. Mortenson, Michael E., Geometric Modeling, Third Edition, Industrial Press Inc., 2006.
4. Saxena and Sahay, Computer Aided Engineering Design, Anamaya Publications
5. Faux, I. D. and Pratt, M. J., Computation Geometry for Design and Manufacture, John Wiley (Ellis Horwood Ltd.), 1983.
6. Choi, B. K., Surface Modeling for CAD/CAM, Elsevier.
7. Farin, Gerald, Curves and Surfaces for Computer Aided Geometric Design – A Practical Guide, Academic Press Inc.1991.
8. Lee, Kunwoo, Principles of CAD/CAM/CAE Systems, Addison Wesley, 1999.
9. Yamaguchi, Curves and Surfaces in Computer Aided Geometric Design, Springer, 1988.
10. Ryan, D. L., Computer-Aided Graphics and Design, Marcel Dekker Inc., 1994.

Subject Code:	CS313a	**Course Title**	S/W testing and Quality Assurance
Contact Hours	L- 3 T- 0 P- 0	**Credit**	4
Programme	B.Tech	**Semester**	VIII
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Mid-term (20%), Quiz II (10%), End term (40%), Term Project (20%)		

Introduction to quality assurance, **[5 H]**

Software Testing, Testing levels, unit testing, unit testing frameworks like JUnit, integration testing, system testing, user acceptance testing, alpha and beta testing **[5 H]**

Testing techniques, black box techniques like equivalence partitioning, boundary value analysis, White box techniques like, structural testing, control flow based - block, branch, predicate, MCDC, path testing, data flow based- p-use, d-use, all-use, and others, mutation testing, coverage criteria and code coverage, examples and case studies **[12 H]**

Code reviews and inspections, Static code analysis, SCA tools like Findbugs, and others **[5 H]**

Other specialized Testing like performance testing, load testing, security testing, GUI testing **[5 H]**

Regression testing, Comparing testing techniques, evaluations, **[5 H]**

Testing process, testing artifacts, defect classification, other dynamic analysis **[5 H]**

Text/Reference books:

1. Paul C. Jorgensen. Software Testing: A Craftsman's Approach, Third Edition, Auerbach Publication, 2008.
2. Cem Kaner, Jack Falk. Testing Computer Software, 2nd Edition, Wiley, 1999.

Subject Code:	CS313b	**Course Title**	Network Security & Cryptography
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	VI
Pre-requisites	NIL		
Evaluation scheme	Project/Quiz I (30%), Mid term (30%), End term (40%)		

Course Introduction and terminology, Conventional Cryptography: Definitions, Classical encryption techniques, Finite fields, Perfect Secrecy DES, AES and other symmetric cryptography. **[12H]**

Asymmetric Cryptography: Number Theory, public key cryptography: RSA, ElGamal, and Elliptic Curve Cryptography, Key management. **[10H]**

Authentication: Message authentications and hash functions, hash algorithms, Digital Signatures and Authentication Protocols. **[10H]**

Network and System Security: a. Vulnerability, Monitoring/Sniffing, Spoofing
b. Firewalls, Intrusion Detection, c. PGP, Kerberos, d. IPSec, SSL **[10H]**

Text/Reference books:

1. W Stallings, "Cryptography and Network Security: Principles and Practice, 5/e", Prentice Hall.
2. C Kaufman, R Perlman, M Speciner, Network Security, 2/e" , Pearson Education, 2006.
3. B A Forouzan, "Cryptograpgy and Network Security", Tata McGraw Hill, 2007.
4. Aviel D Rubin, "White Hat Security Arsenal: Tackling the Threats", Addison-Wesley, 2001.
5. P. Garrett. "Making and Breaking Codes- An Introduction to Cryptology", Prentice-Hall, 2001.
6. Nigel Smart, "Cryptography: An Introduction", McGraw-Hill, 2002.
7. B. Schneier. "Applied Cryptography". Second Edition. John Wiley & Sons, Inc., 1996.
8. A. Menezes, P. van Oorschot, S. Vanstone. "Handbook of Applied Cryptography", CRC press, 1997.

Subject Code:	CS313c	**Course Title**	Artificial Intelligence
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	VI
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Mid term (25%), Quiz II (10%), End term (40%), Project (20%)		

Overview: foundations, scope, problems, and approaches of AI. **[2H]**

Intelligent agents: reactive, deliberative, goal-driven, utility-driven, and learning agents ,Artificial Intelligence programming techniques **[3 H]**

Problem-solving through Search: forward and backward, state-space, blind, heuristic, problem-reduction, A, A*, AO*, minimax, constraint propagation, neural, stochastic, and evolutionary search algorithms, sample applications. **[5 H]**

Knowledge Representation and Reasoning: ontologies, foundations of knowledge representation and reasoning, representing and reasoning about objects, relations, events, actions, time, and space; predicate logic, situation calculus, description logics, reasoning with defaults, reasoning about knowledge, sample applications. **[6 H]**

Planning: planning as search, partial order planning, construction and use of planning graphs **[4 H]**

Representing and Reasoning with Uncertain Knowledge: probability, connection to logic, independence, Bayes rule, bayesian networks, probabilistic inference, sample applications. **[5 H]**

Decision-Making: basics of utility theory, decision theory, sequential decision problems, elementary game theory, sample applications. **[9 H]**

Machine Learning and Knowledge Acquisition: learning from memorization, examples, explanation, and exploration. learning nearest neighbor, naive Bayes, and decision tree classifiers, Q-learning for learning action policies, applications. **[8 H]**

Text/Reference books:

1. Nilsson, N. J. Artificial Intelligence - A Modern Synthesis. Palo Alto: Morgan Kaufmann. (1998).
2. Nilsson, N. J., Principles of Artificial Intelligence. Palo Alto, CA: Tioga (1981).
3. Rich, E., & Knight, K., Artificial Intelligence. New York: McGraw-Hill (1991).

Subject Code:	CS314a	**Course Title**	Antenna Theory & Design
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	VI
Pre-requisites	NIL		
Evaluation scheme	Quiz I (15%), Mid-Term (30%), Quiz II (15%), End-Term (40%)		

Fundamental Concepts: Radiation mechanism, Radiation pattern, near-and far-field regions, reciprocity, directivity and gain, bandwidth, quality factor, effective aperture, polarization, input impedance, efficiency, Friis transmission equation, reciprocity theorem, vector potentials for electric and magnetic current sources. **[6H]**

Radiation from Wires and Loops: Infinitesimal dipole, finite-length dipole, linear elements near conductors, dipoles for mobile communication small circular loop. **[10H]**

Antenna Arrays: Analysis of uniformly spaced Two-element and N-element linear arrays with uniform and non-uniform amplitudes excitation, extension to planar arrays, synthesis of antenna arrays. **[10H]**

Aperture Antennas: Field equivalence/ Huygens', Principle, radiation from rectangular and circular apertures, design considerations, Babinet's principle. **[8H]**

Microstrip Antennas: Basic characteristics of microstrip antennas, feeding techniques, methods of analysis, design of rectangular and circular patch antennas, microstrip antenna arrays and feed networks, basics of active antennas. **[6H]**

Text/Reference books:

1. Antenna Theory: Analysis and Design, Constantine A. Balanis, Wiley, Indian Edition, 2005.
2. Antenna and Wave propagation, J D Kraus, TMH.
3. Antenna and Wave propagation, A. R. Harish and M. Sachidananda, Oxford University Press, 2007.
4. *Electromagnetic Waves and Radiating Systems*, E.C. Jordan and K.G. Balmain, Prentice Hall of India, 2005.

Subject Code:	EC314b	**Course Title**	Wavelet and Filter Bank
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	VI
Pre-requisites	NIL		
Evaluation scheme	Quiz I (15%), Mid-Term (30%), Quiz II (15%), End-Term (40%)		

Fundamentals of Multirate Theory: Decimation and Interpolation, multirate identities, Polyphase representation, Digital Filter Banks, Maximally decimated filter banks, Errors in the QMF bank, Perfect reconstruction (PR) QMF Bank, Design of an alias free QMF Bank. **[14H]**

M-channel perfect reconstruction filter banks: Uniform band and no uniform filter bank, tree structured filter bank, Cosine Modulated filter banks: Cosine Modulated pseudo QMF Bank, Alias cancellation, Phase distortion, closed form expression, Polyphase structure, PR Systems. **[10H]**

Fourier analysis: Fourier Transforms, Short Time Fourier Transform and the Uncertainty Principle; Continuous and Discrete Wavelet Transform: Basic Properties of Wavelet Transforms, Orthonormal Wavelets, Wavelet Series, and Multiresolution Analysis, Scaling Functions and Orthonormal Wavelet Bases, Constructions of Orthonormal Wavelets, Compactly Supported Wavelets. **[10H]**

Application of wavlet & filter bank: speech/biomedical signal compression, enhacment, communication system. **[8H]**

Text/Reference books:

1. P.P. Vaidyanathan. Multirate systems and filter banks. Prentice Hall. PTR. 1993.
2. K. Chui, An Introduction to Wavelets, Academic Press USA.
3. I. Daubechies, Ten Lectures on Wavelets, SIAM, 1990.
4. Lokenath Debnath, Wavelet Transforms and Their Applications, Birkhauser 2002.
5. S. Mallat, A wavelet Tour of Signal Processing, Academic Press USA 2009.
6. N.J. Fliege. Multirate digital signal processing. John Wiley 1994

Subject Code:	EC314c	**Course Title**	Biomedical Instrumentation
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	VI
Pre-requisites	NIL		
Evaluation scheme	Quiz I (15%), Mid-Term (30%), Quiz II (15%), End-Term (40%)		

Physiology and Transducer: Cell and its structure – Action and resting – Potential propagation of action potential – Sodium pump – Nervous system – CNS – PNS – Nerve cell – Synapse – Cardio pulmonary system – Physiology of heart and lungs – Circulation and respiration – Transducers – Different types – Piezo-electric, ultrasonic, resistive, capacitive, inductive transducers – Selection criteria. **[9H]**

Electro – Physiological Measurements: Basic components of a biomedical system – Electrodes – Micro, needle and surface electrodes – Amplifiers – Preamplifiers, differential amplifiers, chopper amplifiers – Isolation amplifier. ECG – EEG – EMG – ERG – Lead systems and recording methods – Typical waveforms. **[9H]**

Non-Electrical Parameter Measurements: Measurement of blood pressure – Cardiac output – Cardiac rate – Heart sound – Respiratory rate – Gas volume – Flow rate of Co2, o2 in exhaust air - PH of blood, ESR, GSR measurements – Plethysmography. **[9H]**

Medical Imaging And PMS: X-ray machine - Radio graphic and fluoroscopic techniques – Computer tomography – MRI – Ultrasonography – Endoscopy – Thermography – Different types of biotelemetry systems and patient monitoring – Electrical safety. **[7H]**

Assisting And Therapeutic Equipments: Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators – Diathermy – Heart – Lung machine – Audio meters – Dializers. **[7H]**

Text/Reference books:

1. Leslie Cromwell, Fred J.Weibell, Erich A.Pfeiffer, 'Bio-Medical Instrumentation and Measurements', II Edition, Pearson Education, 2002 / PHI.
2. R.S.Khandpur, 'Handbook of Bio-Medical instrumentation', Tata McGraw Hill Publishing Co Ltd., 2003
3. M.Arumugam, 'Bio-Medical Instrumentation', Anuradha Agencies, 2003.
4. L.A. Geddes and L.E.Baker, 'Principles of Applied Bio-Medical Instrumentation', John Wiley & Sons, 1975.
5. J.Webster, 'Medical Instrumentation', John Wiley & Sons, 1995.
6. C.Rajarao and S.K. Guha, 'Principles of Medical Electronics and Bio-medical Instrumentation', Universities press (India) Ltd, Orient Longman ltd, 2000.

Subject Code:	ME314a	**Course Title**	Vibration of Mechanical Systems
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	VI
Pre-requisites	NIL		
Evaluation scheme	Quizes (20%); Mid-sem (35%) and End-sem (45%)		

Introduction to vibration and un-damped free vibrations:
Types of vibrations.Single degree of freedom systems and Simple problems.Formulation- Newton's second law, Energy method and Principle of virtual work. Introduction, undamped free vibration – natural frequencyof free vibration, stiffness of spring elements, effect of mass of spring. **[10H]**

Damped free vibrations:
Single degree freedom systems, different types of damping, concept of critical damping and its importance, study of response of viscous damped systems for cases of under damping, critical and over damping, Logarithmic decrement. **[6H]**

Forced Vibration:
Single degree freedom systems, steady state solution with viscousdamping due to harmonic force, solution by complex algebra.Concept of response, Reciprocating and rotating unbalance, vibration isolation – transmissibility ratio. Energy dissipated by damping, sharpness of resonance, base excitation. **[8H]**

Systems with two degrees of freedom:
Introduction, principal modes and normal modes of vibration, co-ordinate coupling, generalized and principal co-ordinates, free vibration in terms of initial conditions. Geared systems.Forced Oscillations – Harmonic excitation. Applications: (a) Vehicle suspension (b) Dynamic vibration absorber (c) Dynamics of Reciprocating Engines. **[9H]**

Numerical methods for Multi degree Freedom Systems:
Orthogonality of principal modes, Holzer's method, Rayleigh's method. **[4H]**

Vibration monitoring and analysis:
Introduction, Accelerometer and vibrometers.Machinery signatures, Selection of Transducers and signal conditioning.Analysis Techniques, Machine failure modes, Measurement location, Vibration severity criteria, vibration frequency analysis.Case studies. **[5H]**

Text/Reference books:

1. Thomson, W.T., Theory of vibration with applications, Third Edition, 1997.
2. Rao, S. S., Mechanical Vibrations, Fourth Edition, Addison Wesley, 2004.
3. Caollacott, R. A.; Chapman, Mechanical Fault Diagnosis and Condition Monitoring, Chapman and hall, 1977.
4. Rao, J. S., Advanced Theory of Vibration, Wiley Eastern Ltd. New Delhi, 1992.
5. Jones, R. J. and Wykes, C., Holographic and Speckle Interferometry, Cambridge University Press, Cambridge, 1983.

Subject Code:	ME314b	**Course Title**	Computer Aided Design
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	VI
Pre-requisites	NIL		
Evaluation scheme	Quizzes (20%); Mid-sem (20%) Programming Project (20%) and End-sem (40%)		

Introduction:
Objective, scope, overview, CAD software, mathematical background, applications **[4H]**

Transformations:
Rotation, translation, scaling, reflection, shear and combined transformations in 2D and 3D, computer-aided assembly **[6H]**

Projections:
Orthographic, axonometric, oblique and perspective projections **[4H]**

Curves:
Parametric representation of analytic curves, representation of synthetic curves- Hermite/ Ferguson, Bezier, B-spline, rational curves, NURBS/NUBS, curve manipulations, Analytical properties **[10H]**

Surfaces:
Surface representation, parametric representation of analytic surfaces- plane, ruled, surface of revolution etc., representation of synthetic surfaces- Hermite, Bezier, B-spline, coons, sculptured etc., surface manipulations, curves on surfaces, surface with irregular boundaries, analytic properties, application in reverse engineering, design of turbine blades etc. **[8H]**

Solids:
Introduction, representation of solids, fundamentals of solid modeling, solid representation schemas (B-rep, CSG, Sweep, ASM etc), solid manipulations, solid modeling-based applications in manufacturing and assembly (CNC machining, Rapid prototyping). **[8H]**

Advanced Topics:
Geometric modeling using point clouds, CAD/CAM data exchange **[2H]**

Text/Reference books:

1. Zeid, Ibraheim, CAD/CAM: Theory and Practice, Revised First Edition, Tata McGraw Hill, 2007.
2. Rogers, D.F and Adams, J.A., Mathematical Elements for Computer Graphics, Tata McGraw Hill, 2002.
3. Mortenson, Michael E., Geometric Modeling, Third Edition, Industrial Press Inc., 2006.
4. Saxena and Sahay, Computer Aided Engineering Design, Anamaya Publications
5. Faux, I. D. and Pratt, M. J., Computation Geometry for Design and Manufacture, John Wiley (Ellis Horwood Ltd.), 1983.
6. Choi, B. K., Surface Modeling for CAD/CAM, Elsevier.
7. Farin, Gerald, Curves and Surfaces for Computer Aided Geometric Design – A Practical Guide, Academic Press Inc.1991.
8. Lee, Kunwoo, Principles of CAD/CAM/CAE Systems, Addison Wesley, 1999.
9. Yamaguchi, Curves and Surfaces in Computer Aided Geometric Design, Springer, 1988.
10. Ryan, D. L., Computer-Aided Graphics and Design, Marcel Dekker Inc., 1994.

Subject Code:	ME314c	**Course Title**	Computational Fluid Dynamics
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	VI
Pre-requisites	NIL		
Evaluation scheme	Assignment (10%), Quizzes (20%), Projects (20%), Mid-sem (15%) and End-sem (35%)		

Review of equations governing fluid flow and heat transfer, common boundary conditions. **[3 H]**

2. Review of Matrix inversion techniques. **[3 H]**

3. Finite-difference method, discretisation and numerical solutions. **[4 H]**

4. 1-D steady-state conduction problem, tridiagonal matrix solution. **[3 H]**

5. 2-D steady-state conduction problem, Line-by-line method. **[3 H]**

6. Time-stepping, explicit and implicit schemes. **[3 H]**

7. 2-D unsteady conduction problems, explicit scheme. **[4 H]**

8. Implicit scheme, Gauss-Seidel algorithm, ADI. **[3 H]**

9. Wave-equation discretisation, Upwind and other convective schemes. **[2 H]**

10. Dispersion and dissipation errors, stability and consistency. **[3 H]**

11. Vorticity-streamfunction formulations **[3 H]**

12. Navier-Stokes Equations- SMAC schemes. **[3 H]**

13. Finite Volume Method **[3 H]**

14. Operator-Splitting Algorithm **[3 H]**

Text/Reference books:

1. Computational Fluid Flow and Heat Transfer, Eds K. Muralidhar and T. Sundararajan, Narosa, India.
2. Computer Simulation of Flow and Heat Transfer, P.S. Ghoshdastidar, Tata McGraw Hill.
3. Computational Fluid Flow and Heat Transfer, Tannehill, Anderson &Pletcher, Taylor & Francis Series
4. Computational Methods for Fluid Dynamics, Ferziger & Peric, Springer

Subject Code:	CS314a	**Course Title**	Wireless and Mobile networks
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	VI
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Mid term (30%), Quiz II (10%), End term (50%)		

An Overview of Wireless Systems: Wireless History, taxonomy of wireless networks, Cellular Generations (from1G to 4G), Current & Future Wireless Technologies, and Trends. **[2 H]**

Radio Propagation and Interference: Radio wave propagation, Multi-path characteristic of radio wave, Short/long term fading, Indoor and Outdoor propagation models. **[8 H]**

Digital Modulation in Modern Wireless Systems: QPSK, DQPSK, p/4 DQPSK, n-QAM, OFDM. **[6 H]**

Multiple Access Techniques: Contention-Based (Random-based) Protocols: ALOHA, CSMA, Reservation based Protocols: FDMA, TDMA, CDMA, Fundamental of SC-FDMA and OFDMA, FHSS, DSSS. **[8 H]**

Cellular concept: Basic principles of cellular systems, e.g., Cell layout, Planning, Interference. **[7 H]**

Traffic Channel Allocation & Mobility: Fixed Channel Allocation (FCA), Dynamic Channel Allocation (DCA), Hybrid Channel Allocation (HCA), Mobile IP. **[2 H]**

Wireless LAN: Operation of IEEE 802.11 Wireless LAN, incl. CSMA/CA, RTS/CTS, power management, 802.11a/b/g/n, 802.11e **[3H]**

Wireless PAN: Overview of operation of low-power wireless systems based on IEEE 802.15.1 (Bluetooth) and IEEE 802.15.4 (Zigbee). **[4 H]**

Introduction to WiMAX and LTE. **[2 H]**

Text/Reference books:

1. Dharma P. Agrawal, Qing-An Zeng, Introduction to Wireless and Mobile Systems, 3rd Edition, CL-Engineering, ISBN-13: 978-1439062050
2. Kaveh Pahlavan, Principles of Wireless Networks: A Unified Approach, 2nd Revised edition ISBN-13: 978-0470697085.
3. Garg, Wireless Communications and Networks, Morgan Kaufmann 2007, ISBN 978-0-12-373580-5.
4. Anurag Kumar, D Manjunath and Jury, Wireless Networking, Morgan Kaufmann 2008, ISBN 978-0-12-374254-4.
5. T.S. Rappaport, "Wireless Communications - Principles and Practice," 2nd edition Pearson 2002, ISBN13: 9780130422323, ISBN10:0-13-042232-0
6. Jochen Schiller, "Mobile Communications" 2nd edition Pearson 2003 ISBN-10: 0321123816, ISBN-13: 9780321123817
7. Andrea Goldsmith, "Wireless Communications", Cambridge University Press, ISBN-10: 0521837162 | ISBN-13: 978-0521837163
8. William Stallings, "Wireless Communications and Networks", Second Edition, Pearson 2005, ISBN: 0-13-191835-4

Subject Code:	CS314b	**Course Title**	Machine Learning
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	VI
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Mid-term (20%), Quiz II (10%), End term (40%), Project (20%)		

Learning Problem, Designing a Learning System, Types of Learning **[2 H]**

Supervise Learning: Linear and Logistic regression, Decision Tree Learning, Instance-Based Learning, kNN and CBR, Bayesian Learning, Naive Bayes Classifier, Artificial Neural Network (ANN), SVM **[20 H]**

Unsupervised Learning: Mixture Models and EM, Clustering, K-Means, DBSCAN, Hierarchical clustering, Association Rule Mining, Dimensionality Reduction **[10 H]**

Performance Evaluation, Confusion Metrics, Evaluating Hypotheses, Confidence Interval, Hypothesis Testing **[5 H]**

Ensemble Learning Bagging and Boosting Formulating **[2 H]**

Computational Learning Theory, Issues and practical advice in Machine Learning **[3 H]**

Text/Reference books:

1. Tom Mitchell. *Machine Learning*, Mc Graw Hill, 1997.
2. Chris Bishop, *Pattern Recognition and Machine Learning*, Springer, 2007

Subject Code:	CS314c	**Course Title**	Human Computer Interactions
Contact Hours	L-4, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	VI
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Mid-term (20%), Quiz II (10%), End term (40%), Project (20%)		

Introduction to Human-Computer Interaction. Task-centered system design: task-centered process, development of task examples, evaluation of designs through a task-centered walk-through **[5]**

User-centered design and prototyping: assumptions, participatory design, methods for involving the user, prototyping, low fidelity prototypes, medium fidelity **[10]**

Methods for evaluation of interfaces with users: goals of evaluation, approaches, ethics, introspection, extracting the conceptual model, direct observation, constructive interaction, interviews and questionnaires, continuous evaluation via user feedback and field studies, choosing an evaluation method **[10]**

Beyond screen design: characteristics of good representations, information visualization, Tufte's guidelines, visual variables, metaphors, direct manipulation **[5]**

Graphical screen design: graphical design concepts, components of visible language, graphical design by grids. Design principles and usability heuristics: design principles, principles to support usability, golden rules and heuristics, HCI patterns, HCI design standards: process-oriented standards, product-oriented standards, strengths and limitations of HCI Standards **[12]**

Text/Reference books:

1. Dix A. et al., Human-Computer Interaction. Harlow, England: Prentice Hall, 2004
2. Yvonne Rogers, Helen Sharp, Jenny Preece, Interaction Design: Beyond Human Computer Interaction, 3rd Edition, Wiley, 2011

Subject Code:	CS314d	**Course Title**	Compiler Design
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	VI
Pre-requisites	NIL		
Evaluation scheme	Project/Quiz I (30%), Mid term (30%), End term (40%)		

Introduction: Model of a compiler, translators, interpreters, assemblers, languages, types of compilers. **[2L]**

Finite Automata and Regular Expressions: Finite automata, non-deterministic and deterministic finite automata, Acceptance of strings by NDFA and DFA, Transforming NDFA to DFA, minimization/Optimization of a DFA, related algorithm, Regular sets and regular expression, Obtaining regular expression from finite automata, lexical analyzer design. **[10L]**

Context-Free Grammar and Syntax Analysis: Syntax analysis, CFG, derivation of a parse tree, reduction of grammar, useless grammar symbols, Elimination of null and unit productions, elimination of left recursion Regular grammar, Right linear and left linear grammar. Parsing, Top-Down and Bottom-up parsing, general parsing strategies, Brute-force approach, recursive descent parser and algorithms, simple LL(1) grammar, LL(1) with null and without null rules grammars, Bottom-up parsing- Handle of a right sentential form, LR(1) parsers, Shift-reduce parsers, operator precedence parsing. **[10L]**

Syntax-Directed Definitions and Translations: Specification of translations, implementation of translation specified by syntax-directed definition, L-attributed definitions, and syntax-directed translation schemes, intermediates code generation, representing three-address statement, translation schemes for programming language constructs. **[10L]**

Code Optimization: Definition, Loop optimization, Elimination of local and global common sub Expressions, Loop Unrolling, Loop Jamming**.** **[5L]**
Code Generation: Definition, machine model, code generation methods, peephole optimization.
Error Handling: Error recovery, recovery from various phases and parsing. **[5L]**

Text/Reference books:

1. Aho Alfred, Lam Monica, Sethi, Ravi, Ullman Jeffery, Compilers Principles, Techniques and Tools.
2. Tremblay, Jean Paul; Sorenson, Paul G.; The Theory and Practice of Compiler Writing, 2005.
3. Holub, Allen I., Complier Design in C, 1990.
4. Bates, Barrett; Gustafson, Couch, Compiler Construction Theory and Practice,1988.
5. John Levine, Tony Manson & Doug Brown, Lex & Yaac.

Subject Code:	EC315L	**Course Title**	DSP+Microwave
Contact Hours	L-0, T-0, P-3	**Credit**	2
Programme	B.Tech	**Semester**	VI
Pre-requisites	NIL		
Evaluation scheme	Quiz I (15%), Mid-Term (30%), Quiz II (15%), End-Term (40%)		

A. DSP

1. Performance of liner artmetic operation on signal (linear convolution).
2. Genration of discrete time signal and visulization of computer
3. Genration of Transfer function from Poles and Zeros supplied by the user.
4. Output of the system for the given difference equation..
5. Plotting of Magnitude and Phase response of the system.
6. Implementation of DIT FFT algorithm for evalution of DFT and IDFT.
7. Introdution to the Xilinx and DSP-development board for the realization.
8. Introdution to the Xilinx and DSP-development board for the realization.
9. Fourier transform of various windowing functions.
10. Introdution to the Xilinx and DSP-development board for the realization.
11. Difference equation implementtation using TMS320C6713 and Xilinx
12. Linear convolution using TMS320C6713 and Xilinx

B. Microwave

1. Study of Microwave Bench & Its Components
2. Operation of Microwave Bench as Transmission Line & reading frequency from Frequency Meter.
3. Verification of Frequency Measurement with slotted section.
4. Low & High VSWR Measurement using double minima method
5. Calculating Impedance of an SS Tuner using Microwave Bench.
6. Determination of Standing Wave Ratio and Reflection Coefficient.
7. Microwave Measurements using Gun Oscillator
    a) Study of I-V Characteristics of Gun Diode
    b) Frequency and Wavelength Measurement
8. Microwave Measurements using Horn Antenna.
    a) Measurement of the gain and Polar Pattern of the Horn Antenna.
    b) Measurement of Phase shift and Dielectric Constant.
9. Study of E-Plane Tee, H-Plane Tee and Magic Tee.
10. Study of Directional Coupler, Isolator & Attenuator.

Text/Reference books:

1. *Practical digital signal processing* by Edmund Lai, Elesevier.
2. *Practical digital signal processing using microcontroller* by Dogan Ibrahim, elector.
3. *Linear Systems and Signals* by B.P. Lathi, Oxford University Press
4. *Digital Signal Processing: A Computer Based Approach* by S. K. Mitra Tata McGraw Hill, 2006.

Subject Code:	ME315L	**Course Title**	Adv. Manufacturing+NCCNC
Contact Hours	L-0, T-0, P-3	**Credit**	2
Programme	B.Tech	**Semester**	VI
Pre-requisites	NIL		

Evaluation scheme

1. Milling Process Force Measurement and Analysis, effect of process parameters
2. Drilling Process Force Measurement and Analysis, effect of process parameters
3. Turning Force Measurement and Analysis, effect of process parameters
4. Sheet Metal Punching Punching/Shearing using AMADA machine
5. Sheet Metal Bending Bending using AMADA machine
6. Meteorology Quality Control: Measurement & Inspection of components
7. EDM Functioning and experimentation on Electric Discharge Machine
8. AWJM M/c operation, Job preparation on Abrasive Water Jet Machine
9. Injection Molding Learning the functions of Cincinnati Injection Molding Machine
10. Turning Using G&M codes, making program and component on EMCO Turning
11. Milling Using G&M codes, making program and component on EMCO Turning
12. Rapid Prototyping Knowledge of machine operation and insight software for product fabrication

Text/Reference books:

1. Rao P N.,"CAD/CAM Principles and Practice", Tata McGraw-Hill
2. Robert Quesada, T. Jeyapoovan, "Computer Numerical Control : Machining Center and Turning Centers" , Tata McGraw-Hill
3. S K SINHA,"CNC Programming", Galgotia Pubs.
4. CNC Machine Manuals
5. Chang, Wysk and Wang, Computer Aided Manufacturing, Prentice Hall International. 3rd Edition
6. Web Resources

Subject Code:	CS315L	**Course Title**	Lab based Project 3
Contact Hours	L-0, T-0, P-3	**Credit**	2
Programme	B.Tech	**Semester**	VI
Pre-requisites	NIL		

Evaluation scheme

Lab based Project 3

Semester VII

Subject Code:	ES406a	**Course Title**	Communication Systems
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	VII
Pre-requisites	NIL		
Evaluation scheme	Quiz I (15%), Mid-Term (30%), Quiz II (15%), End-Term (40%)		

Introduction to communication systems, need for modulation, brief review of signals & systems, Fourier series and Fourier transform. [3H]

Analog signal Transmission: Amplitude Modulation, Single Side Band, Suppressed Side Band & VSB Modulation, Superhetrodyne Receivers, Angle Modulations, Frequency Modulation Generation and Detection, Demodulation of Modulated Signals, FM Receivers. [12H]

Pulse and Digital communications: Pulse width modulation, pulse position modulation, sampling theorem, pulse amplitude modulation, Pulse code modulation, Introduction to digital modulation techniques, Modems, Broadband communication systems. [12H]

Elements of long-distance telephony, Radar Systems, TV communication, and introduction to fibre communication technology. [10H]

Introduction to information theory and error control coding. [5H]

Text/Reference books:

1. G. Kennedy, B. Davis, "Electronic Communication Systems", 4e, Tata McGraw Hill Publications.
2. Communication System, Haykin, S., Fourth Edition, Wiley and Sons, 2005.
3. Modern Digital and Analog Communication System, Lathi, B.P., Oxford University Press.

Subject Code:	ES406b	**Course Title**	Electrical Drives and Control
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	VII
Pre-requisites	NIL		
Evaluation scheme	Quiz I (15%), Mid-Term (30%), Quiz II (15%), End-Term (40%)		

Introduction: Classification of Electric Drives, Requirements of Electric Drives, Some Applications. **[6H]**

Converters and control: Phase controlled converters, Four quadrant operation, Choppers, AC to DC converters. [**8H]**

DC motor drives: Speed-torque characteristics DC shunt, PMDC and series motors, Dynamic model, Speed and position control methods. **[10H]**

Inverters and PWM: Voltage source inverters, current source inverters, PWM techniques, sine triangle comparison, harmonic elimination, hysteresis current controllers, space vector pwm. **[8H]**

AC motor drives: d-q model of induction motor, constant flux speed control structure, vector control model, vector control structure**.** **[10H]**

Text/Reference books:

1. M. H. Rashid, "Power Electronics - Circuits, Devices and Applications", P.H.I Private Ltd. New Delhi, Second Edition, 1994.
2. Mohan, Undeland, Robbins, "Power Electronics", 3rd edition, John Wiley & Sons, 2002.
3. Bose B.K., "Modern Power Electronics & AC Drives", 1st edition, PHI, 2002.
4. P. C. Sen., “Principles of Electrical Machines and Power Electronics”, John Wiley & Sons, 1997.

Subject Code:	ES406c	**Course Title**	Sensros and Actuators
Contact Hours	L-2, P-2	**Credit**	4
Programme	B.Tech/ M.Tech.	**Semester**	VII
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Mid term (20%), Quiz II (10%), End term (30%) Lab (30%)		

1. Introduction : Classification of sensors and actuators, sensing and actuating strategies, general requirements for interfacing and actuation, sensing, transduction, actuation. [2 H]

2. Performance Characteristics of Sensors and Actuators: Input/output characteristics, accuracy, errors, repeatability, sensitivity analysis, hysteresis, Nonlinearity, saturation, frequency response, dynamic characteristics, calibration, resolution, excitation, impedance, applications. [3 H]

3. Temperature Sensors and Thermal Actuators: Thermoresistive sensors: Thermistors, Resistance temperature sensors, Silicon resistive sensors, Thermoelectric sensors, PN junction temperature sensors, Optical and acoustic temperature sensor. [3H]

4. Optical sensors: Photodiodes, phototransistors and photoresistors based sensors, Photomultipliers, light-to-light detectors, infrared sensors (thermal, PIR, AFIR, thermopiles), CCD sensors and detectors. [3H]

5. Electric and Magnetic Sensors and Actuators: Motors as actuators (linear, rotational, stepping motors), magnetic valves, inductive sensors (eddy current, LVDT, RVDT, Proximity), Hall Effect sensors, Magnetoresistive sensors, Magnetostrictive sensors and actuators, Magnetometers (fluxgate, search-coil, Squid), Voice coil actuators (speakers and speaker-like actuators), Bolometers (microwaves). [4 H]

6. Mechanical Sensors and Actuators: Accelerometers (capacitive, piezoelectric, piezoresistive, thermal), Force sensors (strain gauges, tactile sensors), Pressure sensors (semiconductor, piezoresistive, capacitive, VRP), Gyroscopes (mechanical, optical, fiber-optics). [5 H]

7. Acoustic Sensors and Actuators: Ultrasonic sensors (piezoelectric, electromagnetic), Piezoelectric actuators, Piezoelectric Resonators, Microphones, hydrophones, speakers, buzzers. [3 H]

8. MEMs and Smart Sensors: Micro-Electro-Mechanical (MEMs) Sensors and Actuators, Smart sensors, ASIC based sensors, Wireless Sensors and Issues Associated with Wireless Sensors, Sensor Arrays). [3H]

11. Interfacing Methods and Circuits: Amplifiers: operational amplifiers, power amplifiers, A/D and D/A converters, bridge circuits, interfacing to microprocessors, data transmission, excitation methods and circuits, Power requirements, signal translation, isolation, noise, interference, compensation (Temperature, drift, etc.). [2H]

Lab work

1] Experiment on Strain Gauge.
2] Experiment on LVDT.
3] Digital-to-Analog converter using R-2R & Binary.
4] Experiment on Optical Transducer.
5] Study of H-Bridge & design using Transistors.
6] Study of PWM (Pulse Width Modulation) & its use to control the speed of a DC Motor.
7] Study of Stepper Motor & its control circuit.
8] Study of Servo Motor & its control circuit.
9] Assembly of Speaker (Study of Voice Coil Actuator).
10] Experiment on Basic Op-Amp Circuit & its use as comparator.
11] Demonstration of Piezoelectric Actuation.
12] Construction of Project.

Text/Reference books:

1. Ida, N., Sensors, Actuators, and their Interfaces; Scitech Publishing
2. deSilva, Sensors and Actuators: Control System Instrumentation, CRC Press

Subject Code:	ES406d	**Course Title**	Geometric Modeling
Contact Hours	L-3	**Credit**	4
Programme	B.Tech	**Semester**	VII
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Mid term (20%), Assignments (10%), Quiz II (10%), Term Project (15%), End term (35%)		

1. Introduction: What is Geometric Modeling, History, Background Mathematics, Parametric representations [**2 H**]
2. Curves: Conic Curves, Points on a Curve, Hermite Curves, Bézier Curves, B-Spline Curves [**10 H**]
3. Surfaces: Quadric Surfaces, Points on a Surface, Bicubic Hermite Suafaces, Bézier Surfaces, B-Spline Surfaces [**10 H**]
4. Solids: Topology of Models, Graph-Based Models, Boolean Models, Constructive Solid Geometry, Boundary Models, Sweep Solids, Controlled Deformation Solids [**10 H**]
5. Geometric Properties: Local properties of a Curve, Global properties of a Curve, Local properties of a Surface, Global properties of a Surface, Global properties of a Complex Solids, Relational Properties, Intersections [**10 H**]

Text/Reference books:

Text Books

1. Michael E. Mortenson, Geometric Modeling, Industrial Press Inc. Edition: 3rd

Reference Books

1. I.D. Faux and M.J. Pratt, Computation Geometry for Design and Manufacture, John Wiley (Ellis Horwood Ltd.).
2. Choi, B.K, Surface Modeling for CAD/CAM, Elsevier.
3. Farin, Gerald, Curves and Surfaces for Computer Aided Geometric Design – A Practical Guide, Academic Press Inc.

Subject Code:	ES406e	**Course Title**	Computer Graphics
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	VII
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Mid Sem (25%), Quiz II (10%), Project (20%) End Sem (35%)		

Conceptual Framework of an Interactive Graphical Simulation System, Graphics Architectures, The fundamentals of input, display, and hardcopy devices, Graphical User Interfaces, Interactive input methods.

Scan conversion of basic geometric primitives, Filled area primitives, Character generation, Attributes of output primitives, Antialiasing techniques, Introduction to OpenGL, Basic object representation and rendering functions.

2D and 3D Geometrical Transformations, Viewing Transformation, Window-to-Viewport transformation, 2D line and polygon clipping.

Three dimensional display methods and object representation, Basic modelling concepts through curves and surfaces.

Visual realism, Illumination models, Shading models, Color models, Texture generation and object rendering, Visible Surface Determination.

Text/Reference books:

Text Book:

D. Hearn, and M. P. Baker, Computer Graphics with OpenGL, 4th Edition, PHI, 2006.

Reference Books:

1. F.S. Hill Jr., Computer Graphics Using OpenGL, Second Edition, PHI, 2005.
2. J. Foley, A. Van Dam, S.K. Feiner, J.F. Hughes, Computer Graphics, Principles and Practice, Pearson Education, 2002.
3. R.S.Wright and M. Sweet, OpenGL Super Bible, Pearson Education, 2016.

4. E. Angel, OpenGL: A Primer, Third Edition, Pearson Addison Wesley, 2008.

Subject Code:	ES406f	**Course Title**	Multimedia Processing
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	VII
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Mid Sem (25%), Quiz II (10%), Project (15%), End Sem (40%).		

Introduction to Multimedia Systems and Processing, Computer Representation of Audio, Image, and Video, Image compression and decompression systems, Redundancies and their Classification, Entropy and Information Theory, Lossless and lossy image compression, Quality measures of reconstructed images. [6H]

Lossless Compression (Run Length Encoding, Variable Length Coding, and Dictionary-Based Coding techniques): Huffman coding, Shannon's Coding Theorem for noiseless channels, Arithmetic and LempelZiv coding. [6H]

Lossy Compression: Uniform and non-uniform quantization, Rate-distortion function and Source Coding Theorem, Delta modulation and DPCM, Transform coding and discrete cosine transform, JPEG.[6H]

Multiresolution Analysis: Introduction to wavelets, scaling functions and ladder of subspaces, Subband coding, Conditions for perfect reconstruction, Subband decomposition of images, Discrete wavelet transform. Embedded wavelet coding, JPEG-2000. [6H]

Video Coding and Motion Estimation: Basic building blocks and temporal redundancy, Motion estimation algorithms, Video coding standards –MPEG-4 and H.264. [4H]

Audio Coding: Basic of Audio Coding, transform and filter banks, Format and encoding, Psychoacoustic models. [4H]

Multimedia Synchronization: Basic definitions and requirements, Time stamping and pack architecture, References model and specification, Packet architectures and audio-video interleaving, Playback continuity. [6H]

Video Indexing and Retrieval: Content based image retrieval, Video content representation, Video sequence query processing. [4H]

Text/Reference books:

1. P. Havaldar and G. Medioni, Multimedia Systems – Algorithms, Standards and Industry Practices, Cengage Learning, 2009.
2. R. Steinmetz and K. Nahrstedt, Multimedia Fundamentals: Media Coding and Content Processing, Second Edition, Prentice Hall, 2002.
3. NPTEL Course on Multimedia Processing by IIT Kharagpur.
4. Coursera – Course on Fundamentals of Digital Image and Video Processing

Subject Code:	EC416a	**Course Title**	Advanced Analog Circuits Design
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	VII
Pre-requisites	NIL		
Evaluation scheme	Quiz I (12.5%), Mid term (25%), Quiz II (12.5%), End term (50%)		

Review of Basic Single-Transistor Amplifier Stages, MOS and BJT. Biasing. Limitations MOS device models, Single-stage amplifiers, Single-stage amplifier frequenscy response. **[4 H]**

Current sources and mirrors; active loads, Differential amplifiers, source-coupled pairs. **[6 H]**

Design of an Op-Amp internal stages, Differntial input balnced output/unbalance out differnce amplifer stage, level shiftter, power amplifier stage analysis and design. Design to achive high CMRR. **[10 H]**

Linear voltage regulators, Switching voltage regulators, Interference and grounding, Continous and switched capacitor filter, Timers, Active filter, Phase-locked loop. **[6 H]**

Digital / Analog converters: - Characterization, lineality (DNL, INL), dynamic characteristics. - Parallel architectures. - Enhanced resolution techniques. - Serial architectures. - Analog / Digital converters: - Sample & hold. - Caracterization, lineality (DNL, INL), dynamic characteristics. - Serial architectures. - Parallel architectures. Pipeline. - Advanced techniques (folding, interpolation, interleaved). **[10 H]**

Noise in circuits Oscillators and comparators, Feedback op-amps and stability, Differential amplifiers. **[6 H]**

Text/Reference books:

1. Adel S. Sedra and Kenneth C. Smith, Microelectronic Circuits, Fifth edition, Oxford University Press.
2. Design of Analog CMOS Integrated Circuits, 1st Edition, Behzad Razavi, McGraw-Hill, 2001.
3. Field-Effect Devices and Advanced MOS Devices, (volumes IV and VII of the Modular Series on Solid State Devices), Addison-Wesley.
4. Analysis and Design of Analog Integrated Circuits, Gray, Hurst, Lewis and Meyer, 4th Ed., Wiley, 2001.

Subject Code:	EC416b	**Course Title**	Detection and Estimation Theory
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	VII
Pre-requisites	NIL		
Evaluation scheme	Quiz I (15%), Mid-Term (30%), Quiz II (15%), End-Term (40%)		

Background: Review of Gaussian variables and processes; problem formulation and objective of signal detection and signal parameter estimation in discrete-time domain. **[2 H]**

Statistical Decision Theory: Bayesian, minimax, and Neyman-Pearson decision rules, likelihood ratio, receiver operating characteristics, composite hypothesis testing, locally optimum tests, detector comparison techniques, asymptotic relative efficiency. **[8 H]**

Detection of Deterministic Signals: Matched filter detector and its performance; generalized matched filter; detection of sinusoid with unknown amplitude, phase, frequency and arrival time, linear model. **[6 H]**

Detection of Random Signals: Estimator-correlator, linear model, general Gaussian detection, detection of Gaussian random signal with unknown parameters, weak signal detection. **[6 H]**

Nonparametric Detection: Detection in the absence of complete statistical description of observations, sign detector, Wilcoxon detector, detectors based on quantized observations, robustness of detectors. **[6 H]**

Estimation of Signal Parameters: Minimum variance unbiased estimation, Fisher information matrix, Cramer-Rao bound, sufficient statistics, minimum statistics, complete statistics; linear models; best linear unbiased estimation; maximum likelihood estimation, invariance principle; estimation efficiency; Bayesian estimation: philosophy, nuisance parameters, risk functions, minimum mean square error estimation, maximum a posteriori estimation. **[8 H]**

Signal Estimation in Discrete-Time: Linear Bayesian estimation, Weiner filtering, dynamical signal model, discrete Kalman filtering. **[6 H]**

Text/Reference books:

1. H.L.VanTrees,"Detection, Estimation and Modulation Theory: Part I, II, and III", John Wiley, NY, 1968.
2. H. V. Poor, "An Introduction to Signal Detection and Estimation", Springer, 2/e, 1998.
3. S.M.Kay,"Fundamentals of Statistical Signal Processing: Estimation Theory", ", Prentice Hall PTR, 1993.
4. S.M.Kay,"Fundamentals of Statistical Signal Processing: Detection Theory", Prentice Hall PTR, 1998.

Subject Code:	EC416c	**Course Title**	Industrial Microwave and Communication
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	VII
Pre-requisites	NIL		
Evaluation scheme	Quiz I (15%), Mid-Term (30%), Quiz II (15%), End-Term (40%)		

Waveguide Components:

Overview of Attenuators, Phase Shifters, Matched Loads, Detector Mounts, slotted sections, E and H Plane Tees, etc. Signal Generators: Fixed Frequency, Sweep frequency and synthesized frequency oscillators, PLL for high frequency generation **[10 H]**

Industrial Microwave:

Noise Sources and Noise meters used in microwave measurements, frequency meters and VSWR meters, Measurement of frequency, attenuation, VSWR and impedance, cavity measurements: Q factor, bandwidth; Dielectric and magnetic properties of materials: Cavity and waveguide methods, Measurement of Power: Calorimetric and Microwave bridges; principles of Time and frequency domain reflectometry, Spectrum Analyser and Network Analyser, Measurement of Scattering parameters of passive and active devices.

[10 H]

Processes in Industrial Microwave:

Microwave in process control instrumentation, Microwave waste disposal, Microwave in agriculture and medicine, hyperthermia, etc. Microwave Heating, Microwave absorbers, EMC and EMI.

[10 H]

Microwave Communication:

Microwave Radio and its components, Free space propagation model, ground reflection, Earth and its effect on propagation, Clutter theory, Fresnel Zones: First and Second order Fresnel Zones, Signature width of radio, tolerance limits, Practical Link Budget calculations, Atmospheric Attenuation

Text/Reference books:

1. Microwave Devices and Circuits, Samuel Y Liao, Pearson
2. Microwave Engineering, David M Pozar, Wiley
3. T.S. Rappaport, "Wireless Communications," Pearson Education, 2003.

Subject Code:	ME416a	**Course Title**	Energy Conversion Device
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	VII
Pre-requisites	NIL		
Evaluation scheme	Quiz (20%), Mid-sem (20%) and End-sem (60%)		

COMMERCIAL ENERGY **(6 H)**

Coal, Oil, Natural Gas, Nuclear power and Hydro -their utilization pattern in the past, present and future projections of consumption pattern – Sector - wise energy consumption – environmental impact of fossil fuels – Energy scenario in India – Growth of energy sector and its planning in India.

SOLAR ENERGY **(10 H)**

Solar radiation at the earth's surface – solar radiation measurements – estimation of average solar Radiation - solar thermal flat plate collectors - concentrating collectors, Solar radiation - beam and diffuse radiation, solar constant, earth sun angles, attenuation and measurement of solar radiation Local solar time, derived solar angles, sunrise, sunset and day length. flat plate collectors, concentrating collectors Solar air heaters - types, solar driers, storage of solar energy - thermal storage, solar pond Solar water heaters, solar distillation, solar still, solar cooker, solar heating & cooling of buildings, photo voltaic - solar cells & its applications.

WIND ENERGY **(6 H)**

Nature of the wind –power in the wind – factors influencing wind – wind data and energy estimation - wind speed monitoring -wind resource assessment - Betz limit - site selection - wind energy conversion devices - classification, characteristics, applications – offs hore wind energy-

Hybrid systems - safety and environmental aspects – wind energy potential and installation in India -

Repowering concept.

BIO – ENERGY (6 H)

Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - direct combustion – biomass gasification - pyrolysis and liquefaction - biochemical Conversion - anaerobic digestion - types of biogas Plants – applications - alcohol production from biomass – bio diesel production – Urban waste to energy conversion - Biomass energy program me in India.

TURBINES AND PUMPS (10 H)

Introduction, turbines, different types turbines, pelton wheel (or turbine), velocity triangles, radial flow reaction turbine, Francis turbines, Axial flow reaction turbines, reciprocating pumps - variations of velocity and acceleration in the suction and delivery pipes due to acceleration of the piston, centrifugal pumps – work done by the centrifugal pump on water, minimum speed for starting a centrifugal pump, multistage centrifugal pumps for high head and high discharge.

OTHER TYPES OF ENERGY (4 H)

Ocean energy resources - principle of ocean thermal energy conversion (OTEC) - ocean thermal power plants - ocean wave energy conversion - tidal energy conversion – small hydro – geothermal energy - geothermal power plants – hydrogen production and storage - Fuel cell – principle of working - various types - construction and applications.

Text/Reference books:

1. Non - conventional energy by B H Khan, Tata McGraw - Hill, New Delhi.
2. Fundamental of turbo machinery – B.K. Venkanna, PHI, New Delhi 2009
3. An introduction to Energy Conversion: Turbo machinery, volume 3 (Second Edition) Manohar Prasad, V. Kadambi.
4. Fluid mechanics and Hydraulic Machines by Dr. R. K. Bansal laxmi publications.

Subject Code:	ME416b	**Course Title**	Industrial Instrumentation & Metrology
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	VII
Pre-requisites	NIL		
Evaluation scheme	Quiz (15%), Mid-sem (35%) and End-sem (50%)		

Industrial Instrumentation: Theory and Experimentation in Engineering problem solving approaches, types of engineering experiments, computer simulation and physical experimentation: Generalized measuring system, types of inputs analog and digital signals, standards, calibration and uncertainly. [08 H]

Measurement system; performance characteristic, static performance characteristics-static calibration linearity static sensitivity, repeatability, hysteresis threshold-resolution, readability and span: Analysis of experimental data; Causes and types of experimental error, un-certainly analysis statistical analysis of data , probability distributions and curve fitting: Dynamic performance characteristics: Input types Instrument types zero order instrument, first order instrument second order instrument. [09 H]

Experiment plans, Model building, Measurement Methods and Application Measurement of force and torque; Measurement of strain and stress; Measurements ofpressure; Flow measurement and flow visualization, measurement of temperature, optical methods of measurements; [09 H]

Data Acquisition and Processing : Types and configurations of DAS, Signal conditioning, A/D, D/A conversion: Design, Planning, Execution and Analysis of experimental projects. [06 H]

Metrology: Measurement of length, measurement of angle, measurement of geometric forms, straightness, flatness, roundness etc. Mechanical and optical methods. Measurement of screw threads and gears.Measurement of surface roughness and texture, introduction to CMM in-process gages, Inspection and quality monitoring. [10 H]

Text/Reference books:

1. Mechanical Measurements by S.P. Venketeshan, IIT Madras Anne Book Pvt. Ltd. 4821 ParwanaBhawan, 1st floor 24 Ansari Road, Darya ganj, New Delhi-110 002.
2. Engineering Metrology by R. K. Jain, Khanna Publishers, and New Delhi 1997.
3. E.O. Deobelin, Measurement systems, Applications and Design 4th Edition Tata McGraw Hill 1990.
4. T.G. Beckwith, R.D. Marangoni and J.H. Tenhard Mechanical Measurements 5th ed. Addison Wesley 1993.
5. Holman, Experimental Methods for Engineers McGraw Hill 1994.

Subject Code:	ME416c	**Course Title**	Rapid Product Development Technologies
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	VII
Pre-requisites	NIL		
Evaluation scheme	Mid Sem Exam (20%), End Sem Exam (40%), Quizzes/Programming Assignment (20%) and Programming/Automation Project (20%)		

Overview of Rapid Product Development:

Product Developing Cycle, Components of RPD, Classification of manufacturing processes. Preprocessing: Solid Modeling, Data exchange formats, STL file format, RP Preprocessing. **[4 H]**

Rapid Prototyping (RP):

Introduction to RP, Need of RP; Basic Principles of RP, Steps in RP, Process chain in RP in integrated CAD-CAM environment, Advantages of RP, Classifications of different RP techniques, Selection of RP processes, Issues in RP, Emerging trends. [**8 H]**

RP Techniques:

Solid RP, liquid RP techniques and Powder RP Techniques - Process Technology and Comparative study of Selective laser sintering, Selective powder binding, etc. **[10 H]**

Rapid Tooling (RT):

Introduction to RT, Indirect RT processes – silicon rubber molding, epoxy tooling, spray metal tooling and investment casting. Direct RT processes – laminated tooling, powder metallurgy based technologies, welding based technologies, direct pattern making, emerging trends in RT. **[5 H]**

Reverse Engineering:

Geometric data acquisition, 3D reconstruction. **[5 H]**

Applications and case studies:

Engineering applications, Medical applications **[5 H]**

Special Topic on RP:

Programming in RP, Modelling, Slicing, Internal Hatching, Surface Skin Fills, Support Structure. Overview of the algorithms for RP&T and Reverse Engineering. **[5 H]**

Text/Reference books:

1. Chua, C.K., Leong, K.F., Rapid Prototyping: Principles and Applications in Manufacturing, John Wiley and Sons Inc., 2000.
2. Pham, D.T., Demov, S.S., Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, Springer-Verlag London Limited, 2001.
3. Hopkinson, N., Hague, R.J.M. and Dickens, P.M., Rapid Manufacturing and Industrial Revolution for the Digital Age, John Wiley and Sons Ltd, Chichester, 2005.
4. Noorani, R., Rapid Prototyping: Principles and Applications, John Wiley & Sons, Inc., New Jersey, 2006.
5. Zeid, I., Mastering CAD/CAM, Tata McGraw Hill, 2006

6. Gebhardt, A., Rapid Prototyping, Hanser Gardner Publications, Inc., Cincinnati, 2003.
7. Gibson, I., Software Solutions for Rapid Prototyping, Professional Engineering Publication Ltd., 2002.
8. Patri, K. V., and Weiyin, Ma, Rapid Prototyping - Laser-based and Other Technologies, Kluwer Academic Publishers, U.S.A., 2003.
9. Rapid Prototyping Journal
10. Journal of Virtual and Physical Prototyping
11. Selected papers from International Journal of Machine Tools and Manufacture, International Journal of Advanced Manufacturing Technology, Computer Aided Design, Computer Aided Design and applications, etc.
12. Mortenson, M.E., Geometric Modelling, John Wiley and Sons, Inc., 1997
13. Saxena, A., Sahay, B., Computer Aided Engineering Design, Anamaya Publishers, New Dehi, 2005
14. Rogers, D.F and Adams, J.A., Mathematical Elements for Computer Graphics, Tata McGraw Hill, 2002.
15. Zeid, I., CAD/CAM: Theory and Practice, Revised First Edition, Tata McGraw Hill, 2007.
16. Faux, I. D. and Pratt, M. J., Computation Geometry for Design and Manufacture, John Wiley (Ellis Horwood Ltd.), 1983.
17. Venuvinod, P.K. and Ma, W., Rapid prototyping: Laser based and other technologies, Kluwer Academic Publishers,2004.
18. Gibson, I., Advanced Manufacturing Technology For Medical Application, John Wiley & Sons,Singapore,2005.
19. Kamrani, A.K. and Nasr, E.A., Rapid Prototyping Theory And Practice , Springer,USA ,2006.
20. Hilton, P.D. and Jacobs, P.F., Rapid Tolling: Technologies and Industrial Applications, Dekker,New York ,2005.
21. Bidanda, B. and Bartolo, P., Virtual Prototyping & Bio Manufacturing In Medical Applications, Springer,USA ,2008.

Subject Code:	CS416a	**Course Title**	Pattern Recognition
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	VII
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Mid term (25%), Quiz II (10%), End term (40%), Project (20%)		

Introduction: Feature extraction and Pattern Representation, Concept of Supervised and Unsupervised Classification, Introduction to Application Areas

[2 H]

Statistical Pattern Recognition: Bayes Decision Theory, Minimum Error and Minimum Risk Classifiers, Discriminant Function and Decision Boundary, Normal Density, Discriminant Function for Discrete, Features, Parameter Estimation, Maximum Likelihood Estimation

[9 H]

Dimensionality Problem: Dimension and accuracy, Computational Complexity, Dimensionality Reduction, Fisher Linear Discriminant, Multiple Discriminant Analysis

[4 H]

Nonparametric Pattern Classification: Density Estimation, Nearest Neighbour Rule, Fuzzy Classification

[3 H]

Linear Discriminant Functions: Separability, Two Category and Multi Category Classification, Linear Discriminators , Perceptron Criterion, Relaxation Procedure, Minimum Square Error Criterion, Widrow-Hoff Procedure, Ho-Kashyap Procedure, Kesler's Construction

[6 H]

Neural Network Classifier: Single and Multilayer Perceptron, Back Propagation Learning, Hopfield Network, Fuzzy Neural Network

[7 H]

Time Varying Pattern Recognition: First Order Hidden Markov Model, Evaluation Decoding, Learning

[5 H]

Unsupervised Classification: Clustering, Hierarchical Clustering, Graph Based Method, Sum of Squared Error Technique, Iterative Optimization

[5 H]

Text/Reference books:

1. Pattern Classification by Richard o. Duda, Peter E. Hart, and David G. Strok, Wiley.
2. Pattern Recognition and Machine Learning by Christopher M. Bishop, Springer.
3. Machine Learning by Tom M. Mitchell, Mcgraw Hill Education.
4. Pattern Recognition by Theodoridis, Academic Pr.

Subject Code:	CS416b	**Course Title**	Internet Technology
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	VII
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Mid-term (20%), Quiz II (10%), End term (40%), Assignments (20%)		

Evolution of Internet, TCP/IP: addressing and routing. [5]

Internet applications: FTP, Telnet, Email, Chat. [5]

World Wide Web: HTTP protocol. [5]

Designing web pages: HTML, forms, JavaScript, JAVA servlets, Perl. PHP, DHTML, XML. [10]

E-Commerce and security issues including symmetric and asymmetric key, encryption and digital signature, authentication. [10]

Emerging trends, Internet telephony, virtual reality over the web, etc. Intranet and extranet, firewall design issues. [7]

Text/Reference books:

1. Douglas E.Comer, *Computer Networks and Internets with Internet Applications* (Third Edition), Prentice Hall, 2001
2. H M Deitel, Internet and WWW- How to Program, 5th Edition, Pearson Education, 2014.
3. Jeffrey C. Jackson, *Web Technologies: A Computer Science Perspective*, Pearson Education, 2006.

Subject Code:	CS416c	**Course Title**	Cyber Security
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	VII
Pre-requisites	NIL		
Evaluation scheme	Project/Quizes (30%), Mid term (30%), End term (40%)		

Security Concepts and Mechanisms: Overview of Networking Concepts, Information Security Concepts, Security Threats and Vulnerabilities, Cryptography **[10H]**
Security Management: Security Management Practices, Security Laws and Standards **[11H]**
Information and Network Security: Access Control and Intrusion Detection, Server Management and Firewalls, Security for VPN and Next Generation Technologies **[11H]**
System and Application Security: Security Architectures and Models, System Security, OS Security **[10H]**

Text/Reference books:

1. Mike Shema, Anti-Hacker Tool Kit, Mc Graw Hill, 4th edition, 2014.
2. Nina Godbole and Sunit Belpure, Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley, 2011
3. Dieter Gollmann , Computer Security, Wiley, 3rd Edition, 2011
4. Ross Anderson , Security Engineering: A Guide to Building Dependable Distributed Systems, Wiley, 2nd Edition, 2008

Subject Code:	CS416d	**Course Title**	Computational Geometry
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	VII
Pre-requisites	NIL		
Evaluation scheme	Project/Quiz I (30%), Mid term (30%), End term (40%)		

Basic Geometric Concepts: points, lines, polygons; subdivisions; arrangements; polytopes; cell complexes. **[5H]**

Geometric Searching: fractional cascading; segment tree; interval tree, range tree; priority search tree. **[5H]**

Point Location: slab method; trapezoid method; chain method; bridged chain method**.** **[5H]**

Plane-Sweep Algorithms: intersection of segments; intersection of rectangles; trapezoidation. **[6H]**

Convex Hulls: 2-dimensional convex hull; dynamic convex hull; 3-dimensional convex hull**.** **[6H]**

Proximity: closest pair; furthest pair; Voronoi diagrams; triangulations. **[7H]**

Graph Drawing: planar drawings; straight-line drawings; orthogonal drawings; polyline drawings; upward drawings; hierarchical drawings; visibility representations. **[8H]**

Text/Reference books:

1. Mark de Berg, Mar van Kreveld, Mark Overmars, and Otfried S hwarzkopf, Computational Geometry: Algorithms and Applications, Springer-Verlag, 2nd edition, 2000
2. H. Edelsbrunner, Algorithms in Combinatorial Geometry, Springer-Verlag, 1987
3. H. Edelsbrunner , Geometry and Topology for Mesh Generation. Cambridge Univ. Press, 2001
4. K. Mulmuley, Computational Geometry: An Introduction Through Randomized Algorithms.,Prenti e-Hall, 1994
5. . F. Preparata and M. Shamos, Computational Geometry: An Introduction, Springer-Verlag, 1985
6. T.H. Cormen, C.E. Leiserson, R.L. Rivest, and C. Stein, Introduction to Algorithms, 2nd ed, MIT Press and M Graw-Hill, 2001.

Subject Code:	EC417a	**Course Title**	Satellite Communication
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	VII
Pre-requisites	NIL		
Evaluation scheme	Quiz I (15%), Mid-Term (30%), Quiz II (15%), End-Term (40%)		

SATELLITE ORBITS: Introduction Kepler's Laws, orbital parameters, orbital perturbations, station keeping, and geo stationary and non-Geo-stationary orbits – Look Angle Determination- Limits of visibility –eclipse-Sub satellite point –Sun transit outage. **[8 H]**

SATELLITE LINK DESIGN: Satellite uplink and downlink Analysis and Design, link budget, E/N calculation- performance impairments-system noise, inter modulation and interference, Propagation Characteristics and Frequency considerations- System reliability and design lifetime. **[10 H]**

SATELLITE ACCESS: Modulation and Multiplexing: Voice, Data, Video, Analog – digital transmission system,Digital video Brocast, multiple access: FDMA, TDMA, CDMA, Assignment Methods,Spread Spectrum communication, compression – encryption. **[6 H]**

EARTH SEGMENT: Earth Station Technology-- Terrestrial Interface, Transmitter and Receiver, Antenna Systems TVRO, MATV, CATV, Test Equipment Measurements on G/T, C/No, EIRP, Antenna Gain. **[8 H]**

SATELLITE APPLICATIONS:INTELSAT Series, INSAT, VSAT, Mobile satellite services: GSM, GPS, INMARSAT, LEO, MEO, Satellite Navigational System. Direct Broadcast satellites (DBS)- Direct to home Broadcast (DTH), Digital audio broadcast (DAB)- Worldspace services, Business TV(BTV), GRAMSAT. **[8 H]**

Text/Reference books:

1. Dennis Roddy, 'Satellite Communication', McGraw Hill International, 4th Edition, 2006.
2. Timothy Pratt – Charles Bostian & Jeremy Allmuti, Satellite Communications, John Willy & Sons (Asia) Pvt. Ltd, 2nd Edition 2004
3. Bruce R. Elbert, 'The Satellite Communication Applications' Hand Book, Artech House Bostan London, 1997.

Subject Code:	EC417b	**Course Title**	Mixed-Mode Circuit Design
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	VII
Pre-requisites	NIL		
Evaluation scheme	Quiz I (15%), Mid-Term (30%), Quiz II (15%), End-Term (40%)		

Basic CMOS Circuit Techniques, Continuous Time And Low voltage Signal Processing: Mixed-Signal VLSI Chips-Basic CMOS Circuits-Basic Gain Stage-Gain Boosting Techniques-Super MOS Transistor-Primitive Analog Cells-Linear VoltageCurrent Converters-MOS Multipliers and Resistors-CMOS, Bipolar and Low-Voltage BiCMOS Op-Amp Design-Instrumentation Amplifier Design-Low Voltage Filters. **[10 H]**

Basic BiCMOS Circuit Techniques, Current -Mode Signal Processing: Continuous Time Signal Processing-Sampled-Data Signal Processing-Switched-Current Data Converters. **[5 H]**

Sampled-Data Analog Filters, Over Sampled A/D Converters And Analog Integrated Sensors: First-order and Second SC Circuits-Bilinear Transformation - Cascade Design-Switched-Capacitor Ladder Filter-Synthesis of Switched-Current FilterNyquist rate A/D Converters-Modulators for Over sampled A/D Conversion-First and Second Order and Multibit Sigma-Delta Modulators-Interpolative Modulators – Cascaded Architecture-Decimation Filters-mechanical, Thermal, Humidity and Magnetic Sensors-Sensor Interfaces. **[10 H]**

Analog VLSI Interconnects: Physics of Interconnects in VLSI-Scaling of Interconnects-A Model for Estimating Wiring Density-A Configurable Architecture for Prototyping analog Circuits. **[7 H]**

Statistical Modeling and Simulation, Analog/ Mixed Computer-Aided Design: Review of Statistical Concepts - Statistical Device Modeling- Statistical Circuit Simulation-Automation Analog Circuit Design-automatic Analog Layout-CMOS Transistor Layout-Resistor Layout-Capacitor Layout-Analog Cell Layout-Mixed Analog -Digital Layout. **[10 H]**

Text/Reference books:

1. Paul R. Gray and Robert G.Meyer, " Analysis and Design of Analog Integrated Circuits", John Wiley & Sons.
2. Mohammed Ismail, Terri Fiez, " Analog VLSI signal and Information Processing ", 1994, McGraw-Hill International Editons.
3. Behzad Razavi, " Design of Analog CMOS Integrated Circuits", Tata Mc-Graw Hill.
4. Y. Tsividis, " Mixed Analog-Digital Devices and Technology", Mc-Graw Hill.
5. Alan B. Gnebene, " Bipolar and MOS analog integrated circuit design",John Wiley & Sons.
6. Mohammed I. Elmasy," Digital Bipolar circuits ", John Wiley & Sons.
7. Greogorian and Tames, " Analog Integrated Circuit For Switched Capacitor Circuit

Subject Code:	EC417c	**Course Title**	Power System Engineering
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	VII
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Mid term (30%), Quiz II (15%), End term (45%)		

Introduction: Power generation from conventional sources; thermal, hydro, nuclear and gas power plants - their functions and control; types of prime movers, generators and excitation systems. **[10 H]**

Transmission lines: Equivalent circuit of a transmission lines, line parameters, corona, interference of power lines with communication circuits, line insulators. Cables, per unit system, symmetrical components, fault analysis, switching surges. **[14 H]**

Integrated operation and mathematical modeling of power systems, basic concepts of load flow, protection. **[12 H]**

Load management and tariffs. **[3 H]**

Deregulated power system and introduction to smart grid. **[3 H]**

Text/Reference books:

1. J.J. Grainger and W.D. Stevenson Jr., *Power System Analysis,* Mc Graw Hill International, 1994.
2. B.M. Weedy and B.J. Cory, *Electric Power Systems,* John Wiley & Sons, 2002.
3. I.J. Nagrath and D.P. Kothari, *Power System Engineering,* Tata Mc Graw Hill Publishing Co., 1994.
4. C.L Wadhwa, "Electrical Power System", New age International (p) Limited Publisher, Reprint, 2008.

Subject Code:	ME417a	**Course Title**	Mechanical Vibration and Condition Monitoring
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	VII
Pre-requisites	NIL		
Evaluation scheme	Quizes (20%), Mid-sem (35%) and End-sem (45%)		

Review of Free and forced vibrations of single degree of freedom system. Vibration isolation and transmissibility, Vibration measuring instruments. **[6 H]**

Multi Degrees of freedom systems, Introduction, Influence co-efficient, Maxwell reciprocal theorem,Automobile vehicle suspension, coupling, Vibration absorbers, Various numerical methods for solution of multi degree of freedom systems. **[8 H]**

Whirling of shafts with and without air damping. Discussion of speeds above and below critical speeds. **[6 H]**

Vibration of Continuous Systems: Introduction, vibration of string, longitudinal vibration of rods,torsional vibration of rods, Euler's equation for beams, simple problems. **[8 H]**

Non-linear vibration, PhasePlane, Conservative systems, Stability of equilibrium. The Duffing Oscillator. **[4 H]**

Introduction to condition monitoring of machinery, Condition monitoring methods, Types and Benefits of Vibration Analysis. Vibration Signals from Rotatingand Reciprocating Machines. Signal Classification, Stationary and Cyclostationary signals. **[10 H]**

Text/Reference books:

1. Thomson, W.T., Theory of vibration with applications, Third Edition,1997.
2. Rao, S. S., Mechanical Vibrations, Fourth Edition, Addison Wesley, 2004
3. Randall. R.B., Vibration-Based Condition Monitoring: Industrial, Aerospace and Automotive Applications, Wiley, United Kingdom, 2011.
4. Caollacott, R. A.; Chapman, Mechanical Fault Diagnosis and Condition Monitoring, Chapman and hall, 1977.
5. Rao, J. S., Advanced Theory of Vibration, Wiley Eastern Ltd. New Delhi, 1992

Subject Code:	ME417b	**Course Title**	Advance Manufacturing Processes
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	VII
Pre-requisites	NIL		
Evaluation scheme	Quiz (15%), Mid-sem (35%) and End-sem (50%)		

Conventional Machining Processes

Electron Beam Machining (EBM), Plasma Arc Machining (PAM) Laser Beam Machining (LBM), Abrasive Jet Machining (AJM), Water Jet Cutting (WJM), Ultrasonic Machining (USM), Electro-Chemical Machining (ECM), Electric Discharge Machining (EDM), Wire EDM. [20H]

Assembly

Jigs and fixtures, principles of location and clamping, synthesis of simple jigs and fixtures. Principles of assembly, engineering theory of dimensional chains, fully interchangeable and selective assembly. [6H]

Metrology:

Limits, fits and tolerance; automated inspection and CMM. Selection of Manufacturing processes for a given product. [4H]

High Speed Machining ;

Introduction and concepts of HSM. Issues related to HSM. Comparison with conventional manufacturing processes. [2H]

Finishing Processes:

Introduction to finishing process, grinding, Lapping, Honing, Super Finishing. [4H]

Precision Manufacturing Processes:

Introduction to micro fabrication processes and M4 processes: concepts of accuracy, errors, influences of dimensional wear on accurancy. [2H]

Text/Reference books:
1. V.K. Jain Advanced Machining processes, Allied Publishers New Delhi 2002.
2. Boothroyd G and Knight, W.A. Fundamentals of Machining and Machine Tools, 3rd ed. Saint Luice Pr. 2005.
3. Black S.C. Chiles, V.Lissaman, A.J. Martin, S.J. Principles of Engineering Manufactures Arnold Edn. 1996.
4. Kalpakjian, S. and Schimd S.R. Manufacturing Engineering and Technology, Prentice Hall 4th edition 2005.
5. G.F. Benedict, Nontraditional Manufacturing processes, Marcel Dekker, Inc. New York 1987.
6. A.Ghosh and A.K. Malik Manufacturing Science Affiliated East West press Ltd. New Delhi 1985.
7. P.C. Pandey, and H.S. Shan Modern Machining Processes, TMH Publishing Co.Ltd. New Delhi 1980.
8. J.A. McGeough, Advanced Methods of Machining, Chapman and Hall, London 1988.

Subject Code:	ME417c	**Course Title**	Automobile Engineering
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	VII
Pre-requisites	NIL		
Evaluation scheme	Quiz (15%), Mid-sem (35%) and End-sem (50%)		

Chassis: **[4 H]**

Importance of chassis and its components, Vehicle performance

Clutch: **[6 H]**

Driving system and Plate clutch (uniform pressure and uniform wear),Cone clutch (uniform pressure and uniform wear), Energy lost by plate clutch during engagement, Centrifugal clutch.

Gear box: **[6 H]**

Torque and tooth load in epicyclic gear trains, Sliding mesh and constant mesh gears, Epicyclic gears and hydra-matic transmission,Numerical problems on the above topics

Propeller shaft: **[3 H]**

Types of driving shafts, Mechanics of Hotchkiss and torque tube drives

Universal joint: **[1 H]**

Slip joint, Hook's joint.

Differential and rear axle: **[4 H]**

Differential, Rear axle, Axle shaft, Axle housing.

Brakes: **[6 H]**

Theory of band brake, blocks brake, and band and block brake, Internal expansion, Hydraulic brakes, Hand or parking brakes, Braking of vehicle moving in a curved path,Numerical problems on the above topics.

Steering systems: **[4 H]**

Ackerman steering gear,Devis steering gear, Turning circle radii, Standard steering gears, Power steering.

Brake wheel: **[3 H]**

Braking of vehicle, Heat generated due to braking operation, Types of wheels, Design consideration of wheels, Wheel alignment.

Supercharging and Turbocharging: **[4 H]**

Supercharger, Supercharging methods for SI and CI engines, Turbocharging, Supercharge Engine

Text/Reference books:
1. Joseph Heitner, Automotive Mechanics – Principles and Practice, - Affiliated East West Press, 2nd edition, 1980.
2. J.A. McGeough, Advanced Methods of Machining, Chapman and Hall, London 1988. 1.N. K. Giri, Automotive Mechanics, Khanna Publishers, 1996
3. Kripal Singh, Automobile Engineering, - Vol. I & II, Standard Publishers & distributors

Subject Code:	CS417a	**Course Title**	Advanced Computer Architecture
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	VII
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Mid term (30%), Quiz II (10%), End term (50%)		

Introduction: Microprocessor Advances, Number of transistors, Chip size, Power dissipation **[1 H]**

Pipeline execution and Hazard avoidance: Simplified Computer structure, Clock synchronous design, Instruction fetch, decode, Operand read, ALU operation, LSU operation, Result write back; Pipeline Execution, Eliminating structural hazard, Resource scheduling, Data hazard, Pipeline control, Branch instruction execution, Pipeline processor performance, Number of pipeline stages. [5H]

Review of Cache and its Performance Effect: Performance effect of memory access, Performance effect of cache, Cache structure, Direct map, Full associative, Set associative, Cache management, LRU, Multi-level cache, I/D split cache, How cache works. [2H]

Review of Arithmetic Units: Binary number representation, 1bit full adder, Ripple carry adder, Generate and Propagate signals, Parallel prefix Adder, Kogge-Stone adder, Han-Carlson adder; Multiplier, Binary multiplier, Booth's algorithm, Radix-4 modified Booth algorithm, Wallace tree, Pipelined Multiplier; Division, Restoring division, Non restoring division, SRT division; Floating point numbers, IEEE754, Floating point adder, Floating point multiplier, Iterative floating point division, Newton-Raphson method, Goldschmidt method. **[5 H]**

Memory management and Protection Mechanism: Segment based memory management, Page based memory management, Page table, Memory protection, Supervisor/User mode, Translation look-aside buffer (TLB), Multi level page table, Large page, Virtually indexed-physically tagged cache, TLB for multi-processing, Virtual storage, Virtual machine. [4H]

Architectures for Higher Performance: Superscalar execution, Out-of-Order execution, Anti-dependency hazard, Register renaming, Reorder buffer, Pipelined non-blocking cache, Load store unit, Memory dis-ambiguation, Commit mechanism, Control hazard reduction, Branch prediction, Single level 2bit predictor, Tow level predictor, Branch target buffer, Return stack. [6H]

Multi-processor System: Shared Memory system, Cache coherency, MSI protocol, snoop invalidate, snoop writeback, MESI, MOSI, MOESI, MESIF protocol, False sharing; Multiprocessor memory access, Mutual exclusion, Atomic memory access; Shared memory system, Distributed memory system; Static and dynamic networks, Static network topologies, Bisection band width, network diameter, dynamic network topology, Fat tree; Shared memory multiprocessor OS, Shared memory system programming, fork exec, pthread, OpenMP, Multiprocessing with distributed memory system, Programming with MPI Library. **[7 H]**

Basic ARM Architecture: Memory and addressing, Registers, Program counter, Condition codes, The instruction set, Group1: data manipulation (arithmetic operation and logical operation), Group2: load and store, Group3: multiple load and store, Group4: branch, Group5: software interrupt. [6H]

ARMv7-Architecture:32-bit-addressing,Application Program Status Register(APSR),SIMD, Thumb.[3H]

ARMv8-A Architecture: 64-bit addressing and 64-bit architecture, Virtual addressing, Registers, Instruction format, Advanced SIMD. **[3 H]**

Text/Reference books:

1. David A. Patterson, John L. Hennessy, "Computer Organization and Design, Fifth Edition: The Hardware/Software Interface (The Morgan Kaufmann Series in Computer Architecture and Design)
2. Kai Hwang, Advanced Computer Architecture: Parallelism, Scalability, Prgrammability, McGraw-Hill Inc.,US, 1993.
3. Betty Prince, High Performance Memories: New Architecture DRAMs and SRAMs — Evolution and Function, 1st Edition, Wiley, 1996.
4. ARM® Architecture Reference Manual ARMv7-A and ARMv7-R edition.
5. ARM® Architecture Reference Manual ARMv8, for ARMv8-A architecture profile Errata markup.

Subject Code:	CS417b	**Course Title**	Cloud Computing
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	VII
Pre-requisites	NIL		
Evaluation scheme	Project/Quiz I (30%), Mid term (30%), End term (40%)		

Overview of Distributed Computing: Trends of computing, Introduction to distributed computing, Next big thing: cloud computing [4H]

Introduction to Cloud Computing: What's cloud computing, Properties & Characteristics, Service models, Deployment models, Public cloud, private cloud and hybrid clouds [8H]

Cloud Computing Models including Infrastructure/Platform/Software – as-a-service: Resource Virtualization, Cloud platform & Management, Web services [15H]

Cloud issues and challenges: Cloud OS, Cloud Architectures including Federated Clouds, Scalability, Performance, QoS , Security and Privacy issues in the Cloud [15H]

Text/Reference books:

1. Kai Hwang Geoffrey C. Fox Jack J. Dongarra, Distributed and Cloud Computing, 1st edition, Morgan Kaufmann, 2011.
2. Ray J Rafaels, Cloud Computing: From Beginning to End, Create Space Independent Publishing Platform, 2015
3. Thomas Erl, Ricardo Puttini, Zaigham Mahmood, Cloud Computing: Concepts, Technology & Architecture, Prentice Hall, 2013

Subject Code:	CS417c	**Course Title**	Object Oriented Analysis and Design
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	VII
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Mid-term (20%), Quiz II (10%), End term (40%), Project (20%)		

Introduction to Object-Orientation, Objects and Classes, Attributes, Methods, Object Relationships like Association, Aggregation and Composition, Inheritance, Polymorphism and Dynamic Binding
Interfaces, Programming constructs for various OO concepts, Components of UML class diagrams, and Sequence diagrams **[12 H]**
Requirement analysis, SRS, Use case modeling, Identification of domain objects and interactions modeling, domain modeling, UML Component diagram/package diagram, Subsystem design, goals, Architectural patterns, Component of UML Activity diagrams, and Statechart, Object design (solution domain) **[12 H]**
Methodologies for object-oriented analysis and design (OOAD), Design patterns, Common design patterns. Creational, Structural and Behavioral patterns **[12 H]**
Refactoring, Code smells, Reverse Engineering Design from Code, Design Evaluations **[6 H]**

Text/Reference books:

1. Bernd Bruegge, Allen Dutoit: "Object-Oriented Software Engineering: Using UML, Patterns, and Java", Addison Wesley.
2. Blaha and Rumbaugh "Object-oriented modeling & Design with UML, 2nd Ed, PHI

Subject Code:	EC418a	**Course Title**	Time Frequency Analysis
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	VII
Pre-requisites	NIL		
Evaluation scheme	Quiz I (12.5%), Mid-Term (25%), Quiz II (12.5%), End-Term (50%)		

Theory: Basics of Fourier Analysis, Spectral Theory, Fundamentals of Time Frequency Analysis, Instantaneous Frequency and the Complex Signal, Uncertainty Principle, The Need for Time-Frequency Analysis, Gabor Transform, The Short-Time Fourier Transform/Spectrogram, Time-Frequency Localization, Continuous Wavelet Transform/Scalogram, Multiresolution Analysis, Quadratic Time Frequency Transform, Wigner-Ville Distribution, Signal Processing Applications. [20H]

Basic of MATLAB, Implementation of discrete signal, DSP mathematical problem solving by using MATLAB, Frequency domain analysis, Time frequency algorithm implementation, basic filter designing. [22H]

Text/Reference books:

1. "*A Wavelet Tour of Signal Processing* (3rd edition), S. Mallat, Academic Press, 2008, ISBN: 978-0123743701.
2. "*Time-Frequency Analysis, Prentice Hall*"; Leon Cohen, 1994, ISBN: 978-0135945322.
3. , "*Time-Frequency Signal Analysis and Processing: A Comprehensive Reference",*B. Boashash Elsevier Science, 2003, ISBN-13: 978-0080443355.
4. *"Wavelet Transforms: Introduction to Theory& Applications",* R. M. Rao and A. S. Bopardikar, Prentice Hall, 1998, ISBN-13: 978-020163463.
5. "*IEEE International Symposium on Time-Frequency and Time-Scale Analysis*", IEEE Press, NY, 1992. (Publ. TH4788 or ISBN 0-7803-0805-0)

Subject Code:	EC418b	**Course Title**	Radio Frequency Integrated Circuits Design
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	VII
Pre-requisites	NIL		
Evaluation scheme	Quiz I (15%), Mid-Term (30%), Quiz II (15%), End-Term (40%)		

Basic concepts and definitions: Definition of RF and FCC Regulations Wireless Standards, Transceiver Architectures, Noise, Linearity, Dynamic Range, matching networks/impedance transformers. **[8 H]**

Passive components/Devices: Inductors, Capacitors, Resistors, Transmission lines, Transformers, Variable and Constant capacitors **[5 H]**

Amplifiers: Low noise amplifiers (LNAs): LNA topologies, LNA Design, Noise Sources, Nonlinearity, Gain and Band switching; Power amplifiers (Pas): General Classification and parameters, Cascode ouput stages, large signal analysis and impedance matching **[10 H]**

Mixers: Performance parameters, Passive and Active mixers, Downconvesrion and Upconversion mixers, Mixers Topologies **[5 H]**

Oscillators and Frequency synthesizers: Basic principle and performance parameters, tank and other topologies based oscillators, Voltage-Controlled Oscillators (VCOs), Frequency multipliers, Integer-and fractional-N synthesizers **[12 H]**

Text/Reference books:

1. RFMicroelectronics, Behzad Razavi, 2nd Ed, Pearson
2. Ulrich L. Rohde, Matthias Rudolph, RF / Microwave Circuit Design for Wireless Applications, 2nd Edition, 2012.

Subject Code:	EC418c	**Course Title**	Physics of Semiconductor Devices
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	VII
Pre-requisites	NIL		
Evaluation scheme	Quiz I (15%), Mid-Term (30%), Quiz II (15%), End-Term (40%)		

Introduction to Quantum Mechanics Principle of Quantum Mechanics, Schrodinger's wave equation, Application of Schrodinger's wave equation, extension of wave theory to atoms. Introduction to the Quantum Theory of Solids. **[5 H]**

Electrical conductions in solids, Drift current, Density of states function, Statistical mechanics. The Semiconductor in Equilibrium, Charge carriers in semiconductor, Dopant atoms and energy levels, Extrinsic semiconductor, Statistics of donors and acceptors, charge neutrality, position of Fermi level. [5H]

Carrier Transport Phenomena, Carrier drift, carrier diffusion, Hall effect, graded impurity distribution. Non equilibrium excess carriers, Carrier generation and recombination, Characteristics of excess carriers, Ambipolar transport, Quasi-Fermi energy level. **[10 H]**

The p-n Junction: Basic structures of the PN junction, Zero bias condition, forward bias, reverse bias condition. The p-n Junction Diode current components I/V Characteristics, small signal model of p-n junction, generation- recombination current, junction breakdown, charge storage and diode transient.[10H]

The metal-semiconductor and semiconductor hetero-junctions, Schottky Barrier diode, Ohmic and rectifying contacts, Hetreo junction materials, energy band diagram, two dimension electron gas, equilibrium electrostatics and I/V characteristics. Junction field effect transistor, basic concept, device characteristics MESFET, Non ideal effects, high electron mobility transistor quantum well structures.[6H]

Fundamentals of the Metal-Oxide-Semiconductor Field-Effect Transistor: Two terminal MOS structure, basic MOSFET operation, non ideal effects, MOSFET scaling, threshold voltage modification, radiation and hot electron effects. **[6 H]**

Text/Reference books:

1. S.M. Sze Physics of Semiconductor Devices Wiley-Interscience
2. 'Semiconductor physics and devices' 5th edition Neaman Donald A. Mc Graw Hill
3. Physics of Semiconductor Devices Michael Shur, (Prentice Hall, 1990)
4. Physics of Semiconductor Devices, Massimo Rudan Springer Publication

Subject Code:	ME418a	**Course Title**	Advance Solid Mechanics
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	VII
Pre-requisites	NIL		
Evaluation scheme	Quizzes (20%), Mid Term (20%), End term (40%), Course Project (20%)		

Analysis of Stresses and Strains in rectangular and polar coordinates: Cauchy's formula, Principal stresses and principal strains, 3D Mohr's Circle, Octahedral Stresses, Hydrostatic and deviatoric stress, Differential equations of equilibrium, Plane stress and plane strain, compatibility conditions. Introduction to curvilinear coordinates. **[10 H]**

Generalized Hooke's law and theories of failure. Energy Methods. **[5 H]**

Bending of symmetric and unsymmetric straight beams, effect of shear stresses, Curved beams, Shear center and shear flow, shear stresses in thin walled sections, thick curved bars. **[8 H]**

Torsion of prismatic solid sections, thin walled sections, circular, rectangular and elliptical bars, membrane analogy. **[5 H]**

Thick and thin walled cylinders, Composite tubes, Rotating disks and cylinders. **[5 H]**

Euler's buckling load, Beam Column equations. **[4 H]**

Strain measurement techniques using strain gages, characteristics, instrumentations, principles of photo-elasticity. **[4 H]**

Text/Reference books:

[1] L. S. Srinath, Advanced Mechanics of Solids, 2nd Edition, TMH Publishing Co. Ltd., New Delhi, 2003.

[2] R. G. Budynas, Advanced Strength and Applied Stress Analysis, 2nd Edition, McGraw Hill Publishing Co, 1999.

[3] A. P. Boresi, R. J. Schmidt, Advanced Mechanics of Materials, 5th Edition, John Willey and Sons Inc, 1993.

Subject Code:	ME418b	**Course Title**	Management of Production System
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	VII
Pre-requisites	NIL		
Evaluation scheme	Quizes (15%); Mid-sem (35%) and End-sem (50%)		

1. Overview and introduction of production and operations management (P/OM) **[3 H]**
2. P/OM's key role in productivity attainment **[3 H]**
3. P/OM strategies: forecasting life cycle stages **[3 H]**
4. Quality management: strategic issues **[3 H]**
5. Methods for quality control (QC) **[5 H]**
6. Facilities planning **[3 H]**
7. Capacity management **[4 H]**
8. Materials management (MM) **[3 H]**
9. Aggregate planning (AP) **[3 H]**
10. Inventory management **[3 H]**
11. Material requirements planning (MRP) **[3 H]**
12. Production scheduling **[2 H]**
13. Cycle-time management **[2 H]**
14. Project management **[2 H]**

Text/Reference books:

[1] L.N. Aggarwal and Parag Diwan, Management of Production System,

[2] Thomas E. Vollmann, William L. Bery, D. Clay Whybark, Manufacturing Planning and Control Systems Galgotia Publications (P) Ltd

[3] Production & Operations Management by Adam & Ebert

[4] Production and operations management by Martin K. Starr

Subject Code:	ME418c	**Course Title**	Design of Mechanical Systems
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	VII
Pre-requisites	NIL		
Evaluation scheme	Quizes (20%); Mid-sem (35%) and End-sem (45%)		

Design for strength, rigidity, stiffness, reliability and manufacturing:
Theory of failures – Special consideration while designing for rigidity.Effect ofhollow section on rigidity, methods for improving rigidity.Reliability considerations in design. **[6 H]**

Design for Manufacturing:
General design principles for manufacturability - strength and mechanical factors, design consideration for casting, machining and assembly. **[4 H]**

Limits, fits, and tolerances:
Types of tolerances and fits, design considerations for interference fits, Geometric tolerances - Assembly limits -Datum features - Tolerance stacks, interchangeability and selective assembly. **[4 H]**

Fatigue consideration in design:
Variable load - basic concept; load or stress variations- different patterns Cyclic stressing/straining - materials response and the origin of fatigue failure. Stress life relations; S-N curve-fatigue strength and endurance limit. Factors influencing fatigue and endurance strength modification factors, Effect of stress concentration and fatigue stress concentration definition.Effect of mean stress - Goodman and Soderberg's relations. Design approach to fatigue - design for infinite life and finite life Design of members under combined (steady and variable) loading conditions. **[10 H]**

Design of IC Engine Parts:
Piston, Piston Ring, Cylinder and cylinder lining, Connecting rod, Crankshaft. **[6 H]**

Design of Transmission Devices:
Design of speed gear box – Aims of speed regulation, stepped and stepless drive, intermediate spindle speeds, speed diagram, structural (Ray) diagram, speeds in G.P., kinematic arrangement of gears, calculation of number of teeth, deviation diagram, selection of module, check for dynamic load and wear. Shaft design. Selection of bearing and seals. Design of housing. **[12 H]**

Text/Reference books:

[1] Mehta, N. K., Machine Tool Design and Numerical Control, Tata McGraw Hill.
[2] Norton, Robert L., Machine Design: An Integrated Approach, Third Edition, Pearson Education, 2005.

Subject Code:	CS418a	**Course Title**	Complex Networks
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	VII
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Mid-term (20%), Quiz II (10%), End term (40%), Project (20%)		

Graph, Introduction to Complex Networks, Complex Network Examples, Fundamentals of Network Theory, Mathematics of Networks, Types of Graphs, Hypergraphs, weighted and directed graphs, trees, degree, paths components Centrality, Spectral analysis of Network, Bipartite Networks [10 H]

ER Model, Generalized Random Graphs, Diameter and Clustering Coefficient, Degree Distribution, Milgram Small World Experiment, Small World Network properties, Watts and Strogatz Model, An algorithmic perspective of small world phenomenon, Configuration model [10 H]

Power Laws, Preferential Attachment and Rich get Richer process, Barabasi Albert Model [10 H]

Generating functions, Component sizes, Phase Transition, Giant Component, Number of Neighbors and average path length.[7]

Random Failure and Targeted attack [5]

Text/Reference books:

1. Mark Newman, *Networks: An Introduction*, Oxford University Press, Oxford, 2010.
2. David Easley and Jon Kleinberg *Networks, Crowds, and Markets: Reasoning About a Highly Connected World*, Cambridge University Press, 2010.

Subject Code:	CS418b	**Course Title**	Data Mining and Data Warehousing
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	VII
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Mid term (30%), Quiz II (10%), End term (50%)		

Introduction to Data Mining: What is data mining? , Related technologies - Machine Learning, DBMS, OLAP, Statistics, Data Mining Goals, Stages of the Data Mining Process, Data Mining Techniques, Knowledge Representation Methods. **[2 H]**

Data Warehouse and OLAP: Data Warehouse and DBMS, Multidimensional data model, OLAP operations. **[6 H]**

Data preprocessing: Data cleaning, Data transformation, Data reduction, Discretization and generating concept hierarchies, Experiments with Weka 3 Data Mining System-filters, discretization. **[4 H]**

Data mining knowledge representation: Task relevant data, Background knowledge, Interestingness measures, Representing input data and output knowledge, Visualization techniques. **[3 H]**

Attribute-oriented analysis: Attribute generalization, Attribute relevance, Class comparison, Statistical measures. **[3 H]**

Association rules Mining: Motivation and terminology, Example: mining weather data, Basic idea: item sets, Generating item sets and rules efficiently, Correlation analysis. **[5 H]**

Classification Algorithms: Basic learning/mining tasks, Inferring rudimentary rules: 1R algorithm, Decision trees, Covering rules. **[4 H]**

Prediction mining algorithms: The prediction task, Statistical (Bayesian) classification, Bayesian networks, Instance-based methods (nearest neighbor), Linear models. **[4 H]**

Evaluating what's been learned: Basic issues, Training and testing, Estimating classifier accuracy (holdout, cross-validation, leave-one-out), Combining multiple models (bagging, boosting, stacking), Minimum Description Length Principle (MLD). **[2 H]**

Clustering Algorithms: Basic issues in clustering, First conceptual clustering system: Cluster/2
Partitioning methods: k-means, expectation maximization (EM), Hierarchical methods: distance-based agglomerative and divisible clustering, Conceptual clustering: Cobweb**.** **[5 H]**

Text mining: extracting attributes (keywords), structural approaches (parsing, soft parsing), Bayesian approach to classifying text**.** **[2 H]**

Web mining: classifying web pages, extracting knowledge from the web Data Mining software and applications**.** **[2 H]**

Text/Reference books:

1. Ian H. Witten and Eibe Frank, Data Mining: Practical Machine Learning Tools and Techniques, Second Edition, Morgan Kaufmann, 2005, ISBN: 0-12-088407-0.
2. Jiawei Han, Micheline Kamber and Jian Pei, Data Mining: Concepts and Techniques, 3rd ed., Morgan Kaufmann Publishers, July 2011. ISBN 978-0123814791.
3. Margaret H Dunham, Data Mining: Introductory And Advanced Topics, Pearson Education India, 01-Sep-2006.
4. Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Introduction to Data Mining, Pearson; US ed edition, May 2005.
5. Mehmed Kantardzic, Data Mining: Concepts, Models, Methods, and Algorithms, 2nd Edition, Wiley-Blackwell, 2011.

Subject Code:	CS418c	**Course Title**	Advanced Algorithms
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	VII
Pre-requisites	NIL		
Evaluation scheme	Project/Quiz I (30%), Mid term (30%), End term (40%)		

Performance of algorithms: space and time complexity; **[2H]**

Data Structures: Priority Queues: lists, heaps, binomial heaps, Fibonacci heaps; Search Trees: binary search trees, red-black trees, AVL trees, splay trees, B/B+-trees; **[10H]**

Design Paradigms: greedy method, divide-and-conquer, dynamic programming **[10H]**

Graph Algorithms: Shortest path, Spanning trees, Network flow; **[5H]**

Computational intractability and Approximation algorithms **[10H]**

A selection of advanced topics: Parallel algorithm, External Memory algorithm **[5H]**

Text/Reference books:

1. T. H. Cormen, C E Leiserson, R L Rivest and C Stein, Introduction to Algorithms, MIT Press, 2001.
2. J .Kleinberg and E. Tardos, Algorithm Design, Addison Wesley, 2005.
3. A. Aho, J. E. Hopcroft and J. D. Ullman, The Design and Analysis of Computer Algorithms, Addison-Wesley, 1974.
4. S Sahni, Data Structures, Algorithms and Applications in C++, McGraw-Hill, 2001.
5. M. T. Goodrich and R. Tamassia, Algorithm Design: Foundations, Analysis and Internet Examples, John Wiley & Sons, 2001.

Subject Code:	CS318d	**Course Title**	Mesh Free Computations
Contact Hours	L-3, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	VII
Pre-requisites	NIL		
Evaluation scheme	Quiz I (15%), Mid term (30%), Quiz II (15%), End term (40%)		

Overview: Why Mesh Free, Definition of Mesh Free, Solution Procedure for Mesh Free methods Categories of Mesh Free methods **[07 H]**

Mesh Free Shape Function Construction **[07 H]**

Mesh Free methods based on global weak forms **[07 H]**

Mesh Free methods based on local weak forms **[07 H]**

Mesh Free Collocation Methods **[10 H]**

Mesh Free methods based on local weak forms and Collocation **[04 H]**

Text/Reference books:

1. G R Lui, Y T Gu "An Introduction to mesh free methods and their programming", Springer, 2005
2. W Chen, Z J Fu, C S Chen, "Recent advances in radial basis function collocation methods", Springer, 2014

Subject Code:	PR499	**Course Title: Project**	
Contact Hours	L-0, T-0, P-0	**Credit**	4
Programme	B.Tech	**Semester**	VII
Pre-requisites	NIL		
Evaluation scheme	End-Term (100%)		

Semester VIII

Subject Code:	ES407a	**Course Title**	Fundamentals of RF & Microwave Electronics
Contact Hours	L- 3 T- 0 P- 0	**Credit**	4
Programme	B.Tech	**Semester**	VIII
Pre-requisites	NIL		
Evaluation scheme	Quiz I (15%), Mid-Term (30%), Quiz II (15%), End-Term (40%)		

Mathematical foundation in understanding of signals, circuits and devices:basic properties of Fourier Transforms, transmission line theory, T and π equivalent circuit, behaviour of transmission line at radio & microwave frequency. **[10 H]**

DC and Low Frequency Circuit Concepts: BJT Biasing, mode of operation small signal AC analysis. FET circuits at DC, AC analysis, first and second order AC models of FETs, high frequency models of BJT and FETs, single pole approximation, differential amplifiers, and frequency response. **[10 H]**

Circuit Representation of Two Port RF/ Microwave Networks: Impedance, Admittance, Hybrid, Transmission Matrix, Generalized S parameters, Reciprocal Networks, Loss less Networks, Signal Flow graphs and its Applications. **[10 H]**

Impedance Matching and network selection:power gain concept, mismatch factor, return loss, input/output VSWR, maximum gain, constant gain design, figure of merit, matching network design using lumped and distributed elements, stability consideration in active networks. **[10 H]**

Text/Reference books:

1. T.C. Edwards,Foundations for Microstrip Circuit Design 1st Edition, Wiley Interscience.
2. Ulrich L. Rohde, Matthias Rudolph,RF / Microwave Circuit Design for Wireless Applications, 2nd Edition, 2012.

Subject Code:	ES407b	**Course Title**	Internet of Things
Contact Hours	L- 3 T- 0 P- 0	**Credit**	4
Programme	B.Tech	**Semester**	VIII
Pre-requisites	NIL		
Evaluation scheme	Quiz I (15%), Mid-Term (30%), Quiz II (15%), End-Term (40%)		

IoT definitions: overview, applications, potential & challenges, and architecture. **[6 H]**

Internet in general and Internet of Things, Internet of Everything, Web of Things, and Making Things Smart. **[5 H]**

IoT communication protocols, packets, services, performance parameters of a packet network as well as applications such as web, Peer-to-peer, sensor networks, and multimedia. **[6 H]**

Business Issues, Aspects and Models of the Internet of Things. Making and Getting Things onto the Internet. **[5 H]**

Local Area Networks, MAC level, link protocols such as: point-to-point protocols, Ethernet, WiFi 802.11, cellular internet access, and Machine-to-machine. **[6 H]**

Mobile Networking: roaming and handoffs, mobile IP, and ad hoc and infrastructure less networks. **[6 H]**

IoT examples: Case studies, e.g. sensor body-area-network and control of a smart home. **[6 H]**

Text/Reference books:

Kurose, James F.; Ross, Keith W. **Computer networking: a top-down approach,** 5th ed., international ed.: Boston, Mass.: Pearson, cop. 2010

Subject Code:	ES407c	**Course Title**	Applied Photonics
Contact Hours	L- 3 T- 0 P- 0	**Credit**	4
Programme	B.Tech	**Semester**	VIII
Pre-requisites	NIL		
Evaluation scheme	Quiz I (15%), Mid-Term (30%), Quiz II (15%), End-Term (40%)		

Introduction: Review of basic optics, wave propagation, polarization, diffraction, Gaussian Beams, Electrooptic effect, electro-optic modulators and their design considerations, Acousto-optic effect, Raman Scattering and Bragg diffraction, acousto-optic modulators and deflectors. [10H]

Fibres: Principles of optical communication systems, optical sources and detectors, Optical fibres: mode of an optical fibre, multimode fibres, single mode fibres and their propagation characteristics, Dispersion management in optical fibres and link design considerations.[10H]

Integrated optics: Planar and channel waveguides, coupled and dielectric waveguides, dielectric backed waveguides, directional couplers, optical switch, electro-optic and acousto-optic waveguide devices. Display devices, holography and optical information processing. [10H]

Photonics: Introduction to Photonic crystals, Lithium Niobate Crystal, its lattice structure, polarization and anisotropy in the crystal, Photonic Band Gap effect, guided wave structure and components on Photonic Crystals, diffraction limit and constraints on physical dimensions. [10H]

Text/Reference books:

1. Photonic Crystals: Molding the Flow of Light, John D. Joannopoulos, Princeton University Press.
2. Optical Fibre Communications, Gerd Keiser, TMH, 2008.
3. IEEE Journal of Lightwave Technology, IEEE Photonics Journal.

Subject Code:	ES407d	**Course Title**	Operations Research
Contact Hours	L- 3 T- 0 P- 0	**Credit**	4
Programme	B.Tech	**Semester**	VIII
Pre-requisites	NIL		
Evaluation scheme	Quiz (15%), Mid-sem (35%) and End-sem (50%)		

Modeling with Linear Programming - Two-Variable LP Model, Graphical LP Solution, Solution of a Maximization Model, Solution of a Minimization Model, Selected LP Applications; **[6 H]**

The Simplex Method and Sensitivity Analysis - LP Model in Equation Form, Transition from Graphical to Algebraic Solution, The Simplex Method, Artificial Starting Solution, Special Cases in the Simplex Method, Sensitivity Analysis - Graphical and Algebraic Sensitivity Analysis; **[6 H]**

Duality and Post-Optimal Analysis - Definition of the Dual Problem, Primal-Dual Relationships, Economic Interpretation of Duality, Post-Optimal Analysis; **[6 H]**

Transportation Model and Its Variants - Definition of the Transportation Model, The Transportation Algorithm, The Assignment Model; **[6 H]**

Network Models - Minimal Spanning Tree Algorithm, Shortest-Route Problem, LP Formulation of the Shortest-Route Problem, Maximal flow model, LP Formulation of Maximal Flow Model, Critical Path (CPM) Computations, Construction of the Time Schedule, LP Formulation of CPM;. **[7 H]**

Integer Linear Programming - Integer Programming Algorithms, Branch-and-Bound (B&B) Algorithm, Cutting-Plane Algorithm, Traveling Salesperson Problem (TSP), Heuristic Algorithms, B&B Solution Algorithm, Cutting-Plane Algorithm; **[7 H]**

Deterministic Dynamic Programming - Recursive Nature of Computations in DP, Forward and Backward Recursion, Selected DP Applications. **[8 H]**

Text/Reference books:

1. Hamdy A. Taha Operations Research: An Introduction, Pearson.
2. Frederick S. Hiller, Gerald J. Lieberman, Introduction to Operations Research, McGraw Hill.
3. Ravindran, Phillips and Solberg, Operations Research: Principles and Practice, Wiley India.
4. Hillier and Liberman, Introduction to Operations Research: Concepts and Cases, McGraw-Hill.

Subject Code:	ES407e	**Course Title**	Internet of Things (IoT)
Contact Hours	L- 3 T- 0 P- 0	**Credit**	4
Programme	B.Tech	**Semester**	VIII
Pre-requisites	NIL		
Evaluation scheme	Quiz I (15%), Mid-Term (30%), Quiz II (15%), End-Term (40%)		

IoT definitions: overview, applications, potential & challenges, and architecture. **[6 H]**
Internet in general and Internet of Things, Internet of Everything, Web of Things, and Making Things Smart. **[5 H]**
IoT communication protocols, packets, services, performance parameters of a packet network as well as applications such as web, Peer-to-peer, sensor networks, and multimedia. **[6 H]**
Business Issues, Aspects and Models of the Internet of Things. Making and Getting Things onto the Internet. **[5 H]**
Local Area Networks, MAC level, link protocols such as: point-to-point protocols, Ethernet, WiFi 802.11, cellular internet access, and Machine-to-machine. **[6 H]**
Mobile Networking: roaming and handoffs, mobile IP, and ad hoc and infrastructure less networks. **[6 H]**
IoT examples: Case studies, e.g. sensor body-area-network and control of a smart home. **[6 H]**

Text/Reference books:

Kurose, James F.; Ross, Keith W. **Computer networking: a top-down approach,** 5th ed., international ed.: Boston, Mass.: Pearson, cop. 2010

Subject Code:	ES407f	**Course Title**	Social network Analysis
Contact Hours	L- 3 T- 0 P- 0	**Credit**	4
Programme	B.Tech	**Semester**	VIII
Pre-requisites	NIL		
Evaluation scheme			

Modeling with Linear Programming - Two-Variable LP Model, Graphical LP Solution, Solution of a Maximization Model, Solution of a Minimization Model, Selected LP Applications; **[06 hr]**
The Simplex Method and Sensitivity Analysis - LP Model in Equation Form, Transition from Graphical to Algebraic Solution, The Simplex Method, Artificial Starting Solution, Special Cases in the Simplex Method, Sensitivity Analysis - Graphical and Algebraic Sensitivity Analysis; **[06 hr]**
Duality and Post-Optimal Analysis - Definition of the Dual Problem, Primal-Dual Relationships, Economic Interpretation of Duality, Post-Optimal Analysis; **[06 hr]**
Transportation Model and Its Variants - Definition of the Transportation Model, The Transportation Algorithm, The Assignment Model; **[06 hr]**
Network Models - Minimal Spanning Tree Algorithm, Shortest-Route Problem, LP Formulation of the Shortest-Route Problem, Maximal flow model, LP Formulation of Maximal Flow Model, Critical Path (CPM) Computations, Construction of the Time Schedule, LP Formulation of CPM; **[07 hr]**
Integer Linear Programming - Integer Programming Algorithms, Branch-and-Bound (B&B) Algorithm, Cutting-Plane Algorithm, Traveling Salesperson Problem (TSP), Heuristic Algorithms, B&B Solution Algorithm, Cutting-Plane Algorithm; **[07 hr]**
Deterministic Dynamic Programming - Recursive Nature of Computations in DP, Forward and Backward Recursion, Selected DP Applications. **[08 hr]**

Text/Reference books:

1. Hamdy A. Taha Operations Research: An Introduction, Pearson.
2. Frederick S. Hiller, Gerald J. Lieberman, Introduction to Operations Research, McGraw Hill.
3. Ravindran, Phillips and Solberg, Operations Research: Principles and Practice, Wiley India.
4. Hillier and Liberman, Introduction to Operations Research: Concepts and Cases, McGraw-Hill.

Subject Code:	HS405a	**Course Title**	Culture and Technology
Contact Hours	L- 3 T- 0 P- 0 GD-1	**Credit**	4
Programme	B.Tech	**Semester**	VIII
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Mid-Term (30%), Quiz II (10%), End-Term (50%)		

Culture, Technology and Innovation – **[8L]**

Culture a Technique- Remaking of the human Being, Technological advancement Vs. Culture, Four Cradles and Fertile Crescent, Science and Technology- an instrument of culture- invention of wheel and fire, Philosophy -an advancement in thought and Intuitions, Art and architecture, Inventions and discoveries- from hunting and food gathering to Mass scale manufacturing.

Age of Enlightenment **[5L]**

Advancement in Science and Technology- Pros and cons,Accomplishment of Science and Technology and status of Human society.

Age of Revolution **[5L]**

Industrialization and mutual dependency,Urbanization and Nuclear families, Growth of Classes

Age of Internationalization **[8L]**

Growth of Liberalism,Growth of Nationalism and migration of Technology from source to, destinations miles apart,Nations at competition- Arms Race, Imperialism- Need identification and weathering of Culture

Age of World Civilization- **[10L]**

Limitations of Science and Technology,Limitations of Art and Civilization,Outbreak of hostilities- Two World Wars- contribution of Technology and loosening of cultural moorings.

Search for Stabilization- **[6L]**

Globalization and Proliferation of Science and Technology, Stereotype population and world- wide technology, Modernization, Commitment and Consciousness, New Power Relationship- Need for Culture driven Technology.

Text/Reference books:

1. World Civilizations: Their History and Their Culture VOL. A,B,C.
2. A Cultural History of India- A.L.Basham
3. The Heroes of History- Will Durant
4. Technopoly: The Surrender of Culture to Technology by Neil Postman
5. Culture and Technology Paperback – January 15, 2003by Andrew Murphie (Author), John Potts
6. Culture and Technology: A Primer by Jennifer Daryl Slack (Author),
7. The Cultural Studies Reader Paperback – Import, 9 Mar 2007by Simon During (Editor)

Subject Code:	EC419a	**Course Title**	RF and Microwave Engineering
Contact Hours	L- 3 T- 0 P- 0	**Credit**	4
Programme	B.Tech	**Semester**	VIII
Pre-requisites	NIL		
Evaluation scheme	Quiz I (15%), Mid-Term (30%), Quiz II (15%), End-Term (40%)		

Waveguides and Resonators: Review of EM Theory: Wave propagation through waveguides - rectangular, circular, elliptical-cutoff frequency, modes, group and phase velocities. Power Transmission and losses in Waveguides. Excitation of various modes in Waveguides, Microwave cavities – Rectangular and Circular Cavity Resonators. Semi-circular Cavity Resonators, Q factor of a Cavity Resonators. **[12 H]**

Microwave Components: Microwave Hybrid Circuits –Waveguide Tees and Scattering Matrices. Magic Tee and Hybrid Rings (Rat-race circuits) and their Scattering matrices. Waveguide Corners, Bends and Twists, irises, windows, Directional couplers. Two-hole Directional Couplers, S-matrix of a Directional Coupler. Circulators and Isolators. **[12 H]**

Microwave Devices and Measurements: Microwave Transistor; Tunnel Diode; Varacter Diode; Schottky Diode; Gunn diode, IMPATT diodes. Klystron, Magnetron, Traveling Wave

Tubes.Measurement of power, frequency and wavelength, Measurement of impedance, SWR, attenuation, Q of cavity and noise factor. **[10 H]**

Microwave Integrated circuits: MMIC, strip and microstrip lines, slot and coplanar lines, planar circuits, Passive elements, components and devices, Analytical methods associated with MIC theory, MMIC Fabrication Techniques, Printed Antennas, Future trend in MICs. **[6 H]**

1. *EM Wave and Radiating System by Jordan and Balmain*
2. *Foundations for Microwave Engineering by Robert E Collin*
3. *Microwave Devices and Circuits by Samuel Y Liao*
4. *Practical MMIC Design by Steve Marsh*

Subject Code:	EC419b	**Course Title**	Power Electronics
Contact Hours	L- 3 T- 0 P- 0	**Credit**	4
Programme	B.Tech	**Semester**	VIII
Pre-requisites	NIL		
Evaluation scheme	**Quiz I & II (15%), Midterm (25%), Assignments/Class Performance (10%), End term (50%) (Tentative, decided at the beginning of the semester in consultation with the students)**		

Introductions: Power semi semiconductor devices, Types of power electronic circuits and design of P Power electronics equipment, Applications of Power electronics. **[7 H]**

Semiconductor Diodes and Circuits: Diode Characteristics, Power Diode Types, Series and Parallel connected diodes, Diodes with different types of loads(R, RC, RL, LC, RLC Loads), Freewheeling diodes. **[7 H]**

Diode Rectifiers: Single phase half wave rectifier, Single phase full wave rectifier, Single phase full wave rectifier with RL Load, Three phase Bridge rectifier, Three phase Bridge rectifier with RL Load DC-DC Converters: Principles of stepdown chopper and operation, Principle of stepup chopper and operation, classification of choppers. **[7 H]**

Thyristors: Thyristor Characteristics, Thyristor Turn on and Turn off, Two-transistor model of Thyristor, Thyristor types, Series and Parallel operation of Thyristor Controlled Rectifiers: Principle of phase controlled converter operation, Single phase full-converters, Single phase semi-converter, Principle of three phase half wave Converters, Three phase full converters, Three phase Semi-converter. **[7 H]**

Inverters: Single phase series resonant inverter, Single phase bridge inverters, Three phase bridge inverters, Voltage control of inverters. **[5 H]**

AC Voltage Controllers: Principle of On-Off and phase controls, Single phase ac voltage controller with resistive load, Single phase ac voltage controller with inductive load, Three phase ac voltage controllers , Single phase Cyclo Converters, Three phase Cyclo Converters Some Applications. **[9 H]**

Text/Reference books:

1. M.H. Rashid, “Power Electronics: Circuits, Devices & Applications”; Prentice Hall (I) Pvt Ltd.
2. Singh M.D., Khanchandani K.B. "Power Electronics", 2nd Edition, Tata McGraw-Hill, 2007.
3. Sen P.C., “Power Electronics”, Tata McGraw-Hill, 2008.
4. Mohan, Undeland, Robbins, “Power Electronics”, 3rd edition, John Wiley & Sons, 2002.
5. Bose B.K., “Modern Power Electronics & AC Drives”, 1st edition, PHI, 2002.

Subject Code:	EC419b	**Course Title**	Advance Filter Design
Contact Hours	L- 3 T- 0 P- 0	**Credit**	4
Programme	B.Tech	**Semester**	VIII
Pre-requisites	NIL		
Evaluation scheme	Quiz I (15%), Mid-Term (30%), Quiz II (15%), End-Term (40%)		

Module I: Introduction of DSP **[8 H]**

Discrete-time signals, sequence operations, sampling, Digital Signal Processing and its applications, filter and its applications, Discrete Fourier and Z-transforms, system function for linear shift-invariant systems, Fast Fourier Transform (FFT), fast convolution by FFT using the overlap-save or overlap-add methods, FFT algorithms in linear filtering and correlation.

Module II: Introduction of Digital Filter **[10 H]**

Design of Infinite Impulse Response (IIR) digital filters by transformation from analog filters: Impulse Invariance, Bilinear Transformation, Matched Z-transforms, Design of LP, HP, BP, SP IIR Filters.

Design of Finite Impulse Response (FIR) digital filters by Windowing, Frequency Sampling, Design of optimum equi-ripple linear phase FIR filters, Design of LP, HP, BP, SP IIR Filters.

Module III: Advance methods of Filter Design **[10 H]**

Optimization Methods for IIR and FIR filter Design: Deczky's method for IIR filter design in the frequency domain, Pade approximation method, Least- squares design method in time domain, Implementation aspects: Quantization of parameters, Finite word-length, and Filter Structures.

Module IV: Computer Aproaches of Filter Design **[10 H]**

Computer Aided Design of FIR and IIR digital filters, Design of Digital filters by Criterion Minimization, Computer Added Design of equireple FIR Filters, Digital IIR and FIR Filter Design Using MATLAB.

Module V: Application of Digital Filters **[4 H]**

Application of Digital Filters in Signal and Image processing, Biomedical signal processing, Speech Processing etc.

Text/Reference books:

1. S. K. Mitra, Digital Signal Processing: A Computer Based Approach. Tata McGraw Hill. McGraw Hill, 2006.
2. John G.Proakis, Dimitris G.Manobakis, Digital Signal Processing, Principles, Algorithms and Applications, Third edition, (2000) PHI
3. Digital Signal Processing Emmanuel C Ifeachor, Barrie W Jrevis, Pearson Education.

Subject Code:	ME419a	**Course Title**	Computer Integrated Manufacturing
Contact Hours	L- 3 T- 0 P- 0	**Credit**	4
Programme	B.Tech	**Semester**	VIII
Pre-requisites	NIL		
Evaluation scheme	Quiz (15%), Mid-sem (35%) and End-sem (50%)		

Introduction: Production Systems; Automation in Production Systems; Manual Labor in Production Systems; Automation Principles and Strategies **[3 H]**

Manufacturing Operations: Manufacturing Industries and Products; Manufacturing Operations; Production Facilities; Product/Production Relationships; Lean Production **[3 H]**

Manufacturing Models and Metrics: Mathematical Models of Production Performance; Manufacturing Costs **[3 H]**

Material Transport Systems: Introduction to Material Handling Equipment; Material Transport Equipment; Analysis of Material Transport Systems **[3 H]**

Storage Systems: Storage System Performance and Location Strategies; Conventional Storage Methods and Equipment; Automated Storage Systems; Engineering Analysis of Storage Systems. **[3 H]**

Introduction to Manufacturing Systems: Components of a Manufacturing System; Classification of Manufacturing Systems; Overview of the Classification Scheme **[3 H]**

Single-Station Manufacturing Cells: Single Station Manned Workstations; Single Station

Automated Cells; Applications of Single Station Cells; Analysis of Single Station Cells **[3 H]**
Manual Assembly Lines: Fundamentals of Manual Assembly Lines; Analysis of Single Model Assembly Lines; Line Balancing Algorithms; Mixed Model Assembly Lines; **[3 H]**
Workstation Considerations; Other Considerations in Assembly Line Design; Alternative Assembly Systems **[3 H]**
Automated Production Lines: Fundamentals of Automated Production Lines; Applications of Automated Production Lines; Analysis of Transfer Lines. **[2 H]**
Automated Assembly Systems: Fundamentals of Automated Assembly Systems; Quantitative Analysis of Assembly Systems. **[2 H]**
Cellular Manufacturing: Part Families; Parts Classification and Coding; Production Flow Analysis; Cellular Manufacturing; Applications of Group Technology; Quantitative Analysis in Cellular Manufacturing. **[3 H]**
Flexible Manufacturing Systems: What is a Flexible Manufacturing Systems; FMS Components; FMS Applications and Benefits; FMS Planning and Implementation Issues; Quantitative Analysis of Flexible Manufacturing Systems. **[3 H]**
Quality Programs for Manufacturing: Quality in Design and Manufacturing; Traditional and Modern Quality Control; Process Variability and Process Capability; Statistical Process Control; Six Sigma; The Six Sigma DMAIC Procedure; Taguchi Methods in Quality Engineering; ISO 9000.

[3 H]

Inspection Principles and Practices: Inspection Fundamentals; Sampling vs. 100% Inspection; Automated Inspection; When and Where to Inspect; Quantitative Analysis of Inspection **[2 H]**

Text/Reference books:

[1] Computer Integrated Manufacturing by by James A. Rehg (Author), Henry W. Kraebber (Author)

Subject Code:	ME419b	**Course Title**	Fracture and Fatigue
Contact Hours	L- 3 T- 0 P- 0	**Credit**	4
Programme	B.Tech	**Semester**	VIII
Pre-requisites	NIL		
Evaluation scheme	Quiz (15%), Mid-sem (35%) and End-sem (50%)		

Fracture:

History and overview of Fracture Mechanics; Structural failure and design philosophies; Ductile and brittle fracture of materials; The fracture mechanics approach to design; Griffith's theory of brittle failures; Irwin's stress intensity factors. **[8 H]**

LEFM; Stress concentration, Energy balance criteria, stress intensity factor, crack tip plastic zone, crack resistance, KIc, the critical value, Relation of G&K, KIc measurement. EPFM: Fracture beyond yield, CTOD, experimental determination of CTOD, use J integrals and measurement of JIc and JR. Fracture Toughness measurement: Standards and its application in design. **[12 H]**

Fatigue crack propagation: Fatigue crack growth theories, crack closure, Microscopic theories of fatigue crack growth; Application of theories of fracture mechanics in design and materials development. **[12 H]**

Fatigue

Introduction / Characteristics of Fatigue Fracture / Evaluation of Fatigue Resistance / Fatigue-Crack Growth Rates / Design against Failure / Cyclic Stress-Strain Behavior / Creep-Fatigue Interactions / Polymeric Fatigue / Fatigue of Composites / Summary **[10 H]**

Text/Reference books:

1. Fracture Mechanics: Fundamentals and Applications, Third Edition
2. Mechanical Behavior of Materials. Second Edition. Thomas H. Courtney
3. Mechanical Behavior of Materials: Engineering Methods for Deformation, Fracture, and Fatigue by Norman E. Dowling

Subject Code:	ME419c	**Course Title**	Refrigeration and Air Conditioning
Contact Hours	L- 3 T- 0 P- 0	**Credit**	4
Programme	B.Tech	**Semester**	VIII
Pre-requisites	NIL		
Evaluation scheme	Quiz (15%), Mid-sem (35%) and End-sem (50%)		

Introduction

Refrigeration Machine and Reversed Carnot Cycle,	**[2 H]**
Vapour Compression System	**[2 H]**
Refrigerants	**[1 H]**
Multipressure Systems	**[2 H]**
Refrigerant Compressors	**[2 H]**
Condensers	**[1 H]**
Expansion Devices	**[1 H]**
Evaporators	**[1 H]**
Complete Vapour Compression System	**[2 H]**
Gas Cycle Refrigeration	**[2 H]**
Vapour-Absorption System	**[3 H]**
Ejector-Compression System	**[3 H]**
Properties of Moist Air	**[2 H]**
Psychrometry of Air-Conditioning Processes	**[2 H]**
Design Conditions	**[2 H]**
Solar Radiation	**[2 H]**
Heat Transfer through Building Structures	**[3 H]**
Load Calculation and Applied Psychometrics	**[3 H]**
Design of Air-Conditioning Apparatus	**[3 H]**
Refrigeration and Air-Conditioning Control	**[2 H]**
Application in Food Refrigeration processing and Chapter Industrial Air Conditioning	**[2 H]**

Text/Reference books:

[1] Refrigeration and Air Conditioning (English) 3rd Edition by CP Arora.
[2] Fundamentals of Engineering Thermodynamics by Moran and Shapiro (Wiley).
[3] Thermodynamics: An Engineering Approach by Cengel and Boles (TMH)
[1] Engineering Thermodynamics by P K Nag (TMH)

Subject Code:	CS419a	**Course Title**	Computer Vision
Contact Hours	L- 3 T- 0 P- 0	**Credit**	4
Programme	B.Tech	**Semester**	VIII
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Mid term (25%), Quiz II (10%), End term (40%), Project (20%)		

Introduction: Introduction to Computer Vision, Image Formation and Representation, Transformation: Orthogonal, Euclidean, Affine, Projective, etc.[3H]

Low-level processing: Image analysis, preprocessing, Fourier Transform, Convolution and Filtering, Image Enhancement, Restoration, Histogram Processing [5H]

Feature Extraction: Edges - Canny, LOG, DOG; Line detectors (Hough Transform), Corners - Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG, GLOH, Scale-Space Analysis- Image Pyramids and Gaussian derivative filters, Gabor Filters and DWT [7H]

Image Segmentation: Region Growing, Edge Based approaches to segmentation, Graph-Cut, Mean-Shift, MRFs, Texture Segmentation; Object detection[7H]

Object Recognition: Structural Approaches, Model-based Approaches, Appearance and Shape-based Approaches, Probabilistic Paradigms. [4H]

Pattern Analysis: Clustering: K-Means, K-Medoids, Mixture of Gaussians, Classification: Discriminant Function, Supervised, Un-supervised, Semi-supervised; Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA, LDA, ICA; Non-parametric methods [7H]

Motion Analysis: Background Subtraction and Modeling, Optical Flow, KLT, Spatio-Temporal Analysis, Dynamic Stereo; Motion parameter estimation [4H]

Applications and Performance Evaluation Measures: CBIR, CBVR, Security and Surveillance (Activity Recognition, Biometrics etc.), Medical imaging, Document processing, image fusion, Super-resolution, Augmented Reality, Performance Evaluation Measures. [5H]

Text/Reference books:

1. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited 2011.
2. Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, 2003.
3. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.
4. K. Fukunaga; Introduction to Statistical Pattern Recognition, Second Edition, Academic Press, Morgan Kaufmann, 1990.
5. R.C. Gonzalez and R.E. Woods, Digital Image Processing, Addison- Wesley, 1992.

Subject Code:	CS419b	**Course Title**	Distributed Systems
Contact Hours	L- 3 T- 0 P- 0	**Credit**	4
Programme	B.Tech	**Semester**	VIII
Pre-requisites	NIL		
Evaluation scheme	Quiz I (15%), Mid term (30%), Quiz II (15%), End term (40%)		

Introduction, Architectures, Processes, Communication.	**[10 H]**
Naming, Synchronization, Consistency and Replication	**[10 H]**
Fault Tolerance, Security, Distributed Object-based Systems	**[10 H]**
Distributed File Systems, Distributed Web-based Systems	**[07 H]**
Distributed Coordination-based Systems	**[05 H]**

Text/Reference books:

A S Tanenbaum, "Distributed Systems: Principles and Paradigms", PHI, 2007

Subject Code:	CS419c	**Course Title**	Quantitative Methods in Software Engineering
Contact Hours	L- 3 T- 0 P- 0	**Credit**	4
Programme	B.Tech	**Semester**	VIII
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Mid-term (20%), Quiz II (10%), End term (40%), Term Project (20%)		

Assessment in Software Engineering**,** Software Measurement and Metrics, Research Method in SE - Controlled Experiment, Case studies, Surveys, and others	**[12 H]**
Controlled Experiments, Design of Experiments, Simulation Methods, Examples and Case Studies for Controlled Experimentations, Data Collection and Analysis, Validity and Interpretation	**[12 H]**
Case Studies and Surveys, Design and Execution, Data Collection, Data Analysis, Statistical Data Analysis, Validity and Interpretation	**[12 H]**
Planning, Designing, Conducting Empirical Studies, Replication, Documentation, Review, Examples	**[6 H]**

Text/Reference books:

1. Basics of Software Engineering Experimentation, Natalia Juristo and Ana M. Moreno, Kluwer, 2001.
2. Guide to Advanced Empirical Software Engineering, Forest Shull, Janice Singer, and Dag I.K. Sjøberg, Springer 2008

Subject Code:	EC420a	**Course Title**	Advanced Control Systems
Contact Hours	L- 3 T- 0 P- 0	**Credit**	4
Programme	B.Tech	**Semester**	VIII
Pre-requisites	NIL		
Evaluation scheme	Quiz I (15%), Mid-Term (30%), Quiz II (15%), End-Term (40%)		

Introductions: Introduction and applications of Control Theory in different fields. **[1 H]**

State Variable Analysis and Design: State Variable Representation, Conversion between State Variable Models to Transfer function and Vice-versa, Eigen Values, Eigen Vectors, Diagonalization, Solution of State Equations, Controllability and Observability, Pole placement by State feedback, Design of State Observer: Full order and Reduced order state observer, Compensator Design by Separation Principle Servo Design: Introduction of the Reference input by Feed-forward Control, State Feedback with integral Control **[8 H]**

Digital Control System, The z-transform, Inverse z-transform, Pulse Transfer Function, z- and s-plane relationship, z-transform analysis of Sampled-data Control System, Stability analysis of Sampled-data Control System, **[8 H]**

Design of Feedback Control System: Preliminary consideration of Classical Design, Realization and Design of Basic Compensator, Design of PID controller **[8 H]**

Design of Digital Control System: Z-plane Specifications of Control System Design, Digital Compensator Design using Frequency Response Plots, Digital Compensator design using Root locus plots, Design of Digital PID controller **[8 H]**

Optimal Control Systems: Parameter Optimization, Optimal Control Problem: Transfer Function Approach, Optimal Control Problem: State Variable Approach **[5 H]**

Introduction to Adaptive Control(Model Reference Adaptive Control), **[4 H]**

Text/Reference books:

1. Digital Control and State Variable Methods by M Gopal, McGraw-Hill, 2003
   Control Systems Engineering by I J Nagrath and M Gopal, New age International, 2007

Subject Code:	EC420b	**Course Title**	VLSI Test and Testability
Contact Hours	L- 3 T- 0 P- 0	**Credit**	4
Programme	B.Tech	**Semester**	VIII
Pre-requisites	NIL		
Evaluation scheme	Quiz I (15%), Mid-Term (30%), Quiz II (15%), End-Term (40%)		

Fundamental of VLSI Testing Basic of VLSI testing, Scope of testing and verification in VLSI design process, Issues in test and verification of complex chips, embedded cores and SOCs. **[12 H]**

Fault Modeling and Testing Fault models, fault detection and redundancy, fault equivalence and fault location, fault dominance, automatic test pattern generation, Design for testability, Scan design, Test interface and boundary scan. System testing and test for SOCs. Delay fault testing. **[12 H]**

Test automation and Design verification BIST for testing of logic and memories, Test automation, Design verification techniques based on simulation, analytical and formal approaches. **[10 H]**

Module 4 Functional and Timing verification

Functional verification, Timing verification, Formal verification, Basics of equivalence checking and model checking, Hardware emulation. **[8 H]**

Text/Reference books:

1. M. Abramovici, M. A. Breuer and A. D. Friedman, Digital System Testing and Testable Design, Jaico Publishing House, 1990.
2. T. Kropf, Introduction to Formal Hardware Verification, Springer Verlag, 2000.
3. Neil H. E. Weste and Kamran Eshraghian, Principles of CMOS VLSI Design, Addison Wesley, Second Edition, 1993.
4. Neil H. E. Weste and David Harris, Principles of CMOS VLSI Design, Addison Wesley, Third Edition, 2004.
5. M. Bushnell and V. D. Agrawal, Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits, Kluwer Academic Publishers, 2000.
   Parag K. Lala, Digital Circuit Testing and Testability, Academic Press, 1997

Subject Code:	EC420c	**Course Title**	Information Theory and Coding
Contact Hours	L- 3 T- 0 P- 0	**Credit**	4
Programme	B.Tech	**Semester**	VIII
Pre-requisites	NIL		
Evaluation scheme	Quiz I (15%), Mid-Term (30%), Quiz II (15%), End-Term (40%)		

Review of probability theory, Entropy: marginal entropy, joint entropy, conditional entropy and the chain rule for entropy. Mutual information between ensembles of random variables. **[6 H]**
Source Coding theorems: prefix, variable and fixed length codes. Channel models and channel capacity. Channel Coding theorem. **[9 H]**
Linear Block Codes: Generator and parity check matrices, Minimum Distance, Syndrome decoding, Bounds on minimum distance. [**9 H]**
Cyclic Code: Finite Fields, binary BCH codes, RS Codes. **[9 H]**
Convolutional Codes: Encoders, Trellis, Viterbi decoding. **[9 H]**

Text/Reference books:

1. Thomas M. Grover and Joy A. Thomas, "*Elements of Information Theory,"* Wiley.
2. John G. Proakis and Masoud Salehi, "*Digital Communications*," 5th edition, McGraw Hill.

Subject Code:	ME420a	**Course Title**	Optimization Techniques
Contact Hours	L- 3 T- 0 P- 0	**Credit**	4
Programme	B.Tech	**Semester**	VIII
Pre-requisites	NIL		
Evaluation scheme	Quiz (15%), Mid-sem (35%) and End-sem (50%)		

Classical Optimization method
Single variable optimization; Multi variable optimization with no constraints (semidefinite case, saddle point), with equality constraints (solution by direct substitution, method of constrained variation, method of Lagrange multipliers), with inequality constraints (Kuhn-Tucker conditions, constraint qualification); Convex programming problem, NLP: One dimensional minimization methods **[8 H]**
Elimination methods: Interval halving method; Fibonacci method; Golden section method **[5 H]**
Interpolation method: Direct root methods (Newton method, quasi-Newton method, secant method), NLP: Unconstrained optimization techniques **[4 H]**
Direct search methods: Random search; Grid search; Univariate; Pattern directions; Hooke and Jeeves' method; Powell (conjugate directions, algorithms); Rosenbrocks; Simplex (Reflection, Expansion, Contraction) **[5 H]**
Indirect search methods: Gradient of a function; Steepest descent (Cauchy); Conjugate gradient (Fletcher-Reeves); Newton's; Marquardt; Quasi-Newton (Variable metric); Davidon-Fletcher-Powell; Broydon-Fletcher-Goldforb-Shanno; NLP: Constrained optimization techniques **[5 H]**
Direct methods: Random search method; Sequential linear programming; Feasible directions (basic approach); Feasible directions (Zoutendijk's method); Rosen's gradient projection; Generalized reduced gradient; Sequential quadratic programming **[4 H]**
Indirect methods: Transformation techniques; Penalty function method (basic approach); Interior penalty function method; Convex programming; Exterior penalty function; Interior penalty function method (Extrapolation technique); Penalty function method (Mixed equality and inequality constraints); Penalty function method (Parametric constraints); Augmented Lagrange multiplier method; Checking convergence; Integer programming (IP) **[6 H]**
Integer linear programming: Graphical representation; Gomory's cutting plane; Bala's algorithm for 0-1 programming **[2 H]**
Integer nonlinear programming: Integer polynomial programming; Branch and bound method; Sequential linear discrete programming; Generalized penalty function method **[3 H]**

Text/Reference books:

[1] Engineering Optimization: Theory and Practice by SS Rao.

Subject Code:	ME420b	**Course Title**	Mechanics of Composite Materials
Contact Hours	L- 3 T- 0 P- 0	**Credit**	4
Programme	B.Tech	**Semester**	VIII
Pre-requisites	NIL		
Evaluation scheme	(20%), Mid-sem(25%), Project (15%) and End-sem(40%)		

Introduction

Basic concepts and mechanical behaviour of laminated fiber-reinforced composite materials, applications to engineering structures, different types of fibers and matrices. **[8 H]**

Micromechanics

Prediction of elastic constants and strengths, mechanics of load transfer from matrix to fiber. **[8 H]**

Macromechanics

Theory of elasticity for anisotropic materials, constitutive law for laminae, transformation of stresses, strains and material properties. Constitutive law for laminates and significance of [A], [B] and [D] stiffness matrices, stress and strain analyses of laminates, failure criteria, hygrothermal stresses, bending of plane anisotropic beams, classical and first order theories of laminated composite plates, analysis of Sandwich Plates, buckling analysis of laminate composite plates, first order shear deformation theory, inter-laminar stresses and delamination. **[20 H]**

Several Aspects of Design

Composite tailoring and design issues, statics and elastic stability of initially curved and twisted composite beams, plates and sandwich structures. **[5 H]**

Text/Reference books:

[1] R M Jones (1999), "Mechanics of Composite Materials (2nd Ed)," Taylor and Francis, India.

[2] B D Agarwal, L J Broutman and K Chandrashekhara (2006), "Analysis and Performance of Fiber Composites (3rd Ed)," John Wiley and Sons, Inc., New Delhi, India.

[3] Autar K Kaw (2006), "Mechanics of Composite Materials (2nd Ed)," Taylor and Francis, USA.

[4] Reddy, J.N., Mechanics of Laminated Composite Plates and Shells – Theory and Analysis, CRC Press, 2nd Edition, 2004.

Subject Code:	ME420c	**Course Title**	Metal Forming
Contact Hours	L- 3 T- 0 P- 0	**Credit**	4
Programme	B.Tech	**Semester**	VIII
Pre-requisites	NIL		
Evaluation scheme	Assignment (5%), Quizzes (20%), Midsem (25%), Endsem (40%) and Term paper seminar (10%)		

1. **Forming**: Review of stress and strain behavior of materials; plastic stress-strain relations (isotropic and anisotropic), plastic and tangent modulus, yield criteria, flow rule, plastic potential, strain hardening; plastic instability; empirical stress-strain equations; effect of pressure, strain-rate and temperature; stress equilibrium and virtual work; deformation and recrystallization; cold and hot working; heat effect during forming. **[10H]**
2. **Plasticity**: Yield criteria, isotropic and anisotropic hardening, rules of plastic flow, Levy-Mises and Prandtl-Reuss equations, Isotropic and anisotropic yield theories: von Mises', Tresca, Hill's 1948 and 1979 yield criteria. **[8H]**
3. **Analysis**: Mechanics of deformation in forming processes, determination of loads, pressures, torques and powers required in metal forming processes; analysis of stress tensor, eigen values, deviatoric and hydrostatic stress, components, octahedral stresses, analysis of strain and strain-rates; spring back; theory and applications of slab method, limit analysis – upper and lower bound technique, slip-line filed method. **[10H]**
4. **Forming Processes**: Drawing and sheet metal work, Stamping, FLD concept, FLC prediction, Forging, Extrusion; Rolling; Bending, Deep drawing, Wire and Tube drawing; High Velocity Forming. **[12H]**
5. Factors affecting deformation mechanisms in different metal forming processes. **[2H]**

Text/Reference books:

1. Metal Forming: Processes and Analysis, B. Avitzur, Tata McGraw-Hill Publishing Co. Ltd., 1977
2. Theory of Plasticity, J. Chakrabarty, McGraw Hill, 1998.
3. Metal forming Mechanics and Metallurgy, W. F. Hosford, R. M. Caddell, Printice-Hall, 2007
4. Fundamentals of Metal Forming, R. H. Wagoner, J. L. Chenot, John Wiley, 1997
5. Basic engineering plasticity, DWA Rees, Elsevier, 2006
6. Modeling of metal Forming and Machining Processes, P. M. Dixit, U. S. Dixit, Springer-Verlag, 2008
7. Engineering plasticity, W. Johnson, P. B. Mellor, Von Nostrand Reinhold Company, 1972
8. Plasticity theory and its application in metal forming, V. Gopinathan, Wiley Eastern limited,

Subject Code:	CS420a	**Course Title**	Big Data Analytics
Contact Hours	L- 3 T- 0 P- 0	**Credit**	4
Programme	B.Tech	**Semester**	VIII
Pre-requisites	NIL		
Evaluation scheme	Project/Quiz I (30%), Mid term (30%), End term (40%)		

Introduction: Introduction: Big Data Challenges [6L]

Big Data Collection: Data Cleaning and Integration, Hosted Data Platforms and the Cloud[6L]

Big Data Storage Modern Databases, Distributed Computing Platforms, NoSQL, NewSQL [10L]

Big Data Systems: Characteristics of Big Data and Dimensions of Scalability, Multicore

Scalability, Security, User Interfaces for Data[10L]

Big Data Analytics: Getting Value out of Big Data, Machine Learning Tools, Fast Algorithms, Data Compression, Information Summarization [10L]

Text/Reference books:

1. EMC education services, "Data Science and Big data analytics", Willey India, 2015
2. Technical papers from major journals and major conferences on computing, networking, cloud computing.

Subject Code:	CS420b	**Course Title**	Principles of Programming Languages
Contact Hours	L- 3 T- 0 P- 0	**Credit**	4
Programme	B.Tech	**Semester**	VIII
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Mid-term (20%), Quiz II (10%), End term (40%), Term Assignments (20%)		

Introduction, Programming Languages, Syntax, Grammar, Ambiguity, Syntax and Semantics, Data Types (Primitive/Ordinal/Composite data types, Enumeration and sub-range types, Arrays and slices, Records, Unions, Pointers and pointer problems) **[10 H]**

Expressions, Type conversion, Implicit/Explicit conversion, type systems, expression evaluation, Control Structures **[5 H]**

Binding and Types of Binding, Lifetime, Referencing Environment (Visibility, Local/Nonlocal/Global variables) , Scope (Scope rules, Referencing operations, Static/Dynamic scoping) **[5 H]**

Subprograms, signature, Types of Parameters, Formal/Actual parameters, Subprogram overloading, Parameter Passing Mechanisms, Aliasing, Eager/Normal-order/Lazy evaluation) , Subprogram Implementation (Activation record, Static/Dynamic chain, Static chain method, Display method, Deap/Shallow access, Subprograms as parameters, Labels as parameters, Generic subprograms, Separate/Independent compilation) **[12 H]**

Logic Programming, Predicate calculus, Clausal form, Resolution, PROLOG programming language, Facts and rules, Backtracking, Lists, Limitations of PROLOG) , Functional Programming (Lambda notation, Referential transparency, Functional forms, LISP and SCHEME programming languages, S-expression, Define and Eval functions) **[10 H]**

Text/Reference books:

1. Allen B. Tucker, Robert Noonan, Programming Languages: Principles and Paradigms, McGraw-Hill, 2006
2. Bruce J. MacLennan, Principles of Programming Languages: Design, Evaluation, and Implementation, 3rd Edition, Oxford University Press, 1999.
3. T.W.Pratt, M.V.Zelkowitz, Programming Languages, Design and Implementation, Prentice Hall, 4th Edition, 2001

Subject Code:	CS420c	**Course Title**	Approximation Algorithms
Contact Hours	L- 3 T- 0 P- 0	**Credit**	4
Programme	B.Tech	**Semester**	VIII
Pre-requisites	NIL		
Evaluation scheme	Project/Quiz I (30%), Mid term (30%), End term (40%)		

Introduction and Methodology: P vs NP, NP Optimization problems, Approximation Ratio, Additive vs Multiplicative, Pros and Cons [5H]

Techniques: Greedy and combinatorial methods, Local search, Dynamic programming and approximation schemes, Linear programming rounding methods (randomized, primal-dual, dual-fitting, iterated rounding), Semi-definite program based rounding, Metric methods [15H]

Problems: Tour problems: Metric-TSP, Asymmetric TSP, TSP Path, Orienteering,

Number Problems: knapsack, bin packing; Scheduling: multiprocessor scheduling, precedence constraints, generalized assignment; Connectivity and network design: Steiner trees, Steiner forests, Buy at bulk network design, Survivable Network Design; Covering problems: vertex cover, set cover and generalizations; Packing problems: maximum independent set, packing integer programs; Constraint satisfaction: max k-Sat; Clustering: k-center, k-median, facility location; Cut problems: max cut, multiway cut, k-cut, multicut, sparsest cut, bisection; Routing problems: congestion minimization, maximum disjoint paths, unsplittable flow [15H]

Hardness of approximation: simple proofs, approximation preserving reductions, some known results [7H]

Text/Reference books:

1. Vijay Vazirani, *Approximation Algorithms*, Springer, 2001.
2. Dorit S. Hochbaum, *Approximation Algorithms for NP-hard Problems*, PWS Publishing, 1997.
3. Rajeev Motwani and Prabhakar Raghavan, *Randomized Algorithms*, Cambridge University Press, 2000.
4. Jon Kleinber and Eva Tardos, *Algorithm Design*, Addison-Wesley, 2006.

Subject Code:	CS420d	**Course Title**	Randomized Algorithms
Contact Hours	L- 3 T- 0 P- 0	**Credit**	4
Programme	B.Tech	**Semester**	VIII
Pre-requisites	NIL		
Evaluation scheme	Project/Quiz I (30%), Mid term (30%), End term (40%)		

Tools and Techniques: Basic probability theory; randomized complexity theory; game-theoretic techniques; Markov, Chebyshev, and moment inequalities; limited independence; coupon collection and occupancy problems; tail inequalities and Chernoff bounds; conditional expectation and martingales; Markov chains and random walks; stable distributions; probability amplification and derandomization. **[20L]**

Applications: sorting and searching; data structures; combinatorial optimization and graph algorithms; geometric algorithms and linear programming; approximation and counting problems ; metric embedding; online and streaming algorithms; nearest neighbors, and clustering; number-theoretic algorithms. **[22L]**

Text/Reference books:

1. Motwani and Raghavan. Randomized Algorithms, Cambridge University Press, 1995.
2. Mitzenmacher and Upfal. Probability and Computing: Randomized Algorithms and Probabilistic Analysis, Cambridge University Press, 1995.
3. William Feller. An introduction to Probability Theory and Its Applications, Volumes I and II, John Wiley, New York, 1968.
4. Patrick Billingsley. Probability and Measure, John Wiley and Sons, 1986.

Subject Code:	EC421a	**Course Title**	CMOS Memory System Design
Contact Hours	L- 3 T- 0 P- 0	**Credit**	4
Programme	B.Tech	**Semester**	VIII
Pre-requisites	NIL		
Evaluation scheme	Quiz I (15%), Mid-Term (30%), Quiz II (15%), End-Term (40%)		

Introduction to SRAM memory **[10H]**

Overview, volatile memory, non-volatile memory, on-chip memory, on-chip memory types. Review of CMOS circuit design, sensing circuitry basics, write circuitry and other peripheral circuities, refresh, kickback, SRAM (Read and Write operation, 6T, 8T cell implementation etc.).

DRAM Memories **[10H]**

Introduction to DRAM, High speed DRAM architectures, open and folded arrays organizations, bandwidth, latency, and cycle time, power, timing circuits. DRAM Cells read and write operations, issues and challenges related to destructive read operations. Peripheral circuitries, row and column decoders.

FLSAH Memories **[10H]**

Operation of FLASH memories (FLASH array sensing and programming), Charge Pump, PROM, EPROM, EEROM, NAND and NOR flash memories.

Emerging Memories **[10H]**

Emerging devices for memories such as Memristor, and other memories (RRAM, PCRAM, STRAM etc)

Text/Reference books:

1. Semiconductor Memories: A Handbook of Design, Manufacture and Application, Betty Prince, Wiley, 2nd Edison, 1996.
2. DRAM Circuit Design: Fundamental and High-Speed Topics, Keeth, Baker, Johnson, and Lin, Wiley, IEEE 2007.
3. CMOS Circuit Design, Layout, and Simulation, Jacob Baker, Wiley-IEEE, Third Edition, 2010.
4. Semiconductor Memories: Technology, Testing, and Reliability, Ashok K. Sharma, Wiley-IEEE, 2013.

Subject Code:	EC421b/CS421b	**Course Title**	Image Processing
Contact Hours	L- 3 T- 0 P- 0	**Credit**	4
Programme	B.Tech	**Semester**	VIII
Pre-requisites	NIL		
Evaluation scheme	Quiz I (15%), Mid-Term (30%), Quiz II (15%), End-Term (40%)		

Digital Image Fundamentals; **[10H]**

Image Enhancement in Spatial Domain: Gray Level Transformation, Histogram Processing, Spatial Filters; Image Transforms: Fourier Transform and their properties, Fast Fourier Transform, Other Transforms; Image Enhancement in Frequency Domain; **[17H]**

Color Image Processing; Image Restoration; Image Compression; **[5H]**

Morphological operators; Image Segmentation: edge detection, Hough transform, region based segmentation; Representation and Description. **[10H]**

Text/Reference books:

1. *Digital Image Processing* R. C. Gonzalez and R. E. Woods, Third Edition, Pearson, 2012.
2. *Image Processing,Analysis, and Machine Vision*, M Sonka, V Hlavac, and R Boyle, Third Edition, Thomson Engineering, 2007
3. *Digital Image processing* W. K. Pratt, third Edition, John Wiley & Sons Inc., 2001.
4. *Fundamentals of Digital Image Processing*Anil K. Jain, Pearson Education, 2006.

Subject Code:	EC421c	**Course Title**	Optical Communication
Contact Hours	L- 3 T- 0 P- 0	**Credit**	4
Programme	B.Tech	**Semester**	VIII
Pre-requisites	NIL		
Evaluation scheme	Quiz I (15%), Mid-Term (30%), Quiz II (15%), End-Term (40%)		

Optical Fibres:

Introduction to Modern Communication Trends, Optical Fibres: Ray and mode theories, V number, types of fibres, single mode, multimode, step and graded index fibres, attenuation and dispersion issues, fibre fabrication methods **[12H]**

Optical Sources:

Parameters of Optical sources for OFC, LED: direct and indirect band gap semiconductors, materials used for fabrication, fabrication techniques, Surface and edge emitting LEDs, Internal and External Quantum Efficiency, Laser Diodes: Fabry Perot cavities, modes in LDs, fabrication process, VCSELs, Lasing equations [**10H]**

Optical Detectors:

Photodetectors, PIN diodes, APDs, Phototransistors, Fibre Optic Receivers: Receiver noise, Receiver Configurations, Sensitivity Issues, etc. **[10H]**

Applications:

Design Considerations of an Optical Fibre Transmission System, Link Budget Equations, Digital Link Design, modulation techniques, EDFA, Advanced FO systems: POF systems, Long haul and very high data rate systems, WDM, DWDM **[8H]**

Text/Reference books:

1. *Optical Fibre Communications*, Gerd Keiser, TMH, 2008.
2. *Optical Fibre Communications: Principles and Practice*, John M Senior, Pearson education, 2009.
3. *Introduction to Fibre Optics*, Ajoy Ghatak and K. Thaygarajan, Cambridge university Press

Subject Code:	ME421a	**Course Title**	IC Engine
Contact Hours	L- 3 T- 0 P- 0	**Credit**	4
Programme	B.Tech	**Semester**	VIII
Pre-requisites	NIL		
Evaluation scheme	Quiz (15%), Mid-sem (35%) and End-sem (50%)		

A. **INTRODUCTION:** **[5 H]**

1. Basic definitions:
2. Brief history of the engine:
3. Definitions of various terms used in engines
4. Classification of engines - different types of engines:

B. **THERMODYNAMICS OF CYCLES:** **[4 H]**

1. Air Standard Cycles
2. Variable Specific Heat Calculations
3. The Air Standard Engine
4. Fuel Air cycles
5. Real Cycles:
6. Computer Simulation

C. **FUELS:** **[3 H]**

1. Properties of fuels and their measurement
2. Requirements of fuels for the petrol engine
3. Requirements of fuels for the diesel engine
4. Conventional fuels for the petrol and diesel engines
5. Alternative fuels for the petrol and diesel engines necessity for alternative fuels, requirements for alternative fuels.

D. **INTAKE SYSTEM:** **[2 H]**

1. Intake and exhaust processes in a four-stroke cycle engine:
2. Volumetric efficiency

E. **FUEL METERING IN A SPARK IGNITION ENGINE:** **[2 H]**

1. Mixture requirements in an si engine
2. Principle of carburetion
3. Fuel injection in a spark ignition (petrol) engine, mpfi

F. **COMBUSTION IN THE SPARK. IGNITION ENGINE:** **[2 H]**

1. Basic combustion process
2. Analysis of cylinder pressure data
3. Ignition
4. Abnormal combustion
5. In cylinder motion

G. **COMBUSTION IN THE COMPRESSION IGNITION ENGINE:** **[4 H]**

1. Basic combustion process
2. Analysis of cylinder pressure data
3. Fuel injection
4. Incylinder motion
5. CRDI

H. **Misc:** Hybrid powertrain architecture, Features like engine auto start/stop, ECU: **[2 H]**

I. **ENGINE EMISSIONS - FORMATION AND CONTROL:** **[4 H]**

1. Nature and sources of engine emissions.
2. Mechanism of pollutant formation in engines.
3. Emission control strategies.
4. Instruments for measuring exhaust emissions.
5. Emission system: muffuler and catelytic converter.
6. Introduction to Bharat stage emission standards, co2 emission and carbon credit

J. **ENGINE TESTING AND PERFORMANCE CHARACTERISTICS:** **[5 H]**

1. Measurement techniques.
2. Performance factors and ratings.
3. Types of performance tests.
4. Performance characteristics of si engines
5. Performance characteristics of ci engines.

6. Heat balance

K. **COOLING SYSTEMS:** **[3 H]**

Need. Variation of gas temperature.Piston temperature distribution.Theory of engine heattransfer and correlation. Parameters affecting engine heat transfer. Air-cooled systems.Types ofwater-cooling systems.Radiators.Fans. Correlation for the power required for engine cooling.

L. **LUBRICATION SYSTEMS:** **[3 H]**

Causes of engine friction. Function of lubrication. Mechanism of lubrication.Journal bearinglubrication.Types of lubrication systems.Lubrication of engine components.

M. **SUPERCHARGING AND TURBOCHARGING:** **[3 H]**

Supercharger, Supercharging methods for SI engines, Turbocharging In CI engines,Supercharged Engine performance evaluation.

Text/Reference books:

[1] Ganesan, V. Internal Combustion Engines, Second Edition, Tata McGrawHill Publishing Company Limited, New Delhi.

[2] Mathur, R.P. And Sharma, M.L. A Course In Internal Combustionengines, 8thedition, Dhanpatrai and Sons, New Delhi.

[3] Fundamentals Of I.C. Engines - P.W. Gill, J.H. Smith And EJ. Ziurys.

Subject Code:	ME421b	**Course Title**	Gas Turbine and Propulsion
Contact Hours	L- 3 T- 0 P- 0	**Credit**	4
Programme	B.Tech	**Semester**	VIII
Pre-requisites	NIL		
Evaluation scheme	Quiz (15%), Mid-sem (35%) and End-sem (50%)		

1. Introduction: Propulsion, Air breathing engines, Rocket engines. **[2 H]**
2. Basic Principles and Fundamentals Equations: Reaction principle, Conservation of momentum, angular momentum and energy, Jet propulsion principle. **[10 H]**
3. Rocket propulsion: Specific impulse, effective exhaust velocity, thrust, momentum equation, single stage, multi stage, payload, nozzle area ratio. **[7 H]**
4. Aircraft gas turbine engine: Thrust, propulsive efficiency, engine components, Brayton cycle, components design. **[5 H]**
5. Parametric cycle analysis of ideal and real engines: Ideal and real ramjet, turbojet and turbofan, optimum bypass and pressure ratios. **[5 H]**
6. Component performance: Inlet and diffuser pressure recovery, compressor and turbine efficiencies, burner efficiency and pressure loss, exhaust nozzle loss and mechanical efficiency of power shaft, performance analysis with variable specific heat. **[6 H]**
7. Engine performance analysis. **[1 H]**
8. Turbomachinery: Euler's equation, axial and centrifugal compressors and axial and centrifugal turbines. **[3 H]**
9. Inlet, nozzle and combustor: Subsonic and supersonic inlets, exhaust nozzle and introduction to combustion systems, main and after burners. **[3 H]**

Text/Reference books:

[1] Mattingly, J. D., "Elements of Propulsion: Gas Turbines and Rockets".

[2] Zucrow, M. J., "Principles of Jet Propulsion and Gas Turbines", John Wiley& Sons.

Subject Code:	ME421c	**Course Title**	Quality, Reliability and Maintenance Engineering
Contact Hours	L- 3 T- 0 P- 0	**Credit**	4
Programme	B.Tech	**Semester**	VIII
Pre-requisites	NIL		
Evaluation scheme	Quiz (15%), Mid-sem (35%) and End-sem (50%)		

QUALITY: Quality conception, quality of design, quality of conformance, cost of quality and value of quality, quality objectives, role of Statistical Quality Control (SQC) for fulfilment of quality objectives; organisation for quality factors influencing quality. In control process and out of control process, causes of deviations, chance causes and assignable causes. **[8 H]**

CONTROL CHARTS: General theory, charts for variables and standard deviation, fraction defectives and number of defects per unit. Process capability studies, Non-conventional control charts. **[09 hr]**

ACCEPTANCE SAMPLING: Elementary concepts, sampling by attributes, single and double sampling plans, use of Dodge Roming and Military standard sampling tables, construction and use of O.C. curves, introduction to sampling by variates, continuous sampling plans. **[8 H]**

RELIABILITY: Introduction, failure rate curve, life testing, relationship between constant failure rate, mean life and other failure rates. O.C. curve for stipulated life; Producer and consumer risk in life testing, sampling plans, MIL-STD procedures for failure sequential life testing plans. Reliability study analysis, synthesis of system reliability, design for reliability, measurement of reliability. **[9 H]**

MAINTENACE ENGINEERING: Machine health monitoring, preventive and predictive maintenance; condition based maintenance; maintenance planning and scheduling; Application of latest techniques like fibre optics, signature analysis, thermography in maintenance engineering; failure analysis of vital components like bearings; seals; gears etc; Maintenance strategies and computer aided maintenance. **[8 H]**

Text/Reference books:

1. Reliability and Maintenance Engineering by RC Mishra
2. J. M. Juran& Frank M. Gryna : Quality Planning and Analysis Tata McGraw-Hill

Subject Code:	CS421a	**Course Title**	Image Reconstruction
Contact Hours	L- 3 T- 0 P- 0	**Credit**	4
Programme	B.Tech	**Semester**	VIII
Pre-requisites	NIL		
Evaluation scheme	Quiz I (15%), Mid term (30%), Quiz II (15%), End term (40%)		

One-dimensional signal processing, Fourier analysis, Line integrals and projections, Fourier slice theorem **[08 H]**
Reconstruction algorithms for parallel projections **[07 H]**
Reconstruction algorithms for fan beam projections **[07 H]**
Reconstruction algorithms for Cone beam projections geometries **[10 H]**
Algebraic reconstruction algorithms **[05 H]**
Optimization based reconstruction algorithms **[07 H]**

Text/Reference books:

G T Herman, “Image reconstruction from projections”, Springer-verlag, 2009

Subject Code:	CS421c	**Course Title**	Statistical Methods in Computer Science
Contact Hours	L- 3 T- 0 P- 0	**Credit**	4
Programme	BTech	**Semester**	VIII
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Mid-term (20%), Quiz II (10%), End term (40%), Assignments (20%)		

Introduction to the probabilistic and statistical techniques used in modern computer systems. Basics of probability and statistical estimation. [10 H]

Graphical models, Mixture models and the EM algorithm, HMM, Kalman Filters, Bayesian Networks and Markov Networks, Variable elimination, junction trees and belief propagation [10 H]

Sampling-based inference, Probabilistic inference, statistical learning, learning Bayesian network, learning Markov models. [10 H]

Decision theory, Markov decision processes. Applications of probabilistic and statistical techniques to algorithms, speech/image processing, robotics**[**12H]

References:

1. D. Koller & N. Friedman, *Probabilistic Graphical Models: Principles and Techniques,* MIT Press
2. **Mari**, Jean-François and **Schott**, René, *Probabilistic and Statistical Methods in Computer Science* Springer, 2001

Subject Code:	EC422a	**Course Title**	Nanophotonics and Plasmonics
Contact Hours	L- 3 T- 0 P- 0	**Credit**	4
Programme	B.Tech	**Semester**	VIII
Pre-requisites	NIL		
Evaluation scheme	Quiz I (15%), Midterm (30%), Quiz II (15%), End term (40%)		

Introduction to Photonics: Electromagnetic waves; light; Maxwell equations; Wave equation; Modes, laser sources, semiconductor quantum wells, photo detectors, quantum dots, nanowires, Dielectric optical waveguides, directional coupler, Machzehnder interferometer, Optical microresonators etc. **[6 H]**

Photonic Crystals: Photonic bandgap (PGB). PBG structures, wave propagation, Construction methods, Applications: wave guides and photonic crystals fibres, optical microcavities, Photonic VLSI. **[8 H]**

Nanophotonics in metals: Electromagnetics of Metals, Electromagnetic Wave Propagation, Dielectric function and dispersion, Surface Plasmon polaritons, Single and multilayer systems, Exaction of surface Plasmon, plasmonic waveguides and resonators, localized surface plasmons, Nanoantennas. Metamaterials and Negative Index at Optical Frequencies,

Transmission through apertures and films: Theory of Diffraction by Sub-Wavelength Aperture, Extraordinary Transmission, Directional Emission via Exit Surface Patterning, Localized Surface Plasmons and Light Transmission Through Single Apertures, Emerging Applications of Extraordinary Transmission, Transmission of Light Through a Film Without Apertures. **[10 H]**

Simulation and Design: Optical microresonators, guiding bending and splitting of light through photonic crystals, microcavity based MUX and DEMUX, photonic crystal fiber, plasmonic waveguides and resonators, Nanoantennas, Extraordinary transmission, Bull's eye structures, Metamaterials. **[12 H]**

Text/Reference books:

1. Fundamentals and Applications by Stefen A. Maer
2. Nanophotonics with Surface Plasmon by Vladimir M. Salaev
3. Photonic crystals:Molding the flow of light by J.D. Joannopoulos
4. Integrated Photonics: fundamentals by G. Lifante

Subject Code:	EC422b	**Course Title**	Application of Signal and Image Processing
Contact Hours	L- 3 T- 0 P- 0	**Credit**	4
Programme	B.Tech	**Semester**	VIII
Pre-requisites	NIL		
Evaluation scheme	Quiz I (12.5%), Mid term (25%), Quiz II (12.5%), End term (50%)		

ECG: Cardiac electrophysiology, relation of electrocardiogram (ECG) components to cardiac events, clinical applications. **[6 H]**

Speech Signals: The source-filter model of speech production,spectrographic analysis of speech. **[6 H]**

Speech Coding: Analysis-synthesis systems, channel vocoders, linear prediction of speech, linear prediction vocoders. **[5 H]**

Imaging Modalities: Survey of major modalities for medical imaging: ultrasound, X-ray, CT, MRI, PET, and SPECT. **[5 H]**

MRI: Physics and signal processing for magnetic resonance imaging. **[5 H]**

Surgical Applications: A survey of surgical applications of medical image processing. Image Segmentation: statistical classification, morphological operators, connected components. **[5 H]**

Application of Signal and Image Processing in power and control systems and mobile robot using physiological signals. [10H]

Text/Reference books:

1. Oppenheim, A. V., and R. W. Schafer, with J. R. Buck. Discrete-Time Signal Processing. 2nd ed. Upper Saddle River, NJ: Prentice-Hall, 1999. ISBN: 9780137549207.
2. Karu, Z. Z. Signals and Systems Made Ridiculously Simple. Huntsville, AL: ZiZi Press, 1995. ISBN: 9780964375215.
3. Duda, R., and P. Hart. Pattern Classification and Scene Analysis. New York, NY: John Wiley & Sons, 1973. ISBN: 9780471223610.
4. Clifford, G., F. Azuajae, and P. McSharry. Advanced Methods and Tools for ECG Data Analysis. Norwood, MA: Artech House, 2006. ISBN: 9871580539661.
5. Rabiner, L. R., and R. W. Schafer. Digital Processing of Speech Signals. Upper Saddle River, NJ: Prentice-Hall, 1978. ISBN: 9780132136037.
6. Lim, J. S. Two-Dimensional Signal and Image Processing. Upper Saddle River, NJ: Prentice Hall, 1989. ISBN: 9780139353222.
7. Gonzalez, R., and R. E. Woods. Digital Image Processing. 2nd ed. Upper Saddle River, NJ: Prentice-Hall, 2002. ISBN: 9780201180756.

Subject Code:	EC422c	**Course Title**	Renewal Energy System
Contact Hours	L- 3 T- 0 P- 0	**Credit**	4
Programme	B.Tech	**Semester**	VIII
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Mid-Term (25%), Quiz II (10%), End-Term (45%), Assignment(10%)		

Introduction: Interrelationship between energy, ecology and environment, Overview of World/India Energy Scenario – Dis-aggregation by end-use, by supply; Fossil Fuel Reserves - Estimates, Duration. **[3H]**

Solar Energy: Solar Radiation, availability, measurement and estimation, Solar Thermal Conversion Device **[12H]**

Wind energy: Principles of wind energy conversion – Site selection considerations – Wind power plant design – Types of wind power conversion systems – Operation, maintenance and economics. **[10H]**

Mini / micro hydro power: classification of hydropower schemes, classification of water turbine, Turbine theory. **[10H]**

Biomass: generation, characterization, use as energy source, Introduction to the principles and operation of fuel cells, Ocean Thermal Energy Conversion. **[6H]**

Energy audit concepts. **[1H]**

Text/Reference books:

1. J. A. Duffie and W. A. Beckman, Solar Engineering of Thermal Processes, second edition, John Wiley, New York, 1991.
2. J. Twidell and T. Weir, Renewable Energy Resources, E & F N Spon Ltd, London, 1986.
3. N. Kothari, Renewable Energy Sources and Emerging Technologies, PHI, Eastern Economy Edition, 2012
4. Boyle, Godfrey, Renewable Energy (2nd edition), Oxford University Press, 2004.

Subject Code:	ME422a	**Course Title**	Smart Materials and Structures
Contact Hours	L- 3 T- 0 P- 0	**Credit**	4
Programme	B.Tech	**Semester**	VIII
Pre-requisites	NIL		
Evaluation scheme	Quiz (20%), Mid-sem (20%), Project (20%) and End-sem(50%)		

Introduction to smart materials and their applications; Piezoelectric, magnetostrictive, and electrostrictive materials. Shape memory alloys, electrorheological and magnetorheological fluids. **[10 H]**

Piezoelectric Material Systems: Fundamentals of Piezoelectricity, Piezoelectric Actuators and Sensors: Principle, working and modeling; Piezoelectric Beams and Plates: Modeling and analysis. **[8 H]**

Shape Memory Alloys: Fundamentals of SMA Behavior; Constitutive Modeling, Actuation Models of Shape Memory Alloys; **[8 H]**

Electroactive Polymer Materials: Classification of Electroactive Polymers; Actuator and Sensor Equations of Ionomeric Polymer Transducers. **[8 H]**

Applications of Smart Materials such as Energy Harvesting, MEMS and NEMS, Active vibration Control **[8 H]**

Text/Reference books:

1. Vijay K. Varadan, K. J. Vinoy, S. Gopalakrishnan, Smart Material Systems and MEMS: Design and Development Methodologies, Wiley, 2006
2. Donald J. Leo, Engineering analysis of smart material systems, John Wiley Sons, Inc., 2007.
3. A V Srinivasan and D Michael McFarland, "Smart Structures – Analysis and Design," Cambridge University Press, 2001.
4. Inderjit Chopra and Jayant Sirohi, Smart Structures Theory, Cambridge University Press, 2014.

Subject Code:	ME422b	**Course Title**	Fault Diagnosis and Prognosis for Engineering Systems
Contact Hours	L- 3 T- 0 P- 0	**Credit**	4
Programme	B.Tech	**Semester**	VIII
Pre-requisites	NIL		
Evaluation scheme	Quizzes (20%), Mid-sem (20%), Seminar/Project (20%) and End-sem(40%)		

Introduction

Historical Perspective, Diagnostic and Prognostic System Requirements, Designing in Fault Diagnostic and Prognostic Systems, Diagnostic and Prognostic Functional Layers. **[4 H]**

Systems approach to condition based maintenance/ prognostics health management

Introduction, Trade Studies, Failure Modes and Effects Criticality Analysis (FMECA), System CBM Test-Plan Design, Performance Assessment, CBM/PHM Impact on Maintenance and Operations, Sensors, Sensor Placement. **[8 H]**

Signal processing and database management systems

Signal Processing in CBM/PHM, Signal Preprocessing, Signal Processing, Vibration Monitoring and Data Analysis, Real-Time Image Feature Extraction and Defect/Fault Classification, The Virtual Sensor, Fusion or Integration Technologies, Usage-Pattern Tracking.

[8 H]

Fault diagnosis

The Diagnostic Framework, Historical Data Diagnostic Methods, Data-Driven Fault Classification and Decision Making, Dynamic Systems Modeling, Physical Model–Based Methods, Model-Based Reasoning, Case-Based Reasoning (CBR), Other Methods for Fault Diagnosis, A Diagnostic Framework for Electrical/Electronic Systems, Vibration-Based Fault Detection and Diagnosis for Bearings. **[8 H]**

Fault prognosis

Model-Based Prognosis Techniques, Probability-Based Prognosis Techniques, Data-Driven Prediction Techniques. **[8 H]**

Fault diagnosis and prognosis performance metrics

Introduction, CBM/PHM Requirements Definition, Feature-Evaluation Metrics, Fault Diagnosis Performance Metrics, Prognosis Performance Metrics, Diagnosis and Prognosis Effectiveness Metrics, Complexity/Cost-Benefit Analysis of CBM/PHM Systems. **[6 H]**

Text/Reference books:

[1] Intelligent Fault Diagnosis and Prognosis for Engineering Systems, George Vachtsevanos, Frank L. Lewis, Michael Roemer, Andrew Hess, Biqing Wu, John Wiley and Sons Ltd.

[2] Randall. R.B., Vibration-Based Condition Monitoring: Industrial, Aerospace and Automotive Applications, Wiley, United Kingdom, 2011.

[3] Bo-Suk Yang, Introduction of Intelligent Machine Fault Diagnosis and Prognosis, Nova Science Pub Inc.

[4] Mobley, R. Keith, An Introduction to Predictive Maintenance, Butterworth-Heinemann.

[5] Rolf Isermann, Fault-Diagnosis Applications: Model-Based Condition Monitoring: Actuators, Drives, Machinery, Plants, Sensors, and Fault-tolerant Systems, Springer-Verlag Berlin and Heidelberg GmbH & Co. KInderjit Chopra and Jayant Sirohi, Smart Structures Theory, Cambridge University Press, 2014.

Subject Code:	ME422c	**Course Title**	Robot Kinematics and Dynamics
Contact Hours	L- 3 T- 0 P- 0	**Credit**	4
Programme	B.Tech	**Semester**	VIII
Pre-requisites	NIL		
Evaluation scheme	Quizzes (20%), Mid-sem (20%), Programming Assignment (20%), End-sem(40%)		

1. Introduction to Robotics **[2 H]**

Introduction to robotics, history of robotics, current research in robotics around the world, classification of Robotics

2. Coordinate Frames, Mapping and Transforms **[4 H]**

Coordinate frames, description of objects in space, transformation of vectors, fundamental rotation matrices, composition of rotations, the axis-angle representation, homogeneous transformations.

3. Direct Kinematic Model **[4 H]**

Forward kinematics, Denavit-Hartenberg Notation, examples of forward kinematics.

4. The Inverse Kinematics **[4 H]**

Inverse kinematics, workspace, solvability, closed form solutions, algebraic vs. geometric solution, solution by a systematic approach.

5. Manipulator Differential Motion and Statics **[4 H]**

Linear and angular velocity of a rigid body, relationship between transformation matrix and angular velocity, manipulator Jacobian, Jacobian inverse, Jacobian singularities, redundancy

6. Dynamic Modeling **[4 H]**

Largrangian mechanics, two degree of freedom manipulator, dynamic model, Lagrange- Euler formulation, Newton-Euler formulation, inverse dynamics.

Text/Reference books:

[1] Saha S.K., "Introduction to Robotics", McGraw Hill Book Publishing Ltd. Third Edition, 2008

[2] Craig J.J., "Introduction to Robotics: Mechanics and Control", Pearson Education India,

First Edition, 2010
[3] Fu K.S., Gonzalez R.C., and Lee C.S.G., "Robotics control, sensing, vision, and intelligence", McGraw Hill Book Co., 1987.
[4] Klafter R.D., Chmielewski T.A. and Negin M., "Robot Engineering an Integrated approach", Prentice Hall of India, New Delhi, 1994.
[5] Deb S.R., "Robotics Technology and Flexible Automation", Tata McGraw-Hill Publishing Co., Ltd., 1994.
[6] Schilling, "Fundamentals of Robotics: Analysis and Control", Pearson Education India
[7] Mark W. Spong, M. Vidyasagar, "Robot Dynamics and Control", John Wiley
[8] Richard P. Paul, "Robot Manipulators: Mathematics, Programming and Control", MIT Press.

Subject Code:	CS422a	**Course Title**	Natural Language Processing
Contact Hours	L- 3 T- 0 P- 0	**Credit**	4
Programme	B.Tech	**Semester**	VIII
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Mid-term (20%), Quiz II (10%), End term (40%), Project (20%)		

Basic Text Processing, Regular expression, sentence segmentation, word stemming. **[2]**
Language modeling problem, Hidden Markov models, N-gram models, parameter estimation, model evaluation, perplexity, smoothing. **[5]**
Text classification, Naïve Bayes and multinomial Naïve Bayes, Evaluation, Sentiment Analysis **[5]**
POS Tagging problems, Viterbi Algorithm for HMM, NER**.** **[5]**
The parsing problem, CFG and Probabilistic context-free grammars (PCFG), CKY Parsing algorithm, weaknesses of PCFGs, Lexicalized PCFG, **[5]**
Information Retrieval, Term-Document Incidence Matrices, The Inverted Index, Introducing Ranked Retrieval, Term Frequency Weighting, Inverse Document Frequency Weighting (10:16) , TF-IDF Weighting. **[8]**
Log-linear models, and their application to NLP problems like tagging, parsing **[10]**
Unsupervised and semi-supervised learning in NLP. **[2]**

Text/Reference books:

1. Jurafsky and Martin, *Speech and Language Processing* 2nd Edition, Prentice Hall
2. Chris Manning and Hinrich Schütze, *Foundations of Statistical Natural Language Processing*, MIT Press. Cambridge, MA: May 1999.

Subject Code:	CS422b	**Course Title**	Visual Cryptography & Data Hiding
Contact Hours	L- 3 T- 0 P- 0	**Credit**	4
Programme	B.Tech	**Semester**	VIII
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Mid-term (20%), Quiz II (10%), End term (40%), Project (20%)		

Introduction, Visual Secret Sharing (VSS), Definition and construction. Naor and Shamir's (k,n) VSS, Proof of correctness, Contrast and pixel expansion. Contrast bounds. **[10 H]**
Visual Cryptography for multiple secrets, XOR based Visual Cryptography, Chaotic map based techniques, Colour image VSS. **[10 H]**
Data hiding schemes, Characteristics of data hiding schemes: Security, Payload, Imperceptibility, Reversible data hiding schemes, Random grid based methods**.** **[12 H]**
Data Hiding Applications: Watermarking, Basic of watermarking schemes, Watermarking in images, audios and videos. **[10 H]**

Text/Reference books:

1. M. T. Raggo and C. Hosmer, Data Hiding: Exposing Concealed Data in Multimedia, Operating Systems, Mobile Devices and Network Protocols, Elsevier, 2012.

2. S. Clemato and C.-Y. Yang, Visual Cryptography and Secret Image Sharing, CRC Press, 2012
3. Cox, M. Miller, J.Bloom, J. Fridrich, and T. Kalker, Digital Watermarking and Steganography, The Morgan Kaufmann Series in Multimedia Information and Systems, 2nd Edition, Morgan Kaufmann, 2007.

Subject Code:	CS422c	**Course Title**	Model Thinking
Contact Hours	L- 3 T- 0 P- 0	**Credit**	4
Programme	B.Tech	**Semester**	VIII
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Mid-term (20%), Quiz II (10%), End term (40%), Assignment (20%)		

Why Model & Segregation/Peer Effects, Aggregation & Decision Models, Thinking Electrons: Modeling People & Categorical and Linear Models **[10 H]**
Tipping Points & Economic Growth, Diversity and Innovation & Markov Processes, Lyapunov Functions & Coordination and Culture **[10 H]**
Path Dependence & Networks, Randomness and Random Walks & Colonel Blotto, Prisoners' Dilemma and Collective Action & Mechanism Design **[12 H]**
Learning Models: Replicator Dynamics & Prediction and the Many Model Thinker **[10 H]**

Text/Reference books:

1. Mikael Krogerus, Roman Tschäppeler, Jenny Piening, Philip Earnhart, The Decision Book - 50 Models for Strategic Thinking, W. W. Norton & Company, 2012
2. Alexander Osterwalder and Yves Pigneur, Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers, Wiley, 2010.
3. Mikael Krogerus and Roman Tschäppeler, The Change Book: Fifty models to explain how things happen, Profile Books Ltd, Jan 2013