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

Effective from Admission year 2017-18 onwards

Department of Electronics & Communication Engineering

National Institute of Technology Sikkim

South Sikkim 737 139

Semester III

MA13101: Computational Mathematics

L	T	P	C
3	1	0	4

Module 1 [10L]: Number Theory

Integers, Divisibility, Prime Numbers, Primality Testing, Unique Factorization, Chinese Remainder Theorem, Congruence, Quadratic Congruence, Exponential and Logarithm, Discrete Logarithms, Quadratic Reciprocity, Diophantine Equations and Arithmetic Functions, Modular Arithmetic, GF(2n) Fields, P≠NP Conjecture, 1-way Functions.

Module 2[10L]: Optimization Techniques

Introduction to Linear Programming Model, Graphical Method, Assignment Problem, Transportation Methods, Simplex Method, Nonlinear Optimization, Genetic Algorithms (GA), Particle Swarm Optimizations (PSO), Ant Colony Optimizations (ACO).

Module 3[10L]: Graph Theory and Combinatorics

Introductions, basic Terminology, Simple Graph, Multi-graph, Pseudo-graph, Degree of a Vertex, Types of Graphs, Sub-graphs, Isomorphic Graph, Paths, Cycles and Connectivity, Eulerian and Hamiltonian Graph, Shortest Path Problems, Representation of Graph (Adjacency and Incidence Matrices), Planar Graph, Graph Coloring, Networks Flows, Matching. Introduction to Combinatory, Fundamental Principles, Factorial Notations, Permutation and Combinations, Pigeonhole Principle, Binomial Theorem, Multimonial Co-efficient, Recurrence Relations, Generating Functions, Interface between Combinatory and Computer Sciences.

Module 4[10L]:Stocahstic Process

Definition and examples of stochastic process, Poisson processes, Random walk, Markov chain; Discrete time Markov chain: Definition and examples, Classification of states, Stationary probability, Finite Markov chain, Transition probability and transition matrix.

Text Books:

1. Douglas B. West, Introduction to Graph Theory, Prentice Hall India.
2. S. R. K. Iyengar and R. K. Jain, Mahinder Kumar Jain, Numerical Methods for Scientific and Engineering Computation by, New age International.
3. Engineering Mathematics by BS Grewal.

EC13101: Network Analysis and Synthesis

L	T	P	C
3	0	0	3

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.
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.

Module 2
Transients in linear circuits: Initial Conditions - Zero state response - Zero input response - Complete Response – Analysis of RC and RL circuits.

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.

Module 4
Symmetrical Two Port Reactive Filters: Filter fundamentals - Pass and stop bands - Constant - k low pass filter - Constant - k high pass filter.
Synthesis: Positive real functions. Properties of positive real functions. Properties of Hurwitz polynomials. Synthesis of LC, RC and RL networks.

Reference Books:

1. William H. Hayt Jr., Jack E. Kemmerly, Jamie D. Phillips, Steven M. Durbin., “Engineering Circuit Analysis,” 9th ed., McGraw Hill
2. F. F. kuo, “Network analysis and Synthesis,” Wiley international Edition, 2008.
3. Valkenberg V., “Network Analysis,” 3rd Ed., Prentice Hall International Edition, 2007.
4. A. Chakrabarti “Circuit Theory Analysis and Synthesis” Dhanapat Ray & Co.

EC13102: Signals and Systems

L	T	P	C
3	0	0	3

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

Objective:

1. Understand the representation of Signals, classification, 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; 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 time;

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.

Text :

- Oppenheim A.V., Willsky A.S. &Nawab S.H., Signals and Systems, 2nd ed., TMH, 1996.

Reference :

1. B. P. Lathi, Linear Systems and Signals, Oxford University Press, 2004.

- Haykin S. &Veen B.V., Signals & Systems, John Wiley, 1999.
- Taylor F.H., Principles of Signals & Systems, McGraw Hill, 1994.
- M. J. Roberts, "Signals and Systems - Analysis using Transform methods and MATLAB", Tata McGraw Hill Edition, 2003.

- Robert A. Gabel, Richard A. Roberts, "Signals and Linear Systems", John Wiley and Sons (SEA) Private Limited, 1995.

EC13103: Semiconductor Devices

L	T	P	C
3	0	0	3

Goal: To introduce 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, infinite potential well, Heisenberg's uncertainty principle, tunnelling phenomenon, E-k diagram, Electron effective mass, Direct and indirect band gap semiconductors.

Charge carriers in semiconductors, 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, MS contacts: Rectifying and ohmic contacts, current voltage characteristics, Fermi level measurement of carrier concentration, mass action law.

Module 3

Bipolar junction transistor: Fundamentals of BJT operation- saturation, active and cut off characteristics, switching characteristics, minority carrier profiles, Distribution of carrier concentration, Quasi Fermi level, minority carrier concentration.

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, CV characteristics, threshold voltage, MOSFET, Output characteristics, transfer characteristics.

Reference Books:

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. Richard S. Muller and Theodore I. Kamins, Device Electronics for Integrated circuits, John Wiley India, 2003.

EC13104: Probability Theory and Stochastic Process

L	T	P	C
2	1	0	3

Module: 1: Probability

sample space and events; axiomatic definition of probability; Probability on finite sample spaces; Joint and conditional probabilities, independence, total probability; Bayes' rule .

Module: 2: Random variables

Definition of random variables, continuous and discrete random variables, cumulative distribution function (cdf); probability mass function (pmf); probability density functions (pdf); Jointly distributed random variables, conditional and joint density and distribution functions, independence; Bayes' rule for continuous and mixed random variables; Function of random variables, Sum of two independent random variables. Mean, variance, moments; Joint moments, conditional expectation; covariance and correlation; uncorrelated and orthogonal random variables; Central limit theorem and its significance.

Module: 3: Random processes

Random process: realizations, sample paths, discrete and continuous time processes; Probabilistic structure of a random process: mean, autocorrelation and auto-covariance 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. Random process through LTI systems.

Text:

- Peyton Z. Peebles Jr., Probability, Random Variables and Random Signal Principles, 4/e, Tata McGraw-Hill, New Delhi, 2002.

Reference :

1. H. Stark, J. W. Woods, Probability and Random Processes with Applications to Signal Processing, Prentice-Hall, 2003.
2. Alberto Leon-Garcia , Probability, Statistics, and Random Processes for Electrical Engineering, Prentice-Hall, 2008.

EC13105: Data Structure and Algorithm

L	T	P	C
3	0	0	3

Pre-requisites: Pointers and Dynamic Memory Allocation, Structures, Recursion

Module 1: Introduction(7 L)

Concept of Data Structures, Abstract Data Type, Algorithms, Performance Analysis, - Time and Space complexity, Asymptotic Notations, Arrays: one dimensional, multi dimensional, Sparse matrix representation: Elementary operations.

Module 2: Stack, Queue, Linked List (10 L)

Stack: Representation, elementary operations and applications such as infix to postfix, postfix evaluation, parenthesis matching, Queue: Simple queue, circular queue, dequeue, elementary operations and applications, Linked list: Linear, circular and doubly linked list, elementary operations and applications such as polynomial manipulation.

Module 3: Tree, Graph (15 L)

Tree: Binary Tree, Representation, Binary Tree traversal, Threaded Binary Tree: operations, Heap Tree: Max, Min, Binary Search tree: operations, Height Balanced Tree: AVL Tree, Multiway search Tree: B Tree, Huffman Tree and applications of tree. Graph: Representation, Graph traversal: BFS, DFS, Topological sort, Minimum cost spanning tree: Prims, Kruskal, Shortest path: Dijkstra's , Floyd's Warshall.

Module 4: Sorting, Searching, Hashing, File Structure (8 L)

Sorting: Selection sort, bubble sort, quick sort, merge sort, heap sort, radix sort, Searching: linear and binary search, Hashing: hash tables, hash functions, open addressing, File structures: Introduction, File types, file organization, file access methods.

Reference Books:

1. E. Horowitz, S. Sahni and S. Anderson-Freed, Fundamental of data Structure in C, W. H Freen Co.
2. A. V Aho, J. D Ullman and J. E Hopcroft, Data Structures and Algorithms, Addison Wesley.
3. S. Lipschutz, Data Structures, Schaum's Outlines Series, TMH.
4. Aaron M. Tenenbaum, Y. Langsam, Moshe J. Augenstein, Data Structures Using C.

Semester IV

EC14101: Analog Circuits

L	T	P	C
3	0	0	3

Module 1

Basic BJT amplifiers: Biasing schemes - Load line concept - Bias stability - 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

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, cascode 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 , Oscillators – Basic principles of oscillators – Analysis of RC Phase Shift, Wein bridge, Colpitts, Hartley and Crystal oscillators. Astable, monostable and bistablemultivibrators using BJT and negative resistance devices - Voltage and current time base generators - Miller & bootstrap configurations.

Module 4
Power amplifiers - Class A, B, AB, C, D & S power amplifiers - Harmonic distortion – Conversion efficiency and relative performance.

Reference:

1. Boylested&Nashesky , Electronic Devices and Circuit Theory, Prentice Hall of India.
2. Razavi, Behzad. Fundamentals of microelectronics. Wiley, 2008.
3. A S Sedra& K C Smith : `Microelectronic Circuits', Oxford University Press.1998.
4. Jacob Millman& Herbert Taub: Pulse, Digital & Switching Waveforms, TMGH 1995.
5. Millman&Halkias : `Integrated Electronics', MGH. 1996 .
6. V.K.Mehta and Rohit Mehta: Principals of Electronics, S.Chand& Company.

EC14102: Analog Communication

L	T	P	C
3	0	0	3

Prerequisites: Signals & Systems, Probability Theory and Stochastic Process.

MODULE 1

Introduction to Analog Communication: Elements of communication system - Transmitters, Transmission channels, and receivers. Concept of modulation, its requirements.
Amplitude modulation (AM): Time domain representation of AM signal, modulation index, frequency domain (spectral) representations, transmission bandwidth of AM. Generation and detection of AM: SSB, DSB, VSB - applications and comparison. Principle of Super heterodyne receiver.

MODULE 2

Angle Modulation: Frequency Modulation (FM) and Phase Modulation (PM): Time and Frequency domain representations, Spectral representation of FM and PM. Narrow and Wide-band angle modulation. Generation of FM: Basic block diagram representation, Concept of VCO. FM generation: Narrowband FM, Armstrong method, wideband FM, use of VCO. Demodulation of FM using Phase Locked Loop.

MODULE 3

Frequency Division Multiplexing (FDM); Stereo – AM and FM: Basic concepts with block diagrams; Random Signals and Noise in Communication System, Noise in receiving systems- Noise Temperature, Noise figure, Noise in cascaded system.
SNR calculation for AM (SSB & DSB) and FM for additive channel noise.
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.

Text:

1. B.P. Lathi, Z.Ding and H.M. Gupta,Modern Digital And Analog Communication Systems, 4/e, Oxford University Press.

Reference:

1. Simon Haykin, "An Introduction To Analog & Digital Communications", Wiley
2. John G Proakis and M. Salehi, Communication System Engineering, 2/e, Pearson Education.
3. Taub and Schilling , "Principles of Communication Systems", 2nd ed., Mc- Graw Hill

EC14103: Digital Electronics

L	T	P	C
3	0	0	3

Module 1

Signed number, Weighted codes - BCD, Excess-3 code, Gray Code. Logic gates and Boolean Algebra.Boolean function representation and minimization techniques: Standard and canonical representation and minimization of Boolean expressions using Karnaugh map.

Module 2

Combinational Logic Circuits : Half Adder, Full Adder, Half Subtractor, Full Subtractor, Full adder using half adder, BDC Adder. Carry Look ahead, Multipliers. Multiplexer/de- multiplexers, Encoders and Decoders.
Sequential Logic Circuits: Latches, Edge Triggered Flip Flops: SR, D, JK, Master slave JK,. Excitation tables, conversion of Flip Flops. State Diagram, Concept of state machine.

Module 3

Counters: Synchronous and Asynchronous counters, Up/Down Counters, Design of Synchronous counters, Cascaded Counters, Counter Decoding, Counter applications.
Shift registers: Shift register functions, Serial in/serial out shift registers, serial in parallel out/shift registers, Parallel In/ Parallel out shift registers, bidirectional Shift registers, Shift register counters, Shift register Applications. DigitalLogic Families: Parameters of Logic Families. Introduction to logic Families: DTL, RTL, TTL, CMOS.
Analog to Digital & Digital to Analog Converters: Design of various A to D and D to A Converters.

Reference Books:

1. Digital Design by M. Morris Mano
2. Fundamentals of digital circuits by a. Anandkumar
3. Digital Fundamentals by Thomas L. Floyd (Text book)
4. Digital Systems: Principles and Applications by Ronald J Tocci
5. Digital Electronics by S. Salivahanan

EC14104: Electromagnetic Field Theory

L	T	P	C
3	0	0	3

Module 1

Vector Calculus recapitulation, Electrostatics: Coulomb’s law, electric field, Gauss’s law, electric potential, Poisson’s equation, Laplace’s equation, solutions toelectrostatic boundary value problems, electric susceptibility and permittivity, boundary conditions, capacitors.Magnetostatics: Lorentz force, Biot-Savart law, magnetic flux density, Ampere’s law, magneticsusceptibility and permeability, boundary conditions.

Module 2

Maxwell’s equations: Faraday’s law of Electromagnetic induction, Continuity equation and displacement current.Plane waves in lossy and lossless mediums. Energy Conservation and Poynting theorem, Electromagnetic wave propagation in non-conducting medium.

Module 3

Transmission Lines: Parameters, Lumped element model, lossless and distortion less line,Propagation constant, Characteristic Impedance; Standing Waves and VSWR.
Fundamentals of Radiation; Radiated field of a Hertzian dipole; Basic Antenna Parameters.

Text books:

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

Reference:

1.Antennas and Radio Wave Propagation, R. E. Collin, McGraw-Hill.
2. Antenna Theory and Design, C. A. BalanisThird edition, John Wiley &Sons.
3. Jordan and Balmain: Electromagnetic waves and radiating systems, Second Edition-PHI.
4. Introduction to Electrodynamics-David Griffiths, third edition-Prentice-Hall

EC14105: Microprocessor and Microcontroller

L	T	P	C
3	0	0	3

Module 1

Introduction to Microprocessor, Microcontroller, Microcomputer; 8085 Microprocessor Architecture, Pin Description, Bus concept and organization, Multiplexing and Demultiplexing of Buses; Static and Dynamic RAM, ROM, Memory map; Signals and Timings, Classification of Instructions, Instruction Format, Instruction Set, Addressing Modes.

Module 2

Assembly Language Programming and Debugging – Simple Assembly Programming,Directives used in Assembly Language, Counter and Time delay, Stack organization andimplementation, Macros and

Subroutines; Debug and Testing of Assembly Language Programs.Interrupts - Types, Applications and Handling; 8259 Programmable Interrupt Controller.

Module 3

Interfacing with 8085 Microprocessor – Interfacing of Simple input/output devices (Switches, LEDs); 8255 Programmable Peripheral Interface; 8254 Programmable Interval Timer; 8279 Keyboard/Display Controller; 8251 USART; Memory Interfacing. Serial Interface - RS232C and RS422A; Parallel Interface.

Module 4

8051 Microcontroller – Introduction of 8051 family; Block diagram description of AT89C51;Internal Architecture - System Clock and Oscillator Circuits, CPU Registers, SFRs, Memory Map, I/O Ports. Simple program and application development.

Text book(s)

1. Ramesh S. Gaonkar, “Microprocessor Architecture, Programming and Applications with the 8085”, Penram Publishers
2. Aditya P. Mathur, “Introduction to Microprocessors”, Tata McGraw Hill
3. Muhammad Ali Mazidi, D. MacKinlay, “The 8051 Microcontroller & Embedded Systems using Assembly and C”, Pearson Education.

Reference book(s)

1. Douglas V. Hall, “Microprocessors and Interfacing”, Tata McGraw Hill
2. Kenneth J. Ayala, “The 8051 Microcontroller – Architecture, Programming and Applications”, Penram Publishers
3. John Uffenbeck, “Microcomputers and Microprocessors – The 8080, 8085 and Z80 Programming, Interfacing and Troubleshooting”, Tata McGraw Hill, 3 rd Edition

EC14106: Control System Engineering

L	T	P	C
3	0	0	3

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 - bilinear transformation stability analysis after bilinear transformation - Routh- Hurwitz techniques - construction of bode diagrams – phase margin - gain margin – digital redesign of continuous time systems

Reference Books:

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. B. S. Manke, " Linear Control systems" khanna publishers, 11th edition, 2012
4. Kuo B.C., "Digital Control Systems", Second Edition, Oxford University Press, 1992
5. Nagarath I.J. &Gopal M., "Control System Engineering", Wiley Eastern Ltd,1995

Semester V

Subjects

HS15101: Engineering Economics

L	T	P	C
2	0	0	2

Module1: (08 hours)
Introduction to basic economics and Engineering economy- How people make decisions, interact and how the economy works, Relationship among Science, Engineering, Technology and Economic Development, Utility Analysis, Laws of Demand and Supply, Market Equilibrium; Elasticity of demand its measurements and application.

Module 2: (08 hours)
Engineering Production function- Output Elasticity, Homogeneous production function, technological progress, Production Function in the short and long run, difference between firm and industry, Economies of scale, Concepts of Cost and revenue Analysis, Break-Even analysis.

Module 3: (08 hours)
Meaning of Market, Structure of markets: Pricing and Output Determination in Perfect competition, Monopoly, Monopolistic and Oligopoly; Macroeconomic concepts-National Income, Business Cycles, Inflation, Deflation, Stagflation; Monetary and Fiscal Policy.

Module 4: (07 hours)
Performance of Indian economy since 1951-Primary Secondary and Tertiary sectors; Economic reforms and liberalization-Indian's growth post liberalization, India's five year plans, Niti Aayog; International Trade-Foreign Exchange Rate, Balance of Payment.

Text books:
1. Gregory. N. Mankiw, "Principles of Microeconomics", Cengage Learning, 7th Edition, 2013.
2. Rudiger Dornbusch and Stanley Fischer, "Macroeconomics", McGraw-Hill Europe. 11th Edition, 2011.
3. Gregory. N. Mankiw, "Principles of Macroeconomics", Cengage Learning, 6th Edition, 2012.
4. JagdishHanda, "Monetary Economics", Routledge, 2nd Edition.
5. Engineering Production Functions: A Survey; Author(s): Sören Wibe; Source: Economica, New Series, Vol. 51, No. 204 (Nov., 1984), pp. 401-411; Stable URL: https://www.jstor.org/stable/2554225
6. Lipsey and Chrystal, "Economics", Oxford University Press, 13th Edition, 2015.

Reference:
1. Hal R. Varian, "Intermediate Microeconomics : A Modern Approach", Springer (India) Pvt. Ltd. India, 8th Edition, 2010.
2. James M. Henderson and Richard E. Quandt, "Microeconomic Theory: A Mathematical Approach", McGraw-Hill Book Company, 3rd Edition, 1980.

EC 15101: Digital Communication

L	T	P	C
3	0	0	3

Prerequisites: Signals & Systems, Analog Communication.

Course Objectives:

1. Knowledge about digital communication system with emphasis on various source coding technique.
2. To understand the concept of baseband digital signal transmission and its detection in presence of Additive White Gaussian Noise (AWGN).
3. Knowledge about basic digital modulation techniques and their comparison.

Course Outcome:

After successfully completing the course, students will be able to,

1. Model a conventional digital communication system and compare it with analog communication system.
2. Analyse the base band digital signal transmission and relate noise-interferences.
3. Detect the digital signal in presence of AWGN and compute the error probability.
4. Design as well as conduct experiments describe the process, analyse and interpret the results to provide valid conclusions for basic digital modulators and demodulators using software (MATLAB) and hardware components.

MODULE – I:

Introduction to Digital Communication; system block diagram.
Digital transmission of analog signals**:** Sampling,Quantization: uniform – non uniform, companding: μ-law & A-law, PCM, DPCM, Delta modulation, Adaptive delta modulation. Line coding techniques and spectrum.

MODULE – II:

Signal space concepts: Geometric structure of the signal space, vector representation, distance, norm and inner product, orthogonalityand orthonormality, signal constellation, geometric interpretation of signals, likelihood functions, Schwarz Inequality,Gram-Schmidt orthogonalization procedure.
Noise and impairments in digital signal transmission, Inter symbol interference, Pulse Shaping, Nyquist criterion for zero ISI, Eye diagram, Equalizer.
Detection of signals in AWGNOptimum receiving filter-Correlator, Matched filter.
Decision Procedure: Maximum aposteriori probability detector- Maximum likelihood detector, Error probability performance of binary signalling.

MODULE – III:

Digital band pass modulation schemes: ASK, FSK, PSK signal space representation. - Coherent & non-coherent detection – Differential modulation schemes – Power spectra of digitally modulated signals, Probability of error of digital modulation schemes-Performance comparison of digital modulation schemes.
Introduction to: Minimum Shift Keying (MSK), Gaussian Minimum Shift Keying (GMSK), and Quadrature Amplitude Modulation (QAM).

Text Books:

1. B. Sklar and P.K. Ray, Digital Communication: Fundamentals and Applications, Pearson Education.
2. Digital Communications, S. Haykin, Wiley India.

Reference:

1. John G. Proakis, Digital Communications, McGraw Hill, 2001.
2. Principles of Communication Systems, H. Taub and D.L.Schilling, TMH Publishing Co.
3. B.P. Lathi, Modern Digital and Analog Communication, Oxford University Press, 2017.

EC 15102: Linear Integrated Circuit

L	T	P	C
2	1	0	3

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 –555 timer- 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 - all pass filter (first & second orders) realizations. DACs and ADCs (in depth design is not expected)-Digital to analog converters - Binary weighted - R-2R ladder - Accuracy - Resolution - Conversion speed – Offset error - Gain error - - Analog to digital converters. 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.

References:

1. Sergio Franco, 'Design with Operational Amplifiers and Analog Integrated Circuits', McGraw Hill 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 2002.
8. Horenstein M.N., 'Microelectronic Circuits & Devices', PHI, 1995.

EC 15103: Digital Signal Processing

L	T	P	C
3	0	0	3

Prerequisites: EC 13103

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

Module 1

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. 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)

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, 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.

References:

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.

EC 15104: Microwave Engineering

L	T	P	C
3	0	0	3

Prerequisites: Electromagnetic Field Theory

Objective:

The course should enable the students to:

1. Realize propagation of microwaves through waveguides, microstrip lines in various modes.
2. Describe microwave generation using vacuum tubes, diodes.
3. Explain the basic working principle and representation of passive microwave components.
4. Study modern applications of microwaves in various fields.

MODULE – I:

Introduction to Microwaves- Microwave Frequency bands and general applications in various bands.

Microwave Transmission-Concept of Modes; Characteristics of TEM, TE TM and Hybrid Modes; Losses associated with microwave transmission; Coaxial Line; Rectangular Waveguide; Circular waveguide; Stripline; Microstrip Line.

Vacuum tube Microwave devices - Klystron - velocity modulation and bunching, Reflex Klystron, traveling wave tube - slow wave structure, Magnetron, Gunn Source

MODULE – II:
Passive Microwave components: S-matrix formalism, Directional Coupler, Power Divider; Magic Tee, attenuator, resonator; isolator, circulator. Microwave filters based on MMIC
Microwave Active components: IMPATT diodes, TRAPATT diode,Schottky Barrier diodes, PIN diodes, Parametric Amplifier

MODULE – III:
Modern Trends in Microwaves Engineering**:** Medical and civil applications of microwaves, Electromagnetic interference / Electromagnetic Compatibility, Effects of Microwave radiation
Microwave Antennas: Reflector antennas, Printed antennas; Realization of microwave filters using Planar Periodic Structures, Partially Reflective Surfaces, Radome

Text Books:

1. David M. Pozar, "Microwave Engineering", Third Edition, Wiley India.
2. Samuel Liao, “Microwave devices and circuits”, PHI

Reference Books:

1. R.E. Collin, "Foundations for Microwave Engineering", Second edition, IEEE Press.
2. Microwave Engineering, A. Das & S. Das, TMH.

EC15105: Computer Networks

L	T	P	C
3	0	0	3

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) - Bridges and LAN switches.

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: Quality of Service issues in networks.Application layer protocol: DNS, Remote Login protocol, File transfer Protocols, Message Transfer Protocol

References:

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

Semester VI

HS16101: Principles of Management

L	T	P	C
2	0	0	2

Module 1 (6 hours)
Introduction of organisations and management, Concept of Industrial Management, Characteristics of Management, Management as an art – profession, Principles of Management, The evolution of management, Organisational environment, , Decision making- types, conditions and decision making process, Decision Making Aids.

Module 2 (8 hours)
Dimensions of P-O-L-C: Vision & Mission; Strategizing; Goal & Objectives; Organization Design, Culture, Human Resource Management, Understanding Work Teams, Motivation, Leadership and Communication and Interpersonal Skills, foundation of Control.

Module 3 (10 hours)
Introduction to Functional areas of Management: Operations Management, Marketing Management, Financial Management.

Module 4 (6 hours)
Introduction to Entrepreneurship: Starts ups, Prospects & Challenges., Environmental Issues, CSR, Sustainability, The role of statistics for Industrial management: Simple Linear Regression and Correlation-Assumptions and Properties of Least Square Estimator, Its Application by taking industrial data and its interpretations, Statistical Software-Eview to be utilized to solve the industrial problems.

Text books:

1. Koontz, H., and Weihrich, H., Essentials of Management: An International, Innovation and Leadership Perspective, 10th ed., McGraw Hill, 2015.
2. Robbins, SP, Bergman, R, Stagg, I, and Coulter, M, Management 7, Prentice Hall, 7th edition, 2015.
3. Richard I Levin, David S Rubin, Statistical management, 7th Edition, Prentice Hall India, 2011.
4. Kotler, P., Keller, Kevin Lane Keller et al. Marketing Management, 3rd Edition, 2016.
5. Eugene F. Brigham and Michael C. Ehrhardt, Financial Mangement: Theory and Practice, South-Western College Pub; 15th Edition, 2016.

References:

1. Mahadevan, B., Operations Management, Theory and Practice, Pearson Education Asia,
2. A. Aswathapa, Organizational Behaviour, 2010
3. Robert R. Reeder, Briety & Betty H. reeder, Industrial Marketing, Prentice Hall of India Pvt. Ltd, New delhi, 2008

EC16101: Embedded System

L	T	P	C
3	0	0	3

Module 1(10 hours):

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

Module 2 (8 hours):

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

Embedded System Development Environment – IDE, Cross compilation, Simulators/Emulators, Hardware Debugging. Hardware testing methods like Boundary Scan, In Circuit Testing (ICT) etc. Bus architectures like I2C, SPI, AMBA, CAN etc.

Module 3 (12 hours) Operating Systems:

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

Module 4 (12 hours)

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

Reference:

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

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EC 16102: Information Theory & Coding

L	T	P	C
3	0	0	3

Prerequisites: Digital Communication

Course Objectives:

1. Knowledge about source coding concept and design of different source encoder and decoder.
2. To understand the concept of error detection and correction in digital data transmission.
3. Knowledge about the design and analysis of different channel encoder and decoders for digital communication transmitter and receiver respectively.

Course Outcome:

After successfully completing the course, students will be able to,

1. Design and analysis source coder and decoder of digital communication system.
2. Understand the necessity and methodology of error detection and correction in communication engineering.
3. Design and analysis the basic as well as modern channel coders and corresponding decoders for error detection and correction in digital data transmission.
4. Design as well as conduct experiments describe the process, analyse and interpret the results to provide valid conclusions for various source coders and channel coders using software (MATLAB) and hardware components.

MODULE – I

Introduction to source coding, logarithmic Information, mutual Information.Different type of source and source Entropy. Lossless source coding**,** Uniquely decodable codes- Instantaneous codes- Kraft's inequality – Average code word length, Optimal codes- Shannon's Source Coding, Huffman coding, Lempel-Ziv Coding.
Channel Capacity**:** Discrete memory-less channel (DMC) and channel transition probabilities, Shannon's Channel Capacity Theorem for DMC. Different types of channels-BSC, BEC.

MODULE – II:

Introduction to channel coding, block codes, single-parity-check codes, Hamming codes, minimum distance of block codes, hard decision and soft decision decoding.
Linear block codes: Introduction**,** Generator Matrices. The standard array, Parity checks matrices, Error syndromes, Error detection and correction.
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 of cyclic codes.

MODULE – III:

Galois fields, Primitive field elements, Irreducible and primitive polynomials, Minimal polynomials. BCH Codes: Construction, Error Syndromes, Decoding, Error location polynomial, The Peterson-Gorenstein-Zierler decoder, Reed-Solomon codes.
Convolutional codes- Convolutional Encoder, Trellis Representation.Viterbi Decoder for convolutional codes.Puncturing, Interleaving, Turbo encoders and Turbo Decoders.

Text Books:

1. Thomas M. Cover and Joy A. Thomas, "Elements of Information Theory", John Wiley & Sons.
2. Salvatore Gravano, "Introduction to Error Control Codes", Oxford.

References:

i. Shu Lin and Daniel. J. Costello Jr., "Error Control Coding: Fundamentals and applications", 2nd Ed., Prentice Hall Inc.
ii. Ranjan Bose, Information theory, coding and cryptography, TMH.

EC 16103: Analog MOS Integrated Circuits

L	T	P	C
3	0	0	3

Module 1 (8 hours)

Introduction to Analog Design.Basic MOS device physics.MOSFET I-V characteristics.threshold voltage, current, 2nd order effects: Channel length modulation, body biaseffect and short channel effects, MOS switch, MOSFET capacitances, MOS small Signal Model.

Module 2 (10 hours)

Single – stage amplifiers: CS stage with registive load, CS stage with diode-connected load, CS stage with triode load, Cs stage with source degeration. Common Gate stage, Cascode stage.

Module 3 (10 hours)

Differential Amplifier: single-ended and Differential operation. Basic Differtial Pair: qualitative Analysis, quantative Analysis. Common Mode Response. Differential Pair with MOS loads. Gilbert Cell. Passive and active current mirrors.

Module 4 (12 hours)

Frequency Response of Amplifiers.Miller effect, CS, CG, CD, Cascode stage, Differential Pair. Noise: Statistical Characteristics of Noise. Types of Noise.Representation of Noise in circuits. One stage Op-Amps.

References:

1. BehzadRazavi" Design of Analog CMOS Integrated Circuits" McGraw Hill Education.
2. Phillip E. Allen, Douglas R Holberg, South Asia Edition, Oxford University Press.

EC 16104: Fundamentals of Wireless Communication

L	T	P	C
3	0	0	3

Pre-requisites: Probability Theory and Stochastic Process, Electromagnetic Field Theory, Digital Communication.

Course Objective

1. Knowledge about cellular concept and various capacity improvement strategies.
2. Knowledge about mobile radio propagation, to understand its different models and associated effects such as multipath delay spread, fading.
3. To understand the concept fading in wireless channel and knowledge about diversity to overcome this effect.
4. Knowledge of spread spectrum systems and multiple access techniques in wireless radio.

Course Outcome

After the completion of the course, students will be able to,

1. Analyse indoor and outdoor radio propagation models considering multipath phenomena.
2. Understand different types of fading, its effect and remedy by adopting diversity technique.
3. Analyse the wireless cellular system design aspects and technical challenges.
4. Understand the capacity improvement strategies in cellular system, and estimation of call blocking, GOS.
5. Understand spread spectrum modulation techniques, distinguish between different multiple access techniques and design GSM system architecture.

MODULE – I:

Introduction to wireless communication and systems, 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; power delay profile, average and rms delay spread, coherence bandwidth and coherence time, flat and frequency selective fading, slow and fast fading, fading models, average fade duration and level crossing rate.

MODULE –III:

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 - synchronization of spread spectrum systems. Multiple access schemes: FDMA, TDMA, and CDMA.
Diversity techniques for wireless radio systems: time, frequency and space diversity, selection diversity, MRC, RAKE receiver, Interleaving.
Basic architecture of GSM (900 MHz) mobile communication and GSM call set-up process.

Text Books:

1. Rapport Thoedore S., Wireless Communications, Principles and Practice, PHI,
2. Lee W.C.Y., Mobile Cellular Telecommunication, MGH, 2002

Reference:

1. Andrea Goldsmith, Wireless Communications, Cambridge University Press.
2. G. L. Stuber, Principles of mobile communications, 2nd Ed., Springer.
3. Simon Haykin and Michael Moher, Modern Wireless Communication, Pearson education.

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

Effective from Admission year 2017-18 onwards

Department of Electronics & Communication Engineering

National Institute of Technology Sikkim

South Sikkim 737 139

ELECTIVES

Credit: 3

EC1*111: High Speed Semiconductor Devices

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

References:

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. SandipTiwari, 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)

EC1*112: 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-Geheterostructure, 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)

References:

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

EC1*113: Power Electronics

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 McGraw 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 McGraw Hill, 199

EC1*114: Active Network Synthesis

Module 1
Network functions - Frequency and impedance denormalization - Types of filters (filter magnitude specs, phasespecs, 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 - Biquads based on general impedance converter – OTA based (two-integrator loop) filters -Higher order filter realization - Cascade realizations, pole-zero pairing - Fully integrated high-frequency filter realizations - Transconductance filters - Log-domain filters – Switched capacitor filters

References:

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

EC1*115: High Speed Digital Circuits

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

References:

1. William S. Dally & John W. Poulton; Digital Systems Engineering, Cambridge Univ 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

EC1*116: Modeling and Testing of Digital Systems

Module 1
Introduction to HDL based Digital Design: – Basic VHDL terminology – basic language elements – Data objectsand types – Behaviouralmodelling – 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 – Boundaryscanstandards – Built-in-self-test – Test pattern generation – BIST architecture examples.

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

EC1*117: Advanced Memory Architecture

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

EC1*118:Wavelet and their Applications

Module 1
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.
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

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

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.
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

Construction of wavelets:Biorthogonality and biorthogonal basis, Biorthogonal system of wavelets - construction, The Lifting scheme.

References:

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.

EC1*119: Advanced Antenna System

Module 1:

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

Module 2:

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

Module 3:

Monopole and Dipole antennas, linear dipole antenna arrays-Broadside and End-fire Arrays, Binomial Array, Dolph-Tschebyscheff Array, loop antenna. Antenna Synthesis- Schelkunoff polynomial method, Fourier transform method

Helical antenna, Yagi – Uda antenna, parabolic antenna, Frequency independent antennas, Microstrip antenna, Fractal antenna, UWB antenna: antenna parameters and measurement; UWB antenna examples: bowtie, Vivaldi, valentine etc.

RF antennas –Smart Antennas- Principle, types, array design, antenna beamforming, direction-of-arrival algorithms, 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.

EC1*120: Quantum Computation

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.

EC1*121: Communication Switching Systems

Pre-requisite: Digital Communication (EC15101)

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.

EC1*122: Advanced Communication Networks

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.;IPaddress 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 PravinVaraiya, 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.

EC1*123: Opto-electronic Devices and Systems

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, 2^{nd} Ed; Pearson Education, 2002
2. AmnonYariv&PochiYeh– Photonics: Optical Electronics in modern communication, 6^{th} Ed; Oxford Univ. Press, 2006
3. Fundamentals of Photonics : B E Saleh and M C Teich, Wiley-Interscience; 1991

EC1*124: Reliability of Semiconductor Devices

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/

EC1*125: 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 –storagedevicesetc

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

EC1*126: 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

EC1*127: Multirate Systems

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 –Polyphase representation, Errors in the QMF - Aliasing and imaging; Methods of cancelling aliasing error, Amplitude and phase distortions; Prefect reconstruction (PR) QMF bank - PR condition; Design of an alias free QMF bank

Module 3
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 phase distortion, polyphase representation - polyphase matrix. Perfect reconstruction system - Necessary and sufficient condition for perfect reconstruction, FIR PR systems, Factorization of polyphase matrices, Design of PR systems

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

Reference:
1. P. P. Vaidyanathan, Multirate Systems and Filter Banks, Prentice Hall, PTR, 1993.
2. N. J. Fliege, Multirate Digital Signal Processing, John Wiley, 1994.
3. Sanjit K. Mitra, Digital Signal Processing: A Computer based Approach,3rdEdition,McGrawHill, 2001.
4. R. E. Crochiere, L. R. Rabiner, Multirate Digital Signal Processing, Prentice Hall Inc, 1983.
5. Fredric J Harris, Multiratesignal 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

EC1*128: 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

EC1*129: Opto-electronic Communication Systems

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, optical link design using power budget and rise-time budget, nonlinear Schrodinger equation (no derivation).

Introduction to optical line coding and modulation for optical communication.

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.

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 3

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)

Module 4

Introduction to optical networking: SONET and SDH standards. Wavelength Division Multiplexing (WDM) systems.

Text books:

1. Gerd Keiser,‘Optical Fiber Communications’, 4th edition, McGraw-Hill Education, 2010.

Reference books:

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.

EC1*130: Radar Engineering

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

EC1*131: Computational Electromagnetics

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.

EC1*132: Signal Compression

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 – LindeBuzoGray 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, 4th 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.

EC1*133: Advanced Wireless Communication

MODULE – I:
Capacity of AWGN Wireless Channel.Introduction to OFDM; Multicarrier Modulation and Cyclic Prefix; Channel model and SNR performance; OFDM Issues – PAPR; Frequency and Timing Offset Issues.

MODULE – II:
Introduction to MIMO, MIMO Receiver Design: Zero Forcing and MMSE Receiver; MIMO channel decomposition, Optimal Power Allocation strategy; MIMO Spatial Multiplexing – VBLAST; MIMO Diversity – Alamouti Code, OSTBC.

MODULE – III:
Basic Concept of Adhoc Wireless Communication: WLAN, Bluetooth, Zigbee, UWB. Basic concept of cognitive radio.Advanced antennas for wireless communication: UWB antenna, MIMO antenna, Smart Antenna, Antenna for CR.

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. C A Balanis: Antenna Theory, John Wiley, Second Edition, 2003.

EC1*134: 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.

EC1*135: 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

EC1*136: Architecture of Advanced Processors

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

References:

1. John Shen and Mikko H Lipasti, Modern Processor Design: Fundamentals of Superscalar Processors, McGraw Hill Publishers , 2005
2. LylaB.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

EC1*137: Radiation and Propagation

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.

EC1*138: VLSI Design

Module 1 (11 hours)

Introduction MOSFET, threshold voltage, current, Channel length modulation, body biaseffect and short channel effects, MOS switch, MOSFET capacitances, MOSFET models forcalculation-Transistors and Layout, CMOS layout elements, parasitics, wires and vias-designrules-layout design SPICE simulation of MOSFET I-V characteristics and parameterextraction

Module 2 (10 hours)

CMOS inverter, static characteristics, noise margin, effect of process variation, supplyscaling, dynamic characteristics, inverter design for a given VTC and speed, effect of inputrise 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 (13 hours)

Static CMOS design, Complementary CMOS, static properties, propagation delay, Elmoredelay model, power consumption, low power design techniques, logical effort for transistorsizing,ratioed logic, pseudo NMOS inverter, DCVSL, PTL, DPTL & Transmission gatelogic, dynamic CMOS design, speed and power considerations, Domino logic and itsderivatives, C2MOS, SPC registers, NORA CMOS –Course project

Module 4 (8 hours)

Circuit design considerations of Arithmetic circuits, shifter, CMOS memory design – SRAMand DRAM, BiCMOS logic - static and dynamic behaviour -Delay and power consumptioninBiCMOS 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

EC1*139: Silicon on Insulator and Advanced MOSFET based structures

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

References:

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.

EC1*140: Speech Processing

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.

References:

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.

EC1*141: 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.

EC1*142: Ultra Wideband Communication

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, SinanGezici, Ismail Guvenc, "Ultra Wideband Positioning Systems", Cambridge University Press.
3. Ismail Guvenc, SinanGezici, ZaferSahinoglu and Ulas C. Kozat "Reliable Communications for short-range Wireless Systems", Cambridge University Press.

EC1*143: Software Engineering

Module 1

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

EC1*144: Internet of Things

Module 1

Wireless Technologies for IoT: Wireless Ad-hoc network protocols standards- WLAN, Zigbee, Bluetooth, UWB- applications. Bluetooth Low Energy (BLE). Wireless Sensors for IoT- Synchronization and Localization, Reconfigurable Sensor Networks

Module 2

Embedded systems for IoT- Overview, characteristics and architecture, Processor basics and System-On-Chip. Sensor based applications through embedded system - Home control, Building automation, Industrial automation, Medical applications.

Module 3

Characteristics, Architectural overview and Functional blocks of IoT. Physical and Logical Design of IoT. IoT architecture outlines and standards. M2M and IoT Technology Fundamentals and differences, Local and wide area networking, Communication models and APIs.

References:

1. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1 st Edition, Academic Press, 2014.
2. Peter Waher, "Learning Internet of Things", PACKT publishing, Birmingham – Mumbai
3. Bernd Scholz-Reiter, Florian Michahelles, "Architecting the Internet of Things", ISBN 978-3-642-19156-5 e-ISBN 978-3-642-19157-2, Springer
4. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118- 47347-4, Willy Publications

Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on Approach)", 1st Edition, VPT, 2014

EC1*145: EMI and EMC

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 EMIGrounding: 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 incidentplane 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 healthcareenvironment.

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 LineImpedance 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-WillianD.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)

EC1*146: Satellite Communication

Module 1

Introduction to Satellite Communication, Satellite orbits- Geo-stationery and Geo-synchronous satellites, communication subsystems: antennas, attitude and control systems, telemetry, tracking and command, power sub-system, transmitter, transponder and receiver.
Satellite link design- system noise temperature, G/T ratio of Earth station, uplink and downlink budgets, combined C/N ratio for uplink, transponder and downlink. System design examples.

Module 2

Analog and digital communication on satellite links- Modulation schemes, noise considerations, propagation effects- rain attenuation.
Multiple access techniques: Frequency division multiple access, time division multiple access, code division multiple access.

Module 3

VSAT systems- design issues, Global Positioning System (GPS), Low Earth Orbit systems- examples of contemporary satellite systems (Iridium).

Text books:

1. T. Pratt, C. Bostian, J. Allnutt, ‘Satellite Communications’, 2nd edition, Wiley, 2008.

Reference:

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

EC1*147:MEMS/NEMS

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.

EC1*148: Modern Antennas and Applications

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Pre-requisites: Electromagnetic Field Theory, Fundamentals of Wireless Communication, Antenna Theory.

MODULE – I:

Review of antenna radiation mechanism and fundamental antenna parameters. Conventional antennas: Microstrip antenna: Basic characteristics, feeding methods, methods of analysis, design of rectangular and circular patch antennas, application of microstrip antennas. Design, performance study and applications of b**roadband Antennas**, frequency independent antennas, Ultra-wideband antennas.

MODULE – II:

Array antenna design and applications.Design and applications of advanced antennas for wireless communication: Smart Antenna, MIMO antenna, Antenna for cognitive radio, Multiband antennas, Circular polarized antennas, Antennas for 4th and 5thgeneration mobile communication.

MODULE – III:

Antenna performance improvement strategies: Integration of metamaterials, ACM, FSS, Superstrate. Frequency notch generation mechanism: slot, resonator, parasitic load. Antenna miniaturization, Antenna for radar.Wearable antenna, Antennas for Bio-medical applications.IoT antenna.

Reference:

1. C A Balanis: Antenna Theory, John Wiley, Second Edition.
2. F. B. Gross, "Smart Antennas for Wireless Communications", McGraw-Hill.
3. D. Guha, Y. M. M. Antar, “Microstrip and Printed Antennas New Trends, Techniques and Applications,” Wiley.
4. A. Sabban, “Novel Wearable Antennas for Communication and Medical Systems,” CRC Press.
5. H. Kawakami, H. Morishita, M. Takahashi, “Design technique of small antennas in the IoT generation,”Kagakujyohoshuppan Co., Ltd.
6. S. C. Gao, Q. Luo, F. Zhu, “Circularly Polarized Antennas,” Wiley-IEEE Press.

EC1*149: Electronic Measurements and Instrumentation

Sec I - Basic Measurement Techniques: Moving coil, Moving Iron, dynamometer, Wattmeter, Electro-static Instruments.

Sec II - Errors in Measurement: Definition of accuracy, precision speed of response, non-linearity, techniques of linearization, classification of errors. Statistical analysis. Introduction to reliability.

Sec III - AC Bridges: Wheatstone Bridge Principle, Kelvin, Wein, Anderson Desauty and Scherring Bridges, measurement of inductance, capacitance and frequency.

Sec IV - Cathode Ray Oscilloscope: Construction and principle of operation. Sweep and sweep synchronization. Measurement of various parameters by CRO. High frequency and low frequency limitations – sampling and storage oscilloscopes.

Sec V - Frequency domain instruments : Wave analyzer, spectrum analyzer

Sec VI - Digital Instrumentation – DVM, DMM, frequency counter

Sec VII - Transducers and actuators: piezoelectric sensors, LVDT, Measurement of pressure, Temperature and flow

Sec VIII - Special Purpose Instruments: Signal generators, Q-meter

Text Books:

1) Electronic Instrumentation – by Kalsi (2/e) (TMH)

2) Modern Electronic Instrumentation and Measuring Instruments: by Helpic& Cooper – PHI/Pearson Education

Reference:

1) Instrumentation, Measurement and Analysis (2/e) by Nakra& Chowdhury

2) Electrical Measuring Instruments & Measurements – by Golding &Wides

3) A course in Electrical & Electronic Measurement & Instruments – A.K. Sawhany (Dhanpat Rai)

4) Elements & Electronic Instrumentation and Measurement (3/e) – by J. Carr (Pearson) 5) Digital Instrumentation – by Bowens (TMH)

EC1*150: Computer Organization & Architecture

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.

References:

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", McGraw 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

EC1*151: MOS Device Modeling

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, flatbandvoltage,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 high frequencies.

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

References:
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

EC1*152: Microelectronics Technology

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, wafer cleaning, Epitaxy, Clean room and safety requirements

Module 2
Oxidation: Kinetics of Silicon dioxide growth both for thick, thin and ultra thin films, thickness characterization methods, multi dimension oxidation modeling
Diffusion and Ion Implantation.

Module 3
Deposition & Growth**:** Various deposition techniques CVD, PVD, evaporation, sputtering, spin coating, epitaxy, MBE, MOCVD, materials used in cleaning, various cleaning methods, Wet etch, Dry etch, Plasma etching, RIE etching, etch selectivity/selective etching.
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.

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.

EC1*153: Artificial Intelligent

Overview: foundations, scope, problems, and approaches of AI.

Module 1 (10 Hrs.)
Intelligent agents: reactive, deliberative, goal-driven, utility-driven, and learning agents Artificial Intelligence programming techniques. Problem-solving through Search: forward and backward, state-space, blind, heuristic, problem-reduction, A, A*, AO*, minimax, constraint propagation, neural, stochastic, and evolutionary search algorithms, sample applications.

Module 2 (10 Hrs.)
Knowledge Representation and Reasoning: ontologies, foundations of knowledge representation and reasoning, representing and reasoning about objects, relations, events, actions, time, and space; predicate logic, situation calculus, description logics, reasoning with defaults, reasoning about knowledge, sample applications.

Module 3 (15 Hrs.)
Planning: planning as search, partial order planning, construction and use of planning graphs. Representing and Reasoning with Uncertain Knowledge: probability, connection to logic, independence, Bayes rule, bayesian networks, probabilistic inference, sample applications.

Module 4 (5 Hrs.)
Decision-Making: basics of utility theory, decision theory, sequential decision problems, elementary game theory, sample applications.

Texts *:*

1. S. Russell and P. Norvig, Artificial Intelligence: A Modern Approach, 2nd Ed, Prentice Hall, 2003

References *:*

1. E. Rich and K. Knight, Artificial Intelligence, McGraw Hill, 1991.
2. P. H. Winston and B. K. P. Horn, Lisp, 3rd Ed, Addison-Wesley, 1989.
3. P. Norvig, Paradigms of Artificial Intelligence Programming: Case studies in Common Lisp, Morgan Kauffman, 1991.
4. I. Bratko, Prolog Programming for Artificial Intelligence, 3rd Ed, Addison-Wesley, 2001.