CURRICULUM STRUCTURE

FOR

BACHELOR OF TECHNOLOGY
IN

ELECTRONICS & COMMUNICATION ENGINEERING

(Applicable from the academic session 2023-2024)

Haldia Institute of Technology

(An Autonomous Institution Under Maulana Abul Kalam Azad University Of Technology, West Bengal)

ELECTRONICS & COMMUNICATION ENGINEERING
HALDIA INSTITUTE OF TECHNOLOGY
SYLLABUS (*as per NEP 2020*)
AY 2023-2024 ONWARDS

2nd Year: 3rd Semester

Sl No.	Field	Theory	Contact Hours/week				Credit Points
			L	T	P	Total	
A. Theory							
1.	EC301	Electronic Devices & Circuits	3	0	0	3	3
2.	EC302	Digital System Design	3	0	0	3	3
3.	EC303	Signals and Systems	3	0	0	3	3
4.	EC304	Network Theory	3	0	0	3	3
5.	ES-CS305	Data Structure (ES)	3	0	0	3	3
6.	BS-M306	Probability and Statistics (BS) /Mathematics-III	3	0	0	3	3
Total Theory						18	18
B. Practical							
7.	EC391	Electronic Devices & Circuits Lab.	0	0	3	3	1.5
8.	EC392	Digital System Design Lab.	0	0	3	3	1.5
9.	EC393	Signals and Network lab	0	0	3	3	1.5
10	ES-CS394	Data Structure & Algorithm Lab (ES)	0	0	3	3	1.5
Total Practical						12	6
Total Hours/Credits						30	**24**
C. Non Credit Course							
11.	*MC381*	*Environmental Science*	*2*	*0*	*0*	*2*	*0*

2ndYear: 4th Semester

Sl No.	Field	Theory	Contact Hours/week				Credit Points
			L	T	P	Total	
A. Theory							
1.	EC401	Analog Communication	3	0	0	3	3
2.	EC402	Control System & Instrumentation	3	0	0	3	3
3.	EC403	Microprocessor &Microcontrollers	3	0	0	3	3
4.	EC404	Electromagnetics Theory & Transmission Lines	3	0	0	3	3
5.	ES-M405	Numerical Methods(ES)	2	0	0	2	2
Total Theory						14	14
B. Practical							
6.	EC491	Analog Communication Lab	0	0	3	3	1.5
7.	EC492	Control System & Instrumentation Lab	0	0	3	3	1.5
8.	EC493	Microprocessor & Microcontrollers Lab	0	0	3	3	1.5
9.	ES-CS494	Python Programming Lab (ES)	0	0	3	3	1.5
10.	HS-HU495	Technical Report Writing Lab	0	0	2	2	1
Total Practical						14	7
Total Hours/Credits						28	**21**
C. Non Credit Course							
11.	*MC481*	*Economics for Engineers*	*2*	*0*	*0*	*2*	*0*

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3rd Year: 5th Semester

A. Theory							
Sl No.	Field	Theory	Contact Hours/week				Credit Points
			L	T	P	Total	
1.	EC501	Microwave & Antenna Engineering	3	0	0	3	3
2.	EC502	Digital Signal Processing	3	0	0	3	3
3.	EC503	Advanced Digital Communication	3	0	0	3	3
4.	EC-CS504	Computer Architecture (ES)	3	0	0	3	3
5.	PE-EC505 A/B/C/D	Program Elective-1	3	0	0	3	3
Total Theory						15	15
B. Practical							
6.	EC591	Microwave & Antenna Engineering Lab	0	0	3	3	1.5
7.	EC592	Digital Signal Processing Lab.	0	0	3	3	1.5
8.	EC593	Advanced Digital Communication Lab.	0	0	3	3	1.5
9.	EC594	Design Lab.-1 (Mini Project-1)	0	0	4	4	2
10.	EC595	Internet of Things (IoT) Lab	0	0	3	3	1.5
Total Practical						16	8
Total Hours/Credits						31	**23**
C. Non Credit Course							
11.	MC581	Essence of Indian Knowledge, Tradition & Culture	2	0	0	2	0

3rd Year: 6th Semester

A. Theory							
Sl No.	Field	Theory	Contact Hours/week				Credit Points
			L	T	P	Total	
1.	EC601	VLSI Design	3	0	0	3	3
2.	PE-EC602 A/B/C/D	Program Elective-2	3	0	0	3	3
3.	PE-EC603 A/B/C/D	Program Elective-3	3	0	0	3	3
4.	OE-EC604 A/B/C/D	Open Elective-1	3	0	0	3	3
5.	OE-EC605 A/B/C/D	Open Elective-2	3	0	0	3	3
Total Theory						15	15
B. Practical							
6.	EC691	VLSI Design Lab.	0	0	3	3	1.5
7.	EC692	Design Lab.-2 (Mini Project-2)	0	0	4	4	2
8.	EC693	Technical Seminar Presentation Lab	0	0	3	3	1.5
9.	ES-CS694	Object Oriented Programming Lab (ES)	0	0	3	3	1.5
10.	EC695	Robotics Lab	0	0	3	3	1.5
Total Practical						16	8
Total Hours/Credits						31	**23**

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4th Year: 7thSemester

A. Theory							
Sl No.	Field	Theory	Contact Hours/week				Credit Points
			L	T	P	Total	
1.	PE-EC701 A/B/C/D	Program Elective – 4	3	0	0	3	3
2.	HS-HU702	Organizational Behaviour	3	0	0	3	3
Total Theory						6	6
B. Sessional							
3.	EC781	Internship-1 During Semester Break(6&7)	0	0	8	8	4
4.	EC782	Project–1	0	0	12	12	6
5.	EC783	Group Discussion	0	0	4	4	2
Total Practical						24	12
Total Hours/Credits						30	**18**
C. Non Credit Course							
6.	*MC781*	*Indian Constitution*	*2*	*0*	*0*	*2*	*0*

4th Year: 8th Semester

A. Theory							
Sl No.	Field	Theory	Contact Hours/week				Credit Points
			L	T	P	Total	
1.	HS-HU 801	Universal Human Values & Ethics	3	0	0	3	3
Total Theory						3	3
B. Sessional							
2.	EC881	Internship – 2 During Semester Break(7&8)	0	0	8	8	4
3.	EC882	Project–2	0	0	12	12	6
4.	EC883	Grand Viva	0	0	4	4	2
Total Practical						24	12
Total Contact /Credits						27	**15**

Total Credit Points

Year 1 = 38
Year 2 = 45
Year 3 = 46
Year 4 = 33

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LIST OF PROGRAM ELECTIVES

Sl No.	Course Code	Course Title	Hours/week			Credits	Semester	Elective No.
			L	T	P			
1	PE-EC505A	Information Theory and Coding	3	0	0	3	5	PE-1
2	PE-EC505B	Internet of Things (IoT)	3	0	0	3		
3	PE-EC505C	Cloud Computing	3	0	0	3		
4	PE-EC505D	Sensors & Transducers	3	0	0	3		
5	PE-EC602A	Satellite Communication	3	0	0	3	6	PE-2
6	PE-EC602B	Embedded System	3	0	0	3		
7	PE-EC602C	Autonomous Mobile Robots	3	0	0	3		
8	PE-EC602D	Power Electronics	3	0	0	3		
9	PE-EC603A	Mobile Communication and Networks	3	0	0	3	6	PE-3
10	PE-EC603B	Wireless Sensor Networks	3	0	0	3		
11	PE-EC603C	Computer Network	3	0	0	3		
12	PE-EC603D	Bio-Medical Electronics	3	0	0	3		
13	PE-EC701A	Optical Communication	3	0	0	3	7	PE-4
14	PE-EC701B	Digital Image Processing	3	0	0	3		
15	PE-EC701C	Augmented Reality (AR) & Virtual Reality (VR)	3	0	0	3		
16	PE-EC701D	FPGA Design	3	0	0	3		

LIST OF OPEN ELECTIVES

Sl No.	Course Code	Course Title	Hours/week			Credits	Semester	Elective No.
			L	T	P			
1	OE-EC604A	Programming with Java	3	0	0	3	6	OE-1
2	OE-EC604B	Machine Learning (ML)	3	0	0	3		
3	OE-EC604C	Data Science (DS)	3	0	0	3		
4	OE-EC604D	Big Data Analytics	3	0	0	3		
5	OE-EC605A	Human Resource Management	3	0	0	3	6	OE-2
6	OE-EC605B	Cyber Security (CS)	3	0	0	3		
7	OE-EC605C	Artificial Intelligence (AI)	3	0	0	3		
8	OE-EC605D	Entrepreneurship	3	0	0	3		

NOTE- The department may offer suitable additional electives based on the expertise available.

MOOCs
for Honours Degree at B.Tech (ECE)

For B.Tech Honours Degree, a B.Tech student will have to earn 20 credits from MOOCs from any established MOOCs platform addition to 162 credits for B.Tech degree.

All of the MOOCs courses are to be taken any MOOCs platform as per following scheme of credit points. There would not be any concept of fixed basket anymore.
MOOCs courses which are taken for earning credits for Honours degree will not be considered in MAR purpose.

For MOOCs platforms like NPTEL/Swayam, Coursera, edX, Udemy, Simpilearn etc
Courses of 4 weeks to 7 weeks or 20 Hours: 1 credit point
Courses of 8 weeks to 11 weeks or 30 Hours: 2 credit point
Courses of 12 weeks to 15 weeks or 40 Hours: 3 credit point
Courses of 16 weeks or 50 Hours: 4 credit point

1st year	4 to 8 credits
2nd year	4 to 8 credits
3rd year	4 to 8 credits
4th year	4 credits

Mandatory Additional Requirements (MAR)
for earning B.Tech (ECE) Degree

A student should acquire a total of minimum 100/75 activity points throughout 4year/3year curriculum which should be acquired by earning a minimum of 25 activity points in each year of his/her study.
MOOCs courses which are taken for earning credits for Honours degree will not be considered in MAR purpose.

Level of Entry in B.Tech Course	**Total duration for earning Points**	**Minimum Points to be earned**
1st Year onwards	1st to 4th Year	100
2nd Year (Lateral Entry) onwards	2nd to 4th Year	75

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1st Year: 1st Semester

A. Theory							
Sl No.	Field	Theory	Contact Hours/week				Credit Points
			L	T	P	Total	
1.	BS-M 101	Mathematics-I	3	1	0	4	4
2.	BS-PH 101	Physics-I	3	1	0	4	4
3.	ES-EE 101	Basic Electrical & Electronics Engg.	3	1	0	4	4
Total Theory						16	12
B. Practical							
4.	BS-PH 191	Physics-I Lab	0	0	3	3	1.5
5.	ES-EE 191	Basic Electrical & Electronics Engg. Lab	0	0	3	3	1.5
6.	ES-ME 191	Workshop Practice	1	0	3	4	2.5
Total Practical						10	5.5
Total Hours/Credits						26	17.5
C. Non Credit Course							
7.	XC-181	Extra-Curricular Activity (NSS, etc.)	0	0	2	2	0

1st Year: 2nd Semester

A. Theory							
Sl No.	Field	Theory	Contact Hours/week				Credit Points
			L	T	P	Total	
1.	BS-M 201	Mathematics-II	3	1	0	4	4
2.	BS-CH 201	Chemistry-I	3	1	0	4	4
3.	ES-CS 201	Programming for Problem Solving	3	1	0	4	4
4.	HM-HU 201	English Language & Technical Comm.	2	0	0	2	2
Total Theory						14	14
B. Practical							
5.	BS-CH 291	Chemistry-I Lab	0	0	3	3	1.5
6.	ES-CS 291	Programming Lab	0	0	3	3	1.5
7.	ES-ME 292	Engineering Drawing	1	0	3	3	2.5
8.	HM-HU 291	Language Lab	0	0	2	2	1
Total Practical						11	6.5
Total Hours/Credits						25	20.5

EC 301	Electronic Devices & Circuits	3L:0T:0P	3 credits

Course Contents:

Module I : (12L)

1. Over View of Semiconductors, P-N Junction Diode, Bipolar Junction Transistors (BJTs), Ebers-Moll Model and Field Effect Transistors (FETs).
2. Special Diode: Schottky Diode, Tunnel Diode, Varactar Diode, SCR, Photodiode, Solar Cell and LED.
3. Diode Circuits: Clipper, Clamper, Voltage Regulation using Zener Diode.

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Module II : (12L)

1. Small Signal Analysis of BJT: BJT h-parameter model, Analysis of Transistor Amplifier Using h-parameter Model, CB, CE and CC Configurations, Simplified h-parameter Model.
2. Power Amplifier: Amplifier Classes and the Classification of Amplifiers, Mode of Operation on the Basis of Q Point or Operating Point (Class A, B, AB, C).
3. Feedback Topologies: Voltage Series, Current Series, Voltage shunt, Current Shunt.

Module III : (12L)

1. Positive Feedback Amplifier, Barkhausen Criterion, RC Oscillators: Phase Shift, Wien Bridge, LC Oscillators: Hartley, Colpitt.
2. Working Principle of a 555 Timer and Application as a Multivibrators: Monostable, Astable and Bistable.
3. OP-AMP: Basic structure and characteristics, inverting and non-inverting amplifiers. OP-AMP Applications: Integrator, Differentiator, Summing Amplifier, Log-Antilog Amplifiers, Schmitt Trigger and Active Filters: Low Pass, High Pass, Band Pass and Band Stop.

Course outcomes (COs)

CO1: Understanding the Principals of Operation of Semiconductor Devices Analyzing Various Electronic Circuits.
CO2: Designing Different Electronic Devices from the Knowledge of Circuit Analysis.
CO3: Implementing Advanced Electronic Circuits for Analog Domain Application.

Text/ Reference Books:

1. Electronic Devices and Circuits Theory, Boylsted & Nashelsky, Third Edition, Pearson Publications.
2. Microelectronic Circuits (Theory and Applications), Sedra and Smith, Fifth Edition, Oxford Publications.
3. Semiconductor Physics and Devices, D. Neamen and D. Biswas, Third Edition, McGraw-Hill Publications.
4. Solid State Electronic Devices, G. Streetman and S. K. Banerjee, 7th Edition, Pearson Publications.
5. Op-amps and Linear Integrated Circuits, Ramakant A. Gayakwad, Fourth Edition, Prentice Hall Education.
6. Electronic Devices and Circuits, Anil K. Maini and Varsha Agrawal, First Edition, Wiley Publications.
7. Electronic Devices (Conventional Current Version), Thomas L. Floyd, Ninth Edition, Pearson Publications.
8. Semiconductor Devices (Physics and Technology), S. M. Sze, 2nd Edition, Wiley Publications.
9. Physics of Semiconductor Devices, S. M. Sze and K. N. Kwok, 3rd Edition, John Wiley & Sons, 2006.
10. Microelectronics, J. Millman and A. Grabel, 2nd Edition, McGraw Hill Publications, 1988.

Course Assessment Marks

1. Continuous Assessments (CA1, CA2 & CA3): 30%
2. End Semester Examination: 70%

EC302	Digital System Design	3L:0T:0P	3 credits

Course Contents:

Module I:(8L)

Binary Number System& Boolean Algebra(recapitulation), De Morgan's Theorem,Codes and Code conversions; Binary arithmetic,Representation in SOP and POS forms; Minimization of logic, Karnaugh's map.

Module II : (8L)

Combinational logic circuits- Adder &subtructures, Encoders&decoders, Multiplexers&de multiplexers, Magnitude comparators, Parity generators and checkers, Code convertors.

Module III:(12L)

Sequential Circuits - Flip-flops -SR, JK, D, T, JK MS Flip Flops, Shift Registers, Ring counter, Johnson counter ,Synchronous and Asynchronous counters , Design of Mod N Counter, FSM.

Module IV:(6L)

A/D and D/A conversion techniques – Basic concepts (D/A:R-2-R only, A/D: successive approximation), Logic families- TTL, ECL, MOS and CMOS – basic concepts and comparison, Classification and characteristics ofmemories: ROM, PROM, RAM-SRAM, DRAM.

Course Outcomes (COs)

CO1: Illustrate fundamentals of digital electronics, number systems, binary arithmetic, codes and minimization of logical expression.
CO2: Describe the basic concepts of combinational, sequential circuits, digital logic families, A/D and D/A conversion techniques.
CO3: Design and implement the fundamental combinational and sequential logic circuits.
CO4: Formulate the circuit design theory for model development of logic circuits.

Text/ Reference Books:

1. Microelectronics Engineering –Sedra& Smith-Oxford.
2. Principles of Electronic Devices & circuits—B L Thereja&Sedha—S Chand
3. Digital Electronics – Kharate – Oxford
4. Fundamentals of Digital Logic – Anand Kumar – PHI
5. Digital Logic and State Machine Design (3rd Edition) – D.J.Comer, OUP
6. Floyed& Jain- Digital Fundamentals-Pearson.
7. Morries Mano- Digital Logic Design- PHI
8. R.P.Jain—Modern Digital Electronics, 2/e ,McGraw Hill
9. D.RayChaudhuri- Digital Circuits-Vol-I & II, 2/e- Platinum Publishers

Course Assessment Marks

1. Continuous Assessments (CA1, CA2 & CA3): 30%
2. End Semester Examination: 70%

EC 303	Signals and Systems	3L:0T:0P	3 credits

Course Contents:

Module I: (12L)

1. Continuous time and discrete time signals: Basic definition, various forms of representation, signal classifications: continuous time vs. discrete time, one dimensional vs. multi-dimensional, deterministic vs. random, periodic vs. aperiodic. energy vs. power, even vs. odd, causal vs. ant causal etc.. Basic continuous time and discrete time signals: unit impulse, unit step, unit ramp, unit parabolic, sinusoidal, exponential, signum, triangular pulse, rectangular pulse, sinc pulse etc.. Transformation of independent variable of a signal: time shifting, time reversal, time scaling, magnitude scaling. (4L)
2. Continuous time and discrete time systems: continuous time system and discrete time system, classifications of continuous time and discrete time systems: linear vs. non-linear, time variant vs. time invariant. Causal vs non- causal, stable vs unstable, ststic vs. dynamic systems. (4L)
3. Convolution: Linear time invariant (LTI) system, impulse response, convolution sum and convolution integral and their properties. (4L)

Module II: 10L)

1. Fourier series: Continuous time Fourier series (CTFS), Dirichlet's conditions for existence of CTFS, trigonometric Fourier series, exponential Fourier series, evaluation of Fourier series coefficients by different symmetry conditions, line and phase spectra, Discrete time Fourier Series (DTFS). (5L)
2. Fourier Transform: Continuous time Fourier Transform (CTFT), Dirichlet's conditions and convergence of CTFT, properties of CTFT, common CTFT pairs, , inverse Fourier transform, frequency domain analysis of continuous time LTI systems by using CTFT. Discrete time Fourier transform (DTFT), convergence of DTFT, properties of DTFT, inverse DTFT, frequency domain analysis of discrete time LTI systems by using DTFT. (5L)

Module III: (10L)

1. Laplace Transform: Laplace transform, existence of Laplace transform, Region of Convergence (ROC(, relationship between Laplace transform and CTFT, S-plane, concept of pole and zero, common Laplace transform pairs, properties of Laplace transform, inverse Laplace transform, transfer function and analysis of continuous time systems in s-domain.(6L)
2. Sampling of continuous time signal, sampling theorem for low pass and band limited signals, Nyquist rate and interval, aliasing effect, various sampling techniques, reconstruction of continuous time signal from sample values. (4L)

Course outcomes (COs)

CO1: Understand the mathematical description and representation of signals and systems to compute convolution operation.

CO2: Analyse and differentiate Fourier series, Fourier transform and Laplace transform for the frequency domain analysis of various signals and systems.

CO3: Attain in-depth knowledge on sampling theorem for taking samples of a continuous time signal and the process of reconstructing a continuous-time signal from its samples.

Text/ Reference Books:

1. Signals & Systems by Alan V. Oppenheim, Alan S. Willsky, S. Hamid Nawab
2. Signals and Systems by A. Anand Kumar (PHI)
3. Signals and Systems by Simon Haykin and Barry Van Veen (Willey).
4. Signals and systems by P. Ramesh Babu and R. Anandanatarajan (SCITECH Publications)
5. Signals and systems by T K Rawat (OUP)
6. Signals and systems by V Krishnaveni and A Rajeswari (Willey).
7. Signals and systems by A Nagoor Kani (MGH)

Course Assessment Marks

1. Continuous Assessments (CA1, CA2 & CA3): 30%
2. End Semester Examination: 70%

EC304	Network Theory	3L:0T:0P	3 credits

Course Contents:

Module I: (10L)

1. **Node Voltage Network Analysis**: Kirchoff's Current law, Formulation of Node equations and solutions, driving point admittance, transfer Admittance, Star delta transformations, Solution of problems with DC and AC sources.
2. **Mesh Current Network Analysis**: Kirchoff's Voltage law, Formulation of mesh equations, Solution of mesh equations by Cramer's rule and matrix method, Driving point impedance, Transfer impedance, Solution of problems with DC and AC sources.
3. **Network Theorems**: Definition and Implication of Superposition Theorem, Thevenin's theorem, Norton's theorem, Reciprocity theorem, Maximum Power Transfer theorem, Millman's theorem. Solutions and problems with DC and AC sources.

Module II: (12L)

1. **Resonant Circuits:** Series and Parallel resonance, Impedance and Admittance Characteristics, Quality Factor, Half Power Points, Bandwidth, Practical resonant and series circuits, Solution of Problems.
2. **Laplace Transform and Circuit Transient:** Laplace transformation of various signals, inverse Laplace Transform, Partial fraction. DC transients in RL, RC and RLC Circuits with and without initial charge. Application of Laplace transformation for analyzing RC, RL and RLC network with and without initial condition. Analysis of time constant, steady state of response, damping factor, over damped, under damped and undamped conditions.

Module III: (12L)

1. **Two Port Networks**: Relationship of Two port network variables, short circuit admittance parameters, open circuit impedance parameters, transmission parameters, hybrid parameter, relationship between parameter sets, network functions for ladder network and general network.
2. **Graph of Network:** Concept of tree and branch, tree link, junction, Incident matrix, Tie set matrix, Cut set matrix. Determination of Loop current and node voltage.
3. **Network Synthesis:** Hurwitz polynomial, Positive real function and its properties, Elementary synthesis concepts, Realization of LC, RC and RL driving point functions.
4. **Filter:** Introduction to band pass, low pass, high pass and band reject filters.

Course outcomes (COs)

CO1: Realization of basic circuit laws, fundamentals of network theorems and determines the characteristics of different types of two port network.
CO2: Analyse the response of different RL, RC and RLC networks with variation of input signals and apply the Laplace transformation on realization of time response of a network.
CO3: Distinguish different network topologies and various synthesis techniques for creating simple circuits.

Text/ Reference Books:

1. Valkenburg and M. E. Van, "Network Analysis", Prentice Hall./Pearson Education
2. A. William Hayt "Engg Circuit Analysis" 6/e Tata McGraw-Hill
3. D. A. Bell- Electrical Circuits- Oxford
4. P. Ramesh Babu- Electrical Circuit Analysis- Scitech
5. A. Sudhakar: "Circuits & Networks:Analysis & Synthesis" 2/e TMH
6. M. S. Sukhija & T. K. NagSarkar- Circuits and Networks-Oxford
7. Sivandam- "Electric Circuits and Analysis", Vikas

Course Assessment Marks

1. Continuous Assessments (CA1, CA2 & CA3): 30%
2. End Semester Examination: 70%

ES-CS 305	Data Structure	3L:0T:0P	3 credits

Module I: (12 L)

Introduction: Basic Terminologies: Elementary Data Organizations, Array in Data Structure Operations: insertion, deletion, traversal etc.
Searching: Linear Search and Binary Search Techniques and their complexity analysis.
Sorting: Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods

Module II: (8 L)

Stacks: Basic operations: Algorithms and their complexity analysis, Applications of Stacks, Implementation of stack using Array, Infix, Prefix & Postfix: their conversions and evaluations.
Queues: Implementation of Queues using Array, Types of Queue: Simple Queue, Circular Queue; Implementation of Queues using stack, Operations on each types of Queues: Algorithms and their analysis.

Module III: (14 L)

Linked Lists: Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue, Header nodes, Doubly linked list: operations on it and algorithmic analysis; Circular Linked Lists: all operations, their algorithms and the complexity analysis.
Graph: Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis.
Trees: Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees.

Course outcomes (COs)
CO1: Understand basic data structures such as arrays, strings, and linked lists.
CO2: Implement linear data structures such as stacks and queues and understand their difference.
CO3: Analyze tree, graphs, sorting and searching along with their basic operations.

Text/Reference books:
1. "Fundamentals of Data Structures", Illustrated Edition by Ellis Horowitz, Sartaj Sahni, Computer Science Press.
2. Algorithms, Data Structures, and Problem Solving with C++", Illustrated Edition by Mark Allen Weiss, Addison-Wesley Publishing Company
3. "How to Solve it by Computer", 2nd Impression by R.G. Dromey, Pearson Education.

Course Assessment Marks
1. Continuous Assessments (CA1, CA2 & CA3): 30%
2. End Semester Examination: 70%

BS-M 306	Probability and Statistics	3L:0T:0P	3credits

Module I: (14L)

Probability theory and random variable:
Probability: Introduction, Conditional Probability, Multiplication Theorem on Probability, Independent Events, Bayes' Theorem, Bernoulli trials.
Random variables: discrete random variable, continuous random variable, probability mass function, probability density function, cumulative distribution function, properties of cumulative distribution function, marginal probability function, moments, mean, variance of random variable.

Module II: (10L)

Some Standard Distributions:
Distributions: Binomial, Poisson, Uniform, Normal, Exponential and Gamma (their applications and properties mean variance and mgf).
One function of two random variables (like addition, multiplication, division for normal distributed random variables).

Module III: (8L)

Statistics:
Measures of Central Tendency & Dispersion: Mean median, mode, range, upper and lower quartiles, variance, and standard deviation. Concept of error function and complementary error function.
Hypothesis testing: concept of hypothesis testing, type-1 type 2 error.

Course outcomes (COs)

CO1: Understand the knowledge on probability and random variables.
CO2: Apply the theoretical concept of probability distributions in the relevant application areas.
CO3: Understand critically the problems that are faced in testing of a hypothesis with reference to the errors in decision making.

Text/ Reference Books:

1. Probability, Random Variables, and Stochastic Processes- Athanasios Papoulis, S. Unnikrishna Pillai.
2. *Probability* and Random Processes with Applications to Signal Processing by *John* G. *Proakis*.
3. Fundamentals of mathematical statistics- Gupta Kapoor.
4. Groundwork of mathematica probability and statistics- Amithabha Gupta

Course Assessment Marks

1. Continuous Assessments (CA1, CA2 & CA3): 30%
2. End Semester Examination: 70%

EC 391	Electronic Devices & Circuits Lab.	0L:0T:3P	1.5 credits

Laboratory Experiments:

1. To Study the Volt Ampere Characteristics of Diode.
2. Conduct Experiment to Test Diode Clipping (Single/Double Ended) and Clamping Circuits (Positive/Negative).
3. Conduct an Experiment on Series Voltage Regulator using Zener Diode and Three Terminal Voltage Regulators – 7805, 7809, 7912 to Determine Line and Load Regulation Characteristics.
4. Study the Characteristics of Photodiode and LED.
5. To Study the Input and Output Characteristics of BJT.
6. To Study the Output and Transfer Characteristics of FET.
7. Design and Set-up the Tuned Oscillator Circuits using BJT, and Determine the Frequency of Oscillation. (R-C Phase Shift Oscillator/Wien Bridge Oscillator)
8. Design and Study the Operation of Monostable/Bistable/Astable Multibhibretor Circuit using 555 Timer.
9. Design and Study the Operation of Schmitt Trigger Circuits – using IC 741 and IC 555.
10. Design and Study the Operation of Active Filters.

Course outcomes (COs)

CO1: Design and Verify the Characteristics of Basic Electronic Circuit and Device.
CO2: Design and Implement Various Types of Oscillators and Multivibrators.
CO3: Design and Implement Various Electronic Circuits Using OP-Amp for Practical Application.

Course Assessment Marks

1. Practical Continuous Assessments (PCA1 & PCA2): 40%
2. End Semester Examination: 60%

EC 392	Digital System Design Lab	0L:0T:3P	1.5 credits

Laboratory Experiments:

1. Realization of basic logic functions using Universal logic gates.
2. Code conversion circuits-BCD to Excess-3 & Vice Versa.
3. Construction of simple decoder & multiplexer circuits using logic gates.
4. 4-bit parity generator & comparator circuits.
5. Design of combinational circuits for BCD to decimal conversion to drive 7-segment display using Logic gates.
6. Construction of 2:4 decoder and 4:1 multiplexer using suitable gates.
7. Construction of simple arithmetic circuits –adder, subtractor using logic gates.
8. Realization of RS-JK & D flip flops using universal logic gates.
9. Realization of universal register using logic gates, JK flip-flops & multiplexer.
10. Realization of Synchronous/ Asynchronous Up/Down counter

Course Outcomes (COs)

CO1: Design and Implement various combinational logic circuits.
CO2 Design and implement various types of counters and registers using flip-flops.
CO3:Analyzing the circuits for real time applications.

Course Assessment Marks

1. Practical Continuous Assessments (PCA1 & PCA2): 40%
2. End Semester Examination: 60%

EC393	Signals & Networks Lab	0L:0T:3P	1.5 credits

Laboratory Experiments:

1. Generation of different continuous and discrete signals using MATLAB.
2. Creation of different functions and plots various signals using functions in MATLAB.
3. Evaluation of Convolution integral, Continuous and Discrete Fourier transform for Periodic & non-periodic signals with the help of MATLAB.
4. Determination of Laplace transform and inverse Laplace transformation using MATLAB.
5. Demonstrate the Nyquist sampling theorem using MATLAB.
6. Characteristics of series and parallel resonant circuit using Hardware.
7. Transient response of R-L and R-C network using Hardware.
8. Transient response of R-L-C series network using Hardware.
9. Determination of Impedance (Z) and Admittance(Y) parameters of two port network using Hardware.
10. Verification of network theorems using Hardware.

Course outcomes (COs)

CO1: Understand the basic MATLAB coding to compute and plot different signals, transformations and solve equations.
CO2: Analyse the characteristics of different networks by variation of input signals and validate the time response characteristics of networks with theoretical approach and experimental results.
CO3: Create different circuits to verify the network theorems and find characteristics parameters of two port network by experimental data.

Course Assessments Marks

1. Practical Continuous Assessments (PCA1 & PCA2): 40%
2. End Semester Examination: 60%

ES-CS 394	Data Structure & Algorithm Lab.	0L:0T:3P	1.5 credits

Experiments should include but not limited to:

Lab.1: Write a C program-

a) to display Fibonacci series up to a range
b) to read n numbers and display it
c) to insert an element in an array
d) to delete an element from an array.
e) to copy a string into another string

Lab. 2: Implementation of Stack Using Array in C.

Lab. 3: Implementation of queue using array in C.

Lab. 4: Implementation of linked lists, inserting, deleting, and inverting a linked list.

Lab. 5: Write a C program to Search an element using binary search.

Lab. 6: Graph representation and Traversal algorithms (BFS, DFS)

Course outcomes (COs)
CO1: Explain implementation and operations of basic data structures: Linked list, stack, queue, tree and graph.
CO2: Apply programming techniques using pointers, dynamic memory allocation and structures to implement data structures: stack, queue, tree and graph.
CO3: Apply the knowledge of data structure in problem solving.

Course Assessment Marks
1. Practical Continuous Assessments (PCA1 & PCA2): 40%
2. End Semester Examination: 60%

MC 381	Environmental Science	2L:0T:0P	0 credits

Course Contents:

Module I: Energy Resources (10L)

Renewable and non-renewable resources-Natural resources and associated problems, Growing energy needs, Renewable and non-renewable energy sources use of alternate energy sources. Mineral resources: Use and exploitation problems, environmental effects of extracting and using mineral resources. Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity. Organic Farming, Bio fertilizers and Bio-pesticides.

Module II: Ecosystems (8L)

Concept of an ecosystem, Structure and function of an ecosystem, Producers, Consumers and Decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, Food webs and ecological pyramids, Flow of energy, Bio-geochemical cycles, Bio-magnification, Ecosystem values, Services and carrying capacity.

Module III: Environmental Pollution (6L)

Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards. Classification and characters of solid waste, factors affecting waste generation, Collection and disposal of solid waste, E- waste and management, Role of an individual in prevention of pollution.

Module IV: Global Environmental problems (8L)

Green house effect, Green house gasses, Global warming, Climate change and their impacts on human environment, Ozone layer depletion, International conventions / protocols: Earth summit, Kyoto protocol & Montreal protocol. Technological solutions for pollution control, Green-belt-development, Rain water harvesting, Remote sensing and GIS methods.

Course Outcomes (COs)

On completion of the course, student will be able to

CO1 – Develop awareness on energy resources of environment.
CO2 – Understand different types of ecosystems exist in nature.
CO3 – Explain different types of pollutants present in Environment and Global Environmental problems.

TEXT/REFERENCEBOOKS

1. Text of Environmnet studies by Anubha Kaushik, New age publishers, 4th Edition.
2. Erach Bharucha, 2010 “Text Book of Environmental Studies”, University Grants Commission, Universities Press (India) Pvt.Ltd., Hyderabad.
3. Text Book of Environmental Studies by Deeshita Dave & P. Udaya Bhaskar, Cengage Learning.
4. Text Book of Environmental Science and Engineering by G.Tyler Miller Jr,2006 Cengage learning
5. Text Book of Environmental Sciences and Technology by M. Anji Reddy, BS Publications.

Course Assessments Marks

1. Continuous Assessments (CA1, CA2 & CA3): 30%
2. End Semester Examination: 70%

EC 401	Analog Communication	3L:0T:0P	3 credits

Course Contents:

Module I : (8L)

1. **Introduction to Communication systems:** Types of Communication systems, Concept of bandwidth, Electromagnetic spectrum and its usage. Elements of Communication System – Transmitter, Receiver and Channel, Limitations and Problems in communication system. Classification of Analog Communication.
2. **Modulation & Multiplexing:** Modulation, Need for modulation, Classification of Modulation techniques, Applications. Multiplexing, Types of Multiplexing, Applications.
3. **Noise in Communication Systems:** Basic concepts, Types of Noise (Internal and External), White Noise, Thermal Noise, Shot Noise, Atmospheric Noise, Partition Noise. Additive White Gaussian Noise (AWGN) channel, Signal to Noise Ratio (SNR), Figure of Merit, Effect of noise in Analog Communication.
4. **Radio Receiver:** Characteristics & Types of Radio Receiver, Super-heterodyne Receiver: block diagram & working principle, Intermediate Frequency (IF), Local oscillator frequency, Image frequency, Image frequency rejection ratio, RF section and characteristics – Frequency changing and tracking, AGC.

Module II: (12L)

1. **Standard Amplitude Modulation (DSB-FC/DSB-TC):** Time domain and Frequency domain description, Modulation index, Single tone modulation, concept of under, over and critical modulation of AM, Power and efficiency calculations in AM waves, Applications and Limitations. Generation of AM wave: square law modulator,switching modulator. Detection of AM wave: square law detector, envelop detector.
2. **Double Side Band Suppressed Carrier modulation (DSBSC):** Time-Domain and Frequency-Domain representation, Applications. Generation of DSBSC wave: balanced modulator, ring modulator. Coherent detection of DSBSC modulated waves, Effect of phase and frequency errors, Costas loop for carrier recovery.
3. **Single Side Band Suppressed Carrier modulation (SSB-SC):** Frequency-Domain and time-domain description of SSB wave, Applications. Generation of SSB modulated wave: Filter method, Phase shift method and the Third method, Demodulation of SSB waves.
4. **Vestigial Side Band Suppressed Carrier modulation (VSB-SC):** Frequency-domain and time-domain description, Generation and detection of VSB modulated wave, Applications and comparison of different AM techniques.
5. **Effect of Noise in Amplitude Modulation:** Figure of Merit calculation for DSB-TC/DSB-FC, DSB- SC and SSB-SC.

Module III: (12L)

1. **Basic Concepts of Angle Modulation:** Time domain and Frequency domain representation, block diagram representation of generation of Angle Modulated Waves (FM & PM), inseparability of FM & PM, Applications.
2. **Frequency Modulation (FM):** Single tone frequency modulation, Spectrum analysis of sinusoidal FM wave, Narrow band and Wide band FM, Modulation index, Constant average power. Generation of FM wave: Direct and Indirect method. Detection of FM wave: Foster seeley Discriminator, Slope Detector, Zero crossing detector, Phase Locked Loop.
3. **Phase Modulation (PM):** Calculation of Bandwidth for FM and PM with Narrow and Wide - band modulation. Comparison of Narrow band FM and AM.
4. **Effect of Noise in Angle Modulation:** Figure of Merit calculation for FM, Pre-emphasis and De- emphasis in FM.
5. **Pulse Analog Modulation:** Types of Pulse Analog Modulation, Pulse Amplitude Modulation (PAM), Pulse Time Modulation (PTM), Pulse Position Modulation (PPM), Pulse Width Modulation (PWM) or Pulse Duration Modulation (PDM).

Course Outcomes (COs)

CO1: Understand the fundamental working principles of analog communication systems and predict effects of noises on various analog modulation schemes.

CO2: Analyze and compare different analog modulation and demodulation schemes for their efficiency and bandwidth.

CO3: Attain in-depth knowledge of transmitter and receiver design and performance parameters in the development process.

Text/ Reference Books:

1. Taub & Schilling, Principles of Communication Systems, Mc-Graw Hill
2. Lathi & Ding, Modern Digital and Analog Communication Systems, Oxford Univ.
3. Prokais & Salehi, Fundamentals of Communication Systems, Prentice Hall
4. S. Haykin, Communication Systems, Willey
5. Carlson, Communication System, Mc-Graw Hill
6. Singh & Sapre, Communication Systems- TMH
7. P K Ghosh- Principles of Electrical Communications- University Press
8. Blake, Electronic Communication Systems- Cengage Learning
9. S Sharma, Analog Communication Systems- Katson Books
10. P. Ramakrishna Rao, Analog Communication- TMH.
11. V. Chandrasekhar, Analog Communication, Oxford Univ.
12. L.W.Couch Ii, Digital and Analog Communication Systems, Macmillan Publishing
13. Sam Shanmugam, Digital and Analog Communication Systems, Willey
14. Bhatia, Electronic Communication, AICTE

Course Assessment Marks

1. Continuous Assessments (CA1, CA2 & CA3): 30%
2. End Semester Examination: 70%

EC 402	Control System & Instrumentation	3L:0T:0P	3credits

Course Contents:

Module I: (12L)

1. **Introduction:** Concepts of Control Systems- Open Loop and closed loop control systems and their differences- Different examples of control systems- Classification of control systems, Feed-Back Characteristics, Effects of feedback. Mathematical models - Translational and Rotational mechanical systems. (4L)
2. **Transfer function representation:** Block Diagram Representation/Reduction, Representation by Signal flow graph - Reduction using mason's gain formula. (4L)
3. **Time response analysis:** Transient response of second order systems - Time domain specifications – Steady state response - Steady state errors and error constants. (4L)

Module II: (16L)

1. **Stability analysis in s-domain:** The concept of stability – Routh's stability criterion – limitations of Routh's stability. Root Locus Technique: The root locus concept - construction of root loci-effects of adding poles and zeros to G(s)H(s) on the root loci. (4L)
2. **Frequency response analysis:** Frequency domain specifications-Bode diagrams-Determination of Frequency domain specifications and transfer function from the Bode Diagram-Phase margin and Gain margin-Stability Analysis from Bode Plots, Polar Plots, Nyquist Plots Stability Analysis. (4L)
3. (a) **Controller**: PI,PD, PID; 3. (b) **Compensator:** Lag, Lead, Lag-Lead (4L)
4. **State space analysis:** Features of state space models, state variables, inputs and outputs, continuous Time models, state space models for Electrical Circuits. Solving the Time invariant state Equations- State Transition Matrix and its Properties – Concepts of Controllability and Observability. (4L)

Module III: (8L)

1. **Introduction to PLC:** Architecture and function, Input-output modules and interfacing, CPU and memory, Relays, Timers, Counters and their uses, Basic Instructions of PLC programming, ladder logic and applications.Idea of PLR. (5L)
2. **Introduction to DCS:** Structure, ICS, Safety Instrumented System (SIS),SCADA, Application of SCADA, Fieldbus digital protocols such as Foundation Fieldbus, PROFIBUS, HART, Modbus, PC Link, etc. Relation of DCS to neural networks and fuzzy logic, optimal distributed controllers. (3L)

Course outcomes (COs)

CO1: Development of mathematical models of physical systems.
CO2: Analysis of time and frequency response and stability of open loop and close loop system.
CO3: Design the various types of controller and compensator.
CO4: Realization of PLC and SCADA programming for various applications.

Text/ Reference Books:

15. Ogata, K.- State Space Analysis of Control Systems , Prentice Hall.
16. Automatic Control Systems 8th edition– by B. C. Kuo 2003– John Wiley and son's.
17. Control Systems Engineering – by I. J. Nagrath and M. Gopal, New Age International (P) Limited, Publishers, 2nd edition.
18. D.C. Sikdar, Instrumentation and Process Control, Khanna Publishing House (2018).
19. Control Systems Engg. by NISE 3rd Edition – John Wiley.
20. Schulz,D. G. and Melsa ,J. L.- State Functions and Linear Control Systems, McGraw Hill, NY.

Course Assessment Marks

1. Continuous Assessments (CA1, CA2 & CA3): 30%
2. End Semester Examination: 70%

EC 403	Microprocessors & Microcontrollers	3L:0T:0P	3 credits

Course Contents:

Module I: (10L)

1. Microprocessor 8085 – Architecture, pin description, Address / Data Bus multiplexing and de-multiplexing. Status and Control signal generation.
2. 8085 microprocessor Instruction set, Classification of instructions, Addressing modes, Bus communication diagram, timing diagram of the instructions, Delay program.
3. Interrupts of 8085 microprocessor. Basic to advance assembly language programming in 8085 microprocessor.

Module II: (15L)

1. Memory interfacing with 8085 microprocessor, Serial and parallel data transfer – Basic concept of serial I/O, DMA controller.
2. Fundamentals of support ICs like 8255A PPI, 8279, 8259. Interfacing and Programming with 8255A PPI.
3. Microprocessor 8086 - Architecture, Pin details, memory segmentation, addressing modes and interrupts.
4. Familiarization of basic Instructions and assembly language programming in 8086 microprocessor.

Module III: (7L)

1. Microcontroller 8051 – Pin configuration, input/output pins, ports, external memory, counters and timers, instruction set, addressing modes, serial data i/o, interrupts. Assembly language Programming using 8051.
2. Brief introduction to PIC microcontroller (16F877): Architecture, PIN details.

Course Outcomes (COs)

CO1: Demonstrate the understanding of Microprocessors and Microcontrollers architecture.
CO2: Apply the knowledge of instructions to develop programming capability in assembly language.
CO3: Analyse the various interfacing and data transfer techniques from memory and implement important peripheral support ICs.

TEXT / REFERENCE BOOKS:

1. Microprocessor architecture, programming and application with 8085 – R. Gaonkar (Penram International)
2. The 8051 microcontroller - K. Ayala (Thomson)
3. Advanced Microprocessors & Peripherals, Ray & Bhurchandi, TMH
4. The 8051 microcontroller and Embedded systems - Mazidi, Mazidi and McKinley (PEARSON)
5. Microprocessors and microcontrollers - N. Senthil Kumar, M. Saravanan and Jeevananthan (OUP)
6. 8086 Microprocessor –K Ayala (Cengage learning)
7. Microprocessors – The 8086/8088, 80186/80386/80486 and the Pentium family – N. B. Bahadure (PHI).
8. The 8051 microcontrollers – Uma Rao and Andhe Pallavi (PEARSON).

Course Assessment Marks

1. Continuous Assessments (CA1, CA2 & CA3): 30%
2. End Semester Examination: 70%

EC-404	ELECTROMAGNETICS THEORY AND TRANSMISSION LINES	3L:0T:	3 credits

Course Contents:

Prerequisites: Review of Vector calculus and orthogonal co-ordinate systems.

Module I: ELECTROMAGNETICS FUNDAMENTALS (8L)

Basic laws of electrostatic fields and magnetostatic fields. Electromagnetic-Gauss's law, Ampere's Circuital law, Faraday's law of Electromagnetic induction., Maxwell's Equations for time varying fields. Boundary conditions at media Interface.

Module II: PLANE WAVES AND WAVE PARAMETERS FOR DIFFERENT MEDIA AND AT INTERFACE (10L)

Homogeneous unbound medium, Wave equations for time harmonic fields, Solution of the wave equation, Uniform plane wave, Wave polarization and types, Wave propagation in conducting medium and free space medium, Phase velocity of a wave, Power flow and Poynting vector.

Plane wave at dielectric interface, Reflection and refraction of waves at dielectric interface for normal and oblique incidence, Total internal reflection, Wave polarization at media interface for parallel and perpendicular cases, Brewster angle.

Module III: TRANSMISSION LINES (8L)

Equations of Voltage and Current on TX line, Propagation constant and characteristic impedance, and reflection coefficient and VSWR, Loss-less and Low loss Transmission line, Input Impedance. Power transfer on TX line, Smith Chart. Applications of transmission lines: Impedance Matching, use transmission line sections as circuit elements. Losses in transmission lines.

Module IV: WAVEGUIDE (8L)

Wave propagation in parallel plane waveguide, Analysis of waveguide general approach, rectangular waveguide, Modal propagation in rectangular waveguide considering TE and TM, Surface currents on the waveguide walls and Field visualization overview, Attenuation in waveguides. Circular wave guides and Microwave resonators brief overview only. Q-factor.

Total: 34 L

Course Outcomes (COs)

On completion of the course, student will be able to

CO1: Outline the fundamental concepts of time varying fields and equations involved in electromagnetics.

CO2: Explain the wave propagation and its various parameters involved for different media as well as interface.

CO3: Apply the concept of wave propagation for transmission line characteristics.

CO4: Illustrate the wave propagation phenomenon inside metallic waveguides.

TEXT/REFERENCE BOOKS

1. E.C. Jordan, and K.G. Balmain, "Electromagnetic Waves and Radiating Systems",2nd Edition, PHI,2006.
2. S.P. Seth, "Elements of Electromagnetic Fields", 2nd Edition, Dhanpat Rai and Sons, 2007.
3. R. K. Shevgaonkar, "Electromagnetic Waves", Tata McGraw Hill, 2005.
4. Samuel Y. Liao, "Microwave devices and circuits", 3rd Edition, Prentice Hall of India, 2003.
5. M. N.O. Sadiku, "Elements of Electromagnetics", Oxford University Press, 2007.
6. G.S.N. Raju, "Electromagnetic field theory and transmission lines", Pearson Education India,2006.

Course Assessment Marks

1. Continuous Assessments (CA1, CA2 & CA3): 30%
2. End Semester Examination: 70%

ES-M 405	Numerical Methods (BS)	2L:0T:0P	2 credits

Module I: (10 L)

Approximation in numerical computation: Truncation and rounding errors, Fixedand floating-point arithmetic, Propagation of errors. Interpolation: Newton forward/backward interpolation, Lagrange's and Newton's divideddifference Interpolation. Numerical integration: Trapezoidal rule, Simpson's 1/3 rule, Expression for correspondingerror terms.

Module II: (8 L)

Numerical solution of a system of linear equations:
Gauss elimination method, Matrix inversion, LU Factorization method, Gauss-Seidel iterative method. Numerical solution of Algebraic equation: Bisection method, Regula-Falsi method,Newton-Raphson method.

Module III: (4 L)

Numerical solution of ordinary differential equation: Euler's method, Runge-Kuttamethods, Predictor-Corrector methods and Finite Difference method.

Course Outcomes (COs)

CO1: Ability to model engineering systems using differential equations and solve the equations both analytically & numerically.

CO2: Analyze and evaluate the accuracy of common numerical methods.

CO3: Ability to assess the approximation techniques to formulate and apply appropriate strategy to solve real world problems.

Text / Reference Books:

1. C. Xavier: C Language and Numerical Methods.
2. Dutta& Jana: Introductory Numerical Analysis.
3. J. B. Scarborough: Numerical Mathematical Analysis.
4. Jain, Iyengar, & Jain: Numerical Methods (Problems and Solution).
5. Balagurusamy: Numerical Methods, Scitech.
6. Baburam: Numerical Methods, Pearson Education.
7. N. Dutta: Computer Programming & Numerical Analysis, Universities Press.
8. Soumen Guha & Rajesh Srivastava: Numerical Methods, OUP.
9. Srimanta Pal: Numerical Methods, OUP.

Course Assessment Marks

1. Continuous Assessments (CA1, CA2 & CA3): 30%
2. End Semester Examination: 70%

EC 491	Analog Communication Lab	0L:0T:3P	1.5 credits

Laboratory Experiments:

1. Design and study of Standard AM modulation and demodulation.
2. Study of DSB-SC modulation and demodulation.
3. Study of SSB-SC modulation and demodulation.
4. Study of FM modulation and demodulation.
5. Design and study of a VCO.
6. Design and study of a PLL to measure the capture & lock frequency.
7. Design and study of Pre-emphasis and De-emphasis circuits.
8. Study of PAM and demodulation.
9. Study the characteristics of a super-heterodyne radio receiver.

Course outcomes (COs)

CO1: Design and examine different types of AM modulators & demodulators to understand the fundamental working principles of analog communication systems.
CO2: Develop and experiment FM modulator & demodulator using PLL & VCO to analyze efficiency and bandwidth.
CO3: Attain in-depth knowledge of super-heterodyne radio receiver design and measure the performance parameters.

Course Assessment Marks

1. Practical Continuous Assessments (PCA1 & PCA2): 40%
2. End Semester Examination: 60%

EC 492	Control System & Instrumentation Lab	0L:0T:3P	1.5credits

Laboratory Experiments:

1. Familiarization with MATLAB Control System tool Box, MATLAB- SIMULINK tool box
2. Determination of step response for 1st order & 2nd order system with an unity feedback on CRO & calculation of control system specifications for variations of system design.
3. Simulation of step response & impulse response for Type-I & Type-II system with unity feedback using MATLAB .
4. Determination of root locus using MATLAB control system toolbox for a given 2^{nd} order transfer function & determination of different control system specifications.
5. Determination of Nyquist Plot using MATLAB control system toolbox for a given 2nd order transfer function & determination of different control system specifications.
6. Determination of approximate transfer function experimentally using Bode Plot.
7. Design and study of instrumentation amplifier.
8. Design of Lag, lead compensators and evaluation of closed loop performance.
9. Design of PID controllers and evaluation of closed loop performance.
10. Design of PID controllers and evaluation of closed loop performance

Course Outcomes (COs)

CO1: To model and analyze simple physical systems and simulate the performance in analog and digital platform.
CO2: To design and implement simple controllers in standard forms.
CO3: To design compensators based on time and frequency domain specifications

Course Assessment Marks

1. Practical Continuous Assessments (PCA1 & PCA2): 40%
2. End Semester Examination: 60%

EC 493	Microprocessors & Microcontrollers Lab	0L:0T:3P	1.5 credits

Laboratory Experiments:

1. Introduction to 8085 microprocessor kit with assembly language program for swapping of data between two memories, exchange the data between two block of memories, copy block of data.
2. Assembly language program for addition of two 8-bit data, addition of two 16 bit data, addition of two BCD number, subtraction of two 8 bit data using 1's and 2's complement.
3. Assembly language program for multiplication of two 8 bit data, division of two 8 bit data, mask off and split up.
4. Assembly language program for searching largest and smallest number from a block of data, sorting in ascending and descending order of a block of data.
5. Assembly language program for addition of two 16 bit data, subtraction of two 16 bit data and multiplication of two 16 bit data in 8086 microprocessor kit.
6. Assembly language program to find the smallest word in an array, find the number of positive and negative data in an array, BCD to binary conversion.
7. Assembly language program for addition of three 8 bit numbers, addition of two BCD numbers, addition of two 16 bit numbers, finding a largest number in a block of data using 8051 microcontroller.
8. Interface a seven segment display with 8051 microcontroller using 74LS240 IC and write the assembly language program.
9. Interface LEDs with 8051 microcontroller using 74LS240 IC and write the assembly language program for traffic light control.

Course Outcomes (COs)

CO1: Apply the knowledge of instructions and logic to execute assembly language programming in 8085 microprocessor.
CO2: Analyze memory segmentation to create simple assembly language programs in advanced microprocessors.
CO3: Implement various interfacing techniques using assembly language programming in microcontrollers.

Course Assessment Marks

1. Practical Continuous Assessments (PCA1 & PCA2): 40%
2. End Semester Examination: 60%

ES-CS 494	Python Programming lab	0L:0T:3P	1.5 credits

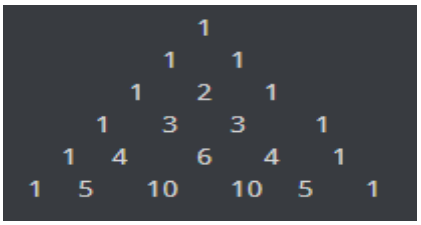
Laboratory Experiments:

Lab 1: INTRODUCTION DATA, EXPRESSIONS, STATEMENTS

1. Write a Python Program
   - To Print Hello world!
   - Add Two Numbers
   - Find the Square Root
   - Swap Two Variables
   - Convert Celsius to Fahrenheit
   - To Check Prime Number
   - Check if a Number is Positive, Negative or 0.
2. Python Program to Check Leap Year.
3. Generating a Four-Digit Random PIN in Python using the random Module.
4. Generating Strong Password using Python (mixture of numbers, alphabets, and other symbols found on the computer keyboard to form an 8-character password)

Lab 2: CONTROLFLOW, LOOPS, & FUNCTIONS

1. Write a Python Program-
   - Check Armstrong number
   - Find the Sum of N natural numbers
   - Find HCF three numbers
   - Find the Factors of a number
2. Print the following pattern



2. Write a python program-
   - Display all prime numbers within a range
   - Swap elements in String list
4. Python Program to Make a Simple Calculator using function.

Lab 3: LISTS, TUPLES, DICTIONARIES

1. Write a python program-
   - Print all odd numbers in a range
   - Find second largest number in a list
   - Multiply all numbers in the list
   - Split String of list on K character
   - Remove duplicates from a list
   - Find the list of words that are longer than n from a given list of words.

2. Write a python program to extract elements with Frequency greater than K in a list.
3. Write a Python program to print the numbers of a specified list after removing even numbers from it.
4. Write a Python program to change the position of every n-th value to the (n+1)th in a list.

Sample list: [10,11,12,13,14,15]
Expected Output: [11, 10, 13,1 2, 15, 14]

Lab 4: Object-Oriented Programming.

3. Introduction to Object Oriented Programming in Python
2. Difference between object and procedural oriented programming
3. What are Classes and Objects?
4. Object-Oriented Programming methodologies:
    - Inheritance
    - Polymorphism
    - Encapsulation
    - Abstraction

Course outcomes (COs)

CO1: To implement the basic concepts of python programming like Math Function, Strings, List, Tuple and Dictionary.
CO2: To implement the programs using conditional and loop statements.
CO3: Develop python programmes utilized searching, sorting and merging algorithms.
CO4: Implementing OOPs concept in Python

Course Assessments

1. Practical Continuous Assessments (PCA1 &PCA2): 40%
2. End Semester Examination: 60%

HS-HU 495	Technical Report Writing Laboratory	0L:0T:2P	1 credits

This laboratory course is designed to equip B.Tech students in Electronics & Communication Engineering with the skills required to produce effective technical reports. Students will engage in hands-on activities, drafting, editing, and presenting technical reports across their own domain and will learn to communicate technical information clearly and precisely.

Laboratory Experiments:

Lab 1: Introduction to Technical Reports
1. Overview of technical report writing principles and expectations.
2. Analysis of exemplary technical reports.
3. Initial group formation for collaborative projects in Electronics & Communication Engineering.

Lab 2: Understanding Audience and Purpose
1. Identifying target audiences and defining objectives for reports.
2. Planning and conducting audience analysis exercises.
3. Formulating project proposals exercises specific to Electronics & Communication Engineering contexts.

Lab 3: Structure and Organization of Reports
1. Principles of logical and effective report structure.
2. Drafting the outline and initial sections of a technical report.
3. Peer review and feedback on report structures.

Lab 4: Visual Elements and Document Design
1. Incorporating visuals, graphics, schematics, tables and relevant technical illustrations into reports.
2. Formatting techniques for enhancing readability.
3. Lab sessions on document design software.

Lab 5: Editing and Revision
1. Strategies for effective editing and revision.
2. Practice sessions on revising draft reports related to Electronics & Communication Engineering discipline.
3. Peer review workshops for feedback and improvement focused on this field.

Lab 6: Specialized Reports and Presentation Skills
1. Writing technical reports specific to Electronics & Communication Engineering domains such as signal processing, telecommunications, etc.
2. Developing oral presentation skills: structuring and delivering technical information effectively.
3. Presentation rehearsals and feedback sessions related to Electronics & Communication Engineering topics.

Lab 7: Final Project and Conclusion
1. Completion and submission of the final technical report.
2. Presentation of the projects to the class.
3. Course review, reflections, and final assessments.

Course outcomes (COs)

CO1: Develop proficiency in drafting and formatting technical reports ensuring relevance and applicability to their academic and professional pursuits.
CO2: Apply principles of clarity, accuracy, and precision in technical communication and utilize appropriate visual aids and formatting techniques to enhance report comprehension for specific learning needs.
CO3: Practice effective revision strategies for technical reports in peer review and improve skills for presenting technical information orally, combining theoretical understanding with practical application and collaborative work.

Course Assessments

1. Practical Continuous Assessments (PCA1 & PCA2): 40%
   Participation and Attendance: 10 ; Quiz on Syllabus & Basic Skills: 10 ; Draft Proposal (peer-reviewed): 20
2. End Semester Examination: 60%
   Final Technical Report (peer-reviewed): 40 ; Oral Presentation and viva: 20

MC-481	ECONOMICS FOR ENGINEERS	2L:0T:0P	0 credits

Course Contents:

Prerequisites: Engineering Economics Overview (definition, function and scope).

Module I: ECONOMICS FUNDAMENTALS (5 L)

Economic Decisions Making - Overview, Problems and Role, Decision making process biref idea.

Fixed and variable cost, Product and Process Costing, Standard Costing, Cost estimation, Relevant Cost for decision making, Cost estimation, Cost control and Cost reduction techniques. Types of Estimate and Estimating Models brief idea only.

Module II: CASH FLOW ANALYSIS (6 L)

Time value of money: simple & compound interest. Cash Flow - Diagrams, Categories & Computation, Debt repayment, Nominal & Effective Interest. Rate Of Return Analysis - Calculations, Annual Cash Flow Analysis, Internal Rate of Return, Calculating Rate of Return, Incremental Analysis; Best Alternative Choosing An Analysis Method, Future Worth Analysis, Benefit-Cost Ratio Analysis, Breakeven Analysis.

Module III: INFLATION AND PRICE INDEXING (5 L)

Inflation And Price Change - Definition, Effects, Causes, Price Change with Indexes, Types of Index, Composite vs Commodity Indexes, Use of Price Indexes In Engineering Economic Analysis. Present Worth Analysis: Viewpoint Of Economic Analysis, Borrowed Money Viewpoint, Effect Of Inflation & Deflation. Taxes.

Module IV: DEPRECIATION AND ACCOUNTING (6 L)

Depreciation, Computing depreciation charges, after tax economic comparison, Break-even analysis; linear and non-linear models, Sensitivity analysis overview only.

Accounting Concepts: Double-Entry system, Journal, Ledger, Trial balance, Final Accounts Book Keeping system brief idea.Concept of financial management-Types of Capital: Fixed and Working Capital and Methods of Raising Finance; Final Accounts- Trading Account, Statement of Profit and Loss, Balance Sheet overview.

Total: 22 L

Course Outcomes (COs):

On completion of the course, student will be able to

CO1: Understand the economic concepts, decision making, costing and price policies.

CO2: Interpret the impact of cash flow, inflation, deflation, depreciation and taxing in context of economic activities.

CO3: Apply the concepts of financial management and accounting in the economic scenario.

TEXT/REFERENCEBOOKS

1. James L.Riggs,David D. Bedworth, Sabah U. Randhawa : Economics for Engineers 4e, TMH.
2. Donald Newnan, Ted Eschembach, Jerome Lavelle : Engineering Economics Analysis, OUP.
3. John A. White, Kenneth E.Case,David B.Pratt : Principle of Engineering Economic Analysis, John Wiley
4. R.Paneer Seelvan: Engineering Economics, PHI.
5. Michael R Lindeburg : Engineering Economics Analysis, Professional Pub.
6. A.R. AryaSri, Managerial Economics and Financial Analysis, TMH Publications, New Delhi.

EC-501	MICROWAVE AND ANTENNA ENGINEERING	3L:0T:0P	3 credits

Course Contents:

Prerequisites: Review of Electromagnetic waves and propagation.

Module I: MICROWAVE PASSIVE COMPONENTS (8L)

N-port networks-Properties of S matrix, Transmission matrix & their relationships; Microwave passive components and their S matrix representation: Attenuators, Phase shifter, Directional coupler, Bethe-hole coupler, Magic tee, hybrid ring, Circulators, Isolators.

Module II: MICROWAVE ACTIVE COMPONENTS (9L)

Design considerations for microwave tubes, current status of microwave tubes, principle of operation of multicavity and reflex klystron, magnetron and traveling wave tube, Operation and circuit applications of Gunn diode, IMPATT diode, PIN Diode, and Schottky barrier diode.

Module III: ANTENNA FUNDAMENTALS AND WIRE ANTENNAS (9L)

Basic antenna elements, properties of antenna, Isotropic radiator. Antenna parameters(definition only):Radiation Intensity, Radiation pattern, Gain, Directivity, FBR, Effective Length, Effective Aperture, Radiation Resistance, Antenna Terminal Impedance, Polarization, Beamwidth, Bandwidth, Antenna temperature, Friis transmission formula. Wire Antennas: Retarded Potentials, Short Electric Dipole, Radiation from alternating current element, half wave Dipole, quarter wave monopole-Fields, Power radiated and Radiation Resistance.

Module IV: TRAVELLING WAVE AND BROADBAND ANTENNAS (6L)

Effect of ground on ungrounded antenna-Methods of excitation-Travelling wave radiators: basic concepts, Long wire antennas-field strength calculations and patterns-V-antennas, Rhombic Antennas, Small Loop antennas-Concept of short magnetic dipole, Helical Antennas, Folded Dipole Yagi-Uda Arrays, Log periodic antennas.

Total: 32 L

Course Outcomes (COs)

On completion of the course, student will be able to

CO1: Explain the functional behavior of microwave passive components using S-matrix.

CO2: Illustrate the operating principle of microwave sources.

CO3: Demonstrate the fundamental concept of radiation mechanism of antennas.

CO4: Apply the principle of radiation method for analyzing different narrow band and broad band antennas.

TEXT/REFERENCE BOOKS

1. Samuel Y. Liao, “Microwave Devices and Circuits”, PHI, 3rd Edition, 1994.
2. R.E. Collin, “Foundation of Microwave Engineering”, McGraw Hill, 2nd Edition, 1992.
3. K.C. Gupta., “Microwaves”, Wiley Eastern Ltd., 1995.
4. M.L. Sisodia and G.S. Raghuvanshi., “Microwave Circuits and Passive Devices”, Wiley Eastern Ltd., 1995.
5. C.A. Balanis, “Antenna Theory and Design”,4th Edition, JohnWileyandSons,2016.
6. J.D. Kraus, “Antennas”, McGraw Hill, 1988.
7. R. E. Collin, “Antennas and Radio Wave Propagation”, McGrawHill,1985.

Course Assessment Marks

1. Continuous Assessments (CA1, CA2 & CA3): 30%
2. End Semester Examination: 70%

EC502	Digital Signal Processing	3L:0T:0P	3 credits

Course Contents:

Module I:(10L)

1. **Discrete Convolution:** Impulse Response and Convolution Sum; Linear Convolution of Finite Sequences; Properties of the Convolution Sum; Deconvolution; Periodic or Circular Convolution; Linear Convolution from Periodic Convolution; Periodic Convolution from Linear Convolution, Sectioned Convolution – Overlap Add & Overlap Save method. (5L)

2. **Z-Transforms:** Z-Transform and ROC of Finite Duration Sequences; Properties of ROC; Properties of Ztransform; Inverse Z-transform; Impulse Response and Transfer Function; Stability and Causality; Solution of Difference Equations Using Z-transforms; Deconvolution Using Z-transform. (5L)

Module II: (10L)

1. **Discrete Fourier Transform (DFT):** Discrete Fourier Transform (DFT) of Discrete Time Signal; Inverse DFT (IDFT); Properties of DFT; Relation Between DFT and Z-Transform; Analysis of LTI Discrete Time Systems using DFT. (5L)

2. **Fast Fourier Transform (FFT):**Fast Fourier Transform (FFT); Computation of inverse DFT Using FFT; Linear Convolution Using DFT; Circular Convolution Using DFT and IDFT. (5L)

Module III: (12L)

1. **Infinite-duration Impulse Response (IIR) Filters:** Frequency response of analog and digital IIR filters, Requirements for Transformation, Impulse invariant transformation, Bilinear transformation, Specifications of digital IIR lowpass filter, Design of lowpass digital Butterworth filter, Design of lowpass digital Chebyshev filter, Analog and Digital Frequency transformation. (4L)

2. **Finite Impulse Response (FIR) Filters:** LTI system as Frequency Selective Filters; Ideal Frequency Response of Linear Phase FIR Filters; Characteristics of FIR Filters with Linear Phase; Frequency Response of Linear Phase FIR filter; Design Techniques for Linear Phase FIR Filters; Fourier Series Method of FIR Filter Design; FIR Filter Design Using Windows; Design of FIR Filters by Frequency Sampling Technique. (4L)

3. **System Realization:** Realization of Discrete-time Systems, Structures for Realization of IIR& FIR Systems, Application of DSP.(4L)

Total Lectures: 32L

Course Outcomes:
At the end of this course, students will be able to
CO1: Understand and differentiate various convolution methods (i.e., linear, circular etc.) on discrete time sequences with examples and exercises.
CO2: Analyze and differentiate Z-transform using different algorithms/methods on discrete time sequences with examples and exercises.
CO3: Analyze and differentiate DFT/IDFT and FFT/IFFT using different algorithms/methods on discrete time sequences with examples and exercises.
CO4: Attain in-depth knowledge to differentiate IIR and FIR digital filters using different techniques for various applications.

Text/Reference Books:

1. Discrete Time Signal Processing, A.V. Oppenheim and Schafer, Prentice Hall.
2. Digital Signal Processing: Principles, Algorithms and Applications, John G. Proakis and D.G. Manolakis, Prentice Hall.
3. L.R. Rabiner and B. Gold, Theory and Application of Digital Signal Processing, Prentice Hall.
4. Digital Signal Processing, A. Anand Kumar, PHI.
5. Digital Signal processing – A Computer Based Approach, S.K. Mitra, TMH.
6. Digital Signal Processing, P. Rameshbabu, Scitech Publications (India).
7. Digital Signal Processing, S. Salivahanan, A. Vallabraj& C. Gnanapriya, TMH.
8. Digital Signal Processing, A. NagoorKani, TMH.

Course Assessment Marks
1. Continuous Assessments (CA1, CA2 & CA3): 30%
2. End Semester Examination: 70%

EC503	Advanced Digital Communication	3L:0T:0P	3 credits

Course Contents:

Module I: (12L)

1. **Signal and Vector:** Analogy between signal and vector, orthogonality and orthonormality, basis function, orthogonal signal space, signal constellation, geometric interpretation of signals.
2. **Digital Data Transmission (Waveform Coding):** Pulse Code Modulation (PCM), quantization, uniform and non-uniform quantization, quantization noise, binary encoding, A-Law and μ -law companding, differential PCM, delta modulation and adaptive delta modulation.
3. **Baseband Transmission:** Digital transmission components, source, multiplexer, line code, regenerative repeater, concept of line coding – polar/unipolar/bipolar NRZ and RZ, Manchester, differential encoding and their PSDs, pulse shaping, Inter Symbol Interference (ISI), Eye pattern, Nyquist criterion for zero ISI, equalizer, zero forcing equalizer, timing extraction.

Module II: (12L)

Pass band Transmission:

1. **Digital modulation techniques:** ASK, FSK and PSK, (coherent and non-coherent). Geometrical representation of ASK, BPSK, QAM and BFSK wave. Concept of DPSK, QPSK and OQPSK. Generation ASK, BPSK, QPSK and BFSK.
2. **Digital Demodulation techniques:** Dump filter, Matched filter, correlator receiver, MAP rule, ML detection.
3. **Probability of error:** ASK, BPSK, BFSK
4. **Other digital modulation techniques:** Concept of Minimum Shift Keying (MSK), GMSK, basic concept of OFDM.

Module III: (8L)

Advanced Communication:

1. **Wireless Communication:** Introduction to wireless communication system, the cellular concept (frequency reuse, handoff strategies, co-channel interference), concept of wireless standard, GSM and 4G LTE.
2. **Optical Communication:** Basic concept of optical communication. Classification of optical fiber, optical source, receiver and amplifier.

Course Outcomes (COs)

CO1: Understand the fundamental concept of digital communication systems and relate analogy between signal and vector.
CO2: Develop the basic concept of different digital modulation as well as demodulation techniques, capable to analyse the error probability of different modulation schemes.
CO3: Understand and apply for advanced digital modulation techniques.
CO4: Able to apply in wireless and optical communication

Text/ Reference Books:

1. Modern Digital and Analog Communication Systems by Lathi and Ding
2. Digital Communications by Proakis and Salehi
3. Wireless Communication by Rappaport
4. Optical fiber communications by G.Keiser
5. Communications Systems, by Simon Haykin

Course Assessment Marks

1. Continuous Assessments (CA1, CA2 & CA3): 30%
2. End Semester Examination: 70%

EC-CS 504	Computer Architecture (ES)	3L:0T:0P	3 credits

Course Contents:

Module I: (6L)

1. Basic Structure of Computers, Computer organization and architecture, Harvard & Von Neumann architecture, Functional units, software, performance issues software, machine instructions and programs, Types of instructions, Instruction sets: Instruction formats, Assembly language, Stacks, Ques, Subroutines.
2. Processor organization, Information representation, number formats.
3. Multiplication & division, ALU design (combinational ALU & sequential ALU), Floating Point arithmetic, IEEE 754 floating point formats. Control Design, Instruction sequencing, Interpretation, Hard wired control - Design methods, and CPU control unit. Microprogrammed Control - Basic concepts, minimizing microinstruction size, multiplier control unit. Microprogrammed computers - CPU control unit.

Module II: (11L)

1. Memory organization, device characteristics, RAM, ROM, Memory mapping and management techniques , Concept of Cache & associative memories, Cache memory organizations, Techniques for reducing cache misses; Hierarchical memory technology: Inclusion, Coherence and locality properties, Virtual memory, memory replacement policies.
2. CPU Organization: Fundamentals, Processor-memory communication [Clock cycles and Timing Diagram], Instruction cycle, RISC & CISC based architecture. System organization, Input - Output systems, Interrupt, DMA, Standard I/O interfaces.

Module III: (11L)

1. Concept of parallel processing, Details of Pipelining, instruction and arithmetic pipeline, data hazards, control hazards and structural hazards, techniques for handling hazards, Pipeline optimization techniques.
2. Flynn's classification –SISD, SIMD, MISD, MIMD architectures, Forms of parallel processing, interconnect network,
3. Instruction-level parallelism: basic concepts, techniques for increasing ILP, superscalar, super pipelined and VLIW processor architectures, Array and Vector processors.

Module IV: (6L)

1. Introduction to Multi-core Processor, Roadmap to modern multi-core processors, architecture and working principle [brief study].
2. Various proposed and implemented methods of load balancing in multi-core processors: their challenges and future directions, Instruction-level parallelism: basic concepts.

Course Outcomes (COs)

CO1:Study and analyze the types of instructions, Instruction sets and Instruction formats and numbering formats.
CO2: Classify the various memory organization systems, memory mapping and techniques.
CO3: Explain the various methods of parallel processing and identify Instruction-level parallelism.
CO4: Illustrate the working principle of modern multi-core processor.

Text/ Reference Books:

1. V.Carl Hammacher, “Computer Organisation”, Fifth Edition
2. A.S.Tanenbum, “Structured Computer Organisation”, PHI, Third edition
3. Y.Chu, "Computer Organization and Microprogramming”, II, Englewood Chiffs, N.J., Prentice Hall
4. M.M.Mano, “Computer System Architecture”.
5. C.W.Gear, “Computer Organization and Programming”, McGraw Hill
6. Hayes J.P, “Computer Architecture and Organization”, PHI, Second edition
7. Q. Chen, and M. Guo, Task Scheduling for Multi-core and Parallel Architectures, Challenges, Solutions and Perspectives, Springer, 2017.

Course Assessment Marks

1. Continuous Assessments (CA1, CA2 & CA3): 30%
2. End Semester Examination: 70%

PE-EC505A	Information Theory & Coding	3L: 0T: 0P	3 credits

Course Contents:

Module I: (12 L)

1.1. Source Coding
Uncertainty and information, average mutual information and entropy, information measures for continuous random variables, source coding theorem, Huffman codes.

1.2. Channel Capacity and Coding
Channel models, channel capacity, channel coding, information capacity theorem, The Shannon limit.

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Module II: (11 L)

2.1. Linear and Block Codes For Error Correction
Matrix description of linear block codes, equivalent codes, parity check matrix, decoding of a linear block code, perfect codes, Hamming codes.

2.2. Cyclic Codes
Polynomials, division algorithm for polynomials, a method for generating cyclic codes, matrix description of cyclic codes, Golay codes.

Module III: (11 L)

3.1. BCH Codes
Primitive elements, minimal polynomials, generator polynomials in terms of minimal polynomials, examples of BCH codes.

3.2. Convolutional Codes
Tree codes, trellis codes, polynomial description of convolutional codes, distance notions for convolutional codes, the generating function, matrix representation of convolutional codes, decoding of convolutional codes, distance and performance bounds for convolutional codes, examples of convolutional codes, Turbo codes, Turbo decoding.

Course Outcomes (COs)
CO1: Design a data compression scheme using suitable source coding technique.
CO2: Understand the knowledge of Block code, Cyclic Codes,
CO3: Understand the knowledge of BCH code and Convolutional codes.
CO4: Design a channel coding scheme for resource constraint applications.

Text/ Reference Books:

1. Information theory, coding and cryptography - Ranjan Bose; TMH.
2. Information theory and coding- M. Kulkarni, K S Shivaprakasha; Wiley.
3. Introduction to Error Control Codes-Salvatore Gravano; Oxford
4. Error Control Coding - Shu Lin and D J Costello Jr; Prentice Hall.
5. Error Correction Coding Mathematical Methods and Algorithms-Todd K Moon; Wiley

Course Assessment Marks
1. Continuous Assessments (CA1, CA2 & CA3): 30%
2. End Semester Examination: 70%

PE EC 505 B	Internet of Things (IoT)	3L:0T:0P	3 credits

Course Contents:

Module I: (14L)

The Internet of Things:
Introduction to Internet of Things, Smart Objects and Things in IoT, connections of smart objects for IoT applications, The Technology behind Internet of Things, Characteristics of IoT, Physical design of IoT, Functional blocks of IoT, Sensing, Actuation.
Internet Principles:
Internet Communications: An Overview (IP, TCP, The IP Protocol Suite (TCP/IP), UDP),
IP Addresses (DNS, Static IP Address and Dynamic IP Address Assignment, IPv6),
MAC Addresses, TCP and UDP Ports, Application Layer Protocols. Introduction to Software-defined Network (SDN), SDN for IoT.
Machine-to-Machine Communications:
Machine-to-Machine Communications, Difference between IoT and M2M, Interoperability in IoT.
Design Principles for Connected Devices:
Personalization, Socialization, and Real-world Awareness of the IoT, Calm and Ambient Technology, Magic as Metaphor, Privacy, Web Thinking for Connected
Devices, Affordances.

Module II: (8L)

Understanding Prototyping:
Sketching, Familiarity, Costs versus Ease of Prototyping, Prototypes and Production,
Memory Management, Performance and Battery Life.
Prototyping Embedded Devices:
Electronics, Embedded Computing Basics, Developing on the Arduino, Raspberry Pi,
Mobile Phone and Tablets, plug computing always-on internet of things.
Prototyping the Physical Design:
Preparation, Sketch, Iterate, and Explore, Non-digital Methods, Laser Cutting, 3D Printing,
CNC Milling, Repurposing/Recycling.

Module III: (9L)

Application of IOT:
IoT in agriculture, home automation, smart vehicles, smart cities and public safety. IIoT in manufacturing sector, oil and natural gas and transportation.
Ethics:
Characterizing the Internet of Things, Privacy, Control, Environment, Solutions, Security in IoT

Course Outcomes (COs)
CO1: Understand building blocks of Internet of Things, characteristics and physical design.
CO2: Implement the networking principles for interconnecting IoT enabled devices.
CO3: Apply the knowledge of programming to configure Arduino and Raspberry Pi for IoT applications.
CO4: Design of IOT based system in various real-time domestic and industrial applications.

Text/ Reference Books:

1. "The Internet 'of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press)
2. “Make sensors”: Terokarvinen, kemo, karvinen and villey valtokari, 1st edition, maker media,2014.
3. "Internet of Things: A Hands-on Approach", by Arshdeep Bahga and Vijay Madisetti
4. “IoT Fundamentals” Pearson publication (CISCO).
5. Waltenegus Dargie,Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice"
6. Beginning Sensor networks with Arduino and Raspberry Pi – Charles Bell, Apress,
7. Adrian McEwen, Hakim Cassimally, “Designing the Internet of Things”, Wiley publication

Course Assessment Marks

1. Continuous Assessments (CA1, CA2 & CA3): 30%
2. End Semester Examination: 70%

PE EC 505C	Cloud Computing	3L:0T:0P	3 credits

Course Contents:

Module I: (13L)

CLOUD COMPUTING BASICS
Cloud Computing Overview, Applications, Internet and the Cloud, First move in the Cloud, Benefits, Limitations and Security Concerns in the Cloud.
CLOUD COMPUTING TECHNOLOGY
Hardware and Infrastructure, Clients, Security, Network, Services, Accessing the Cloud, Platforms, Web Applications, Web APIs, Web Browsers.

Module II: (6L)

CLOUD STORAGE AND STANDARDS
Cloud Storage Overview, Cloud Storage Providers, Standards, Application, Client, Infrastructure, Service.

Module III: (13L)

CLOUD COMPUTING AT WORK
Software as a Service, Overview, Driving Forces, Company Offerings, Industries Developing Applications, Google, Microsoft, Intuit Quick Base, Cast Iron Cloud, Bungee Connect, Development.
ORGANIZATIONS AND CLOUD COMPUTING
Cloud Computing with the Titans, Google, EMC, NetApp, Microsoft, Amazon, IBM, Partnerships, The Business case for going to the Cloud.

Course Outcomes (COs)
CO1: Explain the fundamentals of Cloud Computing.
CO2: Examine the functionality of different cloud technologies.
CO3: Analyse the role and functioning of cloud environment and various cloud storage platforms.
CO4: Examine the working of different cloud services and deploy cloud network.

Text /Reference Books
1. Sosinsky Barrie, "*Cloud Computing: Bible*", Wiley Publication, 2018.
2. Velte Anthony T., Velte Toby J. and Elsenpeter Robert, "*Cloud Computing: A Practical Approach*", Indian Edition, McGraw Hill, 2018.
1. Buyya Rajkumar, Broberg James and Goscinski Anderzej, "*Cloud Computing: Principles and Paradigms*", Wiley Publication, 2011.

Course Assessment Marks
1. Continuous Assessments (CA1, CA2 & CA3): 30%
2. End Semester Examination: 70%

PE EC 505D	Sensors & Transducers	3L:0T:0P	3 credits

Course Contents:

Module I: (6L)

Introduction

Principle of sensing & transduction, Difference between sensors and transducers, Classification of transducers, Basic requirement of transducers, Static characteristics, Dynamic characteristics; Zero, first order and second order transducers, Response to impulse, step, ramp and sinusoidal inputs.

Module II: (18L)

Mechanical and Electromechanical Sensors

Resistive (potentiometric type): Forms, material, resolution, accuracy, sensitivity. Strain gauge: type, materials, sensitivity, gauge factor, variation with temperature, adhesive, rosettes. Inductive sensor, LVDT: Construction, material, output input relationship, I/O curve; Proximity sensor.

Capacitive Sensors

Variable distance-parallel plate type, variable area- parallel plate, serrated plate/teeth type and cylindrical type, variable dielectric constant type, calculation of sensitivity; Stretched diaphragm type: microphone, response characteristics; Piezoelectric element: piezoelectric effect, charge and voltage co-efficient

Thermal Sensors

Material expansion type: solid, liquid, gas & vapor, Resistance change type: RTD materials, tip sensitive & stem sensitive type, thermister material, shape, ranges and accuracy specification; Thermoemf sensor: types, thermoelectric power, general consideration

Module III: (8L)

Magnetic and other Miscellaneous Sensors

Sensor based on Villari effect for assessment of force, torque, proximity, Wiedemann effect for yoke coil sensors, Thomson effect, Hall effect. Radiation sensors: LDR, Photovoltaic cells, photodiodes, photo emissive cell; Geiger counters, Scintillation detectors, Pyroelectric type. Introduction to smart sensors, Fiber optic sensors, Film sensors, MEMS, Nano sensors and Digital transducers.

Course Outcomes (COs)

CO1: Understand the principle and requirements of sensing and transduction.
CO2: Acquire knowledge of various resistive and inductive transducers and sensors.
CO3: Have understanding of various capacitive and thermal sensors.
CO4: Understand fundamentals of various magnetic sensors and other miscellaneous sensors.

Text/ Reference Books

1. Patranabis. D, Sensors and Transducers, Prentice Hall of India
2. H. K. P. Neubert, Instrument transducers, Oxford University press.
3. A. K. Sawhney, A Course in Electrical and Electronics Measurements and Instrumentation, Dhanpat Rai
4. S. Renganathan, Transducer Engineering, Allied Publishers.
5. Murthy D.V.S, “Transducers and Instrumentation”, Prentice Hall of India

Course Assessment Marks

1. Continuous Assessments (CA1, CA2 & CA3): 30%
2. End Semester Examination: 70%

EC-591	MICROWAVE AND ANTENNA ENGINEERING LAB	0L:0T:3P	1.5 credits

Laboratory Experiments:

1. Study the Stationary Waves in a Transmission Line.
2. Measurement of input impedance of a terminated waveguide using Shift in minima technique.
3. Study of Radiation pattern and measurement of beam width of a Simple Dipole antenna.
4. Study of Radiation pattern and measurement of beam width of a Folded Dipole antenna.
5. Study of Radiation pattern and measurement of beam width of a Yagi-Uda antenna.
6. Study of Radiation Pattern and measurement of Gain & Beam width of a Horn Antenna using Rectangular Wave Guide.
7. Study the variation of power output and frequency of a reflex klystron with the repeller voltage.
8. Study of the characteristics of Gunn Diode Oscillator.
9. Measurement of Coupling factor, Directivity, Isolation, and Insertion loss of a multi- hole Directional Coupler using microwave test bench.
10. Study the properties of a magic tee using X-band waveguide test bench.

Course Outcomes (COs)

On completion of the course, student will be able to

CO1: Identify wave propagation phenomenon through different transmission lines.

CO2: Demonstrate the radiation characteristics of low frequency and high frequency antennas.

CO3: Examine the properties of various microwave sources and passive devices.

Course Assessment Marks

3. Practical Continuous Assessments (PCA1 & PCA2): 40%
4. End Semester Examination: 60%

EC592	Digital Signal Processing Lab	0L:0T:3P	1.5 credits

Laboratory Experiments:

1. Linear Convolution of two sequences using commands. Verification of properties of convolution.
2. Circular convolution and Linear with Circular convolution of two sequences using commands.
3. Verifications of the different algorithms associated with filtering of long data sequences and Overlap -add and Overlap-save methods.
4. Z-transform of various sequences - verification of the properties of Z-transform.
5. Linear, Circular and Linear with Circular convolution using Z-transform.
6. DFTs / IDFTs using equation and also using commands.
7. Butterworth filter design with different set of parameters.
8. FIR filter design using rectangular, Hamming and Blackman windows.

Course Outcomes:
At the end of this course, students will be able to

CO1: Understand and differentiate various convolution methods (Linear and Circular) and it's properties using standard simulators.
CO2: Analyze and differentiate Z-transform on discrete-time sequences and it's properties using standard simulators.
CO3: Analyze and differentiate DFTs / IDFTs, FFT/IFFT on discrete-time sequences and it's properties using standard simulators.
CO4: Attain in-depth knowledge to realize IIR and FIR digital filters for various applications.

Course Assessment Marks

1. Practical Continuous Assessments (PCA1 & PCA2): 40%
2. End Semester Examination: 60%

EC593	Advanced Digital Communication Lab	0L:0T:3P	1.5 credits

Laboratory Experiments:

1. Study of PCM and demodulation.
2. Study of DPCM and demodulation.
3. Study of delta modulator and demodulator.
4. Study of adaptive delta modulator and demodulator.
5. Study of BPSK modulator and demodulator.
6. Study of BFSK modulator and demodulator.
7. Study of ASK modulator and demodulator.
8. Study of optical modulation and demodulation.
9. Analysis and Simulation of probability of symbol error for BPSK, QPSK modulation.
10. Analysis and Simulation of probability of symbol error for BFSK modulation.
11. Compare the SER for difference PSK modulation scheme.

Course Outcomes (COs)

CO1: Study and understand the fundamentals of communication systems and various digital modulation techniques.
CO2: Examine each device functionality in different kinds of modulation systems.
CO3: Design and execute experiments using various digital modulation systems to understand the results.
CO4: Analyze the error performance of Digital Modulation Techniques using MATLAB tool.

Course Assessment Marks

1. Practical Continuous Assessments (PCA1 & PCA2): 40%
2. End Semester Examination: 60%

EC 594	Design Lab-1 (Mini Project-1)	0L:0T:4P	2 credits

Guidelines:

1. The mini-project is a team activity having 3 or 4 students in a team. This is electronic product design work with a focus on electronic circuit design. The mini project may be a complete hardware or a combination of hardware and software. Mini Project should cater to a small system required in laboratory or real life. It should encompass components, devices, analog or digital ICs, micro controller with which functional familiarity is introduced.

2. After interactions with Lab teachers and based on comprehensive literature survey/ need analysis, the student shall identify the title and define the aim and objectives of mini-project. Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation. The student is expected to exert on design, development and testing of the proposed work within the Lab schedule. Art work and Layout should be made using CAD based PCB simulation software.

3. Completed mini project (hardware working prototype /model) and documentation in the form of mini project report is to be submitted at the end of semester.

Course Outcomes (COs)**:**

At the end of the course, students will demonstrate the ability to:

CO 1. Conceive a problem statement either from rigorous literature survey or from the requirements raised from need analysis.

CO 2. Design, implement and test the prototype/algorithm in order to solve the conceived problem.

CO 3. Write comprehensive report on mini project work.

Course Assessments

1. Practical Continuous Assessments (PCA1 & PCA2): 40%
2. End Semester Examination: 60%

EC595	Internet of Things (IoT) Lab	0L:0T:3P	1.5 credits

Laboratory Experiments:

1. Arduino/ESP32 - Blinking LED [CO 1]
2. Arduino/ESP32 - Fading LED [CO 1]
3. Controlling LED with push button [CO 2]
4. Controlling LED bar graph [CO 2]
5. Detection of light using photo resistor [CO 2]
6. Interfacing with LCD Display and Print Characters [CO 2]
7. Interface Temperature Sensor LM35 and Display in Serial Monitor [CO 3]
8. Interface Temperature Sensor LM35 and Display in 16×2 LCD Screen [CO 3]
9. Interface Ultrasonic Sensor HC-SR04 and Display in Serial Monitor [CO 3]
10. Interface Ultrasonic Sensor HC-SR04 and Display in LCD Display [CO 3]
11. Interface PIR Sensor and Display in Serial Monitor [CO 3]
12. Interface LCD 16×2 Display using I2C Module with Arduino [CO 2]
13. Interface Gas sensor module MQ2 with Arduino [CO 3]
14. Interface Temperature and Humidity sensor DHT11 with Arduino [CO 3]
15. Interface IR Sensor with Arduino [CO 2]

Course outcomes (COs)

Upon successful completion of the Internet of Things (IoT) Laboratory course, students will be able to:

CO1: Understand IoT Concepts and Development Boards like Arduino.
(Demonstrate a solid understanding of IoT fundamentals, including development boards)

CO2: Develop and Integrate components with IoT Development Board
(Build and troubleshoot component interfacing Arduino)

CO3: Design IoT Solutions from the knowledge of interfacing sensors for real time monitoring.
(Design, deploy, and evaluate complete IoT systems for applications such as smart homes, environmental monitoring etc.)

Course Assessments Marks

1. Practical Continuous Assessments (PCA1 & PCA2): 40%
2. End Semester Examination: 60%

MC581	Essence of Indian Knowledge, Tradition & Culture	2L:0T:0P	0 credits

Course Contents

Module I: (8 L)

1. **Society, State & Polity in Ancient India:** Origin and Evolution of the state in Ancient India, Stages of State Formation, Kingship and administration, Political ideas, The Seven Limbs of the State (Kautilya's saptanga), Society in Ancient India, Varnashrama System, Ashrama (the Stages of Life), Types of Marriages, Historical traditions & challenges faced by Women.
2. **Indian Religion, Philosophy and Practices:** Pre-Vedic (Harappans) and Vedic Religion, Buddhism & Jainism, Six System Indian Philosophy, Shankaracharya, Various Philosophical Doctrines, Bhakti Movement & Sufi movement, Socio-religious reform movement of 19th century, Modern religious practices.

Module II: (8 L)

1. **Indian Literature, Culture, Tradition and Practices:** Evolution of scripts (Brahmi & Harappan) and languages in India, The Vedas, the Upanishads, the Ramayana and the Mahabharata, Puranas, Buddhist & Jain Literature in Pali, Prakrit & Sanskrit, Kautilya's Arthashastra, Languages & Literatures of Ancient India (North & South).
2. **Science, Management and Indian Knowledge System: Science in Ancient India (**Astronomy, Chemistry, Mathematics, Physics, Agriculture, Medicine, Metallurgy, Geography, Biology), Harappan Technologies, Water Management in India, Textile Technology in India, Writing Technology in India, Pyrotechnics in India, Trade in Ancient India.

Module III: (4 L)

1. **Engineering Heritage:** Engineering and Architecture in Ancient India, Sculptures, Seals, coins, Pottery.
2. **Cultural Heritage:** Puppetry, Dance, Music, Theatre, Drama, Painting, Martial Arts Traditions, Fairs & Festivals.

Course Outcomes (COs)

CO1: Develop proficiency in imparting basic principles of thought process, reasoning and inference to identify the roots and details of some of the contemporary issues faced by our nation regarding state, society & polity and try to locate possible solutions to these challenges by digging deep into our past.

CO2: Understanding the principles of holistic life styles of science, arts and literatures related to Ancient India's culture, tradition, religion & philosophy which are important in modern society with rapid technological & societal advancements.

CO3: Familiarization with Indian Knowledge System, Indian perspective of modern scientific & technological world-view and holistic health care system to contribute towards sustainable development.

Course Assessments

1. Continuous Assessments:
Participation & Attendance; Group Discussion & Quiz
2. End Semester Assessment:
Report; Oral Presentation & viva

EC 601	VLSI Design	3L: 0T: 0P	3 credits

Course Contents:

Module I: Introduction to VLSI Design (4 L)

Module 1: VLSI Design flow, Design Hierarchy, Regularity, Modularity and Locality., Scale of Integration (SSI, MSI, LSI, VLSI, ULSI – basic idea only), Types of VLSI Chips (Analog & Digital VLSI chips, General purpose, ASIC, PLA, FPGA),Y-Chart.

Module II: Micro-electronic Processes for VLSI Fabrication (11 L)

Silicon Semiconductor Technology- An Overview, Wafer processing (1L), Oxidation, Epitaxial deposition, Ion-implantation & Diffusion (2L), Etching (1L), Photo-lithography – Positive & Negative photo-resist (1L); Basic CMOS Technology – (Steps in fabricating CMOS (1L)), Basic n-well CMOS process, p-well CMOS process, (1L), Stick diagram with examples (2L),Scaling in MOSFET[2L].

Module III: CMOS for Digital VLSI Circuits (9 L)

CMOS, CMOS inverter characteristics (2L); CMOS logic circuits, NAND & NOR Gates (1L), Complex logic circuits (1L), CMOS Full Adder (1L), CMOS Transmission GATE (1L), Rationed logic , Sequential CMOS logic circuits (1L); SR Latch circuit, clocked JK Latch/ Master-Slave JK (2L).

Module IV: Subsystem Design (5 L)

Adders: Carry ahead adder, Carry save adder,
Multipliers: Serial –parallel Multiplier, array multiplier.
High Density Memory: ROM, Static RAM, Dynamic RAM, SD RAM, Flash memory.

Module V: Architecture Description (5 L)

Introduction, Power distribution, Input/Output, Clock, Hardware Description Languages, Verilog HDL: Behavioral modeling, Structural gate modeling, Switch modelling.

Course Outcomes (CO)

CO1: Understand the VLSI design flow, design principles, and types of VLSI chips to analyze and design integrated circuits.

CO2: Gain knowledge of microelectronic processes for VLSI fabrication, including wafer processing, photolithography, and CMOS technology

CO3: Design and analyze CMOS circuits, including inverters, logic gates, sequential circuits, and subsystem components like adders and multipliers.

CO4: Demonstrate proficiency in subsystem design, memory architecture, and hardware description languages such as Verilog HDL for VLSI design.

Text/ Reference Books:

1. Jan M Rabaey, Anantha Chandrakasan, B Nikolic, Digital Integrated Circuits: A Design Perspective,Second Edition, 2003, Prentice Hall of India.
2. Niel H.E. Weste, David Harris, Ayan Banerjee, CMOS VLSI Design- A circuits and Systems

Perspective, Third Edition, 2013, Pearson education.
3. Debaprasad Das, VLSI Design, OXFORD Higher Education
4. Wayne Wolf, Modern VLSI Design, PHI Learning Private Limited, New Delhi, 2011.
5. Sung-Mo Kang and Yusuf Leblebici, CMOS Digital Integrated Circuits, McGraw Hill, 3rd Edition, 2011.

Course Assessment Marks

1. Continuous Assessments (CA1, CA2 & CA3): 30%
2. End Semester Examination: 70%

PE-EC-602A	SATELLITE COMMUNICATION	3L:0T:0P	3 credits

Course Contents:

Prerequisites: Review of Analog and Digital Communication System and Antennas and Wave Propagation.

Module I: ORBITAL MECHANICS AND LAUNCHERS (10 L)

Origin of Satellite Communications, Historical back-ground, Basic concepts of satellite communications, Frequency allocations for satellite services, Applications, Future trends of satellite communications.
Orbital mechanics, Look angle determination, Orbital perturbations, Orbit determination, Launches and launch vehicles, Orbital effects in communication systems performance.

Module II: SATELLITE SUB SYSTEMS AND SATELLITE LINK DESIGN (8 L)

Attitude and orbit control system, Telemetry, Tracking, Command and monitoring, Power systems, Communication subsystems, Satellite antenna equipment reliability and space qualification.
Basic transmission theory, System noise temperature and G/T ratio, Design of down links, Up link design, Design of satellite links for specified C/N, System design example.

Module III: MULTIPLE ACCESS ANS SATELLITE EARTH STATION TECHNOLOGY (10 L)

Frequency division multiple access (FDMA), Inter modulation, Calculation of C/N. Time division Multiple Access (TDMA), Frame structure, Examples. Satellite switched TDMA onboard processing, DAMA, Code Division Multiple access (CDMA), Spread spectrum transmission and reception.
Introduction, Transmitters, Receivers, Antennas, Tracking systems, Terrestrial interface, Primary power test methods.

Module IV: SATELLITE NAVIGATION AND THE GLOBAL POSITIONING SYSTEM (8 L)

Orbit consideration, Coverage and frequency considerations, Delay & throughput considerations, System considerations, Operational NGSO constellation designs.
Radio and satellite navigation, GPS position location principles, GPS receivers and codes, Satellite signal acquisition, GPS navigation message, GPS signal levels, GPS receiver operation, GPS C/A code accuracy, Differential GPS.

Course Outcomes (COs)
On completion of the course, student will be able to

CO1– Explain the basic principles of satellite communication system, orbital mechanics and launchers.
CO2 –Illustrate the concepts of satellite subsystems and designing of satellite uplink and downlinks.
CO3 –Analyze the concepts of various multiple access techniques and satellite earth station technology.
CO4 –Illustrate the concepts of satellite navigation and global positioning system and its operation.

TEXT/REFERENCEBOOKS

1. Satellite Communications- Timothy Pratt, Charles Bostian and Jeremy Allnutt, WSE, Wiley Publications, 2nd Edition, 2003, John Wiley & Sons.
2. Satellite Communication Engineering- Wilbur L. Pritchand, Robert A Nelson and Henri G. Suyderhoud, 2nd Edition, Pearson Publications.
3. Digital Satellite Communications-Tri. T.Ha, 2nd Edition, 1990, Mc. Graw Hill.
4. Satellite Communications- Dennis Roddy, 2nd Edition, 1996, McGraw Hill.

5. Satellite Communications: Design Principles- M. Richharia, 2nd Edition,BS Publications, 2003.
6. Fundamental of Satellite Communications- K. N Raja Rao, PHI, 2004.

Course Assessment Marks

1. Continuous Assessments (CA1, CA2 & CA3): 30%
2. End Semester Examination: 70%

PE-EC602B	Embedded System	3L:0T:0P	3 credits

Course Contents:

Module I: (5L)

Overview of Embedded System: Embedded System, Embedded Processor in System, Components of Embedded System, Brief introduction to Embedded software in system, Design Process in Embedded System.

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Module II: (12L)

Embedded Hardware:

Processor & Memory: Brief overview of 8051 Architecture and real world interfacing, Introduction to advanced Processor Architectures-ARM, Processor and Memory organization, Parallelism in instruction level, Processor and memory selection.

I/O Types: Serial and Parallel communication Ports, Timer and Counting devices, Watchdog timers, real time clock, Serial bus Communication Protocols- I2C, CAN, and Parallel Communication Protocol- ISA.

Module III: (10L)

Embedded Software Development-

Software Development: Programming concept in ALP (assembly language programming) and High level language-C, Processor directives, functions and macros and other programming elements, Embedded C++ concept only.

Module IV: (9L)

RTOS(Real time operating System)- OS overview, Process, Interrupt and memory management, RTOS overview, Basic Design rule using RTOS, Task scheduling using Priority based scheduling, cyclic scheduling and round robin scheduling.

Embedded system Design using PIC microcontroller: Introduction toMicrochip PIC16 family, PIC16F873

Processor Architecture- features, memory organization, on chip peripherals, Watchdog timer, ADC, Data EEPROM, Asynchronous serial port, SPI mode, I2C mode, Interfacing with LCD, ADC, sensors, stepper motor, key board, DAC.

Course outcomes (COs)

CO1:Understand the functionalities of processor internal blocks, with their requirement and understand the design process in embedded system.

CO2: Comprehend the hardware used to design embedded system that includes processor, memories, I/O system

CO3:Comprehend the hardware used to design embedded system that includes processor, memories, I/O system

CO4: Design and analyse embedded system by using different processor architecture Models

Text Book

1. Microcontrollers Theory and Application, Ajay V. Deshmukh, TMH, 2011.
2. Embedded Systems: Architecture, Programming & Design, Raj Kamal, TMH, 2011 319

Reference Book

1. Embedded System Design: A unified Hardware/ Software Introduction, by Frank Vahid, Willey, 2011.
2. Design with PIC Microcontrollers, J. B. Peatman, Pearson India,2008.

Course Assessment Marks

1. Continuous Assessments (CA1, CA2 & CA3): 30%
2. End Semester Examination: 70%

PE-EC-602C	AUTONOMOUS MOBILE ROBOTS	3L:0T:0P	3 credits

Module I: Introduction to Autonomous Mobile Robots (10 L)

Definition and applications of mobile robots, types of mobile robots: wheeled, legged, aerial, and underwater, challenges in autonomous mobile robotics, overview of autonomous navigation, kinematic models of wheeled robots (differential drive, omni-wheel, ackerman steering), non-holonomic and holonomic constraints, forward and inverse kinematics, dynamics of mobile robots.

Module II: Sensors for Mobile Robots (8 L)

Sensors for Mobile Robots: LIDAR (Light Detection and Ranging), Vision Sensors (Cameras, Depth Sensors, Stereo Vision), IMU (Inertial Measurement Unit), GPS (Global Positioning System), Ultrasonic and Infrared Sensors, Sensor Fusion Techniques, Object Detection and Tracking.

Module III: Localization and Mapping (8 L)

Introduction to Localization, Probabilistic Localization Methods, Markov Localization, Kalman Filters and Extended Kalman Filters (EKF), Monte Carlo Localization, Simultaneous Localization and Mapping (SLAM), Graph-Based SLAM, LIDAR-Based and Visual SLAM , Motion Planning Strategies, Graph-Based Planning, Sampling-Based Planning (RRT, PRM), Obstacle Avoidance Techniques.

Module IV: Control of Mobile Robots (8L)

Feedback and Feed forward Control, PID Controllers for Mobile Robots, Model Predictive Control (MPC), Motion Control Architectures, Open-Loop and Closed-Loop Control, Hybrid Control Architectures, Coordination Strategies in Multi-Robot Teams, Swarm Robotics Principles, and Applications of Swarm Robotics.

Course Outcomes (COs)

On completion of the course, student will be able to

CO1 – Differentiate between mobile robots and manipulators.
CO2 – Explain the basic principle of sensors for mobile robots.
CO3 – Illustrate the concepts of localization and mapping for mobile robot.
CO4 – Analyze the concepts of control for mobile robots.

TEXT/REFERENCEBOOKS

1. Roland Siegwart, Illah R. Nourbakhsh, Introduction to Autonomous Mobile Robots, MIT Press, 2004.
2. Spyros G. Tzafestas, Introduction to Mobile Robot Control, Elsevier, 2014.
3. Gregory Dudek, Michael Jenkin, Computational Principles of Mobile Robotics, Cambridge University Press, 2010.
4. George A. Bekey, Autonomous Robots, MIT Press, 2005.

Course Assessment Marks

1. Continuous Assessments (CA1, CA2 & CA3): 30%
2. End Semester Examination: 70%

PE-EC-602D	POWER ELECTRONICS	3L:0T:0P	3 credits

Module I: POWER SEMICONDUCTOR DEVICES (8 L)

Concept of power electronics, application of power electronics, power semiconductor switches, rectifier diodes, fast recovery diodes, schottky barrier diode, power BJT, power MOSFET, SCR, TRIAC, IGBT and GTO, SCR turn-on and turn-off methods, Triggering circuits, SCR Commutation circuits, SCR Series and Parallel operation, Snubber Circuit.

Module II: RECTIFIERS (8 L)

Principle of operation of single phase and three phase half wave, half controlled, full controlled converters with R, R-L and RLE loads, effects of freewheeling diodes and source inductance on the performance of converters. External performance parameters of converters, techniques of power factor improvement, single phase and three phase dual converters Rectifiers Single phase and three phase controlled Rectifiers with inductive loads, RL load Effect of source inductance performance parameters. Dual Converters.

Module III: CHOPPERS (6 L)

Principle of operation, control strategies, types of choppers circuits based on quadrant of operation, performance parameters, multiphase choppers. Step up and Step down choppers Time ratio control and current limit control, Buck, Boost, Buck Boost and Cuk Converters, Concept of Resonant Switching.

Module IV: INVERTERS (6 L)

Definition, classification of inverters based on nature of input source, wave shape of output voltage, method of commutation & connections. Principle of operation of single phase and three phase bridge inverter with R and R-L loads, performance parameters of inverters, methods of voltage control and harmonic reduction of inverters, series resonant inverter, current Sources Inverter.

Module V: CONVERTERS (4 L)

Introduction, Principal of On-Off control and Phase Control, Single phase Bidirectional Controllers with R and R-L Loads, Three phase full wave controllers, AC Voltage Controllers, Single phase and three phase cycloconveters, Power factor control and Matrix Converters.

Module VI: DC and AC Drives (3 L)

DC Motor Speed control, Induction Motor Speed Control, Synchronous Motor Speed Control, HVDC transmission. Static circuit breaker, UPS, static VAR controller.

Course Outcomes (COs)

On completion of the course, student will be able to

CO1 –Explain the basic principles of power semiconductor devices.
CO2 –Illustrate the concepts of operation of choppers and inverters.
CO3 –Analyze the operation of converters and DC, AC drives.

TEXT/REFERENCEBOOKS

1. P.C. Sen, Power Electronics
2. M.H. Rashid, Power Electronics, PHI/ Pearson Education
3. C.W. Lander, Power Electronics, McGraw Hill

Course Assessment Marks

1. Continuous Assessments (CA1, CA2 & CA3): 30%
2. End Semester Examination: 70%

PE-EC-603A	MOBILE COMMUNICATION AND NETWORKS	3L:0T:0P	3 credits

Module I: Cellular Communication Fundamentals (10 L)

Basic cellular systems, Performance criteria, Uniqueness of mobile radio environment, Operation of cellular systems, analog & digital cellular systems. Cellular System Design Fundamentals: Concept of frequency reuse channels, Co-channel interference reduction factor, Desired C/I from a normal case in an omnidirectional antenna system, Handoff mechanism, Cell splitting.

Module II: Interference in Cellular Mobile System (6 L)

Channel & co-channel interference, Channel antenna system design considerations, umbrella pattern effect, Adjacent-channel interference, Near end – far-end interference, Effect on near-end mobile units.

Module III: Frequency management, channel assignment and handoffs (10 L)

Frequency management, Frequency spectrum utilization, Set-up channels, Fixed channel assignment schemes, Non-fixed channel assignment schemes, Concept of handoff, Initiation of a hard handoff, Delaying a handoff, Forced handoffs, Queuing of handoffs, Power difference, handoffs, Mobile assisted handoff, Soft handoffs, Cellsite handoff, Intersystem handoff, dropout calls.

Module IV: GSM system overview (8 L)

GSM system architecture, GSM radio subsystem, GSM channel types, Frame structure for GSM, Signal processing in GSM, GPRS and EDGE, CDMA 2000, Wireless Local Loop, IMT 2000 and UMTS, Long Term Evolution (LTE), Mobile data networks, Introduction to 4G and concept of NGN.

Course Outcomes (COs)

On completion of the course, student will be able to

CO1 –Explain the fundamentals of cellular communication.
CO2 –Illustrate the concepts of interference in cellular mobile system.
CO3 –Demonstrate the concepts of frequency management, channel assignment and handoffs.
CO4 –Illustrate the concepts of GSM system overview.

TEXT/REFERENCE BOOKS

1. Mobile Cellular Telecommunications: Analog and Digital Systems by William C. Y. Lee; Tata McGraw Hill Publication.
2. Wireless Communications: Principles and Practice by Theodore S. Rappaport; Pearson/PHI Publication.
3. Wireless Communications and Networks: 3G and Beyond by Iti Saha Misra; Tata McGraw Hill Publication.
4. Wireless and Digital Communications by Dr. Kamilo Feher; PHI Publication.
5. T L Singal ,“Wireless Communications ”, McGraw Hill Education.

Course Assessment Marks

1. Continuous Assessments (CA1, CA2 & CA3): 30%
2. End Semester Examination: 70%

PE-EC-603B	WIRELESS SENSOR NETWORKS	3L:0T:0P	3credits

Module I: Wireless Sensor Networks (8 L)

Introduction, Application examples, Types of applications, Challenges for WSNs, Mobile ad hoc networks and wireless sensor networks, enabling technologies for wireless sensor networks, Single-node architecture - Hardware components, wireless LANs, PANs, WANs, and MANs, Wireless Internet.

Module II: Network Architecture (8 L)

Sensor network scenarios, Optimization goals and figures of merit, Design principles for WSNs, Service interfaces of WSNs, Gateway concepts - The need for gateways, WSN to Internet communication, Internet to WSN communication, WSN tunneling.

Module III: MAC Protocols (8 L)

Fundamentals of MAC protocols - Requirements and design constraints for wireless MAC protocols, Important classes of MAC protocols, MAC protocols for wireless sensor networks, Contention-based protocols â€“ CSMA, PAMAS, The IEEE 802.15.4 MAC protocol. Routing Strategies in Wireless Sensor Networks - WSN Routing Techniques, Geographical Routing.

Module IV: Operating Systems for Wireless Sensor Networks (8 L)

Introduction, Operating System Design Issues, Examples of Operating Systems â€“ TinyOS, Mate, MagnetOS, MANTIS, OSPM, EYES OS, SenOS, EMERALDS, PicOS, Performance Modeling of WSNs.

Course Outcomes (COs)

On completion of the course, student will be able to

CO1–Describe the concepts of Wireless Sensor Networks with issues and challenges.
CO2 –Illustrate the design principles of gateway, WSN communications and single node architecture with hardware components and design constraints.
CO3 –Interpret the MAC and Routing protocols for Wireless Sensor Networks.
CO4 –Select operating systems used for WSN.

TEXT/REFERENCEBOOKS

1. Holger Karl and Andreas Willig, â€œProtocols and Architectures for Wireless Sensor Networksâ€•, John Wiley& Sons, Ltd, 2005.
2. Kazem Sohrby, Daniel Minoli, Wireless Sensor Network Technology, Protocols and Applications, Wiley-Inter science.
3. Waltenegus Dargie, Christian Poellabauer,Fundamentals Of Wireless Sensor Networks Theory And Practice by John Wiley & Sons Publications, 2011.
4. Sabrie Soloman, Sensors Handbook by McGraw Hill publication, 2009.
5. Feng Zhao, Leonidas Guibas, Wireless Sensor Networks by Elsevier Publications,2004.
6. Philip Levis, And David Gay Tiny OS Programming by Cambridge University Press, 2009.

Course Assessment Marks

1. Continuous Assessments (CA1, CA2 & CA3): 30%
2. End Semester Examination: 70%

PE-EC-603C	Computer Network	3L:0T:0P	3 credits

Course Contents:

Module I: (6L)

1. Overview of Data Communication and Networking: Introduction; Data communications: components, data representation (ASCII, ISO etc.), direction of data flow (simplex, half duplex, full duplex); network criteria, physical structure (type of connection, topology), categories of network (LAN, MAN,WAN); Internet: brief history, Protocols and standards; Reference models: OSI reference model, TCP/IP reference model, their comparative study.
2. Physical Layer: Overview of data(analog & digital), signal(analog & digital), transmission (analog & digital) & transmission media (guided & unguided); Circuit switching: time division & space division switch, TDM bus; Telephone Network.

Module II : (11L)

1. Data link Layer: Types of errors, framing(character and bit stuffing), error detection & correction methods; Flow control; Protocols: Stop & wait ARQ, Go-Back- N ARQ, Selective repeat ARQ, HDLC.
2. Medium Access sub layer: Point to Point Protocol, LCP, NCP, Token Ring; Reservation, Polling, Mu ltiple access protocols: Pure ALOHA, Slotted ALOHA, CSMA, CSMA/CD, CSMA/CA Traditional Ethernet, fast Ethernet (in brief).

Module III: (11L)

1. Network layer: Internetworking & devices: Repeaters, Hubs, Bridges, Switches, Router, Gateway; Addressing: IP addressing, subnetting; Routing : techniques, static vs. dynamic routing , Unicast Routing Protocols: RIP, OSPF, BGP; Other Procols: ARP, IP, ICMP, IPV6.
2. Transport layer: Process to Process delivery; UDP; TCP; Congestion Control: Open Loop, Closed Loop choke packets; Quality of service: techniques to improve QoS: Leaky bucket algorithm, Token bucket algorithm.

Module IV: (6L)

1. Application layer: Introduction to DNS, SMTP, SNMP, FTP, HTTP & WWW; Security: Cryptography (Public, Private Key based), Digital Signature, Firewalls.
2. Modern Topics (brief study): Wireless LAN IEEE 802.11, Zigbee IEEE 802.15.4, Bluetooth, SDN, SON, Cloud Integrated 5G, B5G and 6G Network.

Course outcomes (COs)

CO1: Study and analyze the network components, modes of communication, standards, and network reference models.
CO2: Classify the specifications and working principle of different layers and their related protocol.
CO3: Explain the working principle, configuration and implementation of network.
CO4: Illustrate the working principle of application layer protocols

Text/ ReferenceBooks:

1. B. A. Forouzan - “Data Communications and Networking (3rd Ed.) “ - TMH
2. A. S. Tanenbaum - “Computer Networks (4th Ed.)” - Pearson Education/PHI
3. W. Stallings - “Data and Computer Communications (5th Ed.)” - PHI/ Pearson Education
4. Black, Data & Computer Communication, PHI
5. Kurose and Rose - “Computer Networking -A top down approach featuring the internet” - Pearson Education.
6. Leon, Garica, Widjaja - “Communication Networks” – TMH.
7. Comer - “Internetworking with TCP/IP , vol. 1, 2, 3(4th Ed.)” - Pearson Education/PHI
8. Leon, Garica, Widjaja - “Communication Networks” – TMH
9. Walrand - “Communication Networks” – TMH.

Course Assessment Marks

1. Continuous Assessments (CA1, CA2 & CA3): 30%
2. End Semester Examination: 70%

PE-EC-603D	BIO-MEDICAL ELECTRONICS	3L:0T:0P	3credits

Module I: Components of Medical Instrumentation Systems (6 L)

Basic Medical Instrumentation System, Static and dynamic characteristics of medical instruments, Bio-signals and characteristics. Problems encountered with measurements from human beings. Sources of Bioelectric Potentials, Resting and Action Potentials.

Module II: Bio-Potential Electrodes and Physiological Transducers (8 L)

Electrode potential and its equivalent circuit, Types of Electrodes-Surface Electrodes, Needle Electrodes, Micro Electrodes. Biochemical Transducers. Bio-Signal Acquisition: Electrical Conduction system of the heart, Electrocardiogram, ECG leads, Einthoven triangle, Plethysmography, EEG 10-20 lead system and EMG.

Module III: Clinical laboratory Measurements (8 L)

Blood cell Counter, Blood flow meters- Electromagnetic blood flow meter, Ultrasonic Doppler blood flow meter, automated blood pressure measurements. Physiological Assist Devices & Therapeutic Equipment: Pacemakers -External & internal, Defibrillators- External & internal, Hemodialysis machine.

Module IV: Monitory and Imaging Equipment (6 L)

Spirometry, Ventilators, Arrhythmia Monitor, Foetal Monitor and Incubator. X-ray machine, Computed Tomography (CT), Magnetic Resonance Imaging System, Ultrasound Imaging system

Module V: Patient Care and Safety (6 L)

The elements of Intensive Care Monitor, Diagnosis, Calibration and reparability of PatientMonitoring equipment, Shock Hazards and Prevention, Physiological Effects and Electrical Current, Shock Hazards from Electrical Equipment, Methods of Accident Prevention, Isolated Power Distribution System.

Course Outcomes (COs)

On completion of the course, student will be able to

CO1– Understand the basic medical instrumentation system and bioelectric potentials.
CO2 –Illustrate different types of electrodes to acquire bio-signals.
CO3 –Demonstrate clinical laboratory measurements and assistive devices.
CO4 –Discuss about the latest developments in medical imaging systems.
CO5- Outline patient care and safety while using biomedical equipment.

TEXT/REFERENCEBOOKS

1. Leslie Cromwell, F.J. Weibell, E.A. Pfeiffer, Biomedical Instrumentation andMeasurements. 2nd Edition, PHI, 2004.
2. Dr. M. Arumugam, Biomedical Instrumentation. 2nd Edition, Anuradha publications, 2002.
3. R.S. Khandpur, Hand-book of Biomedical Instrumentation. 2nd Edition, TMH, 2003.
4. John G. Webster, Medical Instrumentation, Application and Design. John Wiley, 3rdEdition, 2009.
5. Onkar N. Pandey, Rakesh Kumar, Bio-Medical Electronics and Instrumentation. 3rdEdition, Katson Books, 2002.

Course Assessment Marks

1. Continuous Assessments (CA1, CA2 & CA3): 30%
2. End Semester Examination: 70%

OE-EC-604A	Programming with Java	3L:0T:0P	3credits

Course Contents:

Module I: (14 L)

1. **Object-oriented design concepts (4 L)**

   Concepts of object-oriented programming language, Object, Class, relationships among objects, aggregation, links, relationships among classes-association, aggregation, using, instantiation, meta-class, grouping constructs. Difference between OOP and other conventional programming – advantages and disadvantages. Class, object, message passing, inheritance, encapsulation, abstraction, polymorphism.

2. **Basic concepts of object-oriented programming using Java: (10 L)**

   Basic concepts of Java programming – advantages of Java, byte-code & JVM, data types, access specifiers, operators, control statements & loops, array, creation of class, object, constructor, constructor overloading, use of method overloading, this keyword, use of objects as parameter & methods returning objects, call by value & call by reference, static variables & methods, finalize and garbage collection.

Module II: (9 L)

1. **Reusability properties (6L)**

   Super class & subclasses including multilevel hierarchy, process of constructor calling ininheritance, use of super and final keywords with super () method, dynamic method dispatch, use of abstract classes &methods, interfaces. Create packages, import packages, and provide member access to packages.

2. **Implementation of Object-oriented concepts using Java String Class (3L)**

   String (discuss charAt() , compareTo(), equals(), equalsIgnoreCase(), indexOf(), length() , substring(), toCharArray() , toLowerCase(), toString(), toUpperCase() , trim() , valueOf() methods) &StringBuffer classes (discuss append(), capacity(), charAt(), delete(), deleteCharAt(),ensureCapacity(), getChars(), indexOf(), insert(), length(), setCharAt(), setLength(), substring(), toString() methods),concept of mutable and immutable string, command line arguments, basics of I/O operations – keyboard input usingBufferedReader& Scanner classes.

Module III: (8 L)

1. **Exception handling & Multithreading**

   Exception handling basics, different types of exception classes, use of try & catch with throw, throws & finally, creation of user-defined exception classes. Basics of multithreading, main thread, thread life cycle, creation of multiple threads, thread priorities, thread synchronization, inter-thread communication, deadlocks for threads, suspending & resuming threads.

Course outcomes (COs)

CO1: Understand the basic concept of object-oriented programming and its characteristics.
CO2: Implement the concept of object-oriented programming using Java.
CO3: Apply object-oriented programming knowledge to design software solutions for real problems.

Text/ ReferenceBooks:

1. E. Balagurusamy- " Programming with Java: A Primer" – 3rd Ed. – TMH
2. Kathy Sierra, Bert Bates - Head First Java: A Brain-Friendly Guide, 2Nd Edition-O'Reilly
3. Rambaugh, James Michael, Blaha- "Object Oriented Modelling and Design" – PHI
4. Ali Bahrami- "Object Oriented System Development" – McGraw Hill
5. Patrick Naughton, Herbert Schildt- "The complete reference-Java2" – TMH

Course Assessment Marks

1. Continuous Assessments (CA1, CA2 & CA3): 30%
2. End Semester Examination: 70%

OE-EC-604B	MACHINE LEARNING	3L:0T:0P	3credits

Module I: Artificial Neural Networks (5 L)

Introduction, Basic models of ANN, important terminologies, Supervised Learning Networks, Perceptron Networks, Adaptive Linear Neuron, Back-propagation Network. Associative Memory Networks. Training Algorithms for pattern association, BAM and Hopfield Networks.

Module II: Unsupervised Learning Network (5 L)

Introduction, Fixed Weight Competitive Nets, Maxnet, Hamming Network, Kohonen Self-Organizing Feature Maps, Learning Vector Quantization, Counter Propagation Networks, Adaptive Resonance Theory Networks. Special Networks-Introduction to various networks.

Module III: Linear Models (8 L)

Linear Basis Function Models -Maximum likelihood and least squares, Geometry of least squares , Sequential learning, Regularized least squares, Multiple outputs , The Bias-Variance Decomposition, Bayesian Linear Regression -Parameter distribution, Predictive, Equivalent, Bayesian Model Comparison, Probabilistic Generative Models-Continuous inputs, Maximum likelihood solution, Discrete features, Exponential family, Probabilistic Discriminative Models -Fixed basis functions, Logistic regression, Iterative reweighted least squares, Multiclass logistic regression, Probit regression, Canonical link functions

Module IV: Kernel Methods (8 L)

Constructing Kernels, Radial Basis Function Networks - Nadaraya-Watson model, Gaussian Processes -Linear regression revisited, Gaussian processes for regression, Learning the hyper parameters, Automatic relevance determination, Gaussian processes for classification, Laplace approximation, Connection to neural networks, Sparse Kernel Machines- Maximum Margin Classifiers, Overlapping class distributions, Relation to logistic regression, Multiclass SVMs, SVMs for regression, Computational learning theory, Relevance Vector Machines- RVM for regression, Analysis of sparsity, RVM for classification.

Module V: Graphical Models (8 L)

Bayesian Networks, Example: Polynomial regression, Generative models, Discrete variables, Linear-Gaussian models, Conditional Independence- Three example graphs, D-separation, Markov Random Fields -Conditional independence properties, Factorization properties, Illustration: Image de-noising, Relation to directed graphs, Inference in Graphical Models- Inference on a chain, Trees, Factor graphs, The sum-product algorithm, The max-sum algorithm, Exact inference in general graphs, Loopy belief propagation, Learning the graph structure.

Course Outcomes (COs)

On completion of the course, student will be able to

CO1–Ability to understand the concepts of Neural Networks.
CO2 –Illustrate the concepts to select the Learning Networks in modeling real world systems.
CO3 –Analyze the concepts to use an efficient algorithm for Deep Models.
CO4 –Ability to apply optimization strategies for large scale applications

TEXT/REFERENCEBOOKS

1. C. Bishop -Pattern Recognition and Machine Learning- -Springer, 2006.
2. Neural Networks and Learning Machines, Simon Haykin, 3rd Edition, Pearson Prentice Hall.
3. Nils J. Nilsson -Introduction to machine learning, Stanford University Stanford.
4. William J. Deuschle – Undergraduate Fundamentals of Machine Learning, thesis Harvard College, Cambridge.

Course Assessment Marks

1. Continuous Assessments (CA1, CA2 & CA3): 30%
2. End Semester Examination: 70%

OE-EC-604C	DATA SCIENCE (DS)	3L:0T:0P	3 credits

Module I: Introduction to Data Science (6 L)

Definition of Data Science- Big Data and Data Science hype – and getting past the hype – Datafication - Current landscape of perspectives - Statistical Inference - Populations and samples - Statistical modeling, probability distributions, fitting a model – Over fitting. Basics of R: Introduction, R-Environment Setup, Programming with R, Basic Data Types.

Module II: Data Types & Statistical Description (8 L)

Different Types of Attributes, Describing Attributes by the Number of Values, Asymmetric Attributes, Binary Attribute, Nominal Attributes, Ordinal Attributes, Numeric Attributes, Discrete versus Continuous Attributes. Basic Statistical Descriptions of Data: Measuring the Central Tendency: Mean, Median, and Mode, Measuring the Dispersion of Data: Range, Quartiles, Variance, Standard Deviation, and Inter-quartile Range, Graphic Displays of Basic Statistical Descriptions of Data.

Module III: Vectors in DS (8 L)

Creating and Naming Vectors, Vector Arithmetic, Vector sub setting, Matrices: Creating and Naming Matrices, Matrix Sub setting, Arrays, Class. Factors and Data Frames: Introduction to Factors: Factor Levels, Summarizing a Factor, Ordered Factors, Comparing Ordered Factors, Introduction to Data Frame, subsetting of Data Frames, Extending Data Frames, Sorting Data Frames. Lists: Introduction, creating a List: Creating a Named List, Accessing List Elements, Manipulating List Elements, Merging Lists, Converting Lists to Vectors.

Module IV: Conditionals and Control Flow (6 L)

Relational Operators, Relational Operators and Vectors, Logical Operators, Logical Operators and Vectors, Conditional Statements. Iterative Programming in R: Introduction, While Loop, For Loop, Looping Over List. Functions in R: Introduction, writing a Function in R, Nested Functions, Function Scoping, Recursion, Loading an R Package, Mathematical Functions in R.

Module V: Data Reduction (6 L)

Overview of Data Reduction Strategies, Wavelet Transforms, Principal Components Analysis, Attribute Subset Selection, Regression and Log-Linear Models: Parametric Data Reduction, Histograms, Clustering, Sampling, Data Cube Aggregation. Data Visualization: Pixel-Oriented, Visualization Techniques, Geometric Projection Visualization Techniques, Icon-Based Visualization Techniques, Hierarchical Visualization Techniques, Visualizing Complex Data and Relations.

Course Outcomes (COs)

On completion of the course, student will be able to

CO1 – Understand basic terms what Statistical Inference means.
CO2 – Identify probability distributions commonly used as foundations for statistical modelling.
CO3 – Describe the data using various statistical measures.
CO4 – Utilize R elements for data handling and perform data reduction techniques.

TEXT/REFERENCEBOOKS

1. Doing Data Science, Straight Talk from The Frontline. Cathy O'Neil and Rachel Schutt, O'Reilly, 2014
2. K G Srinivas, G M Siddesh, "Statistical programming in R", Oxford Publications.

3. Introduction to Data Mining, Pang-Ning Tan, Vipin Kumar, Michael Steinbanch, Pearson Education.
4. Brain S. Everitt, “A Handbook of Statistical Analysis Using R”, Second Edition, 4 LLC, 2014.

Course Assessment Marks

1. Continuous Assessments (CA1, CA2 & CA3): 30%
2. End Semester Examination: 70%

OE-EC-604D	BIG DATA ANALYTICS	3L:0T:0P	3 credits

Module I: INTRODUCTION (8 L)

Definition and Features of Big Data, Big Data Value, The Development of Big Data, Challenges of Big Data. RELATED TECHNOLOGIES: Cloud Computing–Cloud Computing Preliminaries, Relationship Between Cloud Computing and Big Data, IoT – IoT Preliminaries, Relationship Between IoT and Big Data, Data Center, Hadoop–Hadoop Preliminaries, Relationship between Hadoop and Big Data.

Module II: BIG DATA GENERATION ACQUISITION AND STORAGE (12 L)

Big Data Generation-Enterprise Data,IoT Data, Internet Data, Bio- medical Data, Data Generation from Other Fields, Big Data Acquisition-Data Collection, Data Transportation, Data Pre-processing. Storage System for Massive Data, Distributed Storage System, Storage Mechanism for Big Data - Database Technology, Design Factors, Database Programming Model Data Storage and Analysis, Comparison with Other Systems, A Brief History of Hadoop, Apache Hadoop and the Hadoop Ecosystem, A Weather Dataset, Analyzing the Data with Unix Tools, Analyzing the Data with Hadoop(Map and Reduce, Java MapReduce), Scaling Out, Hadoop Streaming, Hadoop Pipes.

Module III: BIG DATA ANALYSIS (6 L)

Traditional Data Analysis, Big Data Analytic Methods, Architecture for Big Data Analysis - Real-Time vs. Offline Analysis, Analysis at Different Levels, Analysis with Different Complexity, Tools for Big Data Mining and Analysis.

Module IV: BIG DATA APPLICATIONS (8 L)

Application Evolution, Big Data Analysis Fields - Structured Data Analysis, Text Data Analysis, Web Data Analysis, Multimedia Data Analysis, Network Data Analysis, Mobile Traffic Analysis, Key Applications - Application of Big Data in Enterprises, Application of IoT Based Big Data, Application of Online Social Network-Oriented Big Data, Applications of Healthcare and Medical Big Data, Collective Intelligence, Smart Grid.

Course Outcomes (COs)

On completion of the course, student will be able to

CO1 – Understand big data analytics as the next wave for competitive advantage.
CO2 – Explore tools and practices for working with big data.
CO3 – Understand how big data analytics can leverage into a key Component.
CO4 – Illustrate the concepts of stream computing.

TEXT/REFERENCEBOOKS

1. Min Chen, Shiwen Mao, Yin Zhang,Victor C.M. Leung, “Big Data: Related Technologies, Challenges and Future Prospects”, Springer; 2014 edition.
2. Tom White, “Hadoop- The Definitive Guide”, O’reilly, 2nd Edition.

Course Assessment Marks

1. Continuous Assessments (CA1, CA2 & CA3): 30%
2. End Semester Examination: 70%

OE-EC-605A	Human Resource Management	3L:0T:0P	3 credits

Course Contents:

Module I: (6L)

1. Meaning & Definition of HRM
2. Functions of HRM
3. Scope & Objectives of HRM
4. Qualities of an HR manager

Module II: (8L)

1. Human Resource Planning: Meaning & Definition, Importance of HRP,HRP Process. Barriers of HRP, Factors of sound HRP.Recruitment – Meaning & Definition, Sources of Recruitment, Recruitment Process, Effective Recruitment.
2. Training & Performance Appraisal- Definition & Objective,Areas of Training, Meaning & Definition of Performance Appraisal, process, Effective principles of performance Appraisal.

Module III: (10L)

1. Industrial Relations:Concept & Meaning, Objective & Importance, Reasons of poor Industrial Relation. Industrial Disputes- Meaning & Definition, Causes of Industrial Dispute, Prevention of Industrial Dispute, Conditions for good Industrial Relation.

Module IV:-(6 L)

1. Workers Participation in Management: Meaning & Need, Forms of Participation, Scheme of participation,Merits & Demerits.
2. Collective Bargain- Meaning & Definition, Objective & Importance, Process of Collective Bargain, Effective Condition.
3. Employee Discipline-Guidelines for action, Penalties & Punishment, Rewards of Discipline

Course Outcomes (COs)

CO1: To know the professional & personal qualities of an HR manager.
CO2: To learn different methods of selecting human resources, through recruitment, training, &performance appraisal system.
CO3: To know how to develop a favourable working environment in an organization, through participation in management, and maintain a good industrial relation, for benefit of the society.
CO-4: To know about the consequences of industrial dispute and employee indiscipline in an organization.

Text/ Reference Books:

1. Human Resource Management P.SubbaRao, Himalayan Publishing House 2012
2. Human Resource Management K. AswathappaM.c GRAW Hill Education 2013
3. Human Resource Development & management A.M Seikh, S. Chand 2003
4. Human Resource Management S.S Khanka, S Chand, 2014.

Course Assessment Marks

1. Continuous Assessments (CA1, CA2 & CA3): 30%
2. End Semester Examination: 70%

OE-EC-605B	CYBER SECURITY	3L:0T:0P	3 credits

Module I: Introduction to Cyber Security (8 L)

Introduction to Cyber Space and overview of Computer and Web Technology, Architecture of Cyber space, Communication and web technology, Internet, world wide web, advent of Internet, Internet Infrastructure for data transfer and governance, Internet society, Regulation of cyberspace, concept of cyber security, Issues and challenges of Cyber security.

Module II: Cybercrime and Cyber Law (6 L)

Classification of cybercrimes, common cyber crimes-cybercrimes targeting Computer, Cyber Crime against women and children, financial frauds, social engineering attacks, malware and ransomware attacks, zero day and zero click attacks, cybercriminals modus-operandi, reporting of cybercrimes, remedial and mitigation measures, legal perspective of cybercrime , IT Act 2000 and its amendments, cybercrime and offenses, organizations dealing with cybercrime and cyber security in India.

Module III: Social Media Overview and Security (6 L)

Introduction to social networks. Types of Social media, Social media platforms, Social media monitoring, Hashtag, Viral Content, Social media marketing, Social media Privacy, Challenges, opportunities and pitfalls in online social network, Security issues related to social media, Flagging and reporting of inappropriate content.

Module IV: E-Commerce and Digital Payments (8 L)

Electronic Commerce Definition, main components of E-Commerce, Elements of E-Commerce Security, E-Commerce threats, E-Commerce security best practices. Introduction to digital payments, Components of digital payments and stakeholders, modes of digital payments-banking cards, unified payment interface (UPI), e-wallets, Unstructured Supplementary Service Data (USSD), Aadhar enabled payments, Digital payment related common frauds and preventive measures. RBI guidelines on digital payment and customer protection in unauthorized banking transactions. Relevant provisions of payment settlement Act, 2007.

Module V: Digital Devices Security, Tools and Technologies for Cyber Security (6 L)

End point devices and mobile phone security, Password policy, Security Patch management, data backup, Downloading and management of third party software, Device Security policy, Cyber Security Best Practices, Significance of host firewall and Antivirus, Management of host firewall and Antivirus, Wi-Fi Security, Configuration of basic security policy and permissions.

Course Outcomes (COs)

On completion of the course, student will be able to

CO1 – Understand the concept of Cyber Security and issues and challenges associated with it.
CO2 – Demonstrate the Cybercrimes, their nature, legal remedies and as to how to report the crime through available platforms and procedures.
CO3 – Analyze the basic security aspects related to Computer and mobiles. Able to use basic tools and technologies to protect their devices.

TEXT/REFERENCEBOOKS

1. Nina Godbole, Sunit Belapure, “Cyber Security”, Wiley India, 2014, ISBN-13 No.: 9788126521791.
2. E.Maiwald,“Fundamentals of Network Security”, Mc Graw Hills.
3. Marine R.C,”Cybercrime Impact in the New Millennium”, Auther Press.

Course Assessment Marks

1. Continuous Assessments (CA1, CA2 & CA3): 30%
2. End Semester Examination: 70%

OE-EC-605C	ARTIFICIAL INTELLIGENCE	3L:0T:0P	3 credits

Module I: (8L)

Overview of Artificial intelligence, Problems of AI, AI technique, Tic-Tac-Toe problem. Agents & environment, nature of environment, structure of agents, goal based agents, utility based agents, learning agents. Defining the problem as state space search, production system, problem characteristics, issues in the design of search programs.

Module II: (12L)

Solving problems by searching: problem solving agents, searching for solutions; uniform search strategies: breadth first search, depth first search, depth limited search, bidirectional search, comparing uniform search strategies. Greedy best-first search, memory bounded heuristic search: local search algorithms & optimization problems: Hill climbing search, simulated annealing search, local beam search, genetic algorithms; constraint satisfaction problems, local search for constraint satisfaction problems. Games, optimal decisions & strategies in games, the minimax search procedure, alpha-beta pruning, additional refinements, iterative deepening.

Module III: (8 L)

Knowledge representation issues, representation & mapping, approaches to knowledge representation, issues in knowledge representation. Representing simple fact in logic, representing instant & ISA relationship, computable functions & predicates, resolution, natural deduction. Representing knowledge in an uncertain domain, the semantics of Bayesian networks, Dempster-Shafer theory, Fuzzy sets & fuzzy logics.

Module IV: (6 L)

Introduction, Syntactic processing, semantic analysis, discourse & pragmatic processing. Forms of learning, inductive learning, learning decision trees, explanation based learning, learning using relevance information, Introduction to neural network & genetic Algorithm. Representing and using domain knowledge, expert system shells, knowledge acquisition.

Course Outcomes (COs)

On completion of the course, student will be able to

CO1 – Describe the fundamental concepts of AI
CO2 – Illustrate basic search techniques with examples
CO3 – Solve crypt-arithmetic problems.
CO4 – Represent knowledge using semantic network, extended semantic network and frames.

TEXT/REFERENCEBOOKS

1. Artificial Intelligence, Ritch & Knight, TMH
2. Artificial Intelligence A Modern Approach, Stuart Russel Peter Norvig Pearson
3. Artificial Intelligence, A Classical Approach, Munish Chandra Trivedi, Khanna Publishing
4. Introduction to Artificial Intelligence & Expert Systems, Patterson, PHI
5. Poole, Computational Intelligence, OUP
6. Logic & Prolog Programming, Saroj Kaushik, New Age International
7. Expert Systems, Giarranto, VIKAS

Course Assessment Marks

1. Continuous Assessments (CA1, CA2 & CA3): 30%
2. End Semester Examination: 70%

OE-EC605 D	Entrepreneurship	3L:0T:0 P	3 credits

Module-I: (6 L)

New Industrial Policy of 1991,Meaning and Definition of Entrepreneurship, Incentives and benefits available to SSI Units and New Entrepreneurs, Growth of SSI in India. Procedures to startSSIs.

Module-II: (8 L)

Market survey and research pricing and techniques, Distribution Channel, Sales promotion activities. Raising Finance and enterprise launching.

Module-III: (8 L)

Financial Management, Working Capital Management, Costing and Book Keeping: Overview only. Break-Even- Analysis. Taxation: Income Tax, Excise duty, Sales tax, VAT, GST.

Module-IV: (8 L)

Decision making–Types, Personal Management, Motivation and theories of motivation. Preliminary Project Report (PPR), Detailed Project Report (DPR)- Overview.

Total: 30 L

Text Book

1. Entrepreneurial Development: S.S.Khanka. S.Chand, 2019.

Reference Books

1. Industrial Organisation and Engg.Economics. Sharma & Banga.Khanna Publication, 2020.
2. Entrepreneurship New Venture Creation. David H.Holt.Prentice Hall .PHI, 2018.

Course Outcomes (CO)

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

CO1. Know the contribution of an entrepreneur and role of SSI units in growth and development of socio-economic condition of our country.

CO2. Understand market survey, sales promotions, enterprise launching and financial management through costing, book keeping and gain knowledge about different taxation systems.

CO3. Learn about decision making technique along with personal management system and project report.

Course Assessment Marks

1. Continuous Assessments (CA1, CA2 & CA3): 30%
2. End Semester Examination: 70%

EC 691	VLSI Design Lab	0L:0T:3P	1.5 credits

Laboratory Experiments:

1. Design and Simulation of Half and Full adders,

2. Design and Simulation of Half and Full subtractor,

3. Design of MUX/DeMUX circuits.

4. Design of Serial Binary Adder and Ripple Carry Adder.

5. Design of 4-bit binary BCD counters (synchronous/ asynchronous reset).

6. Design of a N- bit shift register of Serial- in Serial –out, Serial in parallel out, Parallel in Serial out and Parallel in Parallel Out.

7. Design of Sequence Detector (Finite State Machine- Mealy and Moore Machines).

8. Design of 4- Bit Multiplier and 4-bit Divider.

9. Design of ALU to Perform – ADD, SUB, AND, OR, 1's compliment, 2's Compliment.

10. CMOS Inverter using SPICE simulation.

11. Design of amplifier using SPICE simulation.

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Course Outcomes (CO)

CO1:.Knowledge on modelling and synthesis of digital system design using HDL programming languages.
CO2: Ability to design using FPGA/CPLD devices.
CO3: An exposure to critical path time calculations and RTL modules.

Course Assessment Marks
1. Practical Continuous Assessments (PCA1 & PCA2): 40%
2. End Semester Examination: 60%

EC-692	DESIGN LAB-2 (MINI PROJECT-2)	0L:0T:4P	2 credits

Guidelines:

1. The mini-project-2 is a team activity having 3-4 students in a team. This is electronic product design work with a focus on electronic circuit design.

2. The mini project-2 may be a complete hardware or a combination of hardware and software. The software part in mini project-2 should be less than 50% of the total work.

3. Mini Project-2 should cater to a small system required in laboratory or real life.

4. It should encompass components, devices, analog or digital ICs, micro controller with which functional familiarity is introduced.

5. After interactions with course coordinator and based on comprehensive literature survey/ need analysis, the student shall identify the title and define the aim and objectives of mini-project-2.

6. Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and submit the proposal within first week of the semester.

7. The student is expected to exert on design, development and testing of the proposed work as per the schedule.

8. Art work and Layout should be made using CAD based PCB simulation software. Due considerations should be given for power requirement of the system, mechanical aspects for enclosure and control panel design.

9. Completed mini project-2 and documentation in the form of mini project-2 report is to be submitted at the end of semester.

10. The tutorial sessions should be used for discussion on standard practices used for electronic circuits/product design, converting the circuit design into a complete electronic product, PCB design using suitable simulation software, estimation of power budget analysis of the product, front panel design and mechanical aspects of the product, and guidelines for documentation /report writing.

Course Outcomes (COs)
On completion of the course, student will be able to

CO1 – Understand a problem statement either from rigorous literature survey or from the requirements raised from need analysis.
CO2 – Design, implement and test the prototype/algorithm in order to solve the problem.
CO3 – Demonstrate comprehensive report on mini project-2 work.

Course Assessment Marks
1. Practical Continuous Assessments (PCA1 & PCA2): 40%
2. End Semester Examination: 60%

EC 693	Technical Seminar Presentation Lab	0L:0T:3P	1.5 credits

Preface: The course 'Seminar' is intended to enable a B.Tech graduate to read, understand, present and prepare report about an academic document. The learner shall search in the literature including peer reviewed journals, conference, books, project reports etc., and identify an appropriate paper/thesis/report in her/his area of interest, in consultation with her/his seminar guide. This course can help the learner to experience how a presentation can be made about a selected academic document and also empower her/him to prepare a technical report.

Course Objectives:

- ✓ To do literature survey in a selected area of study.
- ✓ To understand an academic document from the literate and to give a presentation about it.
- ✓ To prepare a technical report.

General Guidelines

- ➢ The Department shall form an Internal Evaluation Committee (IEC) for the seminar with academic coordinator for that program as the Chairperson/Chairman and seminar coordinator & seminar guide as members. During the seminar presentation of a student, all members of IEC shall be present.
- ➢ Formation of IEC and guide allotment shall be completed within a week after the University examination (or last working day) of the previous semester.
- ➢ Guide shall provide required input to their students regarding the selection of topic/paper.
- ➢ Choosing a seminar topic: The topic for a UG seminar should be current and broad based rather than a very specific research work. It's advisable to choose a topic for the Seminar to be closely linked to the final year project area. Every member of the project team could choose or be assigned Seminar topics that covers various aspects linked to the Project area.
- ➢ A topic/paper relevant to the discipline shall be selected by the student during the semester break.
- ➢ Topic/Paper shall be finalized in the first week of the semester and shall be submitted to the IEC.
- ➢ The IEC shall approve the selected topic/paper by the second week of the semester.
- ➢ Accurate references from genuine peer reviewed published material to be given in the report and to be verified.

Course Outcomes (COs)

CO1: Identify contemporary technical topics and analyze the applicability of modern tools and technology.
CO2: Develop effective presentation and communication skills.
CO3: Demonstrate technical seminar report writing skills along with active interactions.

Lab Evaluation Criteria:

Component	Marks
Technical Content	30
Presentation skills , body language and audience engagement	30
Slide Preparation and report	20
Interaction skills and Q&A	20
Total Marks	**100**

ES-CS-694	Object-Oriented Programming Lab	0L:0T:3P	1.5 credits

Laboratory Experiments:

1. Class, object creation with constructor, and methods.
2. Constructor overloading, method overloading
3. String handling, wrapper class, arrays
4. Inheritance, method overriding.
5. Multiple inheritance, Abstract class, and Interfaces
6. Creating and accessing packages
7. Exception handling
8. Multithreaded programming
9. Mini project-1
10. Mini project-2

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Course Outcomes (COs)

CO1: Understand and implement the fundamental concepts of object-oriented programming, data types, various control and iterative statements, and string functions in Java to solve computational problems. Gain a solid understanding of Java's programming syntax and structure.

CO2: Design robust applications using Java's packages, interfaces, exception handling, and multithreading mechanisms.

CO3: Apply object-oriented principles to design and develop medium-scale real-world applications while adhering to best practices and design patterns. Enhance problem-solving abilities and teamwork skills throughout the process.

Text/ ReferenceBooks:

1. E. Balagurusamy - " Programming with Java: A Primer" – 3rd Ed. – TMH
2. Kathy Sierra, Bert Bates - Head First Java: A Brain-Friendly Guide, 2Nd Edition- O'Reilly
3. Rambaugh, James Michael, Blaha - "Object Oriented Modelling and Design" – PHI
4. Ali Bahrami - "Object Oriented System Development" – Mc Graw Hill
5. Patrick Naughton, Herbert Schildt - "The complete reference-Java2" – TMH .

Course Assessment Marks

1. Practical Continuous Assessments (PCA1&PCA2): 40%
2. End Semester Practical Examination: 60%

EC 695	Robotics Lab	0L:0T:3P	1.5 credits

Laboratory Experiments:

1. Perform experiment on robotic hand movement on Hiwonder software.
2. Perform experiment of Tinker kit robotic arm movement using Arduino programming
3. Perform Pick and Place operations on Tinker kit Robotic Arm using Arduino programming
4. Perform experiment on color sensor-based Tinker kit Robotic Arm movement using programming
5. Perform experiment on ultrasonic sensor-based Tinker kit Robotic Arm movement using programming
6. Perform experiment on finding coordinate system of myCobot
7. Perform color recognition experiment on myCobot
8. Perform experiment on Humanoid Robot using RoboSoul Software
9. Perform experiment on face detection using Humanoid Robot
10. Perform experiment on line following using Humanoid Robot

Course Outcomes (COs)

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

CO1: Understand Tinkerkit Robotic arm configuration, basic components and its application using programming.

CO2: Demonstrate myCobot Robotic arm configuration and programming to perform different tasks.

CO3: Explore the Humanoid Robot basic working module using simulation software to perform specific tasks.

Course Assessments Marks:

1. Practical Continuous Assessments (PCA1 & PCA2): 40%
2. End Semester Examination: 60%

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	1	3	1	1	-	2	2	-	1	3	2	1
CO2	3	2	3	1	3	1	1	-	2	2	-	1	3	2	1
CO3	3	2	3	1	3	1	1	-	2	2	-	1	3	2	1

PE-EC-701A	OPTICAL COMMUNICATION	3L:0T:0P	3 credits

MODULE I: INTRODUCTION TO OPTICAL FIBERS (6 L)

Introduction-general optical fiber communication system- basic optical laws and definitions optical modes and configurations-mode analysis for optical propagation through fiber modes in planar wave guide-modes in cylindrical optical fiber-transverse electric and transverse magnetic modes- fiber materials-fiber fabrication techniques-fiber optic cables-classification of optical fiber single mode fiber-graded index fiber.

MODULE II: TRANSMISSION CHARACTERISTIC OF OPTICAL FIBER (6 L)

Attenuation-absorption-scattering losses-bending losses-core and cladding losses-signal dispersion – inter symbol interference and bandwidth-intra model dispersion-material dispersion waveguide dispersion-polarization mode dispersion-intermodal dispersion, dispersion optimization of single mode fiber-characteristics of single mode fiber-R-I Profile- cutoff wave length-dispersion calculation-mode field diameter.

MODULE III: OPTICAL SOURCES AND DETECTORS (8 L)

Sources: Intrinsic and extrinsic material-direct and indirect band gaps-LED-LED structures surface emitting LED-Edge emitting LED-quantum efficiency and LED power-light source materials-modulation of LED-LASER diodes-modes and threshold conditions-Rate equations-external quantum efficiency-resonant frequencies-structures and radiation patterns-single mode laser-external modulation-temperature effort. Detectors: PIN photo detector-Avalanche photo diodes-Photo detector noise-noise sources SNR-detector response time-Avalanche multiplication noise-temperature effects-comparisons of photo detectors.

MODULE IV: OPTICAL RECEIVER, MEASUREMENTS AND COUPLING (8 L)

Fundamental receiver operation-preamplifiers-digital signal transmission-error sources Front end amplifiers-digital receiver performance-probability of error-receiver sensitivity-quantum limit. Optical power measurement-attenuation measurement-dispersion measurement- Fiber Numerical Aperture Measurements- Fiber cut- off Wave length Measurements- Fiber diameter measurements-Source to Fiber Power Launching-Lensing Schemes for Coupling Management Fiber to Fiber Joints-LED Coupling to Single Mode Fibers-Fiber Splicing-Optical Fiber connectors.

MODULE V: OPTICAL COMMUNICATION SYSTEMS AND NETWORKS (6 L)

System design consideration Point – to –Point link design –Link power budget –rise time budget, WDM –Passive DWDM Components-Elements of optical networks-SONET/SDH Optical Interfaces-SONET/SDH Rings and Networks-High speed light wave Links-OADM configuration Optical ETHERNET-Soliton.

Course Outcomes (COs)

On completion of the course, student will be able to

CO1 – Realize basic elements in optical fibers, different modes and configurations.
CO2 – Analyze the transmission characteristics associated with dispersion and polarization techniques.
CO3 – Illustrate the use of optical sources, detectors, fiber optic receiver systems and coupling techniques.
CO4 – Design optical communication systems and its networks.

TEXT/REFERENCEBOOKS

1. John M.Senior, Optical fiber communication, Pearson Education, second edition.2007.
2. Rajiv Ramaswami, Optical Networks, Second Edition, Elsevier, 2004.
3. J.Gower, Optical Communication System, Prentice Hall of India, 2001.
4. Govind P. Agrawal, Fiber- Optic communication systems, third edition, John Wiley & sons, 2004.

Course Assessment Marks

1. Continuous Assessments (CA1, CA2 & CA3): 30%
2. End Semester Examination: 70%

PE-EC-701B	DIGITAL IMAGE PROCESSING	3L:0T:0P	3 credits

Course Contents:

Module I: Digital image fundamentals & Image Transforms (6 L)

Digital Image fundamentals, Sampling and quantization, Relationship between pixels. 2-D FFT, Properties. Walsh transforms, Hadamard Transform, Discrete cosine Transform, Discrete Wavelet Transform.

Module II: Image enhancement (10 L)

Introduction, Image Enhancement in Spatial Domain, Enhancement Through Point Operation, Types of Point Operation, Histogram Manipulation, gray level Transformation, local or neighborhood operation, median filter, spatial domain high- pass filtering. Filtering in Frequency Domain, Obtaining Frequency Domain Filters from Spatial Filters, Generating Filters Directly in the Frequency Domain, Low Pass (smoothing) and High Pass (sharpening) filters in Frequency Domain.

Module III: Image Restoration and Segmentation (6 L)

Degradation Model, Algebraic Approach to Restoration, Inverse Filtering, Least Mean Square Filters, Constrained Least Squares Restoration. Detection of discontinuities. Edge linking and boundary detection, Thresholding, Region oriented segmentation.

Module IV: Image Processing and Compression (10 L)

Dilation and Erosion, Dilation, Structuring Element Decomposition, Erosion, Combining Dilation and Erosion, Opening and Closing, the Hit or Miss Transformation. Redundancies and their Removal Methods, Fidelity Criteria, Image Compression Models, Huffman and Arithmetic Coding, Error Free Compression, Lossy Compression, Lossy and Lossless Predictive Coding, Transform Based Compression, JPEG 2000 Standards.

Course Outcomes (COs)

On completion of the course, student will be able to

CO1 –Explain the fundamentals of digital image and image transform.
CO2 –Illustrate the concepts of image enhancement in spatial and frequency domain.
CO3 –Analyze the concepts of image restoration and segmentation.
CO4 –Illustrate the concepts of image processing and compression.

TEXT/REFERENCEBOOKS

1. Digital Image Processing- Rafeal C. Gonzalez, Richard E. Woods, 3rd Edition, Pearson, 2008
2. Digital Image Processing- S Jayaraman, S. Essakkirajan, T. Veerakumar-TMH,2010
3.Fundamentals of Digital Image Processing-A.K. Jain,PHI,1989
4.Digital Image Processing and computer Vision-Somka, Halavac, Boyle - Cengage learning (Indian edition)2008,
5. Digital Image Processing using Matlab, Rafeal C. Gonzalez, Richard E. Woods, Steven L. Eddins, Pearson Education.

Course Assessment Marks

1. Continuous Assessments (CA1, CA2 & CA3): 30%
2. End Semester Examination: 70%

PE-EC-701C	AUGMENTED REALITY (AR) & VIRTUAL REALITY (VR)	3L:0T:0P	3 credits

Module I: Introduction (6 L)

Introduction to Augmented-Virtual and Mixed Reality, Taxonomy, technology and features of augmented reality, difference between AR ,VR and MR, Challenges with AR, AR systems and functionality, Augmented reality methods, visualization techniques for augmented reality.

Module II: VR systems and software development (10 L)

VR as a discipline, Basic features of VR systems, Architecture of VR systems, VR hardware : VR input hardware: tracking systems, motion capture systems, data gloves, VR output hardware: visual displays. Challenges in VR software development, Master/slave and Client/server architectures, Cluster rendering, Game Engines and available sdk to develop VR applications for different hardware (HTC VIVE, Oculus, Google VR).

Module III: Stereoscopic Vision & Haptic rendering (8 L)

Fundamentals of the human visual system, Depth cues, Stereopsis, Retinal disparity, Haptic sense, Haptic devices, Algorithms for haptic rendering and parallax, Synthesis of stereo pairs, Pipeline for stereo images. AR software, Camera parameters and camera calibration, Marker-based augmented reality, AR Toolkit.

Module IV: 3D interaction techniques and application (8 L)

3D Manipulation tasks, Manipulation Techniques and Input Devices, Interaction Techniques for 3D Manipulation. VR Technology in Film & TV Production. VR Technology in Physical Exercises and Games. Demonstration of Digital Entertainment by VR.

Course Outcomes (COs)

On completion of the course, student will be able to

CO1 – Describe how VR and AR systems work.

CO2 – Illustrate the fundamental techniques for the design and development of AR and VR.

CO3 – Identify and examine state-of-the-art AR and VR design problems and solution from the industry and academia.

CO4 – Develop software that reflects fundamental techniques for the design and deployment of VR and AR experiences.

TEXT/REFERENCEBOOKS

1. George Mather, Foundations of Sensation and Perception:Psychology Press; 2 edition, 2009.
2. The VR Book: Human-Centered Design for Virtual Reality, by Jason Jerald.
3. Learning Virtual Reality by Tony Parisi, O' Reilly
4.Burdea, G. C. and P. Coffet. Virtual Reality Technology, Second Edition.Wiley-IEEE Press, 2003.
5. Alan B. Craig, Understanding Augmented Reality, Concepts and Applications, Morgan Kaufmann, 2013.

Course Assessment Marks

1. Continuous Assessments (CA1, CA2 & CA3): 30%
2. End Semester Examination: 70%

PE-EC-701D	FPGA DESIGN	3L:0T:0P	3 credits

Course Contents:

Module I: (6 L)
Verilog HDL Coding Style: Lexical Conventions - Ports and Modules – Operators – Gate Level Modeling - System Tasks &Compiler Directives - Test Bench - Data Flow Modeling - Behavioral level Modeling -Tasks & Functions.

Module II: (6 L)
FPGA Architectural options, coarse vs fine grained, vendor specific issues (emphasis on Xilinx FPGA), Antifuse, SRAM and EPROM based FPGAs, FPGA logic cells, interconnection network and I/O Pad.

Module III: (10 L)
Verilog Modelling of Combinational and Sequential Circuits: Behavioral, Data Flow and Structural Realization – Adders – Multipliers- Comparators - Flip Flops - Realization of Shift Register - Realization of a Counter- Synchronous and Asynchronous FIFO –Single port and Dual port RAM – Pseudo Random LFSR – Cyclic Redundancy Check.

Module IV: (12 L)
Synchronous Sequential Circuit: State diagram-state table –state assignment-choice of flipflops – Timing diagram –One hot encoding Mealy and Moore state machines – Design of serial adder using Mealy and Moore state machines - State minimization – Sequence detection- Design examples: Sequence detector, Serial adder, Vending machine using One Hot Controller. System Design Examples using Xillinx FPGAs – Traffic light Controller, Real Time Clock-Interfacing using FPGA: VGA, Keyboard, LCD, Embedded Processor Hardware Design.

Course Outcomes (COs)
On completion of the course, student will be able to

CO1 – Design and optimize complex combinational and sequential digital circuits.
CO2 – Design and model digital circuits with Verilog HDL at behavioural, structural, and RTL Levels
CO3 – Understand the FPGA Architecture
CO4 – Implementation of the combinational and sequential digital circuits in FPGA

TEXT/REFERENCEBOOKS

1. M.J.S. Smith, “Application Specific Integrated Circuits”, Pearson, 2000.
2. Peter Ashenden, “Digital Design using VHDL”, Elsevier, 2007.
3. Peter Ashenden, “Digital Design using Verilog”, Elsevier, 2007. 4. W. Wolf, “FPGA based system design”, Pearson, 2004.
4. Clive Maxfield, “The Design Warriors’s Guide to FPGAs”, Elsevier, 2004.
5. Samir Palnitkar, “Verilog HDL: A Guide to Digital Design and Synthesis” Prentice Hall, Second Edition, 2003.

Course Assessment Marks
1. Continuous Assessments (CA1, CA2 & CA3): 30%
2. End Semester Examination: 70%

HS-HU-702	ORGANIZATIONAL BEHAVIOUR	3L:0T:0P	3 credits

Module I: Introduction

Definition, Nature and Scope –Environmental and organizational context – Impact of IT, globalization, Diversity, Ethics, culture, reward systems and organizational design on Organisational Behaviour. Cognitive Processes-I : Perception and Attribution: Nature and importance of Perception – Perceptual selectivity and organization – Social perception – Attribution Theories – Locus of control –Attribution Errors –Impression Management.

Module II: Cognitive Processes

Personality and Attitudes - Personality as a continuum – Meaning of personality - Johari Window and Transactional Analysis - Nature and Dimension of Attitudes – Job satisfaction and organisational commitment-Motivational needs and processes- Work- Motivation Approaches Theories of Motivation- Motivation across cultures – Positive organizational behaviour: Optimism – Emotional intelligence – Self-Efficacy.

Module III: Dynamics of Organizational Behaviour

Communication – types - interactive communication in organizations barriers to communication and strategies to improve the follow of communication – Decision Making: Participative decision making techniques – creativity and group decision making .
Stress and Conflict: Meaning and types of stress –Meaning and types of conflict - Effect of stress and intra-individual conflict - strategies to cope with stress and conflict.
Power and Politics: Meaning and types of power – empowerment - Groups Vs. Teams – Nature of groups –dynamics of informal groups – dysfunctions of groups and teams – teams in modern work place.

Module IV: Leading High performance

Job design and Goal setting for High performance- Quality of Work Life- Socio technical Design and High performance work practices – Behavioural performance management: reinforcement and punishment as principles of Learning –Process of Behavioural modification - Leadership theories - Styles, Activities and skills of Great leaders.

Course Outcomes (COs)
On completion of the course, student will be able to

CO1 - Analyze individual human behaviour in the workplace as influenced by diversity, ethics, culture, reward system, organizational design and perceptions.
CO2 - Illustrate motivational theories that lead to positive organizational behavior.
CO 3- Explain the processes used in developing communication and decision making.
CO4 - Analyze group dynamics and explain various leadership theories and style.

TEXT/REFERENCEBOOKS

1. Luthans, Fred: Organizational Behaviour 10/e, McGraw-Hill, 2009.
2. Mc Shane: Organizational Behaviour, 3e, TMH, 2008.
3. Nelson: Organizational Behaviour, 3/e, Thomson, 2008.
4. New strom W. John& Davis Keith, Organisational Behaviour-- Human Behaviour at Work, 12/e, TMH, New Delhi, 2009.
5. Pierce and Gardner: Management and Organisational Behaviour: An Integrated perspective, Thomson, 2009.
6. Robbins, P. Stephen, Timothy A. Judge: Organisational Behaviour, 12/e, PHI/Pearson, New Delhi, 2009.

Course Assessment Marks

1. Continuous Assessments (CA1, CA2 & CA3): 30%
2. End Semester Examination: 70%

MC 781	INDIAN CONSTITUTION	2L:0T:0P	0 credits

Module I: Introduction (4 L)

Constitution' meaning of the term, Indian Constitution: Sources and constitutional history, Features: Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy.

Module II: Union and State Government and its Administration (6 L)

Structure of the Indian Union: Federalism, Centre- State relationship, President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha, Role and Position, CM and Council of ministers, State Secretariat: Organisation, Structure and Functions

Module III: Local Administration District's Administration head (6 L)

Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation, Pachayati raj: Introduction, PRI: Zila Pachayat, Elected officials and their roles, CEO Zila Pachayat: Position and role, Block level: Organizational Hierarchy (Different 4.departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.

Module IV: Election Commission Election Commission (4 L)

Role and Functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and Functioning, Institute and Bodies for the welfare of SC/ST/OBC and women.

Course Outcomes (COs)

On completion of the course, student will be able to

CO1 – Explain the meaning, sources, and historical development of the Indian Constitution.
CO2 – Analyze the structure and functioning of the Indian government at the central and state levels.
CO3 – Evaluate the significance of local administration.
CO4 – Assess the role and functioning of the Election Commission in conducting free and fair elections.

TEXT/REFERENCEBOOKS

1. 'Indian Polity' by Laxmikanth
2. 'Indian Administration' by Subhash Kashyap
3. 'Indian Constitution' by D.D. Basu
4. 'Indian Administration' by Avasti and Avasti

EC-781	INTERNSHIP-1	0L:0T:8P	4 credits

Intersnip-1/ Industrial Training-1 course aims to cover core engineering fundamentals, industry-specific knowledge, safety protocols and industry awareness, and professional development, aiming to bridge theoretical knowledge with practical application and industry readiness.

Course Outcomes (COs):

On completion of the course, student will be able to

CO1:Participate in team or group during industrial training/internship, and understand modern tool usage, techniques and industry awareness.

CO2: Interact with industrial personnel and follow engineering practices, management, industrial safety rules and professional ethics.

CO3: Know how to build interpersonal and team skills and develop interactive presentation skills.

CO4: Prepare industrial training/internship reports.

Course Assessments Marks

1. Industry Awareness and Orientation (30 M)
2. Professionalism and work ethics (30 M)
3. Presentation, interaction and Viva-voce (20 M)
4. Report of industrial training /internship (20 M)

Total: 100 Marks

EC-782	PROJECT WORK-1	0L:0T:12P	6 credits

Project-1 during 7th semester involves a hands-on, in-depth exploration of a specific topic within the broad area of Electronics and Communication Engineering or interdisciplinary domain, culminating in a report and presentation. This is expected to provide a good initiation for the students for research and innovation work, thereby finding solutions to contemporary problems as individual and team.

Project-1 mainly includes:

1. Survey of published literature on the assigned topic.
2. Working out a preliminary approach and action plan to the assigned problem: Problem Formation and methodologies to be adopted.
3. Conducting preliminary analysis for prototype modeling, simulation or design using modern tools and techniques.
4. Preparing a report and presentation on the work progress.

Course Outcomes (COs):

At the end of the course, the student should be able to:

CO1: Identify complex engineering problems relevant to the society and industry.

CO2: Apply modern technologies, tools and systems in the field of Electronics & Communication Engineering or relevant discipline to analyze the identified problem.

CO3: Design and implement a viable solution to the problem with professional, societal and ethical values for better sustainability.

CO4: Apply communication & presentation skills and develop report writing as individual and team work.

Course Assessments Marks:

1. Problem formulation, literature survey and methodologies for proposed work (20 M)
2. Involvement, Planning and Organization as individual and team with professional and ethical values (20 M)
3. Modern tool usage, innovation and utility in societal and environmental context (20M)
4. Presentation and interaction skills, Viva (20M)
5. Final report and scope of extension in form of paper / implementation in real life (20M)

Total : 100 M

EC-783	GROUP DISCUSSION	0L:0T:4P	2 credits

Group Discussion focuses on preparing students for real-world professional communication, enhancing their interpersonal skills, problem solving skills, time management skills and improving their ability to articulate ideas and opinions effectively as individual and team on contemporary technical or relevant socio-economic issues / topics.

Course Outcomes (COs):

On completion of the course, student will be able to :

CO1: Understand the key skills and behaviours involving active participation, listening, logical and critical thinking required to facilitate a group discussion.

CO2: Demonstrate the ability to articulate ideas/views clearly and resolve conflicts effectively in group discussions.

CO3 : Develop interpersonal and facilitation skills with respect and inclusivity as individual and team.

Course Assessments Marks:

1.Participation (25 M)

2. Active listening, logical and critical thinking (25 M)

3. Communication skills & Conflict resolution (25 M)

4. Interpersonal and facilitation skills as individual and team (25 M)

Total: 100 Marks

HS-HU 801	UNIVERSAL HUMAN VALUES AND ETHICS	3L:0T:0P	3 credits

Module 1: INTRODUCTION TO UNIVERSAL HUMAN VALUES AND ETHICS (10 L)

Definition of Values and Ethics, The importance of universal human values in diverse societies. Types of values: moral, social, personal, and spiritual. Ethical theories and frameworks: Utilitarianism, Deontology, Virtue Ethics: Overview only.

Core Human Values: Respect, Responsibility, Compassion, Fairness, Honesty. Universal Human Rights and their ethical implications, The Role of Religion and Culture in Shaping Values and promote harmony.

Module 2: ETHICS IN PERSONAL AND PROFESSIONAL LIFE (10 L)

Ethical Decision Making in Personal Contexts: Integrity, honesty, and moral responsibility
Conflicts between personal interests and ethical principles, Self-respect, respect for others, and promoting ethical behavior.

Workplace Ethics and Integrity, Professional responsibility, accountability, and transparency. Conflicts of interest and ethical practices in professional settings.

Module 3: SOCIO-ETHICAL RESPONSIBILITY AND CONTEMPORARY ETHICAL ISSUES (10 L)

Sustainable Development and Environmental Ethics: Corporate Social Responsibility (CSR), Ethical Dilemmas and Conflict Resolution. Global ethical challenges: Climate change, human rights, and digital ethics.
Ethical implications of emerging technologies, and ethical considerations in the age of globalization and cultural diversity.

Course Outcomes (COs)
On completion of the course, student will be able to:
CO1: Understand the fundamental concepts of human values, ethics, and their significance in individual, professional, and societal contexts.
CO2: Examine and analyze various ethical dilemmas and their resolution in personal and professional life using universal ethical frameworks.
CO3: Apply ethical decision-making models to real-world situations, and promote the importance of responsibility, integrity, and sustainability in a global context.

TEXT/REFERENCE BOOK:

1. A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2020.

Course Assessment Marks
1. Continuous Assessments (CA1, CA2 & CA3): 30%
2. End Semester Examination: 70%

EC-881	INTERNSHIP-2	0L:0T:8P	4 credits

Intersnip-2 / Industrial Training-2 course aims to cover core engineering fundamentals, industry-specific knowledge, safety protocols and industry awareness, and professional development. The objective is to bridge the theoretical knowledge with practical application and industry readiness, so as to prepare the graduates with professional work ethics and engineering practices as individual and team.

Course Outcomes (COs):

On completion of the course, student will be able to

CO1:Participate in team or group during industrial training/internship, and understand modern tool usage, techniques and industry awareness.

CO2: Interact with industrial personnel and follow engineering practices, management, industrial safety rules and professional ethics.

CO3: Know how to build interpersonal and team skills and develop interactive presentation skills.

CO4: Prepare industrial training/internship reports.

Course Assessments Marks

1. Industry Awareness and Orientation (30 M)
2. Professionalism and work ethics (30 M)
3. Presentation, interaction and Viva-voce (20 M)
4. Report of industrial training /internship (20 M)

Total: 100 Marks

EC-882	PROJECT WORK-2	0L:0T:12P	6 credits

Project-2 during final 8th semester enables the students to further extend the investigations and project work taken up during the previous semester. This focuses on further development/ modifications, if any, and thereby final implementation of the project work, testing and designing, and final report submission.

Project-2 involves:

1. Review and finalization of the approach to the problem related to the project title /work.
2. Detailed Analysis / Modeling / Simulation / Design / Problem solving for the work.
3. Final implementation, results, conclusions and future directions. Also, preparing a paper in extended form for Presentation or publication, if possible, is encouraged.
4. Preparing a final report and presentation.

Course Outcomes (COs):

At the end of the course, the student should be able to:

CO1: Identify complex engineering problems relevant to the society and industry.

CO2: Apply modern technologies, tools and systems in the field of Electronics & Communication Engineering or relevant discipline to analyze the identified problem.

CO3: Design and implement a viable solution to the problem with professional, societal and ethical values for better sustainability.

CO4: Apply communication & presentation skills and develop report writing as individual and team work.

Course Assessments Marks:

1. Problem formulation, literature survey and methodologies for proposed work (20 M)
2. Involvement, Planning and Organization as individual and team with professional and ethical values (20 M)
3. Modern tool usage, innovation and utility in societal and environmental context (20M)
4. Presentation and interaction skills, Viva (20M)
5. Final report and scope of extension in form of paper / implementation in real life (20M)

Total : 100 M

EC-883	GRAND VIVA	0L:0T:4P	2 credits

The Grand Viva during the program exit is an oral examination that typically takes place at the end of the final semester. It is meant to assess the student's overall understanding, depth and practical understanding of the courses they have studied throughout the program. The viva typically covers a broad spectrum of topics, mainly including core subjects, project work, internships, and interdisciplinary topics in the contemporary scenario.

The Grand Viva at the final semester of a B.Tech program is vital because it not only tests academic knowledge but also evaluates a student's practical abilities, problem-solving and analytical skills, communication, and professional maturity. It serves as a capstone to a student's academic journey, preparing them for their future career or higher studies while providing valuable feedback and insights into their strengths and areas for improvement.

Course Outcomes (COs):

At the end of the course, the student should be able to:

CO1: Demonstrate comprehensive knowledge and problem solving skills in the field of Electronics & Communication Engg.

CO2: Communicate effectively with professionalism, ethical awareness and responsibility.

CO3: Present and actively interact exhibiting technical proficiency and interpersonal skills.

Course Assessments Marks:

1. Knowledge and Exploring capability (30M)
2. Self learning, critical thinking and problem solving skills for lifelong learning (30 M)
3. Professionalism and Ethical awareness (20 M)
4. Interpersonal skills and interactive presentation (20M)

Total: 100 Marks