Scheme of Instruction, Evaluation

and

Syllabi of

B.E. (ELECTRONICS AND COMMUNICATION ENGINEERING)

(III and IV semester)

With effect from Academic Year 2023-24

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

UNIVERSITY COLLEGE OF ENGINEERING

(Autonomous)

Osmania University

Hyderabad – 500 007, TS, INDIA

Estd.1917

Estd.1929

SCHEME OF INSTRUCTION AND EVALUATION
B. E (ELECTRONICS AND COMMUNICATION ENGINEERING)
SEMESTER-III

(With effect from AY: 2023-24)

SNo	Code	Course Title	Scheme of Instruction			Contact Hrs/Wk	Scheme of Evaluation			Credits
			L	T	P		Hrs	CIE	SEE	
Theory										
1	**BS903MT**	Engineering Mathematics –III (PDE and Numerical Methods)	3	-	-	3	3	40	60	3
2	**PC301EC**	Analog Electronics -I	3	-	-	3	3	40	60	3
3	**PC302EC**	Signal Analysis and Transform Techniques	3	-	-	3	3	40	60	3
4	**PC303EC**	Switching Theory and Logic Design	3	-	-	3	3	40	60	3
5	**PC304EC**	Pulse and Digital Circuits	3	-	-	3	3	40	60	3
6	**PC305EC**	Network Analysis and Synthesis	3	-	-	3	3	40	60	3
Practicals										
7	**PC351EC**	Electronic Devices Lab	-	-	2	2	3	25	50	1
8	**PC352EC**	Pulse and Digital Circuits Lab	-	-	2	2	3	25	50	1
9	**PC353EC**	Network Analysis & Synthesis Lab	-	-	2	2	3	25	50	1
		Total	**18**	**-**	**6**	**24**	**27**	**315**	**510**	**21**

BS 903 MT	ENGINEERING MATHEMATICS–III (PDE & Numerical Methods)					
Pre-requisites	Mathematics courses of first year of study (M-I and M-II)		**L**	**T**	**P**	**C**
			3	-	-	3
Evaluation	**SEE**	60 Marks	**CIE**		40 Marks	

Course Objectives:	
The course is taught with the objectives of enabling the student to:	
1	Apply general methodology to solve linear first order and second order partial differential equations
2	To study the classification of second order partial differential equations and solve them by using separation of variables methods
3	To introduce a few numerical methods to solve nonlinear algebraic and transcendental equations and system of linear equations
4	To provide the necessary basic concepts of numerical differentiation, numerical integration
5	To solve the Initial Volume Problems

Course Outcomes:	
On completion of this course, the student will be able to:	
CO-1	Find the solutions of first and second order PDE
CO-2	Find solutions of the heat equation, wave equation, and the Laplace equation subject to boundary conditions.
CO-3	Solve nonlinear equations, system of linear equations.
CO-4	Find Numerical Integration
CO-5	Perform numerical differentiation.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	1	1	-	-	1	-	-	2	-	-
CO2	3	2	1	2	2	2	-	-	1	-	-	2	-	-
CO 3	3	2	2	3	2	2	-	-	1	-	-	2	-	-
CO4	3	2	1	1	1	2	-	-	1	-	-	2	-	-
CO5	3	2	2	3	1	2	-	-	1	-	-	2	-	-

Correlation rating: Low/Medium/High: 1/2/3respectively.

UNIT– I

Definition of Partial Differential Equations, First order partial differential equations ,Solutions of first order linear PDEs , Solution to homogenous and non-homogenous linear partial differential equations of second order by complimentary function and particular integral method..

UNIT - II

Second-order linear equations and their classification, Initial and boundary conditions, D'Alembert's solution of the wave equation, Heat diffusion and vibration problems, Separation of variables method to Solve simple problems in Cartesian coordinates. The one dimensional diffusion equation and its solution by separation of variables

UNIT– III

Bisection method, Newton-Raphson method, Solution of linear system of equations-Gauss elimination method, LU decomposition method, Gauss-Jacobi and Gauss-Seidel iteration methods

UNIT– IV

Interpolation, Lagrange’s interpolation, Newton’s divided difference interpolation, Newton’s Forward and Backward difference interpolations. Numerical differentiation, Interpolation approach, Numerical integration-Trapezoidal rule, Simpson’s 1/3 rule,

UNIT–V

Taylor’s series method, Euler’s method, Picard’s method of successive approximations, Runge-Kutta method of 4^{th} order.

Suggested Reading:

1	R. K. Jain & S.R.K Iyengar, Advanced Engineering Mathematics, Narosa Publications, 4th Edition 2014.
2	Erwin Kreyszi, Advanced Engineering Mathematics, John Wiley, 9th Edition, 2012.
3	B.S. Grewal, Higher Engineering Mathematics, Khanna Publications, 43rd Edition, 2014.
4	M.K.Jain, S.R.K. Iyengarand R.K.Jain, Numerical methods for scientific and engineering computation, 6th edition, New Age International Limited.,2012
5	B.V . Ramana, Higher Engineering Mathematics, 23rd reprint, 2015.
6	S.S.Sastry, Introductory Methods of Numerical Analysis, 5th edition, PHI Private Limited, 2012.
7	H.K. Dass, Er. Rajnish Varma, higher Engineering Mathematics, S.Chand Technical 3rd Edition.

PC 301 EC	ANALOG ELECTRONICS -I					
Pre-requisites	Electronic devices and Circuits		**L**	**T**	**P**	**C**
			3	-	-	3
Evaluation	**SEE**	60 Marks	**CIE**		40 Marks	

Course Objectives:	
The course is taught with the objectives of enabling the student to:	
1	Learn concepts of Small signals amplifiers
2	Study the design concepts Low Frequency transistor amplifiers.
3	Learn concepts of transistor amplifiers at high frequency.
4	Design concepts of multi stage amplifiers.
5	Have a basic knowledge of Operational-Amplifiers.

Course Outcomes:	
On completion of this course, the student will be able to :	
CO-1	Design and Analyze small signal single stage
CO-2	Design and Analyze Multistage RC coupled and Transformer Amplifiers using BJT and FET.
CO-3	Analyze of low frequency, mid frequency and high frequency response of Multistage amplifiers
CO-4	Analyze of high input resistance transistor circuits.
CO-5	have a basic concept of characteristics Operational-Amplifiers;

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	1	2	-	-	-	-	-	-	-	-	1	-
CO3	3	2	2	-	-	-	-	-	-	-	-	-	1	-
CO4	2	2	2	-	-	-	-	-	-	-	-	-	1	-
CO5	3	2	2	2	-	-	-	-	-	-	-	-	-	-

Correlation rating: Low / Medium / High: 1 / 2 / 3 respectively.

UNIT–I

Small Signal – Low Frequency Transistor Model: Two Port Devices and Hybrid Model, h-Parameters and Measurement. Conversion Formulas for the Parameters of the Three Transistor Configurations. Analysis of Transistor Amplifier Circuit using h-parameters. Comparison of CB, CE and CC Amplifier Configurations. Linear Analysis of a Transistor Circuit with Appropriate Model. The FET Small Signal Model, Common Source and Common Drain Amplifier Circuits.

UNIT–II

Transistor at high frequencies: High frequency T-model, Miller theorem, the CB Short circuit current Frequency Response, The Alpha cutoff frequency, the CE Short circuit current, Frequency Response, Hybrid PI model CE short circuit current gain obtained with the Hybrid-Pi

model and resistive load. Transistor amplifier response with source resistance, Gain-Band width product.

UNIT–III
Multistage Amplifiers: Classification of amplifiers, Distortion in amplifiers, frequency response of RC-coupled, single stage, Transformer coupled amplifier and their analysis. Step response of amplifier, rise time, tilt, slag, square wave testing, interacting and non interacting stage, effect of emitter by pass capacitor on low frequency response.

UNIT-IV
Low frequency transistor amplifier circuits: cascading transistor amplifiers, n-stage cascaded amplifier, the decibel, high input resistance transistor circuits, cascade transistor reconfiguration.

UNIT – V
Operational Amplifiers: Classification of Integrated Circuits, Operational Amplifier Block Diagram, Ideal and practical characteristics of Op-Amps, Op-Amp features and parameters. Op-Amp measurements, input and output offset voltages and currents, Slew rate, CMRR, PSRR, frequency response.

Suggested Reading:

1	Millman J., Halkias C.C. and Satyabrata Jit, *Electronic Devices and Circuits*, 3rd edition, Tata McGraw-Hill, 2011.
2	S Salivahanan, N Kumar, and A Vallavaraj, Electronic Devices and Circuits, 2nd ed., McGraw Hill Education, 2007.
3	Millman J., Halkias C.C. and Parikh C, *Integrated Electronics*, 2nd edition, Tata McGraw-Hill, 2009.
4	JB Gupta, *Electronic Devices and Circuits*, S.K Kataria & sons, 5th Edition, 2012
5	Ramakanth A. Gayakwad, "*Op-amps and Linear Integrated Circuits*", 3rd Edition, Prentice-Hall of India private Limited, New Delhi, 1995.

PC 302 EC	SIGNAL ANALYSIS AND TRANSFORM TECHNIQUES					
Pre-requisites	-		**L**	**T**	**P**	**C**
			3	-	-	3
Evaluation	**SEE**	60 Marks	**CIE**		40 Marks	

Course Objectives:	
The course is taught with the objectives of enabling the student to:	
1	To familiarize different types of signals and systems typically encountered in Communication engineering.
2	To familiarize with basic operations on signals and mathematical representation of signals
3	To understand the behavior of signal in time and frequency domain
4	To understand convolution, correlation operations on continuous and discrete time signals
5	To analyze the response of systems on application of step, ramp inputs using Laplace & Z-transforms

Course Outcomes:	
On completion of this course, the student will be able to:	
CO-1	Be able to describe signals mathematically and understand how to perform mathematical operations on signals
CO-2	Understand and resolve the signals in frequency domain using Fourier series and Fourier transforms
CO-3	Be able to compute the output of an LTI system given the input and impulse response through convolution sum and convolution integral
CO-4	Understand the sampling theorem and the process of reconstructing a continuous signal from its samples
CO5	Be able to solve a linear constant coefficient difference equation using Z transform techniques

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	1	1	-	-	-	-	2	-	-	3	-
CO2	2	2	2	2	1	1	-	-	-	1	-	-	3	-
CO3	2	1	2	2	2	2	-	-	-	2	-	-	3	-
CO4	3	2	2	2	2	1	-	-	-	2	-	-	2	-
CO5	2	3	2	3	2	1	-	-	-	1	-	-	2	-

Correlation rating: Low / Medium / High: 1 / 2 / 3 respectively.

UNIT – I

Introduction to Signals & Systems: Classification of signals, elementary signals, Operations on signals, classification of systems, Exponential and Trigonometric Fourier series, Dirichlet's condition

UNIT – II

Fourier Transform: Representation of aperiodic signal, Introduction of Fourier transform, Convergence, properties of Fourier Transform, Fourier transform of periodic signals, Singularity function, Parseval's theorem, Energy spectral density.

UNIT – III

Laplace Transform: Review of Laplace transforms, region of convergence and properties, poles and zeros, relation between Laplace and Fourier transforms, properties of Laplace transform, inverse Laplace transform, Solutions to differential equation and system behavior.

UNIT – IV

Sampling: Sampling of continuous time signals, sampling theorem, Aliasing effect, reconstruction of a signal and its samples.

Convolution & Correlation of signals: Convolution integral, Properties of convolution, Graphical method of convolution, Convolution of Discrete time signals, overlap-add and overlap-save method of discrete convolution, Definition of correlation, Auto correlation, Properties of Autocorrelation, Cross correlation of signals..

UNIT – V

Z Transform: Definition of Z-Transform, Properties of Z-Transform, Region of convergence of Z-Transform, Inverse Z Transform using Inspection, Partial fraction expansion, Power series Expansion, Contour integration methods, Parseval's relation analysis of discrete time systems using Z-Transform. Realization of discrete time system using Direct form, Cascade parallel forms.

Suggested Reading:

1	Alan V. Oppenheim, Alan. S. Wilsky, S. Hamid Nawab, *Signals and Systems*, 2nd edition, Prentice Hall of India, 2007
2	Lathi B.P., *Signals Systems Communications*", 1st edition, B.S. Publications, 2006
3	Simon Haykin and Van veen, "Signal and system", Willy, second edition

PC 303 EC	SWITCHING THEORY AND LOGIC DESIGN					
Pre-requisites	Engineering Mathematics		**L**	**T**	**P**	**C**
			3	-	-	3
Evaluation	**SEE**	60 Marks	**CIE**		40 Marks	

Course Objectives:

The course is taught with the objectives of enabling the student to:	
1	To introduce common forms of number representation in logic circuits.
2	To familiarize with basic techniques for the design of digital circuits and fundamental concepts used in the design of digital systems.
3	To understand the concepts of combinational logic circuits.
4	To understand the concepts of sequential logic circuits.
5	To familiarize with various logic families in Digital ICs.

Course Outcomes:	
On completion of this course, the student will be able to :	
CO-1	Acquire the knowledge on number systems and Boolean Algebra theorems to minimize combinational functions.
CO-2	Design various combinational circuits.
CO-3	Acquire knowledge on usage of Flip-flops in various circuits
CO-4	Design Sequential circuits for the given specifications.
CO-5	Acquire knowledge on Logic families and their interfacing

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	1	2	1	-	-	-	-	-	2	1	-
CO2	2	3	3	2	2	1	-	-	-	-	-	1	1	-
CO3	2	3	3	2	2	1	-	-	-	-	-	1	1	-
CO4	3	2	1	1	1	-	-	-	-	-	-	2	1	-
CO5	2	2	3	2	2	-	-	-	-	-	-	2	1	-

Correlation rating: Low / Medium / High: 1 / 2 / 3 respectively.

UNIT–I

Number Systems

Number systems, Conversion and Complements Codes- Weighted and Non-weighted codes and their Properties.

Boolean Algebra

Basic Theorems and Properties, Switching Functions- Canonical and Standard Forms, Function

Simplification using Theorems, Digital Logic Gates, Universal Gates, Two level NAND/NOR realization of Boolean Function, Multilevel realization of Boolean Function.

Minimization with Theorems

Karnaugh Map Method - Up to four Variables, Don't Care Map Entries, Tabular Method

UNIT–II

Combinational Logic Circuit Design and Applications

Adders, Subtractors, comparators, Multiplexers, De-multiplexers, Encoders, Decoders and Code-converters, Hazards and Hazards Free Realizations. Practical aspects related to Combinational Logic Design- Fan-in and Fan-out, Propagation Delay.

UNIT–III

Flip-flops:

Architectural difference of Combinational and Sequential circuits, SR Latch, Types of Traditional Clocked Flip Flops: SR, JK, JK Master Slave, D and T Type Flip Flops, Excitation Tables of all Flip Flops, Conversion from one type of Flip-Flop to another, Flip-flop parameters.

UNIT-IV

Sequential Circuits :

Shift Registers – Left, Right and Bidirectional Shift Registers.

Counters - Synchronous UP/DOWN counters, Mod-N counters, Ring and Twisted Ring Counter, Frequency Divider.

Finite State Machines - Mealy and Moore models. ASM Charts, State Diagrams, Analysis and Design of Synchronous Sequential Circuits.

UNIT – V

Logic Families: Introduction, Digital IC Technology (characteristics of digital ICs), TTL - Operation, O/p configurations & characteristics, Improved TTL Series, Connecting TTL Outputs together and Tristate TTL, ECL, CMOS. IC interfacing- TTL driving CMOS and CMOS driving TTL.

Suggested Reading:

1	Zvi Kohavi & Niraj K. Jha, *Switching and Finite Automata Theory* - 3rdEdition, Cambridge, 2010.
2	R. P. Jain, 3rd edition, *Modern Digital Electronics* –Tata McGraw-Hill, 2007.
3	Morris Mano, *Digital Design*- PHI, 4th Edition,2006
4	Ronald J. Tocci, Neal S. Widmer, Gregory L. Moss, *Digital Systems - Principles and Applications*, Pearson 10th Ed, 2007.
5	Fredriac J. Hill, Gerald R. Peterson, *Introduction to Switching Theory and Logic Design*, 3rd Ed, John Wiley & Sons Inc.

PC 304 EC	PULSE AND DIGITAL CIRCUITS					
Pre-requisites	Electronic devices and circuits		**L**	**T**	**P**	**C**
			3	**-**	**-**	**3**
Evaluation	**SEE**	60 Marks	**CIE**		40 Marks	

Course Objectives:	
The course is taught with the objectives of enabling the student to:	
1	To study various linear wave shaping circuits.
2	To study various non-linear wave shaping circuits.
3	To study different types of multi-vibrators.
4	To study the features of voltage and current time-base generators, data converters.
5	To study various Blocking oscillator circuits, Synchronization and frequency division circuits.

Course Outcomes:	
On completion of this course, the student will be able to :	
CO-1	Design various linear wave shaping circuits.
CO-2	Design various non-linear wave shaping circuits such as clippers and clamper circuits.
CO-3	Design Bi-stable, Monostable and Astable multi-vibrator circuits.
CO-4	Design sweep circuits and data converters.
CO-5	Design Blocking oscillator circuits, Synchronization and frequency division circuits.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	1	1	1	-	-	-	-	1	2	1	-
CO2	3	2	2	1	1	1	-	-	-	-	1	2	2	-
CO3	2	3	3	2	2	1	-	-	-	-	1	1	1	-
CO4	3	3	3	2	1	1	-	-	-	-	1	1	-	-
CO5	2	2	1	1	1	-	-	-	-	-	1	1	-	-

Correlation rating: Low / Medium / High: 1 / 2 / 3 respectively.

UNIT–I

LINEAR WAVE SHAPING: High pass, low pass RC circuits, their response for sinusoidal, step, pulse, square, ramp and exponential inputs. RC network as differentiator and integrator; Attenuators, its applications in CRO probe, RL circuits and their response for step input, Ringing circuit.

UNIT–II

NON-LINEAR WAVE SHAPING : Diode clippers, Transistor clippers, clipping at two independent levels, Transfer characteristics of clippers, Emitter coupled clipper; Clamping operation, clamping circuits using diode with different inputs, Clamping circuit theorem,

practical clamping circuits, effect of diode characteristics on clamping voltage, Transfer characteristics of clampers.

UNIT–III

MULTIVIBRATORS: Transistor as a switch, Switching times of a transistor, Analysis And Design of Fixed Bias, Self Bias Bistable Multi Vibrator, Commutating Capacitors, Triggering of Binary Circuits, Emitter Coupled Bistable Multivibrator (Schmitt Trigger) and its applications. Analysis and Design of Collector Coupled Monostable Multi vibrator and Astable Multivibrator, Triggering of Monostable Multivibrator, Applications of Monostable Multivibrator and Astable Multivibrator.

UNIT-IV

Sweep Circuits: General features of a time-base signal, Exponential voltage sweep circuit, basic principles of Miller and Bootstrap time-base generators, transistor Miller voltage sweep generator, transistor bootstrap voltage sweep generator, simple current sweep circuit, linearity correction through adjustment of driving waveform, transistor current time base generator. Introduction to 555 Timer and its functional diagram, sweep generator circuits using 555 timers.

Data Converters: Introduction to ADC and DAC, basic Digital to Analog conversion techniques, Weighted resistor DAC, Inverted R-2R ladder DAC, parallel comparator ADC, successive approximation ADC, Dual slope ADC, Flash type ADC, applications of ADC and DAC

UNIT – V

Blocking oscillator circuits: A triggered transistor blocking oscillator (base timing and emitter timing), An Astable transistor blocking oscillator (diode-controlled and RC-controlled), Applications of blocking oscillators.

Synchronization and frequency division: Pulse synchronization of relaxation devices, frequency division in the sweep circuits, Monostable relaxation circuits as dividers, Synchronization of sweep circuit with symmetrical signal, sine wave frequency division with a sweep circuit, a sinusoidal divider using regeneration and modulation, Synchronization of a sinusoidal oscillator with pulses.

SUGGESTED READING:

1	Jacob Millmann and Herbert Taub, *"Pulse, Digital and Switching waveforms",* 3rd Edition, Tata McGraw Hill
2	Millman J and C. C. Halkias, *Integrated Electronics*, 2nd Edition Tata McGraw
3	D. Roy Chowdary and Shail B Jain, "*Linear Integrated Circuits*", 4th Edition, New Age International (P) Limited, New Delhi, 2018.
4	Anand Kumar A, *"Pulse and Digital Circuits"*, 2nd Edition, Prentice
5	Jacob Millmann and Herbert Taub, *"Pulse, Digital and Switching waveforms",* 3rd Edition, Tata McGraw
6	David A. Bell, *"Solid State pulse circuits",* 4th Edition, Prentice Hall India.

PC 305 EC	NETWORK ANALYSIS AND SYNTHESIS					
Pre-requisites	-		**L**	**T**	**P**	**C**
			3	**0**		
Evaluation	**SEE**	60 Marks	**CIE**		40 Marks	

Course Objectives:	
The course is taught with the objectives of enabling the student to:	
1	To introduce about Network Theorems and Network Topology
2	To introduce the concepts of Two Port networks, study of the different two port parameter representations and principles of two port network parameters topology description of networks
3	To introduce the concepts of resonance, complex frequency and Transient Analysis
4	To Analyze and Design different LC filters and Attenuators
5	To synthesize various networks using R, L and C combinations

Course Outcomes:	
On completion of this course, the student will be able to :	
CO-1	Learn how to develop and employ circuit theorems like superposition and Thevenin-Norton equivalent circuits etc
CO-2	Analyze given Electrical Circuit in terms of A,B,C,D and Z,Y Parameter Model and Solve the circuits and how they are used in real time applications. Able to analyze the topologic description of networks. Ability to Solve Circuits using Tree, Node, Branch, Cutset, Tie Set Methods
CO-3	Analyze small RLC circuits Series and parallel Resonance of RC, RL and RLC circuits. Able to solve Transient Analysis
CO-4	Design different types of filters and Attenuator
CO-5	Synthesize the RL, RC & RLC networks Foster and Cauer Forms

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	1	2	3	1	1	2	1	-	2	2	3	2
CO2	3	2	2	1	2	-	2	2	1	2	1	2	3	2
CO3	2	2	3	2	2	-	1	1	2	1	1	1	2	2
CO4	1	1	2	3	1	1	-	2	-	1	1	1	1	1
CO5	2	1	2	2	3	-	1	2	1	-	-	1	1	2

Correlation rating: Low / Medium / High: 1 / 2 / 3 respectively

UNIT–I
Network Theorems: Nodal and Mesh analysis,Superposition theorem, Thevenin's Theorem, Norton's Theorem, Maximum Power Transfer Theorem, Reciprocity Theorem and Tellegen's Theorem. **Network Topology**: Graph, Tree, Tie set, cut set matrix, Impedance matrix formulation of node loop equations using tie-set, cut-set analysis

UNIT–II
Two port networks: Z, Y, h, g, ABCD parameters, equivalence of two ports, Condition for Symmetry and Reciprocity. T-Π transformations, inter connection of two ports networks, Brune's test for interconnection

UNIT–III
Response of R, L, C Networks: DC and AC excitation of RL, RC and RLC circuits, Transient Analysis. Resonance-Series and parallel. Quality factor, Bandwidth of Resonant Circuits,

UNIT-IV
Filters, Attenuators and Equalizers: Characteristic Impedance, Image Impedance, Iterative Impedance and propagation constant. Design of constant-K LP, HP, BPF, BS filters. m-derived, composite filters, lattice filters. Symmetrical, Asymmetric-T, PI section networks, Introduction about Attenuators and equalizers

UNIT – V
Network Synthesis: Fosters reactance theorems, Positive real function, Hurwitz polynomial, Driving point Impedance and admittance. Synthesis of one port RC, RL and LC networks using Foster and Cauer forms.

SUGGESTED READING:

1	Van Valkenberg M.E, *Network Analysis*, 3rd edition, Prentice Hall of India, 1996
2	Hayt W H, Kemerly J E Durbin, *Engineering Circuit Analysis*, 7th edition, Tata McGraw Hill, 2006
3	Smarajit Ghosh, *Network Theory Analysis and Synthesis,* PHI Learning private Limited,2013
4	B. Somanathan Nair, S.R.Deepa, *Network Analysis and Synthesis*, ELSEVIER India Ltd 2012
5	S P Ghosh, A K Chakraborthy, *Network Analysis and Synthesis,* McGraw Hill Education(India)Pvt Ltd 2014

PC 351 EC	ELECTRONIC DEVICES LAB					
Pre-requisites	Electronic Devices		**L**	**T**	**P**	**C**
					2	**1**
Evaluation	**SEE**	50 Marks	**CIE**		25 Marks	

Course Objectives:	
The Lab is being conducted with the objectives of enabling the student to:	
1	To study the working of CRO
2	To understand the characteristics of various Diodes
3	To know the working of rectifiers with/without filters for AC to DC conversion
4	To understand the input and output characteristics of different Transistor configurations of BJT and FET
5	To study the characteristics of different devices like UJT, SCR , LEDs etc.

Course Outcomes:	
On completion of this course, the student will be able to :	
CO-1	Use CRO for various measurements like amplitude, frequency and phase of the signals
CO-2	Work with various diodes like Si, Ge and Zener diodes
CO-3	Know the operation of various rectifiers with/without filters
CO-4	Calculate the parameters like input & output impedances of BJT and FET
CO-5	Know the working of special devices like UJT, SCR, LEDs etc

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	-	1	-	-	-	-	-	-	-	-	2	-
CO2	1	1	-	1	-	-	-	-	-	-	-	-	2	1
CO3	2	1	-	1	-	-	-	-	-	-	-	-	2	2
CO4	1	1	-	1	-	-	-	-	-	-	-	-	2	2
CO5	2	-	-	-	-	-	-	-	-	-	-	-	2	2

Correlation rating: Low / Medium / High: 1 / 2 / 3 respectively.

Experiment–I
Study of CRO: CRO for various measurements like amplitude, frequency and phase of the signals

Experiment–II
Verification of VI characteristics of Semiconductor Diodes (Si & Ge), Forward Bias and

Reverse Bias

Experiment –III
Verification of Static Characteristics and voltage regulation of Zener Diode

Experiment -IV
Calculation of Ripple Factor and % Regulation for Half-wave, Full-wave and Bridge rectifiers

Experiment– V
Calculation of Ripple Factor and % Regulation for Half-wave, Full-wave and Bridge rectifiers with Filters

Experiment– VI
Analyze the Static Characteristics of CB Configuration of Transistor and compute input & output impedances

Experiment– VII
Analyze the Static Characteristics of CE Configuration of Transistor and compute input & output impedances

Experiment– VIII
Analyze the Static and Transfer Characteristics of FET and compute gain & output/transimpedances

Experiment– IX
Verification of Characteristics of special device UJT

Experiment– X
Verification of Characteristics of special device SCR

SUGGESTED READING:

1	David Bell. A, Laboratory Manual for Electronic Devices and circuits, Prentice hall of India, 2001
2	Robert L. Boylestad , Louis Nashelsky "Electronic Devices and Circuit Theory",11th edition, Pearson Publishers, 2012

PC 352 EC	PULSE AND DIGITAL CIRCUITS LAB					
Pre-requisites	Pulse and digital circuits		**L**	**T**	**P**	**C**
			-	-	2	1
Evaluation	**SEE**	50 Marks	**CIE**		25 Marks	

Course Objectives:	
The course is taught with the objectives of enabling the student to:	
1	To understand the response of RC
2	To study the output response of clipping and clamping circuits.
3	To understand the design concepts of multi-vibrators.
4	To study the characteristics of a Schmitt trigger and sweep circuits
5	To understand the design concepts of Analog to Digital and Digital to Analog converter.

Course Outcomes:	
On completion of this course, the student will be able to :	
CO-1	Design linear wave shaping circuits using RC network.
CO-2	Design clippers and clamping circuits
CO-3	Design pulse generator circuits such as multi-vibrators
CO-4	Design pulse generator circuits such as time-based generators
CO-5	Design Analog to Digital converter and Digital to Analog converter.

CO/PO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	2	1	1	1	1	-	-	-	-	1	2	2	-
CO2	3	2	1	1	2	1	-	-	-	-	1	2	2	-
CO3	2	3	1	2	1	1	-	-	-	-	1	1	2	-
CO4	2	3	1	2	2	1	-	-	-	-	1	1	2	-
CO5	3	2	1	1	1	1	-	-	-	-	1	-	2	-

Correlation Rating: Low / Medium / High:1 / 2 /3 respectively.

Experiment - I
Study the response of RC- High pass and RC-low pass circuits for the different excitation inputs.

Experiment - II
Design of Clippers circuits

Experiment - III
Design of Clampers circuits

Experiment - IV
Design a Collector coupled Astable Multivibrator

Experiment - V
Design a Collector coupled Monostable Multivibrator

Experiment - VI
Design a Collector coupled Bitable Multivibrator

Experiment - VII
Design a Schmitt Trigger circuit using transistors

Experiment - VIII
Design a Boot strap voltage sweep circuit using transistors,

Experiment - IX
Design a Miller voltage sweep circuits using transistors

Experiment –X
Design a sweep generator circuits using 555 timers

Experiment - XI
Design a linear sweep generator circuits using 555 timers

Experiment - XII
Design a 4-bit Digital to Analog converter (DAC) using R-2R ladder network

Experiment - XIII
Design a 4-bit Digital to Analog converter (DAC) using weighted resistor network

Experiment - XIV
Design an 8-bit Analog to Digital converter (ADC) using a successive approximation method.

Experiment - XV
Design an 8-bit Analog to Digital converter (ADC) using a dual-slope integration method

General Note: Mini Project cum Design exercise:

SUGGESTED READING:

1	Robert Boylestad and Louis Nashelsky, "*Electronic Devices and Circuit theory*", 10th Edition, Prentice Hall of India Private Limited, New Delhi, 2009
2	David A. Bell, "*Laboratory Manual for Electronic Devices and Circuits*", 4th Edition, Prentice-Hall of India Private Limited, New Delhi, 2004
3	Jacob Millmann and Herbert Taub, "Pulse, Digital and Switching waveforms", 3rd Edition, Tata McGraw- Hill publishing company Limited, New Delhi, 2017

PC 353 EC	NETWORKS ANALYSIS AND SYNTHESIS LAB					
Pre-requisites	Network analysis and synthesis		**L**	**T**	**P**	**C**
			-	-	2	1
Evaluation	**SEE**	50 Marks	**CIE**		25 Marks	

Course Objectives:	
The course is taught with the objectives of enabling the student to:	
1	To design and test different network theorems
2	To design and understand of two-port networks
3	To understand resonance phenomena of RLC resonance circuits
4	To Study the frequency response of K-LPF and K-HPF
5	To Study the frequency response of M-LPF and M-HPF

Course Outcomes:	
On completion of this course, the student will be able to :	
CO-1	Able to analyze and verify Different Network theorems.
CO-2	Able to understand two-port networks and resonance circuits
CO-3	Able to calculate frequency response of K-LPF and K-HPF
CO-4	Able to understand resonance phenomena of RLC resonance circuits
CO-5	Able to calculate frequency response of M-LPF and M-HPF

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	2	1	1	-	-	-	-	-	-	-	2	-
CO2	1	2	1	2	2	-	-	-	-	-	-	-	2	-
CO3	2	-	3	1	1	-	-	-	-	-	-	-	2	-
CO4	3	2	-	-	1	-	-	-	-	-	-	-	2	-
CO5	1	1	2	2	3	-	-	-	-	-	-	-	2	-

Correlation rating: Low / Medium / High: 1 / 2 / 3 respectively.

Experiment - I
Verification of Reciprocity and Tellegen's Theorems.

Experiment - II
Verification of Maximum Power Transfer and Superposition Theorems

Experiment - III
To calculate and verify "Z and Y" parameters of a two port network

Experiment - IV

To calculate and verify "ABCD and h-" parameters of a two port network

Experiment - V
To study the phenomenon of resonance in series RLC circuit and obtain resonant frequency

Experiment - VI
To study the phenomenon of resonance in parallel RLC circuit and obtain resonant frequency

Experiment - VII
Design and verification of Constant K Low Pass filter.

Experiment – VIII
Design and verification of Constant K High Pass filter.

Experiment – IX
Design and verification of m-Derived low pass filter.

Experiment –X
Design and verification of m-Derived high pass filter.

SUGGESTED READING:

1	Van Valkenberg M.E, *Network Analysis*, 3rd edition, Prentice Hall of India, 1996
2	Hayt W H, Kemerly J E Durbin, *Engineering Circuit Analysis*, 7th edition, Tata McGraw Hill, 2006
3	S P Ghosh, A K Chakraborthy, *Network Analysis and Synthesis*, McGraw Hill Education(India)Pvt Ltd 2014

SCHEME OF INSTRUCTION AND EXAMINATION
B. E. (ELECTRONICS AND COMMUNICATION ENGINEERING)

SEMESTER – IV
(With effect from AY 2023-24)

SNo	Code	Course Title	Scheme of Instruction			Contact Hrs/Wk	Scheme of Evaluation			Credits
			L	T	P		Hrs	CIE	SEE	
Theory										
1	PC 401 EC	Analog Electronics -II	3	-	-	3	3	40	60	3
2	PC 402 EC	Probability Theory and Stochastic Process	3	-	-	3	3	40	60	3
3	PC 403 EC	Digital Signal Processing	3	-	-	3	3	40	60	3
4	PC 404 EC	Electromagnetic Waves and Transmission Lines	3	-	-	3	3	40	60	3
5	PC 405 EC	Communication Theory	3	-	-	3	3	40	60	3
6	PC 406 EC	Computer Architecture and Organization	3	-	-	3	3	40	60	3
7	**Professional Elective-I**		3	-	-	3	3	40	60	3
	PE 411EC	Electronic Measurements and Instrumentation								
	PE 412 EC	Operating Systems								
	PE 413 CS	Data science using R								
Practicals										
8	PC451EC	Analog Electronics Lab	-	-	2	2	3	25	50	1
9	PC452EC	Digital Signal Processing Lab	-	-	2	2	3	25	50	1
		Total	**21**	**-**	**4**	**25**	**27**	**330**	**520**	**23**

PC 401 EC	ANALOG ELECTRONICS II					
Pre-requisites	Analog Electronics-I		**L**	**T**	**P**	**C**
			3			**3**
Evaluation	**SEE**	60 Marks	**CIE**		40 Marks	

Course Objectives:	
The course is taught with the objectives of enabling the student to:	
1	Analyze frequency response of Amplifiers in different frequency ranges.
2	Familiarize with concept and effect of negative feedback
3	Study positive feedback and Design different types of oscillators.
4	Design Power Amplifiers and calculate their efficiencies.
5	Familiarize with concept of tuned Amplifiers

Course Outcomes:	
On completion of this course, the student will be able to :	
CO-1	Identify the type of negative feedback, Analyze and design of negative feedback amplifiers.
CO-2	Design Audio Frequency and Radio Frequency oscillators
CO-3	Distinguish between the classes of Power Amplifiers and their design considerations.
CO-4	Compare the performance of single and double Tuned Amplifiers.
CO-5	Able to demonstrate an understanding of operational amplifiers and their applications

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	-	1	-	-	1	1	-	-	-	2	-
CO2	3	2	1	2	1	-	-	1	-	-	-	-	1	-
CO3	3	2	2	-	1	-	-	1	-	--	-	-	-	-
CO4	2	1	2	-	-	-	-	1	1	-	-	-	2	-
CO5	3	2	2	2	1	-	-	1	2	-	-	-	-	-

Correlation rating: Low / Medium / High: 1 / 2 / 3 respectively.

UNIT–I
Feedback Amplifiers Analysis and Design: The feedback concept, General characteristics of negative feedback amplifier, Effect of negative feedback on input and output impedances, Voltage and current, series and shunt feedbacks. Stability considerations .

UNIT–II
Oscillators Analysis and Design: Positive feedback and conditions for sinusoidal oscillations, RC oscillators, LC oscillators, Crystal oscillator, Amplitude and frequency stability of oscillator.

UNIT–III
Large Signal Amplifiers: BJT as large signal audio amplifiers, Classes of operation, Harmonic distortion, power dissipation, efficiency calculations. Design considerations of transformer coupled and transform less push-pull audio power amplifiers under Class-A. Class-B, Class c and Class-AB operations

UNIT-IV
RF Voltage Amplifiers: General consideration, Analysis and design of single tuned and double tuned amplifiers with BJT, Selectivity, gain and bandwidth. Comparison of multistage, single tuned amplifiers and double tuned amplifiers. The problem of stability in RF amplifiers, introduction to staggered tuned amplifiers.

UNIT – V
Operational Amplifier Applications: Inverting and non-inverting amplifiers with ideal and non-ideal op-amps, voltage followers, Difference Amplifier, Summing amplifiers, ideal and practical Integrator, Differentiator, Voltage to current and current to voltage converters, precision Rectifiers

SUGGESTED READING:

1	Jacob Millman, Christos C. Halkias, and Satyabrata Jit, Electronic Devices and Circuits, 3rd ed., McGraw Hill Education, 2010.
2	David A. Bell, Electronic Devices and Circuits, 5th ed., Oxford University Press, 2009
3	S Salivahanan, N Kumar, and A Vallavaraj, Electronic Devices and Circuits, 2nd ed., McGraw Hill Education, 2007.
4	Jacob Millman, Christos Halkias, Chetan Parikh, Integrated Electronics, 2nd ed., McGraw Hill Education (India) Private Limited, 2011.
5	Ramakanth A. Gayakwad, "*Op-amps and Linear Integrated Circuits*", 3rd Edition, Prentice-Hall of India private Limited, New Delhi, 1995.

PC 402 EC	PROBABILITY THEORY AND STOCHASTIC PROCESSES					
Pre-requisites	Probability Theory Basics		**L**	**T**	**P**	**C**
			-	**3**	**-**	**3**
Evaluation	**SEE**	60 Marks	**CIE**		40 Marks	

Course Objectives:	
The course is taught with the objective of enabling the student to:	
1	Understand different types of random variables & their density distribution functions.
2	Learn one random variable characteristic function of different variables using their density functions.
3	Learn the concepts of sequences of random variables, Properties of Random vectors.
4	Understand elementary concepts of the Rom Processes or distribution functions.
5	Understand the functions of two random variables' probability density distribution of the joint random variables.

Course Outcomes:	
On completion of this course, the student will be able to:	
CO-1	Solve using an appropriate sample space by the concepts of probabilities and
CO-2	Understand multiple random variables relate the same through examples to real problems.
CO-3	Characterize LTI systems' response driven by a stationary random process using autocorrelation and power spectral density functions.
CO-4	Apply these principles in areas where noise is a serious challenge.
CO-5	Understand the usefulness of stochastic processes in their professional area.

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	-	-	-	1	-	-	-	-	-	-	1	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	1	2
CO3	3	2	-	1	2	-	-	-	-	-	-	-	-	-
CO4	3	2	-	1	-	-	-	-	-	-	-	-	2	-
CO5	3	2	-	1	2	-	-	-	-	-	-	-	-	-

Correlation rating: Low / Medium / High: 1 / 2 / 3 respectively.

UNIT–I

Concepts of Probability and Random Variable: Definitions, Probability Induction, Causality versus Randomness, Review of Set Theory, Probability Space, Conditional Probability. Repeated Trials Combined Experiments, Bernoulli Trials, Bernoulli's Theorem Games of Chance. Random Variable: Definition, Distribution Density Functions, Specific Random Variables their probability density distribution functions: Normal, Exponential, Gamma, Chi-Square, Raleigh, Nakagami- m, Uniform, Beta, Cauchy, Laplace Maxwell, Bernoulli, Binomial, Poisson,

Geometric, Negative Binomial Conditional Distributions, Asymptotic Approximations for Binomial Rom Variable.

UNIT–II
Functions of One Random Variable: Function of a Random Variable $g(\mathbf{x})$, The Distribution of $g(\mathbf{x})$, Mean, Variance, and Moments. Characteristic Functions of random variables with the above distributions.
UNIT–III
Two Random Variables: Bi-variate Distributions, One Function of Two Random Variables, Two Functions of Two Rom Variables, Joint Moments, Joint Characteristic Functions, Conditional Distributions, and Conditional Expected Values

UNIT-IV
Sequences of Random Variables: General Concepts, Conditional Densities, Characteristic Functions, Normality, Mean Square Estimation, Stochastic Convergence Limit Theorems. Random Numbers: Meaning, Generation of random sequence, pseudo-random binary sequence. Applications of random numbers.

UNIT – V
Stochastic Processes: General elementary concepts definitions of stationary, Ergodic, random processes independence, spectral density, white color noise, Response to linear systems stochastic inputs, Markov Processes.

SUGGESTED READING:

1	A Papoulis, S.U. Pillai, "Probability, Rom Variables Stochastic Processes", 4th edition, Tata McGraw-Hill, 2008.
2	Peyton Z Peebles, "Probability, Rom Variables & Rom Signal Properties", 4th edition, Tata McGraw-Hill, 2001.
3	Carl Helstrom, "Probability Stochastic Processes for Engineers", Macmillan Publishing Company, 1984.
4	Richard H. Williams, "Probability, Statistics, Rom Processes for Engineers", Thomson Learning, 1st edition, 2003.

PC 403 EC	DIGITAL SIGNAL PROCESSING					
Pre-requisites	-		**L**	**T**	**P**	**C**
			3	-	-	3
Evaluation	**SEE**	60 Marks	**CIE**		40 Marks	

Course Objectives:	
The course is taught with the objectives of enabling the student to:	
1	To study about discrete time systems and to learn about the DFT and FFT algorithms.
2	To study the design techniques for FIR and IIR digital filters
3	To study the finite word length effects in signal processing
4	To understand Multi rate signal processing
5	To study the architecture of TMS processor

Course Outcomes:	
On completion of this course, the student will be able to :	
CO-1	Find DFT of a given signal through Fast Fourier Transform techniques.
CO-2	Design FIR and IIR type digital filters.
CO-3	Identify filter structures and evaluate the coefficient quantization effects.
CO-4	Understand sample rate conversion techniques.
CO-5	Compare the architectures of DSP and General Purpose Processors.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	3	2	-	-	2	1	3	-	2	3	-
CO2	1	2	3	2	3	-	-	1	2	2	-	2	3	-
CO3	3	2	1	2	3	-	-	3	3	2	-	3	3	-
CO4	3	1	2	2	2	-	-	2	2	3	-	2	2	-
CO5	1	3	2	3	2	-	-	3	2	2	-	2	2	2

Correlation rating: Low / Medium / High: 1 / 2 / 3 respectively.

UNIT– I

Introduction: Concept of frequency in continuous and discrete time signals, DFT and its properties, linear convolution, circular convolution. Computational complexity of direct Computation of DFT, Fast Fourier Transform, DIT and DIF, FFT algorithms for RADIX-2 case, in-place computation, Bit reversal, Finite word length effects in FFT algorithms, Use of FFT in Linear Filtering

UNIT - II

FIR Filters: FIR digital filter design techniques. Properties of FIR digital filters, design of FIR filters using windows and frequency sampling techniques, linear phase characteristics. Realization diagrams for IIR and FIR filters, finite word length effects

UNIT– III

IIR Filters: Analog filter design – Butterworth and Chebyshev approximations, IIR digital filter design techniques, impulse invariant technique. Bilinear transform technique. Comparison of FIR and IIR filters, frequency transformations.

UNIT– IV

Multirate signal processing: Introduction, decimation by a factor D, interpolation by a factor I, sampling rate conversion by a rational factor I/D, design of practical sampling rate converter, S/W implementation of sampling rate converter, application of Multirate signal processing.

UNIT–V

DSP Processors: Introduction to Fixed point Digital Signal Processors, TMS 320C54XX processor-architecture, addressing modes, instruction set, Assembly programming, programming issues, Applications of DSP processors.

Suggested Reading:

1	John G.Proakis and Dimitris G. Manolakis, *"Digital Signal Processing principles, Algorithms and Applications"*, 3rd Edition, Prentice-Hall of India Private Limited, New Delhi, 1997.
2	Alan V. Oppenheim and Ronald W. Schafer, "*Discrete Time Signal Processing*", 3rd edition, Prentice Hall, Upper Saddle River, NJ,2010.
3	Sanjit K. Mitra, "*Digital Signal Processing: A Computer-Based Approach*", 4/e, McGraw-Hill, New York,2011.
4	Avatar sing and S.Srinivasan, *"Digital Signal Processing implementation using DSP Microprocessors with Examples from TMS320C54XX"*, Thomson Books Icole, 2004.

PC 404 EC	ELECTROMAGNETIC WAVES AND TRANSMISSION LINES					
Pre-requisites	-		**L**	**T**	**P**	**C**
			3	-	-	3
Evaluation	**SEE**	60 Marks	**CIE**		40 Marks	

Course Objectives:	
The course is taught with the objectives of enabling the student to:	
1	To become familiar with the fundamental concepts of electrostatics and magneto static laws and their applications.
2	To familiar with the four Maxwell's equations used to study time varying EM or dynamic fields and apply them to solve practical EM problems.
3	To acquaint with theoretical analysis of the characteristics of electromagnetic waves in a wide variety of Practical Mediums.
4	To familiar with fundamentals of Transmission line theory.
5	To acquaint with transmission line impedance calculations

Course Outcomes :	
Students will be:	
CO-1	Able to express and elaborate Maxwell's Equations in differential and integral forms and the constitutive relations between the flux densities and field intensities of the electrostatics, magneto-statics.
CO-2	Able to express the time varying fields in integral and differential form of Maxwell's Equations.
CO-3	Able to derive the Helmholtz wave equations in its various forms and the wave nature of their solutions for time-harmonic waves in various mediums.
CO-4	Able to apply fundamental electromagnetic concepts in applications such as Transmission Lines and Antennas.
CO-5	Able to understand the impedance matching concepts using the smith chart

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	3	2
CO2	3	3	1	-	-	-	-	-	-	--	-	-	3	2
CO3	2	3	-	-	-	-	-	-	-	-	-	-	2	2
CO4	3	-	-	1	1	1	1	-	-	-	-	-	2	2
CO5	3	2	2	2	-	-	-	-	-	-	-	-	3	3

Correlation rating : Low / Medium / High : 1 / 2 / 3 respectively.

UNIT - I

Electrostatics: Review of Vector Calculus and Coordinate systems and Transformation, Coulomb's Law, Electric Field Intensity, Electric field due to different charge distributions - Electric Field due to Line Charge, Sheet Charge and Volume Charge Distribution. Electric Flux, Flux Density, Gauss's Law and Applications. Energy and Potential, Potential Field of a Point Charge, System of Charges, potential gradient, Energy density in Electrostatic fields, Electric Dipole, convection and conduction currents, continuity equation and relaxation time, Poisson's and Laplace's Equations, Capacitance and Capacitors.

UNIT - II

Magneto-statics: Biot-Savart Law, Ampere's Circuital Law, Applications of Ampere's Law, Magnetic Flux Density, Magnetic Scalar and Vector Potentials, Forces due to magnetic fields, Magnetic Dipole, Magnetization, Inductors and Inductances, Magnetic Energy.

UNIT - III

Time Varying Fields and Maxwell's Equations: Faraday's Law, Transformer and Motional EMF's, Displace Current, Maxwell's Equations in Differential and Integral Forms, Time-Varying Potentials, Electromagnetic Boundary Conditions, Time-Harmonic Fields.

UNIT - IV

EM Wave Propagation: Uniform Plane Wave, Wave Propagation in Free Space, Dielectrics, Good Conductors-Skin Effect. Poynting's Theorem and Wave Power, Poynting Vector, Instantaneous, average and complex pointing vector, Wave Polarization-Linear, Circular and Elliptical polarizations, Reflection of Uniform Plane Waves at Normal incidence and Oblique incidence angles, Reflection coefficient, Transmission coefficient, power and energy calculations.

UNIT - V
Transmission Lines: Circuit representation, Equations of voltage and current on transmission line, propagation constant and characteristic impedance, Loss less Line, Distortion less Line, Infinite line concepts, Input impedance relations of open and short-circuited transmission lines, reflection coefficient and VSWR. The Smith Chart, Transmission Line Impedance Matching- Impedance Matching by Quarter wave Transformer, Single Stub Matching and Double Stub Matching..

Suggested Reading:

1	Matthew N, O. Sadiku, *Principles of Electromagnetics*, Oxford University Press, 2009, 4th edition.
2	David K.Cheng, *Field and Wave Electromagnetics*, Pearson Education, 2001, 2nd edition
3	W.H.Hayt, Jr.and J.A Buck,*Engineering Electromagnetics*, Tata Mc Graw-Hill, 2006, 7thedition

PC 405 EC	COMMUNICATION THEORY					
Pre-requisites	-		**L**	**T**	**P**	**C**
			3	-	-	3
Evaluation	**SEE**	60 Marks	**CIE**		40 Marks	

Course Objectives:	
The course is taught with the objectives of enabling the student to:	
1	To understand the concept of modulation and linear modulation techniques.
2	To understand the angle modulation schemes and characteristics of transmitters and receivers.
3	To study the types of noise and influence analog modulation.
4	To understand the Pulse Analog modulation schemes
5	To interpret the principles of information theory

Course Outcomes:	
On completion of this course, the student will be able to :	
CO-1	Able to compare the performance of AM, FM and PM schemes with reference to band width. Understand generation of AM, FM, PM schemes.
CO-2	Able to evaluate the performance of AM and FM transmitters and receivers.
CO-3	Able to identify sources of noise, noise figure, signal to noise ratio for AM, FM and PM.
CO-4	Understand the concept of pulse modulation and compare their performance.
CO-5	Able to acquire knowledge about information theory and access entropy and efficiency of various channels.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	1	2	-	-	-	2	-	-	1	1
CO2	3	2	2	2	1	2	-	-	-	2	-	-	1	1
CO3	3	3	2	2	1	2	-	-	-	2	-	-	1	1
CO4	3	2	2	2	1	2	-	-	-	2	-	-	2	1
CO5	3	2	2	2	1	2	-	-	-	2	-	-	2	2

Correlation rating : Low / Medium / High : 1 / 2 / 3 respectively.

UNIT - I

Linear modulation schemes: Need for modulation, double-sideband suppressed-carrier (DSB-SC) modulation, conventional amplitude modulation (AM), single side band (SSB) modulation and vestigial-sideband (VSB) modulation. Generation and demodulation of the above, Frequency Division Multiplexing.

UNIT – II

Angle modulation schemes: frequency modulation (FM) and phase modulation (PM), conceptofinstantaneousfrequency,NBFM,WBFM,FMspectrumintermsofBesselfunction, direct and indirect (Armstrong's) methods of FM generation, discriminators, phase locked loop (PLL), FM receiver.

AM and FM radio transmitters, Principles of tuned radio frequency (TRF) and super heterodyne receivers, choice of intermediate frequency (IF).

UNIT - III

Noise performance of AM, FM and PM systems: Sources of noise, thermal noise, shot noise, noise in linear systems, equivalent noise band width, noise temperature, noise figure. Signal-to noise ratio (SNR) calculations for DSB-SC AM,SSB, FM and PM systems.

UNIT – IV

Analog Pulse modulation schemes: sampling of continuous-time signals, low pass and band pass sampling, practical aspects of sampling and reconstruction of signals. Pulse amplitude modulation (PAM), Time Division Multiplexing, Pulse time modulation schemes-pulse width modulation(PWM)and pulse position modulation(PPM), generation and demodulation

UNIT - V
Information Theory: Introduction, Information entropy, properties of entropy, information rate, types of information sources, channels, types of channels, joint entropy, conditional entropy, redundancy, mutual information, channel capacity

Suggested Reading:

1	K Sam Shanmugam, *"Digital and Analog Communication Systems*", John Wiley & sons, 1979.
2	JohnG.Proakis,*"DigitalCommunications*",4thEdition,TataMcGraw-HillpublishingcompanyLimited, New Delhi, 2003
3	PRamakrishnaRao,"*DigitalCommunication*",TataMcGraw-HillEducationPrivate Limited, New Delhi, 2011.

PC 406 EC	COMPUTER ARCHITECTURE AND ORGANIZATION					
Pre-requisites	-		**L**	**T**	**P**	**C**
			3	-	-	3
Evaluation	**SEE**	60 Marks	**CIE**		40 Marks	

Course Objectives:	
The course is taught with the objectives of enabling the student to:	
1	To familiarize with Central Processing Unit (CPU) concepts.
2	To understand register, architecture, addressing modes and instruction set of Intel
3	To design data path and control units of Central Processing Unit (CPU)
4	To know IO processor and cache memory organization.
5	To understand CPU performance enhancement strategies

Course Outcomes :	
On completion of this course, the student will be able to :	
CO1	Design Arithmetic and Logic Unit for the given specifications.
CO2	Demonstrate data path and control unit realizations of CPU.
CO3	Analyze cache memory and IO organizations
CO4	Incorporate pipeline concept in a Central Processing Unit (CPU).
CO5	Develop programs of Intel Microprocessor

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PS0 2**
CO 1	3	1	-	3	-	-	-	-	3	-	2	2	2	3
CO 2	3	3	3	2	3	-	-	-	3	2	3	3	2	3
CO 3	2	-	1	-	-	-	-	-	-	-	-	1	2	3

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PS0 2
CO 4	3	3	3	2	2	-	-	-	2	2	2	2	2	3
CO 5	3	3	3	3	3	-	-	-	3	3	3	3	3	3

Correlation rating: Low / Medium / High: 1 / 2 / 3 respectively.

UNIT– I

CPU Organization: Register Transfer Language (RTL), Common bus structure, Arithmetic, Logic and Shift Unit using multiplexer, Design of Basic CPU, HDL Realization of Basic CPU

UNIT– II

Data Path Design: Fixed-Point Arithmetic: Addition, Subtraction, Booth's algorithms for multiplication, Array Multiplier and Wallace tree multiplication, Division - Restoring and Non-restoring algorithms, Overhead in floating point arithmetic, HDL descriptions of Fixed-Point arithmetic

UNIT– III

Control Design: Basic concepts, Hardwired Control unit design approach: classical and one-hot methods, Micro-programmed Control unit approach: basic concept, micro-program sequencer, Design examples: control unit designs for GCD processor, DMA controller and CPU control unit.

UNIT– IV

Memory Organization: Memory Organization: Memory hierarchy, Main memory: RAM, ROM, DRAM, Multi

System Organization: System Organization: communication methods, IO and system control: Programmed IO, DMA and interrupts and Input

UNIT–V

Performance Enhancement Strategies: Reduced Instruction Set Computer (RISC): characteristics and architecture, Parallel processing: Pipeline – Arithmetic and Instruction, Pipeline Conflicts,

The 8086 Microprocessor Family- Overview, 8086 architectures, Flag Register, Segmented memory, Maximum and Minimum mode of operation, Addressing modes, Memory read and Write bus cycles, Instruction Set: data transfer, arithmetic, logical, program Jumps and String instructions, Addressing Modes and Practicing Programs of 8086

Suggested Reading:

1	Morris Mano M, *Computer System Architecture*, 3rd edition, Prentice Hall India, 2007.
2	John P. Hayes, *Computer Architecture and Organization*, 3rd edition, McGraw Hill, 1998.
3	Douglas V.Hall, "Microprocessors and Interfacing Programming and Hardware", 2nd Edition, Tata McGraw- Hill publishing company Limited, New Delhi, 1994.

PC 451 EC	ANALOG ELECTRONICS LAB					
Pre-requisites	Analog Electronics-I and Analog Electronics -II		**L**	**T**	**P**	**C**
			-	-	2	1
Evaluation	**SEE**	50 Marks	**CIE**		25 Marks	

Course Objectives:	
The course is taught with the objectives of enabling the student to:	
1	To understand the design concepts of transistor amplifiers at high frequency.
2	To understand the design concepts of multi stage amplifiers.
3	To understand the design concepts of feedback amplifiers.
4	To understand the design concepts of oscillators.
5	To study the design concepts of power and tuned amplifiers.

Course Outcomes:	
On completion of this course, the student will be able to :	
CO-1	Design the different types of feedback amplifiers.
CO-2	Implement RC & LC oscillator circuits for the given specifications.
CO-3	Design and analyze various tuned amplifiers
CO-4	Determine the frequency response of tuned amplifiers
CO-5	Design simple circuits using Opamps

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	-	1	-	-	1	1	-	-	-	2	-
CO2	3	2	1	2	1	-	-	1	-	-	-	-	1	-
CO3	3	2	2	-	1	-	-	1	-	-	-	-	2	-
CO4	2	1	2	-	-	-	-	1	1	-	-	-	1	-
CO5	3	2	2	2	1	-	-	1	2	-	-	-	3	-

Correlation Rating: Low / Medium / High:1 / 2 /3 respectively.

Experiment - I
Design and Analysis of frequency response of multistage stage RC coupled amplifier using BJT and FET

Experiment - II
Design and Analysis of frequency response of transformer coupled amplifier

Experiment - III
Verification of Miller's Theorem

Experiment - IV
Design and analysis of Darlington Bootstrap amplifier
Experiment - V
Design and Analysis of Voltage Series Voltage Shunt Feedback Amplifier

Experiment - VI
Design and Analysis of Current Series Current Shunt Feedback Amplifier

Experiment - VII
Design and Analysis of RC Phase Shift Oscillator, Wien Bridge Oscillator

Experiment - VIII
Design and Analysis of Colpitts and Hartley Oscillators,

Experiment - IX
Design and verification of Inverting and non-inverting amplifiers and summing amplifier using operational amplifier.

Experiment –X
Design, testing of IF and RF tuned Amplifier with load.

Experiment - XI
Design the Class 'A' power Amplifier and verify characteristics of power amplifier.

Experiment - XII
Design the Class 'B' power Amplifier and verify characteristics of power amplifier.

SUGGESTED READING:

1	Robert Boylestad and Louis Nashelsky, "*Electronic Devices and Circuit theory*", 10th Edition, Prentice Hall of India Private Limited, New Delhi, 2009
2	David A. Bell, "*Laboratory Manual for Electronic Devices and Circuits*", 4th Edition, Prentice-Hall of India Private Limited, New Delhi, 2004

PC 452 EC	DIGITAL SIGNAL PROCESSING LAB					
Pre-requisites			**L**	**T**	**P**	**C**
			-	-	3	1.5
Evaluation	**SEE**	50 Marks	**CIE**		25 Marks	

Course Objectives :	
The course is taught with the objectives of enabling the student:	
1	To understand the concept of basic signals and to generate them using MATLAB.
2	To understand the concept of N-point FFT algorithm.
3	To understand the concept of analog and digital filters and simulation using MATLAB.
4	To study the architecture of TMS320 C54x.
5	To understand the concept of Linear Convolution and simulate it using CCSTUDIO

Course Outcomes :	
On completion of this course, the student will be able to :	
CO-1	Examine the frequency response and impulse response of discrete-time LTI systems
CO-2	Interpret discrete-time signals using DFT
CO-3	Apply FFT algorithms for various signal processing operations.
CO-4	Analyze IIR and FIR digital filters
CO-5	Design IIR and FIR digital filters for real time DSP applications

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	3	3	-	-	3	2	2	-	2	3	-
CO2	3	2	3	2	2	-	-	2	2	3	-	2	3	-
CO3	-	2	2	2	2	-	-	-	2	-	-	-	3	-
CO4	3	2	3	2	2	-	-	2	2	3	-	2	3	-
CO5	2	3	2	3	3	-	-	3	2	2	-	2	3	-

Experiment - I
(a)Generation of basic signals based on recursive difference equations. (b) Operations on Basic sequences

Experiment - II
(a) Linear and Circular Convolutions in time domain and frequency domain (b) Determination of autocorrelation and Power Spectrum of a given signal(s)

Experiment - III
(a) Fast Fourier Transform – DIT and DIF algorithm (b) Spectrum analysis using DFT

Experiment - IV
(a) Generation of windows – Rectangular, Hamming and Hanning window (b) Design of LPF, HPF, BPF and BSF using windowing technique

Experiment - V
(a) Design of Butterworth Filter using Impulse Invariant and Bilinear transformation (b) Design of Chebyshev Filter using Impulse Invariant and Bilinear transformation

Experiment - VI
(a) Implementation of Decimation and Interpolation Process. (b) Implementation of I/D sampling rate converters

Experiment - VII
(a) Study of TMS320C54X DSP processor (b) Arithmetic operation using TMS320C54XX

Experiment - VIII
MAC operation using various addressing modes

Experiment - IX
(a)Perform Linear Convolution of given sequences/Signals (b)Perform Circular Convolution of given sequences/Signals

Experiment –X
(a) FFT Implementation (b) Waveform Generation – Sine wave and Square wave

Experiment - XI
Implementation of FIR filter on DSP processor

Experiment - XII
Implementation of IIR filter on DSP processor .

SUGGESTED READING:

1	John G Proakis, Vinay K. Ingle, “Digital Signal Processing Using MATLAB”, Third Edition, © 2012 by Cengage Learning
2	Sanjit K. Mitra, “Digital Signal Processing: A Computer - Based Approach” second edition,McGrawHill
3	B. Preetham Kumar, “Digital Signal Processing Laboratory”, © 2005 by CRC Press

PE 411 EC	ELECTRONIC MEASUREMENTS AND INSTRUMENTATION					
Pre-requisites	-		**L**	**T**	**P**	**C**
			3	-	-	3
Evaluation	**SEE**	60 Marks	**CIE**		40 Marks	

Course Objectives :	
The course is taught with the objectives of enabling the student to:	
1	To familiarize with various measurement parameters and Standards of measurement.
2	To learn the design principles of Ammeters, Voltmeters and Ohmmeters
3	To understand the operation and applications of CRO
4	To understand about the operation of various Transducers.
5	To understand the working principles and applications of Signal generators and Wave analyzers

Course Outcomes :	
On completion of this course, the student will be able to :	
CO-1	Analyze the various characteristics of measurement parameters and
CO-2	Able to design various ranges of Ammeters, Voltmeters and Ohmmeters.
CO-3	Use the CROs for various applications and explore its features.
CO-4	Explore various types of Transducers and their characteristics.
CO-5	Analyze the operation of various Signal generators and Wave analyzers.

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	-	2	1	-	-	-	-	-	-	1	1	-
CO2	2	2	-	2	1	-	-	-	-	-	-	1	2	1
CO3	2	2	-	1	-	-	-	-	-	-	-	-	1	-
CO4	2	2	-	-	-	-	-	-	-	-	-	-	2	1
CO5	1	1	-	1	-	-	-	-	-	-	-	-	2	1

Correlation rating: Low / Medium / High: 1 / 2 / 3 respectively.

UNIT- I

Measurement Parameters: Introduction of measurement system. Performance characteristics of Instruments, Static and Dynamic Characteristics. Error in Measurement, Types of Errors, Statistical analysis of errors, Limiting errors, Standards of measurement, Fundamental and Derived Units, Systems of Units, International System of Units.

UNIT-II

Voltmeters, Ammeters and Ohmmeters: Basic meter movement, Permanent Magnet Moving Coil movement, D'Arsonval movement, DC Ammeters, Ayrton Shunt, DC Voltmeters, Multi range Voltmeter, Voltmeter Sensitivity, Loading effect, Series- type Ohmmeter, Shunt-type Ohmmeter, Digital Voltmeters, Ramp type, Staircase-Ramp type, Successive approximation type, Dual- slope type (Qualitative treatment only)

UNIT- III

CRO: Basic Principle of CRT, its features, Block diagram and operation of CRO, Oscilloscope Controls, Waveform display, Measurement of frequency and Phase using Lissajous method, Applications and Advantages of CRO, Types of CRO: Dual Beam CRO, Dual Trace CRO, Sampling Oscilloscope, Storage Oscilloscope, Digital storage Oscilloscope.

UNIT- IV

Transducers: Introduction, Electrical Transducer, Factors for Selecting a Transducer, Active and Passive Transducers, Operation and applications of Resistive transducers, Strain gauges, Temperature Measurement: Thermistors, Thermocouple, Thermometer, Inductive transducers, LVDT and RVDT, Capacitive transducers, Piezo-electric Transducers and Photo- electric transducers.

UNIT-V

Signal Generators and Wave analyzers: Basic standard signal generator, Fixed and Variable AF Oscillator, AF Sine and Square wave generator, Function generator, Pulse generator, Sweep Frequency generator, Wave Analyzers, Heterodyne wave analyzer, Harmonic distortion analyzer, Spectrum analyzer (Qualitative treatment only).

Suggested Reading:

1	Albert D.Helfrick and William D.Cooper, "*Modern Electronic Instrumentation and Measurement Techniques",* Prentice-Hall of India Private Limited, New Delhi, 1996.
2	H S Kalsi, *"Electronic Instrumentation", Tata* McGraw-Hill Company Limited, NewDelhi, 2004.
3	David A.Bell, *"Electronic Instrumentation and Measurements",* 2nd Edition, Prentice-Hall of India Private Limited, New Delhi, 1994.

PE 412 EC	OPERATING SYSTEMS					
Pre-requisites	-		**L**	**T**	**P**	**C**
			3	-	-	3
Evaluation	**SEE**	60 Marks	**CIE**		40 Marks	

Course Objectives:	
The course is taught with the objectives of enabling the student to:	
1	To introduce the concepts of OS structure and process synchronization
2	To study different memory management strategies
3	To familiarize the implementation of file system
4	To understand the principles of system security and protection
5	To discuss the design principles and structure of Windows 7 and Linux

Course Outcomes :	
On completion of this course, the student will be able to :	
CO-1	Evaluate different process scheduling algorithms
CO-2	Describe the steps in address translation and different page replacement strategies
CO-3	Compare different file allocation methods and decide appropriate allocation strategy for given type of file
CO-4	Explain the mechanisms available in an OS to control access to resource
CO-5	Understand kernel modules, process management, memory management and file systems in linux

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	1	2	2	-	-	-	-	-	2	-	-
CO2	2	1	2	1	2	1	-	-	-	-	-	2	-	-
CO3	2	2	2	2	2	1	-	-	-	-	-	2	-	-
CO4	2	3	1	2	2	1	-	-	-	-	-	3	-	-
CO5	3	2	1	1	2	-	-	-	-	-	-	-	-	-

Correlation rating: Low / Medium / High: 1 / 2 / 3 respectively.

UNIT– I

Introduction to Operating Systems: OS structure and strategies, Process concepts, Multithreaded Programming, Process scheduling, Process synchronization, Deadlocks.

UNIT– II

Memory management strategies with example architectures: Swapping, Contiguous allocation, Paging, Segmentation, Segmentation with paging , Virtual memory management : Demand paging, Page replacement, Thrashing

UNIT– III

File system interface: File concepts, Access methods and protection. File system implementation: File system structure, Allocation methods, Directory implementation of file systems, Mass storage structures, I/O systems.

UNIT– IV

System Protection: Principles and Domain, Access Matrix and implementation, Access control and access rights, Capability based systems, Language based Protection.

System Security: Problem, Program threats, cryptography, user authentication, implementing security defenses, Firewalling, Computer security Classification

UNIT–V

Case Studies: The Linux System–Design principles, Kernel modules, Process management, Scheduling, Memory management, File systems, Input and Output, Inter process communication. Windows 7 –Design principles, System components, Terminal services and fast user switching File systems, Networking, Programmer interface

Suggested Reading:

1	Abraham Silberschatz, Peter B Galvin, Operating System Concepts, 9th edition, Wiley, 2016
2	William Stallings, Operating Systems-Internals and Design Principles, 8th edition, Pearson, 2014.
3	Andrew S Tanenbaum, Modern Operating Systems, 4th edition, Pearson, 2016.

PE 413 CS	DATA SCIENCE USING R					
Pre-requisites	-		**L**	**T**	**P**	**C**
			3	-	-	3
Evaluation	**SEE**	60 Marks	**CIE**		40 Marks	

Course Objectives:	
The course is taught with the objectives of enabling the student to:	
1	To learn basics of R Programming environment: R language, R- studio and R packages
2	To learn various statistical concepts like linear and logistic regression, cluster analysis, time series forecasting
3	To learn Decision tree induction and association rule mining
4	Explore the concept of decision trees and their applications in classification tasks
5	Implement clustering techniques to group similar data points together

Course Outcomes :	
On completion of this course, the student will be able to :	
CO-1	Use various data structures and packages in R for data visualization and summarization
CO-2	Use linear, non-linear regression models, and classification techniques for data analysis
CO-3	Use clustering methods and association rule mining
CO-4	Demonstrate proficiency in time series data analysis, including data reading, decomposition, and forecasting using ARIMA and exponential smoothing models in R
CO-5	Apply clustering techniques in R to group similar data points together

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2														
CO3														
CO4														
CO5														

Correlation rating: Low / Medium / High: 1 / 2 / 3 respectively.

UNIT– I

Introduction to R: Introduction, Downloading and Installing R, IDE and Text Editors, HandlingPackages in R.

Getting Started with R: Introduction, Working with Directory, Data Types in R, Few Commandsfor Data Exploration

Loading and Handling Data In R: Introduction, Challenges of Analytical Data Processing, Expression, Variables, Functions, Missing Values Treatment In R, Using As Operator To Change The Structure Of The Data, Vectors, Matrices, Factors, List, Few Common Analytical Tasks, Aggregation And Group Processing Of A Variable, Simple Analysis Using R, Methods For ReadingData, Comparison Of R GUI‟s For Data Input.

UNIT– II

Exploring Data In R: Introduction, Data Frames, R Functions for Understanding Data in Data Frames, Load Data Frames, Exploring Data, Data Summary, Finding the Missing Values, InvalidValues and Outliers, Descriptive Statistics, Spotting Problems In Data with Visualization.

UNIT– III

Linear Regression Using R: Introduction, Model Fitting, Linear Regression, Assumptions of LinearRegression, Validating Linear Assumption.

Logistic Regression: Introduction, What Is Regression? Introduction to Generalized Linear Model, Logistic Regression, Binary Logistic Regression, Diagnosing Logistic Regression..

UNIT– IV
Decision Tree: Introduction, What Is a Decision Tree? Decision Tree Representation In R, Appropriate Problems For Decision Tree Learning, Basic Decision Tree Learning Algorithm, Measuring Features, Hypothesis Space Search In Decision Tree Learning, Inductive Bias In Decision Tree Learning, Why Prefer Short Hypotheses, Issues In Decision Tree Learning. **Time Series in R:** Introduction, What Is Time Series Data, Reading Time Series Data, DecomposingTime Series Data, Forecasts Using Exponential Smoothing, ARIMA Models

UNIT–V
Clustering: Introduction, What Is Clustering, Basic Concepts in Clustering, Hierarchical Clustering,K-Means Algorithm. **Association Rules:** Introduction, Frequent Item set, Data Structure Overview, Mining Algorithm Interfaces, Auxiliary Functions, Sampling from Transaction, Generating Synthetic Transaction Data, Additional Measures of Interestingness, Distance Based Clustering Transaction and Association **Mining Frequent Patterns, Associations and Correlations:** Basic Concepts and Methods. Frequent Item set, Closed Item set And Association Rules. Frequent Item set: Mining Methods, Pattern Evaluation Methods

Suggested Reading:

1	Seema Acharya, "*Data Analytics using R*", McGraw Hill education
2	Nina Zumel and John Mount, "*Practical Data Science with R*", Manning Shelter Island
3	Crawley, Michael J., " The R book", John Wiley & Sons, Ltd