SCHEME & SYLLABUS

of

B.TECH.

ELECTRONICS & COMMUNICATION ENGINEERING

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGG.
NATIONAL INSTITUTE OF TECHNOLOGY, HAMIRPUR-177 005 (HP)

New Scheme
2014

FIRST YEAR												
I Semester							II Semester					
S. No.	Code	Subject	L	T	P	Credits	S. No.	Code	Subject	L	T	P	Credits
1	ECS-111	Engineering Mathematics-I	3	1	0	3	1	ECS-121	Engineering Mathematics-II	3	1	0	3
2	ECS-112	Physics for Electronics Engineering	3	1	0	3	2	ECS-122	Chemistry for Electronics Engineering	3	1	0	3
3	ECS-113	Basic Environmental Science & Engineering	3	1	0	3	3	ECH-123	Communication Skills	3	1	0	3
4	ECD-114	Basic Electronics Engineering	3	1	0	3	4	ECD-124	Basic Electrical Engineering	3	1	0	3
5	ECD-115	Engineering Graphics	1	0	3	3	5	ECD-125	Electromagnetic Field Theory	3	1	0	3
6	ECS-116	Physics Lab	0	0	3	1	6	ECS-126	Chemistry Lab	0	0	3	1
7	ECD-117	Basic Electronics Lab	0	0	3	1	7	ECH-127	Communication Skill Lab	0	0	3	1
8	ECD-118	Workshop	1	0	3	2	8	ECD-128	Basic Electrical Lab	0	0	3	1
			H=30			19				29			18

Credit=37 Contact Hours=59

SECOND YEAR													
III Semester							**IV Semester**						
S. No.	**Code**	**Subject**	**L**	**T**	**P**	Credits	S. No.	**Code**	**Subject**	**L**	**T**	**P**	Credits
1	ECS-211	Engineering Mathematics-III	3	1	0	3	1	ECD-221	Linear Integrated Circuits	3	1	0	3
2	ECD-212	Analog Electronics	3	1	0	3	2	ECD-222	Electronic Switching Circuits	3	1	0	3
3	ECD-213	Digital Electronics and Logic Design	3	1	0	3	3	ECD-223	Analog Communication Systems	3	1	0	3
4	ECD-214	Network Analysis and Synthesis	3	1	0	3	4	ECD-224	VLSI & MEMS technology	3	1	0	3
5	ECD-215	Communication Theory	3	1	0	3	5	ECD-225	Electronic Measurement & Instrumentation	3	1	0	3
6	ECD-216	Data Structure and Algorithm	3	1	0	3	6	ECD-226	Reliability and Quality Management	3	1	0	3
7	ECD-217	Analog Electronics Lab	0	0	3	1	7	ECD-227	Linear Integrated Circuits Lab	0	0	3	1
8	ECD-218	Digital Electronics Lab	0	0	3	1	8	ECD-228	Analog Communication Lab	0	0	3	1
9	ECD-219	Circuit Design & Simulation lab	0	0	3	1	9	ECD-229	Electronic Measurement and Instrumentation Lab	0	0	3	1
10	ECD-210	Data Structure and Algorithm Lab	0	0	3	1	10						
			H=36			22				33			21

Credit=43 CH=69

THIRD YEAR													
V Semester							VI Semester						
S. No.	Code	Subject	L	T	P	Credits	S. No.	Code	Subject	L	T	P	Credits
1	ECD-311	Microprocessor Theory and Applications	3	1	0	3	1	ECD-321	Microcontroller & Embedded Systems	3	1	0	3
2	ECD-312	Digital Communication and Systems	3	1	0	3	2	ECD-322	Wireless Communication	3	1	0	3
3	ECD-313	Antenna & Wave propagation	3	1	0	3	3	ECD-323	Digital Signal Processing	3	1	0	3
4	ECD-314	Electronics Device Modeling	3	1	0	3	4	ECD-324	Analog & Digital VLSI Design	3	1	0	3
5	ECD-315	Control System	3	1	0	3	5	ECO-325	Open Elective-II	3	1	0	3
6	ECO-316	Open Elective-I	3	1	0	3	6	ECD-326	HDL Based Design	1	0	3	2
7	ECD-317	Digital Communication Lab	0	0	3	1	7	ECD-327	VLSI & MEMS Lab	0	0	3	2
8	ECD-318	Electronics Device Modeling Lab	0	0	3	1	8	ECD-328	Microcontroller & Embedded Lab	0	0	3	2
9	ECD-319	Microprocessor Lab	0	0	3	1	9	ECD-329	Digital Signal Processing Lab	0	0	3	2
10							10	ECD-320	Seminar	0	0	3	2
			H=33			21				36			25

Credit=46 CH=69

FOURTH YEAR													
VII Semester							***VIII Semester***						
S. No.	**Code**	**Subject**	**L**	**T**	**P**	Credits	**S. No.**	**Code**	**Subject**	**L**	**T**	**P**	Credits
1	ECH-411	Engineering Economics & Management	3	1	0	3	1	ECD-421	Microwave Devices & Systems	3	1	0	3
2	ECD-412	Optical Communication Systems	3	1	0	3	2	ECD-422	Spread Spectrum & CDMA	3	1	0	3
3	ECD-413	Industrial Electronics	3	1	0	3	3	ECD-423	Data Communication & Computer Networks	3	1	0	3
4	ECE-414	Elective-I	3	1	0	3	4	ECE-424	Elective-III	3	1	0	3
5	ECE-415	Elective-II	3	1	0	3	5	ECE-425	Elective-IV	3	1	0	3
6	ECD-416	Project-I	0	3	6	4	6	ECD-426	Microwave Devices & Systems Lab	0	0	3	2
7	ECD-417	Optical Communication Systems Lab	0	0	3	2	7	ECD-427	Communication & Network Simulation Lab	0	0	3	2
8	ECD-418	Industrial Electronics Lab	0	0	3	2	8	ECD-428	Project-II	0	3	9	6
9	ECD-419	Industrial Training Viva	0	0	0	2	9	ECD-429	General Proficiency	0	0	0	3
10	ECD-410	Term Paper	0	0	0	1	10						
			35			26				38			28

Credit=52 CH=73

Total Credit = 18+19+22+21+21+25+26+28=180
Total Hours = 29+30+36+33+33+36+35+38 = 270

Elective-I:

ECE-414 (a)	Satellite Communication
ECE-414 (b)	T.V. and Display Technology
ECE-414 (c)	Biomedical Electronics
ECE-414 (d)	Signal and Systems
ECE-414 (e)	Mobile Communication
ECE-414 (f)	Telecommunication Management

Elective-II:

ECE-415 (a)	MEMS & Sensor Design
ECE-415 (b)	FPGA & SoC Design
ECE-415 (c)	RF IC Design
ECE-415 (d)	Advanced IC Design
ECE-415 (e)	HDL Based Design

Elective -III:

ECE-424 (a)	Optical Networks
ECE-424 (b)	Wireless Sensor Networks
ECE-424 (c)	Signal processing for Image and Video
ECE-424 (d)	Error Control & Coding
ECE-424 (e)	Radar & Navigational Aids

Elective -IV:

ECE-425 (a)	Low Power VLSI Design Techniques
ECE-425 (b)	VLSI Interconnects & Packaging
ECE-425 (c)	NanoElectronics
ECE-425 (d)	CAD of Integrated Circuits

Open Electives:

1. Data structure
2. Optimisation Techniques
3. Operation Research
4. Professional Ethics and Human Values
5. Numerical Analysis
6. MEMS and Sensor Design
7. Telecommunication Syatems

ECS-111	ENGINEERING MATHEMATICS-I	L	T	P	C
		3	1	0	3

1. **MATRICES:**
   Matrices, Related matrices, Complex matrices (Hermitian and skew-Hermitian matrices, Unitary matrix), Solution of linear system of equations, Rank of a matrix, Gauss-Jordan method, Normal form of a matrix, Vectors, Linear dependence, Consistency of a linear system of equations, Rouche's theorem, System of linear homogeneous equations, Linear and orthogonal transformations, Characteristic equation, Eigen values, Eigen vectors, Properties of eigen values, Cayley-Hamilton theorem, Reduction to diagonal form, Quadratic form and their reduction to canonical form.

2. **INFINITE SERIES:**
   Convergence and divergence of infinite series, Geometric series test, Positive term series, p-series test, [Comparison test, D'Alembert's ratio test, Cauchy's root test (Radical test), Integral test, Raabe's test, Logarithmic test, Gauss's test] (without proofs), Alternating series and Leibnitz's rule, Power series, Radius and interval of convergence.

3. **DIFFERENTIAL CALCULUS:**
   Indeterminate forms, Partial Differentiation and its geometrical interpretation, Homogeneous functions, Euler's theorem and its extension, Total differentials, Composite function, Jacobian, Taylor's and Maclaurin's infinite series, Errors and increments, Introduction to limits and Indeterminate forms, Maxima and minima of functions of two variables, Method of undetermined multipliers. Curve tracing.

4. **INTEGRAL CALCULUS:**
   Quadrature, Rectification, Surface and Volume of revolution for simple curves, Double integrals and their applications, Change of order of integration, Change of variables, Triple integrals and their applications, Change of variables.

5. **VECTOR CALCULUS:**
   Differentiation of vectors, Curves in space, Velocity and acceleration, Relative velocity and acceleration, Scalar and vector point functions, Vector operator del, gradient, divergence and curl with their physical interpretations, Formulae involving gradient, divergence and curl. Line, surface and volume integrals, Theorems of Green, Stokes and Gauss (without proofs) and their verifications and applications, Irrotational and Solenoidal fields.

TEXT BOOKS:

1. Advanced Engineering Mathematics: by Erwin Kreyszig, John Wiley and Sons, NC, New York.
2. Advanced Engineering Mathematics: by R. K. Jain & S. R. K Iyengar, Narosa Pub. House.

REFERENCE BOOKS:

1. Advanced Engineering Mathematics: by C. R. Wylie & L. C. Barrett, McGraw Hill
2. Differential & Integral Calculus: by N. Piskunov, MIR Publications.

ECS-112	PHYSICS FOR ELECTRONICS ENGINEERING	L	T	P	C
		3	1	0	3

1. **SEMICONDUCTOR DEVICE PHYSICS:**
   Energy bands in solids, the E-k diagram, Density of states, Occupation probability, Fermi level and quasi Fermi levels, Fermi-Dirac Statistic, Effective mass, Conductivity as a function of temperature p-n junctions, Schottky junction and Ohmic contacts, Semiconductor optoelectronic materials, Bandgap modification, Heterostructures and Quantum Wells.

2. **MAGNETIC AND DIELECTRIC PROPERTIES OF MATERIALS:**
   Origin of magnetism, dia, Para, Ferro, antiferro and ferrimagnetisms, soft and hard magnetic materials, dielectric properties, Piezo, pyro and Ferro electricity.

3. **STRUCTURE OF MATERIALS:**
   Space lattice and unit cells, crystal system, Symmetry operation, Structures of common metallic, Semiconductor ceramic and, Miller Indices, Packing fractions, Structure determination using X-ray diffraction, Braggs law, and lattice parameter determination. Bonding in solids, coordination number, ceramics, silicates and clay structures, glass transition temperature, non-crystalline materials.

4. **INTERACTION OF PHOTONS WITH MATERIALS:**
   Rates of emission and absorption, spontaneous and stimulated emission, Condition for amplification by stimulated emission, the laser amplifier, characteristics of laser light, three and four level laser system, coherence,Ruby, He-Ne, CO2 and semiconductor lasers.
   Optical Fiber, physical structure and basic theory, modes in optical fibers, step index and graded index fibers, losses in optical fibers, applications of optical fibers.

5. **SUPERCONDUCTIVITY:**
   Introduction and discovery of superconductivity, superconducting materials, Meissner effect, critical magnetic field and critical current, type -I and type-II superconductors, Isotope effect, BCS theory of superconductivity, flux quantization, SQUIDS, applications of superconductivity.

TEXT / REFERENCES BOOKS:

1. J.Singh, Semiconductor Optoelectronics:Physics and Technology, McGraw-Hill Inc. (1995)
2. Introduction to Solid State Physics, C. Kittel.
3. Solid State Physics, N.W. Ashcroft and N.D. Mermin.
4. A text Book of Engineering Physics; M.N. Avadhanulu and P.G. Kashirsagar, S. Chand & Co.
   Ltd.
5. Modern Engineering Physics; A.s. Vasudeva, S. Chand & Co. Ltd.
6. Optical Electronics; AK Ghatak and Thyagarajan, Foundation Books, New Delhi.
7. Concepts of modern Physics; Arthur and Beiser, McGraw Hill Publication.
8. Optical Fiber Communication and Technology, D.K. Mynbaev and L.L.Scheiner, Pearson Education

ECS-113	BASIC ENVIRONMENTAL SCIENCE & ENGINEERING	L	T	P	C
		3	1	0	3

1. **ENVIRONMENTAL MANAGEMENT, RESOURCES AND LEGISLATION:**
   Environmental disturbances, quantification of environmental issues, soil resources and their classification, equitable use of resources, natural resource management, food chain and trophic levels, environmental impacts of energy development, legislation.

2. **GLOBAL ATMOSPHERIC CHANGE:**
   The atmosphere of earth, global temperature, greenhouse effect, radiative forcing of climate change, global warming potential, carbon cycle, carbon emissions from fossil fuels, regional impacts of temperature change, global initiatives

3. **PHYSICAL, CHEMICAL AND BIOLOGICAL PROCESSES:**
   Particle dispersion, methods of expressing particle concentrations, stoichiometry, chemical equilibria, solubility of gases in water, carbonate system, organic chemistry, nuclear chemistry, nuclear fission and fusion, basic atmospheric properties, fundamentals of microbiology.

4. **POPULATION AND ECONOMIC GROWTH:**
   The nature of human population growth, population parameters, industrialisation, urbanisation, sustainable development, sustainable consumption, resettlement and rehabilitation issues, health and the environmental impacts.

5. **SOLID AND HAZARDOUS WASTE MANAGEMENT:**
   Integrated solid waste management, hazardous waste management, biomedical waste treatment technologies and disposal options, e-waste management, waste minimisation for sustainability, waste management – Indian scenario.

6. **POLLUTION AND MONITORING:**
   Water resources, characteristics of water, water pollutants, oxygen demanding wastes, surface water quality, groundwater quality, water and wastewater treatment systems.
   Air quality standards, emission standards, criteria pollutants, air pollution and meteorology, atmospheric dispersion, emission controls.
   Effect of noise on people, rating systems, community noise sources and criteria, traffic noise prediction, noise control.

TEXTS/REFERENCES:

1. Mackenzie L. Davis and David A. Cornwell.2010. Introduction to Environmental Engineering, 4e. Tata McGraw-Hill Education Private Limited New Delhi.
2. Gilbert M. Masters.2007. Introduction to Environmental Engineering and Science, 2e. Pearson Education. Dorling Kindersley (India) Pvt. Ltd. Delhi.
3. J. Glynn Henry and Gary W. Heinke.2004. Environmental Science and Engineering, 2e. Pearson Education (Singapore) Pte. Ltd.

ECD-114	BASIC ELECTRONICS ENGINEERING	L	T	P	C
		3	1	0	3

1. **SEMI-CONDUCTORS AND DIODES:**
   Introduction, Insulators, semiconductors and metals, Mobility and conductivity, Intrinsic and extrinsic semiconductors, Charge density, current components in semiconductors, Continuity equation, PN junction diode- Characteristics and analysis, Types of diodes- Zener, Photodiodes, LED, Varactor diode, tunnel diodes.

2. **DIODE APPLICATIONS:**
   Rectifiers and filter circuit: Half wave rectifier, Full wave rectifier, bridge rectifier and their analysis, L,C and Pi filters, Series and shunt diode clippers, Clipping at two independent levels, Clamping operation , Clamping circuit, Practical clamping circuits, Basic regulator supply using zener diode.

3. **TRANSISTORS:**
   Construction and characteristics of BJT, Transistor configuration: CB, CE, CC configuration, Transistor at low frequency, Small signal low frequency transistor model(h-parameters), Analysis of transistor amplifier using h-parameters, Transistor biasing and bias stabilization: Operating point, Stability factor, Analysis of fixed bias, collector to base bias, Emitter resistance bias circuit and self bias circuit, Bias compensation techniques.

4. **FIELD EFFECT TRANSISTOR:**
   Construction and characteristics of JFET, JFET biasing circuit, JFET amplifier, MOSFET construction and characteristics.

5. **AMPLIFIERS AND OSCILLATORS:**
   Classification of amplifiers, concept of feedback, Characteristics of feedback amplifiers, Single stage RC coupled amplifier, Oscillators, Criterion for oscillation, Types of oscillators: Hartley oscillator, Colpitt oscillator, RC-phase shift oscillator, Wein bridge oscillator.

6. **OPERATIONAL AMPLIFIERS:**
   Introduction, inverting and non-inverting configuration, Applications of op-amp: Adder, subtractor, Integrator, Differentiator, Comparator and practical op-amps.

TEXT BOOKS:

1. Integrated devices & Circuits by Millman & Halkias.
2. Electronics Devices and Circuit Theory by R. Boylestad.

REFERENCE BOOKS:

1. Electronics Devices and Circuits-II by A.P.Godre & U.A. Bakshi.
2. Electronics Devices and Circuit by G.K. Mithal.

ECD-115	ENGINEERING GRAPHICS	L	T	P	C
		1	0	3	3

1. **INTRODUCTION (MINIMUM 1 SHEET):**
   Importance, Significance and Scope of Engineering Graphics, General Introduction to Drawing Instruments and their Use, Introduction to IS code of drawing. Layout of Drawing Sheets, Principle of Dimensioning and Scaling, Lettering: Single Stroke Vertical and inclined Letter, Line types such as Elevation lines- Construction lines – Section lines – Hidden lines – Centre lines.

2. **ORTHOGRAPHIC PROJECTIONS (MINIMUM 4 SHEETS):**
   Simple orthographic projections, first and third angle, Projection of points and lines in different quadrant, Traces, Inclinations, True lengths of line, Projection on auxiliary plane, Shortest distance, Intersecting and Non Intersecting lines. Planes other than reference planes– perpendicular and oblique planes, traces, inclinations etc. , projection of lines lying in the plane, conversion of oblique plane into auxiliary plane and related demonstrative problems. Different cases of plane figures of different shapes and making different angles with one or both reference planes and lines lying in the plane figure making different given angles, Obtaining true shape of the plane figure by projection. Projection of solids, simple cases of solids placed in different positions, axes faces and lines lying in the faces of solids making given angles, Development of surfaces – development of simple objects like Tetrahedron, Cube, Octahedron, Square based pyramid and Pentagonal based prism, Introduction to Isometric Projections.

3. **SECTIONS OF SOLIDS (MINIMUM 2 SHEETS):**
   Importance, Principles, Types, Cutting plane representation, section lines and conventional practices, Demonstrative examples showing sections of Cube, Cylinder, Cone, Pyramid and Prism.

4. **GRAPHICS (MINIMUM 1 SHEET):**
   Determination of various Reactions in Beams and Trusses by Graphical Methods (Funicular and Maxwell diagrams).

5. **CAD (MINIMUM 2 SHEETS):**
   Introduction to CAD tools – basics, The User Interface, Start, Organize, and Save a Drawing, Control the Drawing Views, Display Multiple Views in Model Space, 2D tools & commands of CAD software, Creating Drawings & Using text, Use of Drawing and modify toolbar, Grouping of Objects, Complete 2D drawing, Drawing and modify toolbar for 3D drawing, Work on three dimensional objects.

BOOKS:

1. Engineering Drawing and Graphics+Auto CAD- K. Venugopal. New Age International Publishers.
2. Engineering Drawing - N.D. Bhat and V.M.Panchal. Charotar Publishing House.
3. Engineering Drawing - P.S. Gill. S.K. Kataria& Sons Publishers.

ECD-118	WORKSHOP	L	T	P	C
		1	0	3	2

1. **ELECTRONICS COMPONENTS:**
   Resistors: classification of resistors, Materials used for resistors, Maxi mum power rating, tolerance, temperature co-efficient, Carbon film resistors, standard Wire wound resistors, Color Coding, LDR. Capacitors: Materials used for capacitors, working voltage, capacitive reactance. Coding of capacitors Fixed Capacitor types: Disc, Ceramic capacitor, Aluminum electrolytic capacitor, Variable capacitor types: Air Gang, PVC gang capacitor, Trimmer mica capacitor.
   Inductors: Air core, iron core, ferrite core inductor, frequency range Inductors: A.F., R.F., I.F., Transformers used in electronic circuits. Diodes: Use of p-n junction diodes and Special Diodes, Zener diode, Varactor diode, LED, photo diode, etc. Transistors: Use of transistors in electronic circuits, testing of BJT and FET, understand and interpret the data sheet of transistors. ICs: IC packages, Pin identification of ICs, understand and interpret the data sheet of transistors.

2. **MEASURING INSTRUMENTS:**
   Use Analog & digital multimeters, CRO, power supply and Function generator, Testing various electrical and electronic components using multimeters and CRO.

3. **CABLES, CONNECTORS AND SWITCHES:**
   CABLES: General specifications of cables- characteristic impedance, current carrying capacity, flexibility. Types of cables: SWG Single core, Multi core, Single strand, Multi strand and their types, Shielded wires, Coaxial cables, Twisted pair, UTP cables, Flat ribbon cable, Teflon coated wires, optical Fiber Cable.
   CONNECTORS: General specifications of connectors- contact resistance, breakdown voltage, insulation resistance, applications of BNC, D series, Audio, Video, printer, edge, FRC, RJ 45 connectors. SWITCHES: Toggle switch- SPDT, DPDT, TPDT, Centre off, Without center-off, Rotary switch types depending on their poles and positions Rocker switch, Push button latch and non-latch, Tactile switch, Micro switch, Limit switch, DIP switch, Thumb wheel switch- BCD, Decimal, Membrane switch.

4. **WORKSHOP PRACTICE:**
   Use of various workshop tools: nose pliers, wire stripper, wire cutter. Study and understanding electronic circuit diagrams. Transfer and testing of circuit diagram to Bread. General purpose PCB, Custom made PCB- types of PCB and their use, Transfer and testing of circuit diagram to PCB, Soldering and De-soldering - technique-requirements and methods.

TEXT BOOKS:

1. Raina K. B., Bhattacharya S. K., Juneja T., "Electrical engineering materials and electronic components," TTTI Chandigarh.
2. Dhir S.M., "Electronic Components and Materials," Tata McGraw Hills publishing company Ltd., N.Delhi.

REFERENCE BOOKS:

1. Thomas H.Jones, "Electronic Components Handbook," Reston Publishing.
2. Data sheets of transistors and ICs.

ECS-121	ENGINEERING MATHEMATICS-II	L	T	P	C
		3	1	0	3

1. **FOURIER SERIES**
   Euler's formula, Conditions for a Fourier expansion, Functions having points of discontinuity, Change of interval, Odd and even periodic functions, Expansion of odd and even periodic functions, Half-range series, Typical wave-forms, Parseval's formula, Practical harmonic analysis.

2. **ORDINARY DIFFERENTIAL EQUATIONS:**
   Brief review of first order ordinary differential equations, Exact equations, Equations reducible to exact equations, Equations of the first order and higher degree, Clairaut's equation, Applications of differential equations of first order (Orthogonal trajectories). Linear differential equations with constant co-efficients, Complimentary functions and particular integral, Method of variation of parameters, Equations reducible to linear equations with constant co-efficients (Cauchy's and Legendre's linear equations), Simultaneous linear equations with constant co-efficients, Applications of linear differential equations in engineering.

3. **COMPLEX NUMBERS:**
   Applications of De Moivre's theorem, Exponential, Circular, Hyperbolic and Logarithmic functions of a complex variable, Inverse Hyperbolic functions, Real and imaginary parts of Circular and Hyperbolic functions, Summation of the series-'C+iS' method.

4. **FUNCTIONS OF COMPLEX VARIABLE:**
   Limit and derivative of complex functions, Cauchy-Riemann equations, Analytic functions and its applications, Geometrical representation of complex function, Conformal mapping and standard transformations, Complex integration, Cauchy's theorem, Cauchy's integral formula, Series of complex terms, Taylor's and Laurent's series, Cauchy's residue theorem and its application for the evaluation of real definite integrals.

5. **INTEGRAL TRANSFORMS:**
   Laplace Transforms of standard functions and their properties, Inverse Laplace Transforms, General Properties of inverse Laplace transforms and Convolution Theorem, Laplace Transforms of periodic functions, Bessel functions, Error function, Dirac-delta Function, Heaviside's Unit Function, Applications to linear simultaneous differential equations.

TEXT BOOKS:

1. Advanced Engineering Mathematics: by Erwin Kreyszig, John Wiley and Sons, NC, New York.
2. Advanced Engineering Mathematics: by R. K. Jain & S. R. K Iyengar, Narosa Pub. House.

REFERENCE BOOKS:

1. Advanced Engineering Mathematics: by C. R. Wylie & L. C. Barrett, McGraw Hill.
2. Vector Calculus: by C. E. Weatherburn. John Wiley and Sons, NC, New York.
3. Complex variables and Applications: by R. V. Churchill, T. J. Brown & R. F. Verhey, McGraw Hill.
4. Differential Equations: by Shepley L. Ross, John Wiley & Sons, New York.

ECS-122	CHEMISTRY FOR ELECTRONICS ENGINEERING	L	T	P	C
		3	1	0	3

1. **Polymers**
   Introduction, classification, tacticity, types of polymerization, coordination polymerization, mechanisms of polymerization, synthesis and applications of some important polymers Effect of polymer structure on properties, Moulding of plastics into articles, Conducting polymers: preparation, types, properties and applications.
2. **Science of Composite Materials**
   Introduction, Classification, constituents of composites, Fiber reinforced composites, unidirectional fibre reinforced composites, short fibre reinforced composites, particle reinforced composites, important types and failures of fiber reinforced composites, Advantages and applications of composites.
3. **Characterization Techniques**
   Introduction to spectroscopy; UV-Visible spectroscopy- Absorption laws, Instrumentation, formation of absorption bands, Theory of electronic spectroscopy, Chromophore and auxochrome concept, fluorescence & phosphorescence, application of UV-Visible spectroscopy ; IR spectroscopy- Principle, theory of molecular vibrations, selection rules, spectral features of some classes of compounds, important features of IR spectroscopy and applications; NMR- Principle, relaxation processes, Instrumentation, shielding-desheilding effects, spinspin coupling, coupling constant, applications of NMR; MS spectroscopy- Basic principle, Instrumentation, determination of molecular formulae, important features of mass spectroscopy; Chromatography- Introduction, types, gas chromatography ; thermal method-instrumentation, fundamental principles and applications of TGA, DTA and DSC.
4. **Nanochemistry**
   Introduction to nanochemsitry, synthesis, characteristics and applications of carbon nanostructures fullerenes, carbon nanotubes and graphene.
5. **Fuels and Non-Conventional Energy Sources**
   Introduction, classification, solid, liquid and gas fuel; Nuclear energy- Breeder reactor and light water nuclear reactor for power generation (Block diagram only), solar energy conservation and solar cells; Fuel Cells-Introduction, types and their characteristics, alternate fuels.
6. **Corrosion and Its Control**
   Introduction, Types of corrosion – chemical and electrochemical, Mechanisms of corrosion, factors affecting corrosion and different protection techniques for corrosion control.
7. **Lubricants**
   Introduction, Mechanisms of lubrication, Types and selection of lubricants, synthetic lubricants, properties and different methods for testing of lubricating oils and greases. Books recommended.

TEXT BOOKS:

1. Applied Chemistry- A textbook for engineers and technologist by H.D. Gesser.
2. Engineering Chemistry: by P C Jain & Monika Jain
3. A Text Book of Engineering Chemistry: by Shashi Chawla

REFERENCE BOOKS:

1. Fundamental of organic spectroscopy by Y. R. Sharma
2. Introduction to spectroscopy by Pavia, Lampman, Kriz.
3. Science and Engineering of Materials by Askeland and Phule
4. Introduction to nanotechnology by C. P. Poole Jr. and F.J. Owens
5. Principles of polymerization by George Odian
6. Textbook of polymer science by F.W. Billmeyer Jr.

ECH-123	COMMUNICATION SKILLS	L	T	P	C
		3	1	0	3

1. **The Process of Communication**
   Introduction. What is communication? Barriers to communiction. Different types of communiction. Written vs. oral communicatio. Diffeent types of face-to-face interactions, characteristics and conventions of conversation, conversational problems of second foreign language users, difference between conversation and other speech events.
2. **Telephone Techniques**
   Speaking and listening, commonly used phrases in telephone conversations, reading: confence calls, vocabulary, writing and listening, leaving a message, grammar and usage: the perfct tense, pronunciation: contracted forms.
3. **Job Applications And Interviews**
   Reading, vocabulary, apply for a job, curriculum vitae, language focus: some useul words, study skills: prepriing for an interview, listening, speaking , writing.
4. **Group Discussions:**
   Reading, writing skills, listening: how to be succesful in a group discussion, study skills, language facts, vicabulary, speaking, grammar: connectives, pronunciation
5. **Managing Organistional Structure**
   Warm up, value to influence and lead, reading: the role of a manager, vocabulary: leadership. Speaking and listening, language focus, degree of probability Grammar: modals, wriing, reports, pronunciation.
6. **Meetings**
   Reading: a sucessful meeting, speaking: one to one meetings, language focus: opening, middle and close, study skills, editing, listening, criteria for sucssful meetings, vocabulary, grammar: reporting verbs, writing:memos, pronunciation: stress according to part of speech.
7. **Taking Notes And Preparing Minut**
   Taking notes, the note-taking skill: the essential components, the note-taking skill: an example preparing minutes, format of minutes, language and style of minutes, grammar: using the passive voice.
8. **Presenttion Skills-1**
   Reading, presentation skills, grammar: verbs often required in presentations, language focus, listening: importance of body language in presentations, speaking: preparing an outline of a presentation, pronunciation.
9. **Prentation Skills-II**
   Reading: structure of presentation, study skills: visual aids, ending the presentation, language focus: taking about increase and decrease grammar: prepositions. Listening: podium panic, speaking, pronunciation: emphasizing the important words in context.
10. **Negotiation Skills**
    Language focus, idiomatic expressions, study skills: process of negotiations, grammar: phrasal verbs, listening: effective negotiations, speking, writing.

Reference books:

1. Effective technical communication by M. Ashraf rizvi Pub:tata McGrow Hill (2009)
2. Developing communiction skills by krishna mohan Pub: Mac Millan India Limited (2009)
3. An approach to communiction skills by Indrajit Bhatacharya Pub: Dhanpat Rai Co. Pvt. Ltd. New Delhi (2007)
4. Handbook of practicl commu. Skills by Wright, Chrissie, Pub: jaico publishing house, mumbai (2007)
5. The skills of communicating by bill Scott. Pub: jaico publishing house, mumbai (2009).

ECD-124	BASIC ELECTRICAL ENGINEERING	L	T	P	C
		3	1	0	3

1. **Electric Circuits**

   Introduction to linear and non linear circuits, circuit elements, various sources and source transformation, star delta transformation, solution of D.C. circuits using Kirchoff's laws, signal wave forms and passive elements specifications, basic theorems, generation of A.C. sinusoidal voltage and currents, average and r.m.s. values, Form factor and peak factor, phasor representation, phasor in polar, rectangular and exponential forms, terminal relationship for pure passive elements and their combination in series and parallel.

   Analysis of single phase series, parallel and series-parallel circuits. Active and reactive power, p.f. and volt-ampares, frequency response and Q-factor. Analysis of balanced three phase a.c. circuits - Introductory concept, voltage, current and power in three phase balanced circuits.

   Introduction to Domestic Electric Wiring and Storage Batteries.

2. **Electromagnetic and Transformer**

   Magnetic circuit concept, B-H curves characteristics of magnetic materials, practical magnetic circuits, magnetic circuits with D.C. and A.C. excitation, hysteresis and eddy current losses.

   Magnetic force, self and mutual inductances, Faraday`s laws, Lenz`s Law, statically and dynamically induced emfs, energy stored in magnetic fields. Principle of Transformer operation, construction & equivalent circuit of transformer.

3. **Measuring Instruments**

   Introduction to galvanometer (Moving coil and moving iron), ammeter, voltmeter, wattmeter, energy meter, use of shunt and multiplier.

4. **Electrical Machines**
5. Fundamentals of D.C. and A.C. machines.

BOOKS/REFERENCES:

1. Fundamentals of Electric Circuits by Charles K Alexander and Matthew N. O. Sadiku, TMH Publication, 2nd Edition, 2009.
2. Electrical Engineering Fundamentals by Vincent Del Toro, PHI Publication, Second Edition
3. Electrical Technology by H Cotton, CBS Publishers and Distributors,7th Edition, 2005
4. Basic Electrical Technology by A.E. Fitzgerald, McGraw Hill Publication

ECD-125	ELECTROMAGNETIC FIELD THEORY	L	T	P	C
		3	1	0	3

1. **INTRODUCTION:**
   Fundamental of vector algebra, Scalar & vector fields, Introduction and transformation on different coordinate systems: (rectangular, cylindrical and spherical co-ordinate system). Introduction to line, surface and volume integrals, definition of gradient, divergent and curl of a vector and their physical significance.

2. **ELECTROSTATICS:**
   Principal of Coulomb's law, definition of electric field intensity from point charges, field due to continuous distribution of charges on an infinite and finite line, Electric Field due to an infinite uniformly charged sheet. Gauss's law and its applications, Electric flux density, potential fields duo to electric dipole, laplace's and poison's equations.

3. **MAGNETOSTATICS:**
   Definition and explanation on Magnetic Field intensity due to a finite and infinite wire carrying current. Magnetic field intensity on rectangular loop carrying current, Ampere's Circuital law and its applications, Biot-savart law, the Lorentz force equation for a moving charge, Magnetic Vector Potential.

4. **TIME VARYING EM FIELDS:**
   Maxwell's equation in differential and integral vector form and their interpretations, continuity of currents, conduction and displacement current, boundary conditions, Helmholtz equations, uniform plane wave in dielectric and conductor media, skin effect and depth of penetration, reflection and refraction of plane waves at boundaries for normal incidence and surface impedance. Energy Flow and Poynting theorem, interpretation of E×H, Simple application, complex pointing vector.

5. **TRANSMISSION LINES:**
   Transmission line model, parameters and properties of transmission line equations, reflections in transmission lines; voltage, current and impedance relations-open, short circuit and matched lines, Standing wave ratio; impedance matching, quarter and half wave lines, single stub and double stub matching; circle diagram - Smithchart.

TEXT BOOKS:

1. Matthew N.O.Sadiku: "Elements of Engineering Electromagnetics" Oxford University Press.
2. Engineering Electromagnetics by William Hayt, TATA McGraw-Hill.
3. Narayana Rao, N : "Elements of Engineering Electromagnetics", Pearson Education.
4. Electromagnetic waves & radio system by Jorden R.F.

REFERENCES:

1. Electromagnetics, JD Kraus, McGraw-Hill.
2. Electromagnetic Field Theory Fundamentals by Bhag Singh Guru and Hüseyin R. Hiziroglu, Cambridge University Press.
3. Principle and applications of Electromagnetic fields by Ptonsey R and Collin R.P.

ECS-211	ENGINEERING MATHEMATICS-III	L	T	P	C
		3	1	0	3

1. **Fourier transforms**
   Periodic functions, Fourier transforms, Finite Fourier Sine and Cosine Transforms, Properties of Fourier Transforms, Applications of Integral Transforms to simple engineering problems. Differential Equations in electric and electronics circuits.

2. **Partial Differential Equations:**
   Formation and solution of partial differential equations, Lagrange's Linear Equation of the first order, homogenous linear equations with constant coefficients, Classification of Partial Differential Equations, Method of Separation of variables, Solution of Wave equations, diffusion equations, Laplace's equations, transmission line equations, simple applications of PDES.

3. **Special FUNCTIONS:**
   Series solutions ordinary differential equations, Solution of Bessel and Legendre differential equation, Bessel functions, Legendre functions, recurrence relations, orthogonality properties, Ber and Bei functions.

4. **Probability, Distributions & Statistics:**
   Introduction to Random variables & probability, Conditional Probability, Probability density function, Discrete and continuous distribution, Mean, medium, mode and standard deviations of standard distributions, Central Limit theorem, Generating functions, correlation and regression analysis. Urn model, Stochastic Independence, Independent trials, Baye's Rule, Bernoulli Trials, Binomial, Gaussian, Rayleigh, exponential, geometrical and uniform distributions, their density functions and applications.

5. **Convolution Ergodicity & Queuing Models:**
   Stochastic process, Queuing systems and displines, Poisson and exponential process, classification of queues, Markov chains, definition, examples, Markovian models & finite population Markovian Models, Ergodicity, Random walk with retaining barrier, absorbing barriers, characteristics of queuing systems, queuing Notations.

Books Recommended:

1. Advanced Engineering Mathematics: by Erwin Kreyszig, John Wiley and Sons.
2. Advanced Engineering Mathematics: by C.R. Wylie & L C Barrett, McGraw Hill.
3. Differential Equations: by Shepley L. Ross, John Wiley and Sons.
4. Probability, Random Variables and Stochastic Processes, McGraw Hill
5. Probability and Statistics with Reliability and Queuing and Computer Science Applications: by K S Trivedi, Prentice Hall of India.

ECD-212	ANALOG ELECTRONICS	L	T	P	C
		3	1	0	3

1. **Low Frequency Transistor Amplifier**
   Equivalent circuit of BJT using h-parameter for CB, CE and CC & configuration, calculation of transistor parameter for CB, CE & CC using h-parameters, comparison of transistor amplifier configuration.

2. **Multistage Amplifier**
   General cascaded system, RC coupled amplifier and its frequency response, merits and demerits, cascade amplifier, Darlington compound configuration, multistage frequency effect.

3. **High Frequency Response of Transistor Amplifier**
   High frequency model for CE configuration, approximate CE high frequency model with resistive load, CE short circuit current gain, HF current gain with resistive load.

4. **Large Signal Amplifier**
   Analysis and design of class A, B, AB, C amplifiers, push pull amplifiers, transformer less output stages, distortion calculations.

5. **Tuned Amplifier**
   General behaviour of tuned amplifiers, resonance-series and parallel resonant circuit, calculations of circuit impedance at resonance. Variation of impedance with frequency, Q-factor of a circuit & coil, Band width of series & parallel resonant circuit, advantages and disadvantages of tuned amplifiers. Single tuned amplifiers, voltage gain & frequency response of single tuned amplifiers, double tuned amplifiers. Analysis & design of class C amplifiers.

6. **Feedback Amplifier**
   Feedback concept, characteristics of negative and positive feedback. Effect of negative and positive feedback on input impedance, output impedance, gain, and noise and frequency response.

7. **Oscillators**
   Classification of Oscillators, frequency and frequency stability of oscillatory circuits, Tuned based Oscillators, Hartley Oscillator, Colpitts Oscillators Clapp Oscillator, Crystal Oscillator, Phase Shift Oscillator, Wein Bridge Oscillator

TEXT BOOKS:

1. Integrated devices & circuits by Millman & Halkias.
2. Electronic Devices & circuit theory by R. Boylestad.

ECD-213	DIGITAL ELECTRONICS & LOGIC DESIGN	L	T	P	C
		3	1	0	3

1. Number System & Codes

Number systems and their inter-conversion, Binary Arithmetic (Addition, Subtraction, Multiplication and Division), Diminished radix and radix compliments, BCD codes, Excess-3 code, Gray code, Hamming code, error detection and correction.

2. Logic Gates & Logic Families

Digital Logic Gates, Various Logic Families like RTL, DTL, TTL and ECL, I^2L, working and their characteristics, MOS and CMOS devices, TTL CMOS Interfacing, IEEE/ANSI-representation of Logic Families.

3. Combinational Logic Design

Boolean Algebra, Basic Theorems and properties of Boolean Algebra, Boolean Functions, Canonical and Standard forms-map method, Two, Three, Four and Five variable maps, Sum of products and Product of Sums Simplification, NAND and NOR implementation, incompletely specified functions, Ex-OR functions, The tabulation method, Determination of Prime implicants, Selection of Essential Prime implicants, The cube notation, Sharp operation, Iterative Consensus, Generalized Consensus, Minimization of Multiple output switching functions, Determining Prime implicants using Generalized Consensus, Finding a Minimum cover, Breaking cyclic and similar structures, Standard IC's and their applications

4. MSI and PLD Components

Binary adder and subtractor, Multiplexers, Decoders/Demultiplexers, Read Only Memory, Programmable Logic Arrays, Programmable Array Logic, Implementation of Combinatorial Logic using these devices.

5. Sequential Logic Design

Introduction, S-R Flip-flops, JK flip-flop, D flip-flop, T flip-flop, master slave flip-flop. Flip-flop excitation table, Interconversion of flip-flop, Classification of sequential circuits, Register and Counter circuits. A to D and D to A converter circuits.

Text Books:

1. Digital Design: M. Morris Mano, Prentice Hall of India.
2. Modern Digital Electronic: R.P.Jain (TMH)

References:

1. Digital Principle and Applications Malvino and Leach- (TMH)
2. Modern Digital Systems Design: Cheung (WPC)
3. Fundamentals of Digital Electronics: Anand Kumar (PHI)

ECD-214	NETWORK ANALYSIS & SYNTHESIS	L	T	P	C
		3	1	0	3

1. **Introduction**
   Review of circuit analysis using Kirchoff's laws, nodal and mesh analysis, solution by classical method and Laplace transform, concept of independent and dependent sources, analysis of special signal waveforms, and duality of networks, Brief review of Signals and Systems.

2. **Network Theorems**
   Superposition and Reciprocity theorem, Thevenin's and Norton's theorem, Millman's theorem, maximum power transfer theorem, compensation, Tellegan's theorem, analysis of circuits using theorems.

3. **Transient Analysis of Networks**
   Network elements, Transient response of R-L, R-C, R-L- C for DC and sinusoidal excitation, Initial condition, Solution using differential equation approach and Laplace transform method.

4. **Network Analysis**
   State variable method, Analytic and numerical solutions, Two Port Networks, Graph theoretic analysis for large scale networks, Formulation and solution of network graph of simple networks, State space representation, Analysis using PSPICE.

5. **Network Synthesis**
   Network realizability, Hurwitz Polynomials, Positive real functions, Properties of RC, RL & LC networks, Foster and Cauer forms of realization, Transmission zeroes, Synthesis of transfer functions.

6. **Passive Filter Design**
   Butter worth and Chebyshev approximations, Normalized specifications, Frequency ransformations, Frequency and impedance denormalisation, Types of frequency selective filters, Linear phase filters.

Text Books:

1. "Network and systems" by D.Roy - Choudhary
2. "Circuit Analysis - with computer applications to problem solving" by Someshwar C. Gupta, Jon W. Bayless, Behrouz Peikari.

References:

1. Franklin F. Kuo, "Network Analysis and Synthesis ", John Wiley.
2. Vanvalkenburg, "Network Analysis ", Printice Hall of India Pvt. Ltd., New Delhi, 1994.

ECD-215	COMMUNICATION THEORY	L	T	P	C
		3	1	0	3

1. **FREQUENCY AND TIME DOMAIN REPRESENTATION AND ANALYSIS**
   Introduction to information, messages & signals, Classification of signals., The discrete and continuous spectrum, Power spectrum ,Energy density spectrum , Dirac delta functions, Sampling theory and approximations, Convolution of signals, LTI systems.

2. **RANDOM SIGNAL THEORY**
   Discrete probability theory, Continuous random variables, Statistically independent random variables, Probability density functions of sums, Transformation of density functions, Ergodic Process, Correlation functions, Spectral density and White noise.

3. **NOISE**
   Atmospheric, Thermal, Shot and Partition noise, Noise figure and experimental determination of noise figure, Shot noise in temperature limited diode and space charge limited diodes, Pulse response and Digital noise.

4. **TRANSMISSION THROUGH NETWORKS**
   Networks with random input, Auto-correlations, Spectral density and probability density input-output relationships, Optimum system and non-Linear systems, Maximum criterion, Equivalent noise bandwidth.

5. **BASIC INFORMATION THEORY**
   Definition of information, Units of information, Entropy, Uncertainty and information rate of communication, Redundancy, Relation between system capacity and information content of messages, Shannon's theorem, Discrete noisy channel, Channel capacity for different discrete channels.

TEXT BOOKS:

1. Hancock J.C. "Elements of Communication Theory".
2. Sharma Sanjay "Signals and Systems".

REFERENCE BOOKS:

1. Swartz, "Information & Transmission".
2. Taub & Schilling, "Principals of Communication System".
3. Simon Hay Kin "Communication Systems".

ECD-216	DATA STRUCTURE AND ALGORITHM	L	T	P	C
		3	1	0	3

1. **INTRODUCTION:**
   Data types, data structures, abstract data types, the running time of a program, the running time and storage cost of algorithms, complexity, asymptotic complexity, big O notation, obtaining the complexity of an algorithm.

2. **DEVELOPMENT OF ALGORITHMS:**
   Notations and Analysis, Storage structures for arrays - sparse matrices - structures and arrays of structures, Stacks and Queues: Representations, implementations and applications.

3. **LINKED LISTS:**
   Singly linked lists, Linked stacks and queues, operations on Polynomials, Doubly Linked Lists, Circularly Linked Lists, Operations on linked lists- Insertion, deletion and traversal, dynamic storage management – Garbage collection and compaction.

4. **TREES:**
   Basic terminology, General Trees, Binary Trees, Tree Traversing: in-order, pre-order and post-order traversal, building a binary search tree, Operations on Binary Trees - Expression Manipulations - Symbol Table construction, Height Balanced Trees(AVL), B-trees, B+ -trees.

5. **GRAPHS:**
   Basic definitions, representations of directed and undirected graphs, the single-source shortest path problem, the all-pair shortest path problem, traversals of directed and undirected graphs, directed acyclic graphs, strong components, minimum cost spanning tress, articulation points and biconnected components, graph matching.

6. **SORTING AND SEARCHING TECHNIQUES:**
   Bubble sorting, Insertion sort, Selection sort, Shell sort, Merge sort, Heap and Heap sort, Quick sort, Radix sort and Bucket sort, Address calculation, Sequential searching, Binary Searching, Index searching, Hash table methods.

TEXT AND REFERENCE BOOKS:

1. J.P. Tremblay and P.G. Sorenson, “An Introduction to Data Structures with applications”, Tata McGraw Hill.
2. S.Sahni, “Data structures, Algorithms ad Applications in C++”, WCB/McGraw Hill.
3. Aho ,Ullman and Hopcroft, “ Data Structures and Algorithms”.
4. Y. Langsam, M. J. Augenstein and A. M. Tenenbaum, “Data Structures using C”, Pearson Education
5. Richard F. Gilberg, Behrouz A. Forouzan, “Data Structures – A Pseudocode Approach with C”, Thomson Brooks / COLE

ECD-221	LINEAR INTEGRATED CIRCUITS	L	T	P	C
		3	1	0	3

1. **DIFFERENTIAL AND CASCODE AMPLIFIERS**: Emitter coupled differential amplifiers & its circuit configurations, FET differential amplifier, Differential amplifier with swamping resistor, constant current bias & current mirror. Cascade differential amplifier stages. Level translator. Cascade configuration.

2. **INTRODUCTION TO OPERATIONAL AMPLIFIERS**: The basic operational amplifier & its schematic Bsymbol, Block diagram representation of OP-AMP, Power supply requirements of an OP-AMP, Evolution of OP-AMP., Specification of a typical OP-AMP (741).

3. **THE PRACTICAL OP-AMP:** Input offset voltage, input bias current, input offset current. total output offset voltage, thermal drift, error voltage, variation of OP-AMP parameter with temperature & supply voltage. Supply voltage rejection ration (SVRR), CMRR-Measurement of OP-AMP parameters.

4. **FREQUENCY RESPONSE OF AN OP-AMP:** Frequency response compensator networks. Frequency response of internally compensated OP-AMP & non-compensated OP-AMP. High frequency OP-AMP equivalent circuit, open loop voltage gain as a function of frequency. Slew rate, causes of slew rates and its effects in application.

5. **OPERATIONAL AMPLIFIER CONFIGURATIONS & LINEAR APPLICATION:**
6. Open loop OP-AMP configurations- The differential amplifier, inverting amplifier, non-inverting amplifier, negative feed back configurations - inverting and non inverting amplifiers, voltage followers & high input impedance configuration, differential amplifiers, closed loop frequency response & circuit stability, single supply operation of OP-AMP, summing, scaling and averaging amplifier, voltage to current & current to voltage converters, integrators & differentiators, logarithmic & anti logarithmic amplifiers

7. **ACTIVE FILTERS & OSCILLATORS:** Advantages of active filters, classification of filters, response characteristics of butter worth, chebyshev, causal filters, first order and second order butter worth filters- low pass and high pass types. Band pass & band reject filters. Oscillator principles, types of oscillators - phase shift, wein bridge & quadrature. square wave, triangular wave and saw tooth wave generators, voltage controlled oscillator.

8. **COMPARATORS & CONVERTERS:** Basic comparator & its characteristics, zero crossing detector, voltage limiters, clippers & clampers, small signal half wave & full wave rectifiers, absolute value detectors, sample and hold circuit.

TEXT BOOKS:

1. OP-AMP and linear integrated circuits 2nd edition, PLHI by Ramakant A. Gayakwad.
2. Design with operation amplifiers and Analog Integrated circuits by Sergei Franco.
3. Integrated Electronics: Analog and Digital circuits & system by Millman & Halkias.
4. Linear Integrated Circuits by D.R.Chaudhary (WEL).

ECD-222	ELECTRONIC SWITCHING CIRCUITS	L	T	P	C
		3	1	0	3

1. **Introduction to Sequential Circuits**
   Flip –Flops, Flip-Flop conversions, Classification of Sequential Circuits. Registers and Counter circuits.

2. **Design & Analysis of Synchronous Sequential Circuits**
   Sequential circuits introductory examples, Counters, Finite state Machines, Sequence Detector and Sequence Generator circuits, Definite state model Basic definition, Capabilities & Limitation of finite state machines, state equivalence & machine minimization, simplification of incompletely specified machines, Extraction of maximum compatibles, synthesis & analysis of synchronous sequential circuits.

3. **Design & Analysis of Asynchronous Sequential Circuits**
   Introduction to asynchronous circuits, timing diagram, state diagram & flow tables, fundamental mode circuits, synthesis, state assignment in asynchronous sequential circuits.

4. **Hazards**
   Introduction, gate delays, generation of spikes, production of static hazards in combinational networks, elimination of static hazards, design of hazard free combinational networks, hazard free asynchronous circuit design, dynamic hazards, essential hazards.

5. **Contact Networks & Symmetric Networks**
   Relay contents, analysis & Synthesis of contact Networks, Properties of symmetric functions Synthesis &identification of symmetric functions, Iterative Networks.

Text Books:

1. Switching and finite automata theory by ZVI Kohavi.
2. Logical design of switching circuits by Douglas Lewin.

References:

1. Logic Design by N.N Biswas.

ECD-223	ANALOG COMMUNICATION SYSTEMS	L	T	P	C
		3	1	0	3

1. **Modulation Techniques**
   Various frequency bands used for communication, Types of Communication and need of modulation. Introduction to AM, FM, PM, frequency spectrum of AM Waves, Representation of AM, Power relation in AM waves, Need and description of SSB, Suppression of carrier, Suppression of unwanted side-bands, Independent sideband system, Vestigial sideband system, Mathematical representation of FM, Frequency spectrum of AM waves, Phase Modulation, Comparison between analog and digital modulation, wideband and narrow band FM.

2. **AM Transmitters and Receivers**
   AM Transmitters: Generation of AM, low level and high level modulation, comparison of levels, AM transmitter block diagram, collector class C modulator, Base Modulator, Transistor Vander Bil modulator, DSB S/C modulator. AM Receiver: Tuned radio frequency (TRF) receiver. Super heterodyne receiver, RF section and characteristics, mixers, frequency changing and tracking, IF rejection and IF amplifiers. Detection and automatic gain control (AGC), AM receiver characteristics.

3. **FM Transmitters and Receivers**
   FM Transmitters: Basic requirements and generation of FM, FM Modulation methods: Direct methods, Variable capacitor Modulator, Varactor Diode Modulator, FET Reactance Modulator, Transistor Reactance Modulator, Pre-emphasis, Direct FM modulator, AFC in reactance modulator, Disadvantages of direct method, Indirect modulators, RC-phase shift modulators, Armstrong FM systems. FM Receivers: Limiters, single and double-tuned demodulators, balanced slope detector, Foster-Seely or Phase Discriminator, De-emphasis, ratio Detector, Block diagram of FM Receivers, RF Amplifiers, FM Receiver characteristics.

4. **SSB Transmitters and Receivers**
   Generator of SSB, balanced modulator circuit, filter method, phase shift method, third method, Phase cancellation method, Demodulation of SSB, product demodulator, Diode detection technique of SSB.

5. **Pulse Modulation Techniques**
   Pulse amplitude modulation and demodulation, Pulse width modulation and demodulation, Pulse position modulation and demodulation, Sampling theorem, Time Division Multiplexing, Frequency Division Multiplexing.

Text Books:

1. Electronic communication systems by George Kennedy.
2. Principle of communication systems by Taub and schilling.

References:

1. Electronic communication systems by Tomasi.

ECD-224	VLSI & MEMS Technology	L	T	P	C
		3	1	0	3

1. **Miniaturization of Electronic Systems & its impact on characterization**
   Introduction, Trends & Projections in microelectronics. Semiconductor materials and their merits and demerits. Monolithic chips trends, Advantages, limitations & classification of ICs.
2. **Monolithic Fabrication Techniques**
   Crystal growth: Source of silicon, Single crystalline and Poly crystalline, Requirement of purity for electronics industry, Electronics grade silicon production, Crystal growth techniques: Bridgeman method, float zone method, Czocharalski method, Wafer Preparation & Crystal Defects.
   Epitaxial Process: Need of epitaxial layer, vapors phase epitaxy -reactor design, chemistry of epitaxial process, transport mechanism doping & auto doping, selective epitaxy, epitaxial process induced defects, molecular beam epitaxy, merits and demerits among epitaxial processes, recent trends in Epitaxy.
   Oxidation: Importance of oxidation, types of oxidation techniques, growth mechanism & kinetics, factors affecting the growth mechanisms, silicon oxidation model, dry & wet oxidation, oxidation induced faults, recent trends in oxidation.
   Lithography: Basic steps in lithography**,** lithography techniques-optical lithography, electron beam lithography, x-ray lithography, ion beam lithography, resists and mask preparation of respective lithographies, printing techniques-contact, proximity printing and projection printing, merits and demerits of lithographies, recent trends in lithography at nano regime.
   Etching: Performance metrics of etching, types of etching- wet and dry etching, dry etching techniques-ion beam or ion-milling, sputter ion plasma etching and reactive ion etching (RIE), merits and demerits of etching, etching induced defects.
   Diffusion and Ion Implantation: Diffusion mechanisms, diffusion reactor, diffusion profile, diffusion kinetics, parameters affecting diffusion profile, Dopants and their behavior, choice of dopants, Ion Implantation- reactor design, impurity distribution profile, properties of ion Implantation, low energy and high energy ion implantation.
   Metallization: Desired properties of metallization for VLSI, metallization choices, metallization techniques –vacuum evaporation, sputtering.
3. **Monolithic Components & their Isolation**
   Diodes and Transistors, MOSFETs (Enhancement and depletion mode), Resistors, Capacitors, MOS, CMOS. Various isolation techniques.
4. **Assembly Techniques & Packaging of VLSI chip**
   Introduction to packaging, packaging process, package design considerations, various package types.
5. **Fundamentals of MEMS/NEMS Design & Fabrication**
   Needs for MEMS, MEMS material, MEMS Features, MEMS design limits and safety factors, MEMS processing techniques: Lithography, Galvanik Abforming (LIGA), Lift-off, Chemical Mechanical Polishing, Surface micromachining, Bulk micromachining, Deep Reactive Ion Etching, Application of MEMS, Recent trends in MEMS/NEMS. Challenges and opportunities associated with bringing MEMS to market, Basic MEMS operating principles.

Text Books:

1. S.M. Sze, “VLSI Technology”, TMH
2. S.K. Gandhi, “VLSI Fabrication Principles”, John Willey & Sons
3. S.D Senturia, “Microsystems design”. Kluwer Academic Publishers,2001
4. N.P. Mahalik, “ MEMS”, Tata McGraw Hills Publishers.

References:

1. G.T.A. Kovacs, “Micromachined transducer”, McGraw Hill, 1998.
2. Botkar, “Integrated Circuits”, Khanna Publishers
3. D. Nagchoudhuri, “Principles of Microelectronics Technology” PHI

ECD-225	ELECTRONIC MEASUREMENT & INSTRUMENTATION	L	T	P	C
		3	1	0	3

1. **Instrumentation Scheme & Characteristics**
   Definition, Application and Methods of measurements, instrument classification, Functional Elements of an instrument, input output configuration of measuring instruments, Methods of Correction for interfering and modifying inputs, Standards, calibration, Accuracy, Precision, Loading effects, selection of instruments, Measurement systems–Static and dynamic characteristics, Zero order, first order and second order systems & their response.

2. **Error analysis**
   Types of errors, Methods of error analysis, uncertainty analysis, statistical analysis, Gaussian Error distribution, Rejection of data, method of least square, curve fitting, graphical analysis, General consideration in data analysis.

3. **DC & AC Measurement:**
   Analog Ammeter, Voltmeter and Ohmmeters, PMMC, Moving Iron, Electro-dynamometer, Electrostatic, Ohmmeter, Digital type voltmeter, AC voltmeter using rectifier, true RMS voltmeter, Digital VOM meter.

4. **Transducers**:
   Principles, classification, Guidelines for selection, Requirements, Types and Application of Transducers, Resistance, Capacitance, inductance Transducers, Potentiometer, Strain gauges, LVDT, Piezo Electric transducers, Resistance Thermometers, Thermocouples, Thermistors, Photosensitive Device, Capacitive transducer, Hall Effect transducers, Micro-sensors (Pyroelectric sensors, Thermo sensors using Semiconductor devices, Thermal radiation sensor), Measurement of physical parameters force, pressure, velocity, humidity, moisture, speed, Proximity and displacement.

5. **Display and Indicating Devices:**
   Telemetry & Remote sensing, GIS (Geographical information System), Digital display devices & Recorder, CRO.

6. **Signal Generators & Analyzers**
   Function generators, RF signal generators, Sweep Frequency generator, Frequency synthesizer, Wave analyzer, Harmonic distortion analyzer, Spectrum analyzer.

Text Books:

1. Electronic Instrumentation& Measurement by William D Cooper & Albert C. Helfric, PHI Pub.
2. Electrical and Electronic Measurements and Instrumentation by A. K Sawhney.

References

1. Instruments & Measurement for Electronic by Clyde N. Herrick.

ECD-226	RELIABILITY AND QUALITY MANAGEMENT	L	T	P	C
		3	1	0	3

1. **RELIABILITY**:
   Life of components and classification of failures of components and systems, importance of reliability definition of reliability, distribution function (i) normal (ii) log-normal (iii) exponential and wibull and their importance in reliability theory.

2. **RELIABILITY EVALUATION**:
   For non-maintained and maintained system having functional blocks in (i) series (ii) parallel (iii) series parallel (iv) Non series parallel

3. **RELIABILITY IMPROVEMENT**:
   Improvement of components: Redundancy, stand by with perfect and imperfect switching, comparison of component redundancy to system redundancy.

4. **AVAILABILITY OF SYSTEM**:
   Types of availability and factors affecting it.

5. **MAINTAINABILITY**:
   Concept and definition of maintainability, objective of maintenance, classification of maintenance, factors effecting maintenance levels, diagnostic instruments, documentation, inventory control of spare parts, Maintenance personnel, Pre-votive maintenance schedules for Electronic and Communication Systems.

TEXT BOOKS

1. Reliability engineering by A.K. Gobil.
2. Concept of Reliability Engineering-I (Second Ed.) by S.Srinath

REFERENCE BOOKS

1. Reliability engineering by K.K. Agarwal.

ECD-311	MICROPROCESSOR THEORY & APPLICATIONS	L	T	P	C
		3	1	0	3

1. **Introduction to Microprocessors & Microcomputers**
   History and Evolution, types of microprocessors, Microcomputer Programming Languages, Microcomputer Architecture, Intel 8085 Microprocessor, Register Architecture, Bus Organization, Registers, ALU, Control section, Instruction set of 8085, Instruction format, Addressing modes, Types of Instructions.

2. **Assembly Language Programming and Timing Diagram**
   Assembly language programming in 8085, Macros, Labels and Directives, Microprocessor timings, Micro instructions, Instruction cycle, Machine cycles, T-states, State transition diagrams, Timing diagram for different machine cycles.

3. **Serial I/O, Interrupts and Comparison of Contemporary Microprocessors**
   Serial I/O using SID, SOD. Interrupts in 8085, RST instructions, Issues in implementing interrupts, Multiple interrupts and priorities, Daisy chaining, interrupt handling in 8085, Enabling, Disabling & masking of interrupts.

4. **Data Transfer techniques**
   Data transfer techniques, Parallel & Programmed data transfer using 8155. Programmable parallel ports & handshake input/output, Asynchronous and Synchronous data transfer using 8251. PIC (8259), PPI (8255), DMA controller (8257).

5. **Microprocessor Interfacing Techniques**
   Interfacing Traffic Light Interface, Stepper Motor, 4 Digit 7 Segment LED , Elevator, Musical Tone Generator & 8 Channel 12Bit ADC with Multiplexor & A/D converters, D/A converters.

6. **Architecture of Typical 16-Bit Microprocessors (Intel 8086)**
   Introduction to a 16 bit microprocessor, Memory address space and data organization, Segment registers and Memory segmentation, Generating a memory address, I/O address space, Addressing modes, Comparison of 8086 & 8088, Basic configurations of 8086/8088, Min. Mode, Max. Mode & System timing, Introduction to Instruction Set of 8086.

Text Books:

1. R.S. Gaonkar, Microprocessor Architecture, Programming & Applications with the 8085/8080A, Wiley Eastern Ltd.
2. A.H. Mukhopadhyay, Microprocessor, Microcomputer and Their Applications, 3rd Edition Alpha Science International, Ltd.

References:

1. M. Rafiquzzman: Microprocessors: Theory & Applications (Intel & Motorola), PHI.
2. Berry .B. Bray INTEL 8086/88, 80186, 286, 386, 486, Pentium Pro & Pentium IV.

ECD-312	DIGITAL COMMUNICATION AND SYSTEMS	L	T	P	C
		3	1	0	3

1. **Analog to Digital Conversion**
   Noisy communications channels, The sampling Theorem, low pass signals and band pass signals, pulse Amplitude modulation, channel bandwidth for a PAM signal, Natural sampling, Flat top sampling, signal recovery & holding, Quantization of signal, Quantization error, pulse code modulation (PCM), Delta Modulation, adaptive delta modulation.

2. **Digital Modulation Techniques:**
   Binary phase shift keying, differential phase shift keying, differential encoded PSK, QPSK, Quadrate Amplitude shift keying (QASK) Binary frequency shift keying.

3. **Data Transmission**:
   Base band signal receiver, probability of error, the optimum filter, and white noise-the matched filter, probability of error of the matched filter, coherent reception: correlation, application of coherent reception in PSK and FSK. Correlation receiver for QPSK.

4. **Noise in Pulse Code & Delta Modulation Systems**:
   PCM transmission, calculation of quantization noise, the O/P signal power, the effect of thermal noise, O/P signal to noise ratio in PCM, Delta Modulation, Quantization noise in delta modulation, the O/P signal to quantization noise ratio in delta modulation, O/P signal to noise ratio in delta modulation.

5. **Information Coding and Decoding**:
   Coding for error detection and correction, Block coding – coding, anticoding, Hadamard code, Hamming code, Cyclic Codes, Convolution coding and decoding, Viterbi algorithm, Shannon Fano and Hoffman Codes.

Text Books:

1. Taub & Schilling: Principles of communication systems- McGraw-Hill Education (India).
2. Simon Haykin: Communication systems - John-Wiley & sons, Inc.

Reference Books:

1. Couch: Digital and Analog Communication Systems, 6th edn. Pearson Education.
2. Bernard Sklar: Digital Communication, 2nd Edn. Pearson Education.
3. Marvin K. Simon, Sami M. Hinedi, William C. Lindsey: Digital Communication Techniques, PHI.

ECD-313	ANTENNA AND WAVE PROPOGATION	L	T	P	C
		3	1	0	3

1. **ELECTROMAGNETIC RADIATION**
   Radiation phenomenon from an oscillation dipole in free space, induction and radiation fields, Retarded potentials, Radiated power and radiation resistance from a short dipole , half wave dipole and quarter wave monopole.

2. **ANTENNA BASICS**
   Directional properties of antennas, Radiation patterns, antenna gain and aperture, antenna terminal impedance, self and mutual impedance, front to back ratio, antenna beam width and bandwidth, antenna efficiency, antenna beam area, polarization, antenna temperature and Reciprocity properties of antennas.

3. **ANTENNA ARRAYS**
   Classification of arrays, linear arrays of two point sources, linear arrays of n-point sources, pattern multiplication, array factor, linear arrays of equal amplitude and spacing (Broadside and end fire arrays) of n-point sources, directivity and beam width, non-uniform arrays excitation using Binomial series.

4. **SPECIAL ANTENNAS**
   VLF and LF antennas(Hertz and Marconi antennas), effects of antenna height and effect of ground on performance of antenna , Rhombic antennas, Loop antennas , receiving antenna and radio direction finders. Folded dipole antennas, Yagi-uda antenna, horn antennas, microwave dish, helical antennas, frequency independent antennas, microstrip antennas, fractal antennas.

5. **GROUND WAVE PROPAGATION**
   Characteristics for ground wave propagation, reflection at the surface of a finitely conducting plane and on earth, Attenuation Calculation of field strength at a distance.

6. **IONOSPHERE PROPAGATION**
   The ionosphere, formation of the various layers, their effective characteristics, reflection and refraction of waves by ionosphere, virtual height, maximum frequency, skip distance, regular and irregular variation of ionosphere, Fading and Diversity reception, ordinary and extraordinary waves.

7. **SPACE WAVE PROPAGATION**
   Space wave, range and effect of earth, Troposphere waves-reflection, refraction, duct propagation, Troposphere scatter propagation link

Text Book

1. J.D. Kraus, "Antennas, "McGraw Hill.
2. C.A. Balanis “Antennas Theory and Design”, Willey.
3. K D Prasad “Antenna & Wave Propagation”.

Reference Book

1. E.C. Jorden & B.C.Balmann," Electromagnetic waves & radiating System", P.H.I.
2. R.E.Collins, 'Antennas and Radio Propagation ", McGraw-Hill, 1987.

ECD-314	ELECTRONICS DEVICE MODELLING	L	T	P	C
		3	1	0	3

1. **Introduction to device modelling**
   Introduction, physical significance of device modelling, various devices used in device modelling. material used in device modelling.

2. **Junction Diodes**
   Depletion region of a p-n junction, Depletion-region capacitance, DC, small signal, large signal, high frequency model of diodes. Measurement and extraction of diode model-parameters.

3. **BJT**
   DC, small signal, high frequency of bipolar junction transistors. Extraction of BJT model parameters, Transistor frequency response.

4. **MOSFETs**
   MOSFET fundamentals, Types of MOSFETs, Concept of threshold voltage, Large signal behavior MOSFETs, Comparison of operating regions of Bipolar and MOS Transistors, Shichman Hodges and Level-1 MOS Models, Introduction to Charge–Sheet Models.

5. **Short & Narrow Channel Effects in MOSFETs**
   Velocity saturation from horizontal field, Mobility degradation from the vertical field, Weak Inversion in MOS Transistors, Transistor frequency in weak inversion, Narrow & Short Channel Effects in MOSFETs.

6. **Modern VLSI Devices**
   Principal of hetrojunction devices, High speed devices compound devices, opto devices.

Text Books:

1. S.M.Kang & Y.Leblibici, CMOS Digital Integrated Circuits-Analysis & Design, TMH, 3rd Ed.
2. S.M. Sze, Physics of Semiconductor Devices, Wiley Pub.

References

1. H.M. Rashid, Introduction to PSPICE, PHI.
2. B.G. Streetman & S. Baneerjee, Solid State Electronic Devices, PHI.
3. B. Razavi, Design of Analog CMOS Integrated Circuits,TMH.

ECD-315	CONTROL SYSTEM	L	T	P	C
		3	1	0	3

1. **Basic Concepts**
   Historical review, Definitions, Classification, Relative merits and demerits of open and closed loop systems.

2. **Mathematical Models of Control System**
   Linear and non-linear systems, Transfer function, Mathematical modeling of electrical, mechanical and thermal systems, Analogies, Block diagrams and signal flow graphs.

3. **Control Components**
   DC servomotor, AC servomotor, Potentiometers, Synchronous, Stepper-motor.

4. **Time and Frequency Domain Analysis**
   Transient and frequency response of first and second order systems, Correlation ship between time and frequency domain specifications, Steady-state errors and error constants, Concepts and applications of P, PD, PI and PID types of control.

5. **Stability Analysis**
   Definition, Routh-Hurwitz criterion, Root locus techniques, Nyquist criterion, Bode plots, Relative stability, Gain margin and phase margins.

6. **State Variable Analysis**
   Introduction, Concept of State, State variables & State models, State Space representation of linear continuous time systems. State models for linear continuous –time systems, State variables and linear discrete time systems, Solution of state equations, Concept of Controllability & Observability.

BOOKS/REFERENCES:

1. Discrete time Control Systems by K. Ogata, Prentice Hall International,2nd Edition,1995.
2. Control System Engineering by Nagrath and Gopal,New Age International, 4th Edition,2006
3. Warwick, Kevin, An Introduction to Control Systems, World Scientific Publishing Co. Ptv. Ltd, 2nd ed, 1996.
4. Levine, W. S., Control System Fundamentals, CRC Press,3rd ed, 2000.
5. Distefano, Joseph J. , Stubberud, Allen R., Williams, Ivan J., Feedback and Control
6. Systems, Schaum's Outlines, 2nd ed, 1990.

ECO-316/ECO-325 Open elective-I/II	MEMS AND SENSOR DESIGN	L	T	P	C
		3	1	0	3

1. **Introduction to MEMS**
   Introduction to MEMS and Microsystems, Materials and Substrates for MEMS, Sensors/Transducers, Sensors characterization and classifications, microactuators, Application of MEMS.

2. **Material Properties**
   MEMS materials, structural and sacrificial materials, properties of silicon, mechanical, electrical and thermal properties of materials, Basic modeling of elements in electrical and mechanical systems.

3. **MEMS Fabrication**
   MEMS Fabrication Technologies, single crystal growth, micromaching, photolithography, microsterolithography, thin film deposition, impurity doping, diffusion, etching, bulk and surface micromaching, etch stop technique and microstructure, LIGA.

4. **Mechanical Sensors & Actuators**
   Stress and Strain, Hooke's Law. Stress and Strain of Beam Structures, Cantilever, Pressure sensors, Piezoresistance Effect, Piezoelectricity, Piezoresistive Sensor, capacitive sensors, Inductive sensors, MEMS inertial sensors, micromachined microaccelerometer for MEMS, Parallel-plate Actuator, piezoactuators.

5. **Magnetic Sensors**
   Magnetic material for MEMS, magnetic sensing and detection, mannetoresistive sensors, hall effect, magnetodiode, megnetotransitors, MEMS magnetic sensors, RF MEMS.

6. **Thermal Sensors:**
   Temperature coefficient of resistance, Thermo-electricity, Thermocouples, Thermal and temperature sensors, heat pump, micromachined thermocouple probe, thermal flow sensors, shape memory allloy.

Text Books:

1. Analysis and Design Principles of MEMS Devices by Minhang Bao, ELSEVIER.
2. M. J. Usher, "Sensors and Transducers", McMillian Hampshire.
3. N. P. Mahalik, "MEMS" Tata McGraq Hill.

References

1. R.S. Muller, Howe, Senturia and Smith, "Microsensors", IEEE Press.
2. S. M. Sze, Semiconductor Sensors, Willy –Interscience Publications.

ECO-316/ECO-325 Open elective-I/II	TELECOMMUNICATION SYSTEMS	L	T	P	C
		3	1	0	3

1. **Introduction**
   Basic elements of communication network. Switching systems. Signaling and signaling functions.

2. **Telecommunication systems**
   Digital telephone network.T1 Carrier systems. TDM hierarchy. Data under voice. Digital switching. Echo cancellers.

3. **Transmission modes**
   Introduction Synchronous and asynchronous transmission. Line coding .Error performance. TDM. TDM loops and rings.

4. **Switching systems**
   Space and time divided switches. Multistage switches. Design examples. Path finding. Switching matrix control. Digital time division switch. Time Space switching. Time Space Time switching. Digital Switching in analog environment.

5. **Timing recovery**
   Introduction Timing recovery. Jitter. Network synchronization. Digital subscriber access-ISDN network. ADSL. Traffic analysis

Text Books:

1. J.C. Bellamy, Digital Telephony, (3/e), Wiley, 2000.
2. E.Keiser&E.Strange, Digital Telephony and Network Integration, (2/e), Van Nostrand, 1995.

Reference Books:

1. ThiagarajanViswanathan, Telecommunication Switching Systems and Networks, PHI, 2006.
2. J.E. Flood, Telecommunications Switching, Traffic and Networks, Prentice Hall, 1995.

ECD-321	MICROCONTROLLER & EMBEDDED SYSTEMS	L	T	P	C
		3	1	0	3

1. **Microcontroller**
   Introduction to Microcontrollers, Evolution, Microprocessors vs. Microcontrollers, MCS-51 Family Overview, Important Features, Architecture. 8051 Pin Functions, Architecture, Addressing Modes, Instruction Set, Instruction Types.

2. **Programming**
   Assembly Programming, Timer Registers, Timer Modes, Overflow Flags, Clocking Sources, Timer Counter Interrupts, Baud Rate Generation. Serial Port Register, Modes of Operation, Initialization, Accessing, Multiprocessor Communications, Serial Port Baud Rate

3. **Interrupts**
   Interrupt Organization, Processing Interrupts, Serial Port Interrupts, External Interrupts, and Interrupt Service Routines. Microcontroller Specification, Microcontroller Design, Testing, Timing Subroutines, Look-up Tables, Serial Data Transmission.
4. **Introduction to Embedded Systems**
   Background and History of Embedded Systems, Definition and Classification, Programming languages for embedded systems: desirable characteristics of programming languages for embedded systems, Low-level versus high-level languages, Main language implementation issues: control typing. Major programming languages for embedded systems. Embedded Systems on a Chip (SoC), IP Cores and the use of VLSI designed circuits.
5. **Embedded software development**
   Software development flow, polling, interrupt driven, multi-tasking systems, data types in C programming, Inputs, outputs and peripheral accesses, microcontroller interfaces. Architecture of an RTOS, Important features of RTOS, Embedded Systems Programming, Locks and Semaphores, Operating System Timers and Interrupts, Exceptions, Tasks. Task states and scheduling, Task structures, Synchronization, Communication and concurrency, Semaphores, Real-time clock and system clock.
6. **32-Bit Cortex-M Architecture**
   Technical overview, Important features, Instruction set, Memory system, exceptions and interrupts, exception handling, low power and system control features. Development with Keil and mbed.

Text Books:

1. Mazidi Muhammad Ali, The 8051 Microcontroller and Embedded Systems, second edition, Pearson publications
2. Joseph Yiu, The Definitive Guide to ARM Cortex-M3 processors, third edition, Newnes publication

References:

1. Jonathan W. Valvano, Volume 1, Introduction to ARM Cortex-M Microcontrollers (fifth edition, CreateSpace)
2. Jonathan W. Valvano, Volume 2, Real-Time Interfacing to ARM Cortex-M Microcontrollers (fourth edition, CreateSpace).
3. Jonathan W. Valvano, Volume 3, Real-Time Operating Systems for ARM Cortex-M Microcontrollers (second edition, CreateSpace).

ECD-322	WIRELESS COMMUNICATION	L	T	P	C
		3	1	0	3

1. **Introduction**
   Evolution of wireless communication systems, Examples of wireless communication systems.

2. **The cellular concept – system design fundamentals**
   Concept of frequency reuse, Channel assignment strategies, Handoff strategies, Interference and system capacity, Trunking and grade of service, Improving coverage and capacity in cellular systems.

3. **Propagation models**
   Free space propagation model, Two-ray ground reflection model, Distance power loss, Macro-cell propagation model, Micro-cell propagation model, Shadowing model, Multipath effects in mobile communication, Models for multipath reception.

4. **Equalization, diversity and channel coding**
   Fundamentals of equalization, Adaptive equalizers, Linear and nonlinear equalization, Algorithms for adaptive equalization, Diversity techniques, Fundamentals of channel coding, Overview of error detection and correction codes.

5. **Multiple access techniques**
   Introduction to multiple access, Frequency division multiple access, Time division multiple access, Spread spectrum multiple access, Space division multiple access, Packet radio, Orthogonal frequency division multiple access; Introduction to wireless systems and standards.

Text Book:

1. Wireless Communications: Principles and Practice by Theodore S. Rappaport; Pearson / PHI Publication

References:

1. Wireless Communications and Networks: 3G and Beyond by Iti Saha Misra; Tata McGraw Hill Publication
2. Mobile Cellular Telecommunications: Analog and Digital Systems by William C. Y. Lee; Tata McGraw Hill Publication
3. Wireless and Digital Communications by Dr. Kamilo Feher; PHI Publication

ECD-323	DIGITAL SIGNAL PROCESSING	L	T	P	C
		3	1	0	3

1. **Discrete-time signals and systems**
   Basic elements of a digital signal processing system, Advantages of digital signal processing, Classification of signals, The concept of frequency in continuous-time and discrete-time domain, Discrete-time signals and systems, Analysis of discrete-time linear shift-invariant systems, Linearity, Causality and stability criterion, Discrete-time systems described by difference equations.

2. **Discrete-time Fourier transform**
   The Fourier transform of discrete-time signals (DTFT), Properties of the DTFT, The frequency response of an LTI discrete-time system, The Fourier series of discrete-time signals (DTFS).

3. **Discrete Fourier Transform**
   Frequency domain sampling and the DFT, Properties of the DFT, Linear filtering methods based on the DFT, Efficient computation of the DFT: Decimation-in-time and decimation-in frequency Fast Fourier transform algorithms.

4. **Z-transform**
   Introduction to the Z-transform & the inverse Z-transform, Properties of the Z-transform, relationship between the Fourier transform and the Z-transform, Rational Z-transforms & the System function, Analysis of linear time-invariant systems in the Z-domain.

5. **Digital filter structures**
   Digital filter categories, Realization structures for FIR & IIR digital filters, Implementation of digital filters : Direct form-I, Direct form-II, Cascade form and Parallel form structures for FIR and IIR filters.

6. **Digital filter design**
   General considerations of digital filter design, Linear phase digital filters, Simple digital FIR filters : Low pass, High pass filters, Digital IIR filters : Low pass, High pass , Band pass, Band stop filters.

Text Books:

1. Digital Signal Processing: Principles, Algorithms and Applications by John G. Proakis & Dimitris G. Manolakis; Pearson Education.
2. Digital Signal Processing by Sanjit K. Mitra; Tata McGraw Hill Publication.

References:

1. Digital Signal Processing by Alan V. Oppenheim & Ronald W. Schafer; PHI Publication.
2. Theory & Application of Digital Signal Processing by Rabiner & Gold; PHI Publication.

ECD-324	ANALOG AND DIGITAL VLSI DESIGN	L	T	P	C
		3	1	0	3

1. **MOSFETS**

   Fundamentals of Enhancement Mode MOSFETs, Depletion Mode MOSFETs, Weak & strong Inversion Conditions, Threshold Voltage Concept in MOSFETs, Current-Voltage (IV) Characteristics of a MOSFET, Limitations in IV Model and MOSFET Parasitics. Trends & Projections in VLSI Design & Technology, Flow of VLSI Circuit Design. Scaling in MOS devices.

2. **VLSI Design Styles**

   NMOS, CMOS Process flow, Noise Margin, Inverter Threshold Voltage, NMOS Inverter design and characteristics, CMOS Inverter Design and Properties, Delay and Power Dissipation. Parallel & Series Equivalent circuits, Static CMOS Circuit Design and Precharge-Evaluate logic, Dynamic CMOS logic circuits.

3. **VLSI Physical Design**

   Stick Diagrams, Physical Design Rules, Layout Designing, Euler's Rule for Physical Design. Reliability issues in CMOS VLSI, Latching.

4. **Memory Design**

   ROM Design, SRAM Design.

5. **CMOS Amplifier**

   Single stage CS amplifier, CG amplifier, CD amplifer

6. **CMOS Differential amplifier**

   Single Stage MOS Amplifier, Differential Amplifier and their analysis.

TEXT BOOKS:

1. B.G. Streetman & S. Banerjee, "Solid State Electronic Devices", PHI.
2. S.M. Kang & Y. Leblebici, "CMOS Digital Integrated Circuits-Analysis & Design".
3. B. Razavi, "Design of Analog CMOS Integrated Circuits", TMH.

REFERENCES:

1. K. Eshraghian & Pucknell, "Introduction to VLSI", PHI.

ECD-326	HDL BASED DESIGN	L	T	P	C
		1	0	3	2

1. **Introduction**
   Introduction and levels of abstraction, modeling and hierarchical design concepts, Languages, Compilation & Simulation, concurrency, Logic value system,

2. **Language concepts**
   Lexical conventions, data types, modules and ports, behavioral modeling, dataflow modeling, structural modelling

3. **RTL Design**
   Control & Data partitioning, Synthesis concepts, non synthesizable constructs, operators, expressions, conditional statements, post synthesis simulation, basic test bench

4. **Advanced**
   Procedures and timing control, procedural blocks, loops, Tasks and functions, Testbench modeling techniques, Path delay modeling, Timing analysis, User defined premitives, compiler directives, system tasks.

5. **Hardware modules**
   Boolean equations, Encoders, Decoders, multiplexers, cascaded multiplexers, adders, comparators, multipliers, shifters, Mealy & Moore finite state machine, Implementation on FPGA.

TEXT BOOKS:

1. Peter J. Ashenden, The Designer's Guide to VHDL, 2nd Edition, Morgan Kaufmann Publishers, 2001.
2. J. Bhasker, A Verilog HDL Primer, Star Galaxy Press, 1996.
3. Samir Palnitkar, Verilog HDL : A Guide to Digital Design and Synthesis, Prentice Hall, 1996.

REFERENCES:

1. Vivek Sagdeo, The Complete Verilog Book, Kluwer Academic Publishers.
2. Douglas J. Smith, HDL Chip Design : A Practical guide for Designing, Synthesizing and Simulating ASICs and FPGAs using VHDL or Verilog, Doone Pubns, 1996.
3. Ben Cohen, VHDL Coding Styles and Methodologies, Kluwer Academic Publishers, 1999
4. J. Bhasker, A VHDL Primer, Third Edition, Prentice Hall, 1998.

ECH-411	ENGINEERING ECONOMICS & MANAGEMENT	L	T	P	C
		3	1	0	3

1. **Basic Economics Concept**
   Stock and flow, static and dynamic economics. Micro economics and macro economics, National Income concept.

2. **Market Demand**
   Demand, meaning and types, law of demands, exception to the law of demand, Elasticity of demand, Method of measuring elasticity of demand, marginal utility analysis.

3. **Production Analysis**
   Production function, law of returns, least cost combinations, cost and cost curves. Choice of plant size in the long run, law of supply, elasticity of supply.

4. **Cost Concepts and Estimation**
   Cost element, economics Vs accounting concept of cost and revenues, standard cost, Actual cost, overhead cost, cost control, Break-Even Analysis.

5. **Economic Appraisal Techniques**
   Long range and Short range budgeting, Industrial securities, criteria for project appraisal, social benefit-cost analysis, Deputation concept and techniques.

6. **Monetary System**
   Money and its function, function of the commercial bank and central bank, monetary policy.

7. **Inflation and Business Cycles**
   Causes, Effects and method of control Inflation. Concept of business cycles.

8. **Introduction to International Economics**
   Classification theory and modern theory of international trade, meaning of foreign exchange, equilibrium rate of exchange, purchasing power parity theory, impact of globalization of Indian Economy.

TEXT BOOKS/REFERENCES:

1. A Text book of Economic Theory: by stonier and hauge,pearson Publication.
2. Modern Economic Theory: by Sampat Mukherjee, New Age International Publisher
3. Engineering Economics:by Degramo ,prentice Hall.
4. International Economics: by Bo Sodersten ,Macmillan.
5. Principle of Macroeconomics : by Rangarajan and Dholokia, Tata McGraw Hill.
6. Monetary Economics: by Suraj B.Gupta, S chand.
7. Project planning analysis, Selection, Implementation and review: by Prasanna Chandra, Tata McGraw Hill Education.
8. Cost Accounting: by Jawahar Lal ,McGraw Hill.

ECD-412	OPTICAL COMMUNICATION SYSTEMS	L	T	P	C
		3	1	0	3

1. **OVERVIEW**
   The Electromagnetic Spectrum, Properties of Light, Dual Nature of Light Concept of a photon, Wave Model, Characteristics of light waves. Concepts of information, general communication systems, evolution of Basic Fiber Optic Communication System, Benefits and disadvantages of Fiber Optics. Transmission Windows. Transmission Through Optical Fiber, The Laws of Reflection and Refraction, Light rays and light waves, Reflection of light from optical surfaces, Refraction of light from optical interfaces, The Numerical Aperture (NA), The Optical Fiber, Types of Fiber.

2. **LOSSES IN OPTICAL FIBER**
   Attenuation, Material absorption losses, linear and non linear scattering losses, fiber bend loss, dispersion viz. inter modal dispersion and intra modal dispersion, overall fiber dispersion and polarization, Dispersion shifted and dispersion flattened fibers, attenuation and dispersion limits in fibers, Kerr nonlinearity, self phase modulation, combined effect of dispersion and self phase modulation.

3. **FIBER MATERIAL, COUPLERS AND CONNECTORS**
   Preparation of optical fiber: liquid-phase techniques, vapor phase deposition techniques, Connector Principles, Fiber End Preparation, splices, connectors.

4. **OPTICAL SOURCES AND DETECTORS**
   Sources: Basic principle of surface emitter LED and edge emitter LED- material used, structure, internal quantum efficiency and characteristics, LASER Diode - material used, structure, internal quantum efficiency and characteristics, working Principle and characteristics of Distributed feedback (DFB) laser. Detectors: PIN photodiode - material used, working principle & characteristics, Avalanche Photodiode: - material used, working principle and characteristics

5. **ADVANCED TOPICS**
   Optical TDM, SCM, WDM and Hybrid multiplexing methods, Fiber Optic Networks, Transreceivers for Fiber-Optic Networks, Semiconductor Optical Amplifiers, Erbium Doped Fiber Amplifiers (EDFAs).

6. **OPTICAL NETWORKS**
   Elements and Architecture of Fiber-Optic Network, SONET/SDH, ATM, IP, Optical Line Terminals (OLT), Optical Add-Drop Multiplexers, Optical Cross Connects.

TEXT BOOKS:

1. Optical Fiber Communication Principles & Practice by John M.Senior, PHI Publication
2. Optical Communication Systems by John Gowar, PHI Publications.

REFERENCES:

1. Optical Fiber Communication by Gerd Keiser, Mc Graw Hill International Publications.
2. Fundamentals of Fibre Optics in Telecommunication and sensor systmes by Bishnu P.Pal, New Age International (P) Ltd.
3. Optical Networks Practical Perspective, by Rajiv Ramaswami, Kumar N. Sivarajan, Elsevier.

ECD-413	INDUSTRIAL ELECTRONICS	L	T	P	C
		3	1	0	3

1. **POWER SEMICONDUCTOR DEVICES**
   Thyristor: Thyristor characteristics, Thyristor turn-on methods, Thyristor protection, Series and parallel operation of thyristors, Thyristor commutation; Characteristics of Diac and Triac; Power diode; Power transistor; Power MOSFET; IGBT.

2. **PHASE CONTROLLED CONVERTERS**
   Principle of phase control, Single-phase half-wave circuit with different types of load, Single-phase full-wave mid-point converter, Single-phase full-wave bridge converters, Single-phase semiconverter, Three-phase thyristor converters, Single-phase and three-phase dual converters.

3. **DC CHOPPERS**
   Principle of chopper operation and control strategies, Step-up and step-down choppers, Types of chopper circuits, Voltage-commutated chopper, Current-commutated chopper, Load-commutated chopper.

4. **INVERTERS**
   Single-phase voltage source inverters, Modified McMurray half-bridge and full-bridge inverter, McMurray-Bedford half-bridge and full-bridge inverter, Pulse-width modulated inverters, Current source inverters, Series inverters, Parallel inverter.

5. **APPLICATIONS OF INDUSTRIAL ELECTRONICS**
   Switched mode power supply (SMPS), Uninterruptible power supplies, Solid state relays.

TEXT BOOKS:

1. Power Electronics: Circuits, Devices and Applications by Muhammad H. Rashid; Pearson / PHI Publication.
2. Power Electronics by Dr. P. S. Bimbhra; Khanna Publishers.

REFERENCES:

1. Power Electronics by P. C. Sen; Tata McGraw Hill Publication.
2. Power Electronics by C. W. Lander; McGraw Hill Publication.

ECE-414(A)	SATELLITE COMMUNICATION	L	T	P	C
		3	1	0	3

1. **ORBITAL MECHANISM**
   Satellite orbit and orbital equations, Kepler's laws of planetary motion, locating satellite in the orbit, locating satellite with respect to earth, Look angle calculation, coverage angle and slant range, orbital perturbations, satellite launching, orbital effects in communication subsystem performance.

2. **SATELLITES**
   Satellite subsystems, Attitude and orbit control system, Telemetry tracking command and monitoring, power system, communication subsystem, satellite antennas.

3. **SATELLITE LINK DESIGN**
   Basic link analysis, Interference analysis, terrestrial interference, Intermodulation interference, inter-symbol interference and rain induced attenuation, uplink power control, system availability, system design for link without frequency reuse and system design for link with frequency reuse.

4. **EARTH STATION**
   Earth station antenna types, Antenna gain, antenna gain to noise temperature ratio, G/T measurement, frequency division multiple access, FDM-FM-FDMA, Single channel per carrier.

5. **SATELLITE BASED NAVIGATION SYSTEM:**
   The principle of measuring signal transit time, Basic principles of satellite navigation, Signal travel time Determining position, The effect and correction of time error, functional segments of GPS, Improved GPS: DGPS, SBAS, A-GPS and HSGPS.

TEXT BOOKS:

1. Tri, T.Ha, "Digital Satellite Communications, " (Second Edition) Tata McGraw Hill.
2. Timothy Pratt, Jeremy E., "Satellite Communications," Willey.
3. G S Rao, "Global Navigation Satellite Systems," Tata McGraw Hill.

REFERENCE BOOKS:

1. Nagaraja, "Electronic Navigation", Tata McGraw Hill.
2. Jay Farrell, "The Global Positioning System & Inertial Navigation," Tata McGraw Hill.

ECE-414(B)	TV AND DISPLAY TECHNOLOGY	L	T	P	C
		3	1	0	3

1. Cathode ray tube display (CRT).
2. Liquid crystal display (LCD) - High-Performance Addressing display (HPA), Thin-film transistor display (TFT).
3. Light-emitting diode display (LED), Electroluminescent display (ELD), Organic light-emitting diode display (OLED).
4. 3D Display, Mobile Displays.
5. Fundamentals of HDTV, IPTV.

TEXT/REFERENCE BOOKS:

1. Joseph A. Castellano, Handbook of Display Technology, Gulf Professional Publishing, 1992.
2. Chen J., Cranton W., Fihn M, Handbook of Visual Display Technology, Springer, 2012.

ECE-414(C)	BIOMEDICAL ELECTRONICS	L	T	P	C
		3	1	0	3

1. **Biomedical Signals**
   Origins of Bioelectric Signals, Human body, Heart and Circulatory System, Electrodes, Transducers, ECG, EMG.

2. **Recording & Monitoring Instruments :**
   RecordingElectrodes,Recording Electrodes, Recording ,Electrodes, Recording Electrodes, Physiological Transducers, Biomedical Recorders, Biomedical Recorders, Heart rate measurement, Temperature measurement, Foetal Monitoring System, Foetal Monitoring System, Foetal Monitoring System, Foetal Monitoring System, Biomedical Telemetry.

3. **Imaging System:**
   Working with X-Rays, CT scanner, NMR, NMR, Ultrasonic System, Ultrasonic System, Ultrasonic System.

4. **Therapeutic & Physiotherapy Equipment's:**
   Cardiac Pacemakers, Cardiac defibrillator, SW Diathermy & MW Diathermy.

5. **Patient Safety**
   Electric Shock Hazards, Test Instruments, Biomedical Equipment's, Biomedical Equipment's.

Text Books

1. Handbook of Biomedical Instrumentation by R.S. Khandpur.
2. Biomedical Instrumentation and Measurements: Leslie Cromwell, PHI.

Reference Books:

1. Introduction to bioinformatics: T.K. Attuwood, Pearson Education.
2. Introduction to biomedical equipment Technology: Joseph J. Carr & John M Brown, Pearson Education.

ECE-414(D)	SIGNAL AND SYSTEMS	L	T	P	C
		3	1	0	3

1. **Linear Wave Shaping:**
   High pass, low pass RC circuits, their response for sinusoidal, step, pulse, square and ramp inputs. RC network as differentiator and integrator, attenuators, its applications in CRO probe, RL and RLC circuits and their response for step input, Ringing circuit.

2. **Non- Linear Wave shaping:**
   Diode clippers, Transistor clippers, clipping at two independent levels, Transfer characteristics of clippers, Emitter coupled clipper, Comparators, applications of voltage comparators, clamping operation, clamping circuits using diode with different inputs, Clamping circuit theorem, practical clamping circuits, effect of diode characteristics on clamping voltage, Transfer characteristics of clampers.

3. **Switching characteristics & Devices:**
   Diode as a switch, piecewise linear diode characteristics, Transistor as a switch, Break down voltage consideration of transistor, saturation parameters of Transistor and their variation with temperature, Design of transistor switch, transistor-switching times.

4. **Time Base Generators :** General features of a time base signal, methods of generating time base waveform, Miller and Bootstrap time base generators – basic principles, Transistor miller time base generator,Transistor Bootstrap time base generator, Current time base generators.

5. **Synchronization & frequency Shaping :** Principles of Synchronization, Frequency division in sweep circuit, Astable relaxation circuits, Monostable relaxation circuits, Synchronization of a sweep circuit with symmetrical signals, Sine wave frequency division with a sweep circuit. Sampling gate Basic operating principles of sampling gates, Unidirectional and Bi-directional sampling gates, Reduction of pedestal in gate circuits, Applications of sampling gates.

6. **Classification of signals and systems**
   Continuous time signals (CT signals), discrete time signals (DT signals) - Step, Ramp, Pulse, Impulse, Exponential, Classification of CT and DT signals - periodic and periodic, random singals, CT systems and DT systems, Basic properties of systems - Linear Time invariant Systems and properties.

TEXT BOOKS:

1. Pulse, Digital and Switching Waveforms - J. Millman and H. Taub, McGraw-Hill.
2. Solid State Pulse circuits - David A. Bell, PHI.
3. A.V. Oppenheim, A.S. Willsky and I.T. Young, "Signals and Systems", Prentice Hall, 1983.

REFERENCES:

1. Pulse and Digital Circuits – A. Anand Kumar.
2. Wave Generation and Shaping - L. Strauss.

ECE-414(E)	MOBILE COMMUNICATION	L	T	P	C
		3	1	0	3

1. **Introduction**
   Wireless communication systems, Applications of wireless communication systems, Types of wireless communication systems, trends in mobile communication systems.

2. **Cellular Mobile Systems:** Basic cellular systems, Performance criteria, Uniqueness of mobile radio environment, Operation of cellular systems, analog & digital cellular systems.

3. **Elements of Cellular Radio System Design**
   Concept of frequency reuse channels, Co-channel interference reduction factor, Desired C/I from a normal case in an omnidirectional antenna system, Handoff mechanism, Cell splitting.

4. **Interference in Cellular Mobile System**
   Co-channel interference, Design of an omnidirectional antenna system in the worst case, Design of a directional antenna system, Lowering the antenna height, Power control, Reduction in CI by tilting antenna, umbrella pattern effect Adjacent-channel interference, Near-end – far-end interference, Effect on near-end mobile units.

5. **Frequency management, channel assignment and handoffs**
   Frequency management, Frequency-spectrum utilization, Set-up channels, Fixed channel assignment schemes, Non-fixed channel assignment schemes, Concept of handoff, Initiation of a hard handoff, Delaying a handoff, Forced handoffs, Queuing of handoffs, Power-difference handoffs, Mobile assisted handoff, Soft handoffs, Cell-site handoff, Intersystem handoff, dropout calls.

6. **GSM system overview**
   GSM system architecture, GSM radio subsystem, GSM channel types, Frame structure for GSM, Signal processing in GSM, GPRS and EDGE.

7. **Wireless Networks**
   Overview of Wi-Fi, WiMAX and Bluetooth technology (Basic features and physical specifications).

Text Books:

1. Mobile Cellular Telecommunications: Analog and Digital Systems by William C. Y. Lee; Tata McGraw Hill Publication.
2. H. Labiod, H. Afifi, C. De Santis: WI-FI, BLUETOOTH , ZIGBEE and WIMAX-Springer-2007
3. Wireless Communications: Principles and Practice by Theodore S. Rappaport; Pearson / PHI Publication

References:

1. Wireless Communications and Networks: 3G and Beyond by Iti Saha Misra; Tata McGraw Hill Publication
2. Wireless and Digital Communications by Dr. Kamilo Feher; PHI Publication

ECE-414(F)	TELECOMMUNICATION MANAGEMENT	L	T	P	C
		3	1	0	3

1. **Principles and Evolution of Switching Systems:**
   Basics of switching system, manual switching system, rotary dial telephone, signaling tones, Strowger switching components, step-by-step switching, design for 100 line, 1000 line, 10,000 line exchange, touch tone dial telephone, cross bar switching and exchange organization. Four wire concept, operation of hybrid, echo suppressors. Centralized and distributed SPC, software architecture, application software, enhanced services offered by SPC.

2. **Space Division Switching:**
   Two, three and multistage space division networks, blocking probability calculations using Lee's method. Time Division Switching: Basic time division space switching, time division time switching, time multiplexed space switching, time multiplexed time switching. Combination Switching: S-T, T-S, S-T-S, T-S-T and other multistage combination switching.

3. **Traffic Engineering:**
   Network traffic load and parameters, GOS and blocking probability, modeling switching systems, incoming traffic and service time characterization, blocking models and loss systems, delay systems.

4. **Telephone Networks:**
   Subscriber loop systems, high data rate digital subscriber loop, asymmetric digital subscriber loop, VDSL, transmission plan, transmission systems, numbering plan, charging plan, basics of signaling, In channel signaling, common channel signaling.

5. **Data Networks:**
   Data transmission in PSTN, switching techniques for data transmission, OSI reference model, Satellite based data networks, fiber optic networks, protocol stacks, internetworking. ISDN services, transmission channels and user network interface in ISDN, ISDN protocol architecture, ISDN standards, ISDN numbering and addressing. Introduction to the basic principles of frame relay, TCP/IP and ATM.

Text Books:

1. Thiagarajan Viswanathan, "Telecommunication Switching Systems and Networks", PHI Learning, New Delhi, 2008.
2. John C. Bellamy, "Digital Telephony", John Wiley and Sons, Third edition, 2000.

Reference Book:

1. J.E.Flood, "Telecommunication switching traffic and networks", Pearson Education Ltd, New Delhi, 2001.

ECE-415(A)	MEMS & SENSOR DESIGN	L	T	P	C
		3	1	0	3

1. **Introduction to MEMS**
   Introduction to MEMS and Microsystems, Materials and Substrates for MEMS, Sensors/Transducers, Sensors characterization and classifications, microactuators, Application of MEMS.

2. **Material Properties**
   MEMS materials, structural and sacrificial materials, properties of silicon, mechanical, electrical and thermal properties of materials, Basic modeling of elements in electrical and mechanical systems.

3. **MEMS Fabrication**
   MEMS Fabrication Technologies, single crystal growth, micromaching, photolithography, microsterolithography, thin film deposition, impurity doping, diffusion, etching, bulk and surface micromaching, etch stop technique and microstructure, LIGA.

4. **Mechanical Sensors & Actuators**
   Stress and Strain, Hooke's Law. Stress and Strain of Beam Structures, Cantilever, Pressure sensors, Piezoresistance Effect, Piezoelectricity, Piezoresistive Sensor, capacitive sensors, Inductive sensors, MEMS inertial sensors, micromachined microaccelerometer for MEMS, Parallel-plate Actuator, piezoactuators.

5. **Magnetic Sensors**
   Magnetic material for MEMS, magnetic sensing and detection, mannetoresistive sensors, hall effect, magnetodiode, megnetotransitors, MEMS magnetic sensors, RF MEMS.

6. **Thermal Sensors:**
   Temperature coefficient of resistance, Thermo-electricity, Thermocouples, Thermal and temperature sensors, heat pump, micromachined thermocouple probe, thermal flow sensors, shape memory allloy.

Text Books:

1. Analysis and Design Principles of MEMS Devices by Minhang Bao, ELSEVIER.
2. M. J. Usher, “Sensors and Transducers”, McMillian Hampshire.
3. N. P. Mahalik, “MEMS” Tata McGraq Hill.

References

1. R.S. Muller, Howe, Senturia and Smith, “Microsensors”, IEEE Press.
2. S. M. Sze, Semiconductor Sensors, Willy –Interscience Publications.

ECE-415(B)	FPGA & SoC DESIGN	L	T	P	C
		3	1	0	3

1. **Revision of basic Digital systems:**
   Combinational Circuits, Sequential Circuits, Timing, Power Dissipation. Current state of the field. SoC, IP Design, SoPC. Design methodology, System Modeling, Hardware-Software Co-design, Device Technology and Application Domains.

2. **Digital system Design:**
   Top down Approach to Design, Case study. Data Path, Control Path, Controller behavior and Design, Case study Mealy & Moore Machines, Timing of sequential circuits, Pipelining, Resource sharing, FSM issues (Starring state, Power on Reset, State diagram optimization, State Assignment,Asynchronous Inputs, Output Races, fault Tolerance.

3. **HDL for synthesis:**
   Introduction, Behavioral, Data flow, Structural Models. Simulation Cycles. Process. Concurrent Statements. Sequential Statements. Loops. Delay Models. Sequential Circuits, FSM Coding. Library. Functions, Procedures. Test benches.

4. **FPGA deisgn:**
   Introduction.Logic Block Architecture.Routing Architecture. Programmable Interconnections. Design Flow. Xilinx Virtex-V (Architecture). Boundary Scan. Programming FPGA's. Constraint Editor, Static Timing Analysis. One hot encoding. Applications. Tools. Embedded System on Programmable Chip.Hardware-software co-simulation, Bus function models, BFM Simulation. Debugging FPGA Design.

5. **SoC design:**
   System-level and SoC design methodologies and tools, HW/SW Co-design, analysis, partitioning, real-time scheduling, hardware acceleration, Virtual platform models, co-simulation and FPGAs for prototyping of HW/SW systems, Introduction to SystemC, SoC and IP integration, verification and test.

Textbooks:

1. Zainalabedin Navabi, Verilog, analysis and modeling of digital systems, McGraw-Hill.
2. D. Black, J. Donovan, SystemC: From the Ground Up, Springer, 2004.

References:

1. Jon F Wakerly, Digital Design: Principles and Practices, Prentice Hall.
2. G. De Micheli, Synthesis and Optimization of Digital Circuits, McGraw-Hill, 1994.

ECE-415(C)	RF IC DESIGN	L	T	P	C
		3	1	0	3

1. **Characteristics of passive IC components at RF frequencies**:
   Interconnects, resistors, capacitors, inductors and transformers – Transmission lines. Noise – classical two-port noise theory, noise models for active and passive components

2. **High frequency amplifier design:**
   Zeros as bandwidth enhancers, shunt-series amplifier, f_T doublers, neutralization and unilateralization

3. **Low noise amplifier design**:
   LNA topologies, power constrained noise optimization, linearity and large signal performance

4. **Mixers**:
   Nonlinear systems as linear mixers, multiplier-based mixers, subsampling mixers, diode-ring mixers

5. **RF power amplifiers**:
   Class A, AB, B, C, D, E and F amplifiers, modulation of power amplifiers, design and linearity considerations

6. **Oscillators & synthesizers**:
   Basic topologies, VCO, describing functions, resonators, negative resistance oscillators, synthesis with static moduli, synthesis with dithering moduli, combination synthesizers – phase noise considerations.

Text Books:

1. Thomas H. Lee, The Design of CMOS Radio-Frequency Integrated Circuits, 2nd ed., Cambridge, UK: Cambridge University Press, 2004.
2. Behzad Razavi, RF Microelectronics,2nd Ed., Prentice Hall, 1998.

Reference Books:

1. A.A. Abidi, P.R. Gray, and R.G. Meyer, eds., Integrated Circuits for Wireless Communications, New York: IEEE Press, 1999.
2. R. Ludwig and P. Bretchko, RF Circuit Design, Theory and Applications, Pearson, 2000.

ECE-415(D)	ADVANCED IC DESIGN	L	T	P	C
		3	1	0	3

1. **Operational Amplifier Design** using CMOS as well as Bipolar technologies. Linear and non linear applications of operational amplifiers. Active filters, response characteristics of Butter worth, Chebyshev and causal filters. Design and analysis of higher order filters of all types.

2. **Design of Super Buffer Circuits** for driving large capacitive loads. Design and analysis CMOS Schmitt trigger circuit.

3. **Comparators** and their characteristics zero crossing detector, voltage limiters, absolute value detectors, sample and hold circuit.

4. **Biomedical applications** of instrumentation amplifier. Design and analysis of multi-vibrator circuits using transistors, Op-Amps and 555 Timer.

5. **Design and analysis of oscillator circuits** using transistors and Op-Amps. Phase shift, Wein Bridge and quadrature oscillators. Square wave, triangular wave, saw tooth wave generators and voltage controlled oscillator.

6. **Differential and Feedback Amplifiers** and their analysis.

Text Books:

1. P.E. Allen, D. R. Holberg, ‘CMOS Analog Circuit Design’.
2. S.M. Kang & Y. Leblebici, ‘CMOS Digital Integrated Circuits-Analysis & Design’, TMH.
3. R.A. Gayakwad, ‘OP-AMP and Linear Integrated Circuits’, 2nd edition, PHI.

References:

1. J. Millman & H. Taub, ‘Pulse, Digital and Switching Waveforms’, TMH.
2. B.G. Streetman and S. Banerjee, ‘Solid State Electronic Devices’, PHI.
3. B. Razavi, ‘Design of Analog CMOS Integrated Circuits’, Tata Mcgraw Hill, 2005.

ECE-415(E)	HDL based design	L	T	P	C
		3	1	0	3

1. **Introduction**
   Introduction and levels of abstraction, modeling and hierarchical design concepts, Languages, Compilation & Simulation, concurrency, Logic value system

2. **Language concepts**
   Lexical conventions, data types, modules and ports, behavioral modeling, dataflow modeling, structural modelling.

3. **RTL Design**
   Control & Data partitioning, Synthesis concepts, non synthesizable constructs, operators, expressions, conditional statements, post synthesis simulation.

4. **Hardware modules**
   Boolean equations, Encoders, Decoders, multiplexers, cascaded multiplexers, adders, comparators, multipliers, sorters, shifters, static and dynamic memories, Mealy & Moore finite state machine, Implementation on FPGA

Text Books:

1. Peter J. Ashenden, The Designer's Guide to VHDL, 2nd Edition , Morgan Kaufmann Publishers, 2001
2. J. Bhasker, A Verilog HDL Primer, Star Galaxy Press, 1996
3. Samir Palnitkar, Verilog HDL : A Guide to Digital Design and Synthesis, Prentice Hall, 1996

References:

1. Vivek Sagdeo, The Complete Verilog Book, Kluwer Academic Publishers.
2. Douglas J. Smith, HDL Chip Design : A Practical guide for Designing, Synthesizing and Simulating ASICs and FPGAs using VHDL or Verilog, Doone Pubns, 1996.
3. Ben Cohen, VHDL Coding Styles and Methodologies, Kluwer Academic Publishers, 1999.
4. J. Bhasker, A VHDL Primer, Third Edition, Prentice Hall, 1998.

ECD-421	MICROWAVE DEVICES & SYSTEMS	L	T	P	C
		3	1	0	3

1. **Introduction on Microwaves**
   Frequency allocations and frequency plans, Microwave waveguide, Rectangular waveguide and its analysis, circular waveguide, modes of propagation, dominant modes, cut off wavelength, mode excitation.
2. **Microwave generators and amplifiers**
   Limitations of conventional tubes at microwave frequency, reflex klystron, two and multi cavity klystron amplifiers and oscillators and their analysis, Basics on Magnetrons and traveling wave tube and their applications.
3. **Microwave devices**
   Scattering matrix of microwave waveguide junction, properties of S-matrix, E-plane tee, H-plane tee, magic tee, attenuators, directional couplers, ferrite devices, Faraday rotation, gyrator, isolator, circulators and cavity resonators
4. **Microwave solid-state devices**
   Gunn diode and its modes of operation, Avalanche IMPATT diode, TRAPATT diode, operations and V-I characteristics of Tunnel diode, Schottky diode, Backward diode and Varactor diodes, PIN diode and its applications.
5. **Microwave Measurements**
   Measurement of standing wave ratio, measurement of wavelength and frequency, measurement of power, radiation pattern measurement of antenna.
6. **Micro-Strip Lines**
   Introduction on Micro strip lines, characteristic impedance of micro strip lines, losses in micro strip lines, quality factor of micro strip, parallel strip lines, coplanar strip lines and shielded strip lines.
7. **Microwave Link**
   Microwave radio station, microwave transmitter and receiver, multiplexing equipment, microwave link.

Text Books:

1. Foundations for Microwave Engineering, International student edition, R E.Collins
2. Microwave Engg by M Kulkarni,
3. Microwave Devices and Circuits ‘3rd edition’ Samuel Y Liao.

Reference Books:

1. Microwave Engg, David M. Pozar, Wily Publication
2. Microwave Engineering by A Das and S K Das
3. Microwave Engineering Rajeswari Chatterjee
4. Microwaves by M.L.Sisodiya and Vijay Laxmi Gupta

ECD-422	SPREAD SPECTRUM AND CDMA	L	T	P	C
		3	1	0	3

1. **Principles of direct spread spectrum**
   Direct spectrum system: Definition and concepts, Spreading Sequences and Waveforms, Random Binary Sequence, Shift-Register Sequences, Periodic Auto Correlations, Polynomials over the Binary Field, Systems with PSK Modulation, Power Spectral density of DSS-CDMA, Pulsed Interference, De-spreading with Matched Filter.
2. **Frequency Hopped Systems**
   Concepts and characteristics, Modulations, MFSK, Hybrid Systems, Frequency Synthesizers, Direct Frequency Synthesizer, Digital Frequency Synthesizer, Indirect Frequency Synthesizers.
3. **Spreading Code Acquisition and Tracking**
   Initial Code acquisition, Acquisition strategy: Serial Search, Parallel Search, multi-dwell detection, false alarm and miss probability for matched filter receiver, False alarm and miss probability for radiometer, mean overall acquisition time for serial search.
4. **Performance of Spread Spectrum System**
   Link performance of direct sequence spread spectrum CDMA in (i) Additive White Noise Channel (ii) Multipath fading Channel. Concept of Rake Receiver, Performance of RAKE receiver in multipath fading.
5. **CDMA Systems**
   CDMA-IS-95: Forward link Channels, Reverse link Channels, Power Controls and Handoff Procedure in IS-95, Overview of CDMA based 3G Systems.

Text Books:

1. Don Torrieri: Principles of Spread Spectrum Communication Systems- Springer Science & Business Media, Inc.
2. Andrew J. Viterbi: CDMA: Principles of Spread Spectrum Communication – Addison-Wesley Publishing Company.

References:

1. Mosa Ali Abu-Rgheff, “Introduction to CDMA Wireless Communications”, Elsevier Academic Press.
2. R. MichaelBuehrer, “Code Division Multiple Access-CDMA”, Morgan & Claypool Publishers Series.
3. Jhong S. Lee and Leonard E. Miller, “CDMA Systems Engineering Handbook”, Artech House Publishers.
4. R. Michael Buehrer, “Code Division Multiple Access (CDMA),” Morgan and Claypool Publishers.

ECD-423	DATA COMMUNICATION & COMPUTER NETWORKS	L	T	P	C
		3	1	0	3

1. **Introduction to Data Communication**
   Goals and Applications of Networks, Wireless Network, Interfaces and services. Reference Models: The OSI reference model, TCP/IP reference model.

2. **Physical Layer**
   Data and Signals, Digital and Analog transmission, Transmission Media, Wireless transmission, Switching

3. **Data Link Layer**
   Data link layer design issues, Services provided to Network layers, Framing, Error control, Flow control, Error detection and correction, Elementary data link protocols, An unrestricted Simplex protocol, A Simplex Stop-and-Wait protocol, Simplex Protocol for a noisy channel, Sliding Window protocols, A protocol using go-back-N, A protocol using selective repeat, Example data link protocol-HDLC, PPP.

4. **Medium Access Sublayer**
   Channel Allocations, Random Access, ALOHA, Carrier Sense Multiple Access Protocols, Collision free Protocols, Limited contention protocols, Controlled Access, Channelization, Wired LANs: Ethernet, Wireless LANs.

5. **Network Layer**
   Network Layer Design issue, Logical Addressing, Address Mapping, Error Reporting and Multicasting, Delivery Forwarding and Routing.

6. **Transport Layer**
   Process to Process Delivery: UDP,TCP and SCTP.

7. **Application Layer**
   Design issues of the layer, Domain Name systems, File Transfer, http, web documents, Virtual Terminals.

Text Books:

1. J Frauzon “Computer Communication and Networks”.
2. W. Stallings, “Data and computer communication”, PHI.

References:

1. S. Keshav, “An Engineering Approach on Computer Networking”, Addison Welsey.
2. Wayne Tomasi “Introduction to Data Communications and Networking” Pearson.
3. A.S. Tanenbaum, “Computer Networks”, PHI.

ECE-424(A)	OPTICAL NETWORKS	L	T	P	C
		3	1	0	3

1. **Introduction to Optical Network**
   Services, Circuit Switching, Packet Switching, Optical Networks, Optical Layer, Transparency and All Optical Networks, Optical Packet Switching, Transmission Basics, Network Evolution.

2. **Optical Amplifiers**
   Stimulated Emission, Spontaneous Emission, Erbium Doped Fiber amplifiers, Raman amplifiers, Semiconductor Optical Amplifiers, Cross talk in SOAs.

3. **Multiplexers and Filters to Wavelength Converters**
   Gratings, Diffraction Pattern, Bragg Gratings, Fiber Gratings, Fabry-Perot filters, Multilayer Dielectric Thin-Film Filters, Mach-Zehnder Interferometers, Arrayed Waveguide Grating, Acousto-Optic Tunable Filter, High channel Count Multiplexer Architectures, Optoelectronics Approach, Optical Gating, Interferometric Techniques, Wave Mixing.

4. **Transmission System Engineering**
   System Model, Power Penalty, Transmitter, Receiver, Optical Amplifiers, Cross talk, Dispersion, Fiber Nonlinearities, Wavelength Stabilization Design of Soliton Systems, Design of Dispersion –Managed Soliton Systems.

5. **Client Layers of the Optical Layer**
   SONET/SDH, ATM, IP, Storage Area Networks, Gigabit and 10-Gigabit Ethernet.

6. **WDM Network Elements & Design**
   Optical Line Terminals, Optical Line Amplifiers, Optical Add/Drop Multiplexers, Optical Cross connects. Cost Trade-Offs: A Detailed Ring Network Example, LTD and RWA Problems, Dimensioning Wavelength-Routing Networks, Statistical Dimensioning Models, Maximum Load Dimensioning Models

7. **Access Networks**
   Network Architecture Overview, Enhanced HFC, and fiber to the Curb (FTTC).

Textbooks/References

1. Optical Networks: A practical Perspective. Ramaswami & K.N. Sivarajan Morgan
2. Kaufmann 2nd Edition. G.P. Agarwal, "Fiber optic communication systems ", 2nd Edition, John Wiley & Sons, New York, 1997.
3. Franz and Jain, "Optical communication system ", Narosa Publications, New Delhi, 1995.
4. G.Keiser, "Optical fiber communication ", Systems, McGraw-Hill, New York, 2000.
5. Franz & Jain, "Optical communication ", Systems and components, Narosa Publications, New Delhi, 2000.

ECE-424(B)	WIRELESS SENSOR NETWORKS	L	T	P	C
		3	1	0	3

1. **Introduction**
   Wireless sensor networks: the vision, Networked wireless sensor devices Applications of wireless sensor networks, Key design challenges

2. **Network deployment**
   Structured versus randomized deployment, Network topology, Connectivity in geometric random graphs, Connectivity using power control, Coverage metrics, Mobile deployment

3. **Localization and Time synchronization**
   Key issues, Localization approaches, Coarse-grained node localization using minimal information, Fine-grained node localization using detailed information, Network- wide localization, Theoretical analysis of localization techniques, Key issues of time synchronization, Traditional approaches, Fine-grained clock synchronization, Coarse-grained data synchronization

4. **Wireless characteristics and Medium-access**
   Wireless link quality, Radio energy considerations, The SINR capture model for interference, Traditional MAC protocols, Energy efficiency in MAC protocols, Asynchronous sleep techniques, Sleep-scheduled techniques, and Contention-free protocols.

5. **Sleep-based topology control and Energy-efficient routing**
   Constructing topologies for connectivity, Constructing topologies for coverage, Set K-cover algorithms, Cross-layer issues, Metric-based approaches, Routing with diversity, Multi-path routing, Lifetime-maximizing energy-aware routing techniques, Geographic routing, Routing to mobile sinks

6. **Dta-centric networking**
   Data-centric routing, Data-gathering with compression, Querying, Data-centric storage and retrieval, the database perspective on sensor networks

7. **Transport reliability and congestion control**
   Basic mechanisms and tunable parameters, Reliability guarantees, Congestion control, Real-time scheduling

Text/Reference Books:

1. Bhaskar Krishnamachari: Networking Wireless Sensors- Cambridge University Press
2. Kazem Sohraby, Daniel Minoli, Taieb Znati: Wireless Sensor Networks: Technology, Protocols and Applications- John Wiley & Sons

ECE-424(C)	SIGNAL PROCESSING FOR IMAGE AND VIDEO	L	T	P	C
		3	1	0	3

1. **Digital image fundamentals**
   Image acquisition, representation, visual perception, quality measures, sampling and quantization, basic relationship between pixels, imaging geometry, color spaces, Video spaces, analog and digital video interfaces, video standards.

2. **Two dimensional systems**
   Properties, analysis in spatial, frequency and transform domains.

3. **Image transforms**
   DFT, DCT, Sine, Hadamard, Haar, Slant, KL transform, Wavelet transform. Image enhancement – point processing, spatial filtering,

4. **Image restoration**
   Inverse filtering, de-blurring. Video processing – display enhancement, video mixing, video scaling, scan rate conversion.

5. **Image compression**
   lossless and lossy compression techniques, standards for image compression – JPEG, JPEG2000.

6. **Video compression**
   Motion estimation, intra and interframe prediction, perceptual coding, standards - MPEG, H.264 Image segmentation – feature extraction, region oriented segmentation, descriptors, morphology, Image recognition .

Text/Reference Books:

1. R. C. Gonzalez and R E Woods, Digital Image Processing, Pearson Education, 2002
2. A K Jain, Fundamentals of Digital Image Processing, Pearson Education,1989
3. W Pratt, Digital Image Processing, Wiley, 2001
4. Al Bovik, Handbook of Image and Video, Academic Press, 2000
5. Keith Jack, Video Demystified, LLH, 2001

ECE-424(D)	ERROR CONTROL & CODING	L	T	P	C
		3	1	0	3

1. **Linear Block Codes**
   The Repetition codes, Vector space over binary field, Syndrome Error Detection, Minimum distance of block codes, Hamming codes, Error detection and correction, Shortened and extended linear block codes.

2. **Cyclic Codes**
   Definition, Polynomials, Generator polynomials, Encoding and Decoding, Generator and Parity check matrices for cyclic codes. Linear feedback shift registers for encoding and decoding cyclic codes, The Meggitt decoder.

3. **BCH and RS codes**
   Galois fields, GF(2^3), GF(2^4), GF(2^5), Primitive field elements, Irreducible and primitive polynomials, Minimal Polynomials, Definition and construction of binary BCH Codes, Decoding of BCH Codes, Error location Polynomial, PGZ - Decoder, RS codes, The Berlekamp algorithm.

4. **Convolution Codes**
   Convolution codes and encoders, Convolution encoder representation, The Veterbi decoder.

5. **LDPC and Turbo Codes**
   Introduction to LDPC and Turbo Codes.

Text Books:

1. J. C. Moreira, P. G. Farrell, “Essentials of Error – Control Coding”, Wiley.
2. S. Gravano, “Introduction to Error Control Codes”, Oxford University Press.

Reference Books:

1. Shu Lin and Daniel J. Costello Jr., “Error Control Coding: Fundamentals and Applications”, Prentice Hall.
2. Tood K. Moon, “Error Correction Coding” Wiley.

ECE-424(E)	RADAR & NAVIGATIONAL AIDS	L	T	P	C
		3	1	0	3

1. **Introduction**
   Working Principle of Radar, Radar Frequencies, Radar Equation, Minimum detectable signal, integration of radar pulses, Pulse repetition frequency and range ambiguities, Applications of Radar.

2. **Radar systems**
   Elementary Radar signal processing, RADAR cross section, RADAR detection, range & Doppler measurements, tracking,

3. **CW Radar**
   The Doppler Effect, FM-CW radar- Multiple frequency radar , MTI Radar- Principle, Delay line cancellers- Staggered PRF, MTI-Pulse Doppler radar- Tacking Radar –Sequential lobing-Conical Scan- Monopulse – Acquisition- Comparison of Track. Detection of Radar signals in noise –Matched filter criterion-detection criterion – Extraction of information and waveform design , Propagation of radar waves –Radar clutter

4. **Navigation Aids**
   Radio Direction Finding - The Loop Antenna - Loop Input Circuits - An Aural Null Direction Finder - The Goniometer - Errors in Direction Finding - Adcock Direction Finders - Direction Finding at Very High Frequencies - Automatic Direction Finders - The Commutated Aerial Direction Finder - Range and Accuracy of Direction Finders Radio Ranges - The LF/MF Four course Radio Range - VHF Omni Directional Range(VOR) - VOR Receiving Equipment - Range and Accuracy of VOR - Recent Developments. Global Positioning System (GPS)

Books Recommended:

1. Skolnik, “Introduction to Radar Systems”, Tata McGraw Hill.
2. Peyton Z. Peebles, Jr, “Radar Principles”, John Wiley and Sons (2004).
3. Nagaraja, “Electronic Navigation”, Tata McGraw Hill.
4. M.Skolnik, Introduction to Radar system, McGraw Hill 2002.
5. R.J Sullivan, Radar foundation for imaging & advanced concepts, PHI, 2004.

ECE-425(A)	LOW POWER VLSI DESIGN TECHNIQUES	L	T	P	C
		3	1	0	3

1. **Introduction:**
   Need for low power VLSI chips, Sources of power dissipation on Digital Integrated circuits, Physics of power dissipation in CMOS devices, Dynamic dissipation in CMOS, leakage power dissipation, Impact of technology Scaling, Technology & Device innovation.

2. **Low Power Design:**
   Circuit Level: Transistor & gate sizing, Circuit techniques for leakage power reduction, supply voltage scaling techniques, DTCMOS, MTCMOS, low voltage low power design, Flip Flops & Latches design,
   Logic Level: Gate reorganization, signal gating, logic encoding, state machine encoding, pre-computation logic.
   Low Power Architecture & Systems: Power & performance management, switching activity reduction, parallel architecture with voltage reduction, flow graph transformation, Low Power bus.

3. **Power Estimation**
   Simulation Power analysis: SPICE circuit simulators, gate level logic simulation, capacitive power estimation, static state power, gate level capacitance estimation, data correlation analysis in DSP systems,
   Probabilistic power analysis: Random logic signals, probability & frequency, probabilistic power analysis techniques.

4. **Low Power Clock Distribution**
   Power dissipation in clock distribution, single driver Vs distributed buffers, Zero skew Vs tolerable skew, Various clock distribution networks

Text Books:

1. Gary K. Yeap, "Practical Low Power Digital VLSI Design", KAP, 2002
2. Rabaey and Pedram, "Low power design methodologies" Kluwer Academic,1997

Reference Books:

1. Kaushik Roy, Sharat Prasad, "Low-Power CMOS VLSI Circuit Design" Wiley, 2000.
2. Kait-Seng Yeo, Kaushik Roy, "Low-Voltage Low-Power VLSI subsystems" Tata McGraw-Hill, 2009.

ECE-425(B)	VLSI INTERCONNECTS & PACKAGING	L	T	P	C
		3	1	0	3

1. **Interconnects**
   Small, Intermediate and long interconnects in VLSI, Interconnect Parasitics: Resistance, Inductance and Capacitance. Interconnect RC Delays: Elmore Delay Calculation. Interconnect Models: Lumped RC Model, Distributed RC Model, Transmission line model. SPICE Wire Models: Distributed RC lines in SPICE, Transmission line models in SPICE.

2. **Scaling issues in VLSI Devices and Interconnects**
   Scaling and its effect on performance parameters.

3. **Interconnect Delay**
   Methods for improving interconnect RC delay

4. **CMOS Repeater Driven Interconnects**
   The Static Behavior- Switching Threshold, Noise Margins, The Dynamic Behavior- Computing the capacitances, Propagation Delay: First order An**a**lysis, Propagation Delay from a Design perspective. Power, energy and Energy-Delay- Dynamic Power Consumption, Static Consumption, Transient analysis of repeater loaded interconnects and analysis of Power Consumption using SPICE

5. **Transmission line model of Interconnects**
   Lossy line, Termination Conditions, Crosstalk and Noise in interconnects.

6. **Advanced Interconnect Techniques**
   Reduced-swing Circuits, Current-mode Transmission Techniques, Clocking of high-speed systems, CNT and Optical Interconnects.

7. **Packaging Techniques**
   Introduction to packaging, Package design considerations, VLSI Assembly Techniques, Packaging fabrication technology, THM, Surface Mounting.

Text Books:

1. H.K. Bakoglu, "Circuits, Interconnections & Packaging for VLSI", Addison Wesley Publication Company Inc.
2. A.K. Goel, High-Speed VLSI Interconnections, Wiley Interscience, 2nd Edition, 2007.

Reference Books:

1. M. A. Elgamel, M. A. Bayoumi, Interconnect Noise Optimization in Nanometer Technologies, Springer.
2. Jan M. Rabaey, Analysis and Design of Digital Integrated Circuits– A design Perspective, TMH, 2nd Edition 2003.
3. F.Moll, M.Roca, Interconnection Noise in VLSI Circuits, Kluwer Academic Publishers.

ECE-425(C)	NANOELECTRONICS	L	T	P	C
		3	1	0	3

1. **Introduction of Nanoelectronics**
   The "Top-Down" Approach; The "Bottom-Up" Approach; Why Nanoelectronics; Nanotechnology Potential; MOS Scaling theory-Issues in scaling MOS transistors; Short channel effects; Requirements for non-classical MOS transistor; Metal gate transistor-Motivation, requirements, Integration Issues; High-k gate based MOSFET-Motivation, requirements, integration issues of high-k.

2. **Quantum Mechanics of Electrons**
   General postulates of quantum mechanics; Time-independent Schrodinger's equation-boundary conditions on the Wave function; Analogies between quantum mechanics and classical electromagnetic; probabilistic current density; Multiple particle systems; Spin and angular Momentum.

3. **Free and Confined Electrons**
   Free Electrons; Free electron gas theory of metals; Electrons confined to a bounded region of space and quantum numbers; Partially confined electrons- finite potential wells; Quantum wells; Quantum wires; Quantum dots.

4. **Tunnel Junctions and Applications of Tunneling**
   Tunneling through a potential barrier; Potential energy profiles for material interfaces; Applications of tunneling; Coulomb blockade, Single-Electron Transistor (SET).

5. **Germanium Nano MOSFETs**
   Strain, Quantization; Advantages of germanium over silicon; PMOS versus NMOS; Compound semiconductors - material properties; MESFETs; Compound semiconductors MOSFETs in the context of channel quantization and strain; Hetero structure MOSFETs exploiting novel materials, strain, quantization.

6. **Non-Conventional MOSFET Structures**
   SOI-PDSOI and FDSOI; Ultrathin body SOI-double gate transistors, integration issues; Vertical transistors–FinFET and Surround gate FET; Carbon Nanotube Transistors (CNT); Semiconductor Nanowire FETs and SETs; Molecular SETs and Molecular Electronics.

Text Books:

1. Fundamentals of Modern VLSI Devices, Y. Taur and T Ning, Cambridge University Press.
2. Fundamental of Nanoelectronics, George W. Hanson Pearson Education.

References:

1. Silicon VLSI Technology, Plummer, Deal, Griffin, Pearson Education India.
2. Encyclopedia of Materials Characterization, Edited by Brundle, C.Richard; Evans, Charles A. Jr.; Wilson, Shaun, Elsevier.

ECE-425(D)	CAD OF INTEGRATED CIRCUITS	L	T	P	C
		3	1	0	3

1. **Introduction to Hierarchical and Structured Design**
   Role of CAD Tools in the VLSI design process, CAD Algorithms for switch level and circuits simulation, Techniques and algorithms for symbolic layout, Algorithms for physical design – Placement and routing Algorithms, Compaction, Circuit extraction and Testing.

2. **Specification of Combinational Systems Using VHDL**
   Introduction to VHDL, Basic language element of VHDL, Behavioral Modeling, Data flow modeling, Structural modeling, Subprograms and overloading, VHDL description of gates.

3. **Description and Design of Sequential Circuits**
   Standard combinational modules, Design of a Serial adder with accumulator, State graph for control network, Design of a binary multiplier, Multiplication of a signed binary number, Design of a binary divider.

4. **Register-Transfer Level Systems**
   Execution graph, Organization of system, Implementation of RTL Systems, Design of RTL systems, Analysis of RTL systems.

5. **Data Subsystems**
   Storage modules, Functional modules, Data paths, Control subsystems, Micro programmed controller, Structure of a micro programmed controller, Micro instruction format, Micro instruction sequencing, Micro instruction Timing, Basic component of a micro system, Memory subsystem.

6. **I/O Subsystem**
   Processors, Operation of the computer and cycle time. Binary decoder, Binary encoder, Multiplexers and demultiplexers, Floating Point arithmetic-representation of floating point number, Floating point multiplication, Adders, Multipliers.

7. **PLA based synthesis**
   Multilevel logic synthesis, Logic optimization, Logic simulation, Compiled and event simulators, Relative advantages and disadvantages, Layout Algorithms, Circuit partitioning, Placement and routing algorithms, Automatic test program generation, Combinational testing, D-Algorithm and PODEM algorithm, Scan-based testing of sequential circuits, Testability measures for circuits.

Text Books

1. J. Bhaskar, “A VHDL Primer”, Addison Wesley, 1999.
2. M. Ercegovac, T. Lang and L.J. Moreno, “Introduction to Digital Systems”, Wiley, 2000.
3. C. H. Roth, “Digital System Design using VHDL”, PWS Publishing.
4. G. DeMicheli, “Synthesis and optimization of digital circuits”, McGraw Hill.

References

1. J.F. Wakerly, “Digital Design-Principles and Practices”, PHL
2. Douglas Perry, “VHDL”, MGH.