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

.

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", 2ndEd., 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.