DETAILED SYLLABI OF

B.Tech DEGREE PROGRAMME IN

ELECTRONICS AND COMMUNICATION ENGINEERING

(Applicable from 2010 Admission onwards)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

NATIONAL INSTITUTE OF TECHNOLOGY CALICUT

MA 1001: MATHEMATICS I

L	T	P	C
3	1	0	3

Module 1 (12 hours)
Preliminary Calculus : Partial differentiation, Total differential and total derivative, Exact differentials, Chain rule, Change of variables, Minima and Maxima of functions of two or more variables. **Infinite Series :** Notion of convergence and divergence of infinite series, Ratio test, Comparison test, Raabe's test, Root test, Series of positive and negative terms, Idea of absolute convergence, Taylor's and Maclaurin's series.

Module 2 (17 hours)
First order ordinary differential equations: Methods of solution, Existence and uniqueness of solution, Orthogonal Trajectories, Applications of first order differential equations. **Linear second order equations:** Homogeneous linear equations with constant coefficients, fundamental system of solutions, Existence and uniqueness conditions, Wronskian, Non homogeneous equations, Methods of Solutions, Applications.

Module 3 (13 hours)
Fourier Analysis : Periodic functions **-** Fourier series, Functions of arbitrary period, Even and odd functions, Half Range Expansions, Harmonic analysis, Complex Fourier Series, Fourier Integrals, Fourier Cosine and Sine Transforms, Fourier Transforms.

Module 4 (14 hours)
Gamma functions and Beta functions, Definition and Properties. Laplace Transforms, Inverse Laplace Transforms, shifting Theorem, Transforms of derivatives and integrals, Solution of differential Equations, Differentiation and Integration of Transforms, Convolution, Unit step function, Second shifting Theorem, Laplace Transform of Periodic functions.

Reference:

1. Kreyszig E, 'Advanced Engineering Mathematics' 8th Edition, John Wiley & Sons New York, (1999)
2. Piskunov, 'Differential and Integral Calculus, MIR Publishers, Moscow (1974).
3. Wylie C. R. & Barret L. C 'Advanced Engineering Mathematics' 6th Edition, McGraw Hill, New York, (1995).
4. Thomas G. B. 'Calculus and Analytic Geometry' Addison Wesley, London (1998).

MA 1002: MATHEMATICS II

L	T	P	C
3	1	0	3

Module 1 (14 hours)

Linear Algebra I: Systems of Linear Equations, Gauss' elimination, Rank of a matrix, Linear independence, Solutions of linear systems: existence, uniqueness, general form. Vector spaces, Subspaces, Basis and Dimension, Inner product spaces, Gram-Schmidt orthogonalization, Linear Transformations.

Module 2 (14 hours)

Linear Algebra II: Eigen values and Eigen vectors of a matrix, Some applications of Eigen value problems, Cayley-Hamilton Theorem, Quadratic forms, Complex matrices, Similarity of matrices, Basis of Eigen vectors – Diagonalization.

Module 3 (13 hours)

Vector Calculus I: Vector and Scalar functions and fields, Derivatives, Curves, Tangents, Arc length, Curvature, Gradient of a Scalar Field, Directional derivative, Divergence of a vector field, Curl of a Vector field.

Module 4(15 hours)

Vector Calculus II: Line Integrals, Line Integrals independent of path, Double integrals, Surface integrals, Triple Integrals, Verification and simple applications of Green's Theorem, Gauss' Divergence Theorem and Stoke's Theorem.

Reference:

1. Kreyzig E, Advanced Engineering Mathematics, 8th Edn, John Wiley & Sons, New York (1999).
2. Wylie C. R & Barrret L. C, Advanced Engineering Mathematics, 6th Edn, Mc Graw Hill, New York (1995).
3. Hoffman K & Kunze R, Linear Algebra, Prentice Hall of India, New Delhi (1971).

PH 1001: PHYSICS

L	T	P	C
3	0	0	3

Module 1 (6 hours)
Theory of Relativity: Frames of reference, Galilean Relativity, Michelson-Morley experiment, postulates of Special Theory of Relativity, Lorentz transformations, simultaneity, length contraction, time dilation, velocity addition, Doppler effect for light, relativistic mass and dynamics, mass energy relations, massless particles, Description of General Theory of Relativity.

Module 2 10 hours)
Quantum Mechanics (Dual nature of matter, properties of matter waves, wave packets, uncertainty principle, formulation of Schrödinger equation, physical meaning of wave function, expectation values, time-independent Schrödinger equation, quantization of energy – bound states, application of time-independent Schrödinger equation to free particle, infinite well, finite well, barrier potential, tunneling, Simple Harmonic Oscillator, two-dimensional square box, the scanning tunneling microscope.

Module 3 (12 hours)
Statistical Physics: Temperature, microstates of a system, equal probability hypothesis, Boltzman factor and distribution, ideal gas, equipartition of energy, Maxwell speed distribution, average speed, RMS speed, applications – Lasers and Masers, Quantum distributions – many particle systems, wave functions, indistinguishable particles, Bosons and Fermions, Bose-Einstein and Fermi-Dirac distribution, Bose-Einstein condensation, Specific heat of a solid, free electron gas and other applications.

Module 4 (14 hours)
Applications to Solids : Band theory of solids, conductors, semi-conductors and insulators, metals – Drude model and conductivity, electron wave functions in crystal lattices, E-k diagrams, band gaps, effective mass, semiconductors, Fermi energy, doping of semiconductor, conductivity and mobility of electrons, Hall effect, Fundamentals of mesoscopic physics and nano technology: size effects, interference effect, quantum confinement and Coulomb blockade. Quantum wells, wires, dots, nanotubes, semiconductor nano materials, Magnetism: dipole moments, paramagnetism, Curie's law, magnetization and hysterisis, Ferromagnetism and Anti-Ferromagnetism.

Reference:

1. J. R. Taylor, C.D. Zafiratos and M. A. Dubson, Modern Physics for Scientists and Engineers, , 2nd Ed., Pearson (2007)
2. Arthur Beiser, Concepts of Modern Physics, 6th Ed., Tata Mc Graw –Hill Publication (2009)
3. Robert Eisberg and Robert Resnick, Quantum Physics of atoms, Molecules, Solids, Nuclei and Particle, , 2nd Ed., John Wiley(2006)
4. B. G. Streetman, Solid state Devices, , 5th Ed., Pearson (2006)

CY 1001: CHEMISTRY

L	T	P	C
3	0	0	3

Pre-requisites: Nil

Module 1 (8 hours)
Chemical Bonding Quantum mechanical methods in chemical bonding: molecular orbital theory, symmetry of molecular orbitals, MOs for homonuclear diatomic molecules, application of MO theory to heteronuclear diatomics, valence bond theory, hybridization, hybridization involving d orbitals, conjugated molecules, Huckel molecular orbital theory of conjugated systems, metallic bonding, band theory .

Module 2 (14 hours)
Spectroscopy : General features of spectroscopy, interaction of radiation with matter, theory and application of rotational, vibrational, Raman, electronic, mass, NMR, fluorescence and photoelectron spectroscopy.

Module 3 (12 hours)
Transition Metal Chemistry: Bonding in transition metal complexes: coordination compounds, crystal field theory, octahedral, tetrahedral and square planar complexes, crystal field stabilization energies, Jahn-Teller theorem, spectral and magnetic properties. Bio-Inorganic chemistry: Trace elements in biology, heme and non-heme oxygen carriers, haemoglobin and myoglobin-cooperativity; Bohr effect, Hill coefficient, oxy and deoxy haemoglobin, reversible binding of oxygen.

Module 4 (8 hours)
Aromaticity : Electron delocalization, resonance and aromaticity; molecular orbital description of aromaticity and anti-aromaticity, annulenes; ring current, NMR as a tool, diamagnetic anisotropy; aromatic electrophilic substitutions, aromatic nucleophilic substitutions, benzyne; reaction mechanisms, reactivity and orientation.

Reference:

1. J. E. Huheey, E.A. Keiter and R.L. Keiter, Inorganic Chemistry, Principles of Structure and Reactivity, Harper Collins, New York 1997.
2. F. A. Cotton and G Wilkinson, Advanced Inorganic Chemistry, 5th Edition, WileyInterscience, New York, 1988.
3. J. D. Lee, Concise Inorganic Chemistry, Chapman & Hall, London, 1996.
4. W. L. Jolly, Modern Inorganic Chemistry, McGraw-Hill International, 2nd Edition, New York, 1991.
5. R. T. Morrison and R N Boyd, Organic Chemistry, 6th Edition, Prentice Hall, New Delhi,1999.
6. P. Bruice, Organic Chemistry, 3rd Edition, Prentice Hall, New Delhi , 2001.
7. F. Carey, Organic Chemistry, 5th Edition, McGraw Hill Publishers, Boston, 2003.
8. J. Mc Murray, Organic Chemistry, 5th Edition, Brooks/ Cole Publishing Co, Monterey,2000.
9. C.N. Banwell and E. M. McCash, Fundamentals of Molecular Spectroscopy, McGraw- Hill, International, UK, 1995.
10. William Kemp, Organic Spectroscopy, 3rd edition, Palgrave, New York, 2005.
11. R.M. Silverstein, F.X. Webster and D.J. Kiemle, Spectrometric Identification of Organic Compounds**,** 7th edition**,** John-Wiley and Sons, New York, 2005.
12. D. L. Pavia, GM. Lampman, GS. Kriz and J.R Vyvyan, I, Spectroscopy, Cengage Learning India Pvt. Ltd, New Delhi, 2007.
13. B. R.Puri, L. R. Sharma and M. S. Pathania, Principles of Physical Chemistry, Vishal Publishing CO. Delhi, 2008.
14. P.W. Atkins, Physical Chemistry, 6th Edition, Oxford University Press, Oxford, 1998.

MS 1001: PROFESSIONAL COMMUNICATION

L	T	P	C
3	0	0	3

Module 1 (11 hours)
Verbal Communication: received pronunciation; how to activate passive vocabulary; technical/non-technical and business presentations; questioning and answer skills; soft skills for professionals; role of body postures, movements, gestures, facial expressions, dress in effective communication; Information/ Desk/ Front Office/ Telephone conversation; how to face an interview/press conference; Group discussions, debates, elocution.

Module 2 (9 hours)
Reading Comprehension: skimming and scanning; factual and inferential comprehension; prediction; guessing meaning of words from context; word reference; use and interpretation of visuals and graphics in technical writing.

Module 3 (11 hours)
Written Communication: note making and note taking; summarizing; invitation, advertisement, agenda, notice and memos; official and commercial letters; job application; resume and curriculum vitae; utility, technical, project and enquiry reports; paragraph writing: General – Specific, Problem – Solution, Process – Description, Data – Comment.

Module 4 (11 hours)
Short essays: description and argument; comparison and contrast; illustration; using graphics in writing: tables and charts, diagrams and flow charts, maps and plans, graphs; how to write research paper; skills of editing and revising; skills of referencing; what is a bibliography and how to prepare it.

Reference:

1. Adrian Doff and Christopher Jones: Language in Use – Upper intermediate, self study workbook and classroom book. (Cambridge University Press)[2000]
2. Sarah Freeman: Written Communication (Orient Longman)[1978]
3. Mark Ibbotson: Cambridge English for Engineering (Cambridge University Press) November 2008
4. T Balasubramanian: English Phonetics for Indian Students: A Workbook(Macmillan publishers India) 2000
5. Chris Mounsey: Essays and Dissertation (Oxford University Press) February 2005.
6. Sidney Greenbaum: The Oxford English Grammar (Oxford University Press) March 2005
7. Krishna Mohan and Meera Banerji: Developing Communication Skills (Mac Millan india Ltd)[2000]
8. Krishna Mohan and Meenakshi Raman: Effective English Communication (Tata Mc- Graw Hill)[2000]

ZZ 1003: BASIC ELECTRICAL SCIENCES

L	T	P	C
3	0	0	3

Module 1 (11 Hours)

Two Terminal Element Relationships: Inductance - Faraday's Law of Electromagnetic Induction-Lenz's Law - Self and Mutual Inductance-Inductances in Series and Parallel-Mutual Flux and Leakage Flux-Coefficient of Coupling-Dot Convention-Cumulative and Differential Connection of Coupled Coils- Capacitance - Electrostatics-Capacitance-Parallel Plate Capacitor-Capacitors in series and parallel- Energy Stored in Electrostatic Fields-. v-i relationship for Inductance and Capacitance - v-i relationship for Independent Voltage and Current Sources – Magnetic Circuits**:** MMF, Magnetic Flux, Reluctance- Energy Stored in a Magnetic Field-Solution of Magnetic Circuits. Analysis of Resistive Circuits: Solution of resistive circuits with independent sources- Node Analysis and Mesh Analysis-Nodal Conductance Matrix and Mesh Resistance Matrix and symmetry properties of these matrices-Source Transformation- Circuit Theorems - Superposition Theorem-Thevenin's Theorem and Norton's Theorem- Maximum Power Transfer Theorem

Module 2 (10 Hours)

Single Phase AC Circuits: Alternating Quantities- Average Value - Effective Value - Form and Peak factors for square, triangle, trapezoidal and sinusoidal waveforms - Phasor representation of sinusoidal quantities - phase difference -Addition and subtraction of sinusoids - Symbolic Representation: Cartesian, Polar and Exponential forms- Analysis of a.c circuits R, RL, RC, RLC circuits using phasor concept - Concept of impedance,
admittance, conductance and susceptance – Power in single phase circuits – instantaneous power – average power – active power – reactive power – apparent power – power factor – complex power – Solution of series, parallel and series-parallel a.c circuits.

Module 3 (14 hrs)

Introductory Analog Electronics: Semiconductor Diode: Principle, Characteristics - Applications: Rectifier Circuits -Zener Diode, LED, Photo diode, IR diode Bipolar Junction Transistor: Principle, Operation, Characteristics (CB, CE, CC) - Principle of working of CE, CB and CC amplifiers, quantitative relations for midband operation, input and output resistance levels – qualitative coverage on bandwidth – cascading considerations. Introductory Digital Electronics: Transistor as a switch – switching delays, inverter operation Digital Electronics : Number Systems and Conversions- Logic Gates and Truth Tables – Boolean Algebra – Basic canonical realizations of combinatorial circuits. Standard Combinatorial Circuit SSI and MSI packages (Adder, Code Converters, 7-Segment Drivers, Comparators, Priority Encoders etc) MUX-based and ROM-based implementation of combinatorial circuits.

Module 4 (7 hours)

Measuring instruments: Basics of electronic/digital voltmeter, ammeter, multimeter, wattmeter and energy meter. Measurement of Voltage, Current and Resistance. Introduction to Cathode Ray Oscilloscope - CRT, Block diagram of CRO

Reference:

1. James W Nilsson and Susan A Riedel, Electric Circuits, Pearson, 8th Edn, 2002
2. Robert L Boylestead & L Nashelsky, Electronic Devices and Circuit Theory, Pearson, 9th Edition, 2007
3. Morris Mano , Digital Design , PHI, 3rd Edition, 2005
4. Golding & Widdis, Electrical Measurements an Measuring Instruments;- Wheeler Publishers, 5th edition, 1999.
5. Rangan, Sarma and Mani, Instrumentation Devices and Systems, Tata McGraw Hill, 1997
6. A.K. Sawhney: A course in Electrical and Electronic Measurements and Instrumentation, Dhanpat Rai and Co,16th Edition, 2006
7. Suresh Kumar K.S, Electric Circuits & Networks, Pearson Education, 2009
8. Adel S Zedra and Kennath C Smith, Microelectronics, Oxford University Press, 2004

ZZ 1001: ENGINEERING MECHANICS

L	T	P	C
3	0	0	3

Part A--Statics

Module 1 (12 hours)
Fundamentals of mechanics: idealisations of mechanics, vector and scalar quantities, equality and equivalence of vectors, laws of mechanics. Important vector quantities: Position vector, moment of a force about a point, moment of a force about an axis, the couple and couple moment, couple moment as a free vector, moment of a couple about a line. Equivalent force systems: Translation of a force to a parallel position, resultant of a force system, simplest resultant of special force systems, distributed force systems. Equations of equilibrium: Free body diagram, free bodies involving interior sections, general equations of equilibrium, problems of equilibrium, static indeterminacy.

Module 2 (10 hours)
Applications of Equations Equilibrium: Trusses: solution of simple trusses, method of joints, method of sections; Friction forces: laws of Coulomb friction, simple contact friction problems. Properties of surfaces: First moment, centroid, second moments and the product of a plane area, transfer theorems, rotation of axes, polar moment of area, principal axes, concept of second order tensor transformation.

Part B—Dynamics

Module 3 (10 hours)
Kinematics of a particle: Introduction, general notions, differentiation of a vector with respect to time, velocity and acceleration calculations, rectangular components, velocity and acceleration in terms of cylindrical coordinates, simple kinematical relations and applications. Particle dynamics: Introduction, rectangular coordinates, rectilinear translation, Newton's law for rectangular coordinates, rectilinear translation, cylindrical coordinates, Newton's law for cylindrical coordinates.

Module 4 (10 hours)
Energy and momentum methods for a particle: Analysis for a single particle, conservative force field, conservation of mechanical energy, alternative form of work-energy equation, Linear momentum, impulse and momentum relations, moment of momentum. Vibrations: Single degree of freedom systems, free vibration, undamped and damped, forced vibration, sinusoidal loading, introduction to multi degree of freedom systems, illustration using two degree-of-freedom systems.

Reference:

1. H. Shames, Engineering Mechanics—Statics and Dynamics, 4th Edition, Prentice Hall of India,1996.
2. F.P. Beer and E.R. Johnston, *Vector Mechanics for Engineers – Statics,* McGraw Hill Book Company 2000.
3. J.L. Meriam and L.G. Kraige, *Engineering Mechanics – Statics*, John Wiley & Sons, 2002.

ZZ 1002: ENGINEERING GRAPHICS

L	T	P	C
2	0	3	3

Module 1 (4Lecture+6drawing hours)
Introduction to Engineering Graphics – Drawing instruments and their use – Different types of lines - Lettering & dimensioning – Familiarization with current Indian Standard Code of Practice for Engineering Drawing. Scales, Plain scales, Diagonal scales, Vernier scales. Introduction to orthographic projections- Horizontal, vertical and profile planes – First angle and third angle projections – Projection of points in different coordinates – Projections of lines inclined to one of the reference planes

Module 2
Projections of lines inclined to both the planes – True lengths of the lines and their angles of inclination with the reference planes – Traces of lines. **(4Lecture+6 drawing hours)**
Projection of plane lamina of geometric shapes inclined to one of the reference planes – inclined to both the planes, Traces of planes **(2Lecture+3 drawing hours)**
Projections on auxiliary planes **(2 lecture +3 drawing hours)**

Module 3 (4Lecture+6 drawing hours)
Projections of polyhedra and solids of revolution, projection of solids with axis parallel to one of the planes and parallel or perpendicular to the other plane – Projections with the axis inclined to one of the planes. Projections of solids with axis inclined to both the planes – Projections of spheres and combination of solids.

Module 4
Sections of solids by planes perpendicular to at least one of the reference planes – True shapes of sections. **(2 lectures, 3 drawing hours)**
Developments, development of the lateral surface of regular solids like, prisms, pyramids, cylinders, cones and spheres, development of truncated solids **(2 lectures +3 drawing hours)**
Isometric projection – Isometric scale – Isometric views – Isometric projection of prisms, pyramids, cylinders, cones, spheres and solids made by combination of the above. **(2 lectures +6 drawing hours)**

Reference:

1. Bhatt N. D**,** Elementary Engineering Drawing, Charotar Publishing House, Anand, 2002
2. Narayana K L & Kannaiah P, Engineering Graphics, Tata McGraw Hill, New Delhi, 1992
3. Luzadder W J, Fundamentals of Engineering Drawing, Prentice Hall of India, New Delhi, 2001
4. Thomas E French & Charkes J V, Engineering Drawing & Graphing Technology, McGraw Hill Book Co, New York, 1993
5. Venugopal K, Engineering Drawing & Graphics, New Age International Pvt. Ltd., New Delhi, 1994

ZZ 1004: COMPUTER PROGRAMMING

L	T	P	C
2	0	0	2

Module 1 (7 Hours)
Data Types, Operators and Expressions: Variables and constants - declarations - arithmetic, relational and logical operators – Assignment operator and expressions – conditional expressions – precedence and order of evaluation.
Control Flow: Statements and blocks – if-else, switch, while, for and do-while statements – break and continue statements, goto and labels.

Module 2 (7 Hours)
Functions and Program structure: Basics of functions, Parameter passing – scope rules - recursion.

Module 3 (7 Hours)
Pointers and Arrays: Single and multidimensional arrays - Pointers and arrays – address arithmetic - Passing pointers to functions.

Module 4 (7 Hours)
Structures and Unions: Basics of structures, Structures and functions – Arrays of Structures – Pointers to structures – self referential structures – Type definitions – Unions. **Input and Output:** Standard input and output – Formatted output – variable length argument list – file access.

Reference:

1. B. W. Kernighan and D. M. Ritchie, The C Programming Language (2/e), Prentice Hall, 1988.
2. B.S. GottFried, Schaum's Outline of Programming with C(2/e), McGraw-Hill, 1996.
3. C. L. Tondo and S. E. Gimpel, The C Answer Book(2/e), Prentice Hall, 1988.
4. B. W. Kernighan, The Practice of Programming, Addison-Wesley, 1999.

PH 1091: PHYSICS LAB

L	T	P	C
0	0	2	1

LIST OF EXPERIMENTS

1. Magnetic Hysteresis loss - Using CRO
2. Band gap using four probe method
3. Hall effect- determination of carrier density, Hall coefficient and mobility
4. Solar cell characteristics
5. Double refraction – measurement of principle refractive indices.
6. Measurement of N.A & Attenuation
7. Measurement of e/m of electron – Thomson's experiment
8. Determination of Planck's constant
9. Measurement of electron charge – Milliken oil drop experiment
10. Determination of Magnetic Field along the axis of the coil
11. Newton's rings
12. Laurent's Half shade polarimeter –determination of specific rotatory power
13. Study of P-N junction
14. Study of voltage-current characteristics of a Zener diode.
15. Laser – measurement of angle of divergence & determination of l using grating
16. Measurement of Magnetic susceptibility- Quincke's Method / Gouy's balance.
17. Mapping of magnetic field

NOTE: Any 8 experiments have to be done.

Reference:

1. Avadhanulu, Dani and Pokley,Experiments in Engineering physics, S. Chand & Company ltd (2002).
2. A.C. Melissinos, J. Napolitano, Experiments in Modern Physics, Academic Press (2003)
3. S.L. Gupta and V. Kumar, Practical physics, Pragathi Prakash (2005)

CY 1094: CHEMISTRY LABORATORY

L	T	P	C
0	0	2	1

Pre-requisites: Nil

Total Hours: 28

Potentiometric and conductometric titrations, complexometric and iodimetric estimations, polarimetry, determination of pH, single step organic / inorganic preparations, colorimetry, determination of eutectic point.

Reference:

1. G.H Jeffery, J Bassett, J Mendham, R.C Denny, Vogel's Text Book of Quantitative Chemical Analysis, Longmann Scientific and Technical, John Wiley, New York.
2. J.B Yadav, Advanced Practical Physical Chemistry, Goel Publishing House, 2001.
3. A.I Vogel, A.R Tatchell, B.S Furnis, A.J Hannaford, P.W.G Smith, Vogel's Text Book of Practical Organic Chemistry, Longman and Scientific Technical, New York, 1989.

CIVIL ENGINEERING WORKSHOP
(PART OF ZZ 1091: WORKSHOP PRACTICE I)

L	T	P	C
0	0	3	2

Introduction to Construction Materials: Cement, sand, coarse aggregate, structural steel, brick, timber, concrete – methods of testing **(3 hours)**

Masonry: English bond – Flemish bond –wall –junction – one brick – one and a half brick - Arch construction. **(6 hours)**

Plumbing: Study of water supply and sanitary fittings—water supply pipe fitting –tap connections - sanitary fittings. **(3 hours)**

Surveying: Introduction to land surveying and linear measurements; Introduction to leveling. **(9 hours)**

There will be an evaluation in the last week which will be in the form of a **written test.**
Total duration of the work shop : 24 hours (3×7 = 21 hours (lab work) + 3 hours test).

ELECTRICAL & ELECTRONICS ENGINEERING WORKSHOP (4 weeks)
(Part of ZZ 1091: WORKSHOP PRACTICE I)

L	T	P	C
0	0	3	2

Four exercises from the following list of Exercises are to be carried out.

1. a. Familiarization of wiring tools, lighting and wiring accessories, various types of wiring systems.
b. Wiring of one lamp controlled by one switch.
2. a. Study of Electric shock phenomenon, precautions, preventions; Earthing
b. Wiring of one lamp controlled by two SPDT Switch and one 3 pin plug socket independently.
3. a. Familiarization of types of Fuse, MCB, ELCB etc.
b. Wiring of fluorescent lamp controlled by one switch from panel with ELCB & MCB.
4. a. Study of estimation and costing of wiring
b. Domestic appliance – Wiring, Control and maintenance: Mixer machine, Electric Iron, fan motor, pump motor, Battery etc.
5. a. Familiarization of electronic components colour code , multimeters.
b. Bread board assembling - Common emitter amplifier
6. a. Study of soldering components, solders, tools, heat sink.
b. Bread board assembling – phase shift oscillator
7. a. Soldering practice - Common emitter amplifier
b. Soldering practice - Inverting amplifier circuit
8. a. Study of estimation and costing of soldering –PCB: 3 phase connections
b. Domestic appliances – Wiring PCB, control, Identification of fault: Electronic Ballast, fan regulator, inverter, UPS etc.

Reference:

1. K B Raina & S K Bhattacharya: Electrical Design Estimating and costing, New Age International Publishers, New Delhi, 2005
2. Uppal S. L., Electrical Wiring & Estimating, Khanna Publishers---5th edition, 2003
3. John H. Watt, Terrell Croft :American Electricians' Handbook: A Reference Book for the Practical Electrical Man - McGraw-Hill, 2002
4. G. Randy Slone - Tab Electronics Guide to Understanding Electricity and Electronics, Mc- GrawHill, 2000
5. Jerry C Whitaker - The Resource Handbook of Electronics, CRC Press-2001

ZZ 1092: WORKSHOP PRACTICE II

ELECTRICAL & ELECTRONICS ENGINEERING WORKSHOP (4 WEEKS)

Four exercises from the following list of Exercises are to be carried out.

L	T	P	C
0	0	3	2

1. a. Familiarization of wiring tools, lighting and wiring accessories, various types of wiring systems.
b. Wiring of one lamp controlled by one switch.
2. a. Study of Electric shock phenomenon, precautions, preventions; Earthing
b. Wiring of one lamp controlled by two SPDT Switch and one 3 pin plug socket independently.
3. a. Familiarization of types of Fuse, MCB, ELCB etc.
b. Wiring of fluorescent lamp controlled by one switch from panel with ELCB & MCB.
4. a. Study of estimation and costing of wiring
b. Domestic appliance – Wiring, Control and maintenance: Mixer machine, Electric Iron, fan motor, pump motor, Battery etc.
5. a. Familiarization of electronic components colour code , multimeters.
b. Bread board assembling - Common emitter amplifier
6. a. Study of soldering components, solders, tools, heat sink.
b. Bread board assembling – phase shift oscillator
7. a. Soldering practice - Common emitter amplifier
b. Soldering practice - Inverting amplifier circuit
8. a. Study of estimation and costing of soldering –PCB: 3 phase connections
b. Domestic appliances – Wiring PCB, control, Identification of fault: Electronic Ballast, fan regulator, inverter, UPS etc.

Reference:

1. K B Raina & S K Bhattacharya: Electrical Design Estimating and costing, New Age International Publishers, New Delhi, 2005
2. Uppal S. L., Electrical Wiring & Estimating, Khanna Publishers---5th edition, 2003
3. John H. Watt, Terrell Croft :American Electricians' Handbook: A Reference Book for the Practical Electrical Man - McGraw-Hill, 2002
4. G. Randy Slone - Tab Electronics Guide to Understanding Electricity and Electronics, Mc- GrawHill, 2000
5. Jerry C Whitaker - The Resource Handbook of Electronics, CRC Press-2001

ZZ 1092: WORKSHOP PRACTICE II

(Eight classes of 3 hour duration each)

L	T	P	C
0	0	3	2

The course is intended to expose the student to the manufacturing processes through hands on training in the sections of Central Workshop. After the course, the student acquires the skill in using various tools, measuring devices, and learns the properties of different materials at varying conditions.
1) Carpentry: Study of tools and joints – plaining, chiseling, marking and sawing practice, one typical joint- Tee halving/Mortise and Tenon/ Dovetail
2) Fitting: Study of tools- chipping, filing, cutting, drilling, tapping, about male and female joints, stepped joints- one simple exercise of single V joint for welding exercise.
3) Welding: Study of arc and gas welding, accessories, joint preparation, Exercise of a single V joint
4) Smithy: Study of tools, forging of square or hexagonal prism/ chisel/bolt
5) Foundry: Study of tools, sand preparation, moulding practice.
6) Sheet Metal work: Study of tools, selection of different gauge sheets, types of joints, fabrication of a tray or a funnel
7) Plumbing Practice: Study of tools, study of pipe fittings, pipe joints, cutting, and threading
8) Lathe Exercise: Study of the basic lathe operations, a simple step turning exercise.

Reference:

1) Chapman W.A.J., Workshop Technology. Parts 1 & 2, 4th Edition, Viva Books P. Ltd., New Delhi, 2002
2) Hajra Choudhury.Workshop Technology Vol 1 & 2, Media Promoters & Publishers P.Ltd, Bombay, 2004
3) Welding Handbook. Miami, American Welding Society, 2000
4) Metals Handbook. Vol 6, Welding, Brazing & Soldering. Metals Park, Ohio, American Society of Metals, 1998
5) Serope Kalpakjian. Manufacturing Engineering & Technology. Pearson Steven R. Schmid Education (Asia) Inc., Delhi, 2002.
6) Anderson J., Shop Theory. Tata McGraw Hill, New Delhi, 2002
7) Olson D.W., Wood and Wood working. Prentice Hall India. 1992
8) Douglass J.H., Wood Working with Machines. McKnight &McKnight Pub. Co. Illinois, 1995
9) Tuplin W.A., Modern Engineering Workshop Practice Odhams Press, 1996
10) P.L. Jain. Principles of Foundry Technology. 4th Edition, Tata McGraw Hill, 2008.
11) R.K.Singal, Mridul Singal, Rishi Sringal. Basic Mechanical Engineering. 2007

EC 1001: INTRODUCTION TO ELECTRONICS ENGINEERING

L	T	P	C
2	0	0	2

Module 1 (7 hours)
Basics of Electronics: Semiconductors, Band structure of Silicon, doping, PN junctions, MOSFET, simple inverter configurations, large scale integration concepts.

Module 2 (7 hours)
Signal Processing basics: Filtering, sampling, simple analog and digital filter configurations.

Module 3(7 hours)
Communication basics: Signals and noise, ideas of AM and FM, PCM, noise immunity.

Module 4 (7 hours)
Basics of linear circuit design: Transfer function, speed and bandwidth, superposition of signals and noise, signal-to-noise ratio.

Reference:

1. Millman & Halkias: Electronic Devices & Circuits, MGH, 2007
2. George Kennedy: Electronic Communication Systems, MGH, 1992
3. B P Lathi: Signal Processing & Linear Systems, Oxford University Press, 2000

MA 2001: MATHEMATICS III

L	T	P	C
3	1	0	3

Module 1: (11L + 4 T)
Probability distributions:- Random variables, Binomial distribution, Hyper- geometric distribution, Mean and variance of a probability distribution, Chebyshev's theorem, Poisson distribution, Geometric distribution, Normal Distribution, Uniform distribution, Gamma distribution, Beta distribution, Weibull distribution. Joint distribution of two random variables.

Module 2: (11L + 3 T)
Sampling distributions and Inference concerning means:- Population and samples, The sampling distribution of the mean (σ known and σ unknown), Sampling distribution of the variance, Maximum Likelihood Estimation, Point estimation and interval estimation, point estimation and interval estimation of mean and variance, Tests of hypothesis, Hypothesis concerning one mean, Inference concerning two means.

Module 3: (10 L + 3 T)
Inference concerning variances proportions:- Estimation of variances , Hypothesis concerning one variance, Hypothesis concerning two variances , Estimation of proportions , Hypothesis concerning one proportion , Hypothesis concerning several proportions, Analysis of r x c tables, Chi – square test for goodness of fit.

Module 4: (10 L + 4 T)
Regression Analysis:- Bi-variate Normal distribution- joint, marginal and conditional distributions. Curve fitting, Method of least squares, Estimation of simple regression models and hypothesis concerning regression coefficients, Correlation coefficient- estimation of correlation coefficient, hypothesis concerning correlation coefficient. Estimation of curvilinear regression models,
Analysis of variance:- General principles, Completely randomized designs, Randomized block diagram, Latin square designs, Analysis of covariance.

Reference:

1. Johnson, R. A., Miller and Freund's Probability and Statistics for Engineers, 6th edn., PHI, 2004.
2. Levin R. I. & Rubin D. S., Statistics for Management, 7th edn, PHI, New Delhi, 2000.
3. S.M. Ross, Introduction to Probability and statistics for Engineers, 3rd edn, Academic Press(Elsevier), Delhi 2005.

EC 2011: NETWORK THEORY

L	T	P	C
3	0	0	3

Module 1 (11 hours)
Review of Network Theorems: Thevenin's & Norton's theorem - Superposition theorem - Maximum power transfer theorem – Reciprocity Theorem - Millman’s theorem.

Introduction to Network Topology: Definition of basic terms – Incidence matrix – Tie-sets - Cut-sets: Analysis and formulation of network equations using tie-set and cut-set.

Transients in linear circuits: Initial Conditions - Zero state response - Zero input response - Complete Response – Analysis of RC and RL circuits with impressed DC voltage – RC network as differentiator and integrator - Compensated Attenuators – DC transients in RLC circuits.

Module 2 (11 hours)
S-Domain Analysis of Circuits - Review of Laplace transform - Transformation of a circuit into S-domain - Transformed equivalent of inductance, capacitance and mutual inductance - Impedance and admittance in the transform domain - Node analysis and mesh analysis of the transformed circuit

Network functions - Impulse response and Transfer function - Poles and Zeros – Restriction of pole and zero locations of network functions - Steady state response and Frequency response from Laplace transform - Frequency response by transform evaluation on j-axis - Frequency response from pole-zero plot by geometrical interpretation. Bode plots.

Module 3 (11 hours)
Two port networks: Characterization in terms of impedance - Admittance - Hybrid and transmission parameters - Inter relationships among parameter sets - Interconnection of two port networks - Series, parallel and cascade.
Symmetrical two port networks: T and π Equivalent of a two port network - Image impedance - Characteristic impedance and propagation constant of a symmetrical two port network.
Symmetrical Two Port Reactive Filters: Filter fundamentals - Pass and stop bands - Constant - k low pass filter - Constant - k high pass filter-m-derived T and π sections and their applications for infinite attenuation and filter terminations - Band pass and band elimination filters.

Module 4 (9 hours)
Synthesis: Positive real functions - Driving point functions - Brune's positive real functions - Properties of positive real functions.

Testing driving point functions - Application of maximum modulus theorems - Properties of Hurwitz polynomials - Even and odd functions - Strum's theorem - Driving point synthesis - RC elementary synthesis operations - LC network synthesis - Properties of RC network functions - Foster and Cauer forms of RC and RL networks.

Reference:

1. Van Valkenburg M E, Network Analysis 3rd Edition, Prentice Hall 1974.
2. Van Valkenberg M.E., Introduction to Modern Network Synthesis, John Wiley and Sons, Inc, 1960.
3. Franklin. F. Kuo, Network Analysis and Synthesis, II Ed, John Wiley & sons, 1999.
4. Hayt, Kimmerly, Engineering Circuit Analysis, 5th Ed., McGraw Hill, 1993.
5. Desoer C.A. & Kuh E.S., Basic Circuit Theory, McGraw-Hill, 1985.
6. Ryder J.D., Networks, Lines and Fields, Prentice Hall, 2nd Ed., 1991.
7. B. P. Lathi, Linear Systema and Signals, Oxford University Press, 2nd Ed., 2006.
8. Roy Choudhary, Network and Systems, Wiley Eastern, 2nd Ed., 1988.

EC 2012: LOGIC DESIGN

L	T	P	C
4	0	0	4

Module 1 (14 hours)
Review of number systems and Boolean algebra - Simplification of functions using Karnaugh map and Quine McCluskey methods - Boolean function implementation. . Variable Entered Mapping: VEM plotting theory – VEM Reading theory – Minimization and combinational design.

Examples of combinational digital circuits: Arithmetic Circuits, Comparators and parity generators, multiplexers and demultiplexers, decoders and encoders. Combinational circuit design using Multiplexers, Demultiplexers, ROM, PAL, PLA.

Module 2 (14 hours)
Introduction to Sequential circuits: Latches and flip-flops (RS, JK, D, T and Master Slave) - Design of a clocked flip-flop – Flip-flop conversion - Practical clocking aspects concerning flip-flops.
Counters: Design of single mode counters and multimode counters – Ripple Counters – Synchronous counters - Shift registers – Shift Register counters – Random Sequence Generators.

Module 3 (14 hours)
Design and analysis of sequential circuits: General model of sequential networks - State diagrams – Analysis and design of Synchronous sequential Finite Sate Machine – State reduction – Minimization and design of the next state decoder. Asynchronous sequential logic: Analysis and Design – Race conditions and Cycles – Hazards in combinational circuits – Hazard free realization.
Practical design aspects: Timing and triggering considerations in the design of synchronous circuits – Set up time - Hold time – Clock skew.

Module 4 (14 hours)
Logic families - Fundamentals of RTL, DTL and ECL gates - TTL logic family - TTL transfer characteristics - TTL input and output characteristics - Tristate logic – Wired logic and bus oriented structure – Practical aspects - Schottky and other TTL gates - MOS gates - MOS inverter - CMOS inverter - Rise and fall time in MOS and CMOS gates - Speed power product - Interfacing BJT and CMOS gates

Reference:

1. Roth C.H., Fundamentals of Logic Design, Jaico Publishers. V Ed., 2009
2. Taub & Schilling: Digital Integrated Electronics, MGH,1998.
3. W. I. Fletcher, An Engineering Approach to Digital Design, Prentice-Hall, Inc., Englewood Cliffs, NJ, 1980
4. Tocci, R. J. and Widner, N. S., Digital Systems - Principles and Applications, Prentice Hall, 10th Ed., 2007
5. Wakerly J F, Digital Design: Principles and Practices, Prentice-Hall, 2nd Ed., 2002
6. Mano M. M., Computer System Architecture, Prentice Hall 1993.
7. Katz R, Contemporary Logic Design, Addison Wesley, 1993.
8. Lewin D. & Protheroe D., Design of Logic Systems, Chapman & Hall, University and Professional Division, 1992, II Ed.
9. T. L. Floyd, Digital Fundamentals, Prentice Hall, June 2005.

EC 2013: SOLID STATE DEVICES

L	T	P	C
4	0	0	4

Module 1 (19 hours)
Band theory of solids: Review of quantum mechanics, wave nature of election, time independent Schrödinger Equation, solutions for a free electron, electron tapped in finite potential well, Heisenberg's uncertainty principle, tunneling phenomenon, KP Model, Band theory of solids, E-k diagram, Electron effective mass, energy band gap- Direct and indirect band gap semiconductors. [9 hours]

Carrier Statistics: Charge carriers in semiconductors, Fermi Dirac statistics, intrinsic and extrinsic semiconductors, carrier transport, mobility, conductivity, carrier life time, recombination, steady state carrier generation, quasi Fermi levels, drift and diffusion of carriers, continuity equation [10 hours]

Module 2 (10 hours)
PN Junction: PN junction at equilibrium, Forward and reverse bias junctions, steady state conditions, forward and reverse bias, break down of junctions, transient and AC conditions, non ideal junctions
MS contacts: Rectifying and ohmic contacts, current voltage characteristics

Module 3 (12 hours)
Bipolar junction transistor: Fundamentals of BJT operation- saturation, active and cut off characteristics, switching characteristics, minority carrier profiles, BJT models, Frequency limitations of BJTs.

Module 4 (15 hours)
Field Effect Transistors: The Junction FET - Pinch-off and Saturation- Gate control- transfer and drain characteristics. [3hours]
Metal Insulator semiconductor devices: The ideal MOS capacitor, band diagrams at equilibrium, accumulation, depletion and inversion, surface potential, CV characteristics, effects of real surfaces, work function difference, interface charge, threshold voltage, MOSFET, Output characteristics, transfer characteristics, sub threshold characteristics, MOSFET scaling [12 hours]

Reference:

1. Ben G Streetman , Solid state devices, 5e, 2002, Pearson Education
2. Donald A Neaman, Semiconductor physics and devices, McGraw Hill, 2003
3. Sheng S. Li, Semiconductor physical electronics, Plenum press, 1993
4. S.M.Sze, Physics of semiconductor devices, McGraw Hill, 2nd ed., 1999,
5. M. S. Tyagi, Introduction to Semiconductor Materials and Devices, John Wiley and Sons, 2004.
6. Jean-Pierre Colinge, Physics of Semiconductor Devices, Kluwer Academic Publishers, 2002, access online at (NITC intranet) http://www.springerlink.com/content/978-1-4020-7018-1/
7. Richard S. Muller and Theodore I. Kamins, Device Electronics for Integrated circuits, John Wiley India, 2003.
8. Robert F. Pierret and Gerold W. Neudeck, Modular Series on Solid State Devices: Volume I: Semiconductor Fundamentals, Prentice Hall, 1988.
9. Gerold W. Neudeck, George W. Neudeck, Modular Series on Solid State Devices: Volume II: The PN Junction Diode, Prentice Hall, 1989.
10. Gerold W. Neudeck, George W. Neudeck, Modular Series on Solid State Devices: Volume III: The Bipolar Junction Transistor, Prentice Hall, 1989.
11. Robert F. Pierret and Gerold W. Neudeck, Modular Series on Solid State Devices: Volume IV: Field Effect Devices, Prentice Hall, 1990
12. R. F. Pierret, Modular Series on Solid State Devices: Volume VI: Advanced Semiconductor Fundamentals, Prentice Hall, 2003.

EC 2014: SIGNALS AND SYSTEMS

L	T	P	C
3	0	0	3

Module 1 (11 hours)

Elements of signal theory: Signals as functions- Signal taxonomy- basic operations on signals- Some signal models - impulse function, step functions and other singularity functions.

Systems : Time-domain representation and analysis of LTI and LSI systems – Convolution -Convolution sum, convolution integral and their evaluation - Causality and stability considerations.

Module 2 (12 hours)

Signal analysis: Signals and vectors – inner product of signals – norm- notion of length of signal and distance between signals– orthogonal signal space – Fourier series representation - Fourier Transform and integral – Fourier Transform theorems – power spectral density and energy spectral density – Hilbert Transform – In-phase and quadrature representation of bandpass signals

Frequency domain analysis of LTI systems: Frequency response Function – signal transmission through a linear system – ideal filters – band width and rise time

Module 3 (8 hours)

Sampling: sampling theorem – sampling with Zero Order Hold and reconstruction – interpolation

Frequency analysis of discrete time signals and systems – Discrete time Fourier series and Discrete time Fourier Transform – Frequency response function – Discrete Fourier Transform.

Module 4 (11 hours)

Laplace transform: Region of convergence – Analysis of continuous time systems – Transfer function – Frequency response from pole – zero plot

Z-transform: Region of convergence – Properties of ROC and Z transform - Analysis of LSI systems - Transfer function- Frequency response from pole – zero plot

Reference:

1. B. P. Lathi, Linear Systems and Signals, Oxford University Press, 2004.
2. Oppenheim A.V., Willsky A.S. & Nawab S.H., Signals and Systems, Second edition , Tata McGraw Hill, 1996
3. Haykin S. & Veen B.V., Signals & Systems, John Wiley,1999
4. Taylor F.H., Principles of Signals & Systems, McGraw Hill, 1994
5. Lathi B.P., Modern Digital & Analog Communication Systems, Third edition, Oxford University Press, 2001
6. R.F. Ziemer, W.H. Tranter and D.R. Fannin, Signals and Systems - Continuous and Discrete, 4th Edn. Prentice Hall, 1998
7. Douglas K. Lindner, "Introduction to Signals and Systems", Mc-Graw Hill International Edition,1999.
8. Robert A. Gabel, Richard A. Roberts, "Signals and Linear Systems", John Wiley and Sons (SEA) Private Limited, 1995.
9. M. J. Roberts, "Signals and Systems - Analysis using Transform methods and MATLAB", Tata Mc Graw Hill Edition, 2003

EC 2018: BASIC ELECTRONICS LAB

L	T	P	C
0	0	3	2

1. Familiarization of CRO, Function Generators, Power Supplies and multi-meters
2. Diode characteristics: silicon, germanium and zener diodes
3. BJT characteristics; CB & CE; Calculation of h-parameters
4. JFET characteristics; Calculation of FET parameters
5. Uni-junction Transistor characteristics and relaxation oscillator
6. Design of filter circuits- passive filters- Low pass, high pass and band pass filters.
7. Rectifiers- Half wave , Full wave & Bridge rectifiers
8. Resonance circuits - Series and Parallel resonance.
9. Voltage regulators- Zener regulator - Series Voltage Regulator.

Reference:

1. Ben G Streetman , Solid state devices, 5e, 2002, Pearson Education
2. Donald A Neaman, Semiconductor physics and devices, McGraw Hill, 2003
3. Millman & Halkias : `Integrated Electronics', MGH. 1996

EC 2019: ELECTRONICS WORKSHOP

L	T	P	C
0	0	3	2

1. Familiarisation and Testing methods of Active and Passive components.
2. Voltage Multiplier circuits.
3. Zener Voltage regulators.(Variable and Fixed types)
4. Linear Voltage regulators.(Variable and Fixed types)
5. Single stage Amplifier and troubleshooting methods.
6. Multivibrators using Transistors and ICs.
7. Waveform generators using OP Amps.
8. Flip flops and oscillators using logic gates.
9. Soldering and troubleshooting of working circuits.
10. Mini project. (PCB fabrication and circuit development)
11. Assignment. (Project circuit simulation- using simulation tools)

Reference:

1. Millman & Halkias : `Integrated Electronics', MGH. 1996
2. Robert Boylestad & Louis Nashelsky : `Electronic Devices & Circuit Theory', PHI.1995
3. Sergio Franco, 'Design with Operational Amplifiers and Analog Integrated Circuits', McGraw Hill Book Company 1998
4. Jacob Millman & Herbert Taub: Pulse, Digital & Switching Waveforms, TMGH 1995

MA 2002: MATHEMATICS IV

L	T	P	C
3	1	0	3

Module 1 : (11L + 4T)
Series Solutions and Special Functions : Power series solutions of differential equations, Theory of power series method, Legendre Equation, Legendre Polynomials, Frobenius Method, Bessel's Equation, Bessel functions, Bessel functions of the second kind, Sturm- Liouville's Problems, Orthogonal eigenfunction expansions.

Module 2: (12L + 4T)
Partial differential Equations : Basic Concepts, Cauchy's problem for first order equations, Linear Equations of the first order, Nonlinear Partial Differential Equations of the first order, Charpit's Method, Special Types of first order equations, Classification of second order partial differential equations, Modeling: Vibrating String, Wave equation, Separation of variables, Use of Fourier Series, D'Alembert's Solution of the wave equation, Heat equation: Solution by Fourier series, Heat equation: solution by Fourier Integrals and transforms, Laplace equation, Solution of a Partial Differential Equations by Laplace transforms.

Module 3: (10L + 3T)
Complex Numbers and Functions: Complex functions, Derivative , Analytic function, Cauchy- Reimann equations, Laplace's equation, Geometry of Analytic functions: Conformal mapping, Linear fractional Transformations, Schwarz - Christoffel transformation, Transformation by other functions.

Module 4: (9L + 3T)
Complex Integration : Line integral in the Complex plane, Cauchy's Integral Theorem, Cauchy's Integral formula, Derivatives of analytic functions.Power series, Functions given by power series, Taylor series and Maclaurin's series. Laurent's series, Singularities and Zeros, Residue integration method, Evaluation of real Integrals.

Reference:

1. Kreyszig E, Advanced Engineering Mathematics, 8th Edition, John Wiley & Sons, New York, 1999 .
2. I.N. Sneddon, Elements of Partial Differential Equations, Dover Publications,2006.
3. Wylie C. R. & Barret L. C., Advanced Engineering Mathematics, 6th Edition, Mc Graw Hill, New York,1995.
4. Donald W. Trim, Applied Partial Differential Equations, PWS – KENT publishing company, 1994.

EC 2021: ELECTRONIC CIRCUITS I

L	T	P	C
4	0	0	4

Module 1 (16 hours)
Basic BJT amplifiers: Biasing schemes - Load line concept - Bias stabilty - Analyses and design of CC, CE and CB configurations - RC coupled and transformer coupled multistage amplifiers — Thermal runaway in BJT amplifiers
FET amplifiers: Biasing of JFET and MOSFET - Analyses and design of common source, common drain and common gate amplifier configurations – Thermal runaway in MOS amplifiers
Power amplifiers - Class A, B, AB, C, D & S power amplifiers - Harmonic distortion – Conversion efficiency and relative performance

Module 2 (12 hours)
Frequency response of amplifiers – Low frequency response of BJT and FET amplifiers, lower cut off frequency - hybrid π equivalent circuit of BJT - high frequency response of BJT amplifiers –upper cut off frequency – transition frequency - miller effect , high frequency response of FET amplifiers.

Wide band amplifiers - Wide banding techniques – CC–CE /CD-CS cascade, cascode amplifier, Darlington pair – Wide banding using inductors.

Module 3 (14 hours)
Feedback and stability – Introduction to negative feedback – Basic feedback concepts – Ideal feedback topologies - Voltage shunt, Voltage series, Current series and Current shunt feedback configurations – Loop gain – Stability of feedback circuit – Bode plots – Nyquist stability criterion – Phase and gain margins – Oscillators – Basic principles of oscillators – Analysis of RC Phase Shift, Wein bridge, Colpitts, Hartley and Crystal oscillators

Module 4 (14 hours)
Switching characteristics of a BJT - BJT switches with inductive and capacitive loads - Non saturating switches - Astable, monostable and bistable multivibrators using BJT and negative resistance devices - Voltage and current time base generators - Miller & bootstrap configurations

Reference:

1. A S Sedra & K C Smith : `Microelectronic Circuits', Oxford University Press.1998
2. Jacob Millman & Herbert Taub: Pulse, Digital & Switching Waveforms, TMGH 1995
3. Donald A. Neamen, Electronic Circuit Analysis and Design, 2nd Edition, MCGraw Hill 2003
4. Millman & Halkias : `Integrated Electronics', MGH. 1996
5. D L Schilling & C Belove : `Electronic Circuits', Third Ed; MGH. 2002
6. Robert Boylestad & Louis Nashelsky : `Electronic Devices & Circuit Theory', PHI.1995
7. William H Hayt Jr : `Electronic Circuit Analysis & Design'.1994
8. Theodore F Bogart : `Electronic Devices & Circuits'.2003
9. Mark N Horenstein : `Microelectronic Circuits & Devices', PHI.2002
10. Millman & Grabel : Microelectronics : MGH 1989
11. Richard C. Jaeger : Microelectronic circuit design, MGH 2007

EC 2022: ELECTROMAGNETIC FIELD THEORY

L	T	P	C
4	0	0	4

Module 1 (15 hours)

Review of Vector Calculus: Orthogonal coordinate systems, Coordinate transformation, Gradient of scalar fields, Divergence and Curl of vector fields.

Electrostatics: Coulomb's law, electric field, flux and Gauss's law, curl and divergence of electrostatic fields, electric potential, Poisson's equation, Laplace's equation, solutions to electrostatic boundary problems, method of images, work and energy in electrostatics, induced dipoles and polarization, field inside a dielectric, electric displacement, electric susceptibility, permittivity and dielectric constant, boundary conditions, capacitors, surface charge and induced charge on conductors.

Module 2 (12 hours)

Magnetostatics: Lorentz force, Biot-Savart law, magnetic flux density, divergence and curl of flux density, Ampere's law, magnetic vector potential, magnetization, torque and force on magnetic dipoles, magnetic field inside matter, magnetic field intensity, magnetic susceptibility and permeability, magnetic materials, boundary conditions

Module 3 (16 hours)

Electrodynamics: Electromagnetic induction, inductance, continuity equation, displacement current, Maxwell's equations, boundary conditions, Poynting's theorem, energy and momentum in electromagnetic field.

Electromagnetic Waves: EM waves in vacuum and in matter, monochromatic plane waves, group velocity, wave polarization, Lorentz gauge, retarded potentials,

Module 4 (13 hours)

Refection and transmission at interfaces: Normal and Oblique incidence of uniform plane electromagnetic waves at conducting boundary, dielectric boundary

Transmission lines: Quasi-TEM analysis, characteristic impedance, standing wave ratio, impedance matching techniques, Smith Chart

Reference :

1. David J Griffiths: Introduction to Electrodynamics, Third edition, PHI,1999
2. David Cheng: Field and Wave Electromagnetics, Second edition, Pearson Education Asia, 2001
3. Nannapaneni Narayana Rao: Elements of Engineering Electromagnetics, Fifth edition, Prentice Hall, 1999
4. Matthew N. O. Sadiku: Elements of Electromagnetics, Fourth Edition, Oxford University Press, 2006
5. J D Krauss: Electromagnetics, Fourth edition, MGH, 1992

EC 2023: MICROPROCESSORS AND MICRO CONTROLLERS

L	T	P	C
3	0	0	3

Module 1 (5 hours)
Introduction: History of microprocessors –Basics of computer architecture-Computer languages –CISC and RISC- Review of binary arithmetic

Module 2 (15hours)
Intel 8086 processor: The architecture of 8086 —use of MASM - Programming concepts- Programming using instructions for data transfer ,arithmetic, logical and shift and rotate operations String manipulations – Procedures-Macros-ASCII operations-high level language constructs –I/O instructions–Modular programming

Module 3 (12 hours)
Hardware and Interfacing: The pin configuration, clock and power on reset of 8086-minimum and maximum modes. Interfacing chips- PPI 8255 -Timer8253/54 –Keyboard Display Interface 8279-DMA Controller 8237- Programmable Interrupt Controller 8259

Module 4 (10 hours)
Intel 8051 microcontroller : architecture –ports, timers, interrupts, serial data transmission instruction set - programming

Reference:

1. Lyla B.Das, The x86 Microprocessors , Pearson Education, 2010
2. Muhammed Ali Mazidi, Janice Gillispie Mazidi ,Rolin D Mc Kinlay ,The 8051 Microcontroller and Embedded Systems Using Assembly and C , Second Edition ,2008 , Pearson Education

EC 2024: FUNDAMENTALS OF COMMUNICATION

L	T	P	C
4	0	0	4

Module 1 (14 Hours)

Fundamental of communication systems, signals and information, system block Diagram, performance metrics and data rate limits.

Review of Fourier series and Transforms – Energy/Power Spectral Density.

Random variables: Discrete and continuous random variables - Probability distribution functions – Expectation – Higher order moments -moment generating function; characteristic functions.

Random vectors: Joint probability distribution functions, joint probability densities, conditional probability distributions functions, conditional probability densities, Correlation and covariance - independence and un-correlation

Transformations of random variables: scalar valued function of one random variable, functions of several random variables- Fundamental Theorem of expectation.

Module 2 (14 Hours)

Random processes: Introduction and specification, *n*th order joint distribution, mean and auto-correlation function, auto-covariance function, Cross-correlation and cross-covariance function

Stationary processes: Strict-sense stationarity, wide-sense stationarity (WSS), cyclo stationarity - auto-correlation function, cross-correlation function, and power spectral density of a WSS random process - Wiener-Khinchine theorem, low-pass and band-pass processes, power and banwidth calculations.

Time averaging and ergodicity: Time averages - interpretation, mean and variance; ergodicity: general definition, ergodicity of the mean, ergodicity of the auto-correlation function.

Random processes as inputs to linear time invariant systems: Gaussian processes as inputs to LTI systems, white Gaussian noise.

Module 3 (14 Hours)

Introduction to carrier modulation - Amplitude modulation, AM spectrum, power relations, double sideband suppressed carrier (DSBSC) and single sideband modulation (SSB) schemes, DSBSC/SSBSC spectrum, Vestigial sideband modulation and spectrum.

Generation of AM signals, modulators and transmitters, product modulators, square-law modulators and balanced modulators - Frequency translation and frequency division multiplexing, Propagation characteristics of AM signals.

Frequency modulation (FM), Narrowband FM, Wideband FM, FM spectrum, Transmission bandwidth, Generation of FM signals- direct and indirect methods- Phase modulation-relationship between FM and PM signals.

Module 4 (14 Hours)

Radio Receivers - TRF and super-heterodyne receivers- Image frequency, Intermediate frequency (IF)- Automatic gain control.

AM demodulation - coherent detection, envelope (non-coherent) detection of AM signals, DSB-SC and SSB demodulation.

FM demodulation - Basic FM demodulators, Amplitude limiting, ratio detector, PLL based FM detection, Pre-emphasis and de-emphasis.

Performance of analog modulation schemes in the presence of channel noise: Signal to Noise Ratio (SNR) performance of baseband systems – SNR performance of AM systems, Noise in angle modulated systems - SNR performance- threshold effects in angle modulated systems.

Reference:

1. H. Stark, J. W. Woods, Probability and Random Processes with Applications to Signal Processing, Prentice-Hall, 2003.
2. Peyton Z. Peebles Jr., Probability, Random Variables and Random Signal Principles, 4/e, Tata McGraw-Hill, New Delhi, 2002.
3. R.E. Ziemer and W.H. Tranter, Principles of Communications, JAICO Publishing House, 2001
4. B.P. Lathi, Modern Digital and Analog Communication, 3/e, Oxford University Press, 1998.
5. John G Proakis and M. Salehi, Communication System Engineering, 2/e, Pearson Education, 2001.

EC 2028: ELECTRONIC CIRCUITS LABORATORY – I

L	T	P	C
0	0	3	2

1. BJT and JFET Biasing schemes and Bias Stability comparison
2. Emitter follower – frequency and phase response
3. Single stage BJT amplifier – Frequency Response
4. Single stage JFET amplifier – Frequency Response
5. Power amplifier – Class A and Class AB
6. Two stage RC coupled amplier – Frequency Response
7. Cascode Amplifier – Frequency Response
8. Feedback amplifiers
9. Phase Shift Oscillator
10. Colpitts/Hartley Oscillators
11. Astable, Monostable and Bistable Multivibrator with BJT

The experimental results obtained in the lab may be compared with the circuit simulation results.

Reference:

1. A S Sedra & K C Smith : `Microelectronic Circuits', Oxford University Press.1998
2. Jacob Millman & Herbert Taub: Pulse, Digital & Switching Waveforms, TMGH 1995
3. Donald A. Neamen, Electronic Circuit Analysis and Design, 2nd Edition, MCGraw Hill 2003
4. Millman & Halkias : `Integrated Electronics', MGH. 1996
5. D L Schilling & C Belove : `Electronic Circuits', Third Ed; MGH. 2002
6. Robert Boylestad & Louis Nashelsky : `Electronic Devices & Circuit Theory', PHI.1995
7. William H Hayt Jr : `Electronic Circuit Analysis & Design'.1994
8. Theodore F Bogart : `Electronic Devices & Circuits'.2003
9. Mark N Horenstein : `Microelectronic Circuits & Devices', PHI.2002
10. Millman & Grabel : Microelectronics : MGH 1989
11. Richard C. Jaeger : Microelectronic circuit design, MGH 2007

EC 2029: LOGIC DESIGN LAB

L	T	P	C
0	0	3	2

1. Combinational Logic design using basic gates (Code Converters, Comparators).
2. Combinational Logic design using decoders and MUXs.
3. Arithmetic circuits - Half and full address and subtractors.
4. Arithmetic circuits – design using adder ICs, BCD adder.
5. Flip flop circuit (RS latch, JK & master slave) using basic gates.
6. Asynchronous Counters
7. Synchronous counters, Johnson & Ring counters.
8. Sequential Circuit designs (sequence detector circuit).
9. Transfer Characteristics , Measurement of Sinking and Sourcing currents etc. of TTL gates

Reference:

1. Roth C.H., Fundamentals of Logic Design, Jaico Publishers. V Ed., 2009
2. Taub & Schilling: Digital Integrated Electronics, MGH,1998.
3. W. I. Fletcher, An Engineering Approach to Digital Design, Prentice-Hall, Inc., Englewood Cliffs, NJ, 1980
4. Tocci, R. J. and Widner, N. S., Digital Systems - Principles and Applications, Prentice Hall, 10th Ed., 2007
5. Wakerly J F, Digital Design: Principles and Practices, Prentice-Hall, 2nd Ed., 2002
6. Mano M. M., Computer System Architecture, Prentice Hall 1993.
7. Katz R, Contemporary Logic Design, Addison Wesley, 1993.
8. Lewin D. & Protheroe D., Design of Logic Systems, Chapman & Hall, University and Professional Division, 1992, II Ed.
9. T. L. Floyd, Digital Fundamentals, Prentice Hall, June 2005.

EC 3011: ELECTRONIC CIRCUITS - II

Pre-requisite: EC 2021

L	T	P	C
4	0	0	4

Module 1 (16 hours)
Basic BJT/FET Differential amplifier – DC transfer characteristics – Small signal analysis –Differential and Common mode gain and input impedance– Concept of CMRR – Methods to improve CMRR – Constant current source – active load - current mirror - Differential and Common mode frequency response
various stages of an operational amplifier - simplified schematic circuit of op-amp 741 - need for compensation – dominant pole compensation - typical op-amp parameters - slew rate – CMRR,PSRR - open loop gain - unity gain bandwidth - offset current & offset voltage – CMOS op-amp with and without compensation

Module 2 (12 hours)
Linear op-amp circuits - inverting and non-inverting configurations - analysis for closed loop gain - input and output impedances - virtual short concept - current to voltage and voltage to current converters - instrumentation amplifier - nonlinear op-amp circuits - log and antilog amplifiers - 4 quadrant multipliers and dividers - phase shift and wein bridge oscillators - comparators - astable and monostable circuits - linear sweep circuits

Module 3 (12 hours)
Butterworth, Chebychev and Bessel approximations to ideal low pass filter characteristics - frequency transformations to obtain HPF, BPF and BEF from normalized prototype LPF - active biquad filters - LPF & HPF using Sallen-Key configuration - BPF realization using the Delyannis configuration - BEF using twin T configuration - all pass filter (first & second orders) realizations - inductance simulation using Antoniou's gyrator – Switched capacitor filter

Module 4 (16 hours)
DACs and ADCs (in depth design is not expected)-Digital to analog converters - Binary weighted - R-2R ladder - Current steering - Charge scaling - Cyclic & pipeline DACs - Accuracy - Resolution - Conversion speed - Offset error - Gain error - Integral and differential nonlinearity - Analog to digital converters – Track and hold operation - Track and hold errors - ADC conversion techniques - Flash converter - Two step flash - Pipeline – Integrating - Staircase converter - Successive approximation converter - Dual slope ADC
Phase Locked Loop – Block schematic and analysis of PLL – Lock range and capture range – Typical applications of PLL (eg.565) – Basic principles of operation of VCO (eg. 566) and timer (555) and their applications – Voltage regulator ICs – Fixed and adjustable (723) regulators

Reference:

1. Sergio Franco, 'Design with Operational Amplifiers and Analog Integrated Circuits', McGraw Hill Book Company 1998
2. Jacob Baker R., Li H.W. & Boyce D.E., 'CMOS- Circuit Design, Layout & Simulation', PHI 2007
3. Gobind Daryanani, 'Principles of Active Network Synthesis & Design', John Wiley 2003
4. Sedra A.S. & Smith K.C., "Microelectronic Circuits', Oxford University Press 1998
5. Fiore J.M., 'Operational Amplifiers and Linear Integrated Circuits', Jaico Publishing House 2006
6. Gaykward, Operational Amplifiers, Pearson Education, 1999
7. Coughlin R.F. & Driscoll F.F., 'Operational Amplifiers and Linear Integrated Circuits', Pearson Education 2002
8. Horenstein M.N., 'Microelectronic Circuits & Devices', PHI, 1995

EC 3012: DIGITAL COMMUNICATION

L	T	P	C
4	0	0	4

Module 1 (13 Hours)
Analog Pulse Modulation: Sampling theorem for base-band and pass-band signals, Pulse Amplitude modulation: generation and demodulation, PAM/TDM system, PPM generation and demodulation, PWM, Spectra of Pulse modulated signals, SNR calculations for pulse modulation systems.

Digital Pulse modulation: Quantization, PCM, DPCM, Delta modulation, Adaptive delta modulation-Design of typical systems and performance analysis.

Module 2 (13 Hours)
Signal space concepts: Geometric structure of the signal space, vector representation, distance, norm and inner product, orthogonality, Gram-Schmidt orthogonalization procedure.

Matched filter receiver, Inter symbol interference, Pulse Shaping, Nyquist criterion for zero ISI, Signaling with duobinary pulses, Eye diagram, Equalizer, Scrambling and descrambling.

Module 3 (14 Hours)
Review of Gaussian random process, Optimum threshold detection, Optimum Receiver for AWGN channel, Matched filter and Correlation receivers, Decision Procedure: Maximum aposteriori probability detector-Maximum likelihood detector, Error probability performance of binary signaling.

Digital band pass modulation schemes: ASK, FSK, PSK, MSK – Digital M-ary modulation schemes – signal space representation

Module 4 (16 Hours)
Detection of signals in Gaussian noise - Coherent & non-coherent detection – Differential modulation schemes – Error performance of binary and M-ary modulation schemes – Probability of error of binary DPSK – Performance of M-ary signaling schemes in AWGN channels - Power spectra of digitally modulated signals, Performance comparison of digital modulation schemes.

Reference:

1. Simon Haykin, Communication Systems, 3/e, John Wiley & Sons, 1998.
2. John G Proakis and M. Salehi, Communication System Engineering, 2/e, Pearson Education, 2001.
3. B. Sklar and P.K. Ray, Digital Communication: Fundamentals and Applications, 2/e, Pearson Education, 2003.
4. R.E. Ziemer and W.H. Tranter, Principles of Communications, JAICO Publishing House, 2001.
5. B.P. Lathi, Modern Digital and Analog Communication, 3/e, Oxford University Press, 1998.
6. John G. Proakis, Digital Communications, McGraw Hill, 2001.

EC 3013: DIGITAL SIGNAL PROCESSING

Pre-requisite: EC 2014

L	T	P	C
3	0	0	3

Module 1 (9 Hours)
Fourier analysis of discrete-time signals and systems: Discrete Fourier Series, Discrete Time Fourier Transform, Discrete Fourier Transform - Properties; Approximation of Fourier transform through DFT, Fast algorithms for DFT: The FFT algorithm – Prime factor algorithms, Convolution; Linear and circular convolution, Practical implementation, Overlap-save and overlap-add methods, Short-time Fourier transform.

Module 2 (9 Hours)
Digital filters: FIR Filters: Impulse response, Transfer function, Linear phase properties, Design: window based design, frequency sampling design, minimax design. IIR Filters: Impulse response, Transfer function, Pole-zero representation; Butterworth, Chebyshev, inverse Chebyshev and elliptic filter concepts, Approximation problem for IIR filter design: Impulse in variance method, Bilinear transform method, Matched z-transform method, Minimum mean squared error method; Frequency transformations; Realization structures: Direct form 1 and 2.

Module 3 (8 Hours)
(a) Least squares filter design: (4 Hours): Deterministic least squares: Whitening problem: FIR case; Signal modelling: Spectral Factorisation; Lattice structure realization.
(b) Digital Signal Processors: (4 Hours): Architecture and types of instructions, Addressing schemes and Interface details of one of the latest, commonly used Digital Signal Processors (e.g. Digital Signal Processors manufactured by Texas Instruments or Analog Devices.)

Module 4 (16 Hours)
(a) Internal descriptions of digital filters: (8 Hours): Signal flow graphs, State variable descriptions, State variable descriptions from primitive signal flow graphs, Transfer function from state variable descriptions, The difference equation from state variable description, Co-ordinate transformation, Poles, zeros and the state variable description.
(b) Finite length register effects: (8 Hours): Limit cycles, Overflow oscillations, State variable model for overflow, Round-off noise in IIR digital filters, Computation of output round-off noise, Methods to prevent overflow, Scaling rules and scaling operations, Scaling state variable description, Trade-off between round-off and overflow noise, Measurement of coefficient quantization effects through pole-zero movement, Dead-band effects, Constant input limit cycles.

Reference:

1. John G. Proakis, Dimitris G. Manolakis, "Digital Signal Processing: Principles, Algorithms and Applications," Prentice Hall of India Pvt. Ltd., 1997.
2. Boaz Porat, "A Course in Digital Signal Processing," Prentice Hall Inc, 1998.
3. Oppenheim A. V., Schafer R. W., "Discrete-Time Signal Processing," Prentice Hall India, 1996.
4. Chi-Tsong Chen, "Digital Signal Processing: Spectral Computation and Filter Design," Oxford University Press, 2001.
5. Mitra S. K., "Digital Signal Processing: A Computer Based Approach," McGraw-Hill Publishing Company, 1998.
6. Lonnie C. Ludeman, "Fundamentals of Digital Signal Processing," John Wiley& Sons, NY, 1986.
7. R. E. Bogner, A. G. Constantinidis, (Editors), "Introduction to Digital Filtering," John Wiley & Sons, NY, 1975.
8. Emmanuel C. Ifeacher, Barry W. Jervis, "Digital Signal Processing: A Practical Approach," 2nd edn., Pearson Education, 2004.
9. The Manuals of the Digital Signal Processors manufactured by Texas Instruments or Analog Devices (Available online on the web pages of Texas Instruments or Analog Devices).

EC 3014: CONTROL SYSTEMS

L	T	P	C
3	0	0	3

Module 1 (10 hours)
General schematic diagram of control systems - open loop and closed loop systems – concept of feedback - modeling of continuous time systems – Review of Laplace transform - transfer function - block diagrams – signal flow graph - mason's gain formula - block diagram reduction using direct techniques and signal flow graphs - examples - derivation of transfer function of simple systems from physical relations - low pass RC filter - RLC series network - spring mass damper

Module 2 (11 hours)
Analysis of continuous time systems - time domain solution of first order systems – time constant - time domain solution of second order systems - determination of response for standard inputs using transfer functions - steady state error - concept of stability - Routh- Hurwitz techniques - construction of bode diagrams - phase margin - gain margin - construction of root locus - polar plots and theory of nyquist criterion - theory of lag, lead and lag-lead compensators

Module 3 (11 hours)
Basic elements of a discrete time control system - sampling - sample and hold - Examples of sampled data systems – pulse transfer function - Review of Z-transforms - system function - mapping between s plane and z plane - analysis of discrete time systems –- examples - stability - Jury's criterion - bilinear transformation – stability analysis after bilinear transformation - Routh-Hurwitz techniques - construction of bode diagrams - phase margin - gain margin - digital redesign of continuous time systems

Module 4 (9 hours)
Introduction to the state variable concept - state space models - phase variable and diagonal forms from time domain - diagonalization - solution of state equations - homogenous and non homogenous cases - properties of state transition matrix - state space representation of discrete time systems - solution techniques - relation between transfer function and state space models for continuous and discrete cases - relation between poles and Eigen values – Controllability and observability

Reference:

1. Ziemer R.E., Tranter W.H. & Fannin D.R., "Signals and Systems",Fourth Edition, Pearson Education Asia, 1998
2. Ogata K., "Modern Control Engineering", Prentice Hall India,1994
3. Dorf R.C. & Bishop R.H., "Modern Control Systems", Nineth Edition, Addison Wesley,2001
4. Kuo B.C., "Digital Control Systems", Second Edition, Oxford University Press, 1992
5. Ogata K., “Discrete Time Control Systems", Pearson Education, 2001
6. Nagarath I.J. & Gopal M., “Control System Engineering”, Wiley Eastern Ltd,1995

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EC 3018: ELECTRONICS CIRCUIT LABORATORY – II

L	T	P	C
0	0	3	2

1. Differential amplifier and Current Source
2. Measurement of Op-Amp parameters – CMRR, Slew rate, Open loop gain, input and output impedances, Unity gain bandwidth
3. Inverting non-inverting amplifiers, Integrator, Differentiator – frequency response
4. Instrumentation Amplifier using Op-amps and IC – Gain, CMRR and Input impedance
5. Op-amp in comparator application
6. Waveform Generators –Sine, square, Triangular and Ramp
7. Astable and Monostable Multivibrators using op-amp and 555IC
8. Low Pass Filter and High Pass Filter realizations using op-amps
9. Band Pass Filter and Band Stop Filter realizations using op-amps
10. DAC and ADC circuits using op-amp/ICs
11. Regulated power supply with 723 IC

The experimental results obtained in the lab may be compared with the circuit simulation results.

Reference:

1. Sergio Franco, 'Design with Operational Amplifiers and Analog Integrated Circuits', McGraw Hill Book Company 1998
2. Jacob Baker R., Li H.W. & Boyce D.E., 'CMOS- Circuit Design, Layout & Simulation', PHI 2007
3. Gobind Daryanani, 'Principles of Active Network Synthesis & Design', John Wiley 2003
4. Sedra A.S. & Smith K.C., "Microelectronic Circuits', Oxford University Press 1998
5. Fiore J.M., 'Operational Amplifiers and Linear Integrated Circuits', Jaico Publishing House 2006
6. Gaykward, Operational Amplifiers, Pearson Education, 1999
7. Coughlin R.F. & Driscoll F.F., 'Operational Amplifiers and Linear Integrated Circuits', Pearson Education 2002
8. Horenstein M.N., 'Microelectronic Circuits & Devices', PHI, 1995

EC 3019: MICROPROCESSORS AND MICROCONTROLLERS LAB

L	T	P	C
0	0	3	2

1. Assembly language programming of 8086 -TSR ,matrix multiplication and Pascal's triangle
2. Stepper board interfacing to 8086
3. Hex keyboard interfacing to 8086
4. Multiplexed ,dynamic LED display interface to 8086
5. 8279 interface to 8086
6. 8255 interface to 8086
7. Assembly language programming of 8051
8. Timer programming of 8051 ,using status check
9. Timer programming of 8051 ,using interrupts
10. External interrupts programming of 8051
11. LCD interfacing to 8051 –project

Reference:

1. Lyla B.Das, The x86 Microprocessors , Pearson Education, 2010
2. Muhammed Ali Mazidi, Janice Gillispie Mazidi ,Rolin D Mc Kinlay, The 8051 Microcontroller and Embedded Systems Using Assembly and C , Second Edition ,2008 , Pearson Education

ME 4104: PRINCIPLES OF MANAGEMENT

Prerequisite: Nil

L	T	P	C
3	0	0	3

Module 1 (9 Hours)
Introduction to management theory, Characteristics of management, Management as an art – profession, Systems approach to management, Task and responsibilities of a professional manager, Levels of managers and skill required. Management process – planning – mission – objectives – goals – strategy – policies – programmes – procedures.

Module 2 (9 Hours)
Organizing – principles of organizing – organization structures, Directing – delegation – span of control – leadership – motivation – communication, Controlling.

Module 3 (12 Hours)
Decision making process– decision making under certainty – risk – uncertainty – models of decision making, Project management – critical path method – programme evaluation and review technique – crashing.

Module 4 (12 Hours)
Introduction to functional areas of management, Operations management, Human resources management, Marketing management, Financial management.

References:

1. Koontz, H., and Weihrich, H., *Essentials of Management: An International Perspective*, 8th ed., McGraw Hill, 2009.
2. Hicks, *Management: Concepts and Applications*, Cengage Learning, 2007.
3. Mahadevan, B., *Operations Management, Theory and Practice*, Pearson Education Asia, 2009.
4. Kotler, P., Keller, K.L, Koshy, A., and Jha, M., *Marketing Management*, 13th ed., 2009.
5. Khan, M.Y., and Jain, P.K., *Financial Management*, Tata-Mcgraw Hill, 2008.

EC 3021: COMPUTER ORGANIZATION & ARCHITECTURE

L	T	P	C
3	0	0	3

Module 1 (10 hours)
Introduction to Processor Architecture – Design Methodology- System Representation – Gate level – Register level – Processor level – CPU Organization – Data Representation – Basic Formats – Fixed Point Numbers – Floating Point Numbers – Instruction Sets – Instruction Formats – Instruction Types – Programming Considerations.

Module 2 (12 hours)
Datapath Design – Fixed Point Arithmetic – Addition and Subtraction – Multiplication – Division – Arithmetic Logic Units – Combinational ALUs – Sequential ALUs – Floating Point Arithmetic – Pipeline Processing – Control Design : Basic Concepts – Introduction – Hardwired Control – Design Examples – Microprogrammed Control – Basic Concepts – Multiplier Control Unit – CPU Control Unit – Pipeline Control – Instruction Pipelines – Pipeline Performance – Superscalar Processing

Module 3 (10 hours)
Memory Organisation – Memory Hierarchy – Main memory – RAM and ROM chips – Memory Address Map – Memory Connection to CPU – Auxiliary Memory – Magnetic disks – Magnetic Tape – Associative Memory – Hardware Organization - Read Operation – Write Operation – Cache Memory : Associative Mapping – Direct Mapping – Set Associative Mapping –Virtual Memory – Address Space and Memory Space – Address Mapping Using Pages – Associative Memory Page Table – Page Replacement – Memory Management Hardware – Segmented Page Mapping

Module 4 (10 hours)
System Organization – Communication Methods – Basic Concepts – Bus Control – I/O and System Control – I/O Organization – Isolated Versus Memory Mapped I/O - Programmed I/O – DMA and Interrupts – I/O Processors – Operating Systems – Parallel Processing – Processor Level Parallelism – Multiprocessors – Fault Tolerance.

Reference:

1. Patterson D.A. & Hennessy J.L., "Computer Organization and Design", Morgan Kaufmann Publishers, 2002
2. John.P.Hayes “Computer Architecture and Organization”, McGraw-Hill International Editions, Computer Science Series, 1998.
3. Morris Mano “Computer System Architecture”, Prentice-Hall India, Eastern Economy Edition, 2009
4. Carl Hamacher, Zvonko Vranesic & Safwat Zaky, “Computer Organization”, Mc Graw Hill, 2001
5. Pal Choudhuri P., "Computer Organization and Design", Prentice-Hall India, 2^{nd} Edition, 2003
6. William Stallings, "Computer Organization and Architecture", Pearson Education, 4^{th} Edition, 2006

EC 3022: INFORMATION THEORY & CODING

L	T	P	C
4	0	0	4

Module 1 (14 hours)
Entropy and Loss-less Source Coding **:** Entropy, Entropy of discrete random variables- Joint, conditional and relative entropy- Chain rule for entropy, Mutual information and conditional mutual information, Relative entropy and mutual Information
Lossless source coding**-** Discrete Memory-less sources**,** Uniquely decodable codes- Instantaneous codes- Kraft's inequality – Average codeword length, Optimal codes- Huffman coding, Arithmetic Coding, Lemplel-Ziv Coding, Shannon's Source Coding Theorem.

Module 2 (16 hours)
Channel Capacity and Coding Theorem: Channel Capacity**-** Discrete memory-less channels (DMC) and channel transition probabilities, Capacity computation for simple channels- Shannon's Channel Coding Theorem for DMC (proof is optional), Converse of Channel Coding Theorem
Continuous Sources and Channels: Differential Entropy- Mutual information- Waveform channels- Gaussian channels- Shannon-Harley Theorem, Shannon limit, efficiency of digital modulation schemes-power limited and bandwidth limited systems..

Module 3 (16 hours)
Channel Coding- Part-I: Introduction- Error detection and correction, Review of Vector Space, properties, Linear block codes- Construction and decoding, Standard Array decoding, Distance properties.
Characteristics of Finite fields- Construction and basic properties of Finite Fields- Computations using Galois Field arithmetic- Extension Fields. Cyclic codes – Non-systematic and systematic codes-Construction and Decoding- Minimal Polynomials, Conjugates and Conjugacy classes, BCH codes – Construction and decoding - Reed Solomon codes, Introduction to low density parity check codes.

Module 4 (10 hours)
Channel Coding- Part-II**:** Convolutional codes – Encoder representations and Types- Maximum likelihood decoding - Viterbi decoding, Hard decision and Soft decision decoding, Transfer function of convolutional codes, Interleaving, Concatenated codes, Introduction to Turbo codes.

Reference:

1. Thomas M. Cover and Joy A. Thomas, "Elements of Information Theory", John Wiley & Sons, 2006
2. Shu Lin and Daniel. J. Costello Jr., "Error Control Coding: Fundamentals and applications", 2nd Ed., Prentice Hall Inc, 2004.
3. John G. Proakis and M. Salehi, "Digital Communication", 5th Ed., MGH, 2008
4. David J. C. MacKay, "Information Theory, Inference and Learning Algorithms", Cambridge University Press, 2003
5. Robert Gallager, "Information Theory and Reliable Communication", John Wiley & Sons, 1968.
6. R. E. Blahut, "Theory and Practice of Error Control Codes", Addison-Wesley, 1983.

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EC 3023: COMPUTER NETWORKS

L	T	P	C
3	0	0	3

Module 1 (8 hrs)
Introduction: Building blocks- links, nodes - Layering and protocols - OSI architecture - Internet architecture – Multiplexing -Circuit switching vs packet switching - Datagram Networks - Virtual Circuit networks.

Module 2 (10 hrs)
Direct link Networks: Framing - Error detection - Reliable transmission - Multiple access protocols - Ethernet (IEEE 802.3) - Token Rings (IEEE 802.5) - wireless LAN (IEEE 802.11) - Bridges and LAN switches - ATM networks.

Module 3 (14 hrs)
Internetworking: IPv4- addressing, datagram forwarding – ARP - Routing- distance vector (RIP) - Link state (OSPF) - routing for mobile hosts - Global Internet- subnetting – CIDR - inter-domain routing (BGP) - IPv6.
End to End protocols: Simple demultiplexer (UDP) - Reliable byte stream (TCP)- segment format, connection management, sliding window, flow control, adaptive retransmission, congestion control, TCP extension, performance.

Module 4 (10 hrs)
Broadband services and QoS issues: Quality of Service issues in networks- Integrated service architecture- Queuing Disciplines- Weighted Fair Queuing- Random Early Detection- Differentiated Services- Protocols for QOS support- Resource reservation-RSVP- Multi protocol Label switching- Real Time transport protocol.

Reference:

1. Peterson L.L. & Davie B.S., "Computer Networks: A System Approach", Morgan Kaufman Publishers, 3rd edition, 2003.
2. James. F. Kurose and Keith.W. Ross, "Computer Networks, A top-down approach featuring the Internet", Addison Wesley, 3rd edition, 2005.
3. D. Bertsekas and R. Gallager, "Data Networks", PHI, 2nd edition, 2000.
4. S. Keshav, "An Engineering Approach to Computer Networking", Pearson Education, 2005.

EC 3024: ENVIRONMENTAL STUDIES

L	T	P	C
3	0	0	3

Module 1 (8 hours)
Natural Resources: a) Forest resources: Use and over-exploitation, deforestation, case studies- Timber extraction, mining, dams and their effects on forest and tribal people. b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. d) Food resources: World food problems, changes caused by agriculture and over-grazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. e) Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources, case studies, reducing energy consumption in electronic systems, energy audits, sustainable power generation and energy systems. f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. g) Role of an individual in conservation of natural resources. h) Equitable use of resources for sustainable lifestyles.

Module 2 (6 hours)
Ecosystems: Concept of an ecosystem, structure and function of an ecosystem, producers, consumers and decomposers, energy flow in the ecosystem, ecological succession, food chains, food webs and ecological pyramids.
Characteristic features, structure and function of: forest ecosystem, grassland ecosystem, desert ecosystem and aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Module 3 (8 hours)
Biodiversity and its conservation: Genetic, species and ecosystem diversity, bio-geographical classification of India, Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values, Biodiversity at global, national and local levels, India as a mega-diversity nation, Hot-spots of biodiversity, threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts, endangered and endemic species of India, conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Module 4 (8 hours)
Environmental Pollution: Causes, effects and control measures of air pollution, water pollution, soil pollution, marine pollution, noise pollution, thermal pollution and nuclear hazards, solid waste management - causes, effects and control measures of urban and industrial wastes, role of an individual in prevention of pollution, pollution case studies, disaster management - floods, earthquake, cyclone and landslides.
Electronic product life cycle, probable environmental pollution at different stages, electronic waste – materials, waste management, impact of materials and processes used for electronic product manufacturing, recycling electronics, removal of hazardous substances from products.

Module 5 (7 hours)
Social Issues and the Environment: From Unsustainable to Sustainable development, urban problems related to energy, water conservation, rain water harvesting, watershed management, resettlement and rehabilitation of people; its problems and concerns, case studies
Environmental ethics : Issues and possible solutions, climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies, wasteland reclamation, consumerism and waste products.
Issues involved in enforcement of environmental legislation and public awareness.
Design for Environment (DFE), need for regulations, impact of work culture in the modern world.

Module 6 (5 hours)

Human Population and the Environment: Population growth, variation among nations, Population explosion – Family Welfare Programme, environment and human health, role of Information Technology in environment and human health, case studies, biological impact of materials used in electronic products and manufacturing process, impact of signal radiation from electronic products.

Reference:

1. Gurdeep R. Chatwal and Harish Sharma, “A Text Book of Environmental Studies : Environmental Sciences”, Himalaya Publishing House, 2004.
2. Anubha Kaushik and C P Kaushik, “Perspectives in Environmental Studies”, New Age International, 2007.

EC 3028: ANALOG COMMUNICATION LAB

L	T	P	C
0	0	3	2

The goals of Analog Communication Laboratory course are: To perform experiments that demonstrate the theory of analog modulation and demodulation techniques learned in the course EC2024 Fundamentals of Communication and to introduce the students to some of the electronic components that make up communication systems.

List of experiments:

1. AM generation
2. AM detection with simple and delayed AGC
3. DSBSC generation
4. RF Mixer using JFET/BJT
5. Implementation of intermediate frequency amplifier
6. FM generation (reactance modulator)
7. FM demodulation: Foster-seely discriminator and ratio detector
8. PAM generation and demodulation
9. Generation and demodulation of PWM and PPM
10. PLL characteristics
11. FM modulation/demodulation using PLL

Reference:

1. L.W. Couch, Digital and Analog Communication Systems, 7/E, Pearson, 2007.
2. W. Tomasi, Electronics Communication Systems: Fundamentals Through Advanced, 5/e, Pearson, 2007.

EC 3099: MINI PROJECT

L	T	P	Cr
0	0	3	1

The mini project should be on Hardware Design and/or Fabrication in any of the areas in Electronics and Communication Engineering. Microcontroller/DSP/PLD based hardware design is also permitted. Project work can be carried out individually or by a group of maximum of five students under the guidance of a faculty from ECE Department. A committee of the faculty will evaluate the projects during the sixth semester. This course is normally engaged by the department at the beginning of sixth semester.

MS 4003: ECONOMICS

L	T	P	C
3	0	0	3

Module 1 (9 hours)
General Foundations of Economics; Nature of the firm; Forms of organizations-Objectives of firms-Demand analysis and estimation-Individual, Market and Firm demand, Determinants of demand, Elasticity measures and business decision making, Theory of the firm-Production functions in the short and long run

Module 2 (11 hours)
Cost concepts- Short run and long run costs- economies and diseconomies of scale, real and pecuniary economies; Product Markets; Market Structure- Competitive market; Imperfect competition (Monopoly, Monopolistic & Oligopoly) and barriers to entry and exit -Pricing in different markets

Module 3 (11 hours)
Macro Economic Aggregates-Gross Domestic Product; Economic Indicators; Models of measuring national income; Inflation ; Fiscal and Monetary Policies ; Monetary system; Money Market, Capital market; Indian stock market; Development Banks; Changing role of Reserve Bank of India

Module 4 (11 hours)
International trade - Foreign exchange market- Balance of Payments and Trade-Effects of disequilibrium in BOP on business- Trade regulation- Tariff versus quotas- International Trade and development and role of international institutions (World Bank, IMF and WTO) in economic development.

Reference:

1. Gregory.N.Mankiw, "Principles of Macro Economics", Cengage Learning,4th Edition, 2007.
2. Gupta, S.B."Monetary Economics", S. Chand & Co., New Delhi,4th Edition,1998.
3. Guruswamy,S. "Capital Markets", Tata McGraw Hill, New Delhi,2nd edition ,2009
4. Misra, S.K. and V.K. Puri, "Indian Economy – Its Development Experience", Himalaya Publishing House, Mumbai, 27th Edition,2009
5. Pindyck, R.S,, D.L Rubinfield and P.L. Mehta , "Microeconomics", Pearson Eductaion,6th Edition, 2008
6. Samuelson, P.A. and W.D. Nordhaus , "Economics" ,Tata McGraw Hill, New Delhi. 1998.
7. William .J.Baumol and Alan.S. Blinder, "Micro Economics Principles & Policy", Cengage Learning, Indian Edition 9th edition, 2009.

PN : Supplementary materials would be suggested / supplied for select topics on Indian economy

EC 4011: FUNDAMENTALS OF WIRELESS COMMUNICATION

L	T	P	C
4	0	0	4

Module 1 (15 hours)
Mobile radio propagation - free space propagation model - ground reflection model – large scale path loss - small scale fading and multipath propagation - impulse response model of a multipath channel - parameters of a mobile multipath channel - multipath delay spread - doppler spread - coherence band width - coherence time - time dispersion and frequency selective fading - frequency dispersion and time selective fading - concepts of level crossing rate and average fade duration

Module 2 (15 hours)
Digital communication through fading multipath channels - frequency non selective, slowly fading channels - frequency selective, slowly fading channels- calculation of error probabilities - tapped delay line model - the RAKE receiver performance – diversity techniques for mobile wireless radio systems concept of diversity branch and signal paths -combining methods - selective diversity combining - pre-detection and post detection combining - switched combining - maximal ratio combining- equal gain combining

Module 3 (13 hours)
Cellular concept - frequency reuse – cochannel interference - adjacent channel interference -power control for reducing interference - improving capacity in cellular systems – cell splitting - sectoring - hand off strategies - channel assignment strategies - call blocking in cellular networks

Module 4 (13 hours)
Fundamental concepts of spread spectrum systems - pseudo noise sequence - performance of direct sequence spread spectrum systems - analysis of direct sequence spread spectrum systems - the processing gain and anti jamming margin - frequency hopped spread spectrum systems - time hopped spread spectrum systems - synchronization of spread spectrum systems

Reference:

1. Rapport Thoedore S., Wireless Communications, Principles and Practice, PHI, 2003
2. Haykin, S. and Moher M., Modern Wireless Communications, Prentice Hall 2005.
3. Kamilo Feher, Wireless Digital Communications, PHI, 1995
4. Lee W.C.Y., Mobile Cellular Telecommunication, MGH, 2002
5. Proakis J.G., Digital Communications, Third Edition, MGH,2001

EC 4018: DIGITAL SIGNAL PROCESSING LABORATORY

Pre-requisites: EC3013

L	T	P	C
0	0	3	2

The experiments listed below are arranged in a pedagogical order. The instructor shall judiciously choose both simulation experiments using MATLAB/C/C++ and Assembly level implementation on a Digital Signal Processor manufactured by Texas Instruments (TI) or Analog Devices (AD). The first four experiments shall be done using MATLAB/C/C++by simulation. While using MATLAB, elementary commands of MATLAB shall be used, instead of built-in functions, to help the student develop insight in data structures for implementing Signal Processing Algorithms. Experiments from the fourth to the eleventh in the list shall be done both in MATLAB and in the Assembly language of one of the Digital Signal Processors (TI or AD).

1. Construction of the z-plane - Fourier transform, discrete time representations, poles and zeros, graphical calculation of phase and magnitude responses.
2. Linear convolution - Response of a LTI system to an arbitrary input.
3. Frequency response of FIR filters - Minimum Phase filters, Linear phase filters.
4. Convolution of long sequences - Overlap-save and overlap-add methods.
5. FIR Filter Design - Window-based method - Linear phase filters, lowpass, highpass, bandpass, band-reject filters - impulse response, step response, pulse response, response to sinusoids; FIR filters having arbitrary frequency response - Design using frequency sampling method; Least-squares design of FIR filters in time and frequency domains.
6. Discrete Fourier transform - Fast Fourier Transform algorithms - Decimation in time and Decimation in frequency FFT algorithms, Inverse discrete Fourier transform, Convolution with DFT - Circular convolution and Linear Convolution.
7. IIR filter Design - Butterworth and Chebyshev designs, Impulse invariance and Bi-linear transformation methods, pole-zero placements - Integrator, Comb filter.
8. Companding and non-uniform quantization - A-law and μ-law companding – Digital realization.
9. Digital coding of waveforms - Differential pulse code modulation - Adaptive Differential pulse code modulation, Delta modulation, Adaptive Delta modulation and Sigma-delta modulation.
10. Lattice structure realization of digital filters.
11. Linear prediction - Levinson recursion, Levinson-Durbin Algorithm - Lattice realization of prediction error filter; consistent extension of the autocorrelation matrix of a stationary process.

Reference:

1 John G. Proakis, Dimitris G. Manolakis, “Digital Signal Processing: Principles, Algorithms and Applications,” Prentice Hall India Pvt. Ltd., 1997.
2 Boaz Porat, “A Course in Digital Signal Processing,” Prentice Hall Inc, 1998.
3 Oppenheim A. V., Schafer R. W., “Discrete-Time Signal Processing,” Prentice Hall India, 1996.
4 Chi-Tsong Chen, “Digital Signal Processing: Spectral Computation and Filter Design,” Oxford University Press, 2001.
5 Richard A. Roberts, Clifford T. Mullis, “Digital Signal Processing,” Addison-Wesley Publishing Company, 1987.
6 Mitra S. K., “Digital Signal Processing - A Computer Based Approach,” McGraw-Hill Publishing Company, 1998.
7 Lonnie C. Ludeman, “Fundamentals of Digital Signal Processing,” John Wiley& Sons, NY, 1986.
8 R. E. Bogner, A. G. Constantinidis, (Editors), “Introduction to Digital Filtering,” John Wiley & Sons, NY, 1975.
9 Emmanuel C. Ifeacher, Barry W. Jervis, “Digital Signal Processing: A Practical Approach,” 2nd edn., Pearson Education, 2004.
10 The Manuals of the Digital Signal Processors manufactured by Texas Instruments or Analog Devices (Available online on the web pages of Texas Instruments or Analog Devices).

EC 4019: DIGITAL COMMUNICATION LAB

L	T	P	C
0	0	3	2

This laboratory is used for experiments to learn the fundamental concepts for analysis and design of digital and communication systems. Experiments are performed using electronic instrumentation, such as oscilloscopes, noise generators, spectrum analyzers, and network analyzers.

List of experiments:

1. Pulse code modulation
2. Delta modulation
3. Manchester encoder and timing recovery
4. Frequency Shift Keying Modem: Hardware Implementation
5. BPSK Modem: Simulation and Error probability evaluation
6. BPSK generation and detection: Hardware Implementation
7. BPSK Modem: Simulation and Error probability evaluation
8. Linear block codes-generation and detection
9. Cyclic encoder and decoder
10. Differential encoder and decoder
11. Digital microwave links
12. Digital TDM
13. CDMA spreader and de-spreader

Reference:

1. L.W. Couch, Digital and Analog Communication Systems, 7/E, Pearson, 2007.
2. W. Tomasi, Electronics Communication Systems: Fundamentals Through Advanced, 5/e, Pearson, 2007.

EC 4098: MAJOR PROJECT

L	T	P	C
0	0	6	3

The duration of major project is for two continuous semesters from seventh. The project can be analytical work, simulation, hardware design or a combination of these in the emerging areas of Electronics and Communication Engineering under the supervision of a faculty from the ECE Department. Project work can be carried out individually or by a group of maximum of five students. The UG evaluation committee of the department shall evaluate the project during seventh semester for 3 of total of 7 credits assigned for the project.

EC 4094: SEMINAR

L	T	P	C
0	0	3	1

Each student shall present a seminar in the eighth semester on a topic relevant to Electronics and Communication Engineering for about 30 minutes. The topic should not be a replica of what is contained in the syllabus. The topic shall be approved by the Seminar Evaluation Committee of the Department. The committee shall evaluate the presentation of students. A seminar report in the prescribed form shall be submitted to the department after the approval from the committee.

EC 4099: MAJOR PROJECT

L	T	P	C
0	0	6	4

The duration of major project is for two continuous semesters from seventh. The project can be analytical work, simulation, hardware design or a combination of these in the emerging areas of Electronics and Communication Engineering under the supervision of a faculty from the ECE Department. Project work can be carried out individually or by a group of maximum of five students. The UG evaluation committee of the department shall evaluate the project during eighth semester for 4 of total of 7 credits assigned for the project.

ELECTIVES

EC 3031: TELEVISION ENGINEERING

L	T	P	C
3	0	0	3

Module 1 (10 hours)
Principles of television - image continuity - interlaced scanning - blanking - synchronizing - video and sound signal modulation - channel bandwidth - vestigial sideband transmission – television signal propagation – antennas. VSB correction - positive and negative modulation - transmitter block diagram- CCD camera

Module 2 (12 hours)
Television receiver circuits – IF section, video detector-video amplifiers- AGC , Sync processing and AFC-Horizontal and vertical deflection circuits –sound section-tuner .

Module 3 (12 hours)
Colour TV - Colour perception - luminance, hue and saturation - colour TV camera and picture tube - colour signal transmission - bandwidth - modulation - formation of chrominance signal - principles of NTSC, PAL and SECAM coder and decoder

Module 4 (8 hours)
Digital TV - composite digital standards - 4 f sc NTSC standard - general specifications - sampling structure - digital transmission
Cable TV - cable frequencies - co-axial cable for CATV - cable distribution system - cable decoders - wave traps and scrambling methods

Reference:

1. Gulati R.R., Modern Television Engineering, Wiley Eastern Ltd, 2002.
2. Michael Robin & Michael Poulin, Digital Television Fundamentals, McGraw Hill, 1998
3. Bernard Grob & Charles E. Herndon, Basic Television and Video Systems, McGraw Hill International, 1999
4. Dhake A.M., Television Engineering, Tata McGraw Hill, 1993
5. Damacher P., Digital Broadcasting, IEE Telecommunications Series, 1996

EC 3032: POWER ELECTRONICS

L	T	P	C
3	0	0	3

Module 1 (10 hours)
Power diodes - basic structure and V-I characteristics - various types - power transistors - BJT, MOSFET and IGBT - basic structure and V-I characteristics - thyristors - basic structure - static and dynamic characteristics - device specifications and ratings - methods of turning on - gate triggering circuit using UJT - methods of turning off - commutation circuits - TRIAC

Module 2 (10 hours)
Line frequency phase controlled rectifiers using SCR - single phase rectifier with R and RL loads - half controlled and fully controlled converters with continuous and constant currents - SCR inverters - circuits for single phase inverters - series, parallel and bridge inverters - pulse width modulated inverters - basic circuit operation

Module 3 (10 hours)
AC regulators - single phase ac regulator with R and RL loads - sequence control of ac regulators - cycloconverter - basic principle of operation - single phase to single phase cycloconverter - choppers - principle of operation - step-up and step-down choppers - speed control of DC motors and induction motors

Module 4 (12 hours)
Switching regulators - buck regulators - boost regulators - buck-boost regulators - cuk regulators - switched mode power supply - principle of operation and analysis - comparison with linear power supply - uninterruptible power supply - basic circuit operation - different configurations - characteristics and applications

Reference:

1. Ned Mohan et.al, .Power Electronics, John Wiley and Sons, 1989
2. Sen P.C., Power Electronics, Tata Mc Graw Hill,2003
3. Rashid, Power Electronics.,Prentice Hall India,1993
4. G.K.Dubey et.al, Thyristorised Power Controllers, Wiley & Sons, 2001
5. Dewan & Straughen, .Power Semiconductor Circuits, Wiley & Sons, 1984
6. Singh M.D & Khanchandani K.B., Power Electronics, Tata Mc Graw Hill, 1998

EC 3033: MICROELECTRONICS TECHNOLOGY

L	T	P	C
3	0	0	3

Module 1 (6 hours)

Material properties, crystal structure, lattice, basis, planes, directions, angle between different planes, characterization of material based on band diagram and bonding, conductivity, resistivity, sheet resistance, phase diagram and solid solubility, Crystal growth techniques, wafer cleaning, Epitaxy, Clean room and safety requirements

Module 2 (15 hours)

Oxidation: Kinetics of Silicon dioxide growth both for thick, thin and ultra thin films, Deal-Grove model and Improvements in Deal-Grove method for thin and ultra thin oxide layers, thickness characterization methods, multi dimension oxidation modeling

Diffusion and Ion Implantation: Diffusion process, Solid state diffusion modeling, various doping techniques, Ion implantation, modeling of Ion implantation, statistics of ion implantation, damage annealing, thermal budget, rapid thermal annealing, spike anneal, advanced annealing methods, Implant characterization SIMS, spreading resistance method

Module 3 (15 hours)

Deposition & Growth**:** Various deposition techniques CVD, PVD, evaporation, sputtering, spin coating, LPCVD, epitaxy, MBE, ALCVD, Growth of High k and low k dielectrics

Etch and Cleaning**:** materials used in cleaning, various cleaning methods, Wet etch, Dry etch, Plasma etching, RIE etching, etch selectivity/selective etch

Photolithography: Positive photo resist, negative photo resist, comparison of photo resists, components of a resist, light sources, exposure, Resolution, Depth of Focus, Numerical Aperture (NA), sensitivity, contrast, need for different light sources, masks, Contact, proximity and projection lithography, step and scan, optical proximity correction, develop(development of resist), Next generation technologies: Immersion lithography, Phase shift mask, EUV lithography, X-ray lithography, e-beam lithography, ion lithography, SCALPEL

Module 4 (6 hours)

Planarization Techniques: Need for planarization, Chemical Mechanical Polishing

Metallization and Interconnects: Copper damascene process, Metal interconnects; Multi-level metallization schemes, Process integration: NMOS, CMOS and Bipolar process.

Reference:

1. M. Deal and P.Griffin, Silicon VLSI Technology, James Plummer, Prentice Hall Electronics, 2010.
2. Stephen Campbell, The Science and Engineering of Microelectronics Oxford University Press, 1996.
3. S.M. Sze, VLSI Technology, 2nd Edition, McGraw Hill, 1988.
4. S.K. Ghandhi, VLSI Fabrication Principles, John Wiley Inc., New York, 1983.
5. C.Y. Chang and S.M.Sze , ULSI Technology, McGraw Hill Companies Inc, 1996.

EC 3034: MODELING AND TESTING OF DIGITAL SYSTEMS

Pre-requisite: EC2012

L	T	P	C
3	0	0	3

Module 1 (12 Hours)
Introduction to HDL based Digital Design: – Basic VHDL terminology – basic language elements – Data objects and types – Behavioural modelling – Process constructs – Complex signal assignments – Dataflow modelling – delay models – Structural modelling – resolving signal values

Module 2 (12 Hours)
Advanced VHDL features: Generics and Configurations – Subprograms and Overloading – Packages and Libraries – Advanced features – simulation semantics – modelling examples – state machine modelling using VHDL- review of FPGA architectures and design using FPGA. Practical design exercises on VHDL simulator /synthesizer

Module 3 (10 Hours)
Digital System Testing: Fault models – fault equivalence – fault location fault dominance – single and multiple stuck faults – Testing for single stuck faults – Algorithms – random test generation – Testing for bridging faults

Module 4 (8 Hours)
Design for Testability: Ad-hoc design for testability techniques – Classical scan designs – Boundary scan standards – Built-in-self-test – Test pattern generation – BIST architecture examples

Reference:

1. J. Bhasker; A VHDL Synthesis Primer, B.S. Publications 2001
2 VHDL for Engineers ,by Kenneth L Short ,Pearson Education ,2006
3. Miron Abramovici et. al. Digital System Testing and Testable Design, Jaico Publishing House, 2001
4. Charles H. Roth Jr; Digital System Design Using VHDL, Thomson Education,2005

EC 3035: MOS DEVICE MODELING

Pre-requisite : EC2013

L	T	P	C
3	0	0	3

Module 1 (13 hours)
Semiconductor surfaces, Ideal MOS structure, MOS device in thermal equilibrium, Non-Ideal MOS: work function differences, charges in oxide, interface states, band diagram of non ideal MOS, flatband voltage, electrostatics of a MOS (charge based calculations), calculating various charges across the MOSC, threshold voltage, MOS as a capacitor (2 terminal device), Three terminal MOS, effect on threshold voltage

Module 2 (16 hours)
MOSFET (Enhancement and Depletion MOSFETs), mobility, on current characteristics, off current characteristics, subthrehsold swing, effect of interface states on subthreshold swing, drain conductance and transconductance, effect of source bias and body bias on threshold voltage and device operation, Scaling, Short channel and narrow channel effects- High field effects

Module 3 (5 hours)
MOS transistor in dynamic operation, Large signal Modeling, small signal model for low, medium and high frequencies.

Module 4 (8 hours)
SOI concept, PD SOI, FD SOI and their characteristics, threshold voltage of a SOI MOSFET, Multi-gate SOI MOSFETs, Alternate MOS structures.

Reference:

1. E.H. Nicollian, J. R. Brews, Metal Oxide Semiconductor - Physics and Technology, John Wiley and Sons, 2003.
2. Jean- Pierrie Colinge, Silicon-on-insulator Technology: Materials to VLSI Kluwer Academic publishers group, 2004.
3. Yannis Tsividis, Operation and Modeling of the MOS transistor: Oxford University Press, 2010.
4. M.S.Tyagi, Introduction to Semiconductor materials and Devices, John Wiley & Sons, 2004.
5. Donald A Neamen, Semiconductor Physics and Devices: Basic Principles, McGraw-Hill, 2003.
6. Jean-Pierre Colinge, Physics of Semiconductor Devices, Kluwer Academic Publishers, 2002, access online at (NITC intranet) http://www.springerlink.com/content/978-1-4020-7018-1/
7. Y. Taur and T.H. Ning, Fundamentals of Modern VLSI DevicesCambridge University Press, 1998, ISBN: 0-521-55959-6

EC 3036: VLSI CIRCUITS & SYSTEMS

L	T	P	C
3	0	0	3

Pre-requisites: EC2012 & EC2013

Module 1 (12 hours)
Overview of VLSI Design flow- Review of MOS transistors, MOSFET capacitances-Junction capacitances-oxide related capacitances-Ideal switches and Boolean operation-MOSFET as switch-Switch models of inverter-MOSFET realization of inverters- Resistive load, NMOS load and CMOS inverters-DC and Transient analysis-Area, power and noise margin considerations-Stick diagram and layout of CMOS inverter

Module 2 (13 hours)
Multiple input CMOS logic circuits, DC and transient analysis, Pseudo NMOS, Pass transistor, Complementary pass transistor and transmission gate logic styles, realization, Area, power and noise margin considerations, Dynamic circuits, Issues with dynamic circuits-Domino and NORA logic, Designing sequential circuits, clocked CMOS circuits

Module 3 (9 hours)
Cell based design, Standard cells and Data path cells, Logic and circuit design of arithmetic circuits-Adders-Ripple carry, Carry look ahead and other high speed adders, Array and tree multipliers-Logarithmic and barrel shifters, 6T SRAM and DRAM cell design

Module 4 (8 hours)
Driving large capacitive loads, Wire delay models, Lumped C, RC and distributed RC models, Elmore delay model, Delay calculation with distributed circuit elements, Latch up and its prevention, Input and output circuits, ESD protection, power supply noise, Supply voltage scaling and its effect on circuit parameters, Scaling and short channel effects

Reference:

1. Sung –Mo Kang & Yusuf Leblebici, CMOS Digital Integrated Circuits- Analysis & Desing, MGH, Third Ed., 2003
2. John P Uyemura, Introduction to VLSI Circuits and Systems, Wiley India, 2006
3. Neil H.E.Weste, Kamran Eshraghian, Principles of CMOS VLSI Design- A Systems Perspective, Second Edition. Pearson Publication, 2005
4. Jan M.Rabaey, Digital Integrated Circuits- A Design Perspective, Prentice Hall, Second Edition, 2005
5. R.J. Baker, H.W.Li and D.E.Boyce, CMOS Circuit Design, Layout and Simulation, Wiley-IEEE Press, 2007

EC 3037: ACTIVE NETWORK SYNTHESIS

L	T	P	C
3	0	0	3

Pre-requisites: EC 2011, EC 3011

Module1(10 hours)
Network functions - Frequency and impedance denormalization - Types of filters (filter magnitude specs, phase specs, second-order filter functions) - Butterworth, Chebyshev, Elliptic and Bessel filters - Sensitivity - Definition and basic properties - Function sensitivity - Coefficient sensitivity - Q and ω_0 sensitivity

Module 2 (9 hours)
Amplifiers and fundamental active building blocks - Opamps, OTAs, CCIIs, Integrators, gyrators and immittance converters

Module 3 (15 hours)
Second-order filters - Single-amplifier RC biquads - Multiple amplifier biquads (Kerwin-Huelsman-Newcomb filter, Tow-Thomas filter, Akerberg-Mossberg filter) - Biquads based on general impedance converter - OTA-based (two-integrator loop) filters - effects of active nonidealities
Higher order filter realization - Cascade realizations, pole-zero pairing - Multiple-loop feedback realizations - LC ladder simulations

Module 4 (8 hours)
Fully integrated high-frequency filter realisations - Transconductance filters - Log-domain filters - Switched-capacitor filters

Reference:

1. P V Ananda Mohan: Current mode VLSI Analog filters; Springer, 2004
2. Gobind Daryanani: Principles of Active Network Synthesis and Design, John Wiley, 1978
3. M E Van Valkenberg: Analog Filter Design; Oxford Univ Press, 1995
4. Sedra & Brackett: Filter theory & Design – Active & Passive; Matrix Publishers, 1978

EC 3038: EMBEDDED SYSTEMS

L	T	P	C
3	0	0	3

Module 1(10 hours)

Introduction to Embedded systems : Embedded system examples, Parts of Embedded System- Processor, Power supply, clock, memory interface, interrupt, I/O ports, Buffers, Programmable Devices, ASIC,etc. interfacing with memory and I/O devices. Memory Technologies – EPROM, Flash, OTP, SRAM,DRAM, SDRAM etc.

Module 2 (8 hours)

Embedded System Design: Embedded System product Development Life cycle (EDLC), Hardware development cycles- Specifications, Component selection, Schematic Design, PCB layout, fabrication and assembly. Product enclosure Design and Development.

Embedded System Development Environment – IDE, Cross compilation, Simulators/Emulators, Hardware Debugging. Hardware testing methods like Boundary Scan, In Circuit Testing (ICT) etc.

Bus architectures like I^2C, SPI, AMBA, CAN etc.

Module 3 (12 hours)

Operating Systems: Concept of firmware, Operating system basics, Real Time Operating systems, Tasks, Processes and Threads, Multiprocessing and Multitasking, Task scheduling, Task communication and synchronisation, Device Drivers.

Module 4 (12 hours)

System Design Examples : System design using ARM/PSoC/MSP430 processor

Reference:

1. Shibu K.V.: Introduction to Embedded Systems, Tata McGraw Hill, 2009
2. Tim Wilmshurst: An introduction to the design of small-scale embedded systems, Palgrave, 2001.
3. Device data sheets of ARM/PSoC/MSP430
4. Web Resources

EC 3039: MULTIRATE SYSTEMS

L	T	P	C
3	0	0	3

Pre-requisites: EC3013

Module 1 (12 hours)
Multirate System Fundamentals: Sampling theorem: Sub-Nyquist sampling, generalization; Basic multirate operations: up sampling and down sampling - time domain and frequency domain analysis; Identities of multirate operations; Interpolator and decimator design; Rate conversion; Polyphase representation of signals and systems; uniform DFT filter bank, decimated uniform DFT filter bank – polyphase representation.

Module 2 (10 hours)
Multirate Filter Banks: Maximally decimated filter banks: Quadrature mirror filter (QMF) banks - Polyphase representation, Errors in the QMF - Aliasing and imaging; Methods of cancelling aliasing error,
Amplitude and phase distortions; Prefect reconstruction (PR) QMF bank - PR condition; Design of an alias free QMF bank

Module 3 (10 hours)
M-channel Perfect Reconstruction Filter Banks: Filter banks with equal pass bandwidth, filter banks with unequal pass bandwidth – Errors created by the filter banks system - Aliasing and imaging - Amplitude and phase distortion, polyphase representation - polyphase matrix. Perfect reconstruction system - Necessary and sufficient condition for perfect reconstruction, FIR PR systems, Factorization of polyphase matrices, Design of PR systems

Module 4 (10 hours)
Linear Phase Perfect Reconstruction (LPPR) Filter Banks: Necessary conditions for linear phase property; Lattice structures for LPPR FIR QMF banks - Synthesis, M-channel LPPR filter bank, Quantization effects - Types of quantization effects in filter banks - Implementation - Coefficient sensitivity effects, round off noise and limit cycles, dynamic range and scaling.

Reference:

1. P. P. Vaidyanathan, Multirate Systems and Filter Banks, Prentice Hall, PTR, 1993.
2. N. J. Fliege, Multirate Digital Signal Processing, John Wiley, 1994.
3. Sanjit K. Mitra, Digital Signal Processing: A Computer based Approach,3rd Edition,McGraw Hill, 2001.
4. R. E. Crochiere, L. R. Rabiner, Multirate Digital Signal Processing, Prentice Hall Inc, 1983.
5. Fredric J Harris, Multirate signal Processing For Communication Systems, 1st Edition, Pearson Education
6. John G. Proakis, Dimitris G. Manolakis, Digital Signal Processing: Principles, Algorithms and Applications 3rd Edn. Prentice Hall India, 1999.

EC 3040: DIGITAL IMAGE PROCESSING

L	T	P	C
3	0	0	3

Module 1 (8 hrs)

Digital image representation: Basic ideas in digital image processing: problems and applications - Image representation and modeling Sampling and quantization - Basic relationships between pixels - Two dimensional systems - shift in variant linear systems - Separable functions; 2-D convolution; 2-D correlation.

Image perception - light, luminance, brightness and contrast - MTF of the visual system - visibility function - monochrome vision models - image fidelity criteria - colour representation - colour matching and reproduction - colour co-ordinate systems - colour difference measures - colour vision models.

Module 2 (8 hrs)

Image transforms: 2-D Discrete Fourier transform - properties; Walsh Hadamard, Discrete Cosine, Haar and Slant transforms; The Hotelling transform. Matrix theory - block matrices and Kronecker products - Circulant matrix formulation for complexity reduction; Algebraic methods - random fields - spectral density function -

Module 3 (10 hrs)

Image enhancement & Restoration: Image enhancement: Basic gray level transformations – Histogram processing: histogram equalization and modification - Spatial operations - Transforms operations - Multispectral image enhancement - Colour image enhancement

Image restoration: Degradation model; Restoration in presence of noise only – Estimating the degradation function - Inverse _filtering - Wiener _filtering – Constrained Least Squares filtering.

Module 4 (9 hrs)

Image compression: Fundamental concepts of image compression - Compression models - Information theoretic perspective - Fundamental coding theorem – Lossless Compression: Huffman Coding- Arithmetic coding – Bit plane coding – Run length coding - Lossy compression: Transform coding – Image compression standards.

Module 5 (7 hours)

Image segmentation: Detection of Discontinuities – Edge linking and boundary Description: Local processing – Global processing – Hough transform – Thresholding – Region based segmentation.

Reference:

1. R. C. Gonzalez, R. E. Woods, Digital Image Processing, Pearson Education. II Ed.,2002
2. Jain A.K., "Fundamentals of Digital Image Processing,", Prentice-Hall, 1989.
3. Jae S. Lim, Two Dimensional Signal And Image Processing, Prentice-Hall, Inc, 1990.
4. Pratt W.K., "Digital Image Processing", John Wiley, 1991.
5. K. R. Castleman, .Digital image processing., Prentice Hall, 1995.
6. Netravalli A.N. & Hasbell B.G., "Digital Pictures-Representation Compression and Standards", Plenum Press, New York, 1988.
7. Rosenfeld & Kak A.C., "Digital Picture Processing", Vol.1&2, Academic Press, 1982.

EC 4031: MICROWAVE COMMUNICATION

Pre-requisite: EC 2022

L	T	P	C
3	0	0	3

Module 1 (11 hours)
Satellites and orbits**:** Communication satellites –Space-craft subsystems, payload – repeater, antenna, attitude and control systems, telemetry, tracking and command, power sub-system and thermal control. Orbital parameters, satellite trajectory, period, geostationary satellites, non-geostationary constellations.

Module 2 (10 hours)
Earth stations and terrestrial links: Antenna and feed systems, satellite tracking system, amplifiers, fixed and mobile satellite service earth stations. Terrestrial microwave links-line of sight transmission, Transmitters, receivers and relay towers -distance considerations, Digital links.

Module 3 (11 hours)
Communication link design: Frequency bands used, antenna parameters, transmission equations, noise considerations, link design, propagation characteristics of fixed and mobile satellite links, channel modeling, very small aperture terminals, VSAT design issues.

Module 4 (10 hours)
Multiple access techniques: Frequency division multiple access, time division multiple access, code division multiple access.

Reference:

1. M Richharia: 'Satellite Communication Systems', (2nd. Ed.),Macmillan Press Ltd, 1999.
2. Dennis Roddy: 'Satellite Communications', 4th Ed; MGH, 2006
3. Robert M Gagliardi: 'Satellite Communication', Van Nostrand Reinhold, 2000
4. Tri T Ha: 'Digital Satellite Communication', MGH, 2008
5. George M. Kizer: 'Digital Microwave Communication', IEEE Press, 2010

EC 4032: SPEECH PROCESSING

Pre Requisite: EC 3013

L	T	P	C
3	0	0	3

Module 1 (10 hours)
Digital models for the speech signal - mechanism of speech production - acoustic theory – Portnoff's equations-lossless tube models – complete speech production model- digital models –

Module 2 (10 hours)
Speech analysis:-linear prediction of speech - auto correlation - formulation of LPC equation - Solution of LPC equations - Levinson Durbin algorithm - Levinson recursion - Schur algorithm - lattice formulations and solutions – PARCOR coefficients.

Module 3 (12 hours)
Speech synthesis - pitch extraction algorithms - Gold Rabiner pitch trackers – autocorrelation pitch trackers - voice/unvoiced detection - homomorphic speech processing – homomorphic systems for convolution - complex Cepstrums - pitch extraction using homomorphic speech processing.
Spectral analysis of speech - short time Fourier analysis – STFT interpretations-filter bank summation method of short time synthesis

Module 4 (10 hours)
Automatic speech recognition systems - isolated word recognition - connected word recognition -large vocabulary word recognition systems - pattern classification - DTW, HMM - speaker recognition systems - speaker verification systems - speaker identification Systems.

Reference:

1. Rabiner L.R. & Schafer R.W., "Digital Processing of Speech Signals", Prentice Hall Inc., 1978.
2. Thomas F. Quatieri, "Discrete-time Speech Signal Processing: Principles and Practice" Prentice Hall, Signal Processing Series, 1st Edn., 2001.
3. O'Shaughnessy, D. "Speech Communication, Human and Machine". John Wiley & Sons; 2nd Edn, 1999.
4. Deller, J., J. Proakis, and J. Hansen. "Discrete-Time Processing of Speech Signals." Wiley-IEEE Press, Reprint edition, 1999.
5. Owens F.J., "Signal Processing of Speech", Macmillan New Electronics, 1993.
6. Saito S. & Nakata K., "Fundamentals of Speech Signal Processing", Academic Press, Inc., 1985.
7. Papamichalis P.E., "Practical Approaches to Speech Coding", Texas Instruments, Prentice Hall, 1987.
8. Rabiner L.R. & Gold, "Theory and Applications of Digital Signal Processing", Prentice Hall of India,1975.
9. Jayant, N. S. and P. Noll. "Digital Coding of Waveforms: Principles and Applications to Speech and Video. Signal Processing Series", Englewood Cliffs: Prentice-Hall, 2004.
10. Thomas Parsons, "Voice and Speech Processing", McGraw Hill Series, 1986.
11. Chris Rowden, "Speech Processing", McGraw-Hill International Limited, 1992.

EC 4033: WAVELET THEORY

Pre-requisites: EC 2014, EC 3013

L	T	P	C
3	0	0	3

Module 1 (12 Hours)
(1. a) Fourier and Sampling Theory: (6 hours)
Generalized Fourier theory, Fourier transform, Short-time(windowed) Fourier transform,Time-frequency analysis - uncertainty relation, Fundamental notions of the theory of sampling.

(1. b) Theory of Frames: (6 hours)
Bases, Resolution of unity, Definition of frames, Geometrical considerations and the general notion of a frame, Frame projector, Example - windowed Fourier frames.

Module 2 (12 hours)
(2. a) Wavelets: (6 hours)
The basic functions, Specifications, Admissibility conditions, Continuous wavelet trans- form (CWT), Wavelet frames.

(2. b) The multiresolution analysis (MRA) of L2(R): (6 hours)
The MRA axioms, Construction of an MRA from scaling functions - The dilation equation and the wavelet equation, Compactly supported orthonormal wavelet bases – Necessary and sufficient conditions for orthonormality.

Module 3 (12 hours)
(3.a) Construction of wavelets (1): (6 hours)
Regularity and selection of wavelets - Smoothness and approximation order – Criteria for wavelet selection with examples; Splines, Cardinal B-spline MRA, Subband filtering schemes, Compactly supported orthonormal wavelet bases.

(3.b) Wavelet transform: (6 hours)
Discrete wavelet transform (DWT) - Wavelet decomposition and reconstruction of functions in L2(R), Fast wavelet transform algorithms - Relation to filter banks, Wavelet packets - Representation of functions, Selection of basis.

Module 4 (6 hours)
(4) Construction of wavelets (2): (6 hours)
Biorthogonality and biorthogonal basis, Biorthogonal system of wavelets - construction, The Lifting scheme.

Reference:

1. Stephen G. Mallat, \A Wavelet Tour of Signal Processing" 2nd Edition Academic Press, 2000.
2. M. Vetterli, J. Kovacevic, \Wavelets and Subband Coding" Prentice Hall Inc, 1995.
3. Gilbert Strang and Truong Q. Nguyen, \Wavelets and Filterbanks" 2nd Edition Wellesley-Cambridge Press,1998.
4. Gerald Kaiser, \A Friendly Guide to Wavelets" Birkhauser/Springer InternationalEdition, 1994, Indian reprint 2005.
5. Mark A. Pinsky, \Introduction to Fourier Analysis and Wavelets"Brooks Cole Series in Advanced Mathematics, 2002.
6. Christian Blatter, \Wavelets: A primer" A. K. Peters, Massachusetts, 1998.
7. M. Holschneider, \Wavelets: An Analysis Tool"Oxford Science Publications, 1998.
8. Ingrid Daubechies, \Ten Lectures on Wavelets" SIAM, 1990.

EC 4034: RF CIRCUITS

L	T	P	C
3	0	0	3

Module 1 (9 hours)
Characteristics of passive IC components at RF frequencies – interconnects, resistors, capacitors, inductors and transformers – Transmission lines (6 hours)
Noise – classical two-port noise theory, noise models for active and passive components (3 hours)

Module 2 (13 hours)
High frequency amplifier design – zeros as bandwidth enhancers, shunt-series amplifier, f_T doublers, neutralization and unilateralization (6 hours)
Low noise amplifier design – LNA topologies, power constrained noise optimization, linearity and large signal performance (7 hours)

Module 3 (12 hours)
Mixers – multiplier-based mixers, subsampling mixers, diode-ring mixers (5 hours)
RF power amplifiers – Class A, AB, B, C, D, E and F amplifiers, modulation of power amplifiers, linearity considerations (7 hours)

Module 4 (8 hours)
Oscillators & synthesizers – describing functions, resonators, negative resistance oscillators, synthesis with static moduli, synthesis with dithering moduli, combination synthesizers – phase noise considerations.

Reference:

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, Prentice Hall, 1998.
3. A.A. Abidi, P.R. Gray, and R.G. Meyer, eds., Integrated Circuits for Wireless Communications, New York: IEEE Press, 1999.
4. R. Ludwig and P. Bretchko, RF Circuit Design, Theory and Applications, Pearson, 2000.

EC 4035: HIGH SPEED DIGITAL CIRCUITS

L	T	P	C
3	0	0	3

Module 1 (10 hours)

Introduction to high-speed digital design: Frequency, time and distance - Capacitance and inductance effects - High seed properties of logic gates - Speed and power -Modelling of wires -Geometry and electrical properties of wires - Electrical models of wires - transmission lines - lossless LC transmission lines - lossy LRC transmission lines - special transmission lines

Module 2 (10 hours)

Power distribution and noise: Power supply network - local power regulation - IR drops - area bonding - onchip bypass capacitors - symbiotic bypass capacitors - power supply isolation - Noise sources in digital system - power supply noise - cross talk - intersymbol interference

Module 3 (10 hours)

Signalling convention and circuits: Signalling modes for transmission lines -signalling over lumped transmission media - signalling over RC interconnect - driving lossy LC lines - simultaneous bi-directional signalling - terminations - transmitter and receiver circuits

Module 4 (12 hours)

Timing convention and synchronisation: Timing fundamentals - timing properties of clocked storage elements - signals and events -open loop timing level sensitive clocking - pipeline timing - closed loop timing - clock distribution - syncronisation failure and metastability - PLL and DLL based clock aligners

Reference:

1. William S. Dally & John W. Poulton; Digital Systems Engineering, Cambridge University Press, 1998
2. Howard Johnson & Martin Graham; High Speed Digital Design: A Handbook of Black Magic, Prentice Hall PTR, 1993
3. Masakazu Shoji; High Speed Digital Circuits, Addison Wesley Publishing Company, 1996
4. Jan M, Rabaey, et all; Digital Integrated Circuits: A Design perspective, Second Edition, 2003

EC 4036: ANTENNA THEORY

Pre-requisite: EC 2022

L	T	P	C
3	0	0	3

Module 1 (8 hours)
Antenna parameters: Radiation pattern, radiation power density, radiation intensity, directivity, gain, antenna efficiency, half-power beamwidth, bandwidth, polarization, input impedance, radiation efficiency, vector effective length and equivalent areas

Module 2 (12 hours)
Potentials and radiation fields: Retarded potentials, Lienard- Wiechert potentials for a moving charge, fields of a moving point charge, electric dipole radiation, magnetic dipole radiation, radiation from an arbitrary source, power radiated by a point charge, Duality theorem, Reciprocity theorem.

Module 3 (12 hours)
Antennas: Part-I: Monopole and Dipole antennas, linear dipole antenna arrays-Broadside and Endfire Arrays, Binomial Array, Dolph-Tschebyscheff Array, loop antenna.
Antenna Synthesis- Schelkunoff polynomial method, Fourier transform method

Module 4 (10 hours)
Antennas: Part-II : Helical antenna, Yagi – Uda antenna, parabolic antenna, Frequency independent antennas, RF antennas – Microstrip antenna, Fractal antenna
Smart Antennas- Principle, types, array design, antenna beamforming, direction-of-arrival algorithms, adaptive beamforming.

Reference:

1. Constantine A. Balanis, "Antenna Theory-Analysis and Design", 3rd Ed; Wiley-India, 2010
2. John D. Kraus,"Antennas", 2nd Ed; 1988, MGH
3. Robert S. Elliott, "Antenna Theory and Design" Wiley-India, 2007
4. W. L. Stutzman and G. A. Thiele, "Antenna Theory and Design"2nd Ed., Wiley, 1997
5. Frank Gross, "Smart Antennas for Wireless Communications", MGH, 2005.
6. Jordan and Balmain: Electromagnetic waves and radiating systems, PHI, 1968

EC 4037: ANALOG MOS INTEGRATED CIRCUITS

L	T	P	C
3	0	0	3

Pre-requisites: EC2013, EC2021 & EC 3011

Module 1 (8 hours)
Review of MOSFET operation, Threshold voltage, Drain current, Body bias effect, Channel length modulation, Low frequency MOSFET model in saturation region, High frequency MOSFET model, Thermal noise and flicker noise in MOS transistors, MOSFET active resistors, Voltage dividers

Module 2 (10 hours)
Current sources and sinks, Current mirror, Cascode connection, transient response, Matching considerations in current mirrors, Wilson current mirror, Concept of current steering, Current source self biasing circuits, Threshold voltage and thermal voltage referenced self biasing, Beta multiplier referenced self biasing, Start up circuits, Bandgap referenced biasing, voltage references

Module 3 (12 hours)
Gate-Drain connected load, Current source load, Common source, Common drain and Common gate amplifiers, Frequency response, Push pull amplifier, Cascode amplifier, MOS output stages, Class AB amplifier, Differential amplifier and Operational transconductance amplifiers

Module 4 (12 hours)
Nonlinear analog circuits, CMOS comparator, Auto zeroing, Analog multiplier, Gilbert cell as multiplier, MOSFET switch, Non ideal effects of MOSFET switch, Switched capacitor circuits, Switched capacitor integrators, First order and second order switched capacitor filters, switch reduction in switched capacitor circuits

Reference:

1 R.J. Baker, H.W.Li and D.E.Boyce, CMOS CMOS Circuit Design, Layout and Simulation, Wiley-IEEE Press, 2007
2 Gray, Hurst, Lewis and Meyer, Analysis and Design of Analog Integrated Circuits, John Wiley & Sons, Fourth Edition, 2005
3 Geiger, Allen and Strader, VLSI Design Techniques for Analog and Digital Circuits, Circuit Design, McGRAW-Hill international Edition, 1990
4 Franco Maloberti, Analog Design for VLSI System, Kluwer Academic Publishers, 2001
5 Behzad Razavi, Design of Analog CMOS Integrated Circuit, Tata-Mc GrawHill, 2002
6 Philip Allen & Douglas Holberg, CMOS Analog Circuit Design, Oxford University Press, 2002

EC 4038: HIGH SPEED SEMICONDUCTOR DEVICES

L	T	P	C
3	0	0	3

Module 1 (6 hours)
Important parameters governing the high speed performance of devices and circuits: Transit time of charge carriers, junction capacitances, ON-resistances and their dependence on the device geometry and size, carrier mobility, doping concentration and temperature; important parameters governing the high power performance of devices and circuits: Break down voltage, resistances, device geometries, doping concentration and temperature

Module 2 (16 hours)
Materials properties:
Merits of III –V binary and ternary compound semiconductors (GaAs, InP, InGaAs, AlGaAs, SiC, GaN etc.), different SiC structures, silicon-germanium alloys and silicon carbide for high speed devices, as compared to silicon based devices, outline of the crystal structure, dopants and electrical properties such as carrier mobility, velocity versus electric field characteristics of these materials, electric field characteristics of materials and device processing techniques, Band diagrams, homo and hetro junctions, electrostatic calculations, Band gap engineering, doping, Material and device process technique with these III-V and IV – IV semiconductors,

Module 3 (8 hours)
Metal semiconductor contacts and Metal Insulator Semiconductor and MOS devices: Native oxides of Compound semiconductors for MOS devices and the interface state density related issues. Metal semiconductor contacts, Schottky barrier diode, Metal semiconductor Field Effect Transistors (MESFETs): Pinch off voltage and threshold voltage of MESFETs. D.C. characteristics and analysis of drain current. Velocity overshoot effects and the related advantages of GaAs, InP and GaN based devices for high speed operation. Sub threshold characteristics, short channel effects and the performance of scaled down devices.

Module 4 (12 hours)
High Electron Mobility Transistors (HEMT): Hetero-junction devices. The generic Modulation Doped FET(MODFET) structure for high electron mobility realization. Principle of operation and the unique features of HEMT, InGaAs/InP HEMT structures: Hetero junction Bipolar transistors (HBTs): Principle of operation and the benefits of hetero junction BJT for high speed applications. GaAs and InP based HBT device structure and the surface passivation for stable high gain high frequency performance. SiGe HBTs and the concept of strained layer devices; High Frequency resonant – tunneling devices, Resonant-tunneling hot electron transistors

Reference:

1. C.Y. Chang, F. Kai, GaAs High-Speed Devices: Physics, Technology and Circuit Applications Wiley
2. Cheng T. Wang, Ed., Introduction to Semiconductor Technology: GaAs and Related Compounds, John Wiley & Sons,
3. David K. Ferry, Ed., Gallium Arsenide Technology, Howard W. Sams & Co., 1985
4. Avishay Katz, Indium Phosphide and Related materials: Processing, Technology and Devices, Artech House, 1992.
5. S.M. Sze, High Speed Semiconductor Devices, Wiley (1990) ISBN 0-471-62307-5
6. Ralph E. Williams, Modern GaAs Processing Methods, Artech (1990), ISBN 0-89006-343-5,
7. Sandip Tiwari, Compound Semiconductor Device Physics, Academic Press (1991), ISBN 0-12-691740-X
8. G.A. Armstrong, C.K. Maiti, TCAD for Si, SiGe and GaAs Integrated Circuits, The Institution of Engineering and Technology, London, United Kingdom, 2007,ISBN 978-0-86341-743-6.
9. Ruediger Quay, Gallium Nitride Electronics, Springer 2008, ISBN 978-3-540-71890-1, (Available on NITC intranet in Springer eBook section)
10. Prof. Dr. Alessandro Birolini, Reliability Engineering Theory and PracticeSpringer 2007, ISBN-10 3-540-40287-X, Available on NITC intranet in Springer eBook section)

EC 4039: NANOELECTRONICS

L	T	P	C
3	0	0	3

Module 1 (8 hours)
Challenges going to sub-100 nm MOSFETs – Oxide layer thickness, tunneling, power density, non-uniform dopant concentration, threshold voltage scaling, lithography, hot electron effects, sub-threshold current, velocity saturation, interconnect issues, fundamental limits for MOS operation.

Module 2 (10 hours)
Novel MOS-based devices – Multiple gate MOSFETs, Silicon-on-insulator, Silicon-on-nothing, FinFETs, vertical MOSFETs, strained Si devices

Module 3 (16 hours)
Quantum structures – quantum wells, quantum wires and quantum dots, Single electron devices – charge quantization, energy quantization, Coulomb blockade, Coulomb staircase (8 hours)
Heterostructure based devices – Type I, II and III heterojunctions, Si-Ge heterostructure, heterostructures of III-V and II-VI compounds - resonant tunneling devices (diodes & transistors) (8 hours)

Module 4 (8 hours)
Carbon nanotubes based devices – CNFET, characteristics (4 hours)
Spintronics - Spin-based devices – spinFET, characteristics (4 hours)

Reference:

1. Mircea Dragoman and Daniela Dragoman: Nanoelectronics – Principles & devices; Artech House Publishers, 2005
2. Karl Goser: Nanoelectronics and Nanosystems: From Transistors to Molecular and Quantum Devices, Springer 2005
3. Mark Lundstrom and Jing Guo: Nanoscale Transistors: Device Physics, Modeling and Simulation, Springer, 2005
4. Vladimir V Mitin, Viatcheslav A Kochelap and Michael A Stroscio: Quantum heterostructures; Cambridge University Press, 1999
5. S M Sze (Ed): High speed semiconductor devices, Wiley, 1990

EC 4040: OPTO-ELECTRONIC COMMUNICATION SYSTEMS

L	T	P	C
3	0	0	3

Module 1 (13 hours)
Optical fiber fundamentals - Solution to Maxwell's equation in a circularly symmetric step index optical fiber, linearly polarized modes, single mode and multimode fibers, concept of V number, graded index fibers, total number of guided modes (no derivation), polarization maintaining fibers, attenuation mechanisms in fibers, dispersion in single mode and multimode fibers, 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, nonlinear Schrodinger equation (no derivation), fundamental soliton solution

Module 2 (8 hours)
Optical sources - LED and laser diode, principles of operation, concepts of line width, phase noise, switching and modulation characteristics – typical LED and LD structures.

Module 3 (9 hours)
Optical detectors - PN detector, pin detector, avalanche photodiode – Principles of operation, concepts of responsivity, sensitivity and quantum efficiency, noise in detection, typical receiver configurations (high impedance and transimpedance receivers). (9 hours)

Module 4 (12 hours)
Optical amplifiers– Semiconductor amplifier, rare earth doped fiber amplifier (with special reference to erbium doped fibers), Raman amplifier, Brillouin amplifier – principles of operation, amplifier noise, signal to noise ratio, gain, gain bandwidth, gain and noise dependencies, intermodulation effects, saturation induced crosstalk, wavelength range of operation. (12 hours)

Reference:

1. Leonid Kazovsky, Sergio Benedetto and Alan Willner: `Optical Fiber Communication Systems', Artech House, 1996.
2. G.P.Agrawal: `Nonlinear Fiber Optics', 3rd Ed; Academic Press, 2004.
3. G.P.Agrawal : 'Fiber optic communication systems', 3rd Ed; Wiley-Interscience, 2002.

EC 4041: COMMUNICATION SWITCHING SYSTEMS

Pre-requisite: EC 3012

L	T	P	C
3	0	0	3

Module 1 (10 hours)
Electronic switching systems**:** basics of a switching system - stored program control –centralized SPC and distributed SPC, space division switching – strict–sense non-blocking switches - re-arrangeable networks– Clos, Slepian-Duguid, Paull's Theorems - Synchronous transfer mode- asynchronous transfer mode - time division switching – TSI operation.

Module 2 (12 hours)
Multi stage switching networks: Two dimensional switching, Multi-stage time and space switching, implementation complexity of the switches - blocking probability analysis of multistage switches – lee approximation - improved approximate analysis of blocking switch - examples of digital switching systems (eg: AT & T No.5 ESS)

Module 3 (12 hours)
Traffic Analysis: traffic measurements, arrival distributions, Poisson process, holding/service time distributions, loss systems, lost calls cleared – Erlang-B formula, lost calls cleared model with finite sources, delay systems, Little's theorem, Erlang-C formula , M/G/1 model, non-preemptive priority models.

Module 4 (8 hours)
Signaling: customer line signaling - outband signaling - inband signaling - PCM signaling - inter register signaling - common channel signaling principles-CCITT signaling system No: 7 - signaling system performance.
Introduction to ATM switching –Fast packet switching – self routing switches – Banyan network – ATM switches – Design of typical switches.

Reference:

1. John C. Bellamy, Digital Telephony, Third edition, Wiley Inter Science Publications, 2000
2. Schwartz M., Telecommunication Networks - Protocols, Modeling and Analysis, Pearson Education, 2004
3. Joseph Y Hui, Switching and Traffic Theory for Integrated Broadband Networks, Kluwer Academic Publishers, 1990.
4. Viswanathan T., Telecommunication Switching Systems and Networks, Prentice Hall of India Pvt. Ltd, 1992
5. Flood J.E., Telecommunications Switching Traffic and Networks, Pearson Education Pvt.Ltd,2001
6. C.Dhas, V.K.Konangi and M.Sreetharan, Broadband Switching, architectures, protocols, design and analysis, IEEE Computer society press, J. Wiely & Sons INC, 1991
7. Freeman R.L., Telecommunication System Engineering, John Wiley & Sons, 1989
8. Das J, Review of Digital Communication 'State of the Art' in Signalling Digital Switching and Data Networks, Wiley Eastern Ltd., New Delhi, 1988.

EC 4042: RADAR ENGINEERING

Pre requisites: EC 2022, EC 2024

L	T	P	C
3	0	0	3

Module1 (10 hours)
Introduction-Radar Equation-Block diagram-Radar frequencies- Applications- Prediction of range performance – Pulse Repetition Frequency and Range ambiguities –Antenna parameters-System losses

Module 2 (12 hours)
CW Radar-The Doppler Effect- FM-CW radar- Multiple frequency radar – MTI Radar- Principle- Delay line cancellors- Staggered PRF – Range gating- Noncoherent MTI-Pulse Doppler radar- Tacking Radar –Sequential lobbing-Conical Scan- Monopulse – Acquisition

Module 3 (10 hours)
Radar Transmitters- Modulators-Solid state transmitters, Radar Antennas- Parabolic-Scanning feed-Lens-Radomes, Electronically steered phased array antenna-Applications, Receivers-Displays-Duplexers

Module 4 (10 hours)
Detection of Radar signals in noise –Matched filter criterion-detection criterion – Extraction of information and waveform design, Propagation of radar waves –Radar clutter
Special purpose radars-Synthetic aperture radar- HF and over the horizon radar- Air surveillance radar- Height finder and 3D radars – Bistatic radar-Radar Beacons- Radar Jamming and Electronic Counters .

Reference:

1. Introduction to Radar Systems –Merrill I. Skolnik, 3rd Edition, MacGraw Hill, 2002.
2. Radar Handbook -Merril I.Skolnik , McGraw Hill Publishers, 1990
3. Radar Principles for the Non-Specialist, by J. C. Toomay, Paul Hannen SolTech Publishers, 2004
4. Radar systems- Merril I.Skolnik, McGraw Hill Publishers, 2005.

EC 4043: CRYPTOGRAPHY: THEORY AND PRACTICE

L	T	P	C
3	0	0	3

Module 1 (12 hours)
Divisibility – Prime numbers –Euclidean Algorithm – Diophantine equations - Congruence – Euler function - Fermat's little theorem – Euler theorem - Groups and fields - Polynomial ring – Field extension

Module 2 (11 hours)
Classical Cryptography – Substitution and Transposition Cipher – Modern Cryptographic Techniques –Private Key Cryptosystems – Block cipher – Standards – Data Encryption Standard – AES – Linear and differential cryptanalysis

Stream cipher – Key stream generators – Linear feed back shift registers and sequences – RC4 cryptosystem – Attacks on LFSR based stream ciphers

Module 3 (11 hours)
Public key cryptosystems – One way functions – Factorization problem – RSA crypto system – Discrete logarithm problem – Elgamal crypto system – Key management – Diffie Hellmann key exchange – Elliptic curves – arithmetic – cryptographic applications of elliptic curves

Module 4 (8 hours)
Message authentication requirements – Hash function – features of MD5 and SHA algorithms – Security of Hash function – Message Authentication Codes – Digital Signatures – Elgamal DSA – Applications of authentication – Electronic mail security – PGP – Secret sharing

Reference:

1. Douglas A. Stinson, "Cryptography, Theory and Practice", Chapman & Hall, CRC Press Company, Washington, Second Edn., 2002
2. William Stallings, " Cryptography and Network Security", Pearson Education, Second Edn., 2000.
3. Lawrence C. Washington, " Elliptic Curves", Chapman & Hall, CRC Press Company, Washington., 2003
4. David S. Dummit, Richard M. Foote, " Abstract Algebra", John Wiley & Sons, 3rd Edn., 2003
5. Evangelos Kranakis, " Primality and Cryptography", John Wiley & Sons, 1991.
6. Rainer A. Ruppel, " Analysis and Design of Stream Ciphers" , Springer-Verlag,1986

EC 4044: OPTO-ELECTRONIC DEVICES AND SYSTEMS

L	T	P	C
3	0	0	3

Module 1 (10 hours)
Optical processes in semiconductors – electron hole recombination, absorption, Franz-Keldysh effect, Stark effect, quantum confined Stark effect, deep level transitions, Auger recombination

Module 2 (8 hours)
Lasers – threshold condition for lasing, line broadening mechanisms, axial and transverse laser modes, heterojunction lasers, distributed feedback lasers, quantum well lasers, tunneling based lasers, modulation of lasers

Module 3 (8 hours)
Optical detection – PIN, APD, modulated barrier photodiode, Schottky barrier photodiode, wavelength selective detection, microcavity photodiodes.

Module 4 (8 hours)
Optoelectronic modulation - Franz-Keldysh and Stark effect modulators, quantum well electro-absorption modulators, electro-optic modulators, quadratic electro-optic effect quantum well modulators, optical switching and logic devices

Module 5 (8 hours)
Optoelectronic ICs – hybrid and monolithic integration, materials and processing, integrated transmitters and receivers, guided wave devices

Reference:

1. Pallab Bhattacharya: Semiconductor Optoelectronic Devices, 2nd Ed; Pearson Education, 2002
2. Amnon Yariv & Pochi Yeh– Photonics: Optical Electronics in modern communication, 6th Ed; Oxford Univ. Press, 2006
3. Fundamentals of Photonics : B E Saleh and M C Teich, Wiley-Interscience; 1991

EC 4045: SIGNAL COMPRESSION

L	T	P	C
3	0	0	3

Pre-Requisites: EC 3013, EC 3022

Module 1 (9 hours)

Compression Techniques – Lossless and Lossy Compression – Modeling and Coding – Mathematical Preliminaries for Lossless Compression – Huffman Coding – Minimum Variance Huffman Codes – Extended Huffman Coding – Adaptive Huffman Coding – Arithmetic Coding – Application of Huffman and Arithmetic Coding, Golomb Codes, Run Length Coding, Tunstall Codes

Module 2 (9 hours)

Dictionary Techniques – Static Dictionary – Adaptive Dictionary- LZ77, LZ78, LZW - Applications – Predictive Coding – Prediction with Partial Match – Burrows Wheeler Transform – Sequitur- Lossless Compression Standards (files, text, and images, faxes), Dynamic Markov Compression

Module 3 (12 hours)

Mathematical Preliminaries for Lossy Coding – Rate distortion theory: Motivation; The discrete rate distortion function R(D); Properties of R(D); Calculation of R(D); R(D) for the binary source, and the Gaussian source,Source coding theorem (Rate distortion theorem); Converse source coding theorem (Converse of the Rate distortion theorem) - Design of Quantizers: Scalar Quantization – Uniform & Non-uniform – Adaptive Quantization – Vector Quantization – Linde Buzo Gray Algorithm – Tree Structured Vector Quantizers – Lattice Vector Quantizers – Differential Encoding Schemes.

Module 4 (12 hours)

Mathematical Preliminaries for Transforms , Subbands, and Wavelets – Karhunen Loeve Transform, Discrete Cosine Transform, Discrete Sine Transform, Discrete Walsh Hadamard Transform – Transform coding - Subband coding – Wavelet Based Compression – Analysis/Synthesis Schemes – Speech, Audio, Image and Video Compression Standards.

Reference :

1. Khalid Sayood, "Introduction to Data Compression", Morgan Kaufmann Publishers., Second Edn., 2005.
2. David Salomon, "Data Compression: The Complete Reference", Springer Publications, 4^{th} Edn., 2006.
3. Toby Berger, "Rate Distortion Theory: A Mathematical Basis for Data Compression", Prentice Hall, Inc., 1971.
4. K.R.Rao, P.C.Yip, "The Transform and Data Compression Handbook", CRC Press., 2001.
5. R.G.Gallager, "Information Theory and Reliable Communication", John Wiley & Sons, Inc., 1968.
6. Ali N. Akansu, Richard A. Haddad, "Multiresolution Signal Decomposition: Transforms, Subbands and Wavelets", Academic Press., 1992
7. Martin Vetterli, Jelena Kovacevic, "Wavelets and Subband Coding", Prentice Hall Inc., 1995.

EC 4046: MICROWAVE DEVICES & CIRCUITS

Pre-requisite: EC 2022

L	T	P	C
3	0	0	3

Module 1 (10 hours)
Modal analysis of rectangular and circular metallic waveguides– TE and TM modes, guide wavelength, cut-off, mode excitation, re-entrant cavity, Microwave Resonators – analysis, Q factor of resonators, Strip lines and microstrip lines – analysis, filter implementation with transmission lines and strip lines

Module 2 (8 hours)
Passive microwave components – S matrix formalism, directional coupler, waveguide tees, isolator, circulator, phase shifter, impedance matching – single stub and double stub.

Module 3 (16 hours)
Vacuum tube microwave devices – Klystron - velocity modulation and bunching, Reflex klystron, traveling wave tube - slow wave structure and Brillouin diagram. (8 hours)
Semiconductor microwave devices – tunnel diode, Gunn diode, IMPATT diode, TRAPATT diode, heterojunction bipolar transistors – principle, characteristics, noise figure (8 hours)

Module 4 (8 hours)
Low noise microwave amplifiers and oscillators – masers – stimulated emission, noise figure, parametric amplifiers – Manley Rowe relations, up, down and negative resistance parametric amplifier.

Reference:

1. Rajeshwari Chatterji: Microwave, Millimeter wave and sub-millimeter wave vacuum electron devices, Affiliated East - West Press, 1994
2. R E Collin: Foundations for Microwave Engineering, Second Ed, IEEE-Wiley, 2000
3. David M Pozar: Microwave Engineering, Third edition, John Wiley, 2004
4. A S Gilmour: Microwave Tubes, Artech House, 1986
5. P A Rizzi: Microwave Engineering, Prentice Hall, 1988.
6. Sigfrid Yngyesson: Microwave Semiconductor Devices, Kluwer Academic, 1991.
7. Stephen C. C. Harsany: `Principles of Microwave Technology', Prentice Hall, 1997
8. P. Bhartia & I. J. Bahl, Millimetre Wave Engineering and Applications, John Wiley & Sons, 2005.

EC 4047: ADVANCED WIRELESS COMMUNICATION

L	T	P	C
3	0	0	3

Module 1 (10 hours)
Capacity of Parallel AWGN Channels – Capacity of Fading Channels - Frequency Selective Channels - Ergodic and Outage capacity - Channel State Information at Transmitter and Receiver - Capacity MIMO Flat Fading Channel – Dirty Paper Coding.

Module 2 (11hours)
Fundamentals of MIMO communication - Diversity and Spatial Multiplexing Aspects - Uncoded Transmission with ML Detection, ZF Filtering, and MMSE Filtering - VBLAST, and DBLAST Detectors - Alamouti Space-Time Code – Codes for Large Number of Transmit Antennas.

Module 3 (10 hours)
Multiple Access Techniques – Space Division Multiple Access - OFDMA - Combination of MIMO with Multiple Access Techniques - Analysis of Performance and Comparison - Applications in 3^{rd} and 4^{th} Generation Systems

Module 4 (10 hours)
Cooperative Communication – Wireline and Wireless Network Models – Cooperative Strategies and Rates – Network Capacity – AF, CF and DF - Network Coding – 2 Way Relaying – Cooperative Diversity.

Reference:

1. D. Tse, P. Viswanath, Fundamentals of Wireless Communications, Cambridge University Press, 2005.
2. Andrea Goldsmith, Wireless Communications, Cambridge University Press, 2005.
3. Gerhard Cramer et. al, Cooperative Communications (Foundations and Trends in Networking), Now Publishers Inc, 2007

EC 4048: SIGNAL ESTIMATION & DETECTION

L	T	P	C
3	0	0	3

Module 1(10 hours)
Fundamentals of Estimation Theory: Role of Estimation in Signal Processing, Unbiasedness, Minimum variance unbiased(MVU) estimators, Finding MVU Estimators, Cramer-Rao Lower Bound, Linear Modeling-Examples.

Module 2 (15 hours)
Estimation Techniques: Deterministic Parameter Estimation **-** Least Squares Estimation-Batch Processing, Recursive Least Squares Estimation, Matrix Inversion Lemma, Best Linear Unbiased Estimation, Likelihood and Maximum Likelihood Estimation (8 Hrs)
Random Parameter Estimation: Bayesian Philosophy, Multivariate Gaussian Random Variables, Minimum Mean Square Error Estimator (3 Hrs)
State Estimation: Overview of State-Space Modeling, Prediction, Single Stage Predictors, Filtering, The Kalman Filter (4 Hrs)

Module 3 (10 hours)
Fundamentals of Detection Theory: Hypothesis Testing **-** General Modeling of Binary Hypothesis Testing Problem, Bayes' Detection, MAP Detection, ML Detection, Minimum Probability of Error Criterion, Min-Max Criterion, Neyman-Pearson Criterion, Receiver Operating Characteristic Curves, Basics of Multiple Hypothesis Testing.

Module 4 (7 hours)
Detection of Signals in White Gaussian Noise (WGN): Binary Detection of Known Signals in WGN, M-ary Detection of Known Signals in WGN, Matched Filter Approach, Detection of signals with Random Parameters

Reference:

1. Steven M. Kay, "Statistical Signal Processing: Vol. 1: Estimation Theory, Vol. 2: Detection Theory," Prentice Hall Inc., 1998.
2. Jerry M. Mendel, "Lessons in Estimation Theory for Signal Processing, Communication and Control," Prentice Hall Inc., 1995
3. Ralph D. Hippenstiel, "Detection Theory- Applications and Digital Signal Processing", CRC Press, 2002.
4. Monson H. Hayes, "Statistical Digital Signal Processing and Modelling," Wiley India Edn., 2010
5. Harry L. Van Trees, "Detection, Estimation and Modulation Theory, Part 1 and 2," John Wiley & Sons Inc. 1968.
6. Bernard C. Levy, "Principles of Signal Detection and Parameter Estimation", Springer, New York, 2008.
7. Neel A. Macmillan and C. Douglas Creelman, "Detection Theory: A User's Guide (Sec. Edn.)" Lawrence Erlbaum Associates Publishers, USA, 2004.

EC 4049: ARCHITECTURE OF ADVANCED PROCESSORS

Pre –requisites: EC 3019, EC 3021

L	T	P	C
3	0	0	3

Module 1 (8 hours)

Fundamentals: Technology trend -Performance measurement –Comparing and summarizing performance-quantitative principles of computer design –Amdahl's law-Case studies. Principles of processor performance -Processor performance optimization- Performance evaluation methods

Module 2 (10 hours)

Features of advanced Intel processors**:** Enhancements of 80386 and Pentium -Hardware Features, PVAM,-Memory management unit-Virtual Memory and concepts of cache -32 bit programming

Module 3 (14 hours)

Instruction and thread level parallelism: Instruction level parallelism and concepts - - Limitations of ILP-Multiprocessor and thread level parallelism- Pipelining: Issues and solutions- Instruction flow techniques -Program control flow and control dependences

Module 4 (10 hours)

Superscalar and multi core techniques: General principles of superscalar architecture - -Basics ,Pipelining**,** The in-order front end, The out-of-order core, The reorder buffer, Memory subsystem- Multi core processing – facts and figures - Virtualization –concepts

Reference :

1. John Shen and Mikko H Lipasti, Modern Processor Design: Fundamentals of Superscalar Processors, McGraw Hill Publishers , 2005
2. Lyla B.Das, The x86 Microprocessors, Architecture, Programming and Interfacing Pearson Education, 2010
3. Hennessy J. L. & Patterson D. A., Computer Architecture: A Quantitative approach, 4/e, Elsevier Publications, 2007.
4. Patterson D. A. & Hennessy J. L., Computer Organisation and Design: The Hardware/ Software Interface, 3/e, Elsevier Publishers, 2007
5. Jurij Silc, Borut Robic, Th Ungerer: Processor Architecture: From Dataflow to Superscalar and Beyond. Springer-Verlag, June 1999

EC 4050: RADIATION AND PROPAGATION

Pre-requisite: EC2022

L	T	P	C
3	0	0	3

Module 1 (11 hours)
Some types of practical radiating systems – Field and power calculations with currents assumed on the antenna - electric and magnetic dipole radiators - Radiation patters and antenna gain - radiation resistance – antennas above earth or conducting plane traveling wave on a straight wire – V and rhombic antennas – methods of feeding wire antennas

Module 2 (12 hours)
Radiation from fields over an aperture – fields as sources of radiation – Plane wave sources – Examples of radiating apertures excited by plane waves – electromagnetic horns – arrays of elements – radiation intensity with superposition of effects – array of two half-wave dipoles – linear arrays - Yagi - Uda arrays – frequency-independent arrays

Module 3 (7 hours)
Antenna temperature - signal-to-noise ratio – radar and radar cross section – far field, near field and Fourier transform – receiving antennas and reciprocity – reciprocity relations

M**odule 4 (12 hours)**
Effect of earth's conductivity on antenna pattern, effect of earth's conductivity and shape on surface wave propagation, effect of earth's magnetic field on EM waves in ionosphere, plasma and cyclotron frequencies, skip distance, maximum usable frequency

Reference:

1. Simon Ramo, John R Whinnery, and Theodore Van Duzer, Fields and Waves in Communication Electronics, John Wiley and Sons, Third Edition, 2003.
2. John D. Kraus and Daniel A. Fleisch, Electromagnetics with Applucations, McGraw-Hill, Fifth Edition, 1999.
3. C A Balanis: Antenna Theory, John Wiley, Second Edition, 2003.
4. J D Krauss: Antennas, Tata McGraw Hill, Third Edition, 2002.
5. David J Griffiths: Introduction to Electrodynamics, Third edition, PHI, 2007.
6. Jordan and Balmain: Electromagnetic waves and radiating systems, PHI, Second Edition, PHI, 2002.

EC 4051: ELECTRONIC INSTRUMENTATION

L	T	P	C
3	0	0	3

Module 1 (14 hours)
Measurement of voltage, current, power, noise, resistance, capacitance, inductance, time, frequency, charge and pulse energy

Module 2 (7 hours)
Designing for EMC - EMC regulations, typical noise path, methods of noise coupling, methods of reducing interference in electronic systems.

Module 3 (7 hours)
Capacitive coupling, inductive coupling, effect of shield on capacitive and inductive coupling, effect of shield on magnetic coupling, magnetic coupling between shield and inner conductor, shielding to prevent magnetic radiation, shielding a receptor against magnetic fields, shielding properties of various cable configurations, coaxial cable versus shielded twisted pair, braided shields, ribbon cables

Module 4 (7 hours)
Safety grounds, signal grounds, single-point ground systems, multipoint-point ground systems, hybrid grounds, functional ground layout, practical low frequency grounding, hardware grounds, grounding of cable shields, ground loops, shield grounding at high frequencies, guarded instruments.

Module 5 (7 hours)
Protection Against Electrostatic Discharges: Static generation, human body model, static discharge, ESD protection in equipment design

Reference:

1. Electronic Instrument handbook: Clyde F Jr Coombs, Amazon, 1999
2. Joseph J. Carr: Elements of Electronic Instrumentation and Measurements, 3rd Ed, Prentice Hall, 1995
3. Kim R. Fowler: Electronic Instrument Design, Oxford University Press, 1996.
4. Henry W.Ott : Noise Reduction Techniques in Electronic Systems, 2nd Ed; John Wiley & Sons, 1988.

EC 4052: STATE OF THE ART AND FUTURE MEMORIES

Prerequisite: EC2013 or equivalent

L	T	P	C
3	0	0	3

Module 1 (10 hours)

Review of MOS based devices, band diagrams, threshold voltage, body bias effect, drain current and gate current characteristics, subthreshold slope, hot electron effect, various leakages in a MOSFET, tunneling phenomenon, direct tunneling, Fowler-Nordheim tunneling, direct band to band tunneling, SOI MOSFET, PDSOI, FDSOI, current characteristics, Classification of memories

Module 2 (10 hours)
Volatile memories: SRAM, functionality, architecture, timing diagrams, performance and timing specifications, Low voltage SRAMs, SOI SRAMs, Content addressable memories (CAM), 3-transistor DRAM, 1 transistor DRAM , functionality, architecture, timing diagrams, performance and timing specifications, sense amplifier, word line driver, leakage mechanisms in a DRAM, retention, retention time calculations

Module 3 (10 hours)
Non volatile memories**:** FLASH Memories, floating gate theory, structure and working of a SONOS cell, structure and working FLOTOX Memories, multi level flash memories, NOR based flash memories, NAND based flash memories

Module 4 (5 hours)
SOI Based RAM: Parasitic BJTs in a SOI, Z-RAM, Thyristor RAM

Module V (7 hours)
Non silicon based memories**:** PCRAM, MRAM, FeRAM, array device considerations for non silicon based memories

Reference:

1. Ashok K. Sharma, Semiconductor Memories: Technology, Testing and Reliability, Wiley IEEE Press, 1997, ISBN 0780310004
2. Ashok K. Sharma, Advanced Semiconductor Memories: Architectures, Design and Applications, 2003, Wiley-IEEE Press, ISBN 0471208132
3. William D. Brown, Joe Brewer, Nonvolatile Semiconductor Memory Technology: A Comprehensive Guide to Understanding and Using NVSM Devices, Wiley-IEEE Press, 1997, ISBN: 978-0-7803-1173-2
4. Ehrenfried Zschech, Caroline Whelan and Thomas Mikolajick, Materials for Information Technology Devices, Interconnects and Packaging, Springer, ,2005 available online (NIT Calicut intranet) at http://www.springerlink.com/content/978-1-85233-941-8/contents/
5. Joe Brewer, Nonvolatile Memory Technologies with Emphasis on Flash: A Comprehensive Guide to Understanding and Using Flash Memory Devices, Manzur Gill, Wiley-IEEE Press, 2008, ISBN: 978-0-471-77002-2
6. Jean-Pierre Colinge, Physics of Semiconductor Devices, Kluwer Academic Publishers, 2002, eBook ISBN: 0-306-47622-3, Print ISBN: 1-4020-7018-7, access online at (NITC intranet) http://www.springerlink.com/content/978-1-4020-7018-1/
7. Jean-Pierre Colinge, FinFETs and Other Multi-Gate Transistors Springer, 2008, ISBN 978-0-387-71751-7 e-ISBN 978-0-387-71752-4, http://www.springerlink.com/content/978-0-387-71751-7/contents/
8. Amara Amara and Olivier Rozeau, Planar Double-Gate Transistor, From Technology to Circuit, Springer, 2009, ISBN 978-1-4020-9327-2,e-ISBN 978-1-4020-9341-8, http://www.springerlink.com/content/978-1-4020- 9327-2/contents/
9. Y. Taur and T.H. Ning, Fundamentals of Modern VLSI DevicesCambridge University Press, 1998, ISBN: 0-521-55959-6

EC 4053: RELIABILITY OF SEMICONDUCTOR DEVICES

Prerequisites: EC2013 or equivalent

L	T	P	C
3	0	0	3

Module 1 (8 hours)
Introduction to Reliability Physics, Reliability definition, dielectrics, critical field in a dielectric, generation and recombination of carriers, life time of carriers, diffusion length, Types of Defects in a Semiconductor, Avalanche break down, Zener break down, MOSFET scaling, Hot electron effect, velocity saturation, GIDL, Mathematics of Reliability: Weibull statistics, PDF

Module 2 (8 hours)
Kinetics of Negative Bias Temperature Instability: Stress Phase, NBTI: Relaxation, Freq. Independence, and Duty Cycle Dependence, Field Acceleration of Negative Bias Temperature Instability, Dispersive vs. Arrhenius Diffusion, Circuit Implications of NBTI

Module 3 (8 hours)
Scaling Theory of Hot Carrier Degradation, Voltage Dependence of Trap Generation: Lucky Electron Model, On-State Hot Carrier Degradation, Off-State Hot Carrier Degradation , Characterization of Interface Traps, Subthreshold and linear drain current Measurements, Charge-pumping, DC-IV, and GIDL Techniques for Interface Traps, Spin-Dependent Recombination

Module 4 (12 hours)
Breakdown mechanisms of thick dielectrics and thin dielectrics, Time-Dependent Dielectric Breakdown, Kinetics of Trap Generation, Field-dependence of TDDB, Statistics of Oxide Breakdown: Cell percolation model, Theory of Soft and Hard Breakdown, Statistics of Soft-breakdown by Markov Chain, Measurement Techniques: VT, SILC, QY, and Floating Probe, TDDB and Circuits, Theory of Thick dielectrics, Spatial and Temporal Characteristics of dielectric breakdown, Theory of Radiation Damage, Sources of radiation flux and its characteristics, Soft error due to radiation effects, Radiation and hard errors, Radiation, error correction, Stress migration, Electro migration

Module 5 (6 hours)
Introduction to Electro static discharge (ESB), human body model, machine model, methods to contain ESD

Reference:

1. Y. Taur and T.H. Ning, Fundamentals of Modern VLSI Devices Cambridge University Press, 1998, ISBN: 0-521-55959-6
2. R.F. Pierret, Semiconductor Device Fundamentals, Addison-Wesley, 1996, ISBN: ISBN 0-201-54393-1
3. D. K. Schroder, Semiconductor Material and Device Characterization, John Wiley and Sons, 1996, ISBN: 0-471-73906-5
4. Steven H. Voldman, ESD: Physics and Devices 2004, John Wiley & Sons, Ltd ISBN: 0-470-84753-0
5. Jean-Pierre Colinge, Physics of Semiconductor Devices, Kluwer Academic Publishers, 2002, eBook ISBN: 0-306-47622-3, Print ISBN: 1-4020-7018-7, access online at (NITC intranet) http://www.springerlink.com/content/978-1-4020-7018-1/

EC 4054: SILICON ON INSULATOR AND ADVANCED MOSFET BASED STRUCTURES

Prerequisite: EC2013 or equivalent

L	T	P	C
3	0	0	3

Module 1 (11 hours)
Review of MOS device: band diagrams, drain current and subthreshold characteristics, drain conductance, transconductance, substrate bias, mobility, low field mobility, high field mobility, mobility various models, scaling of MOSFET, short channel and narrow channel MOSFET, high-k gate dielectrics, ultra shallow junctions, source and drain resistance

Module 2 (15 hours)
The SOI MOSFE: comparison of capacitances with bulk MOSFET, PD and FD SOI devices, short channel effects, current-voltage characteristics: Lim&Fossum model and C-∞ model, transconductance, impact ionization and high field effects: Kink effect and Hot-carrier degradation, Floating body and parasitic BJT effects, self heating

Module 3 (8 hours)
Multiple gate SOI MOSFETs: double gate, FINFET, triple gate, triple-plus gate, GAA, device characteristics, short channel effects, threshold effect, volume inversion, mobility, FINFET

Module 4 (8 hours)
Physical view of nano scale MOSFET, Nator's theory of the ballistic MOSFET, role of quantum capacitance, scattering theory, MOSFET physics in terms of scattering, transmission coefficient under low and high drain biases, silicon nano wires, evaluation of the I-V characteristics, I-V characteristics of non-degenerate and degenerate carrier statistics

Reference:

1. Jean-Pierre Colinge, Physics of Semiconductor Devices, Kluwer Academic Publishers, eBook ISBN: 0-306-47622-3, Print ISBN: 1-4020-7018-7, access online at (NITC intranet) http://www.springerlink.com/content/978-1-4020-7018-1/
2. Y. Taur and T.H. Ning, Fundamentals of Modern VLSI DevicesCambridge University Press, 1998, ISBN: 0-521-55959-6
3. Jean-Pierre Colinge, FinFETs and Other Multi-Gate Transistors Springer, 2008, ISBN 978-0-387-71751-7 e-ISBN 978-0-387-71752-4, http://www.springerlink.com/content/978-0-387-71751-7/contents/
4. Amara and Olivier Rozeau, Planar Double-Gate Transistor, From Technology to Circuit, Springer, 2009, ISBN 978-1-4020-9327-2,e-ISBN 978-1-4020-9341-8, http://www.springerlink.com/content/978-1-4020-9327-2/contents/
5. Jean- Pierrie Colinge, Silicon-on-insulator Technology: Materials to VLSI Kluwer Academic publishers group, 2004.