Syllabus of B.Tech Degree Programme in Electronics and Communication Engineering

Effective from 2017 Admitted Batch onwards

Department of Electronics & Communication Engineering
National Institute of Technology Sikkim
South Sikkim 737 139

Semester III

EC 13101:Network Analysis and Synthesis

L	T	P	C
3	1	0	4

Objective: To expose the students to the basic concepts of electric circuits and their analysis in time and frequency domain and network synthesis.

Module 1

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

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

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

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 13102: SIGNALS AND SYSTEMS

L	T	P	C
2	1	2	4

Goal: To study and analyze characteristics of continuous, discrete signals and systems

Objective:

1. Understand the representation of Signals, classification of signals, signal transforms and their properties,
2. Understand the concepts in the analysis of continuous time signals and systems,
3. Understand Sampling Theorem and Z-Transform,
4. Understand pole-zero analysis and Inverse Z-Transform
5. Understand the concepts of DFT and Discrete Time systems,

Module 1

Signal : Types of signal; classification of signals; signal operations: scaling, shifting and inversion.

System : Classification of 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

Signal analysis: Signal space and orthogonal bases; fourier series representation of continuous-time signal - continuous-time Fourier transform and its properties – fourier Transform theorems – power spectral density and energy spectral density – Hilbert Transform.

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

Module 3

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

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. M. J. Roberts, "Signals and Systems - Analysis using Transform methods and MATLAB", Tata Mc Graw Hill Edition, 2003.
7. Robert A. Gabel, Richard A. Roberts, "Signals and Linear Systems", John Wiley and Sons (SEA) Private Limited, 1995.

Practical Excerciseusing MATLAB

1. Genration and mathematical operations of signals.

2. Linear convolution.

3. Fourier series and fourier transform

4. DFT and IDFT

5. Construction of S-plane and Laplace Transform

6. Construction of Z-plane and Z-Transform

EC 13103: Probability Theory and Stochastic Process

L	T	P	C
2	1	0	3

Module: 1: Probability

Definitions, scope and history; limitation of classical and relative-frequency-based definitions; Sets, fields, sample space and events; axiomatic definition of probability; Combinatorics: Probability on finite sample spaces; Joint and conditional probabilities, independence, total probability; Bayes' rule and applications.

Module: 2: Random variables

Definition of random variables, continuous and discrete random variables, cumulative distribution function (cdf) for discrete and continuous random variables; probability mass function (pmf); probability density functions (pdf) and properties Jointly distributed random variables, conditional and joint density and distribution functions, independence; Bayes' rule for continuous and mixed random variables Function of random a variable, pdf of the function of a random variable; Function of two random variables; Sum of two independent random variables Expectation: mean, variance and moments of a random variable Joint moments, conditional expectation; covariance and correlation; independent, uncorrelated and orthogonal random variables Random vector: mean vector, covariance matrix and properties Some special distributions: Uniform, Gaussian and Rayleigh distributions; Binomial, and Poisson distributions; Multivariate Gaussian distribution Vector-space representation of random variables, linear independence, inner product, Schwarz Inequality Elements of estimation theory: linear minimum mean-square error and orthogonality principle in estimation; Moment-generating and characteristic functions and their applications Bounds and approximations: Chebysev inequality and Chernoff Bound

Module: 3: Sequence of random variables and convergence

Almost sure (a.s.) convergence and strong law of large numbers; convergence in mean square sense with examples from parameter estimation; convergence in probability with examples; convergence in distribution, Central limit theorem and its significance

Module: 4: Random process

Random process: realizations, sample paths, discrete and continuous time processes, examples Probabilistic structure of a random process; mean, autocorrelation and autocovariance functions Stationarity: strict-sense stationary (SSS) and wide-sense stationary (WSS) processes Autocorrelation function of a real WSS process and its properties, cross-correlation function; Ergodicity and its importance; Spectral representation of a real WSS process: power spectral density, properties of power spectral density ; cross-power spectral density and properties; auto-correlation function and power spectral density of a WSS random sequence; Linear time-invariant system with a WSS process as an input: sationarity of the output, auto-correlation and power-spectral density of the output; examples with white-noise as input; linear shift-invariant discrete-time system with a WSS sequence as input; Spectral factorization theorem; Examples of random processes: white noise process and white noise sequence; Gaussian process; Poisson process, Markov Process

Books:

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. John G Proakis and M. Salehi, Communication System Engineering, 2/e, Pearson Education, 2001.

EC 13104: Semiconductor Physics and Devices

L	T	P	C
3	0	0	3

Goal : Tointroduce the students to understand the physics of the semiconductor device operations.

Module 1

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.

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.

Module 2

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

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

Field Effect Transistors: The Junction FET - Pinch-off and Saturation- Gate control- transfer and drain characteristics. 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.

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 13105 :Analog Electronics-I

L	T	P	C
3	0	0	3

Goal : To impart knowledge on construction, theory, characteristics and applications of electronic devices, operation of amplifiers, oscillators and special semiconductor devices .

Objective :

The course should enable the students to:

1. Understand the Diode operation and its applications.
2. Know about the physical structure, basic operation of BJT, their characteristics and biasing techniques
3. Know about the physical structure, basic operation of FET, MOSFET their characteristics and biasing techniques
4. Learn types of feedback amplifiers and oscillators
5. Study the characteristics of special semiconductor diodes

Module 1

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

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, cascade amplifier, Darlington pair – Wide banding using inductors.

Module 3

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

Switching characteristics of a BJT - BJT switches with inductive and capacitive loads - Non saturating switches - Astable, monostable and bistablemultivibrators 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. Millman&Halkias : `Integrated Electronics', MGH. 1996 .
4. V.K.Mehta and Rohit Mehta: Principals of Electronics, S.Chand& Company.
5. Boylested&Nashesky , Electronic Devices and Circuit Theory, Prentice Hall of India

EC 13201: Analog Electronics Lab

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 BistableMultivibrator 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 HaytJr : `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

Semester IV

EC 14101: Digital Electronics

L	T	P	C
3	1	0	4

Goal : To learn the basic methods and provide the fundamental concepts used in the design of digital systems

Objective :
The course should enable the students to:
1. Learn number systems, binary arithmetics and code generation,
2. Gain knowledge of Boolean expressions, Boolean postulates and theorems, minimization
3. Understand the procedures for the analysis and design of combinational circuits, HDL
4. Learn about sequential circuits, and its design
5. Provide knowledge of the concept of memories and programmable logic devices.

Module 1
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
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

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 nextstate 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

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 14102: Analog Electronics-II

L	T	P	C
3	0	2	4

Prerequisites: EC 13105

Goal: To teach the basic concepts in the design of electronic circuits using linear integrated circuits and their applications in the processing of analog signals.

Objective:
The course should enable the students to:
1. Learn the differential amplifier using BJT/FET.
2. Know the Op -amp characteristics and its linear applications,
3. Learn comparator, Schmitt-Trigger circuits, Voltage regulator and some linear and nonlinear oscillators,
4. Study how an Op-Amp can act as a filter on an electrical signal,
5. Learn the theory and applications of PLL, ADC and DAC.

Module 1

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

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

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 Delyannisconfiguration - BEF using twin T configuration - all pass filter (first & second orders) realizations - inductance simulation using Antoniou's gyrator – Switched capacitor filter

Module 4

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. GobindDaryanani, '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 14103: ELECTROMAGNETIC FIELD THEORY

L	T	P	C
3	0	0	3

Goal: To familiarize the student to the concepts, calculations pertaining to electric, magnetic and electromagnetic fields so that an in depth understanding of antennas, electronic devices, Waveguides is possible.

Objective:

The course should enable the student to

1. Review the basics of Coordinate systems and Vector Calculus static Electric fields and Electric Potential, flux density,
2. Be familiarized with the fundamental theory of static magnetic fields, Obtain field distribution of various sources, to introduce the fundamentals of Magnetic forces and torque ,
3. Understand the Laplace‘s and Poisson‘s equations, Capacitance of various geometries, boundary conditions for electric fields, Study the Inductance, Study Magnetic boundary conditions,
4. Study understand Maxwell‘s equations, the meaning and physical significance, Express Maxwell‘s four equations in integral and differential forms Study the power flow,
5. Know the concept of plane waves, mathematically represent it in various forms, study wave propagation through various media. And wave passage between dissimilar media.

Module 1

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

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

Electrodynamics: Electromagnetic induction, inductance, continuity equation, displacement current, Maxwell’s equations, boundary conditions, EM waves in vacuum and in matter, Poynting’s theorem, energy and momentum in electromagnetic field, Monochromatic plane waves, group velocity, wavepolarization. Refection and transmission at interfaces: Normal and Oblique incidence of uniform plane electromagnetic waves at conducting boundary, dielectric boundary.

Reference :

1. Matthew N. O. Sadiku: Elements of Electromagnetics, Fourth Edition, Oxford University Press, 2006

2. Electromagnetic Waves Shevgaonkar, Tata-McGaw-Hillr –R K
3. Jordan and Balmain: Electromagnetic waves and radiating systems, PHI, Second Edition, PHI, 2002.

EC 14104: Analog Communication

L	T	P	C
3	0	0	3

Prerequisites: EC 13103

Goal : To study the various analog communication fundamentals viz., Amplitude modulation and demodulation; Angle modulation and demodulation, noise performance of various receivers and information theory with source coding theorem.

Objective:

The course should enable the students to:

1. Study the need of modulation, Amplitude Modulation and demodulation,
2. Provide various Angle modulation and demodulation,
3. Study depth analysis in noise performance Continuous wave modulations,
4. Study various pulse modulation techniques,
5. Study some basic information theory with some channel coding theorem.

MODULE – I:

Introduction to Analog Communication: Elements of communication system - Transmitters, Transmission channels & receivers, Concept of modulation, its requirements.

Continuous Wave Modulation:

a) Amplitude modulation(AM-DSB/TC): Time domain representation of AM signal, modulation index , frequency domain (spectral) representations, illustration of the carrier and side band components; transmission bandwidth for AM; Phasor diagram of an AM signal; Calculation of Transmitted power & sideband power & Efficiency ; concept of under, over and critical modulation of AM-DSB-TC. b) Other Amplitude Modulations: Double side band suppressed carrier (DSBSC) modulation: time and frequency domain expressions, bandwidth and transmission power for DSB. Single side band modulation (SSB) both TC & SC and only the basic concept of VSB, Spectra and band-width.

MODULE – II:

Generation & Detection of Amplitude Modulation: a) Generation of AM: Concept of i) Gated and ii) Square law modulators, Balanced Modulator. b) Generation of SSB: Filter method, Phase shift method and the Third method Demodulation for Linear Modulation: Demodulation of AM signals: Detection of AM by envelope detector, Synchronous detection for AM-SC, Effects of

Frequency & Phase mismatch, Corrections. Principle of Super heterodyne receivers: Super heterodyning principle, intermediate frequency, Local oscillator frequency, image frequency.

MODULE – III:

Angle Modulation: a) Frequency Modulation (FM) and Phase Modulation (PM): Time and Frequency domain representations, Spectral representation of FM and PM for a single tone message, Bessel's functions and Fourier series. Phasor diagram; b) Generation of FM & PM: Narrow and Wide-band angle modulation, Basic block diagram representation of generation of FM & PM, Concept of VCO & Reactance modulator c) Demodulation of FM and PM: Concept of frequency discriminators, Phase Locked Loop

MODULE – IV:

Multiplexing: Frequency Division Multiplexing, Time Division Multiplexing, (FDM)b) Stereo – AM and FM: Basic concepts with block diagrams c) Random Signals and Noise in Communication System: i) Noise in Communication systems – Internal & External noise, Noise Temperature, Signal-to-Noise ratio, White noise, thermal noise, Figure of Merit.
iii) Noise performance in Analog Communication systems: SNR calculation for DSB/TC, DSB-SC, SSB-TC, SSB-SC & FM.

Reference:

1. B.P. Lathi, Modern Digital and Analog Communication, 3/e, Oxford University Press, 1998.
2. John G Proakis and M. Salehi, Communication System Engineering, 2/e, Pearson Education, 2001.
3. Taub and Schilling , "Principles of Communication Systems", 2nd ed., Mc- Graw Hill
4. Carlson, Communication System,4/e , Mc-Graw Hill
5. Simon Haykin, "An Introduction To Analog & Digital Communications", Wiley

EC 14201: 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

Analog Communication course 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 14202: Digital Electronics 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.

SEMESTER -V

EC 15101: DIGITAL COMMUNICATION

L	T	P	C
3	1	0	4

Prerequisites: EC 13103, EC 14104

Goal: To introduce the basic concepts of digital modulation techniques to baseband pulse, pass band data transmission, to give an exposure to error control coding and finally to discuss about the spread spectrum modulation schemes.

Objectives:
The course should enable the students to:
1. Understand different methods of pulse digital modulation and demodulation schemes,
2. Analyze baseband pulse transmission and reception, its noise occurrence and noise reduction in communication channel,
3. Analyze pass band digital modulation and demodulation schemes and compare its bit error probability,
4. Understand error control codes with different coding techniques and decoding techniques in data transmission channel,
5. Understand the spread spectrum modulation techniques which are used in digital communication.

MODULE – I:

Introduction to Digital Communications; system block diagram; concept of bandwidth.
Information Theory; Measures of self and mutual information; Entropy and average mutual information; Channel models, channel capacity, The Shannon limit.

MODULE – II:

Analog Pulse Modulation: Sampling for base-band and pass-band signals, Pulse Amplitude modulation: generation and demodulation, PPM generation and demodulation, PWM, Spectra of Pulse modulated signals, SNR calculations for pulse modulation systems.
Digital transmission of analog signals: Quantization: uniform – non uniform, companding: μ-law & A-law, PCM, DPCM, Delta modulation, Adaptive delta modulation

MODULE – III:

Signal space concepts: Geometric structure of the signal space, vector representation, distance, norm and inner product, orthogonality and orthonormality, signal constellation, geometric interpretation of signals, likelihood functions, Schwarz Inequality,Gram-Schmidt orthogonalization procedure.
Noise in communication system, Optimum receiving filter- Correlator, Matched filter, Inter symbol interference, Pulse Shaping, Nyquist criterion for zero ISI, Signaling with duobinary pulses, Eye diagram, Equalizer, Scrambling and descrambling.
Decision Procedure: Maximum aposteriori probability detector- Maximum likelihood detector, Error probability performance of binary signaling.

MODULE – IV:

Digital band pass modulation schemes: ASK, FSK, PSK signal space representation. 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 digital modulation schemes – Performance of M-arysignaling schemes in AWGN channels - Power spectra of digitally modulated signals, Performance comparison of digital modulation schemes.
Minimum Shift Keying (MSK), signal constellation of MSK waveforms, error probability of MSK signal, Gaussian Minimum Shift Keying: GMSK, basic concept of OFDM.

Reference:

1. John G. Proakis, Digital Communications, McGraw Hill, 2001.
2. B. Sklar and P.K. Ray, Digital Communication: Fundamentals and Applications, Pearson Education,
3. Digital Communications, S. Haykin, Wiley India.
4. Principles of Communication Systems, H. Taub and D.L.Schilling, TMH Publishing Co.
5. B.P. Lathi, Modern Digital and Analog Communication, Oxford University Press.
6. Digital Communication, A. Bhattacharya, TMH Publishing Co.

EC 15102: MICROPROCESSORS AND MICRO CONTROLLERS

L	T	P	C
3	0	0	3

Prerequisites: EC 14101

Goal: To learn the architecture programming and interfacing of microprocessors and Microcontrollers**.**

Objective:

The course should enable the students to:

1. Study 8086 architecture,
2. Learn 8086 programming,
3. Study Interfacing concepts,
4. Study 8051 Microcontroller

Module 1

Introduction: History of microprocessors –Basics of computer architecture-Computer languages –CISC and RISCReview of binary arithmetic

Module 2

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

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

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 GillispieMazidi ,Rolin D Mc Kinlay ,The 8051 Microcontroller and Embedded Systems Using Assembly and C , Second Edition ,2008 , Pearson Education

EC 15103: Transmission Line, Antenna & Propagation

L	T	P	C
2	1	0	3

Prerequisites: EC 14103

Module 1

Transmission Line Theory - Definitions, Different Types of Transmission line, Transmission Line Parameters, The Lumped element circuit model for a transmission line, Transmission Line Equation, Condition for lossless line, condition for distortion less line, Relation between Neeper&dB.Propagation constant, Characteristic Impedance; Wavelength; Velocity of Propagation; Distortion-less Line, Reflection and Transmission coefficients; Standing Waves, VSWR, Input Impedance, Smith Chart -Applications; Load Matching Techniques / Quarter wave Matching, Bandwidth problem; Low loss RF transmission lines, line as circuit elements.
Types of transmission line (open 2-wire, coaxial line, micro strip coplanar waveguide), Design principle, Applications and limitations.

Module 2

Maxwell's Equation; Radiation of e.m waves and introducing Antenna; Vector Potential and Retarded Vector Potential; Physical concept of radiation, Radiation pattern, near-and far-field regions, radiation power density, radiation intensity, reciprocity, directivity and gain, effective aperture, half-power beamwidth, bandwidth, polarization, input impedance, efficiency, vector effective length and equivalent areas, Friis transmission equation, radiation integrals and auxiliary potential functions.
Radiation from Wires and Loops: Infinitesimal dipole, finite-length dipole, linear elements near conductors, dipoles for mobile communication, small circular loop.

Module 3

Methods of Propagation: Ground Wave Propagation, Components of ground wave, Field strength dependence on physical factors. Sky wave Propagation; IonosphericLayers; Virtual Height, Critical Frequency, MUF, Skip distance, Sporadic Reflections. Space wave propagation: Tropospheric Scatter, Ducting Super refraction, Sub refrction. B. Friss Transmission Formula, SNR of a Radio Link.

Text Books

Principles of Electromagnetics, 4th Edition, Matthew O H Sadiku, Oxford University Press.
Electromagnetic Field Theory & Transmission Lines, G.S.N. Raju, Pearson Education
C. A. Balanis, "Antenna Theory and Design", 3rd Ed., John Wiley &Sons., 2005
R. E. Collin, "Antennas and Radio Wave Propagation", McGraw-Hill., 1985.

Jordan and Balmain: Electromagnetic waves and radiating systems, PHI, Second Edition, PHI, 2002.
Electromagnetic Waves and Transmission Lines- by G.Prasad, J.Prasad and J.Reddy- Scitech
Antenna (for all application), John D. Kraus and Ronald J. Marhcfka; Tata- MacGraw Hill, 3rd Edition

EC 15104: MICROELECTRONICS TECHNOLOGY

L	T	P	C
3	0	0	3

Prerequisites: EC 13104

Module 1

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, Heterostructures, Homogeneous and Heterogeneous growth, wafer cleaning, Epitaxy, Clean room and safety requirements

Module 2

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

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

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 15105: Control Theory

L	T	P	C
3	0	0	3

Goal: To familiarize the students with concepts related to the operational analysis and stabilization of control systems.

Objectives:

The course will enable the students to:
1. Analyze representation of systems and to derive transfer function models,
2. Provide adequate knowledge in the time response of systems and steady state error analysis,
3. Give basic knowledge in obtaining the open loop and closed–loop frequency responses of systems,
4. Provide the concept of stability of control system and methods of stability analysis,
5. Study the three ways of designing compensation for a control system, various components of control system.

Module 1

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

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 laglead compensators

Module 3

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

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

EC 15201: 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 15202: MICROPROCESSORS AND MICROCONTROLLERS LAB

L	T	P
0	0	3

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 GillispieMazidi ,Rolin D Mc Kinlay, The 8051 Microcontroller and
Embedded Systems Using Assembly and C , Second Edition ,2008 , Pearson Education

SEMESTER -VI

EC 16101: COMPUTER NETWORKS

L	T	P	C
3	0	2	4

Goal: To study the details regarding communication of voice and video, networks and its functions, data conversions, controlling of errors, switching information and its devices, internetworking device and different layers of TCP/IP.

Objective:

1. To study about the physical arrangement of networks, types and modes of networks, data conversions and transmission medium.
2. To study the detection and correction of errors, link control and link protocols of data link layer.
3. To study the access method, electrical specification and implementation of different networks, types of switching.
4. To study about the standardized data interface and it's working principle.
5. To study the logic of link mechanisms used in networks and different layers of TCP/IP.

Module 1

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

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

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

Broadband services and QoS issues: Quality of Service issues in networks- Integrated service architectureQueuing 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, 2 nd
edition, 2000. 4. S. Keshav, "An Engineering Approach to Computer Networking", Pearson Education, 2005

EC 16102: Microwave Engineering

Prerequisites: EC 14103, EC 15103

Objective:

The course should enable the students to:

1Study transmission lines using circuit theory, for analysis of line, define reflection factor, return loss and lossless line, Representation of lines in different form
2. Describe microwave transistor and diodes,
3. Explain the basic working principle and representation of passive microwave components,
4. Study antenna basics and radiation from a current element,

MODULE – I:

Introduction to Microwaves; Microwave Frequency bands; Applications of Microwaves.**Mathematical model of Microwave Transmission:** Concept of Mode; Characteristics of TEM, TE TM and Hybrid Modes; Losses associated with microwave transmission; Concept of Impedance in Microwave transmission.
Analysis of RF and Microwave Transmission Lines: Coaxial Line; Rectangular Waveguide; Circular waveguide; Stripline; Microstrip Line.

MODULE – II:

Microwave Network Analysis: Equivalent Voltages and currents for non-TEM lines; Network parameters for microwave Circuits; Scattering Parameters.
Microwave Devices: Microwave Passive components: Directional Coupler, Power Divider; Microwave Passive components: Magic Tee, attenuator, resonator; isolator, circulator.
Microwave Active components: Diodes, Transistors; oscillators, mixers; Gunn Diodes, IMPATT diodes, Schottky Barrier diodes, PIN diodes; Microwave tubes: Klystron, TWT, Magnetron.

MODULE – III:

Microwave Design Principles: Impedance transformation; Impedance Matching; Microwave Filter Design; RF and Microwave Amplifier Design; Microwave Power amplifier Design; Low Noise Amplifier Design; Microwave Mixer Design; Microwave Oscillator Design.
Microwave Measurements: Power, Frequency and impedance measurement at microwave frequency; Network Analyser and measurement of scattering parameters; Spectrum Analyser and measurement of spectrum of a microwave signal; Noise at microwave frequency and measurement of noise figure; Measurement of Microwave antenna parameters.

REFERENCES

1. David M. Pozar, "Microwave Engineering", Third Edition, Wiley India.
2. S. Ramo, J.R.Whinnery and T.V.Duzer, "Fields and Waves in Communication Electronics", Third Edition, Wiley India.
3. R.E.Collin, "Foundations for Microwave Engineering", Second edition, IEEE Press.
4. Microwave Engineering, A Das & S Das, TMH.
5. Microwave Devices & Circuits, SY Liao , Pearson Education /PHI

EC 16103: Digital Signal Processing

L	T	P	C
3	0	0	3

Prerequisites: EC 13102

Goal: To provide basic knowledge about various signal processing techniques and their importance

Objective:

The course should enable the students to :
1. Study the FFT and Basics of IIR, FIR Filters, Realization

2. Study the IIR Filters,
3. Study the FIR filter and Finite Word Length Problems,
4. Study the Sampling rate conversion,
5. Study the fundamentals of Digital Signal Processors

Review of Signals and Systems: Discrete time complex exponentials and other basic signals—scaling of the independent axis and differences from its continuous-time counterpart—system properties (linearity, time-invariance, memory, causality, BIBO stability)—LTI systems —autocorrelation, Fourier Series, Fourier Transform.

Module 1

Z-Transform: Generalized complex exponentials as eigensignals of LTI systems—z-transform definition—region of convergence (RoC)—properties of RoC—properties of the z-transform—inverse z-transform methods (partial fraction expansion, power series method, contour integral approach)—pole-zero plots—time-domain responses of simple pole-zero plots—RoC implications of causality and stability.

Module 2

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 (radix-2, decimation-in-time, decimation-in-frequency), Convolution; Linear and circular convolution, Practical implementation, Overlap-save and overlap-add methods, Short-time Fourier transform.

Module 3

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. Structures for discrete-time systems: Signal flow graph representation, basic structures for FIR and IIR systems (direct, parallel and cascade), transposition theorem, ladder and lattice structures.

Module 4

Finite wordlength effects in digital filters: Fixed and floating point representation of numbers, quantization noise in signal representations, finite wordlength effects in coefficient representation, roundoff noise, SQNR computation and limit cycle. Finite length register effects : Limit cycles, Overflow oscillations, Round-off noise in IIR digital filters, Computation of output round-off noise, Methods to prevent overflow.

Reference:

1. John G. Proakis, Dimitris G. Manolakis, "Digital Signal Processing: Principles, Algorithms and Applications," Prentice Hall of India Pvt. Ltd., 1997.

2. Oppenheim A. V., Schafer R. W., "Discrete-Time Signal Processing," Prentice Hall India, 1996.

3. Boaz Porat, "A Course in Digital Signal Processing," Prentice Hall Inc, 1998.

4. Mitra S. K., "Digital Signal Processing: A Computer Based Approach," McGraw-Hill Publishing Company, 1998.

5. Lonnie C. Ludeman, "Fundamentals of Digital Signal Processing," John Wiley& Sons, NY, 1986.

6. Chi-Tsong Chen, "Digital Signal Processing: Spectral Computation and Filter Design," Oxford University Press, 2001.

EC 16104: Information Theory & Error Control Coding

L	T	P	C
2	1	0	3

Prerequisites: EC 13103, EC 15101

Goal: To study the information theory with source coding theorem and error control coding

Objective:
1. Study some basic information theory with some channel coding theorem.
2. Study the black codes and its application in digital communication
3. Study the convolution codes and its application.

MODULE – I:

Review of 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.
Channel Capacity**-** Discrete memory-less channels (DMC) and channel transition probabilities, Capacity computation for simple channels- Shannon's Channel Coding Theorem for DMC, 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 – II:

Block Codes: Digital communication channel, Introduction to block codes, Single-parity-check codes, Hamming codes, Minimum distance of block codes, Hard decision and soft decision decoding.
Linear block codes:Introduction to Coding Theory, Linear Block Codes, Generator Matrices. The standard array, Parity checks matrices, Error syndromes, Error detection and correction, Shortend and extended Linear codes.
Cyclic codes: Introduction, Generator Polynomials, Encoding and decoding, Parity check polynomials, Dual codes, Generator and Parity check matrix. Linear feedback shift registers for encoding and decoding cyclic codes.

MODULE – III:

Galois fields, Primitive field elements, Irreducible and primitive polynomials, Minimal polynomials, Solution of equations in Galois field.
BCH Codes: Construction, Error Syndromes, Decoding, Error location polynomial, The Peterson-Gorenstein-Zierler decoder, Reed-Solomon codes, Berlekamp algorithm.
AWGN channels, Coding gain, Encoding and decoding in AWGN channels. LDPC codes.

MODULE – IV:

Convolutional codes- Feedforward Convolutional Encoder, Trellis Representation. Viterbi Decoder for convolutional codes. Puncturing, Interleaving, Turbo encoders and Turbo Decoders. LDPC/Turbo codes in the wireless standards.

References:

i. Thomas M. Cover and Joy A. Thomas, “Elements of Information Theory”, John Wiley & Sons, 2006
ii. Shu Lin and Daniel. J. Costello Jr., “Error Control Coding: Fundamentals and applications”, 2nd Ed., Prentice Hall Inc, 2004.
iii. Information theory, coding and cryptography - Ranjan Bose; TMH.
iv. Salvatore Gravano, “Introduction to Error Control Codes”, Oxford

EC 16201: Microwave Engineering & Antenna Lab

L	T	P	C
0	0	3	2

1. Familiarization with various types of Microwave components and measuring instruments.
2. Measurement of the guide wavelength of a rectangular waveguide.
3. Determination of Voltage Standing Wave Ratio (VSWR) and reflection coefficient of a rectangular waveguide with various types of load.
4. Measurement of the Near & Far field intensity (H plane) of Horn Antenna.
5. Radiation pattern, Gain, Directivity of a Pyramidal Horn Antenna.
6. Study of Characteristics of Gunn Oscillator
7. Study of the Klystron characteristics
8. Calibration of a crystal detector using waveguide test bench.
9. Measurement of Coupling, Isolation and Directivity of Directional Coupler
10. Measurement of reflection coefficient without using slotted line (using two directional couplers and calibrated attenuator).
11. Measurement of wavelength, guided wavelength and frequency using wave guide test bench. Calculation of broad wall dimension of wave guide &ω–β plot.
12. Calibration of attenuator, measurement of A_D and A_R using wave-guide test bench.
13. Measurement of unknown impedance (Inductive, Capacitive and Resonant windows)
14. Study of the Scattering matrix of E - plane Tee / H - plane Tee & a Magic Tee using wave-guide test bench.
15. Measurement of dielectric constant using wave-guide test bench.

EC 16401: MINOR PROJECT

The mini project should be on Hardware Design and/or Fabrication in any of the areas in Electronics and Communication Engineering. Project work can be carried out individually or by a group of maximum of three 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.

Semester VII

EC 17101 Wireless Communication

L	T	P	C
3	0	2	4

Prerequisites: EC 15101, EC 16101

Objective: To impart the fundamentals concepts of wireless communication systems. To introduce various technologies and protocols involved in wireless communication.

MODULE – I:

Introduction to wireless communication and systems, Wireless Standards: Overview of 2G and 3G cellular standards. Cellular Structure, Frequency Reuse, Cell clustering, Capacity enhancement techniques for cellular networks, cell splitting, antenna sectoring, Co-channel and Adjacent channel interferences, Channel assignment schemes – Fixed channel, Dynamic channel and Hybrid channel, mobility management – location management and handoff management, handoff process, different types of handoff. Call blocking in cellular networks.

MODULE –II:

Large scale signal propagation: free space propagation model - ground reflection model, refraction, diffraction and scattering propagation mechanism; Indoor and outdoor propagation model; large scale path loss and lognormal shadowing.
Fading channels: multipath and small scale fading- Doppler shift, statistical multipath channel models, parameters of a mobile multipath channel; narrowband and wideband fading models, power delay profile, average and rms delay spread, coherence bandwidth and coherence time, flat and frequency selective fading, slow and fast fading, average fade duration and level crossing rate.

MODULE –III:

Modulation schemes review: QPSK and variants, QAM, MSK and GMSK, multicarrier modulation, OFDM.

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
Multiple access schemes: FDMA, TDMA, CDMA and SDMA.

MODULE –IV:

Diversity techniques for wireless radio systems selection and MRC receivers, RAKE receiver, equalization: linear-Zero Forcing Equalizer, Adaptive equalizer, Decision Feedback Equalizer. MIMO, spatial multiplexing, diversity/multiplexing tradeoff.
Performance measures: average snr, average symbol/bit error rate.
System examples: GSM, EDGE, GPRS, IS-95, CDMA 2000
Cooperative Communication: Introductory discussion.

Reference:

1. Rapport Thoedore S., Wireless Communications, Principles and Practice, PHI,
2. Lee W.C.Y., Mobile Cellular Telecommunication, MGH, 2002
3. Andrea Goldsmith, Wireless Communications, Cambridge University Press.
4. G. L. Stuber, Principles of mobile communications, 2nd Ed., Springer.
5. Simon Haykin and Michael Moher, Modern Wireless Communication, Pearson education.

EC 17201: Digital Signal Processing Lab

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 17401: Major Project I

L	T	P	C
0	0	4	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 three 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.

Semester VIII

EC 18401 Major Project II

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 three 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 16301 High Speed Semiconductor Devices

L	T	P	C
3	0	0	3

Module 1

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

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

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

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 16302 Signal Estimation and Detection

L	T	P	C
3	0	0	3

Module 1

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

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, TheKalman Filter (4 Hrs)

Module 3

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

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 16303: Introduction to Nanoscience and Nanotechnology

Module 1

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

Novel MOS-based devices – Multiple gate MOSFETs, Silicon-on-insulator, Silicon-on-nothing, FinFETs, vertical MOSFETs, strained Si devices

Module 3

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

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 16304: COMPUTER ORGANIZATION & ARCHITECTURE

L	T	P	C
3	0	0	3

Module 1

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

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

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

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, ZvonkoVranesic&SafwatZaky, “Computer Organization”, Mc Graw Hill, 2001
5. Pal Choudhuri P., "Computer Organization and Design", Prentice-Hall India, 2nd Edition, 2003
6. William Stallings, "Computer Organization and Architecture", Pearson Education, 4th Edition, 2006

EC 16305: POWER ELECTRONICS

L	T	P	C
3	0	0	3

Module 1

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

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

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

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 16306: TELECOMMUNICATION SWITCHING &NETWORKS

L	T	P	C
3	0	0	3

Introduction to Telephone Systems**:** Evolution of Telecommunication; Components and Examples of Telecommunication systems; Pulse dialing& Tone dialing; Telephone Instruments - rotary dial and push button types.
Telecommunication Transmission Lines:- Copper, Co-axial, and Fiber optic cables; Transmission Bridge -Hybrid circuit for 2-wire to 4-wire conversion and vice versa. PCM Carriers.
Subscriber Loop Systems: BORSCHT Functions; Switching hierarchy & routing, signaling techniques-in channel & common channel signaling, SS7.
Switching System: Circuit Switching & Packet Switching, Digital Switching systems - Time division Time switch, Time multiplexed Space switch, Time multiplexed Time'switch, Hybrid switching, ; TS, ST, STS, TST systems; Architecture of 5ESS systems;
Stored Program Control: Software architecture, Application software;. Electronic Exchanges, Introduction to cordless telephones and Digital PABX
Traffic Engineering: Blocking network, blocking probability, grade of service, traffic load, Erlang-B and Ccongestion formulas-case studies
Modems and Their Standards: RS 232C; DTE and DCE, Facsimile Transmission, Broad band transmission-ISDN, DSL and ADSL, ISDN and B-ISDN
IP Telephony: Voice over IP, Session initiation protocol, H.323 signaling, IP multimedia service

References:

O Hersent, D Gurle, J P Petit "IP Telephony" Pearson
J.E.Flood "Telecommunications Switching, Traffic and Networks" Pearson
R L Freeman "Telecommunication System Engineering"- Wiley-India
T. Viswanathan, "Telecommunications Switching Systems & Networks", PHI
J.C.Bellamy "Digital Telephony"- Wiley-India

EC 16307: ACTIVE NETWORK SYNTHESIS

L	T	P	C
3	0	0	3

Module 1

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

Amplifiers and fundamental active building blocks - Opamps, OTAs, CCIIs, Integrators, gyrators and immittance converters

Module 3

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 - OTAbased (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

Fully integrated high-frequency filter realisations - Transconductance filters - Log-domain filters - Switchedcapacitor filters

Reference:

1. P V Ananda Mohan: Current mode VLSI Analog filters; Springer, 2004
2. GobindDaryanani: 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 16308 High Speed Digital Circuits

L	T	P	C
3	0	0	3

Module 1

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

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

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

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 17301: MODELING AND TESTING OF DIGITAL SYSTEMS

	T	P	C
3	0	0	3

Module 1

Introduction to HDL based Digital Design: – Basic VHDL terminology – basic language elements – Data objectsand types – Behavioural modelling – Process constructs – Complex signal assignments – Dataflow modelling –delay models – Structural modelling – resolving signal values

Module 2

Advanced VHDL features: Generics and Configurations – Subprograms and Overloading – Packages andLibraries – Advanced features – simulation semantics – modelling examples – state machine modelling usingVHDL- review of FPGA architectures and design using FPGA. Practical design exercises on VHDL simulator/synthesizer

Module 3

Digital System Testing: Fault models – fault equivalence – fault location fault dominance – single and multiplestuck faults – Testing for single stuck faults – Algorithms – random test generation – Testing for bridging faults

Module 4

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. MironAbramoviciet. 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 17302:TELECOMMUNICATION SYSTEM & NETWORK MODELLING

L	T	P	C
3	0	0	3

Network architectures – topology and hierarchy – evolution – layered architecture
Network Design Issues – application of graph theory – simplex algorithm and linear programming – binary and mixed integer linear programming;
Core Networks – Routing principles – Shortest path algorithm – minimum spanning tree problem– flow control – max flow min cut theory – min cost network flow program – load balancing and optimization – congestion control;
Advanced routing – Steiner trees and multicast – centralized routing (PCE), software defined network – distributed routing on ad-hoc networks, power aware MANET - reliability and route optimization ;Access Networks – Data link layer and media access control technologies – wireless and optical access – resource scheduling and optimization – Bipartite graph and stable matching algorithms – case studies; Access core interface – case studies.
Monte-Carlo simulation; Generation of random variables; PNS generation; Generation of Gaussian random variables; Simulation of communication systems in time and frequency domain; Simulation of error sources in digital channels; Channel simulation, Satellite link; Optical Communication link

References:
1. Network Optimization by V. K. Balakrishnan
2. Linear Network Optimization: Algorithms and Codes byD. Bertsekas
3. Mathematical Aspects of Network Routing Optimization by C. A. S. Oliveira, P. M. Pardalos
4. Network Flows: Theory, Algorithm and Application by R. K. Ahuja, C. L. Magnanti, James
5. Optimization Algorithm for Networks and Graphs – vol. 1 by J. R. Evans, E. Mineka
6. Integer Programming and Network Models – H. A. Eiselt, C. L. Sandblom
7. Interconnections - R. Perlman
8. Computer Networks A. S. Tanenbaum

EC 17303: State of the art and Future Memories

L	T	P	C
3	0	0	3

Module 1

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-Nordheimtunneling, direct band to band tunneling, SOI MOSFET, PDSOI, FDSOI, current characteristics, Classification of memories

Module 2

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

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

SOI Based RAM: Parasitic BJTs in a SOI, Z-RAM, Thyristor RAM

Module V

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. EhrenfriedZschech, 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 17304 Wavelet Theory

L	T	P	C
3	0	0	3

Module 1

(1. a) Fourier and Sampling Theory:

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:

Bases, Resolution of unity, Definition of frames, Geometrical considerations and the general notion of a frame, Frame projector, Example - windowed Fourier frames.

Module 2

(2. a) Wavelets:

The basic functions, Specifications, Admissibility conditions, Continuous wavelet trans- form (CWT), Wavelet frames.

(2. b) The multiresolution analysis (MRA) of L2(R):

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

(3.a) Construction of wavelets :

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:
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
(4) Construction of wavelets:
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 17305 Antenna Theory

L	T	P	C
3	0	0	3

MODULE I
Review ofFundamental Concepts, Radiation from Wires and Loops, Aperture and Reflector Antennas:Huygens' principle, radiation from rectangular and circular apertures, design considerations, Babinet's principle, Radiation from sectoral and pyramidal horns, design concepts, prime-focus parabolic reflector and cassegrain antennas.

MODULE II
Microstrip Antennas: Basic characteristics of microstrip antennas, feeding methods, methods of analysis, design of rectangular and circular patch antennas.
Broadband Antennas: Log-periodic and Yagi antennas, frequency independent antennas, broadcast antennas.

UWB antenna: antenna parameters and measurement; UWB antenna examples: bowtie, Vivaldi, valentine etc.

MODULE III

Antenna Arrays: Analysis of uniformly spaced arrays with uniform and non-uniform excitation amplitudes, extension to planar arrays, synthesis of antenna arrays using Schelkunoff polynomial method, Woodward-Lawson method.

Antenna Synthesis- Schelkunoff polynomial method, Fourier transform method

Smart Antenns: Concept and benefits of smart antennas, Fixed weight beamforming basics, Adaptive beamforming.

References:

1. C. A. Balanis, "Antenna Theory and Design", 3rd Ed., John Wiley &Sons., 2005.
2. W. L. Stutzman, and G. A. Thiele, "Antenna Theory and Design", 2nd Ed., John Wiley &Sons., 1998.
3. R. E. Collin, "Antennas and Radio Wave Propagation", McGraw-Hill., 1985.
4. F. B. Gross, "Smart Antennas for Wireless Communications", McGraw-Hill., 2005.

EC 17306: Quantum Computation

L	T	P	C
3	0	0	3

Module 1

Review of Linear Algebra. The postulates of quantum mechanics. Review of Theory of Finite Dimensional HilbertSpaces and Tensor Products

Module 2

Complexity classes. Models for Quantum Computation. Qubits. Single and multiple qubit gates. Quantum circuits. Bellstates. Single qubit operations. Controlled operations and measurement. Universal quantum gates. QuantumComplexity classes and relationship with classical complexity classes

Module 3

Quantum Algorithms – Quantum search algorithm - geometric visualization and performance. Quantum search as a quantum simulation. Speeding up the solution of NP Complete problems. Quantum search as an unstructured database. Grover’s and Shor’s Algorithms.

Module 4

Introduction to Quantum Coding Theory. Quantum error correction. The Shor code. Discretization of errors,Independent error models, Degenerate Codes. The quantum Hamming bound. Constructing quantum codes – Classicallinear codes, Shannon entropy and Von Neuman Entropy.

References:

1. Nielsen, Michael A., and Isaac L. Chuang
,
Quantum Computation and Quantum Information.
Cambridge, UK,
Cambridge University Press, September 2002
2. Gruska, J. Quantum Computing, McGraw Hill, 1999.
3. Halmos, P. R. Finite Dimensional Vector Spaces, Van Nostrand, 1958.
4. Peres, Asher.
Quantum Theory: Concepts and Methods
.
New York, NY: Springer, 1993. ISBN: 9780792325499.

EC 17307 Communication Switching Systems

L	T	P	C
3	0	0	3

Pre-requisite: EC 3012

Module 1

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

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

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

Signaling: customer line signaling - outbandsignaling - inbandsignaling - 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 17308 ADVANCED COMMUNICATION NETWORKS

L	T	P	C
3	0	0	3

Overview of Internet-Concepts, challenges and history. Overview of high speed networks-ATM. TCP/IP Congestion and Flow Control in Internet-Throughput analysis of TCP congestion control. TCP for high bandwidth delay networks. Fairness issues in TCP.;Real Time Communications over Internet. Adaptive applications. Latency and throughput issues. Integrated Services Model (intServ). Resource reservation in Internet. RSVP.;Characterization of Traffic by Linearly Bounded arrival Processes (LBAP). Concept of (o,, p) regulator. Leaky bucket algorithm and its properties.;Packet Scheduling Algorithms-requirements and choices. Scheduling guaranteed service connections. GPS, WFQ and Rate proportional algorithms. High speed scheduler design. Theory of Latency Rate servers and delay bounds in packet switched networks for LBAP traffic.;Active Queue Management - RED, WRED and Virtual clock. Control theoretic analysis of active queue management.;IP address lookup-challenges. Packet classification algorithms and Flow Identification- Grid of Tries, Cross producting and controlled prefix expansion algorithms.;Admission control in Internet. Concept of Effective bandwidth. Measurement based admission control. Differentiated Services in Internet (DiffServ). DiffServ architecture and framework.;IP switching and MPLS-Overview of IP over ATM and its evolution to IP switching. MPLS architecture and framework. MPLS Protocols. Traffic engineering issues in MPLS. [P control of Optical Routers. Lamda Switching, DWDM Networks.

References

- Jean Wairand and Pravin Varaiya, High Perforamnce Communications Networks, Second Edition, 2000.
- Jean Le Boudec and Patrick Thiran, Network Calculus A Theory of Deterministic Queueing Systems for the Internet, Springer Veriag, 2001.
- Zhang Wang, Internet Qo,5, Morgan Kaufman 2001.
- George Kesidis, ATM Network Performance, Kluwer Academic, 2000 5. Research Papers.

EC 17309 Opto-electronic Devices and Systems

L	T	P	C
3	0	0	3

Module 1

Optical processes in semiconductors – electron hole recombination, absorption, Franz-Keldysh effect, Stark effect, quantum confined Stark effect, deep level transitions, Auger recombination

Module 2

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

Optical detection – PIN, APD, modulated barrier photodiode, Schottky barrier photodiode, wavelength selective detection, microcavity photodiodes.

Module 4

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. 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 &PochiYeh– 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 17310: Reliability of Semiconductor Devices

L	T	P	C
3	0	0	3

Module 1

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

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

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

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. 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 17311:DATA STURCTURES AND ALGORITHMS

L	T	P	C
4	0	0	4

Goal : To introduce students the basics of data structure and algorithm.

Objectives: The course should enable the students to:
1. Learn the major components of a Data Structure and algorithm.
2. Learn the problem solving techniques using data structure and algorithm.
3. Develop skills to implement different algorithm.

Total Hours: 56 Hrs

Module 1

Time and space complexity analysis of algorithms - Asymptotic analysis - Big Oh - Omega - theta notations – Searching and Sorting - Binary search - Quick sort - Heap sort - priority queue using heap - complexity analysis of search and sorting algorithms - average case analysis of quick sort.

Module 2

Linked lists - Stack and Queue - Binary tree - in-order, pre-order and post-order traversals - complexity analysis - representation and evaluation of arithmetic expressions using binary tree - Binary Search trees - insertion, deletion and search - average case complexity analysis.

Module 3

File structure - Merge sort - B Tree - complexity analysis - Data structures for disjoint sets - union by rank and path compression - complexity analysis - Hash tables.

Module 4

Graph representation- DFS, BFS, minimum spanning tree problem - Kruskal's algorithm - implementation using disjoint set data structure - complexity analysis – Prim's algorithm - Shortest path problem - Dijkstra's algorithms - implementation of Prim's and Dijkstra's algorithms using priority queue data structure - complexity analysis. Floyd Warshall algorithm.

References:

1. T. H. Cormen, C. E. Lieserson, R. L. Rivest, C. Stein, Introduction to Algorithms (3/e), MIT Press, 2003
2. S. Dasgupta, C. H. Papadimitriou, U. Vazirani, Algorithms, McGraw Hill, 2006
3. A. V. Aho, J. D. Ullman and J. E. Hopcroft, Data Structures and Algorithms, Addison Wesley, 1983.

EC17312: VLSI Design

L	T	P/S	C
3	0	2	4

Goal: To introduce the technology, design concepts and testing of Very Large Scale Integrated Circuits and to learn the concepts of modeling a digital system using Hardware Description Language**.**

Objective :

The course should enable the students learn about:
1. CMOS Technology,
2. MOS Transistor Theory,
3. Specification using Verilog HDL,
4. CMOS Chip Design,
5. CMOS Testing.

Module 1

Introduction MOSFET, threshold voltage, current, Channel length modulation, body bias effect and short channel effects, MOS switch, MOSFET capacitances, MOSFET models for calculation-Transistors and Layout, CMOS layout elements, parasitics, wires and vias-design rules-layout design SPICE simulation of MOSFET I-V characteristics and parameter extraction

Module 2

CMOS inverter, static characteristics, noise margin, effect of process variation, supply scaling, dynamic characteristics, inverter design for a given VTC and speed, effect of input rise time and fall time, static and dynamic power dissipation, energy & power delay product, sizing chain of inverters, latch up effect-Simulation of static and dynamic characteristics, layout, post layout simulation

Module 3

Static CMOS design, Complementary CMOS, static properties, propagation delay, Elmore delay model, power consumption, low power design techniques, logical effort for transistor sizing, ratioed logic, pseudo NMOS inverter, DCVSL, PTL, DPTL & Transmission gate logic, dynamic CMOS design, speed and power considerations, Domino logic and its derivatives, C2MOS, TSPC registers, NORA CMOS –Course project

Module 4

Circuit design considerations of Arithmetic circuits, shifter, CMOS memory design - SRAM and DRAM, BiCMOS logic - static and dynamic behaviour -Delay and power consumption in BiCMOS Logic

References:

1. Sung-Mo Kang & Yusuf Leblebici, CMOS Digital Integrated Circuits - Analysis & Design, , MGH, Third Ed., 2003
2. Jan M Rabaey, Digital Integrated Circuits - A Design Perspective,Prentice Hall, Second Edition, 2005
3. David A. Hodges, Horace G. Jackson, and Resve A. Saleh, Analysis and Design of Digital Integrated Circuits, Third Edition, McGraw-Hill, 2004
4. R. J. Baker, H. W. Li, and D. E. Boyce, CMOS circuit design, layout, and simulation, Wiley-IEEE Press, 2007
5. Christopher Saint and Judy Saint, IC layout basics: A practical guide, McGraw-Hill Professional, 2001

EC 17313: Operating Systems

Module 1

Review of operating system strategies - resources - processes - threads - objects - operating system organization – designfactors - functions and implementation considerations - devices - characteristics - controllers - drivers – devicemanagement - approaches - buffering - device drivers - typical scenarios such as serial communications – storagedevices etc

Module 2

Process management - system view - process address space - process and resource abstraction - process hierarchy -scheduling mechanisms - various strategies - synchronization - interacting & coordinating processes - semaphores -deadlock - prevention - avoidance - detection andrecovery

Module 3

Memory management - issues - memory allocation - dynamic relocation - various management strategies – virtualmemory - paging - issues and algorithms - segmentation - typical implementations of paging & segmentation systems

Module 4

File management - files - implementations - storage abstractions - memory mapped files - directories and theirimplementation - protection and security - policy and mechanism - authentication - authorization - case study of Unixkernel and Microsoft Windows NT (concepts only)Virtual machines – virtual machine monitors – issues in processor, memory and I/O virtualization, hardware supportfor virtualization.

References:

1. Silberschatz, Galvin and Gagne, Operating System Principles, 7/e, 2006, John Wiley
2. William Stallings, Operating Systems, 5/e, Pearson Education
3. Crowley C., Operating Systems- A Design Oriented Approach, Tata McGraw Hill, New Delhi
4. Tanenbaum A. S., Modern Operating Systems, 3/e Prentice Hall, Pearson Education
5. Gary J. Nutt, Operating Systems - A Modern Perspective,3/e Addison Wesley

EC 17314: Cryptography & Network Security

Module 1

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

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

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

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. EvangelosKranakis, " Primality and Cryptography", John Wiley & Sons, 1991.
6. Rainer A. Ruppel, " Analysis and Design of Stream Ciphers" , Springer-Verlag,1986

EC 18301: MOS DEVICE MODELING

L	T	P	C
3	0	0	3

Module 1

Semiconductor surfaces, Ideal MOS structure, MOS device in thermal equilibrium, Non-Ideal MOS: workfunction 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, thresholdvoltage, MOS as a capacitor (2 terminal device), Three terminal MOS, effect on threshold voltage

Module 2

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

Module 3

MOS transistor in dynamic operation, Large signal Modeling, small signal model for low, medium and highfrequencies.

Module 4
SOI concept, PD SOI, FD SOI and their characteristics, threshold voltage of a SOI MOSFET, Multi-gate SOIMOSFETs, Alternate MOS structures.

Reference:
1. E.H. Nicollian, J. R. Brews, Metal Oxide Semiconductor - Physics and Technology, John Wiley and Sons,
2003.
2. Jean- PierrieColinge, Silicon-on-insulator Technology: Materials to VLSI Kluwer Academic publishers group,
2004.
3. YannisTsividis, 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 18302: MULTIRATE SYSTEMS

L	T	P	C
3	0	0	3

Module 1
Multirate System Fundamentals: Sampling theorem: Sub-Nyquist sampling, generalization; Basic multirateoperations: up sampling and down sampling - time domain and frequency domain analysis; Identities of multirateoperations; 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
Multirate Filter Banks: Maximally decimated filter banks: Quadrature mirror filter (QMF) banks –Polyphaserepresentation, 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 freeQMF bank

Module 3

M-channel Perfect Reconstruction Filter Banks: Filter banks with equal pass bandwidth, filter banks with unequalpass bandwidth – Errors created by the filter banks system - Aliasing and imaging - Amplitude and phasedistortion, polyphase representation - polyphase matrix. Perfect reconstruction system - Necessary and sufficientcondition for perfect reconstruction, FIR PR systems, Factorization of polyphase matrices, Design of PR systems

Module 4

Linear Phase Perfect Reconstruction (LPPR) Filter Banks: Necessary conditions for linear phase property; Latticestructures for LPPR FIR QMF banks - Synthesis, M-channel LPPR filter bank, Quantization effects - Types ofquantization 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,3rdEdition,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

L	T	P	C
3	0	0	3

EC 18303: DIGITAL IMAGE PROCESSING

Module 1

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

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

Image enhancement & Restoration: Image enhancement: Basic gray level transformations – Histogramprocessing: 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

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.

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 18304 Opto-electronic Communication Systems

L	T	P	C
3	0	0	3

Module 1

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

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

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).

Module 4

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 18305 Radar Engineering

L	T	P	C
3	0	0	3

Module1

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

Module 2

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

Radar Transmitters- Modulators-Solid state transmitters, Radar Antennas- Parabolic-Scanning feed-Lens-Radomes, Electronically steered phased array antenna-Applications, Receivers-Displays-Duplexers

Module 4

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 -MerrillI.Skolnik , McGraw Hill Publishers, 1990
3. Radar Principles for the Non-Specialist, by J. C. Toomay, Paul HannenSolTech Publishers, 2004
4. Radar systems- MerrillI.Skolnik, McGraw Hill Publishers, 2005.

EC 18306: Computational Electromagnetics

L	T	P	C
3	0	0	3

MODULE – I:

Introduction: Applications of electromagnetics in research and industry. Historical development of Computational Methods.
Numerical Methods: ODE solvers, Euler, Runge – Kutta, Boundary conditions, Propagation of errors, Survey of numerical packages, Scientific programming with Python and Matlab.
Cauchys integral theorem,Fourier transform integrals with singularity, Singularity extraction technique,Branch point integrals. Saddle point, Stationary phase method for evaluation of radiation integrals. Special functions : Bessel functions, fresnel integrals.

MODULE – II:

Method of Curvilinear Squares. Finite Element Method (FEM): overview of FEM, Variational and Galerkin Methods, shape functions, lower and higher order elements, vector elements, 2D and 3D finite elements, efficient finite element computations.;Method of Moments (MOM): integral formulation, Green's functions and numerical integration, other integral methods: boundary element method, charge simulation method.. Finite Difference Method. Monte Carlo Method. Understanding boundary conditions.

MODULE – III:

Classification based on integral and differential equation solution, time domain and frequency domain solutions.
Time varying Electromagnetic Fields: FDTD simulations with the Yee cell. Courant's stability condition. Eddy currents and skin depth. Multi-resolution Time Domain Methods. Introduction to wavelets. Families of wavelets and orthogonality conditions.

References:

i. Introduction to the Finite-Difference Time-Domain (FDTD) Method for Electromagnetics, S. D. Gedney, Morgan and Claypool Publishing, 2011.
ii. M. V. K. Chari and S. J. Salon, Numerical methods in electromagnetism, Academic Press, 2000.
iii. M. N. O. Sadiku, Numerical techniques in electromagnetics, CRC Press, 1992.
iv. N. Ida, Numerical modeling for electromagnetic non-destructive evaluation, Chapman and Hall, 1995.
v. S. R. H. Hoole, Computer aided analysis and design of electromagnetic devices, Elsevier Science Publishing Co., 1989.
vi. J. Jin, The Finite Element Method in electromagnetics, 2nd Ed., John Wiley and Sons, 2002.
vii. P. P. Silvester and R. L. Ferrari, Finite elements for electrical engineers, 3rd Ed., Cambridge University Press, 1996.

EC 18307 Signal Compression

L	T	P	C
3	0	0	3

Module 1 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

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

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 BuzoGray Algorithm – Tree Structured Vector Quantizers – Lattice Vector Quantizers – Differential Encoding Schemes.

Module 4

Mathematical Preliminaries for Transforms , Subbands, and Wavelets – KarhunenLoeve 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, JelenaKovacevic, "Wavelets and Subband Coding", Prentice Hall Inc., 1995.

EC 18308 Advanced Wireless Communication

L	T	P	C
3	0	0	3

MODULE – I:

Capacity of Parallel AWGN Channels – Capacity of Fading Channels - Frequency Selective Channels - Ergodic and Outage capacity. WSSUS Channel Modeling, RMS Delay Spread; Doppler Fading, Jakes Model, Autocorrelation; Jakes Spectrum; Impact of Doppler Fading.

MODULE – II:

Introduction to OFDM; Multicarrier Modulation and Cyclic Prefix; Channel model and SNR performance; OFDM Issues – PAPR; Frequency and Timing Offset Issues. Introduction to MIMO, MIMO Channel Capacity; SVD and Eigenmodes of the MIMO Channel;MIMO Spatial Multiplexing – BLAST; MIMO Diversity – Alamouti, OSTBC, MRT; OFDMA - Combination of MIMO with Multiple Access Techniques.

MODULE – III:

3G and 4G Wireless Standards: WLAN**;** WCDMA; LTE; WiMAX.
UWB (Ultrawide Band): Definition and Features; UWB Wireless Channels; UWB Data Modulation; Bit-Error Rate Performance of UWB.

MODULE – IV:

Cooperative Communication – Wireline and Wireless Network Models – Cooperative Strategies and Rates – Network Capacity – AF, CF and DF - Network Coding – 2 Way Relaying – Cooperative Diversity.
Relay in wireless communication; Green Communication

Reference:

1. Andrea Goldsmith, Wireless Communications, Cambridge University Press.
2. Wireless Communications, "Andreas Molisch "Wiley IEEE Press.
3. MIMO Wireless Communications " EzioBiglieri" Cambridge University Press.
4. Reliable Communications for Short-range Wireless Systems, "Ismail Guvenc et all" Cambridge.

EC 18309: Neural Networks and Genetic Algorithm

Introduction to Artificial Neural Networks - Introduction to network architectures - knowledge representation - Learning process .Learning algorithms- Neural Network Architectures-MLFFN-Recurrent NN- RBF Network structure - separability of patterns - RBF learning strategies - comparison of RBF, RNN and MLP networks- Hopfield networks- Genetic Algorithm- Application to Engineering problems -Concept of neuro-fuzzy and neuro-genetic systems- GA as an optimization tool for ANN-Application of ANN in forecasting-Signal characterization-Fault diagnosis-Neuro-Fuzzy-Genetic Systems- Case Studies in solving Engineering problems of control, signal/image processing etc.

EC 18310: Wireless Adhoc and sensor Networks

Introduction of ad-hoc/sensor networks; Advantages of ad-hoc/sensor networks; Unique constrints and challenges; Driving Applications; Wireless Communications/Radio Characteristics; Ad-Hoc wireless networks; Media Access Control (MAC) Protocols Issues in designing MAC protocols Classifications of MAC protocols MAC protocols; Routing Protocols; Issues in designing routing protocols Classification of routing protocols Routing protocols.
Networking Sensors Unique features Deployment of ad-hoc/sensor network
Sensor tasking and control Transport layer and security protocols
Sensor Network Platforms and Tools Berkley Motes
Sensor network programming challenges
Embedded Operating Systems Simulators

Applications of Ad-Hoc/Sensor Network and Future Directions.
Ultra wide band radio communication
Wireless fidelity systems

EC 1831: Architecture of Advanced Processors

L	T	P	C
3	0	0	3

Module 1

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

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

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

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. JurijSilc, BorutRobic, ThUngerer: Processor Architecture: From Dataflow to Superscalar and Beyond. Springer-Verlag, June 1999

EC 18312 Radiation and Propagation

L	T	P	C
3	0	0	3

Module 1

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

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

Antenna temperature - signal-to-noise ratio – far field, near field and Fourier transform – receiving antennas and reciprocity – reciprocity relations

M**odule 4**

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 18313 Analog MOS Integrated Circuits

L	T	P	C
3	0	0	3

Module 1

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

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

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

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 BehzadRazavi, Design of Analog CMOS Integrated Circuit, Tata-Mc GrawHill, 2002
6 Philip Allen & Douglas Holberg, CMOS Analog Circuit Design, Oxford University Press, 2002

EC 18314: Silicon on Insulator and Advanced MOSFET based structures

L	T	P	C
3	0	0	3

Module 1

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

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

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

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- PierrieColinge, Silicon-on-insulator Technology: Materials to VLSI Kluwer Academic publishers group, 2004.

EC 18315 Speech Processing

L	T	P	C
3	0	0	3

Module 1

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

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

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

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 18316: Data Base Management System

Module 1

Database System concepts and architecture, Data modeling using Entity Relationship (ER) model and Enhanced ER model, Specialization, Generalization, Data Storage and indexing, Single level and multi level indexing, Dynamic Multi level indexing using B Trees and B+ Trees.

Module 2

The Relational Model, Relational database design using ER to relational mapping, Relational algebra and relational calculus, Tuple Relational Calculus, Domain Relational Calculus, SQL.

Module 3

Database design theory and methodology, Functional dependencies and normalization of relations, Normal Forms, Properties of relational decomposition, Algorithms for relational database schema design.

Module 4

Transaction processing concepts, Schedules and serializability, Concurrency control, Two Phase Locking Techniques, Optimistic Concurrency Control, Database recovery concepts and techniques, Introduction to database security.

References:

1. RamezElmasri and Shamkant B. Navathe, Fundamentals of Database Systems (5/e), Pearson Education, 2008.
2. Raghu Ramakrishnan and Johannes Gehrke, Database Management Systems (3/e), McGraw Hill, 2003.
3. Peter Rob and Carlos Coronel, Database Systesm- Design, Implementation and Management (7/e), Cengage
Learning, 2007.

EC 18317: Ultra Wideband Communication

L	T	P	C
3	0	0	3

Introduction; Definition of UWB; International regulations for UWB signals; UWB standards; Comparison with narrowband; UWB channel characterization and measurement; Channel estimation errors and reliability; Different methods of UWB signal generation; UWB circuits, transceivers and systems; High rate UWB system design; Channel estimation for high rate systems; Adaptive Modulation, coding, MIMO techniques for high rate communication; Zigbee networks and low-rate UWB communication; Cooperative communication for reliability;
UWB antenna design parameters; special features of UWB antenna; Example of UWB antenna design- bowtie, Vivaldi, rugby ball, valentine etc; UWB antenna applications.

Position estimation techniques; time based ranging via UWB radios; Ranging protocols; Practical consideration for UWB system design; Recent trends of UWB communication in research and industry.

References:

1. RanjitGharpurey, Peter Kinget, "Ultra Wideband Circuits, Transceivers and Systems", Springer 2007.
2. ZaferSahinoglu, Sinan Gezici, Ismail Guvenc, "Ultra Wideband Positioning Systems", Cambridge University Press.
3. Ismail Guvenc, Sinan Gezici, ZaferSahinoglu and Ulas C. Kozat "Reliable Communications for short-range Wireless Systems", Cambridge University Press.

Ec 18318: Software Engineering

Module 1

Introduction to Software Engineering – Reasons for software project failure – Similarities and differences between
software and other engineering products.
Software Development Life Cycle (SDLC) – Overview of Phases.
Detailed Study of Requirements Phase: Importance of Clear Specification – Formal specification methods including
algebraic specification in detail.

Module 2

Problem partitioning (subdivision) - Power of Abstraction
Concept of functional decomposition – process modeling - DFDs
Concept of data modeling – ER diagrams
Class and component level designs – Object Oriented Design - UML and Design Patterns (only introduction)

Module 3

Coding and Testing :
Structured programming – internal documentation and need for standards – Methods of version control -
Maintainability.
Introduction to secure programming.
Types of testing – Specification of test cases – Code review process

Module 4

Software Project Management: Introduction to metrics. Software Process Models. Costing, Scheduling and Tracking
techniques. Software configuration management - versioning. Reusable components. Mathematical methods of risk
assessment and management. Methods of software licensing and introduction to free software.

References:
1. Roger S Pressman, Software Engineering: A Practitioner's Approach (6/e.), McGraw Hill, 2008.
2. T C Lethbridge and R Laganiere, Object Oriented Software Engineering (1/e), Tata McGraw Hill, 2004.
3. Pankaj Jalote, Software Engineering: A Precise Approach (1/e), Wiley India, 2010.
4. A Shalloway and J Trott, Design Patterns Explained: A new perspective on object oriented design (2/e),
Pearson, 2004.

EC 18319: EMBEDDED SYSTEMS

Module 1
Introduction to Embedded systems : Embedded system examples, Parts of Embedded System-Processor, Powersupply, 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
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, HardwareDebugging. Hardware testing methods like Boundary Scan, In Circuit Testing (ICT) etc. Bus architectures like I2C, SPI, AMBA, CAN etc.

Module 3
Operating Systems: Concept of firmware, Operating system basics, Real Time Operating systems, Tasks,Processes and Threads, Multiprocessing and Multitasking, Task scheduling, Task communication andsynchronization, Device Drivers.

Module 4
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 18320 EMI EMC

L	T	P	C
3	0	0	3

Introduction To EMI - Definitions, Different Sources of EMI(Electro-magnetic Interference), Electro-static discharge(ESD),Electro-magnetic pulse(EMP),Lightning, Mechanism of transferring Electro-magnetic Energy: Radiated emission, radiated susceptibility, conducted emission, conducted susceptibility, Differential & common mode currents.
Introduction To EMC - Concepts of EMC, EMC units.
EMC requirements for electronic systems - World regulatory bodies- FCC, CISPR etc. Class-A devices, class-B devices, Regulations of the bodies on EMC issues.
Different Mitigation Techniques For preventing EMI
Grounding: Fundamental grounding concepts, Floating ground, Single-point & Multi-point ground, advantages & disadvantages of different grounding processes.
Shielding: Basic concepts of shielding, Different types of shielding, Shielding effectiveness(S.E),S.E of a conducting barrier to a normal incident plane wave, multiple reflection within a shield, mechanism of attenuation provided by shield, shielding against magnetic field & Electric field,
S.E for Electronic metal & Magnetic metal, Skin-depth,S.E for far-field sources, shield seams.
Cross-talks & Coupling, Measurement set for measuring Cross-talk.
Filtering & decoupling.
Non-ideal behavior of different electronic components - Examples: Microwave oven, Personal Computers, Health Hazards-limits, EMC in healthcare environment.
Antennas for EMI Measurements - Broadband antenna measurements, antenna factor.
EMI-EMC Measurements - EMC measurement set, Power losses in cable, calculation of signal source output for a mismatched load, Measuring & Test systems, Test facilities, measurements of radiated emission in open test range & in Anechoic chamber, Conducted emission testing by Line Impedance Stabilization network (LISN).
Time-domain & Frequency-domain Analysis Of Different Signals - Fourier series & Fourier transform of different signals, identifying the frequency, phase& power spectrum of different signals. Time-domain Reflectrometry (TDR) basics for determining the properties of a transmission line.
System Design For EMC - Simple susceptibility models for wires & PCB, Simplified lumped model of the pick-up of incident field for a very short twoconductor line. Biological effects of electromagnetic radiation, SAR and SAR measurements, Phantom models.

Recommended Books:
1. *Introduction to Electromagnetic compatibility*-Clayton R.Paul(John wiley& Sons)
2. *EMC Analysis Methods & Computational Models*-Frederick M Tesche, Michel V.Ianoz, TorbjornKarlsson(John Willey & Sons, Inc)

Reference Books:
1. *EMI/EMC Computational modeling Hand Book*- by Archambelt.

2. *Electrostatic Discharge In Electronics*-Willian D.Greason(John Wiley & Sons, Inc).
3. *The ARIAL RFI Book*-Hare,WIRFI published by-The American Radio Relay League Newington.
4. *Applied Electromagnetic Compatibility*-Dipak L Sengupta& Valdis V Liepa(John Wiley & Sons Inc).
5. *Electromagnetic waves & Radiating Systems*-Jordan & Balmain (Prentice Hall Publication)
6. *Elements Of Electromagnetic*-Matthew N.O.Sadiku (Oxford University Press)

EC 18321 Satellite Communication

L	T	P	C
3	0	0	3

Module 1

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

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

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

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', 4^{th} 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 18322:MEMS/NEMS

L	T	P	C
3	0	0	3

Module 1

An introduction to Micro sensors and MEMS, Evolution of Micro sensors & MEMS, Micro sensors & MEMS applications

Module 2

Microelectronic technologies for MEMS, Micromachining Technology, Surface and Bulk Micromachining, working principle of various MEMS.

Module 3

Micro machined Micro sensors: Mechanical, Inertial, Biological, Chemical, Acoustic, Microsystems Technology, Integrated Smart Sensors and MEMS.

Module 4

Interface Electronics for MEMS, MEMS Simulators, MEMS for RF Applications, Bonding & Packaging of MEMS, Conclusions & Future Trends.

References:

1. Tai-ran Su, MEMS and Microsystems: design and Manufacture, Tata McGraw Hill.
2. S.K. Ghandhi, VLSI Fabrication Principles, John Wiley Inc., New York, 1983.
3. S.M. Sze (Ed), VLSI Technology, McGraw Hill, 1988.
4. Julian W. Gardner, V. K. Varadan, Osama O. Awadelkarim, Microsensors, MEMS, and Smart Devices, ISBN: 047186109X - John Wiley and Sons.
5. Gere & Timoshenko, Mechanics of Materials, PWS-KENT, 1990.
6.Gregory T. A. Kovacs, Micromachined Transducers Sourcebook, WGB/McGraw-Hill,2000, ISBN: 0072907223.
7. M. Madou, Fundamentals of Microfabrication, CRC Press, 2002, ISBN: 0849308267
8. M. Elwenspoek& H. Jansen, Silicon micromachining, Cambridge, 1998, ISBN: 052159054
9. S. Senturia, Microsystem Design, Kluwer Academic Publishers, 2001, ISBN: 0792372468
10. S.Sze, Semiconductor Sensors, John Wiley & Sons, 1994 ISBN: 0471546097
11. Marc Madou, Fundamentals of Microfabrication, CRC Press, 1997.