Department of Electronics Engineering

B. Tech. Electronics and Communication Engineering

SEMESTER – III

Sr. No.	Subject	Code	Credit	Teaching Scheme		
				L	T	P
1.	Mathematics-III	MA 217	04	3	1	0
2.	Analog Circuits	EC 201	04	3	0	2
3.	Signals and Systems	EC 203	04	3	1	0
4.	Data Structures and Algorithms	EC 205	04	3	0	2
5.	Digital Integrated Circuits	EC 207	04	3	0	2
6.	Principles of Communication Systems	EC 209	04	3	0	2
	Total		**24**	**18**	**2**	**8**

SEMESTER – IV

Sr. No.	Subject	Code	Credit	Teaching Scheme		
				L	T	P
1.	Electromagnetic Waves	EC 202	04	3	0	2
2.	Statistical Signal Analysis	EC 204	04	3	1	0
3.	Microprocessor and Microcontrollers	EC 206	04	3	0	2
4.	Linear IC Applications	EC 208	04	3	0	2
5.	Computer Architecture and Organization	EC 210	04	3	0	2
6.	Control Systems	EE 214	03	3	0	0
	Total		**23**	**18**	**1**	**8**

ENGINEERING MATHEMATICS-III

L	T	P	Credit
3	1	0	04

MA 217 **Scheme**

1. **Course Outcomes (COs):**

At the end of the course the students will be able to:

CO1	Describe the convergence and divergence of infinite series.
CO2	Apply a Fourier series for periodic functions in different cases.
CO3	Analyze the Fourier integral and Fourier transform of a function.
CO4	Evaluate the basic properties of matrices, eigenvalue and eigenvectors with applications.
CO5	Develop basic concept of the linear algebra to electronics engineering problems.

2. **Syllabus:**

- **INFINITE SERIES** **(07 Hours)**
  Introduction, Positive term series, Comparison test, Cauchy's root test, D'Alembert's test, Raabe's test, Logarithmic test, Integral test, Gauss's test, Series with arbitrary terms, Rearrangement of terms

- **FOURIER SERIES** **(06 Hours)**
  Definition, Fourier Series with Arbitrary Period, In Particular Periodic Function With Period 2π. Fourier Series of Even and Odd Functions, Half Rang Fourier Series.

- **FOURIER INTEGRAL AND TRANSFORM** **(07 Hours)**
  Fourier Integral Theorem, Fourier Sine and Cosine Integral Complex Form Of Integral, Inversion Formula For Fourier Transforms, Fourier Transform of derivative of a Functions.

- **MATRICES** **(08 Hours)**
  Properties of matrices, Non-singular Matrices, Reduced Row-Echelon form, Systems of linear equations, Solution of system of linear equations,LU Decomposition Method.

- **EIGENVALUES AND EIGENVECTORS** **(07 Hours)**
  Eigen values and eigenvectors, Characteristic polynomials, Minimal polynomials, Diagonalizability, Triangularization, Rational canonical form, Jordon canonical form, Positive Define Matrices, Singular Value Decomposition.

- **VECTOR SPACE AND SUBSPACES** **(07 Hours)**
  Fields, Vector spaces over a field, subspaces, Linear independence and dependence, coordinates, Bases and dimension,Gram-Schmidt orthonormalization, Orthonormal basis, Orthogonal projection.

- **TUTORIALS** **(14 Hours)**

(Total Contact Hours: 56)

3. **Books Recommended:**

1. Malik S.C., and Arora S., "Mathematical Analysis", 5th Ed., Wiley Eastern Ltd., New Age International Publishers, 2017.
2. Kreyszig E., "Advanced Engineering Mathematics", 10th Ed., John Wiley, 2015.

3. Wiely C. R., “Advance Engineering Mathematics”, 6th Ed., McGraw-Hill, 1995.
4. Gilbert Strang, “Introduction to Linear Algebra”, 5th Ed., Wellesley-Cambridge Press, 2016.
5. Kenneth Hoffman and Ray Kunze, “Linear Algebra”, 2nd Ed. PHI publication, 2009.

ANALOG CIRCUITS

L	T	P	Credit
3	0	2	04

EC 201 **Scheme**

1. **Course Outcomes (COs):**

At the end of the course the students will be able to:

CO1	Describe single stage / multistage amplifiers and its frequency response characteristics.
CO2	Apply the concept of current sources / sinks in the differential amplifiers.
CO3	Analyze different amplifiers configurations by deploying negative feedback therein.
CO4	Evaluate the criterion for the stability of analog circuits.
CO5	Design solid state power amplifiers.

2. **Syllabus:**

- **HIGH FREQUENCY AMPLIFIERS** **(10 Hours)**
  Classification of Amplifiers, Distortion in Amplifiers, Frequency Response of An Amplifier, Bode Plots, Step Response of Amplifiers, CE Short Circuit Current Gain, High Frequency Response of a CE Stage, Gain Bandwidth Product, Emitter Follower at High Frequencies, Common Source and Common Drain Amplifier at High Frequencies. Analysis of Multistage Amplifier, Design of Two Stage Amplifier, Frequency Response of Multistage Amplifier, Two Pole Analysis.

- **FEEDBACK AMPLIFIERS** **(12 Hours)**
  Representation of Amplifiers, Feedback Concept, Transfer Gain with Feedback, Characteristics of Negative Feedback Amplifiers. I/O Impedance in Feedback Amplifiers, Analysis of Amplifiers having Voltage Series, Current Series, Current Shunt and Voltage Shunt Feedback, General Analysis of Multistage Feedback Amplifiers, Effect of Negative Feedback on Bandwidth, Frequency Response of Feedback Amplifiers, frequency compensation.
- **POWER AMPLIFIERS** **(08 Hours)**
  Class A, B, AB, and C Power Amplifiers, Transformer Coupled Push–Pull and Complementary Symmetry Push-Pull Amplifier, Heat Sinks, Power Output, Efficiency, Crossover Distortion and Harmonic Distortion, Tuned Amplifiers, High Fidelity Design, Tuned Amplifiers

- **DIFFERENTIAL AMPLIFIERS** **(12 Hours)**
  Differential amplifiers, AC/DC Analysis of Various Differential Amplifiers using BJT/MOSFET, CMRR and I/O Resistances, Output Offset Voltages, Active Load Differential Amplifiers, Current Mirrors using MOSFET, Widlar Current Source, Cascaded Differential Amplifier Stages and Level Translator, Operational Amplifier Design.

(Total Contact Hours: 42)

3. **List of Practicals:**

Practicals are to be performed using breadboard and SPICE Simulators.

1. Study and design a single stage RC coupled amplifier and obtain its high frequency response curve.
2. Study and design a double stage RC coupled amplifier and obtain its high frequency response curve.

3. Study and design a differential amplifier and measure its differential and common mode output voltages.
4. Study and design Voltage Series Feedback amplifier and obtain its frequency response characteristics with and without feedback.
5. Study and design Current Series Feedback amplifier and obtain its frequency response characteristics with and without feedback.
6. Study and design Voltage Shunt Feedback amplifier and obtain its frequency response characteristics with and without feedback.
7. Study & Design Class A Power Amplifier and obtain its efficiency.
8. Study and design Push-Pull Amplifier and obtain its efficiency.
9. Design Current Mirror Circuit using BJT/MOSFET
10. SPICE Simulation for Analog Circuits
11. Mini Project.

4. Books Recommended:

1. Millman Jacob, Halkias Christos C. and Parikh C., "Integrated Electronics", 2nd Ed., McGraw-Hill, 2017.
2. Sedra and Smith, "Microelectronic Circuits", 5th Ed., Oxford University Press, 2005.
3. Md.Gausi, "Electronic circuits", 1st Ed., John Wiley, 2014.
4. A. S. Sedra & K. C. Smith, "Micro Electronic Circuits", 4th Ed., Oxford press, 1998.
5. Boylestad Robert L. and Nashlesky Louis, "Electronics Device & Circuits and Theory", PHI, 10th Ed., 2009.

5. Reference Books:

1. Schilling Donald L. and Belove E., "Electronics Circuits - Discrete and Integrated", 3rd Ed., McGraw-Hill, 1989, Reprint 2008.

SIGNALS AND SYSTEMS

L	T	P	Credit
3	1	0	04

EC 203 **Scheme**

1. Course Outcomes (COs):

At the end of the course the students will be able to:

CO1	Describe Discrete Time Signal, System, Z-Transform and Sampling
CO2	Apply Frequency domain Analysis of Linear Time-Invariant system.
CO3	Analyze Discrete Time Fourier Transform and Discrete Fourier Transform
CO4	Analyze Discrete time system using DFT
CO5	Understand the process of sampling and the effects of under sampling.

2. Syllabus:

- **INTRODUCTION** **(04 Hours)**
  Classification of Signal, Concept of Frequency in Continuous-Time and Discrete-Time Signal.

- **DISCRETE TIME SIGNAL AND SYSTEM** **(07 Hours)**
  Discrete-Time Signals, Discrete Time Systems, Linear Time-Invariant Systems, Properties of LTI Systems, Causal LTI Systems Described by Difference equations, Frequency Domain Representation of Discrete-Time Signals and Systems, Representation of sequences by Fourier Transforms and its properties.

- **Z-TRANSFORM** **(07 Hours)**
  Z-transform, Properties of Region of convergence, Inverse Z-transform, properties of Z-transform.

- **SAMPLING** **(08 Hours)**
  Sampling theorem, Periodic Sampling, Frequency-Domain Representation of Sampling, Reconstruction of a Bandlimited Signals, Discrete-Time Processing of Continuous-Time Signals, Continuous the Sampling Processing of Discrete-Time Processing.

- **FREQUENCY DOMAIN ANALYSIS OF LINEAR TIME-INVARIANT SYSTEMS** **(08 Hours)**
  Frequency Response of LTI Systems, Systems characterized by Linear Constant Coefficient Differential Equations, Frequency Response for Rational systems Functions, Relationship between Magnitude and Phase, Time domain and Frequency domain aspects of ideal and non-ideal filters.

- **DISCRETE TIME FOURIER TRANSFORM (DTFT) and DISCRETE FOURIER TRANSFORM (DFT)** **(08 Hours)**
  Representation of Periodic Sequence: The Discrete Fourier, Properties of the Discrete Fourier Series, Fourier Transform of Periodic Signals, Sampling the Fourier Transform, The Discrete Fourier Transform, Properties of the Discrete Fourier Transform.

- **TUTORIALS** **(14 Hours)**

(Total Contact Hours: 56)

3. Books Recommended:

1. Barry Van Veen Simon Haykin, “Signals and Systems”, 2nd Ed., Wiley, 2007
2. Alan V. Oppenheim, Alan S. Willsky, S. Hamid Nawab, “Signals and Systems Prentice Hall India”, 2nd Ed., Pearson, 2009.
3. B.P. Lathi, “Principles of Linear Systems and Signals”, 2nd Ed., oxford, 22 Jul 2009
4. John G. Proakis, Dimitris G. Manolakis, “Digital Signal Processing, Principles, Algorithms, and Applications”, 4th Ed., PHI, 2007.
5. Robert A. Gable, Richard A. Roberts, “Signals & Linear Systems”, 3rd Ed., John Wiley, 1995.

DATA STRUCTURES AND ALGORITHMS

L	T	P	Credit
3	0	2	04

EC 205 **Scheme**

1. **Course Outcomes (COs):**

At the end of the course the students will be able to:

CO1	Describe the concept of dynamic memory management, data types, algorithms,
CO2	Big-O notation, arrays, linked lists, stacks and queues.
CO3	Apply the hash function and concepts of collision and its resolution methods.
CO4	Analyze problems involving graphs, trees and heaps.
CO5	Evaluate algorithms for solving problems like sorting, searching, insertion and deletion

2. **Syllabus:**

- **INTRODUCTION** **(04 Hours)**
  Algorithms as opposed to programs, Four Fundamental Data Structure, Complexity of Algorithms, Big Oh Notation, Complexity of Mergesort, Role of constant. Big Omega and Big Theta Notions, Time versus space complexity, Worst versus average complexity, Concrete measures for performance, Big-O notation for complexity class, Formal definition of complexity classes.

- **TYPE OF LIST** **(07 Hours)**
  Implementation of Lists, Array Implementation, loops and Iteration Pointer Implementation, Double Linked List Implementation, Stack, Queues, Circular array Implementation, Double linked list, Buddy System Memory Allocation
  SEARCHING ALGORITHMS
  Requirements for searching, Specification of the search problem, A simple algorithm: Linear Search, A more efficient algorithm: Binary Search.

- **DICTIONARIES& HASH TABLES** **(03 Hours)**
  Various Sets of Dictionary, Implantation of Dictionaries, Hash Tables, Closing of Hashing, Analysis of Closed Hashing, Skip Lists, Analysis of Skip Lists.

- **BINARY TREES** **(06 Hours)**
  Definition, Quad trees, Preorder, Inorder, Postorder, Data structures for tree representation, Binary Trees, Binary Trees for Huffman Code construction, Binary Search Tree, Splay Trees, Search, Insert, Delete in Bottom-up Splay, Amortized Algorithm Analysis.

- **BALANCED TREES** **(04 Hours)**
  AVL Trees, Maximum Height of an AVL Tree, Insertions and Deletions, Red-Black Trees, 2-3 Trees, B-Trees, Variants of B-Trees

- **PRIORITY QUEUES AND HEAP TREES** **(04 Hours)**
  Binary Heaps, Creating heap, Implementation of Binary heap, Binomial Queues, Binomial Queue Operations, Binomial Amortized Analysis, Lazy Binomial Queues, Fibonacci heaps, heap time complexity comparison.

- **DIRECTED GRAPHS** **(04 Hours)**
  Data Structures for Graph Representation, Shortest path Problem, Single shortest paths problems, Dynamic programming Algorithms, Warshall's Algorithms, Depth First Search and breadth search, Directed Acyclic Graphs.

- **UNDIRECTED GRAPHS** **(04 Hours)**
  Definitions, Breadth-first search of undirected graphs, Minimum-Cost Spanning, MST Property, Prim's Algorithm, Kruskal's Algorithm, Traveling Salesman Problem using greedy algorithm.

- **SORTING METHODS** **(06 Hours)**
  Bubble Sort, Insertion Sort, Selection Sort, Shellsort, Heap Sort, Quick Sort, Algorithm for Partitioning, Average Case Analysis, Order Statistics, Lower Bound on Complexity for Sorting Methods, Lower Bound on Worst Case Complexity, Lower Bound on Average Case Complexity, Radix Sorting, Merge Sort, Heap Sort and Quicksort.

(Total Contact Hours: 42)

3. List of Practicals:

1. Write a program to perform Insertion and Deletion in an unsorted Array when the number and the positions are given.
2. Write a program to search an element in a sorted array using binary search and search the same element in the same array using linear search.
3. Perform Insertion and Deletion in a Linked List when the number and the positions are given.
4. Given two linked lists List1 = {A1, A2……….,An} and List2 = {B1,B2,……Bm} with data (both lists) in ascending order. Write a program to merge the given lists so that the merged list will be:
   {A1,B1,A2,B2,……..Am,Bm,Am+1,……..An} if n >= m
   {A1,B1,A2,B2,……..An,Bn,Bn+1,……..Bm} if m >= n
5. Write the programs to perform a stack's push, pop, top and isEmpty functions.
6. Write a program to find the height of a binary tree.
7. Write a program to insert and delete an element in a binary search tree.
8. Given a sorted doubly linked list, write a program to convert it into a balanced binary search tree.
9. Write a program to find the shortest path in a weighted graph using the Dijkstra algorithm.
10. Write a program to sort an array using mergesort algorithm.
11. Write a program to implement a separate chaining collision resolution technique.
12. Write the enqueue and deque functions for a queue implemented using a linked list.
13. Write a program to implement heap sort algorithm.
14. Write a program to solve the traveling salesman problem using greedy algorithm.

4. Books Recommended:

1. Narasimha Karumanchi, "Data Structures and Algorithms Made Easy", CareerMonk Publications, 2021.
2. Mark A. Weiss, "Data Structures and Algorithm Analysis in C++", 4th Ed., Published by Pearson (June 13th 2013).
3. Gilles Brassard, "Fundamentals of Algorithms", Pearson Education 2015.
4. E. Horowitz, S. Sahni and S. Rajasekaran, "Computer Algorithms/C++", Second Edition, University Press, 2007.
5. A. V. Aho, J. E. Hopcroft, and J. D. Ullman. Data Structures and Algorithms. Addison-Wesley, Reading, Massachusetts, 1983.
6. Anany Levitin "Introduction to the Design and Analysis of Algorithms" Pearson Education, 2015.

5. Reference Books:

1. Richard F. Gilberg, Behrouz A. Forouzan, “Data Structures – A Pseudocode Approach with C++”, Thomson Brooks / COLE, 1998.

DIGITAL INTEGRATED CIRCUITS

L	T	P	Credit
3	0	2	04

EC 207 **Scheme**

1. **Course Outcomes (COs):**

At the end of the course the students will be able to:

CO1	Recognize the fundamental concepts of devices and various logic families with their comparative analysis
CO2	Explain the operation of MOS transistor and scaling trends in MOSFETs and illustrate various short channel effects.
CO3	Illustrate the various processing techniques of NMOS and CMOS technology.
CO4	Analyze the design of inverter using CMOS logic and estimate the switching parameters therein. Also analyze the power dissipation and CMOS-TTL interfacing.
CO5	Evaluate the performance of different sequential and combinational circuits using CMOS logic.
CO6	Design the sequential and combinational circuits using CMOS with layout and stick diagrams.

2. **Syllabus:**

- **MOS TRANSISTORS** **(08 Hours)**
  Fundamental of MOSFET operation and MOSFET capacitances, MOSFET I-V Characteristics, MOSFET Model, Modeling of MOS Transistor using Spice, Scaling and Small Geometry Effects, Fabrication Process Flow, CMOS N-Well Process and Twin Tub Process.

- **OVERVIEW OF HIGH-SPEED LOGIC FAMILIES** **(08 Hours)**
  BJT Inverter, DC Switching Characteristic, Introduction to TTL, Schottky TTL, and ECL Logic Family, Concept of Noise margin, Fan Out and Propagation Delay, NMOS, PMOS, CMOS, Bi- CMOS Circuits

- **NMOS AND CMOS LOGIC DESIGN** **(12 Hours)**
  Various NMOS Inverters, Determination of VTC, Calculation of VTC Critical Points, CMOS Inverter Technology, VTC, Static Characteristics, Dynamic Behavior, Static and Dynamic Power Dissipation, Power-Delay Product, TTL-CMOS Interfacing.

- **CMOS COMBINATIONAL AND SEQUENTIAL LOGIC CIRCUITS** **(14 Hours)**
  CMOS Logic Circuits, Complex Logic Circuits, Pass transistor and Transmission gate, Behavior of MOS Logic Elements.
  The Bistability Principle, SR Latch Circuit, Clocked Latch and Flip-Flop Circuits, CMOS D-Latch and Edge-Triggered Flip-Flop. Layout Design Rules, Full-Custom Mask Layout Design and Stick Diagrams Antenna effect.

(Total Contact Hours: 42)

3. **List of Practicals:**

1. Introduction to SPICE Circuit Simulator.
2. Realization of MOSFET Characteristics Using Circuit Simulator Characteristics and BSIM Models.

3. Realization of NOR Gate Using RTL Logic. Obtain & Plot its Transfer Characteristics And Determine Noise Margins, Fan-Out and Propagation Delay.
4. Realization of NAND Gate Using TTL Logic. Obtain & Plot Its Transfer Characteristic and Determine Noise margins, Fan-out and Propagation Delay.
5. Implementation of NMOS Inverter, Obtain & Plot Its Transfer Characteristics and Determine Noise margins And Measure Propagation Delay.
6. Implementation of CMOS Inverter. Obtain & Plot Its Transfer Characteristics, Determine Noise Margins and Measure Propagation Delay.
7. Realization Of Inverter Gate Using BiCMOS Logic, Obtain & Plot Its Transfer Characteristics, Determine Noise Margins.
8. Design and Implementation of TTL-CMOS & CMOS-TTL Interfacing.
9. Design and Implementation of Pass transistor and Transmission gate based logic circuits.
10. Design And Implement of JK & SR Flip-Flop using CMOS.
11. Layout of CMOS Inverter and Parasitic Extraction and Obtain VTC of Extracted Net List.

4. <u>Books Recommended:</u>

1. Taub H. and Schilling D., "Digital Integrated Electronics", International Ed., McGraw-Hill, 2008.
2. Sung-Mo Kang and Leblebici Y., "CMOS Digital Integrated Circuits: Analysis and Design", 3rd Ed., Tata McGraw-Hill; 2003.
3. Rabaey Jan, Chandrakasan Anantha Nikolic, "Digital Integrated Circuits: A Design Perspective", 2nd Ed., Pearson Education, 2008.
4. Hodges D. A. and Jackson H. G. "Analysis And Design Of Digital Integrated Circuits", 3rd Ed., McGraw-Hill, 2004.
5. Baker R. J., Li H. W. and Boyce D. E., "CMOS Circuits Design Layout and Simulation", 2nd Ed., PHI 2005.

PRINCIPLES OF COMMUNICATION SYSTEMS

L	T	P	Credit
3	0	2	04

EC 209 **Scheme**

1. Course Outcomes (COs):

At the end of the course the students will be able to:

CO1	Describe the basic principles of communication techniques including important terminology like baseband signals, modulation, bandwidth, noise, system parameters etc.
CO2	Explain about sampling with ADC, signal processing and statistical aspects involved in communication with time and frequency domain fundamentals.
CO3	Implement analog communication systems and digital baseband preparation stage.
CO4	Analyze the performance of various modulation techniques, case study and problem solving as per given parameters.
CO5	Evaluate the various stages of analog communication link, baseband digital and point to point link performance parameters by experimentation using modern tools/simulators and hardware.
CO6	Design various stages of analog communication systemand digital database preparation with optimum parameter selection criteria satisfying performance requirements overcoming noise and interference.

2. Syllabus:

- **ANALYSIS AND TRANSMISSION OF SIGNALS** **(07 Hours)**
  Fourier Series, Fourier Transform Properties and their applications in communication systems, The Exponential Fourier Series, Aperiodic signal representation by Fourier Integral, Transmission of some useful functions, Negative frequency concepts, Signal Transmission Through a Linear System and Convolution concepts, Ideal versus Practical Filter, Channel as a filter, Signal Distortion over a Communication Channel, Signal Energy and Energy Spectral Density, Signal Power and Power spectral Density.

- **AMPLITUDE MODULATION AND DEMODULATION** **(08 Hours)**
  Band-pass Signal Representation Baseband Vs Carrier Communications, DSB-C And DSB-SC Amplitude Modulation, Bandwidth Efficient AM: SSB, Vestigial Sideband (VSB) Transmission, Local Carrier Synchronization, Frequency Division Multiplexing, Phase Looked Loop and Some Applications.

- **ANGLE MODULATION AND DEMODULATION** **(08 Hours)**
  Nonlinear Modulation, Bessel's function, Carson's Rule, Bandwidth of Angle Modulated Waves, NBFM and WBFM, Generating FM Waves, Demodulation of FM Signals, Effects Of Nonlinear Distortion and Interferences, Phase Modulation Concepts.

- **AM/FM TRANSMITTERS AND RECEIVERS** **(06 Hours)**
  AM/FM Transmitter Designs, AM/FM Receiver designs, Super-Heterodyne Principle: RF front end, Local oscillator, Mixer, Intermediate frequency stage, Image Frequency, Automatic Frequency Control, Automatic Gain Control, AM/FM Receivers, FM Broadcasting System. Preemphasis and Deemphasis.

- **NOISE** **(06 Hours)**
  Various Types of Noises: Internal (Shot, Thermal, Agitation, Transit Time) Noise and External (Atmospheric, Extra-Terrestrial, Industrial) Noise, White Noise and Filtered Noise, AWGN Properties, Noise Equivalent Bandwidth Concept, Noise Sampling, Signal To Noise

Ratio.AM and FM systems in presence of noise.

- **PULSE MODULATION TECHNIQUES** **(07 Hours)**
  Sampling and A to D conversion, Quantization techniques—Uniform and Non-uniform, A-law and µ-law, Pulse Code Modulation, Pulse Amplitude Modulation, Pulse Position Modulation, Pulse Width modulation, Digital Telephony Example-T1/E1 carrier system, TDM, DPCM and ADPCM, Delta Modulation.

(Total Contact Hours: 42)

3. List of Practicals:

1. Study of the Spectrum Analyzer.
2. Study of Various Signals and their Spectrum Using MATLAB.
3. DSB-SC And DSB-C AM Transmitter and Receiver with Tone and Voice Input.
4. FM Transmission and Reception Techniques.
5. Frequency Division Multiplexing Techniques.
6. Simulation of AM and FM transceiver models.
7. AM and FM Simulation on MATLAB with AWGN Channel and Concept of SNR.
8. Study of various Pulse Modulation Techniques
9. Sampling and Pulse Code modulation Technique and ADCPM Technique.
10. Delta modulation and demodulation

4. Books Recommended:

1. Lathi B. P., and Ding Zhi, "Modern Digital and Analog Communication Systems", 4th Ed., Oxford University Press 2010/ 5th Ed., 2018.
2. Proakis J. and Salehi M., "Fundamental of Communication Systems", 1st Ed., PHI/Pearson Education-LPE, 2006.
3. Carlson Bruce A., Paul B Crilly "Communication Systems- An Introduction to Signal and Noise in Electrical Communication", 5th Ed., McGraw-Hill, 2011.
4. Leon W. Couch, II "Digital and Analog Communication Systems", 8th Ed., Pearson Education-LPE, 2013.
5. Taub Herbert, Donald Schilling, Goutam Saha "Principal of Communication Systems", 4th Ed., Tata McGraw-Hill, 2013.

ELECTROMAGNETIC WAVES

L	T	P	Credit
3	0	2	04

EC 202 **Scheme**

1. Course Outcomes (COs):

At the end of the course the students will be able to:

CO1	Describe the basic concepts and theorems of electromagnetic theory and its applications.
CO2	Explain the wave propagation and radiation phenomenon in different environments
CO3	Apply the principles of electromagnetic theory and wave propagation to model transmission line and radiating systems.
CO4	Analyze the theoretical concepts based on Maxwell's equation, transmission line theory and antennas.
CO5	Evaluate the wave propagation behavior between two mediums.
CO6	Formulate the aspects of electromagnetic theory for different application.

2. Syllabus:

- **ELECTROMAGNETIC THEOREM and MAXWELL'S EQUATIONS (08 Hours)**
  Divergence and Stoke's Theorem, Coulomb's law, Gauss's law and Applications, Electric Potential, Poisson's and Laplace Equations, Biot-Savart's law, Faraday's law and Ampere's Work law in the Differential Vector form , Flux rule for Motional EMF, Magnetic Vector Potential, Introduction to The Equation of Continuity For Time Varying Fields, Inconsistency of Ampere's Law, Maxwell's Equation, Condition at a Boundary Surface, Poynting Theorem.

- **ELECTROMAGNETIC WAVES (06 Hours)**
  Solution for Free Space Conditions, Uniform Plane Waves and Propagation, The Wave Equations for a Conducting Medium, Sinusoidal Time Variations, Conductors and Dielectrics, Polarization, Reflection by a Perfect Conductor: Normal Incidence and Oblique Incidence, Reflection by a Perfect Dielectric: Normal Incidence and Oblique Incidence, Reflection at the Surface of a Conductive Medium.

- **RADIATION (11 Hours)**
  Potential functions and the Electromagnetic field, Oscillating Electric Dipole derivations for E and H field components in spherical coordinate systems, Power Radiated by a Current Element, Application to Antennas, Radiation from Quarter wave Monopole and Half wave Dipoles, Derivation for Radiation Resistance, Application of Reciprocity Theorem to Antennas, Equality of Directional Patterns and Effective Lengths of Transmitting and Receiving Antennas, Directional Properties of Dipole Antennas, Antenna Feeding Methods, Antenna Parameters and Definitions, Radiation from Wire Antenna.

- **TRANSMISSION LINE ANALYSIS (11 Hours)**
  Transmission Line Equations, Voltage and Current Waves, Solutions for Different Terminations, Transmission-line Loading, Impedance Transformation and Matching, Smith Chart, Quarter-wave and Half-wave Transformers, The Multiple Reflection Viewpoint, Binomial and Tchebeyshev Transformers, Single and Double Stub Matching, Introduction to Microstrip lines, Slot lines and Coplanar lines.

- **GROUNDWAVE PROPAGATION (03 Hours)**
  Plane Earth Reflection, Spherical Earth Propagation, Tropospheric Waves.

- **IONOSPHERIC PROPAGATION** **(03 Hours)**
  The Ionosphere, Reflection and Refraction Waves by the Ionosphere, Regular and Irregular Variations of the Ionosphere.

(Total Contact Hours: 42)

3. List of Practicals:

1. To obtain Radiation Pattern of Dipole Antenna in two planes.
2. To observe Current Distribution on Dipole Antenna.
3. To obtain radiation Pattern of Yagi-Uda Antenna in two planes.
4. Measurement of Dielectric Constant using Solid Dielectric Cell
5. To determine the Standing Wave-Ratio and Reflection Coefficient for different loads
6. To measure an unknown impedance of the given load using Smith chart
7. Phase shift measurement of the given DUT
8. To do gain measurement of different antennas.
9. To realize impedance matching using single and double stub
10. Return loss measurement of given DUT
11. Insertion loss measurement of given DUT
12. To simulate Dipole antenna / Microstip Patch Antena in HFSS
13. To simulate waveguide based components in HFSS.

4. Books Recommended:

1. E.C. Jordan & G. Balmain, “Electromagnetic Waves and Radiating Systems”, 2nd Ed., PHI, Reprint 2011.
2. R. K. Shevgaonkar, “Electromagnetic Waves”, 1st Ed., Tata McGraw Hill, 2006.
3. M.N.O. Sadiku, “Principles of Electromagnetics”, 4th Ed., Oxford University Press, 2011.
4. W.H. Hayt, “Engineering Electromagnetics”, 7th Ed., McGraw Hill, 2006.
5. Roger F. Harrington, “Time-Harmonic Electromagnetic Fields”, Wiley-IEEE Press, 2001.

STATISTICAL SIGNAL ANALYSIS

L	T	P	Credit
3	1	0	04

EC 204 **Scheme**

1. Course Outcomes (COs):

At the end of the course the students will be able to:

CO1	Describe probability, random variable and random process and parameters related to them.
CO2	Classify different types of random variables and random processes.
CO3	Analyze random variables and random processes using knowledge of pdfs, cdfs, autocorrelation functions, power spectral density, etc.and LTI systems with random inputs.
CO4	Evaluate moments & characteristic functions and understand the concept of inequalities and probabilistic limits.
CO5	Design problems based on probability, random variables and random processes.

2. Syllabus:

- **COMBINATORIAL ANALYSIS** **(03 Hours)**
  Introduction, The Basic Principle of Counting, Permutations, Combinations, Multinomial Coefficients, The Number of Integer solutions of Equations

- **PROBABILITY THEORY** **(04 Hours)**
  Scope and History, Probability as Frequency of Occurrence, Set, Fields, Sample Space and Events, Axiomatic Definition of Probability, Mutually Exclusive Events, Joint Probability, Conditional Probability and Statistical Independence, Bays Theorem.

- **RANDOM VARIABLES** **(10 Hours)**
  Continuous and Discrete Random Variables, Cumulative Distribution Function (CDF), Probability Density Function (PDF), Properties of CDF and PDF, Some Special PDFs: Uniform, Gaussian, Rayleigh, Chi-Square, Binomial, Poisson, Transformations of Random Variables, PDF of Transformed Random Variable, Mean and Variance, Chebyshev's Inequality, Moments, Characteristic Functions, Simulation Techniques in MATLAB

- **MULTIPLE RANDOM VARIABLES** **(10 Hours)**
  Bivariate Distributions, One Function to Two Random Variables, Two Function to Two Random Variables, Joint Moments, Multivariate Expectations, Mean And Variance of The Sum of Random Variables, Multivariate Gaussian Distribution, Conditional Distributions, Conditional Expected Values, Correlation Between Random Variables, Law of Large Numbers, Central Limit Theorem and its Significance, Simulation Techniques in MATLAB

- **STOCHASTIC PROCESS** **(07 Hours)**
  Definitions, Statistics of Stochastic Process, Mean, Autocorrelation, Auto covariance, Stationary Processes: Strict Sense Stationary and Wide Sense Stationary, Power Spectral Density, Joint Statistical Averages of Two Random Processes, Cross Correlation and Cross Covariance, Ergodicity, Ergodic Processes, Simulation Techniques in MATLAB

- **SOME SPECIAL PROCESSES** **(04 Hours)**
  Gaussian Processes, Poisson Processes, The Markov Processes With Examples.

- **RANDOM PROCESSES IN LINEAR SYSTEMS** **(04 Hours)**
  Transmission of a Random Process Through LTI System, Stationarity of the Output, Autocorrelation and Power Spectral Density of the Output, Examples with White Noise as the Input, Linear Shift Invariant Discrete Time System with a WSS Sequence as Input

- **TUTORIALS** **(14 Hours)**

(Total Contact Hours: 56)

3. <u>Books Recommended:</u>

1. Papoulis A., S. Unnikrishna Pillai, "Probability, Random Variables and Stochastic Processes", 4th Ed., McGraw-Hill, 2006.
2. Alberto Leon-Garcia, "Probability, Statistics, and Random Processes for Electrical Engineering", 3rd Ed., Pearson, 2007.
3. Steven Kay, "Intuitive Probability and Random Processes using MATLAB", 1st Ed., Springer, 2006.
4. Sheldon Ross, "A First Course in Probability", 9th Ed., Pearson, 2012.
5. Montgomery and Ruger, "Applied Statistics and Probability for Engineers", 1st Ed., John Wiley, 2006.

MICROPROCESSOR AND MICROCONTROLLERS

L	T	P	Credit
3	0	2	04

EC 206 **Scheme**

1. **Course Outcomes (COs):**

At the end of the course the students will be able to:

CO1	Classified microprocessor and microcrontoller with RISC & CISC architectures.
CO2	Describe 8-bit/16-bit microcontroller.
CO3	Analyze merits of ARM controllers along with architectural features and instructions of ARM Cortex-M microcontroller.
CO4	Elevate the knowledge gained for Programming ARM Cortex M for different applications.
CO5	Design embedded system with various peripheral interfacing.

2. **Syllabus:**

- **INTRODUCTION TO MICROPROCESSORS AND MICROCONTROLLER** **(06 Hours)**
  Microprocessor architectures basics, 8085 as Von Neumann CISC CPU. Bus system and its operation. Memory and peripheral interfacing. Advanced Microprocessors, Von Neumann vs Harvard, CISC vs RISC architecture, Overview and features of 8051 microcontroller, Overview of the various commercially available 8-bit/16-bit Microcontrollers

- **ARM 32-BIT MICROCONTROLLER** **(10 Hours)**
  Architecture of ARM Cortex M0+, Various Units in the architecture, Thumb-2 technology, Debugging support, General Purpose Registers, Special Registers, exceptions, interrupts, stack operation, reset sequence. Other Cortex series processors

- **ARM CORTEX M0+ INSTRUCTION SETS AND PROGRAMMING** **(12 Hours)**
  Arm & Thumb Instruction Set: Data Processing Instruction, Branch Instruction, Load Store Instruction, Special instructions, Bit-band operations and CMSIS, Assembly and C Language Programming.

- **EMBEDDED SYSTEM COMPONENTS** **(14 Hours)**
  Embedded Vs General computing system, Classification of Embedded systems, Major applications and purpose of ES. Core of an Embedded System including all types of processor/controller, Peripheral interfacing such as timers, ADC, DAC, Sensors, Actuators, LED/LCD display, Push button switches, Communication Interface standards (onboard and external), Embedded firmware, Other system components, RTOS based embedded system.

(Total Contact Hours: 42)

3. **List of Practicals:**

(The practical set is based on ARM Cortex-M Kit)

1. Introduce Keil ARM – MDK development flow
2. Write an program to flash simple LEDs (D0, D1, ..., D7) connected to Ports in various patterns
3. Write code to show up/down BCD count on Multiplexed 7-segment LED display updated every second. Use two keys (up & down) to change direction of counting.
4. Write a program to display “Welcome to SVNIT” as welcome message on LCD interface.
5. Interface 4x4 keypad and pressed display key on LCD

6. Establish full duplex ASCII communication between kit and PC using UART
7. Generate Sine wave/Triangle/Square wave using SPI based DAC and observe on CRO. Increase or Decrease frequency using Keys in decades.
8. Using the internal PWM module of ARM controller generate PWM and vary its duty cycle
9. Interface DC and stepper motor and demonstrate its operation
10. Demonstrate the use of an external interrupt to toggle an LED ON/OFF
11. Display digital output for given analog input using internal ADC

4. <u>Books Recommended:</u>

1. Joseph Yiu, "The Definitive Guide to the ARM Cortex-M0/M0+ processors, 2nd Ed., Newnes, (Elsevier), 2015.
2. A.N.Sloss, D.Symes and C. Wright, "ARM System Developer's Guide: Designing and Optimizing System Software", Elsevier, 2004.
3. ARM Cortex M0 Technical Reference Manual. Available at:http://infocenter.arm.com/help/topic/com.arm.doc.ddi0432c/DDI0432C_cortex_m0_r0p0_trm.pdf
4. Gaonkar R. S., "Microprocessor Architecture, Programming and Applications with 8085", 5th Ed., Penram International, Indian, 2002.
5. Ram B., "Fundamental of Microprocessor & Microcomputers", 6th Ed., Dhanpat Rai Publications, 2003.

5. <u>Reference Book:</u>

1. Shibu K V, "Introduction to Embedded Systems", 2nd Ed., Tata McGraw Hill, 2009

LINEAR IC APPLICATIONS

L	T	P	Credit
3	0	2	04

EC 208 **Scheme**

1. **Course Outcomes (COs):**

At the end of the course the students will be able to:

CO1	Describe an op-amp fundamentals and its specifications.
CO2	Analyze and design active filters and oscillators using op-amp and functional ICs.
CO3	Classify the working principle of data converters and selecting appropriate D/A and A/D converters for signal processing applications.
CO4	Compare the working of multi vibrators using special application IC 555 and general-purpose op-amp.
CO5	Design the linear and nonlinear applications of an op-amp using IC 741.

2. **Syllabus:**

- **OPERATIONAL AMPLIFIER FUNDAMENTALS** **(06 Hours)**
Operational Amplifier, Basic Op-Amp Configuration, An Op-Amp with Negative Feedback, Voltage Series and Voltage Shunt Configurations, Difference Amplifiers, Instrumentation Amplifier, Specification of an Op-Amp, Offset Voltages and Currents, CMRR, Slew Rate, PSRR, Input Bias and Offset Currents, Frequency Response, GBW Product, Compensated Op-amp and Non-Compensated Op-Amp.

- **GENERAL LINEAR APPLICATIONS** **(06 Hours)**
Summing, Scaling and Averaging Amplifiers, Concept of Negative Resistance, Voltage to Current Converter with Floating and Grounded Load, Current to Voltage Converter, Integrator and Differentiator, Gyrator, Frequency dependent negative resistance circuit.

- **ACTIVE FILTERS AND OSCILLATORS** **(12 Hours)**
First Order Active Filters, Second-Order Active Filters, Multiple Feedback Filters (Band Pass and Band Reject Filters), All Pass Filter, Cascade design of filters, Magnitude and Frequency scaling concept, Oscillators, Phase Shift and Wien Bridge Oscillators, Square, Triangular and Saw Tooth Wave Generators.

- **NON-LINEAR CIRCUITS** **(05 Hours)**
Schmitt Trigger, Voltage Comparator, Voltage Limiters and Window Detector, Concept of Clippers and Clampers Circuit using passive component, Clippers and Clampers using OpAmp, Peak Detector, Precision Rectifiers, Analog Switches.

- **MULTI-VIBRATOR CIRCUIT** **(05 Hours)**
Concept of Multi-vibrator Circuit using passive component, the 555 Timer, Astable Mode operation, Monostable Mode operations, Applications of 555 Timer Circuit.

- **D/A AND A/D CONVERTERS** **(08 Hours)**
Introduction, D/A Converters, Performance Parameters of D/A Converter, Basic D/A Conversion Techniques, Sources of Errors in D/A Converters, D/A Converter IC, A/D Converters, Performance parameters of A/D Converter, Counter Type A/D converter, Successive approximation Conversion, Flash A/D, Single and Dual Slope A/D, A/D Converter IC.

(Total Contact Hours: 42)

3. <u>List of Practicals:</u>

1. Design and implement Zero Crossing Detector, Positive Level Detector and Negative Level Detector or inverting and non-inverting configuration using IC 741.
2. To study the effect of Loading and input impedance for Inverting and Non-inverting negative feedback amplifier using IC 741.
3. Design and implement Inverting and Non-inverting negative feedback amplifier for given gain using IC 741. Also analyze the frequency response.
4. Design and implement Summing, Averaging and Scaling amplifier. Also implement 4 input Subtractor using IC 741.
5. Design and implement Practical Integrator for given cut-off frequency using IC 741. Also analyze the frequency response.
6. Design and implement Practical Differentiator for given cut-off frequency using IC 741. Also analyze the frequency response.
7. Design and implement 1st and 2nd order Low-pass filter for given cut-off frequency using IC 741. Also analyze the frequency response.
8. Design and implement 1st and 2nd order High-pass filter for given cut-off frequency using IC 741. Also analyze the frequency response.
9. Design and implement Notch filter for given notch frequency using IC 741. Also analyze the frequency response.
10. Design and implement All pass filter for given phase difference using IC 741.
11. Design and implement RC Phase shift and Wein bridge oscillator using IC 741.
12. Design and implement Square wave Generator using IC 741.
13. Design and implement Monostable and Astable Multivibrator using 555 timer.
14. Design and implement Voltage Regulator using IC 7805. Also perform Load and Line Regulation.

4. <u>Books Recommended:</u>

1. Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", 4th Ed., McGraw- Hill, Published: May 11, 2016.
2. Coughlin and Driscol, "Op-Amps And Linear Integrated Circuits", 6th Ed., PHI, 2003
3. GayakwadRamakant, "Op-Amps and Linear Integrated Circuits", 4th Ed., PHI, 2003.
4. Salivahanan S., "Linear Integrated Circuits", 4th Reprint, McGraw-Hill, 2010.
5. Roy Choudary D. and Shail B. Jain, Linear Integrated circuits, 4th Ed., New Age International Publishers, 2010.

5. <u>Reference Book:</u>

1. William D. Stanley, “Operational Amplifiers with Linear Integrated Circuits”, 4th Ed., Old Dominion University, Pearson Education, 2002.

COMPUTER ARCHITECTURE AND ORGANIZATION

L	T	P	Credit
3	0	2	04

EC 210 **Scheme**

1. **Course Outcomes (COs):**

At the end of the course the students will be able to:

CO1	Identify the functional architecture of computing systems.
CO2	Estimate the performance of various classes of machines, memories, pipelined architectures etc.
CO3	Compare CPU implementations, I/O methods etc.
CO4	Analyze fast methods of ALU and FP unit implementations.
CO5	Design an instruction encoding scheme for an ISA and Build large memories using small memories for better performance.

2. **Syllabus:**

- **DESIGN OF INSTRUCTION SET ARCHITECTURE (ISA) (12 Hours)**
Various Addressing Modes and Designing of an Instruction Set, Concepts of Subroutine and Subroutine call and return, Introduction to CPU design, Instruction Interpretation and Execution, the instruction set of a modern RISC processor, including how constructs in high-level languages are realized;

- **PROCESSING UNIT (10 Hours)**
The representation of both fixed- and floating-point numbers, together with hardware algorithms for fixed-point arithmetic operations; Basic processor organization, Data path in a CPU, Instruction cycle, Organization of a control unit - Operations of a control unit, Hardwired control unit, Micro programmed control unit.

- **MEMORY SUBSYSTEMS (10 Hours)**
Memory Hierarchy; Cache memory design, Virtual Memory, A Real-World Example of Memory Management, DMA Controller, Overview of SRAM and DRAM Design; Memory bus between CPU and DDR3/DDR4 based SDRAM, Memory controller for DDR3/DDR4.

- **BUSES AND PROTOCOLS (10 Hours)**
Introduction to Input/output Processing, Programmed Controlled I/O transfer, Interrupt Controlled I/O transfer, Introduction to serial and parallel Bus systems, Popular bus architecture standard such as IDE, SCSI, ATA, SATA, USB and IEEE 1394, Network component and protocols such as Ethernet and CAN.

(Total Contact Hours: 42)

3. **List of Practicals:**

1. Verilog implementation of Instruction Decoder
2. Verilog implementation of Datapath with FSM
3. Verilog implementation of Control Unit-Hardwired Control
4. Verilog implementation of Control Unit-Microprogrammed Control
5. Verilog implementation of Wallace Tree Adder
6. Verilog implementation of Booth’s Multiplier
7. Verilog implementation of Division Unit

8. ALU Design using existing blocks
9. Implementation of Direct Mapped Cache Memory Design
10. Implementation of Associate Way Cache design
11. Overall CPU Design

4. Books Recommended:

1. David. A. Patterson and John L. Hennessy, “Computer Organization and Design: The Hardware/Software Interface”, 5th Ed., Morgan-Kaufmann Publishers Inc. 2014
2. Linda Null and Julia Lobur, “The Essentials of Computer Organization and Architecture”, 4th Ed., Jones & Bartlett Learning, 2014
3. Alan Clements, “Principles of Computer Hardware”, 4th Ed., Oxford University Press, 2006
4. Stephen Brown and Zvonko Vranesic, “Fundamentals of Digital Logic with Verilog Design”, McGraw-Hill, 2003
5. M. Morris Mano, “Digital Design”, 3rd Ed., Prentice Hall, Upper-Saddle River, New Jersey, 2002

CONTROL SYSTEMS

L	T	P	Credit
3	0	0	03

EC 214 **Scheme**

1. **Course Outcomes (COs):**

At the end of the course the students will be able to:

CO1	Describe various types of control systems and to impart knowledge of mathematical modelling of physical systems.
CO2	Explain the response of various control systems in the time domain.
CO3	Demonstrate the stability of control systems using a variety of methods.
CO4	Analyze the response and stability of control systems using frequency domain techniques.
CO5	Evaluate various control schemes for linear systems.
CO6	Design of PD,PI, PID controllers.

2. **Syllabus:**

- **INTRODUCTION TO CONTROL SYSTEMS** **(02 Hours)**
  Open loop control and close loop control; illustrative examples of control systems.

- **MATHEMATICAL MODELS OF PHYSICAL SYSTEMS** **(10 Hours)**
  Linear and non-linear systems; equations and transfer functions for linear mechanical translational systems and linear electrical network; Force-Voltage and Force-Current analogy; Block diagram representation of control systems; Block diagram reduction; Transfer functions of armature-controlled and field-controlled DC servomotors and 2-phase AC servomotors; Signal flow graph and Mason’s gain formula.

- **TIME DOMAIN ANALYSIS OF CONTROL SYSTEMS** **(06 Hours)**
  Typical test signals; Response of first-order systems; Transient response of a second order system due to step input; Time domain specifications of a second order system; Impulse and ramp response of second order system; Steady-state errors; Static error coefficients; Error series and dynamic error coefficients.

- **CONCEPTS OF STABILITY** **(08 Hours)**
  Introduction to stability, definition through impulse response function, asymptotic stability and relative stability, Routh-Hurwitz stability criterion. Basic Properties of Root Loci, Construction of Root Loci, Effects of Adding Poles and Zeros.

- **FREQUENCY DOMAIN ANALYSIS OF CONTROL SYSTEMS** **(08 Hours)**
  Steady state response of a system due to sinusoidal input; Frequency response; Logarithmic plots or Bode diagrams; Log-magnitude versus phase plots; Resonant peak and resonant frequency of a second order system; Polar plots; conformal mapping, principal of argument, Nyquist stability criterion, Stability analysis; Relative stability; Gain margin and phase margin; Closed loop frequency response.

- **DESIGN OF CONTROL SYSTEMS** **(08 Hours)**
  Introduction to phase lag, phase lead and phase lag-lead networks and their applications. P, PI, PID Controllers.

(Total Contact Hours: 42)

3. **Books Recommended:**

1. I.J. Nagrath, M. Gopal, "Control system engineering", New Age International Publishers, 3rd Ed., 2001.
2. K. Ogata, "Modern control system engineering", Pearson Education Asia, 4th Ed., 2002.
3. B.C. Kuo, "Automatic control system", Prentice Hall of India, 7th Ed., 1995
4. R.C. Dorf, R.H. Bishop, "Modern control system", Pearson Education Asia. 8th Ed., 2004.
5. N. S. Nice, "Control System Engineering", John willey& sons, 4th Ed., 2004.

4. **Reference Book:**

1. K. Dutton, S. Thompson, B. Barralough, "The Art of Control Engineering", Prentice Hall, 1997.