School of Engineering and Applied Sciences

B. Tech Electronics and Communication Engineering

AY: 2019-2023

Syllabus

Department of Electronics and Communication Engineering
SRM University-Andhra Pradesh.

Semester-I					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
EGL 111 EGL 112	Communicative English **(NON-MINERVA)** Communicative English **(MINERVA)**	3	0	0	3
PHY 101	Engineering Physics	2	0	0	2
PHY 101 L	Engineering Physics Lab	0	0	2	1
ENG 111	Basic Electronics	3	0	0	3
ENG 111L	Basic Electronics lab	0	0	2	1
CSE 101 CSE 101 L CSE 102	Introduction to Programming Using Python**(NON -MINERVA)** Introduction to Programming Using Python Lab**(NON -MINERVA)** Introduction to Programming Using Python**(MINERVA)**	3 0 3	0 0 0	0 2 2	3 1 4
MAT 112	Single Variable Calculus	3	0	0	3
CDC 101	Soft Skills	1	0	0	1
	TOTAL	**15**	**0**	**6**	**18**

Semester-II					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
CDC 102	Soft skills-II	1	0	0	1
ECE 121	Engineering Circuit Analysis	3	0	2	4
CSE 104	Data Structures and algorithms using C	3	0	0	3
CSE 104 L	Data Structures and algorithms using C lab	0	0	2	1
EGL 121	Critical Thinking	3	0	0	3
MAT 121	Multivariable Calculus	3	0	0	3
ENV 111	Environmental Science	2	0	0	2
ENV 111L	Environmental Science lab	0	0	2	1
CHE 101	Chemistry	2	0	0	2
CHE 101L	Chemistry lab	0	0	2	1
	TOTAL	**17**	**0**	**8**	**21**

Semester-III					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
	Humanities/Social Studies Elective	3/4	0	0	3/4
MAT 131	Differential Equations	3	0	0	3
ECE 213	Probability and Statistics for Engineers	3	0	0	3
ECE 211	Digital Electronics	3	0	0	3
ECE 211 L	Digital Electronics Lab	0	0	2	1
ECE 212	Signals and Systems	3	0	0	3
ECE 212 L	Signals and Systems Lab	0	0	2	1
CDC 221	Aptitude	1	1	0	1
ECE 214	Quantum Electronics and Communication	3	0	0	3
CSE 230	Industry Standard Coding Practice-1	0	0	4	1
	TOTAL	**19/20**	**1**	**8**	**22/23**

Semester-IV					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
ISES 212	Industry Specific Employability Skills-IV	1	1	0	1
MAT 211	Linear Algebra	3	0	0	3
ECE 221	Analog Electronics	3	0	0	3
ECE 221 L	Analog Electronics lab	0	0	2	1
EEE 212	Control Systems	3	0	0	3
EEE 212 L	Control Systems Lab	0	0	2	1
ECE 222	Digital Signal Processing	3	0	0	3
ECE 222 L	Digital Signal Processing lab	0	0	2	1
ECE 223	Electromagnetics and Wave propagation	3	1	0	4
CSE 330	Industry Standard Coding Practice-2	0	0	4	1
	TOTAL	**16**	**1**	**10**	**21**

Semester-V					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
ECE 311	Analog Communication	3	0	0	3
ECE 311 L	Analog Communication lab	0	0	2	1
ECE 317	HDL based FPGA Design	3	0	0	3
ECE 317 L	HDL based FPGA Design Lab	0	0	2	1
ECE 313	Microprocessors and Interfacing	3	0	0	3
ECE 313 L	Microprocessors and Interfacing lab	0	0	2	1
CSE 331	Industry Standard Coding Practice-3	0	0	4	1
ECE 314	Transmission lines and waveguides	4	0	0	4
TE ECE 316 ECE 315 ECE 319	**Technical Elective** Information Theory and Coding **(Signal Processing Specialization)** Data Communication Microcontroller and Applications **(Embedded Systems Specialization)**	 3 3 3	 1 0 0	 0 0 2	3/4
OE	**Open Elective**	3/3	0/0	0/2	3/4
ISES 311	Industry Specific Employability Skills-V	1	1	0	0
ECE 310	Internship **(Optional)**	0	0	6	3
	TOTAL	**20**	**1/2**	**10/20**	**23/28**

Semester-VI					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
ECE 321	Microwave theory and Applications	3	0	0	3
ECE 321 L	Microwave theory and Applications lab	0	0	2	1
ECE 320	VLSI Design	3	0	0	3
ECE 320 L	VLSI Design lab	0	0	2	1
ECE 323	Digital Communication	3	0	0	3
ECE 323 L	Digital Communication lab	0	0	2	1
ENG 328	Multidisciplinary Design Project / UROP	0	0	6	3
ECE 215	Electronic Workshop-III on PCB Design	0	0	2	1
ISES 312	Industry Specific Employability Skills-VI	1	1	0	0
OE	**Open Elective**	3/3	0/0	0/2	3/4
TE ECE 328 ECE 329 ECE 411 ECE 430	**Technical Elective** Satellite Communication Optical Communication Embedded systems for Design **(Embedded Systems Specialization)** Convex Optimization **(Signal Processing Specialization)**	 3 3 3 3	 0 0 0 1	 0 0 2 0	 3/4
TOTAL		**16**	**1/2**	**14/18**	**22/24**

Semester-VII					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
TE ECE 409 ECE 326	**Technical Elective** RTOS **(Embedded Systems Specialization)** Radar Engineering	 3 3	 0 0	 2 0	3/4
TE ECE 325 ECE 408	**Technical Elective** Digital Image Processing **(Signal Processing Specialization)** Microcontroller Based Design **(Embedded Systems Specialization)**	 3 3	 1 0	 0 2	4
TE ECE 418 ECE 403	**Technical Elective** Machine Learning **(Signal Processing Specialization)** Digital Switching and Multiplexing	 3 3	 0 0	 2 0	3/4
OE	**Open Elective**	3/3	0/0	0/2	3/4
OE	**Open Elective**	3/3	0/0	0/2	3/4
OE	**Open Elective**	3/3	0/0	0/2	3/4
	TOTAL	**18**	**0/1**	**0/12**	**19/24**

Semester-VIII					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
ECE 421	Capstone Project	0	0	24	12
	TOTAL	**0**	**0**	**24**	**12**

List of HS Electives in III-Semester					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
JOU 406	Basics of Media and Nationalism	3	0	0	3
EGL 102	Technical Writing	4	0	0	4
HIS 100	Idea of India	4	0	0	4
HIS 102	Human Civilization	4	0	0	4

List of Open Electives in V-Semester					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
CSE 411	Big Data Analytics	3	0	2	4
EEE 421	Linear Systems	3	0	0	3
ME 433	Introduction to High Performance Computing	3	0	0	3
MAT 355	Calculus of Variation	4	0	0	4
MAT 306	First course in cryptography	4	0	0	4
BBA 606	Corporate Social Responsibility	3	0	0	3
BIO 113	Biochemistry I - Biomolecules	4	0	0	4
PHY 224	Introduction to Optics	3	0	0	3
HIS 100	Idea of India	4	0	0	4
MAN 001	Mandarin	3	0	0	3
TLC 102	Teaching and Learning	3	0	0	3
EGL 333	Thing Theory	4	0	0	4
COM 108	Investment Analysis	3	0	0	3
BBA 304	Human Resource Management	4	0	0	4
IDEA 104	Dream Discover Disrupt	3	0	0	3
HIS 005	Introduction to Gender	3	0	0	3
IDEA 102	Design Thinking	3	0	0	3

List of Electives					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
ECE 324	Computer Architecture and Organization	3	0	0	3
ECE 419	Fundamentals of wireless communication	3	1	0	4
ECE 410	Adaptive Signal Processing	3	0	0	3
ECE 416	Network Control System	3	0	2	4
ECE 330	Communication Electronics	3	0	0	3
ECE 340	Communication Network Security	3	0	2	4
ECE 331	Digital Design with Verilog	3	0	0	3
ECE 332	Digital System Design	3	0	0	3
ECE 333	DSP Processors and Architectures	3	0	0	3
ECE 334	EMI and EMC Techniques	3	0	0	3
ECE 335	Modern Digital Signal processing	3	0	0	3
ECE 336	Radar Signal Processing	3	0	0	3
ECE 341	Radar Systems	3	0	0	3
ECE 337	Speech Processing	3	0	0	3
ECE 338	Statistical Theory of Communication	3	0	0	3
ECE 339	Wireless Networks	3	0	0	3
ECE 417	Hardware Security	3	0	2	4

SRM UNIVERSITY AP
Andhra Pradesh

SEMESTER-I

SEMESTER-I

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
EGL 111	Communicative English	HS	3	0	0	3

UNIT I: RHETORIC AND PUBLIC SPEAKING
Rhetoric, Critical Thinking and Public Speaking; Thinking Outside the Box; How to Deliver a Speech; Fundamentals of Persuasion.

UNIT II: NONVERBAL COMMUNICATION
Nonverbal Communication; Spatial distance, Eye contact and appearances; How nonverbal communication is more important than words.

UNIT III: COMMUNICATION AND THE MEDIA
Persuasion and the media; Radio, television, film, social media and the internet; How the media sells ideas, images. Products and lifestyles; Fundamentals of Informative/Scientific. Speeches and Research; The Heart of the Speech – Powerful Narratives; The Power of Narrative.

UNIT IV: SMALL GROUP COMMUNICATION
Small group communication; Leadership, Conflict and persuasion in groups. The importance of small groups in business. Dr. A. Fisher's Fundamentals of Small Groups; Group Problem Solving; Learning to say no – don't say you will when you won't. Don't say yes and then don't do it, be true to your word.

UNIT V: PERSUASION, IDEOLOGY AND MEDIA BIAS
Advanced Rhetoric, Ideology, Persuasive Fallacies, How to Construct a Persuasive Speech, How to Present Scientific Data in a Speech, Unmasking Media Bias and Ideology, Full circle – the dangers of rhetoric and ideology.

TEXTBOOKS/REFERENCE

1. Communication: Principles for a Lifetime. Beebe, Beebe and Ivy, 6th Edition, Pearson Publishing.
2. Qualitative Communication Research Methods (2011) Bryan C. Taylor and Thomas R. Lindlof. Sage Publications, New Delhi, India, 3rd Edition.
3. The Fundamentals of Small Group Communication (2008) Scott A. Myers and Carolyn M. Anderson. Sage Publications, New Delhi, India.

SEMESTER-I

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
PHY 101	Engineering Physics	BS	2	0	0	2

UNIT I: INTRODUCTION TO VECTOR ALGEBRA

Gradient, Divergence and curl and their physical significances, Gauss and Stokes theorems, Vector operators in different coordinate (Curvilinear, Cartesian, Cylindrical and spherical) systems.

UNIT II: ELECTROSTATICS

Coulomb's law, Gauss law, Electric field, Electrostatic Potential, Potential energy of system of charges, Boundary Value problems, Capacitance.

UNIT III: DIELECTRICS AND POLARIZATION

Electric dipole and dipole moment, Electric potential due to dipole, Electric field intensity due to dipole, Polarization P,Electric displacement D, Electric susceptibility and dielectric constant, Bound volume and surface charge densities, Electric field at an exterior and interior point of dielectric.

UNIT IV: MAGNETOSTATICS

Biot-Savart law, Ampere's law for force between two current carrying loops, Ampere's circuital law Equation of continuity, Energy density in magnetic field, Magnetization of matter (B, H, M) Magnetic susceptibility and permeability, Hysteresis loss. B-H curve, Diamagnetic, Paramagnetic and ferromagnetic substances.

UNIT V: INTRODUCTION TO ELECTRODYNAMICS

Time varying fields: Faradays law of induction, Generalization of Amperes' law, Maxwell's equation (Differential and Integral form),Wave equation and plane waves in free space.

TEXTBOOKS/REFERENCE:

1. MIT–8.02X online course material.
2. Introduction to Electrodynamics (4rd Edition) – David J. Griffiths (Publisher – PHI Learning, Eastern Economy Editions, 2012)
3. Electricity and Magnetism (Reprints 2007, 1st Edition 2001), A. S.Mahajan, A. A. Rangwala, (Publisher - McGraw-Hill Education)
4. Electricity and magnetism Edward M Purcell, David J Morin, 3rd edition, Cambridge University, 2013.
5. Classical Electrodynamics (3rd Edition) - John David Jackson. (Publisher – Wiley).

SEMESTER-I

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
PHY 101 L	Engineering Physics Lab	BS	0	0	2	1

LIST OF EXPERIMENTS:

1. (a) Revisions of Vernier caliper and Screw Gauge measurement methods.
   (b) Plotting experimental data in graphs and error analysis.
2. To determine the moment of inertia of a flywheel.
3. (a) Measurement of time period for a given compound pendulum with different lengths.
   (b) To determine radius of gyration of a given pendulum
4. Verification of Stefan`s Law.
5. Measurement of specific heat capacity of any given material.
6. Verify of Hooke's law and to determine spring contact for given spring combinations.
7. To determine the rigidity modulus of steel wire by torsional oscillations.
8. To calculate Young's modulus of a given material by deflection method.
9. (a) To measure the capacitance as a function of area and distance between the plates.
   (b) To determine the dielectric constant of different dielectric materials.
10. (a) Measurement of the induced voltage impulse as a function of the velocity of the magnet.
    (b) Calculation of the magnetic flux induced by a falling magnet as a function of the velocity of the magnet.
11. (a) To study the magnetic field along the axis of a current carrying circular loop.
    (b) To study the dependency of magnetic field on the diameter of coil.
12. (a) To investigate the spatial distribution of magnetic field between coils and determine the spacing for uniform magnetic field.
    (b) To demonstrate the superposition of the magnetic fields of the two individual coils.
13. Study of B-H-Curve To study permeability curve of a given material.

SEMESTER-I

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ENG 111	Basic Electronics	ES	3	0	0	3

UNIT I: BASIC CIRCUITS AND DIODES

Ohm's law, Kirchhoff's current and voltage laws.Review of semiconductor materials, doping. Forward and reverse bias characteristics of PN junction diode, depletion and diffusion capacitance, diode piecewise linear model. Design of half-wave, full-wave, bridge rectifiers with and without capacitor, clipping and clamping circuits with and without bias.

UNIT II: BIPOLAR JUNCTION TRANSISTOR

Introduction to bipolar junction transistors (BJTs), NPN and PNP types. Study of common-base, common-collector and common-emitter configurations using BJTs including their input and output I-V characteristics. Current and voltage gain, BJT in active, cut-off and saturation regions. Q-point of BJT.

UNIT III: FIELD EFFECT TRANSISTOR

Introduction to filed effect transistor (FET), operation of JFET, transfer and drain characteristics of JFET, pinch-off region and pinch-off voltage. Introduction to MOSFET, operation of depletion type and enhancement type MOSFET. Transfer and drain characteristics of DMOSFET and EMOSFET. Q-point of FET.

UNIT IV: OPERATIONAL AMPLIFIERS

Introduction to operational amplifier, characteristics of an operational amplifier, negative feedback, inverting and non-inverting op-amps, integrator and differentiator design using op-amp, difference op-amp. Effect of positive feedback, Schmitt trigger circuit.

UNIT V: DIGITAL LOGIC FUNDAMENTALS

Number systems: binary, decimal, octal and hexadecimal number systems, number system conversions. Logic gates: AND, OR, NOT, NAND, NOR, X-OR, X-NOR. De Morgan's laws, Karnaugh maps. Basic combinational logic blocks: adder, subtractor.

TEXTBOOKS

1. Electronic devices and circuits - David A. Bell, 5th edition, Oxford University Press, ISBN: 9780195693409.
2.
3. Electronic Devices and Circuit Theory - R L Boylestad, L Nashelsky, 15th edition.
4. Op-Amps and Linear Integrated Circuits - Ramakant A. Gayakwad, 4th edition.
5. Digital design - Morris Mano, 5th edition.

REFERENCE

1. Engineering Circuit Analysis - William Hayt, J E Kemmerly and S.M. Durbin, 8th Edition, Mc Graw Hill.
2. Integrated Electronics - Millman and Halkias, 2nd edition, Tata McGraw Hill.
3. Electronic Devices and Circuits - Jimme J Cathey, 2nd edition. Schaum's Outlines.

SEMESTER-I

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ENG 111 L	Basic Electronics Lab	ES	0	0	2	1

LIST OF EXPERIMENTS

1. Introduction to Resistor, bread board, DMM and verification of Ohm's law.
2. Verification of Kirchhoff's laws (KCL, KVL).
3. Study of I-V characteristics of PN junction diode.
4. Design of half-wave rectifier using PN junction diode with and without capacitor filter.
5. Design of positive and negative clipping circuits using PN junction diodes.
6. Study of current and voltage gain characteristics of a NPN transistor in common-emitter configuration.
7. Drain characteristics of common source JFET.
8. Design of inverting and non-inverting amplifier circuits using op-amp IC 741.
9. Study of integrator and differentiator circuits using op-amp IC 741.
10. Design of Schmitt Trigger Using IC 741.

SEMESTER-I

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
CSE 101	Introduction to programming using Python	ES	3	0	0	3

UNIT I: INTRODUCTION TO PYTHON

Knowledge, Machines, Languages, Types, Variables Operators and Branching -– Core elements of programs: Bindings, Strings, Input/Output, IDEs, Control Flow, Iteration, Guess and Check – Simple Programs: Approximate Solutions, Bisection Search, Floats and Fractions, Newton-Raphson.

UNIT II: FUNCTIONS

Decomposition and Abstraction, Functions and Scope, Keyword Arguments, Specifications, Iteration vs Recursion, Inductive Reasoning, Towers of Hanoi, Fibonacci, Recursion on non-numeric, Files.

UNIT III: TUPLES AND LISTS

Tuples, Lists, List Operations, Mutation, Aliasing, Cloning – Dictionaries: Functions as Objects, Dictionaries, Example with a Dictionary, Fibonacci and Dictionaries, Global Variables – Debugging: Programming Challenges, Classes of Tests, Bugs, Debugging, Debugging Examples– Assertions and Exceptions, Assertions, Exceptions, Exception Examples.

UNIT IV: CLASSES AND INHERITANCE

Object Oriented Programming, Class Instances, Methods Classes Examples, Why OOP, Hierarchies, Your Own Types – **An Extended Example**: Building a Class, Visualizing the Hierarchy, adding another Class, Using Inherited Methods, Gradebook Example, Generators.

UNIT V: COMPUTATIONAL COMPLEXITY

Program Efficiency, Big Oh Notation, Complexity Classes Analyzing Complexity – Searching and Sorting Algorithms: Indirection, Linear Search, Bisection Search, Bogo and Bubble Sort, Selection Sort, Merge Sort.

TEXTBOOKS/REFERENCE

1. Introduction to Computation and Programming using Python, by John Guttag, PHI Publisher, Revised and Expanded version (Referred by MIT)
2. Python Programming using problem solving Approach by Reema Thareja, Oxford University, Higher Education Oxford University Press; First edition (10 June 2017), ISBN-10: 0199480173.
3. Data Structures and Algorithms in Python by Michael T Goodrich and RoberttoThamassia, Micheal S Goldwasser, Wiley Publisher (2016).

SEMESTER-I

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
CSE 101 L	Introduction to programming using Python lab	ES	0	0	2	1

LIST OF EXPERIMENTS

1. A company decided to give bonus of 5% to employee if his/her year of service is more than 5 years. Ask user for their salary and year of service and print the net bonus amount.
2. Write a program that computes the real roots of a quadratic function. Your program should begin by prompting the user for the values of a, b and c. Then it should display a message indicating the nature of real roots, along with the values of the real roots (if any).
3. Write a Python program to find the factorial of the given number (Example: 5!= 5*4*3*2*1 =120)
4. Write a Python program to read the numbers from the keyboard using a loop, perform the sum and average of all the input numbers until "-10" is encountered.
5. Write a Python program to count the number of strings where the string length is 2 or more and the first and last character are same from a given list of strings.
6. Write a python program for bubble sort algorithm. What is the best case and worst-case time complexity of Bubble sort algorithm? Explain with an example, where the list of elements is not sorted then what would be the output after each iteration/pass.
7. Write a python program for Selection sort algorithm. What is the worst case or average case time complexity of selection sort algorithm?
8. Write a Program in python using object-oriented concept to make calculator which has the following operations: Addition, Subtraction, Multiplications, Divisions, Exponentials, Modulus.
9. Define is inheritance? Explain with suitable example: Single level inheritance, Multiple Inheritance, Multi-level Inheritance.
10. Write a Program in python using object-oriented concept to create a base class called Polygon and there are three derived classes named as triangle, rectangle and square. The base class consists of the input function for accepting sides length and the derived classes must have output function for displaying area of triangle, rectangle and square.

SEMESTER-I

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
MAT 112	Single Variable Calculus	BS	3	0	0	3

UNIT I: SEQUENCES AND SERIES
Sequences, series, Sum of a series, Geometric series, p-series, Comparison test, root test, ratio test.

UNIT II: LIMITS AND CONTINUITY
Limit of a function at a point, one sided limits, Continuity, Limits involving infinity.

UNIT III: DIFFERENTIATION
Derivative at a point, Derivative as a function, Product Rule, Quotient Rule, Chain Rule, Implicit Differentiation, Rolle's Theorem, Mean Value Theorem.

UNIT IV: APPLICATIONS OF DERIVATIVES
Maxima and minima, Monotonic functions and first derivative test, Related rates, Concavity and curve sketching, Optimization problems, Newton's Method, Taylor and MacLaurin Series.

UNIT V: INTEGRATION
Area as a limit of finite sums, Definite and indefinite integral, Fundamental Theorem of Calculus, Integration by substitution and integration by parts, Area between curves, Arc length.

TEXTBOOKS

1. Thomas' Calculus, 14th Edition, (2018) – J. Hass, C. Heil, M. Weir, Pearson Education.
2. Introduction to Real Analysis, Fourth Edition (2014) – R. Bartle, D. Sherbert, John Wiley and Sons.

REFERENCES

1. Calculus and Analytic Geometry, Ninth Edition (2017) – G. Thomas, R. Finney, Addison Wesley.

SEMESTER-I

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
CDC 101	Soft Skills	HS	1	0	0	1

UNIT I: KNOW THYSELF
Grooming & Social etiquette.

UNIT II: PERSONALITY DEVELOPMENT
Personality construct, The KSAB Model, Components of perception, perceptual errors, perception as a precursor of attitude and behavior.

UNIT III: COMMUNICATION
The 3 Vs of communication: Visual or Kinesics, Vocal (Articulation), Verbal, Active listening, Barriers to listening, GARF (Giving and Receiving Feedback).

UNIT IV: PRESENTATION SKILLS
The four Ps of presentation, Handling different types of target audience.

UNIT V: TIME MANAGEMENT & GOAL SETTING
Pressure Cooker (Activity based on Planning, Organizing and Prioritization), Roller Coaster (Activity on setting SMARTER goals, planning & organizing, short- & long-term goals).

TEXTBOOKS

1. The Perception of Deception, David Icke, David Icke Books, 2014,
2. Eye and Brain: The Psychology of Seeing, Richard, Langton Gregory, Princeton University Press, 1997
3. Awaken the Giant Within, Anthony Robbins, Pocket Books, 2001.

SEMESTER-II

SEMESTER-II

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
CDC 102	Soft Skills-II	HS	1	0	0	1

UNIT I: MOTIVATION
Soldiers' Walk and The Japanese Fan (Activities on factors of motivation), Steps to ward off de-motivation.

UNIT II: CREATIVITY & INNOVATION
Short Film: Students would be encouraged to make a ten-minute documentary on various topics to enhance the power of aesthetics and precision. This activity is aimed at creating an interest in research and think out of the box.

UNIT III: CRITICAL & LATERAL THINKING
Fill Me Up, Stimulating Lateral Thinking, The Curious Case of Mary and Kevin (Activities triggering the different types of thinking), The Creative Collage. Critical and lateral thinking can be inculcated with a structured re programming of the neural pathways. These specially designed activities will enhance critical and lateral thinking.

UNIT IV: TEAM DYNAMICS
Story boarding, Frenzy, come to my Island, Striking Cars, Defend the Egg, Tallest Tower (Activities on the different stages of team building, team communication, coordination and collaboration)

UNIT V: MINI PROJECT
Individual projects on topics provided by faculties

TEXTBOOKS

1. Maslow, A. H. (1943) A Theory of Human motivation. In R. J. Lowry (1973) Dominance, Self-Esteem, Self-Actualization: Germinal Papers of A.H. Maslow (pp. 153-173). Belmont, California: Wadsworth Publishing Company, Inc.
2. Sparking Student Creativity, Practical ways to promote innovative and problem solving, Patti Drapeau.
3. Teach yourself to think, Edward de Bono, 1995.

SEMESTER-II

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 121	Engineering Circuit Analysis	C	3	0	2	4

UNIT I: CIRCUIT ANALYSIS

Circuit analysis nodes, paths, loops, branches, resistors in series and parallel, voltage and current division, ideal and practical voltage and current source, source transformations, nodal analysis, the supernode, mesh analysis, the supermesh--with independent and dependent voltage and current sources. Network reduction technique using star – delta transformation. Illustrative examples.

UNIT II: NETWORK THEOREMS

Network theorems superposition theorem, thevinin's theorem, norton's theorem, maximum power transfer theorem, reciprocity theorem, millman's theorems--with independent and dependent voltage and current sources. Illustrative examples.

UNIT III: TWO PORT NETWORKS

Two port networks one port networks, admittance parameters, impedance parameters, hybrid parameters and transmission parameters. Illustrative examples.

UNIT IV: CIRCUIT DYNAMICS AND FORCED RESPONSE

Circuit Dynamics and Forced Response Step Response of a Series RL, RC (First Order System) and RLC Circuit (Second Order System) under DC Source Excitation--Time Constant, Rise Time, Peak Time, Peak Overshoot/Undershoot and Settling Time. Principle of Duality. Illustrative examples.

UNIT V: ELECTROCHEMICAL DEVICES

Single-phase AC circuits Basic Concepts Related to Generation of Sinusoidal AC Voltage, Definitions of Average Value, Root Mean Square Value, Form Factor and Peak Factor. Steady State Analysis of Pure R, L, C Circuits, RL, RC and RLC circuits with Phasor Diagrams under AC Excitation. Concepts of Resonance, Definitions of Real Power, Reactive Power, Apparent Power and Power Factor. Illustrative examples.

TEXTBOOKS/REFERENCE

1. Electrical Engineering Fundamentals, Vincent Del Toro, Pearson, 2016.
2. Circuit Theory Analysis and Synthesis, Abhijit Chakrabarti, Dhanpat Rai & Co. 7th Edition, 2017.
3. Introduction to Electric Circuits, Richard C.Dorf and James A.Svobada ,Wiley India Private Limited ,Sixth Edition ,2007.
4. A Textbook of Electrical Technology, B.L.Theraja and A K Theraja , S Chand and Co.Ltd ., 2000.

LIST OF EXPERIMENTS

1. Verification of Ohm's Law.
2. Verification of Kirchoff's Current Law.
3. Verification of Kirchoff's Voltage Law.
4. Verification of Superposition theorem.
5. Verification of Thevenin's theorem.
6. Verification of Norton's theorem.
7. Verification of Maximum Power transfer theorem.
8. Verification of Reciprocity theorem.
9. Calculation of Z parameters using MATLAB simulation.
10. Calculation of Y parameters using MATLAB simulation.
11. Verification of series resonance using MATLAB simulation.
12. Verification of parallel resonance using MATLAB simulation.

SEMESTER-II

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
CSE 104	Data Structures and Algorithms using C	ES	3	0	0	3

UNIT I: INTRODUCTION TO C PROGRAMMING

Identifiers, basic data types, constants, variables, keywords, operators: arithmetic, relational and logical, increment and decrement operators, conditional operator, assignment operators, Instruction: type declaration, Input-output, conditional, loop control, Arrays, Functions, pointers, dynamic memory management functions Derived types- structures- declaration, definition and initialization of structures, accessing member of structure, arrays of structures, structures and functions, pointers to structures, self-referential structures.

UNIT II: INTRODUCTION TO DATA STRUCTURES

Stacks and Queues: representation and application, implementation of stack and queue operations using C. Linked lists: Single linked lists, implementation of link list and various operation using C, Double linked list, circular list.

UNIT III:TREES

Tree terminology, Binary tree, Binary search tree, infix to post fix conversion, postfix expression evaluation. General tree, AVL Tree, Complete Binary Tree representation.

UNIT IV: GRAPHS

Graph terminology, Representation of graphs, Path matrix, BFS (breadth first search), DFS (depth first search), topological sorting, shortest path algorithms.Implementation of shortest path algorithm using C.

UNIT V: SORTING AND SEARCHING TECHNIQUES

Bubble sort and its algorithm analysis,Selection sort and its algorithm analysis,Insertion sort and its algorithm analysis,Quick sort and its algorithm analysis,Merge sort and its algorithm analysis,Heap sort and its algorithm analysis,Radix sort and its algorithm analysis,Linear and binary search methods and its algorithm analysis,Hashing techniques and hash functions.

TEXTBOOKS

1. Data structure using C, Aaron M. Tenenbaum, Y Langsam and Mosche J. Augenstein, Pearson publication.
2. Data structures and Algorithm Analysis in C , Mark Allen Weiss, Pearson publications, Second Edition Programming in C. P. Dey and M Ghosh , Second Edition, Oxford University Press.
3. Programming with C, Byron Gottfried, McGraw hill Education, Fourteenth reprint,2016.

REFERENCES

1. Fundamentals of data structure in C - Horowitz, Sahani& Anderson Freed, Computer Science Press.
2. Fundamental of Data Structures - (Schaums Series) Tata-McGraw-Hill.
3. G. A. V. Pai: “Data Structures & Algorithms; Concepts, Techniques &
4. Algorithms” Tata McGraw Hill.

SEMESTER-II

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
CSE 104 L	Data Structures and Algorithms using C Lab	ES	0	0	2	1

LIST OF EXPERIMENTS

1. Write a C program to find the factorial of the given number (Example: 5! = 5*4*3*2*1 =120).
2. Write a C program to read the numbers from the keyboard using a loop, perform the sum and average of all the input numbers until "-10" is encountered.
3. Write a C program for implementation of Stack operations using arrays.
4. Write a C program for implementation of Queue operations using arrays.
5. Write a C program for Linked list implementations and problems related to linked list such as inverting list, concatenation, etc.
6. Write a C program for Linked list-based implementation of stack and queue operations.
7. Write a C program for Evaluation of expressions.
8. Write a C program for implementation of Binary tree traversals techniques.
9. Write a C program for implementation of Graph traversals techniques (BFS and DFS).
10. Write a C program for Linear search and Binary search algorithms. What is the best case and worst-case time complexity of those searching algorithms?
11. Write a C program for bubble sort algorithm. What is the best case and worst-case time complexity of Bubble sort algorithm?
12. Write a C program for Selection sort algorithm. What is the worst case or average case time complexity of selection sort algorithm?
13. Write a C program for Insertion sort algorithm. What is the worst case or average case time complexity of Insertion sort algorithm?
14. Write a C program for Quick sort algorithm. What is the worst case or average case time complexity of Quick sort algorithm?
15. Write a C program for Merge sort algorithm. What is the worst case or average case time complexity of Merge sort algorithm?

SEMESTER-II

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
MAT 121	Multivariable Calculus	BS	3	0	0	3

UNIT I: VECTORS AND MATRICES
Three-dimensional coordinate system, Vectors, Dot products, Vector products, Lines, and planes.

UNIT II: PARTIAL DERIVATIVES
Functions of several variables, Limits and continuity for several variable functions, Partial derivatives, The chain rule, Directional derivatives, Gradient.

UNIT III: DOUBLE INTEGRAL ANDLINE, INTEGRAL IN PLANES
Extreme values, Saddle points, Lagrange multipliers.

UNIT IV: TRIPLE INTEGRALS IN 3D
Double and integrated integrals, Area by double integration.

UNIT V: SURFACE INTEGRALS IN 3D
Triple integration and applications.

TEXBOOKS

1. Edwards, Henry C Thomas- Calculus, 14th edition. Chapters 12 to 16 relevant sections.
2. G.B. Thomas, Jr.and R. L. Finney, Calculus and Analytic Geometry, 9th Edn., Pearson Education India, 1996.

REFERENCES

1. T. M. Apostol, Calculus - Vol.2, 2nd Edn., Wiley India, 2003.

SEMESTER-II

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ENV 111	Environmental Science	ES	2	0	0	2

UNIT I: ENVIRONMENTAL CRISIS AND SUSTAINABLE DEVELOPMENT

Environment: Structure and functions in an ecosystem; Ecological succession; Ecological pyramids; Biosphere; Ecological systems and cycles – carbon cycle, water cycle, phosphorous cycle, nitrogen cycle, oxygen cycle; Broad nature of chemical composition of plants and animals; Natural resources covering renewable and non-renewable resources, forests, water, minerals, food and land; Energy sources, growing energy demands.

UNIT II: ECOSYSTEMS

Environmental Pollution: Structure and composition of atmosphere. Pollution – air, water, soil, thermal and radiation. Effects – acid rain, ozone layer depletion and greenhouse gas emission. Control measures. Determination of water and air quality – BOD, COD, TDS, AQI.

UNIT III: RENEWABLE AND NON-RENEWABLE RESOURCES

Environmental Biotechnology: Environmental microbiology; Biomarkers; Biosensors; Biofuels; Biotransformation; Bioremediation, factors affecting bioremediation; Molecular Ecology.

UNIT IV: BIODIVERSITY

Biodiversity and its conservation: Biodiversity hotspots; Values of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values; threats to biodiversity – habitat loss, poaching of wildlife; in-situ and ex-situ conservation.

UNIT V: POLLUTION AND POLICIES

Problems related to urban living, waste management, climate change, sustainable solutions, environmental regulation, and environmental protection acts in India and environmental ethics.

TEXTBOOKS

1. Basu. M, Xavier. S. “Fundamentals of Environmental Studies”, 1st edition, Cambridge University Press, 2016.
2. Raina. M. Maier, Ian L. Pepper, Charles. P. “Environmental Microbiology” 2nd edition, Academic Press, 2004.

REFERENCE

1. Danial. D. C. “Environmental Science”, 8th edition, Jones and Barlett Publishers, MA, 2010.

SEMESTER-II

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ENV 111 L	Environmental Science Lab	ES	2	0	0	1

LIST OF EXPERIMENTS

1. Water parameters- Test for alkalinity and turbidity of water.
2. Determination of dissolved oxygen in water.
3. Test for total suspended solids and total dissolved solids.
4. Determination of total hardness of water by EDTA titration.
5. Determination of biological oxygen demand of wastewater.
6. Determination of chemical oxygen demand of wastewater.
7. Test for iron content in river water.

SEMESTER-II

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
CHE 101	Chemistry	BS	2	0	0	2

UNIT I: CHEMICAL BONDING

Ionic, covalent, and metallic bonds. Theories of bonding: Valence bond theory, nature of covalent bond, sigma (σ) bond, Pi(π) bond. Hybridization: Types of hybridizations, sp2, sp3, sp3d, d2sp3. Shapes of molecules (VSEPR Theory):BeCl2,CO2,BF3,H2O,NH3, CH4,PCl5,XeF2,SF6,XeF4.Molecularorbitaltheory:Linear combination of atomic orbitals (LCAO Method), bond order, homo(H2,O2,N2) and hetero nuclear diatomic molecules(NO,CO).Non-covalent interactions: Vander Waals interactions, dipole-ipole interactions, and hydrogen bonding.

UNIT II: PHASE RULE AND KINETICS

Phase rule: Introduction, Definition of the terms used in phase rule with examples. Application of phase rule to water system, Sulphur system and lead-silver system. Kinetics: Order and molecularity of reactions, zero order, first order and second order reactions.

UNIT III: WATER TECHNOLOGY

Standards for drinking water, Methods of Treatment of water for domestic and industrial purposes: Sedimentation, Coagulation, Filtration, Sterilization, Break point chlorination. Determination of Hardness of water by EDTA method. Demineralization of water. Softening of water: Lime-soda Process, Ion exchange process, Zeolite process. Boiler Troubles: Priming, Foaming, Scale, Sludge, Corrosion, Caustic Embrittlement.

UNITIV: POLYMER CHEMISTRY

Classification of polymers: Natural and synthetic. Thermoplastic and Thermosetting. Degree of polymerization. Types and mechanism of polymerization: Addition (Free Radical, cationic and anionic); condensation and copolymerization. Properties of polymers: Tg, Tactility, Molecular weight average, number average and poly dispersity index. Techniques of polymerization: Bulk, emulsion, solution and suspension.

UNIT V: ELECTROCHEMISTRY

Arrhenius theory of electrolytic dissociation, classification of electrolytes; degree of Dissociation of acids, dissociation constant of weak acids, concept of Ph and pOH,buffer solutions, solubility product, common ion effect indicators and theory of acidbase indicators, conductance of solutions-specific, molar and equivalent conductance, Variation of molar conductance with dilution for strong and weak electrolytes; Migration of ions-Kohlrausch's law of independent migration of ions, Ostwald's dilution law; Nernste equation for single electrode and electrochemical cells.

TEXTBOOKS/REFERENCES

1. A. Bahl and B. S. Bahl, G. D. Tuli, Essentials of physical chemistry, S Chand Publication,2014, ISBN: 8121929784.P.W. Atkins, T.L. Overton, J.P. Rourke, M.T. Weller and F.A. Armstrong Shriver andAtkins' Inorganic Chemistry, 5th Ed., Oxford University Press, London, 2010, ISBN 978-1-42-921820-7.
2. Atkins, P.W.; de Paula, J. Physical chemistry, 8th ed., 2006 Oxford University Press. ISBN0-19-870072-5.
3. B. R. Puri, L. R. Sharma & M. S. Pathania, Principles of Physical Chemistry, 46th Ed.,2013, Vishal Publication Company.
4. F.W. Billmeyer, Text Book of Polymer Science, 3rd Ed., John Wiley & Sons, New York,2003.
5. J. Bard and L.R. Faulkner, Electrochemical methods –Fundamentals and applications, 2nd Ed., John Wiley and Sons, 2001.
6. Jain P.C. & Monika Jain, Engineering Chemistry, Dhanpat Roy & Sons, 2015.

SEMESTER-II

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
CHE 101 L	Chemistry Lab	BS	0	0	2	1

LIST OF EXPERIMENTS

1. Volumetric titration of HCl vs NaOH
2. Conductometric titration of HCl vs NaOH
3. Standardization of potassium permanganate by Oxalic acid
4. Iodometric Determination of Ascorbic Acid (Vitamin C)
5. Determination of hardness of water by EDTA method
6. Determination of strength of given hydrochloric acid using pH meter
7. Estimation of iron content of the given solution using potentiometer
8. Determination of sodium and potassium by flame photometry.

SEMESTER-II

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
EGL 121	Critical Thinking	HS	3	0	0	3

UNIT I
Analyzing Problems, Science of Learning, Logical Thinking.

UNIT II
Analyzing Decisions, Applying logic.

UNIT III
Evaluating Claims and Justifications, Fallacy Detection, Understanding Bias, Mitigating Bias.

UNIT IV
Evaluate and Use Strategies, Identifying the Right Problem and Sub problems, Gaps and Constraints.

UNIT V
Solving Problems, Using Analogies in Problem Solving, Innovative Thinking.

SEMESTER-III

SEMESTER-III

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
MAT 131	Differential Equations	BS	3	0	0	3

UNIT I: FIRST ORDER DIFFERENTIAL EQUATIONS

Geometric meaning of $y' = f(x, y)$,Direction Fields, Euler's Method, Classification of ODEs (Linear, Non-linear, Exact, Separable), Integrating Factor, Bernoulli Equations, Initial Value Problem, Modelling (Free falling object, Radioactivity, RL-circuit).

UNIT II: SECOND AND HIGHER ORDER LINEAR ODEs

Homogeneous Linear ODEs, Modelling of Free Oscillations of a Mass-Spring System, Euler-Cauchy Equations, Non-homogeneous ODEs, Variation of Parameters, Modelling (Forced Oscillations, Electric Circuits).

UNIT III: SYSTEM OF ODEs

Modelling Engineering problems (Electric Network, Mixing problem in two tanks etc.), as systems of ODEs, Wronskian, Phase-Plane Method, Critical Points & Stability, Qualitative Methods for Nonlinear Systems, Nonhomogeneous Linear Systems of ODEs.

UNIT IV: SERIES SOLUTIONS OF ODEs

Introduction to power series method, Legendre's equation & polynomials, Frobenius Method, Bessel's Equations & Functions.

UNIT V: LAPLACE TRANSFORMS

Laplace transforms of standard functions, Shifting Theorems, transforms of derivatives and integrals, Unit step function, Dirac's delta function, Inverse Laplace transforms, Convolution theorem (without proof), Application: Solutions of ordinary differential equations using Laplace transforms.

TEXTBOOKS

1. William Boyce and Richard DiPrima, Elementary Differential Equations and Boundary Value Problems, 11th Edition, Wiley-India.
2. Erwin Kreyszig Advanced Engineering Mathematics, 10th Edition, Wiley-India.
3. Mary L. Boas, Mathematical Methods in Physical Sciences, 3rd Edition, Wiley-India.

REFERENCES

1. Mary L. Boas, Mathematical Methods in Physical Sciences, 3rd Edition, Wiley-India.
2. S. Vaidyanathan, Advanced Applicable Engineering Mathematics, CBS Publishers.

SEMESTER-III

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 213	Probability and Statistics for Engineers	C	3	0	0	3

UNIT I: REVIEW OF BASIC PROBABILITY THEORY

Definition and axioms of probability, probability spaces, joint and conditional probabilities, Independent events, Total probability theorem – Bayes' theorem.

UNIT II: RANDOM VARIABLES

Introduction to the concept of random variables, Continuous and Discrete random variables, Probability (Cumulative) distribution function (CDF), Probability Distribution Function (PDF), Joint distribution function of two random variables. Conditional CDF and PDF, Independent random variables, Various Continuous and Discrete random distributions (Special focus is on Uniform, Gaussian, Poisson random variables).

UNIT III: STATISTICAL AVERAGES

Introduction to the concept of statistical averages, various statistical averages – Expectation, Variance, Mean square value etc., Chebyshev inequality, Central limit theorem.

UNIT IV: RANDOM PROCESSES: TIME DOMAIN ANALYSIS

Introduction to the concept of random process, Classification of random processes, Stationary random processes, Ergodic random processes, Correlation functions and their properties, Gaussian and Poisson random process, Sample t-tests, analysis of statistical means.

UNIT V: RANDOM PROCESSES: FREQUENCY DOMAIN ANALYSIS

Introduction to the concept of Power Spectral Density, Relation between Power spectral density and auto correlation function – Wiener Kinchine Theorem, Noise: White and Coloured, Linear Time Invariant (LTI) systems with random processes as inputs, Noise bandwidth, Band pass, Band limited and narrow band processes.

TEXTBOOKS

1. Probability theory, Random variables and Random signal principles, Peebles, 4th Edition, TMH.
2. Communication Systems, Simon Haykin, 4th Edition, John Wiley & Sons.

REFERENCE

1. Probability and Random Processes for Electric and Computer Engineers, John A Gubner, 1st Edition, CAMBRIDGE University press.
2. Probability, Random variables and Stochastic processes – A Papoulis and Unnikrishnan Pillai, 4th Edition, Mc Grahill Publishers.

SEMESTER-III

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 211	Digital Electronics	C	3	0	0	3

UNIT I: DIGITAL FUNDAMENTALS

4 and 5 variable K-maps, 1's and 2's complements, Codes – Binary. BCD, Excess 3,Gray, Alphanumeric codes, Sum of products and product of sums, Minterms and Maxterms, Quine-McCluskey method of minimization.

UNIT II: COMBINATIONAL CIRCUIT DESIGN

4-bit Adder and Subtractor, Binary Parallel Adder – Carry look ahead adder, BCD Adder, Multiplexer, Demultiplexer, Magnitude Comparator, Decoder, Encoder, Priority Encoder.

UNIT III: SYNCHRONOUS SEQUENTIAL CIRCUITS

Flip flops – SR, JK, T, D, Master/Slave FF – operation and excitation tables, Triggering of FF, Analysis and design of clocked sequential circuits, Design – Moore/Mealy models. State minimization. State assignment. Circuit implementation – Design of Counters, Ripple Counters-Ring Counters, Shift Registers, Universal Shift Register.

UNIT IV: ASYNCHRONOUS SEQUENTIAL CIRCUITS

Stable and Unstable states, Output specifications, Cycles and races, State reduction, Race free assignments, Hazards, Essential Hazards, Pulse mode sequential circuits, Design of Hazard free circuits.

UNIT V: MEMORY DEVICES

Classification of memories – ROM – ROM organization – PROM – EPROM – EEPROM – EAPROM.RAM – RAM organization – Write operation – Read operation –Programmable Logic Devices – Programmable Logic Array (PLA) – Programmable Array Logic (PAL) – Field Programmable Gate Arrays (FPGA) – Implementation of combinational logic circuits using ROM.PLA,PAL.

TEXTBOOKS/REFERENCE

1. M. Morris Mano, "Digital Design", 5th Edition, Pearson Education (Singapore) Pvt. Ltd., New Delhi, 2014.
2. John F.Wakerly, "Digital Design", Fourth Edition, Pearson/PHI, 2008.
3. John.M Yarbrough, "Digital Logic Applications and Design", Thomson Learning, 2006.
4. Charles H.Roth. "Fundamentals of Logic Design", 6th Edition, Thomson Learning, 2013.
5. Donald P.Leach and Albert Paul Malvino, "Digital Principles and Applications", 6th Edition, TMH, 2006.
6. Thomas L. Floyd, "Digital Fundamentals", 10th Edition, Pearson Education Inc, 2011.
7. Donald D.Givone, "Digital Principles and Design", TMH, 2003.

SEMESTER-III

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 211 L	Digital Electronics Lab	C	0	0	2	1

LIST OF EXPERIMENTS

1. Realization of Basic Logic Gates.
2. Design of Code Converters (Binary to Gray) & (Gray to Binary).
3. Design of
   Half-Adder/Subtractor.
   Full-Adder/Subtractor.
   Multiplexers/De Multiplexers.
   ALU Design.
4. Design of Decoder and Encoder/ BCD 7SSD.
5. Design of Magnitude Comparator (2-bit).
6. Design and Verification of Flip-Flops using IC.
7. Design of Asynchronous Counter (Any Mod, Up and Down, Johnson and Ring).
8. Design of Synchronous Counter (Any Mod, Decade counter 74ls90).
9. Design of Universal Shift Register (Serial to Parallel, Parallel to Serial, Serial to Serial and Parallel to Parallel Converters).
10. Design & Verification of Memory (SRAM).

SEMESTER-III

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 212	Signals and Systems	C	3	0	0	3

UNIT I: SIGNALS CLASSIFICATION, TRANSFORMATIONS, REPRESENTATION
Classification of signals: continuous-time/discrete-time, even-odd, periodic-aperiodic, energy-power, random-deterministic. Standard signals: impulse, step, ramp, exponential and sinusoids. Transformations of the independent variable: shifting, scaling and reversal. Representation of periodic signals using Fourier series.

UNIT II: SYSTEMS: CLASSIFICATION AND TIME DOMAIN ANALYSIS
Classification of systems: linear-nonlinear, time-invariant/time-variant, memory, causal, continuous-time/discrete-time. LTI System properties: causality, memory, stability, and invertibility. Impulse response, linear convolution and discrete-time convolution, graphical method to solve convolution.

UNIT III: CONTINUOUS & DISCRETE TIME SYSTEMS: FREQUENCY DOMAIN ANALYSIS
Introduction to Laplace transform and region of convergence, properties of Laplace transform, inverse Laplace transform, initial and final value theorems. Introduction to Z-transform and its region of convergence, properties of Z-transform, inverse Z-transform, the unilateral Z-transform.

UNIT IV: CONTINUOUS & DISCRETE TIME SIGNALS: FOURIER ANALYSIS
Introduction to sampling and reconstruction, aliasing. Continuous time Fourier transform (CTFT), properties of CTFT, convolution property, CTFT of periodic signals. Discrete time Fourier transform (DTFT) and its properties, DTFT of periodic signals.

UNIT V: DISCRETE FOURIER TRANSFORM AND FFT
Introduction to discrete Fourier transform (DFT) and its relation to DTFT, properties of DFT, inverse DFT, convolution using DFT. Computation of DFT using fast Fourier transform (FFT), decimation in time FFT, decimation in frequency FFT.

TEXTBOOKS

1. "Signals and Systems" by Oppenheim, Wilsky and Nawab, Prentice Hall, 2nd edition. ISBN: 9780138147570.
2. "Signals and Systems" by Simon Haykin and Berry Van Veen, 2nd edition, ISBN: 9780471164746.

REFERENCE

1. "Principles of Signal Processing and Linear Systems" by B P Lathi, 2nd edition, ISBN: 9780198062271.
2. "Signals and Systems using MATLAB" by Louis F Chaparro, 2014 edition, Academic Press, ISBN: 9780123948434.

SEMESTER-III

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 212 L	Signals and Systems Lab	C	0	0	2	1

LIST OF EXPERIMENTS

1. Plotting even and odd components of continuous-time signals.
2. Plotting even and odd components of discrete-time signals.
3. Time period calculation of continuous time signals.
4. Time period calculation of discrete time signals.
5. Shifting, scaling and reflection of discrete time signals.
6. Energy and power of signals.
7. Fourier series representation of periodic signals.
8. Verification of Reciprocity theorem.
9. Convolution between two discrete time signals.
10. Finding of Laplace transform.
11. Finding of Z-transforms.
12. Discrete Fourier Transform (DFT) and Inverse DFT.

SEMESTER-III

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
CDC 221	Aptitude	HS	1	1	0	1

UNIT I
Percentages, profit and loss, SI and CI, Time and work, Average and progression.

UNIT II
Time – speed and distance, Number system and arrangements.

UNIT III
Ratio and proportions, Mixtures and Alligation, Direction problems, Direction problems, coding and decoding, Number series and Alphabet series.

UNIT IV
Antonyms, synonyms, odd words, Idioms and phrasal verbs, same word with different part of speech.

UNIT V
Word analogy. Sentence completion, Text completion, Sentence equivalence.

TEXTBOOKS/REFERENCE

1. Arun Sharma – How to prepare for Quantitative Aptitude, Tata Mcgraw Hill..
2. RsAgarwal,A Modern Approach to Verbal and Non Verbal Reasoning,S.Chand Publications.
3. Verbal Ability and Reading comprehension-Sharma and Upadhyay.'
4. Charles Harrington Elstor, Verbal Advantage: Ten Easy Steps to a Powerful Vocabulary, Large Print, September 2000.
5. GRE Word List 3861 – GRE Words for High Verbal Score, 2016 Edition.
6. The Official Guide to the GRE-General Revised Test, 2nd Edition, Mc Graw Hill Publication.

SEMESTER-III

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 214	Quantum Electronics and Communication	C	3	0	0	3

UNIT I: QUANTUM OPERATORS, STATES AND THEIR APPLICATIONS

Quantum states and wave functions, Dirac notation(bra–ket notation) of states, Basis vectors and orthogonality, Linear operators and matrices in Hilbert spaces, Qubits and Bloch sphere, Base states and superposition, Structural randomness, Heisenberg's Uncertainty Principle, Unitary operators and projectors.

UNIT II: QUANTUM LOGICS

Abramsky-Coecke semantics, No-cloning theorem, Quantum entanglement, Entangled states, Bell states, Bell inequalities, Pauli, Hadamard gates, CNOT, Toffoli gates, Quantum teleportation, Universality of two-qubit gates.

UNIT III: QUANTUM ELECTRONICS USING OPTICS

Photon, Laser pulses as quantum states, Single photon (quanta) counting with avalanche photodiode, HOM interference, Pure and mixed states, Quantum states of single photons, Optical Qubits, Optical Two-Qubit Gates (CNOT), Deutsch-Josza algorithm and applications, Quantum Fourier transform, Shor's Algorithm – Periodicity.

UNIT IV: SOLID STATE QUANTUM DEVICES

Quantum states of electron in 1D structures, Design, growth, and exploration of quantum matter hetero structures, Interfaces and superlattice-type structures, Junction transistors, Field Effect transistors, Single Electron Transistor (SET)Tunneling, Coulomb Island and Coulomb Blockade in SET, SET Fabrication: Quantum dots, Graphene SET.

UNIT V: QUANTUM COMPUTING AND COMMUNICATIONS

Density matrix and information propagations, Quantum cryptography, Communication across two-input quantum gate (C-NOT) and Teleportation, Physical realization of quantum computation:
ion trap, Physical realization of quantum computation: cavity QED, Quantum key distribution, Noise and decoherence: DiVincenzo's criteria, Quantum error correction and examples, Circuit for a quantum Fourier transform.

TEXTBOOKS/REFERENCE

1. Phillip Kaye, Raymond Laflamme, and Michele Mosca (2007). An Introduction to Quantum Computing. Oxford University Press.
2. Michael A. Nielsen and Isaac L. Chuang (2000). Quantum Computation and Quantum Information. Cambridge University Press.

SEMESTER-III

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
CSE 230	Industry Standard Coding Practice-1	ES	0	0	4	1

UNIT I
Problem Solving with - Basic coding practices, Expression Evaluation, Operators Usage, Expressions, Control Structures, Loop & Iterations for all test case scenarios.

UNIT II
Problem Solving using time efficient logics, linear list data, Array problems, 2D Arrays and Matrix Data for all test case scenarios.

UNIT III
Problem Solving with - Pointers &Memory referencing, String Handling, functions for all test case scenarios.

UNIT IV
Problem Solving with - parameter passing, Recursions, Recursion Analysis, Structures and unions, Enumerations & Memory allocation for all test case scenarios.

UNIT V
Problem solving with - String manipulations. Lists, display patterns, strings, matrix, tuples, dictionaries, modules, packages, exception handling using Python.

TEXTBOOKS/REFERENCE

1. Problem solving with C++ -9e- Walter Savitch – Pearson.
2. The complete Reference C, Fourth REdition – Herbert Schildt – MC Graw Hill.
3. Programming in Python 3, A complete introduction to Python language - 2e - Mark Summerfield – Addison-Wiley

SEMESTER-IV

SEMESTER-IV

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ISES 212	Industry Specific Employability Skills-IV	HS	1	1	0	1

UNIT I
Permutation and Combination, Probability, Geometry, and Algebra.

UNIT II
Clocks, Calendars and Blood Relations, Arrangements, Cubes and Syllogism.

UNIT III
Introduction to Different Parts of an Argument in Reasoning , Assumption of an Argument Strengthening of an Argument, Weakening of an argument, Para jumbles.

UNIT IV
Word Analogy, Sentence Completion & Text Completion, Sentence Equivalence.

UNIT V
Reading Comprehension, Identification of errors, Sentence correction.

TEXTBOOKS/REFERENCE

1. Arun Sharma – How to prepare for Quantitative Aptitude, Tata Mcgraw Hill.
2. RsAgarwal,A Modern Approach to Verbal and Non Verbal Reasoning,S.Chand Publications.
3. Verbal Ability and Reading comprehension-Sharma and Upadhyay.
4. Manhattan GMAT Sentence Correction Guide, 5th Edition.
5. R.S.Aggarwal, A Modern Approach to Verbal & Non-Verbal Reasoning. S.Chand Publications.
6. The Official Guide to the GRE-General Revised Test, 2nd Edition, Mc Graw Hill Publication.

SEMESTER-IV

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
MAT 211	Linear Algebra	BS	3	0	0	3

UNIT I: MATRICES AND GAUSSIAN ELIMINATION
Introduction, Geometry of linear equations, Gaussian elimination, Matrix notation and matrix multiplication, Triangular f actor and row exchanges, Inverses and transposes.

UNIT II: VECTOR SPACES
Vector spaces and subspaces, Solving Ax=0 and Ax=b, Linear independence, Basis and dimension, The f our fundamental subspaces, Graphs and networks, Linear transformations.

UNIT III: ORTHOGONALITY
Orthogonal vectors and subspaces, Cosines and projections onto lines, Projection and least squares, Orthogonal bases, Gram-Schmidt.

UNIT IV: DETERMINANTS
Introduction, Properties of the determinant, Formulas for the determinant, Applications of determinants.

UNIT V: EIGENVALUES AND EIGENVECTORS
Introduction, Diagonalization of a matrix, Difference equations and power of A^k, Differential equations f or e^{At}, Complex matrices and similarity transformations.

TEXTBOOKS/REFERENCE

1. G. Strang, Linear Algebra and Its applications, Nelson Engineering, 4th Edn., 2007.
2. K. Hoffman and R. Kunze, Linear Algebra, Prentice Hall of India, 1996.
3. S. Axler, Linear Algebra Done Right, 2nd Edn., UTM, Springer, Indian edition, 2010.

SEMESTER-IV

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 221	Analog Electronics	C	3	0	0	3

UNIT I: DIFFERENTIAL AND MULTI-STAGE MOS AMPLIFIERS
MOS Current Mirror, Analysis of MOS Differential Pair, Common Mode Rejection Ratio, DC Offset, MOS Differential Amplifier with current mirror load, Two stage Op-Amp design.

UNIT II: FREQUENCY RESPONSE OF SINGLE STAGE AMPLIFIERS
Review of MOS models, Low frequency response of CS amplifier, High frequency response of CS amplifier, Millers Theorem, High frequency response of CMOS Differential Amplifier.

UNIT III: FEEDBACK AMPLIFIERS
General Feedback structure, Negative feedback, Feedback amplifier types, Stability problem, Frequency compensation.

UNIT IV: SIGNAL GENERATORS AND WAVEFORM SHAPING CIRCUITS
Basic principles of sinusoidal oscillators, Op-amp RC oscillator, Wein Bridge oscillator, MOSFET Crystal oscillators, Bistable multivibrators, 555 timer IC and applications.

UNIT V: OUTPUT STAGES AND POWER AMPLIFIERS
Classification of output stages, Class A output stage, Class B output stage, Class AB output stage, **Active Filters:** Filter Transmission, Types, and specifications. Filter Transfer function, Butterworth, and Chebyshev filters, First order and second order Filter functions.

TEXTBOOKS/REFERENCE

1. Microelectronic Circuits: Theory and Applications, Adel S. Sedra and K . C. Smith, 7th edition, Oxford University Press.
2. BezhadRizavi "Fundamentals of Microelectronics", Wiley, (2006)
3. Integrated Electronics, Jacob Millman, Christos C Halkias, McGraw Hill
4. Education Electronic Devices and Circuits theory– Robert L. Boylestead, Louis Nashelsky, 11th Edition, 2009, Pearson.

SEMESTER-IV

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 221 L	Analog Electronics Lab	C	0	0	2	1

LIST OF EXPERIMENTS

1. Analysis of Feedback circuits with Op-amps.
2. Analysis of Feedback circuits with MOSFETs.
3. Design and Analysis of RC phase shift, LC oscillators.
4. Design and Analysis of Wien Bridge oscillator.
5. Design and Analysis of 555 timer based Astable and Monostable Multivibrators.
6. Design and Analysis of MOSFET based Class A, Class B, Class AB Power amplifier.
7. Design and Analysis of Op-amp based Active filters.
8. Design and Analysis of Voltage regulator circuits.
9. Design and Analysis of Voltage reference circuits.
10. Design and Analysis of ADCs, DACs-I.
11. Design and Analysis of ADCs, DACs-II.
12. Course project.

SEMESTER-IV

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
EEE 212	Control Systems	C	3	0	0	3

UNIT I: INTRODUCTION TO CONTROL SYSTEMS

Introduction, Types of Control Systems, Effect of Feedback Systems, Modelling of Physical Systems, Transfer functions. Block diagrams and Signal Flow graphs.

UNIT II: TIME RESPONSE OF FEEDBACK CONTROL SYSTEMS

Standard test signals, Unit step response of First and Second order Systems. Time response specifications, Time response specifications of second order systems, steady state errors and error constants.

UNIT III: STABILITY ANALYSIS

Concepts of stability, Necessary conditions for Stability, Routh stability criterion, Relative stability analysis, stability criterion, Introduction to Root-Locus Techniques, The root locus concepts, Construction of root loci.

UNIT IV: FREQUENCY DOMAIN ANALYSIS AND STABILITY

Correlation between time and frequency response, Bode Plots, Experimental determination of transfer function. Introduction to polar and inverse polar plots, Bode plots Stability in Frequency Domain: Nyquist stability criterion, assessment of relative stability: gain margin and phase margin. Introduction to lead, lagand lead-lag compensating networks. Design of closed loop systems using compensation techniques intime domain and frequency domain. Brief idea of proportional, derivative and integral controllers.

UNIT V: STATE SPACE ANALYSIS OF CONTINUOUS SYSTEMS

Concepts of state, state variables and state model, derivation of state models from block diagrams, Diagonalization- Solving the Time invariant state Equations- State Transition Matrix and it's Properties Concepts of Controllability and Observability.

TEXTBOOKS

1. Norman S. Nise, Control Systems Engineering, 6th Edition, John Wiley & Sons Inc , 2010.
2. M Gopal, Control Systems: Principles and Design, McGraw Hill Education; 4 Edition, 2012.
3. K. Ogata, Modern Control Engineering, Prentice Hall India, 2006.

REFERENCE

4. Raymond T. Stefani (Author), Bahram Shahian, Clement J. Savant, Gene H. Hostetter.
5. Design of Feedback Control Systems, Oxford University Press, 2001.

SEMESTER-IV

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
EEE 212 L	Control Systems Lab	C	0	0	2	1

LIST OF EXPERIMENTS

1. Using MATLAB for Control Systems.
2. Modeling of Physical Systems using SIMULINK.
3. Linear Time-invariant Systems and Representation.
4. Block diagram creation and reduction with MATLAB.
5. Analysis of first order and second order systems.
6. Effect of Feedback on disturbance & Control System Design.
7. Obtain a root locus for given system with MATLAB. Design a root locus-based compensator to meet design criteria.
8. Obtain a Bode plot for a given system with MATLAB. Design a Bode plot-based compensator to meet design criteria.
9. Obtain a Nyquist plot for a given system with MATLAB. Obtain the stability margins.
10. Introduction to PID controller with Simulink.
11. Open Loop and Closed Loop position control of DC Motor.
12. PID Controller Design for Two Tank System.

SEMESTER-IV

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 222	Digital Signal Processing	C	3	0	0	3

UNIT I: REVIEW OF SIGNALS AND SYSTEMS

Types of Signals, Transformation of signals, LTI system properties, Linear Convolution, Linear Correlation, Sampling Theorem, Discrete Time Fourier Transform, properties, Z-Transform Basics.

UNIT II: DISCRETE FOURIER TRANSFORM

Discrete Fourier transform (DFT), Properties of DFT, circular convolution, circular correlation, DIT FFT Algorithm, IF FFT Algorithm, Linear Filtering based on DFT, Rader's Overlap-save method, Overlap-add method.

UNIT III: IMPLEMENTATION OF DISCRETE-TIME SYSTEMS

Introduction to FIR and IIR systems, Structures for realizing of discrete time systems, Structures for FIR and IIR Systems, Signal Flow Graphs, Direct Form I and Direct Form II Methods, Cascade Form, Parallel Form, Lattice Structures, Transposed Structures, Linear Phase FIR Filter.

UNIT IV: ANALOG AND DIGITAL FILTERS

General considerations – causality and its implications, Characteristics of practical frequency selective filters IIR filter design, Discrete time IIR filter (Butterworth and Chebyshev) from analog filter, IIR filter (LPF, HPF, BPF, BRF) design by Impulse Invariance, Bilinear transformation, Approximation of derivatives.

UNIT V: MULTI-RATE SIGNAL PROCESSING

Decimation, Interpolation, Sampling rate conversion of non-integer factors, Multi stage implementation and polyphase implementation of decimation and interpolation, Digital filter banks, applications of multirate signal processing.

TEXTBOOKS/REFERENCE

1. "Digital Signal Processing" by Tarun Kumar Rawat, Oxford Higher Education, 2017 edition.
2. "Discrete-time signal processing" by A. Oppenheim and R. W. Schafer, Pearson, 2014 edition.
3. "Principles of Signal Processing and Linear Systems" by B P Lathi, Oxford University Press, 2009 edition.
4. "Digital Signal Processing" by J. G. Proakis and D. G. Manolakis, 2007 edition, Pearson India.

SEMESTER-IV

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 222 L	Digital Signal Processing Lab	C	0	0	2	1

LIST OF EXPERIMENTS

1. Obtain linear convolution of two finite length sequences.
2. Obtain DFT / IDFT of given Discrete Time signals.
3. Obtain circular convolution of two finite length sequences.
4. Obtain linear correlation and circular correlation of two finite length sequences.
5. Implementation of FFT of given sequence.
6. Implementation of Butterworth Low Pass Filter.
7. Implementation of Chebyshev Low Pass Filter.
8. Implementation of High Pass IIR filter for a given sequence.
9. Implementation of Low Pass FIR filter for a given sequence.
10. Implementation of Low Pass IIR filter for a given sequence.
11. Implementation of Decimation Procedure.
12. Implementation of Interpolation Procedure.

SEMESTER-IV

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 223	Electromagnetic Wave Propagation	C	3	1	0	4

UNIT I: ELECTROMAGNETIC BOUNDARY CONDITIONS
Review of Electro statics and Magneto statics: Basic laws, Maxwell's equations for static fields, Electric fields in material space: Properties of materials, Continuity equation, Electric and Magnetic boundary conditions.

UNIT II: TIME VARYING ELECTROMAGNETIC FIELDS
Faradays law, Displacement current, Maxwell's equations (final form), Time varying fields – Maxwell's equations, Time harmonic fields – Maxwell's equations.

UNITIII: ELECTROMAGNETIC WAVE PROPAGATION
Introduction to EM wave, Waves in general- various parameters of wave, EM wave propagation in lossy dielectric media, Planewave in lossless dielectric media, Planewaves in free space, Plane waves in good conductors.

UNIT IV: POWER CONSIDERATION OF EM WAVE
Power of EM wave, Poynting's vector, Poynting's theorem, EM wave at boundary between two different media: Reflection of plane wave at normal incidence, Reflection of plane wave at oblique incidence: Parallel polarization, Perpendicular polarization.

UNITV: MODERN APPLICATIONS OF EM WAVES
Microwaves: Telecommunications, Radar systems, Heating systems etc. Electromagnetic Interference and compatibility: Source and characteristics of EMI, EMI control techniques like grounding, shielding, filtering. Optical fiber: Numerical aperture, Attenuation and Dispersion.

TEXTBOOKS

1. Mathew N.O. Sadiku, "Elements of Electromagnetics", 3rd edition, Oxford University press.
2. William Hayt , Buck, "Engineering Electromagnetics", 8th edition, TMH.

REFERENCES

1. K D Prasad, "Antenna and Wave propagation", Satya Prakashan, New Delhi.
2. E C Jordan and Balmain, "Electromagnetic waves and Radiating systems", Pearson Education

SEMESTER-IV

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
CSE 330	Industry Standard Coding Practice-2	ES	0	0	4	1

UNIT I

Problems Solving with: Structure Pointers, formation of links, Operations on Linked lists, Operations on a circular linked list, Operations on a double linked list & Industry Standard Practice Questions.

UNIT II

Problem Solving with - Stack Operations, Queue data structure Implementation, Linear / Binary Search Algorithms, Sorting Algorithms, Industry Standard Practice Questions.

UNIT III

Problem Solving with - Nonlinear data structures, trees operations, application of search property on a binary tree, tree balancing.

UNIT IV

Problem Solving with - Multiway search structures, Operations on a 2-4 tree, nonlinear structures, red, black trees & operations, Tries, String Algorithms &Industry Standard Practice Questions.

UNIT V

Problem Solving with – features of Object-oriented programming, leveraging Standard Template Libraries. Industry Standards of leveraging DBMS concepts, SQL Queries, Entity Relationship Models, Query Optimization, Transactions & Concurrency, Normalization & Industry Standard Practice Questions.

TEXTBOOKS/REFERENCES

1. Fundamentals of Data Structures in C++ - 2e- Sahni Horowitz - Universities Press.
2. Algorithms -4e- Robert Sedgewick & Kevin Wayne - Addison-Wesley Professional.
3. C++ Standard Library A Tutorial and Reference – 2e - Nicolai M. Josuttis - Addison Wesley Longman
4. An Introduction to Database Systems – 8e - C.J. Date – Pearson.
5. Competitive Programming – 3e – Steven Halim, Felix Halim

SEMESTER-V

SEMESTER-V

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 311	Analog Communication	C	3	0	0	3

UNIT I: INTRODUCTION: SIGNALS AND SPECTRA

Introduction to Communication Engineering, Brief review of signals and systems: Fourier series, Fourier Transform and its properties, Hilbert transform, LTI Systems, Analytic representation of Band pass signals, Communication channel, Distortion less transmission.

UNIT II: LINEAR CONTINUOUS WAVE MODULATION

Amplitude modulation (AM), DSB-SC, SSB,VSB Modulation and Demodulation, Modulation index, Super hetrodyne receiver, FDM and carrier spacing in FDM.

UNIT III - EXPONENTIAL CONTINUOUS WAVE MODULATION

Angle modulation, Frequency modulation, Phase modulation: Generation and Demodulation, Feedback demodulators: PLL, Frequency compressive feedback demodulators, FM receivers.

UNIT IV: PERFORMANCE OF ANALOG MODULATION IN PRESENSE OF NOISE

Review of Probability, Random variables and random process, Performance of AM,FM,PM in the presence of noise, Pre-emphasis & De-emphasis.

UNIT V: DIGITAL MODULATION

Introduction to sampling and quantization, PCM, DPCM and Delta Modulation, Digital modulation: PAM, PWM and PPM, Time division multiplexing.

TEXTBOOKS/REFERENCE

1. "Communication Systems: An Introduction to signals and noise in Electrical Communication", by A. Bruce Carlson, Paul B. Crilly, Fifth Edition, McGraw-Hill Education.
2. Communication Systems", by Simon Haykin, Michael Moher, Fifth Edition, Wiley Publishers.
3. "Principles of Communication Systems" by Herbut Taub and Donald L. Schilling, Goutam Saha, Fourth Edition, McGraw Hill Education.

SEMESTER-V

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 311 L	Analog Communication Lab	C	0	0	2	1

LIST OF EXPERIMENTS

1. Analyse and test AM- Modulation & Demodulation.
2. Analyse and test AM - DSB SC.
3. SSB-SC Modulation & Demodulation.
4. Analyse and test FM - Modulation & Demodulation.
5. Phase locked loop.
6. Pre-emphasis & De-emphasis.
7. Sampling Theorem verification.
8. Analyse and Test Pulse Amplitude Modulation & Demodulation.
9. Analyse and Test Pulse Position Modulation and Demodulation.
10. Analyse and Test Pulse Width Modulation & Demodulation.

SEMESTER-V

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 317	HDL based FPGA Design	C	3	0	0	3

UNIT I: INTRODUCTION TO LOGIC DESIGN USING VERILOG HDL

Introduction, Language Elements, Expressions, Modules and Ports, Built-in Primitives, User-Defined Primitives, Dataflow Modeling, Behavioral Modeling, Structural Modeling, Tasks and Functions, Test bench.

UNIT II: COMBINATIONAL AND SEQUENTIAL LOGIC DESIGN USING VERILOG HDL

Combinational Logic-Adder, Subtractor, Multiplexer, Decoder, Priority Encoder, Magnitude comparator, ALU Sequential Logic, Latches, Flip-flops, Counters, Registers, FSMs.

UNIT III: FIELD PROGRAMMABLE GATE ARRAYS

FPGA Evolution, Programmable Logic Devices, Field Programmable Gate Arrays, FPGA Design Techniques, Design Constraints using FPGAs, Design Automation of FPGAs. Simulation, Synthesis, RTL Design Flow. Physical Design Flow, Place and Route, Timing Analysis, Design Pitfalls.

UNIT IV: BEST PRACTICES FOR SUCCESSFUL FPGA DESIGN

Three Steps to Successful FPGA design, The Role of Project Management, Design Specification: Communication Is Key to Success, Engineering Resources, Device Selection, FPGA design environment, Challenges That FPGAs Create for Board Design, Key Factors in Accurate Power Estimation, Recommended Team Based Design Flow, RTL Design for FPGA devices, Writing Effective HDL, RTL Coding Styles for Synthesis, Analyzing the RTL Design, Timing Closure Challenges, Design Sign-off.

UNIT V: HDL COMPLEX DESIGN EXAMPLES AND FPGA APPLICATIONS

Computer Arithmetic Designs- Floating-Point Addition, Floating-Point Subtraction, Floating-Point Multiplication, I/O Modules UART.

TEXTBOOKS/REFERENCE

1. Joseph Cavanagh, Verilog HDL Design Examples, Taylor and Francis, CRC press, 2018.
2. Peter Wilson - Design Recipes for FPGAs using Verilog and VHDL [2nd ed.]-Elsevier (2016).
3. Philip Andrew Simpson (auth.) - FPGA Design_ Best Practices for Team-based Reuse-Springer International Publishing (2015).
4. Pong P. Chu - FPGA Prototyping Using Verilog Examples, Springer.
5. Douglas J Smith-HDL Chip Design: A Practical Guide for Designing, Synthesizing and Simulating ASICs and FPGAs using VHDL or Verilog, Doone Publications.

SEMESTER-V

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 317 L	HDL based FPGA Design Lab	C	0	0	2	1

LIST OF EXPERIMENTS

1. Verilog HDL Implementation, Simulation and Synthesis of Logic gates, 1-bit Adder, subtractors.
2. Verilog HDL Implementation, Simulation and Synthesis of Decoders, Multiplexers and Magnitude comparators.
3. Verilog HDL Implementation, Simulation and Synthesis of 4- bit adder, subtractors.
4. Verilog HDL Implementation, Simulation and Synthesis of Latches and Flip-flops.
5. Verilog HDL Implementation, Simulation and Synthesis of 4-bit Register, Counter, Shift register, universal shift register.
6. Verilog HDL Implementation, Simulation and Synthesis of FSMs.
7. FPGA Introduction and Implementation of above simple Designs.
8. FPGA Introduction and Implementation of above complex Designs.
9. Course Project.
10. Course Project

SEMESTER-V

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 313	Microprocessors and Interfacing	C	3	0	0	3

UNIT I: 8086 MICROPROCESSORS

8086 architecture- Functional Diagram, Register Organization, Memory segmentation, Memory addresses, physical memory organization, Signal descriptions of 8086-common function signals, Minimum and Maximum mode signals, Read Write cycles, Timing diagrams, Interrupt structure of 8086.

UNIT II: ASSEMBLY LANGUAGE PROGRAMMING OF 8086

Instruction formats, addressing modes, instruction set, assembler directives, Simple programs involving logical, Branch and call instructions, Sorting, evaluating arithmetic expressions, String manipulations.

UNIT III: PERIPHERAL INTERFACING WITH 8086 MICROPROCESSORS

8255 PPI, Keyboard, display controllers, Stepper motor, A/D & D/A Converter Interfacing with 8086 microprocessor, Static and Dynamic memories, Vector interrupt table, Interrupt service routine, Introduction to DOS & BIOS interrupts, Programmable Interrupt Controller 8259, DMA controller 8257 Interfacing with 8086 microprocessors.

UNIT IV: COMMUNICATION INTERFACE

Serial communication standards, serial data transfer schemes, 8251 USART architecture and Interfacing, RS232, prototyping, and trouble shooting.

UNIT V: INTRODUCTION TO MICROCONTROLLERS

Overview of 8051 microcontroller, Architecture, I/O ports and Memory organization, addressing modes and instruction set of 8051, Simple programs.

TEXTBOOKS/REFERENCE

1. Ramesh S Gaonkar, “Microprocessor Architecture, Programming and Applications with the 8085”, 6th edition, Penram.
2. D V Hall, “Microprocessors and Interfacing”, MGH, 2nd edition.
3. The 8051 Microcontroller, Kenneth. J. Ayala, Cengage Learning, 3rd Edition.

SEMESTER-V

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 313 L	Microprocessors and Interfacing lab	C	0	0	2	1

LIST OF EXPERIMENTS

1. (a)Addition of two 8-bit numbers.
   (b)Subtraction of two 8-bit numbers.
   (c)Multiplication of two 8-bitnumbers.
   (d) Division of two 8-bit numbers.
2. (a)Addition of two 16-bit numbers.
   (b)Subtraction of two 16-bit numbers.
   (c)Multiplication of two 16-bit numbers.
   (d)Division of two 16-bit numbers.
3. Logical operations using 8086 (a) and (b) or (c)x-or.
4. (a) Two digit BCD addition.
   (b) Two digit BCD subtraction.
5. (a)Sorting of data in ascending order.
   (b)Sorting of data in descending order.
6. (a)Program to test whether the 5-bit is '0' or '1'
   (b)Counting number of '1's in a given data.
7. ASCII arithmetic operations.
8. (a)ALP for conversion of packed BCD to unpacked BCD.
   (b)ALP for conversion of packed BCD to ASCII.
   (c) ALP for conversion of data from BCD to HEX.
9. (a)ALP to move a block of 10 bytes.
   (b)ALP to test the parity of the given data.
10. (a) ALP to interface 8086 with 8255 for control of stepper motor.
    (b)ALP to interface 8086 with 8279 for 7-segment display.
    (c) ALP to interface 8086 with 8255 to implement traffic light model.
    (d) ALP to interface 8086 with elevator.
    (e) ALP to interface 8086 with DDAC.

SEMESTER-V

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
CSE 331	Industry Standard Coding Practice-3	ES	0	0	4	1

UNIT I

Problem solving with - Descriptive statistics, Mean/median/mode, Measures of dispersion/range variance, deviations, mean/median/mode problems, Random variables, Univariate & Bivariate random variables.

UNIT II

Problem solving with - Graphs, Handshaking Lemma, Simple Graphs, DFS/BFS, connected components, coloring, Introduction to DAGs, Spanning Trees, Articulation Points/ Connected points.

UNIT III

Problem solving with - Greedy Methods: Coin change, Fractional Knapsack, Activity Selections/ Job sequencing with Deadlines, Spanning Trees, Dynamic Programming: 0/1 Knapsack, Substructures, longest common substring/subsequence, Longest Increasing sub sequence, Grid based Problems.

UNIT IV

Problem solving with - Divide & Conquer Strategies: Quick/Merge Sort, Min/Power functions, Backtracking, N Queens problem, Finding the path & Grid based problems, iterative/loop free approaches.

UNIT V

R Language Constructs, calculations, Operators, vectors, lists, Practice problems implementing R language, Matrices and data frame, Conditional statements and loops, Problem Solving on R language examples.

TEXTBOOKS/REFERENCE

1. An Introduction to Statistical Learning: with Applications in R - Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani.
2. Introduction to Algorithms by Thomas H. Corman, The MIT Press, 3rd Edition.
3. Introduction to Algorithms: A Creative Approach by Udi Mander, Pearson.
4. R Cookbook - Paul Teetor, O'reilly.
5. Competitive Programming – 3e – Steven Halim, Felix Halim.

SEMESTER-V

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 314	Transmission lines and Waveguides	C	4	0	0	4

UNIT I: TRANSMISSION LINE THEORY

General theory of Transmission lines, the transmission line, general solution. The infinite line – Wavelength, velocity of propagation, Waveform distortion, the distortion-less line. Loading and different methods of loading. Line not terminated in characteristic impedance. Reflection coefficient – calculation of current, voltage, power delivered and efficiency of transmission. Input and transfer impedance – Open and short-circuited lines, reflection factor and reflection loss.

UNIT II: HIGH FREQUENCY TRANSMISSION LINES

Transmission line equations at radio frequencies – Line of Zero dissipation – Voltage and current on the dissipation-less line, Standing Waves, Nodes, Standing Wave Ratio – Input impedance of the dissipation-less line – Open and short-circuited lines – Power and impedance measurement on lines – Reflection losses – Measurement of VSWR and wavelength.

UNIT III: IMPEDANCE MATCHING IN HIGH FREQUENCY LINES

Impedance matching: Quarter wave transformer – Impedance matching by stubs – Single stub and double stub matching – Smith chart – Solutions using Smith chart – Single and double stub matching using Smith chart.

UNIT IV: PASSIVE FILTERS

Characteristic impedance of symmetrical networks – filter fundamentals, Design of filters: Constant K – Low Pass, High Pass, Band Pass, Band Elimination, m- derived sections – low pass, high pass composite filters.

UNIT V: WAVE GUIDES AND CAVITY RESONATORS

General Wave behaviors along uniform Guiding structures, Transverse Electromagnetic waves, Transverse Magnetic waves, Transverse Electric waves, TM and TE waves between parallel plates, TM and TE waves in Rectangularwave guides, Bessel's differential equation and Bessel function, TM and TE waves in Circular wave guides, Rectangular and circular cavity Resonators.

TEXTBOOKS

1. John D Ryder, "Networks, lines and fields", 2nd Edition, PHI, 2010.
2. David K Cheng, "Field and wave electromagnetics", 2nd Edition, Pearson education.

REFERENCE

1. Mathew N.O. Sadiku, "Principles of Electromagnetics", 6th edition, Oxford Higher Education.

SEMESTER-V

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 316	Information Theory and Coding	TE	3	1	0	4

UNIT I: INFORMATION ENTROPY FUNDAMENTALS

Uncertainty, Information, Entropy, Source coding Theorem, Huffman coding, Shannon Fano coding, Discrete Memory less channels, Channel capacity, Channel coding Theorem, Channel capacity Theorem.

UNIT II: DATA AND VOICE CODING

Pulse code Modulation, Differential Pulse code Modulation, Adaptive Differential Pulse Code Modulation, Adaptive sub band coding, Delta Modulation, Adaptive Delta Modulation, Coding of speech signal at low bit rates, Vocoders, Linear Prediction Coding.

UNIT III: ERROR CONTROL CODING

Linear Block codes, Syndrome Decoding, Minimum distance consideration, Cyclic codes, Generator Polynomial, Parity check polynomial, Encoder for cyclic codes, Calculation of syndrome, Convolutional codes.

UNIT IV: COMPRESSION TECHNIQUES

Principles, Text compression, Static Huffman Coding, Dynamic Huffman coding, Arithmetic coding, Image Compression, Graphics Interchange format, Tagged Image File Format, Digitized documents and Introduction to JPEG standards.

UNIT V: AUDIO AND VIDEO CODING

Linear Predictive coding, Code excited LPC, Perceptual coding, MPEG audio coders, Dolby audio coders, Video compression, Principles, Introduction to H.261,MPEG Video standards.

TEXTBOOKS/REFERENCE

1. Thomas M. Cover and Joy A Thomas, “Elements of Information Theory”, 2nd edition, Wiley.
2. Simon Haykin, “Communication Systems”, 4th edition, Wiley.

SEMESTER-V

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 315	Data Communication	TE	3	0	0	3

UNIT I: INTRODUCTION
Uses of computer networks, network hardware, network software, references models, example networks.

UNIT II: PHYSICAL LAYER
The theoretical Basis for data communication, guided transmission media, the public switched telephone network, cable television.

UNIT III: DATA LINK LAYER
Data link layer design issues, error detection and correction, elementary data link protocols, sliding window protocols, example data link protocols.

UNIT IV: NETWORK LAYER
Store and forward packet switching, routing algorithms, congestion control algorithms, internetworking, the network layer in the internet.

UNIT V: APPLICATION LAYER
DNS-the domain name system, electronic mail, the world wide web, multimedia.

TEXTBOOKS

1. Andrew S. Tanenbaum, David J. Wetherall, Computer Networks, 5/e, Pearson Education, 2013.
2. Behrouz A. Forouzan, Data Communications and Networking, 4/e, Tata McGraw Hill Publishers, 2007.

REFERENCE

1. S. Keshav, An Engineering Approach to Computer Networking, Pearson Education, 1997.
2. W.A. Shay, Understanding Communications and Networks, 3/e, Cengage Learning, 2004.

SEMESTER-V

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 319	Microcontroller and Applications	TE	3	0	2	4

UNITI: OVERVIEW OF ARCHITECTURE AND MICROCONTROLLER RESOURCES

Introduction to microcontroller, Resources in advanced and next generation microcontrollers, 8051microcontroller architecture, Internal and external memories and interface, Internal RAM, and SFRs, Counters and timers, Synchronous serial-cum, Asynchronous serial communication, Interrupts and priorities.

UNIT II: 8051 FAMILY MICROCONTROLLERS INSTRUCTION SET

Basic assembly language programming, Data transfer instructions, Data and bit- manipulation instructions, Arithmetic instructions, Instructions for logical operations on the test among the registers, Program flow control instructions, Interrupt control flow.

UNIT III: REAL TIME CONTROL

Interrupt handling structure of MCU, Interrupt latencyand interrupt deadline, Multiple sources of the interrupts, non-maskable interrupt sources, enabling or disabling of the sources, polling mode and priority assignment, non-interrupt interval and density constraints, Real time control, timers, Programmable timers, Free running counter and real time control.

UNIT IV: SYSTEMS DESIGN

Keypad and keyboard interfacings, Keyboard-cum-display controller (8279), Alphanumeric devices, Display systems and its interfaces, Printer interfaces, Interfacing with the flash memory, Analog input interfacing, ADC interfacing with microcontroller.

UNIT V: 16/32 - BIT MICROCONTROLLERS

Introduction to 16/32 bit microcontrollers, MSP430 Microcontroller Architecture and memory organization, ARM 32 bit MCUs, ARM programming model and addressing modes, ARM thumb programming model, ARM and Thumb instruction set.

TEXTBOOKS/REFERENCE

1. Raj Kamal, Microcontrollers: Architecture, Programming, Interfacing and System Design, 2/e, Pearson Education, 2005.
2. Kenneth. J. Ayala, The 8051 Microcontroller, 3/e, Cengage Learning, 2004.
3. Ajay V. Deshmukh, Microcontrollers: Theory and Applications, Tata McGraw Hill, 2005.
4. Mazidi and Mazidi, The 8051 Microcontroller and Embedded Systems, 2/e, Pearson Education, 2007.
5. John H. Davies, MSP430 Microcontroller Basics, 1/e, Newnes, 2008.

LIST OF EXPERIMENTS

1. 8051 Assembly language program for doing arithmetic operation.
2. 8051 GPIO programming – Input/Output and Interrupts (Assembly & C).
3. Pulse width Modulated signal generation using Timers.
4. Universal Asynchronous Receiver Transmitter (UART) Programming.
5. Digital to Analog Converter Interface.
6. Stepper Motor Interface.
7. Traffic light Interface.
8. Seven Segment LED Interface.
9. LCD Interface.
10. Analog to Digital Converter (ADC) and Sensor Interfacing.
11. Mini Capstone Project.

TEXTBOOKS/REFERENCE

1. Mohammed Ali Mazidi, Janice Gillispie Mazidi, Rolin D Mckinlay, "The 8051 microcontrollers and Embedded Systems: Using Assembly and C ", Second Edition, Pearson Education, 2007.
2. Ayala, Kenneth J., "*8051 Microcontroller: Architecture, Programming, and Applications*", 2nd Edition, Delmar Thomson Learning, 1999.
3. David Calcutt, Frederick Cowan, Hassan Parchizadeh, "8051 Microcontroller: An Applications Based Introduction", Newnes, 2003.

SEMESTER-V

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ISES 311	Industry Specific Employability Skills-V	HS	1	1	0	0

UNIT I

Types and Properties of Numbers and Remainders, LCM, GCD, Fractions and decimals, Surds and Progressions.

UNIT II

Permutations, Combinations and Probability, Data Interpretation.

UNIT III

Geometry and Coordinate Geometry, trigonometry and Mensuration.

UNIT IV: REASONING

Syllogism and Non-Verbal Reasoning, Analytical Reasoning.

TEXTBOOKS/REFERENCE

1. Arun Sharma – How to prepare for Quantitative Aptitude, Tata Mcgraw Hill.
2. R.S Agarwal, A Modern Approach to Verbal and Non Verbal ReasoningS.Chand Publications.
3. Arun Sharma– How to Prepare for Data Interpretation & Logical Reasoning for the CAT.

SEMESTER-VI

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 321	Microwave Theory and Applications	C	3	0	0	3

UNIT I: MICROWAVE TRANSMISSION LINES

Introduction, Microwave Spectrum and Bands, Applications of Microwaves. Rectangular Waveguides – TE/TM mode analysis, Expressions for Fields, Characteristic Equation and Cut-off Frequencies, Filter Characteristics, Dominant and Degenerate Modes, Sketches of TE and TM mode fields in the cross-section, Mode Characteristics – Phase and Group Velocities, Wavelengths and Impedance Relations; Power Transmission and Power Losses in Rectangular Guide. Related Problems.

UNIT II: CIRCULAR WAVEGUIDES

Introduction, Nature of Fields, Characteristic Equation, Dominant and Degenerate Modes. Impossibility of TEM mode. Microstrip Lines– Introduction, Z_0 Relations, Effective Dielectric Constant, Losses, Q factor. Cavity Resonators– Introduction, Rectangular and Cylindrical Cavities, Dominant Modes and Resonant Frequencies, Q factor and Coupling Coefficients. Related Problems.

UNIT III: WAVEGUIDE COMPONENTS AND APPLICATIONS

Coupling Mechanisms – Probe, Loop, Aperture types. Waveguide Discontinuities – Waveguide irises, Tuning Screws and Posts, Matched Loads. Waveguide Attenuators – Resistive Card, Rotary Vane types; Waveguide Phase Shifters – Dielectric, Rotary Vane types. Waveguide Multiport Junctions – E plane and H plane Tees, Magic Tee, Hybrid Ring; Directional Couplers – 2 Hole, Bethe Hole types.

UNIT IV: MICROWAVE TUBES

Limitations and Losses of conventional tubes at microwave frequencies. Microwave tubes – O type and M type classifications. O-type tubes : 2 Cavity Klystrons – Structure, Reentrant Cavities, Velocity Modulation Process and Applegate Diagram, Bunching Process and Small Signal Theory – Expressions for o/p Power and Efficiency. Reflex Klystrons – Structure, Applegate Diagram and Principle of working, Mathematical Theory of Bunching, Power Output, Efficiency, Electronic Admittance; Oscillating Modes and o/p Characteristics, Electronic and Mechanical Tuning. Related problems.

UNIT V: MICROWAVE SOLID STATE DEVICES

Introduction, Classification, Applications. TEDs – Introduction, Gunn Diode – Principle, RWH Theory, Characteristics, Basic Modes of Operation, Oscillation Modes. Avalanche Transit Time Devices – Introduction, IMPATT and TRAPATT Diodes – Principle of Operation and Characteristics.

TEXTBOOKS

1. Microwave Devices and Circuits — Samuel V. Liao, Pearson, 3rd Edition, 2003.
2. Microwave Principles — Herbert J. Reich, J.G. Skalnik, P.F. Ordung and H.L. Krauss, CBS Publishers and Distributors, New Delhi, 2004.

REFERENCE

1. Foundations for Microwave Engineering — R.E. Collin, IEEE Press, John Wiley, 2ndEdition, 2002.
2. Microwave Circuits and Passive Devices — M.L. Sisodia and G.S. Raghuvanshi, Wiley Eastern Ltd., New Age International Publishers Ltd., 1995.
3. Microwave Engineering Passive Circuits — Peter A. Rizzi, PHI, 1999

SEMESTER-VI

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 321 L	Microwave Theory and Applications Lab	C	0	0	2	1

LIST OF EXPERIMENTS

1. Study the components used in microwave Test-bench.
2. Study of V-I Characteristics of Gunn Diode.
3. To determine the frequency and wavelength in a rectangular waveguide working on TE_{10} mode.
4. Impedance Measurement.
5. VSWR measurement.
6. Study- Characteristics of Reflex Klystron.
7. Attenuation Measurement.
8. Simulation study of Smith chart - Single and double stub matching.
9. Measurement of S-parameters of E-plane Tee & H-plane Tee.
10. Study the Characteristics of Magic Tee.
11. Measuring of dielectric constant of a material using waveguide test bench at X-band.

SEMESTER-VI

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 320	VLSI Design	C	3	0	0	3

UNIT I: VLSI DESIGN FLOW

Specification, Design entry, Functional simulation, Planning placement and routing, Timing simulation, Digital Design Implementation strategies (ASIC, Custom IC and FPGA Design flows) Introduction. Verilog HDL implementation of basic logic gates. Combinational and Sequential circuits.

UNIT II: MOS TRANSISTOR

Introduction, Ideal I-V characteristics, C-V Characteristics, Simple MOS Capacitance Models, Detailed MOS Gate Capacitance Model, Non-ideal I-V Effects, Mobility Degradation and Velocity Saturation, Channel Length Modulation, Threshold Voltage Effects, Junction Leakage, Body effect, Tunneling, DC Transfer Characteristics: Static CMOS Inverter DC Characteristics, Beta Ratio Effect, Noise Margin, Pass Transistor DC Characteristics.

UNIT III: COMBINATIONAL CIRCUIT DESIGN

CMOS Logic, Inverter, NAND Gate, NOR Gate, Combinational Logic, Compound Gates, Pass Transistors and Transmission Gates, Tristates, Multiplexers, Circuit Families: Static CMOS, Ratioed Circuits, Cascode Voltage Switch Logic, Dynamic Circuits, Complementary Pass-Transistor Logic Circuits, Datapath Subsystem: Single-Bit Addition, Ripple Carry Adder, Carry Look ahead Adder, Carry Save Adder, Unsigned Array Multiplication, 2's Complement Array Multiplication, Wallace Tree Multiplication.

UNIT IV: SEQUENTIAL MOS LOGIC CIRCUITRY

Behavioral of Bistable element, SR Latch Circuitry, Clocked latch and Flip Flop Circuitry, C-MOS D-Latch and Edge Triggered Flip-Flop, Sequencing Static Circuits: Sequencing Methods, Max-Delay Constraints, Min-Delay Constraints Time Borrowing, Clock Skew.

UNIT V: CMOS PROCESSING TECHNOLOGY

CMOS Technologies, Wafer Formation, Photolithography, Well and Channel Formation, Silicon Dioxide (SiO2), Isolation, Gate Oxide, Gate and Source/Drain Formations, Contacts and Metallization, Passivation, Methodology: Lambda Design Rules, Transistor Scaling, Inverter (nMOS and CMOS).

TEXTBOOKS/REFERENCE

1. Jan Rabaey, Anantha Chandrakasan, B.Nikolic, "Digital Integrated Circuits: A Design Perspective", Second Edition, Prentice Hall of India, 2003.
2. M.J. Smith, "Application Specific Integrated Circuits", Addisson Wesley, 1997.
3. N.Weste, K.Eshraghian, "Principles of CMOS VLSI Design", Second Edition, Addision Wesley 1993.
4. R.Jacob Baker, Harry W.LI., David E.Boyee, "CMOS Circuit Design, Layout and Simulation", Prentice Hall of India 2005 3. A.Pucknell, Kamran Eshraghian, "BASIC VLSI Design", Third Edition, Prentice Hall of India, 2007.

SEMESTER-VI

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 320 L	VLSI Design Lab	C	0	0	2	1

LIST OF EXPERIMENTS

1. CMOS inverter.
2. CMOS NOR/ NAND gates.
3. CMOS XOR and MUX gates.
4. CMOS Static / Dynamic logic circuit (register cell).
5. CMOS Latch.
6. Pass transistor.
7. Layout of any combinational circuit (complex CMOS logic gate)
8. 6T SRAM cell Design and Analysis.
9. Layout of 6T SRAM cell and Stability Analysis.
10. Course project.

SEMESTER-VI

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 323	Digital Communication	C	3	0	0	3

UNIT I: INTRODUCTION

Block diagram of digital communication, ADC, DAC. Channel models: Binary symmetric channel, discrete input and continuous output channel, waveform channel (AWGN channel) Source coding: Mathematical model of information, Entropy, Mutual information, coding for discrete memory less channels: Huffman coding.

UNIT II: CHARACTERISATION OF COMMUNICATION SIGLAS AND SYSTEMS

Representation of bandpass signals and systems, representation of stationary stochastic process, signal space representation: Gram-Schmidt orthogonalization procedureRepresentationof digitally modulated signals: M-PAM, M-PSK, QAM, M-FSKSpectral characteristics of digitally modulated signals.

UNIT III: RECEIVER FOR DIGITAL MODULATION

Optimum receiver for signals corrupted by AWGN: Correlation and Matched filter demodulator, Optimum detector, performance of optimum receiver for digital modulation schemes: BER Plots. Simulation of performance of various modulation schemes in the presence of AWGN.

UNIT IV: CHANNEL CODING

Channel capacity, block codes and convolution codes, Simulation of block and convolution codes and performance in the presence of AWGN.

UNIT V: DESIGN OF DIGITAL COMMUNICAITO SYSTEMS

Goals of communication system designer, Shannon–Hartley capacity theorem, error probability plane and bandwidth efficiency plane, modulation & coding tradeoff, Simulation of Digital Communication system design for the given specification.

TEXTBOOKS

1. "Digital Communications" by John G. Proakis, 4th edition, McGrawHill, 2000.
2. "Principles of Communication Engineering" by J M. Wozencraft and I M Jacobs, Waveland Pr Inc, 1990.

REFERENCE

1. B. Sklar, Digital Communications: Fundamentals & Applications, Pearson Education, (2/e), 2001.
2. A.B. Carlson : Communication Systems, 3/e McGraw Hill.

SEMESTER-VI

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 323 L	Digital Communication Lab	C	0	0	2	1

LIST OF EXPERIMENTS

1. Pulse Code Modulation and Demodulation.
2. Differential Pulse Code Modulation and Demodulation.
3. Delta Modulation.
4. Time Division Multiplexing.
5. Companding.
6. Data Formatting.
7. ASK, FSK and PSK.
8. QAM.
9. Differential Phase Shift Keying.
10. Linear Block Code – Encoder and Decoder / Binary Cyclic Code – Encoder and Decoder.

SEMESTER-VI

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ENG 328	Undergraduate Research Opportunity-UROP	PR	0	0	6	3

UNIT I: CONCEPTION OF IDEA
Based on interest conceive an idea, Do a feasibility check of the project.

UNIT II: SUBMISSION OF ABSTRACT OF THE IDEA
Literature Survey of similar/related works, Write an abstract of the proposed idea.

UNIT III: RESOURCE PROCUREMENT AND WORK EXECUTION TIMELINE
Create a checklist of resources required, Resource Procurement, Creating timeline for execution of various modules of the project.

UNIT IV: PROTOTYPE BUILDING AND EXECUTION
Execution of the various modules of the project and intermediate report submission, Initiation of the process for a possible publication or patent.

UNIT V: PRESENTATION OF EXECUTED PROJECT AND REPORT / PAPER SUBMISSION
Presenting the executed work, Submitting the work for a possible publication or patent or both.

TEXTBOOKS/REFERENCES

1. As deemed fit by student under guidance from supervisor for the project execution.

SEMESTER-VI

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ISES 312	Industry Specific Employability Skills-VI	HS	1	1	0	0

UNIT I
Antonyms, synonyms, odd words, Idioms and phrasal verbs, same word with different part of speech, Word analogy. Sentence completion.

UNIT II
Text completion, Sentence equivalence, Introduction to Different Parts of an Argument in Reasoning, Assumption of an Argument, strengthening of an Argument, Weakening of an argument.

UNIT III
Para jumbles, Sentence Completion & Text Completion, Reading Comprehension, Identification of errors, Sentence correction.

UNIT IV
Resume writing, Cover letter.

UNIT V
GD, PI.

TEXTBOOKS/REFERENCES

1. Verbal Ability and Reading comprehension-Sharma and Upadhyay.
2. Charles Harrington Elstor, Verbal Advantage: Ten Easy Steps to a Powerful Vocabulary, Large Print, September 2000.
3. GRE Word List 3861 – GRE Words for High Verbal Score, 2016 Edition.
4. The Official Guide to the GRE-General Revised Test, 2nd Edition, Mc Graw Hill Publication.
5. Soft Skills Training: A Workbook to Develop Skills for Employment Book by Frederick H. Wentz.
6. The Resume Writing Guide: A Step-by-Step Workbook for Writing ...Book by Lisa McGrimmon.

SEMESTER-VI

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 215	Electronic Workshop-III on PCB Design	ES	0	0	2	1

LIST OF EXPERIMENTS

1. Regulated Power supply.
2. Voltage Doubler Circuit.
3. Audio amplifier design.
4. ADC / DAC Converter Circuits.
5. Seven Segment Display.
6. Circuit for Temperature Detection.
7. Circuit for Zero Crossing Detector.
8. Integrator and Differentiator Circuits.
9. Soldering: all the PCB Circuits for Components Mounting.
10. Testing of the Assembled Circuits.

SEMESTER-VI

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 328	Satellite Communication	TE	3	0	0	3

UNIT I: ELEMENTS OF ORBITAL MECHANICS
Equations of motion. Tracking and orbit determination, orbital correction/control, satellite launch systems, multistage rocket launchers and their performance.

UNIT II: ELEMENTS OF COMMUNICATION SATELLITE DESIGN
Spacecraft subsystems, reliability considerations, spacecraft integration.

UNIT III: MULTIPLE ACCESS TECHNIQUES
FDMA, TDMA, CDMA, Random access techniques, Satellite onboard processing.

UNIT IV: SATELLITE LINK DESIGN
Performance requirements and standards, design of satellite links, DOMSAT, INSAT, INTELSAT and INMARSAT. Satellite-based personal communication.

UNIT V: EARTH STATION DESIGN
Configurations, antenna and tracking systems, satellite broadcasting.

TEXTBOOKS

1. Dennis Roddy, Satellite Communications, 4/e, Tata McGraw Hill, 2006.
2. T. Pratt, S. W. Bostian, Satellite Communication, 2/e, John Wiley and Sons, 2006.

REFERENCES

1. Dharma Raj Cheruku, Satellite Communication, 1/e, IK International Publishing, 2010.
2. D. C. Agarwal, Satellite Communication, 1/e, Khanna Publishers, 1991.

SEMESTER-VI

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 329	Optical Communication	TE	3	0	0	3

UNIT I: OVERVIEW OF OPTICAL FIBER COMMUNICATION

The general system, advantages of optical fiber communications. Optical fiber wave guides-introduction, ray theory transmission, total internal reflection, acceptance angle, numerical aperture, skew rays. Cylindrical fibers- modes, V number, mode coupling, step index fibers, graded index fibers.

UNIT II: SINGLE MODE FIBERS

Cut off wavelength, mode field diameter, effective refractive index. Signal distortion in optical fibers- attenuation, absorption, scattering and bending losses, core and cladding losses. Group delay, types of dispersion - material dispersion, wave-guide dispersion, polarization mode dispersion, intermodal dispersion. Pulse broadening.

UNIT III: FIBER SPLICING

Splicing techniques, splicing single mode fibers. Fiber alignment and joint loss multimode fiber joints, single mode fiber joints. Optical fiber connectors: connector types, single mode fiber connectors, connector return loss. Fiber materials: Glass, halide, active glass, chalgenide glass, plastic optical fibers. Source to fiber power launching - output patterns, power coupling, power launching, equilibrium numerical aperture, laser diode to fiber coupling.

UNIT IV: OPTICAL SOURCES

LEDs, structures, materials, quantum efficiency, power, modulation, power bandwidth product. Injection laser diodes- Modes, threshold conditions, external quantum efficiency, laser diode rate equations, resonant frequencies. Reliability of LED and ILD. Optical detectors: physical principles of PIN and APD, detector response time, temperature effect on avalanche gain, comparison of photodetectors.

UNIT V: OPTICAL SYSTEM DESIGN

Considerations, component choice, multiplexing. Point-to- point links, system considerations, link power budget with examples. Overall fiber dispersion in multi-mode and single mode fibers, rise time budget with examples.

TEXTBOOKS/REFERENCES

1. Kodali, Engineering Electromagnetic Compatibility, 2/e, IEEE Press, 2000.
2. Clayton R Paul, Introduction to Electromagnetic Compatibility, John Wiley and Sons, 2010.
3. Electromagnetic Interference and Compatibility IMPACT series, IIT Delhi. (Modules1- 9)

SEMESTER-VI

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 411	Embedded Systems for design	TE	3	0	2	4

UNIT I: INTRODUCTION TO EMBEDDED SYSTEMS

Introduction to embedded systems, examples of embedded systems, Components of embedded systems hardware, Design process in embedded system, Design metrics, design metrics optimization, Time to market, The NRE and unit cost design metrics, The performance design metrics, Von Neumann and Harvard Architecture, CISC and RISC architectures, Introduction to different controllers: Atmel 89C52, ATMEGA 32, Microchip PIC16F877, ARM 7.

UNIT II: CUSTOM PROCESSOR DESIGNS

Processor technology – General-purpose processor, single-purpose processor, and application specific processors. IC Technology – PLD, semi-custom, full custom, Design Technology – RT Synthesis. RT-level combinational and sequential components, Finite state machine with data (FSMD),Finite state machines (FSM),controller and datapath design, Optimization of design, Operation of general-purpose processors – Instruction execution, pipelining, superscalar and VLIW architectures. Design of Soda Vending machine. Design of Elevator controller.

UNIT III: PIC MICROCONTROLLER – ARCHITECTURE AND INTERFACING

Baseline, Mid-range and High-performance PIC devices, Architecture, Memory organization, Instruction Set - Branch, Call, Time Delay Loop, Arithmetic logical instructions, Assembly Language Programs, Bank Switching, Table processing, Macros and Modules. Development tools –MPLAB – Cross compilers, PIC I/O Ports, Timers and Counters, Capture Compare, PWM Modules, Interrupts, Watch Dog Timer.

UNIT IV: COMMUNICATION PROTOCOLS

Concept of protocols. Study of serial and parallel communication protocols – UART, SPI,SCI , I2C, CAN, USB, PCI, Ethernet, Study of wireless protocols - IrDA, Bluetooth, IEEE802.11,Zigbee, RF modules, GSM modem for AT command study.

UNITV: BASICS OF REAL-TIME OPERATING SYSTEM

Need of RTOS in Embedded system software, RTOS services in contrast with computer OS. Features of μCOS II, Foreground/Background systems, Kernel architecture, Task, Task scheduler, context switching, Scheduling algorithms – First come first serve, Round Robin, Round Robin with Priority, Shortest job first, Multitasking, Interrupt service routine (ISR),Semaphores, Mutexes, Events, Inter process communication (IPC) - mailbox, message queues, pipes, timers, memory management.

LIST OF EXPERIMENTS

1. Assembly language programming for PIC microcontrollers.
    - Arithmetic Operations
    - Port I/O Programming
2. Timers and Counter Programming and usage of CCP module.
3. ADC and Data EEPROM Programming.
4. Asynchronous Serial Communication UART Programming.
5. Peripheral Interfacing using synchronous serial communication (SPI/ I2C)
6. Program for making PIC's USB as virtual COM Device (CDC class device)
7. Controller Area Network (CAN) Interface.
8. RTOS program to demonstrate Task management.
9. RTOS program to demonstrate Inter task communication and inter task synchronization.
10. Mini Capstone Project.

TEXTBOOKS/REFERENCES

1. Vahid and Givargis,"*Embedded system design : A unified hardware/software introduction*", John Wiley & Sons, Inc. 2002.
2. Raj Kamal, "Embedded Systems : Architecture, Programming, and Design", The McGraw-Hill Companies, Edition 2, 2008.
3. Steve Furber, "*ARM System-on-chip architecture*", Addison-Wesley Publications, 2nd Ed., 2000.
4. Jean J. Labrosse, "MicroC/OS-II : The Real-Time Kernel", CMP Books, Edition 2, 2002.
5. S.V. Iyer and P. Gupta, "Embedded Realtime Systems Programming", The McGraw-Hill Companies, 2004.
6. Muhammad Ali Mazidi, Rolin D. Mckinlay, Danny Causey "PIC Microcontroller and Embedded Systems using Assembly and C for PIC18', Pearson Education 2008.
7. Dogan Ibrahim, "Advanced PIC Microcontroller Projects in C: From USB to RTOS with PIC18F Series", Newnes, 2008.

SEMESTER-VI

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 430	Convex Optimization	TE	3	1	0	4

UNIT I: MATHEMATICAL CONCEPTS AND INTRODUCTION

Vectors and matrices--linear independence and Rank, Eigen vectors and Eigen values of matrices, Inner product space and properties, Properties of Norm, Gauss elimination, Grand Schmidt orthogonalization, Null space, Woodbury identity, Introduction to optimization, least squares and Linear programming.

UNIT II: CONVEX SETS

Introduction to Convex sets and examples, Introduction to Affine sets and examples, Affine Functions, Linear-fractional and perspective Functions, generalized inequalities, Separating and supporting hyper planes, Dual cones and generalized inequalities, Applications of Convex sets and Affine sets.

UNIT III: CONVEX FUNCTIONS

Introduction to convex functions, Properties of Convex Functions, problems on Convex Functions, Operations that preserve convexity, Conjugate Functions, Introduction to Quasi convex functions, Properties of Quasi convex functions, Log concave and log convex functions, Convexity with respect to generalized inequalities. Applications.

UNIT IV: CONVEX OPTIMIZATION PROBLEMS

Introduction to Convex Optimization, Types of Convex optimization, Convex optimization problems, Linear optimization, Quadratic optimization, Geometric programming, Generalized inequality constraints, Introduction to Vector optimization, Vector optimization problems, Applications.

UNIT V: DUALITY

Introduction to Duality, Introduction to Lagrange dual function, Lagrange dual function problems, Geometric interpretation, Saddle point interpretation, Introduction to Optimality conditions, Different Optimality conditions, Perturbation and sensitivity analysis, Theorems of alternatives, Applications.

TEXTBOOKS

1. Stephen Byod, Lieven Vandenberghe,Convex Optimization, First Edition, Cambridge University Press, 2009.

REFERENCES

1. Mokhtar S. Bazaraa, Hanif D. Sherali, C. M. Shetty, Nonlinear Programming: Theory and Algorithms, 3rd ISBN: 978-0-471-48600-8 June 2006.
2. Gilbert Strang, Linear Algebra and Its Applications, 4 editions, Cengage Learning,2005.

SEMESTER-VII

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 409	Real-Time Operating Systems	TE	3	0	2	4

UNIT I: INTRODUCTION

Basics of Operating Systems – Threads and Processes, Scheduling - Inter process synchronization – Inter process communication, Memory Management – File System - Introduction to Real Time Systems, RTOS Vs General purpose OS – Types of RTOS, Firmware development approaches – When to use RTOS, Commercial and open source RTOS available in Market.

UNIT II: TASK MANAGEMENT

Task -Task states -Task State Transition, Task creation – Task Priorities – Idle Task, Task scheduling – Priority based preemptive scheduling, round robin scheduling – Cooperative scheduling, Task Context – Task Context switch, Task priority change – Task deletion.

UNIT III: INTER TASK SYNCHRONIZATION AND COMMUNICATION

Inter Task Synchronization - Semaphores – Types of Semaphores, Mutexes – System Calls for Task synchronization – Critical sections, Priority inversion – Priority Inheritance – Deadlocks, Events - Event groups – Inter Task Communication, Message queues –Queue creation – Queue Send/Receive System Calls.

UNIT IV: RESOURCE MANAGEMENT AND INTERRUPTS

Memory Management – Dynamic Memory Allocation, Heap – Stack Overflow detection - Software Timers, Attributes, States, Context, and system calls, Interrupt Management – Interrupt Safe System Calls, Deferred Interrupt Processing, Task-Interrupt Synchronization and communication.

UNIT V RTOS TASK PROFILING AND APPLICATIONS

Collection of Run Time Statistics, Thread Safe TCP/IP Stack, Application layer protocols, MQTT, HTTP, Cryptographic Libraries, File System – Cellular Modem Interface.

TEXTBOOKS/REFERENCE

1. Silberschatz,Galvin,Gagne “Operating System Concepts”, 6th ed,John Wiley,2003.
2. Raj Kamal, “Embedded Systems- Architecture, Programming and Design” Tata McGraw Hill,2006.
3. Richard Barry, “Mastering the FreeRTOS™ Real Time Kernel”, Real Time Engineers Ltd 2016.
4. Brian Amos, “Hands on RTOS with Microcontrollers”, Packt Publishing 2020.
5. www.freertos.org
6. Robert Love, “Linux System Programming”, 2nd ed, O’Reilly, 2013.

LIST OF EXPERIMENTS

1. RTOS Configuration, Task creation and Task management API.
2. Task scheduling – Priority based pre-emptive / Round Robin Scheduling.
3. Cooperative scheduling & co routines.
4. Inter Task synchronization – Semaphores, Mutexes and Events.
5. Priority Inversion & Priority inheritance.
6. Program to demonstrate Inter Task Communication using message queues.
7. One shot and auto reload software timers.
8. Profiling: Viewing Run Time and task state information.
9. RTOS Network application development with TCP/IP.
10. Mini Capstone Project.

TEXTBOOKS/REFERENCES

1. Richard Barry, “Mastering the FreeRTOS™ Real Time Kernel”, Real Time Engineers Ltd 2016.
2. Brian Amos, “Hands on RTOS with Microcontrollers”, Packt Publishing 2020.

SEMESTER-VII

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 326	Radar Engineering	TE	3	0	0	3

UNIT I: INTRODUCTION

History and applications of radar, basic radar functions, elements of a pulsed radar, signal processing concepts and operations, basic radar signal processing. Sampling and quantization of pulsed radar signals, domains and criteria for sampling radar signals, sampling in the fast time domain, sampling in the slow time, selecting the PRI, sampling the Doppler spectrum, sampling in the spatial and angle dimensions, Quantization, I/ Q imbalance and digital I/Q.

UNIT II: RANGE PROCESSING

Introduction, the waveform matched filter, matched filtering of moving targets, the ambiguity function, the pulse burst waveform, Design of opamps from specifications.

UNIT III: RADAR WAVEFORMS

Frequency modulated pulse compression waveforms, range side lobe control for FM waveforms, the stepped frequency waveform, phase modulated pulse compression waveforms, Cost as frequency codes.

UNIT IV: DOPPLER PROCESSING

Alternate forms of the doppler spectrum, moving target indication (MTI), pulse doppler processing, pulse pair processing, additional doppler processing issues, clutter mapping and moving target detector, MTI for moving platforms: Adaptive displaced phase center antenna processing.

UNIT V: DETECTION FUNDAMENTALS

Radar detection as hypothesis testing, threshold detection in coherent systems, threshold detection of radar signals, introduction to CFAR detection, spatial filtering. **Beamforming:** Adaptive beamforming.

TEXTBOOKS/REFERENCES

1. N. Levanon, and E. Mozeson, Radar Signals, 1/e, Wiley-Inderscience, 2004.
2. P. Z. Peebles, Radar Principles, 1/e, Wiley Student Edition, 2004.
3. M. I. Skolnik, Introduction to Radar Systems, 3/e, Tata McGraw Hill, 2001.
4. F. E. Nathanson, Radar Design Principles, 1/e, Prentice Hall India, 1999.
5. Mark A. Richards, Principles of Modern Radar – Basic Principles, Yesdee, 2012.

SEMESTER-VII

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 325	Digital Image Processing	TE	3	1	0	4

UNIT I: FUNDAMENTALS OF IMAGE PROCESSING

Image acquisition, image sampling and quantization, Relationships between pixels, image geometry, Gray level transformations, Histogram processing: histogram equalization, Histogram specification, Color image processing: Color fundamentals, color models, Color transformations, applications of image processing.

UNIT II: IMAGE TRANSFORMS

2-D DFT, properties. Walsh transform, Hadamard transform, discrete cosine transforms, Haartransform, Slant transform, KL transform, Comparison of different transforms.

UNIT III: IMAGE ENHANCEMENT

(by spatial domain methods) Arithmetic and logical operations, point processing, Image smoothing and sharpening filters in spatial domain, Enhancement: (by frequency domain methods) Image smoothing and image sharpening filters in frequency domain. Homomorphic filter, Comparison of filters in frequency domain and spatial domain.

UNIT IV: IMAGE COMPRESSION FUNDAMENTALS

Types of redundancy, Lossless compression: Variable length coding, LZW coding, Bit plane coding, predictive coding-DPCM, Lossy compression: Transform coding, Basics of image compression standards: JPEG, JPEG 2000, Basics of vector quantization.

UNIT V: IMAGE SEGMENTATION

Region based segmentation, Detection of discontinuities, Edge linking and boundary detection, thresholding, Image Restoration: Degradation model, Estimation of degradation function, Restoration in the presence of noise only, Restoration filters: Inverse filter, wiener filter, Constraint least square filtering.

TEXTBOOKS/REFERENCE

1. R.C. Gonzalez, R.E. Woods, Digital Image processing, 3/e, Pearson Education, 2009.
2. Anil K. Jain, Fundamentals of Digital Image processing, Prentice Hall of India, 1989.
3. Rafael C. Gonzalez, Richard E. Woods, Steven L., Digital Image Processing using MATLAB, Pearson Education, 2004.
4. William K. Pratt, Digital Image Processing, 3/e, John Wiley and Sons, 2004.
5. S. Jayaraman, S. Esakkirajan, T.Veerakumar, Digital Image Processing, Tata McGraw Hill, 2011.

SEMESTER-VII

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 408	Microcontroller based design	TE	3	0	2	4

UNIT I: ARM ARCHITECTURE AND PROGRAMMING

Arcon RISC Machine – Architectural Inheritance, The ARM Programmer's model – ARM Development tools, ARM Assembly Language Programming – Data processing instructions, Data transfer instructions- Control flow instructions, Writing simple assembly language programs - ARM Organization and Implementation, 3-stage pipeline ARM organization - 5-stage pipeline ARM organization, ARM instruction execution - ARM implementation, ARM processor families.

UNIT II: ARM INSTRUCTION SET

Introduction - Exceptions - Conditional execution - Branch and Branch with Link (B, BL) – BX, BLX – Software Interrupt (SWI) – Data processing instructions, Multiply Instructions – Count leading zeros - Single word and unsigned byte data transfer instructions, Half-word and signed byte data transfer instructions, Multiple register transfer instructions – SWP, Status register to general register transfer instructions, General register to status register transfer instruction- Coprocessor Instructions-Coprocessor data operations, Coprocessor data transfers - Coprocessor register transfers- Breakpoint instruction - Unused instruction space. Memory faults - ARM architecture variants - The Thumb Instruction Set.

UNIT III: EFFICIENT C PROGRAMMING

Overview of C Compilers and Optimization, Basic C Data Types - C Looping Structures, Register Allocation - Function Calls, Pointer Aliasing - Structure Arrangement, Bit-fields - Unaligned Data and Endianness, Division - Floating Point, Inline Functions and Inline Assembly - Portability Issues.

UNIT IV: ARM APPLICATION DEVELOPMENT

Representing a digital signal – Introduction to DSP on ARM, FIR Filter – IIR Filter, Discrete Fourier transform – Exception Handling, Interrupts – Interrupt handling schemes, Firmware and bootloader, Example: Standalone - Embedded Operating Systems, Fundamental Components, Simple Operating System.

UNIT V: DESIGN WITH ARM CORTEX MICROCONTROLLERS

Typical Development flow, CMSIS – Exception programming, Programming for Peripherals of LPC17xx Devices, UART – I2C, SPI – USB, Embedded Ethernet Applications, ADC – DAC, RTC – CAN communication.

LIST OF EXPERIMENTS

1. ARM Assembly language program for doing arithmetic operation.
2. ARM assembly language program for Memory operations.
3. ARM Assembly - Interfacing memory mapped peripherals.
    - Binary Counter with LEDs
    - Real Time Clock
    - Analog to Digital converter
    - Digital to Analog Converter
4. C Program for peripheral interfacing
    - GPIO
    - Real Time Clock
    - Analog to Digital Converter
    - Digital to Analog Converter
5. C Program for Asynchronous and synchronous serial communication.
    - UART
    - I2C/SPI
6. C Program for Fast Fourier Transform.
7. Embedded Ethernet applications.
8. Controller Area Network (CAN) interface.
9. Mini Capstone Project.

TEXTBOOKS/REFERENCES

1. Steve Furber, 'ARM system on chip architecture', Addision Wesley.
2. Andrew N. Sloss, Dominic Symes, Chris Wright, John Rayfield 'ARM System Developer's Guide Designing and Optimizing System Software', Elsevier.
3. ARM Architecture Reference Manual
4. Joseph Yiu, The Definitive Guide to the ARM® Cortex-M3, 2/e, Newnes, 2010.
5. www.arm.com
6. www.nxp.com

SEMESTER-VII

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 418	Machine Learning	TE	3	0	2	4

UNIT I
Introduction to machine learning, Supervised and Unsupervised Learning, Linear Regression, Logistic Regression, Generalized Linear Models.

UNIT II
Gaussian Discriminant Analysis (GDA),Naive Bayes, Support Vector Machines, K-Nearest Neighbor, Decision Trees, Random forest.

UNIT III
Clustering in Machine Learning, Different Types of Clustering Algorithm, K-Means Clustering, Gaussian Mixture Models, Bias-variance trade off.

UNIT IV
Introduction to Neural Networks, Feed-forward Network, Gradient descent optimization, Error Backpropagation, Evaluation of error-function derivatives, Efficiency of backpropagation, under and over fitting.

UNIT V
Introduction to Convolutional neural network (CNN),Backpropagation in CNN, Sparse Kernel Machines, Markov Chain Monte Carlo, Introduction to Reinforment learning.

TEXTBOOKS/REFERENCE

1. Christopher M. Bishop, "Pattern Recognition and Machine Learning" by Springer, 2007.
2. Tom M. Mitchell, "Machine Learning", First Edition by Tata McGraw-Hill Education, 2013.
3. EthemAlpaydin, "Introduction to Machine Learning" 2nd Edition, The MIT Press, 2009.

LIST OF EXPERIMENTS

1. Implement Linear Regression on the given dataset using python/MATLAB.
2. Implement Naïve Bayes classifier using Python/MATLAB.
3. Implement Logistic Regression on the given dataset using python/MATLAB.
4. Implement SVM algorithm using Python/MATLAB.
5. Implement Decision tree classifier and Random Forest classifier using python/MATLAB.
6. Implement Random Forest classifier using python/MATLAB.
7. Implement K-means algorithm for clustering the data using python/MATLAB.
8. Implement K-Nearest Neighbour classifier using python/MATLAB.
9. Emulate logic gates using neural Network using python.
10. Implement single-Layer Neural Network for image/data analysis using Python/MATLAB.
11. Implement Convolution Neural Network for image/data analysis using Python/MATLAB.
12. Implement Markov model for analysis of stock market data using python/MATLAB.

SEMESTER-VII

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 403	Digital Switching and Multiplexing	TE	3	0	0	3

UNIT I: INTRODUCTION

Evolution of telecommunication, Basics of switching system, Step-by-step switching, Design considerations, Principles of crossbar switching, Electronic space division switching, Stored program control, Software architecture, Switching functions.

UNIT II: DIGITAL TRANSMISSION

Frequency division multiplexing, Time division multiplexing, statistical division multiplexing, switching hierarchy, synchronous digital hierarchy both USA and European standards, Message switching, circuit switching and packet switching, space division switching, Time division switching. Two-dimensional switching, grade of service. Non-blocking, digital cross connect, Concentrators, expanders and distributors, Two stage networks, Three stage networks, n-stage networks.

UNIT III: Time Division Switching

Time division space switching, time division time switching, Time multiplexed space switching, Time multiplexed time switching, Space-time combination switching, Three stage combination switching, N-stage combination switching, Signaling techniques.

UNIT IV: TELECOMMUNICATION TRAFFIC

Units of traffic, network traffic load and parameters, Grade of service and blocking probability, Traffic measurement, mathematical model, Incoming traffic and service time characteristics, Blocking models and loss estimates, delay systems, Digital subscriber access– ISDN, High data rate digital subscriber loops, Digital loop carrier systems, fibre in the loop, voice band modems, Digital satellite services, broadband switching systems.

UNIT V: NETWORK SYNCHRONIZATION CONTROL AND MANAGEMENT

Timing, timing inaccuracies, Network synchronization, network control and management, SONET/SDH – SONET multiplexing overview, frame formats, Operation, administration and maintenance, Frequency justification and payload framing, Virtual tributes, DS3 payload mapping,E4 payload mapping, SONET optical standards, SONET rings and networks.

TEXTBOOKS/REFERENCE

1. Viswanathan, Thiagarajan, Bhatnagar, Manav, Telecommunication Switching Systems and Networks, 2/e, Prentice Hall of India, 2015.
2. John C. Bellamy, Digital Telephony, 3/e, Wiley Student Edition, 1999.
3. J E Flood, Telecommunications Switching, Traffic and Networks, Pearson Education, 2004.
4. Gokhale, Introduction to Telecommunications, 2/e, Cengage Learning, 2004.
5. Robert G. Winch, Telecommunication Transmission Systems, 2/e, Tata McGraw Hill, 2004.

SEMESTER-VIII

SEMESTER-VIII

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 421	Capstone Project	PR	0	0	24	12

UNIT I: LITERATURE SURVEY

Do a thorough literature survey in the domain of interest and conceive an idea. Continue the literature survey specifically related to the idea conceived and determine your contribution. Make an abstract of the proposed idea. Preparation of biweekly reports.

UNIT II: METHODOLOGY

Device project plan. Acquire necessary components, software, dataset etc requirements. Testing the existing algorithms, tools, or components. Preparation of biweekly reports and test plans.

UNIT III: RESULTS

Development of complete methodology. Prototype building. Preparation of biweekly reports and test plans.

UNIT IV: DISSERTATION AND DEMONSTRATION OF THE PROJECT

Completion of project dissertation. Demonstration of the project.

UNIT V: WRITING AND SUBMITTING A RESEARCH ARTICLE/PATENT

Writing of a technical paper / patent, Writing and submission of a journal research paper.

TEXTBOOKS/REFERENCE

As deem appropriate by the student under guidance of project faculty guide

HS ELECTIVES

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
JOU 406	Basics of Media and Nationalism	OE	3	0	0	3

UNIT I: INTRODUCTION TO NATIONALISM

Primordial, Constructivist and Instrumentalist understandings, Ethno/Sacred nationalism, Imagined community, The Invention of Tradition, Whose Imagined Community?

UNIT II: MEDIA AND THE PUBLIC SPHERE

Habermasian Concept of Public Sphere, Agenda Setting, Print Capitalism, Banal Nationalism.

UNIT III: MEDIA AND IDEOLOGY

Introduction to Ideology, Ideological State Apparatus, Manufacturing Consent.

UNIT IV: REPORTING ON CASTE, GENDER

Caste and Media, Gender and Media.

UNIT V: EXPLORING MARGINALITIES: MEDIA AND THE NORTHEAST

Representation of NorthEast in national media, Ethnicity and diversity, Resistance movements, insurgency in the media, NorthEast and the Rhetoric of development.

TEXTBOOKS/REFERENCES

1. Dawisha, Adeed. (2002). *Nation and Nationalism Antecedents to Contemporary Debates*. International Studies Review, 4 (1), 3-22.
2. Anderson, Benedict. (2006). *Imagined Communities: Reflections on the Origin and Spread of Nationalism*. Verso.
3. Hobsbawm, Eric. (1983). *Introduction: Invention Traditions*. In Hobsbawm, Eric, Ranger, Terence (Ed.) The Invention of Tradition. UK: Cambridge University Press.
4. Chatterjee, Partha. (1993). *The Nation and its Fragments-Colonial and Postcolonial Histories (Princeton Studies in Culture/Power/History)*. Princeton: Princeton University Press.
5. McQuail, D. (2009) McQuail's Mass Communication Theory, Vistar Publication: New Delhi.
6. Prinsloo, Jeanne. (1999). *Cheer the Beloved Country? Some Thoughts on Gendered Representations, Nationalism and the Media*. Agenda: Empowering Women for Gender Equity. 40, 45-53.
7. Eccleshall, Robert. (1999). *Political Ideologies: An Introduction*. London: Routledge.
8. Jeffrey, R (2016). *Media and Modernity, Communications, Women and the State in India*. Orient Blackswan.
9. Herman, E. S., & Chomsky, N. (1988). *Manufacturing consent: The political economy of the mass media*. New York: Pantheon Books.
10. Kabi, K. H., Pattnaik, N. S. (2015). *Media, Conflict and Peace in Northeast India*. Delhi: Vij Books.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
EGL 102	Technical Writing	OE	4	0	0	4

UNIT I

Sentence Structure (English), Paragraph Writing, Coherence, Cohesion, and Unity, Construction of an Argument and Counter-Argument, Deducing a Conclusion,

UNIT II

The Concept of 'BASIC' (Brief, Appropriate, Simple, Intelligible, and Complete), Writing Vs Drafting, The process of 'Technical' writing, Difference between 'General' and 'Technical' writing (the nuances of technical writing)

UNIT III

What is a Definition? The process / structure of a Definition, What is a Description?, The process / structure of a Scientific Description, Describing an Object, Describing a Process, What is an Explanation?, The mechanism of writing an 'Explanation',

UNIT IV

Synopsis, Research Proposal, Abstract Vs Summary, Referencing and Citations, Bibliography.

UNIT V

Planning a Research Write-up, Structure of a Paper, Designing an effective Abstract, Introduction Section, Discussion, Conclusion.

TEXTBOOKS/REFERENCES

1. Dudley Evans, T. (1998). Developments in English for Specific Purposes: A multidisciplinary approach. U.K: Cambridge University Press.
2. Hutchinson, T., & Waters, A. (1987). English for Specific Purposes: A learner-centered approach. U.K: Cambridge University Press.
3. Jain, A. K. (2001). Professional Communication Skills. New Delhi: S. Chand & Company Limited.
4. Raman, Meenakshi, and Sangeetha Sharma. (2008). Technical Communication: English Skills for Engineers. New Delhi: Oxford University Press.
5. Raman, Meenakshi, and Sangeetha Sharma. (2004) Technical Communication: Principles and Practice. New Delhi: Oxford University Press.
6. Trimble, Louis. English for Science and Technology - A Discourse Approach. (1985). Cambridge: Cambridge University Press.
7. Williams, Phil. Advanced Writing Skills for Students of English. (2018). Brighton: Rumian Publishing.
8. Wilson, Paige and Teresa Ferster Glazier. (2013). The Least You Should Know About English: Writing Skills, Form C (11th Edition). Boston: Cengage Learning

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
HIS 100	Idea of India	OE	4	0	0	4

UNIT I: THE NATION AND ITS MANY ROOTS

What is a Nation? –Theories of Nationalism, The many names of India: India, India, Aryavarta or Bharat, Mother India: Iconising a Nation.

UNIT II: UNEARTHING THE PAST

The Evolutionary Past: Interbreeding Vs Replacement Theory, Out of Africa Theory, what is a civilization? Theories of Civilization, Indus Valley Civilization.

UNIT III: STORIES OF GODS AND PEOPLE

The Emergence of Myths, Myth Vs Reality, Vedic Age in India, Tribes, Caste and Battles.

UNIT IV: POLITY AND GOVERNANCE

Religion, Economy and the State –Asoka, Chankya and the Buddha, Land the Economy: Exploring the Arthasastra, Social Order and the State: Through the Epics, Two millennia of pluralism: Jews, Christians and other religions in India.

UNIT V: TOWARDS UNDERSTANDING THE NATION

The Mughals in India, Multiple Identities – the same heritage, The Past as a Signifier.

TEXTBOOKS

1. Y. N.Harari, A Brief History of Humankind, Harper, 2015.
2. Upinder Singh, A History of Ancient and Early Medieval India, Pearson, 2009.
3. Romila Thapar, Early India: From the Origins to AD 1300, University of California Press, 2004

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
HIS 102	Human Civilizations	OE	4	0	0	4

UNIT I

What is Civilization? Stages of Human evolution; African Origins of Humanity; overview of Hominin evolution: Sexual dimorphism, Development of Language: Patterns of lithic technological development, and stone tool technology, gathering and hunting in human evolution- social and economic structure.

UNIT II

Climate change and end of Ice- Age, towards the Mesolithic period and extension of settlement in new ecological zones, changes in subsistence strategies based on the case studies from West Asia, Europe and Meso America, changes in tool manufacture and social organization. Neolithic Period: Origin of food production; Gender Division of Labor; early farming settlements at Catal Hyuk, Abu Hureya, Jericho, Syria and Jordan; early farming societies in Europe, Asia and the Nile Valley; Neolithic sites, art and architecture; Domestication of animals; burial customs and belief.

UNIT III

Discovery of metals, science of forging metals, development of writing system; Tigris and Euphrates River valley: Emergence of Cities. Urban Revolution: Ancient Egyptian Civilization, Private life in ancient Egypt; Minion Civilization of Crete, Eastern Mediterranean World, Gender in the Mediterranean, Harappan Civilization, Origin of Chinese Civilization.

UNIT IV

Nomadic Pastoralism; pastoral people of middle east; pastoralism in central Asia: Horse, wheel, cart and chariot; impacts on the environment; socio- political interaction with the urban centers. The advent of Iron- its origin and implications.

UNIT V

Ancient Greece; emergence of polis, Athens and Sparta, myth of arcadia. Slave Mode of Production: Emergence of Slavery in ancient Greece, organization of production, nature of classical urbanism, population and forms of slavery; Private life and ancient Greece. Hellenistic Phase: Characteristic features of Hellenism, cities and rural world, art, and culture.

TEXTBOOKS/REFERENCES

1. Amar Farooqui. *Early Social Formations*. Delhi: Manak Publications, 2001.
2. Bogucki, P. *The Origins of Human Society*. Massachusets and Oxford: Wiley Blackwell Publishers,1999.
3. Fernand Braudel, *The Mediterranean in the Ancient World*, Penguin, 2007.
4. R.J Wenke *Pattern in Prehistory*: *Humankind's First Three Million Years,* Oxford University Press, 2006.
5. Redman, C.L. *The Rise of Civilisations. From Early Farmers to Urban Society in the Ancient Near East*. San Fransisco: W.H. Freeeman 1978.
6. V. Gordon Childe, *What Happened in History*, 1942.

OPEN ELECTIVES
V-SEMESTER

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
CSE 411	Big Data Analytics	OE	3	0	2	4

UNIT I

Big Data introduction - definition and taxonomy - Big data value for the enterprise - The Hadoop ecosystem - Introduction to Distributed computing- Hadoop ecosystem – Hadoop Distributed File System (HDFS) Architecture - HDFS commands for loading/getting data - Accessing HDFS through Java program.

UNIT II

Introduction to Map Reduce framework - Basic Map Reduce Programming: - Advanced Map Reduce programming: Basic template of the Map Reduce program, Word count problem- Streaming in Hadoop- Improving the performance using combiners- Chaining Map Reduce jobs- Joining data from different sources.

UNIT III

Querying big data with Hive - Introduction to Hive QL- Hive QL: data definition- data manipulation

UNIT IV

Querying big data with Hive – Hive QL queries- Hive QL Views – Hive QL indexes

UNIT V

Data Analytics using R: Introduction to R, Creating a dataset, Getting started with graphs, Basic data management, Advanced data management.

TEXTBOOKS/REFERENCES

1. Big Data Fundamentals: concepts, Drivers and Techniques: Person Education, 2016
2. Hadoop The Definitive Guide, IV edition, O'Reilly publications
3. Hadoop in Action, Chuck lam, Manning publications
4. Programming, Hive, O'Reily publications
5. Apache Hive Cookbook, PACKT publications
6. R in Action, Robert I. Kabacoff, Manning publications
7. Practical Data Science with R, Nina Zumel John Mount, Manning publications

LIST OF PRACTICAL EXPERIMENTS

1. a. Hadoop Installation
   b. Hadoop Shell Commands
2. a. Writing a file from local file system to Hadoop Distributed file system (HDFS)
   b. Reading a file from HDFS to local file system.
3. a. Implementation of Word Count program using Map Reduce without combiner logic
   b. Implementation of Word Count program using Map Reduce with combiner logic
4. Implementation of Map-Reduce program using partitioner
5. a. Implementation of Maximum temperature program using Map Reduce without combiner logic
   b. Implementation of Maximum temperature program using Map Reduce with combiner logic
6. a. Create a managed table and load the data from LFS
   b. Create a managed table and load the data from HDFS
   c. Create an external table and load the data from LFS
   d. Create an external table and load the data from HDFS
   e.Drop a managed table and check the result in HDFS
   f. Drop an external table and check the data from HDFS
7. Use HiveQL to analyse the stock exchange dataset and calculate the covariance between the stocks for each month. This will help a stock-broker in recommending the stocks to his customers.
8. a.create Hive table
   b. Load data into Hive table

c. Calculate the covariance

9. Implement JOINS using HIVE
   a. Inner Join
   b. Left outer join
   c. Right outer Join
   d) Full outer join
10. Write a R program to create student record using Vector concept.
11. Write a R program to create medical patients status using data frame
    i) Patient age ii) Gender iii) Symptoms iv) Patient Status
12. Write R program to visualize student marks of various subjects using Bar-chart and Scatter plot

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
EEE 421	Linear Systems	OE	3	0	0	3

UNIT I: LINEARITY, LINEAR SPACES AND LINEAR OPERATORS

Review of fields, vector spaces, basis, vector representation, linear transformations, rank and nullity, linear operators and diagonalizability, inner and normed vector spaces, Continuity, linearity, linear systems, time invariance, characteristics, Laplace transform, generalised initial-value theorem, Dirac delta impulse, transforms, superposition integral, frequency domain perspective, Canonical forms: controller, phase variable, controllability, observer, observability, parallel and cascade, Jordan canonical forms. Markov parameters, duality, discrete-time dynamical systems; general state-space descriptions; non-uniqueness; packed matrix representations, Frequency domain: identities and resolvent formulae, transfer function, External and internal descriptions, nonlinear systems and linearization.

UNIT II: SOLUTIONS OF STATE-SPACE DESCRIPTIONS

Existence and uniqueness of solutions of CT systems; examples of nonlinear systems; fundamental theorem, Linear time-varying continuous time systems: Wronskian; state transition matrix and its properties; homogeneous and nonhomogeneous differential equations, Linear time-invariant continuous-time systems; evaluation of state transition matrices; Jordan form; matrix exponentials, Linear discrete-time systems; state transition matrix, Modes of oscillations and modal decomposition; sampled-data systems.

UNIT: III CONTROLLABILITY AND OBSERVABILITY

Determining the initial conditions: observability; setting up initial conditions: observability, Canonical forms revisited, duality, Hankel matrix revisited, connections, Definitions of controllability and observability, characteristics; joint controllability and observability, characteristics, connections; Popov Belevitch Hautus tests; Kalman decomposition, Controllability and observability of discrete-time systems; subtle issues.

UNIT IV: STABILITY OF SOLUTIONS

External and internal stability, Equilibrium points, Stability in the sense of Lyapunov for CT systems, Lyapunov equation; linearised systems; Sylvester's criterion, Stability in the sense of Lyapunov for DT systems.

UNIT V: STATE-SPACE COMPENSATOR DESIGN

Stabilisation by output feedback; stabilisation by cascade compensation, State variable feedback for CT systems: Bass-Gura formula, modal controllability, Ackermann formula, Mayne-Murdoch formula; Transfer function analysis; effect on zeros; noncontrollable modes, Regulator problem; integral-error feedback; Quadratic regulator theory for CT systems, DT systems: Modal controllability, controllability to the origin, state-variable feedback, discrete-time regulator, Asymptotic observers; Combined observer-controller compensators; Reduced-order observers; optimality criterion.

TEXTBOOKS/REFERENCES

1. T. Kailath, Linear Systems, Prentice-Hall, 1980.
2. M. Gopal, "Modern Control Systems Theory." 3rd edition New Age International Publishers, 2014.
3. C.-T. Chen, Linear System Theory and Design, 2nd edition Holt, Rinehart and Winston, 1984.
4. P. J. Antsaklis and A. N. Michel, Linear Systems, Birkhauser, 2006.
5. W. T. Brogan, Modern Control Theory, 3rd edition, Prentice-Hall, 1990

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 433	Introduction to High Performance Computing	OE	3	0	0	3

UNIT I

Introduction to HPC Systems, architecture and OS concepts, Multi-core CPUs, GPU, systems and High-performance clusters.

UNIT II

Introduction to basic numerical methods (stencil computations (_nite di_erences),linear system solutions, integration). Sequential implementation.

UNIT III

Programming paradigms: OpenMP and MPI, Thread Management, CUDA / OpenCL.

UNIT IV

Data Dependency Reduction. Data flow, Loop reordering. Purely Parallel Algorithms, Block Decomposition Methods, Parallel Programming Packages.

TEXTBOOKS

1. Introduction to High Performance Computing for Scientists and Engineers. Chapman & Hall/CRC Computational Science Series.

REFERENCES

1. J. J. Dongarra, I. B. Du_, D. C. Sorensen and H. A. van der Vorst, Solving Linear Systems on Vector and Shared Memory Computers, SIAM, 1991.
2. K. Hwang, Advanced Computer Architecture: Parallelism, Scalability, Programmability, McGraw-Hill, 1993.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
MAT 355	Calculus of Variation	OE	4	0	0	4

UNIT I: METHOD OF VARIATIONS IN PROBLEMS WITH FIXED BOUNDARIES

Introduction – Functionals, Variation and Its Properties, Euler's Equation, Functionals Dependent on Higher-Order Derivatives, Variational Problems in Parametric Form, Some Applications.

UNIT II: VARIATIONAL PROBLEMS WITH MOVING BOUNDARIES

Elementary Problem with Moving Boundaries, One-Sided Variations.

UNIT III: SUFFICIENT CONDITIONS FOR AN EXTREMUM

Field of Extremals, The Function $E(x, y, p, y')$, Transforming the Euler Equations to the Canonical Form,

UNIT IV: VARIATIONAL PROBLEMS INVOLVING A CONDITIONAL EXTREMUM

Constraints of the Form $\varphi(x, y_1, y_2, \cdots y_n)$, Constraints of the Form $\varphi(x, y_1, y_2, \cdots y_n, y'_1, y'_2 \cdots y'_n)$, Isoperimetric Problems.

UNIT V: DIRECT METHODS IN VARIATIONAL PROBLEMS

Introduction to Direct Methods, Euler's Finite-Difference Method, Rayleigh-Ritz Method, Kantorovich's Method.

TEXTBOOKS/REFERENCES

1. L. Elsgolts, *Differential Equations and the Calculus of Variations*, University Press of the Pacific, 2003.
2. A S Gupta, Calculus of Variations, Prentice-Hall of India Pvt. Ltd., New Delhi, 2008.
3. I. M. Gelfand and S. V. Fomin, *Calculus of Variations,* Dover Publications. 1963

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
MAT 306	First course in cryptography	OE	4	0	0	4

UNIT I: ELEMENTARY NUMBER THEORY AND ABSTRACT ALGEBRA

Group-theoretic background: Cyclic group and _nding a generator of a cyclic Group. Integer arithmetic: Basic operations, The Euclidean algorithm. Modular arithmetic: Basic operations, computing modular inverses. Chinese Remainder Theorem, Primality testing, Factoring algorithms, Elliptic curves.

UNIT II: INTRODUCTION AND CLASSICAL CIPHERS

Definition of Cryptography: Classical and Modern Cryptography, The setting of Private-key Encryption, Historical ciphers and their crypto-analysis, Basic Principles of modern Cryptography: Formation of exact definitions, Reliance on precise assumptions and Rigorous Proofs of Security.

UNIT III: PERFECTLY SECRET ENCRYPTION

Definitions and Basic Properties, The One-Time Pad (Vernams Cipher), Limitations of Perfect Secrecy.

UNIT IV: PRIVATE-KEY (SYMMETRIC) CRYPTOGRAPHY

Private-Key Encryption and Pseudo randomness, Message Authentication Codes and Collision-Resistant Hash Functions, Pseudorandom Objects in Practice: Block Ciphers, Private-Key Cryptography Necessary and Sufficient Assumptions.

UNIT V: PUBLIC KEY (ASYMMETRIC) CRYPTOGRAPHY

One-Way Functions and Permutations, Constructing Collision-Resistant Hash Functions, Private-Key Management and the Public-Key Revolution, Public-Key Encryption.

TEXTBOOKS

1. Introduction to Modern Cryptography by Jonathan Katz and Yehuda Lindell, CRC Press.
2. Lecture Notes on Cryptography by Sha_ Goldwasser and Mihir Bellare.
3. A Course in Cryptography by Rafael Pass and Abhi Shelat.
4. A Course in Number Theory and Cryptography by Neal Koblitz

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
BBA 606	Corporate Social responsibility	OE	3	0	0	3

UNIT I: INTRODUCTION TO CORPORATE SOCIAL RESPONSIBILITY

History of Corporate Social Responsibility, Definitions of CSR, Global and Indian Context of Corporate Social Responsibility.

UNIT II: PRINCIPLES OF CSR

Sustainability, Accountability and Transparency, Changing emphasis in companies, Externalizing costs, Ethical Principles of CSR, corporate behavior and reputation.

UNIT III: STAKEHOLDERS AND THE SOCIAL CONTRACT

Types and classification of stakeholders, Stakeholder theory, Regulation and its implications, Due diligence of stakeholders.

UNIT IV: ISSUES IN CSR AND CASE STUDIES

Sustainability, CSR themes and case studies.

UNIT V: CONDUCTING CSR PROJECTS

Planning CSR projects, Steps in Implementation of CSR; challenges and risks, Monitoring and evaluation, Reporting projects.

TEXTBOOKS/REFERENCES

1. Crowther, D. & Aras, G. (2008). Corporate Social Responsibility. Ventus Publishing APS.
2. Shrivastava, L.. (2014). Corporate Social Responsibility. JRU publication.
3. Bansal, P. Roth, R. 2000. Why Companies Go Green: A model of Ecological Responsiveness. The Academy of Management Journal, Vol.43, No.4, pg 717-736. [6]
4. Fry, LW. Keim.GD. Meiners, RE. 1982. Corporate Contributions: Altruistic or for Profit? The Academy of Management Journal, Vol.25, No.1, pg.94 -106.[10]
5. Grace, D, Cohen, S.2005. Business Ethics; Problems and Cases. Australia. Oxford University.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
BIO 113	Biochemistry I - Biomolecules	OE	4	0	0	4

UNIT I: BIOENERGETICS

Biomolecules: water- structure and properties, buffers and its biological importance's. Principles of bioenergetics- Laws of thermodynamics – entropy and enthalpy - standard free energy changes- standard reduction potentials – thermodynamics of coupled reaction.

UNIT II: CARBOHYDRATES

Carbohydrates: definition and functions, classification, properties, monosaccharides, disaccharides, oligosaccharides, polysaccharides- homo- and hetero- polysaccharides. Quantitative and qualitative methods.

UNIT III: LIPIDS

Lipids- Classification- structure and properties- phospholipids- glycolipids- sphingolipids- cholesterol. Fatty acids- saturated and unsaturated fatty acids- biosynthesis and essential fatty acids.

UNIT IV: AMINO ACIDS AND PROTEINS

Amino Acids-Classification and properties. structure and properties of amino acids, Essential and nonessential amino acids, Proteins-classification and functions, levels of protein structure, haemoglobin and myoglobin.

UNIT V: NUCLEIC ACIDS

Nucleic acids- Structure, Purine and Pyrimidine bases structure, Properties and functions of nucleic acids (DNA, RNA). Different forms of DNA and RNA.

TEXTBOOKS/REFERENCES

1. Harper's Illustrated Biochemistry, V. W. Rodwell, D. Bender, K.M. Botham, P.J. Kennelly and P.A. Weil (2018) 31st edition, McGraw Hill-Medical.
2. Lehninger Principles of Biochemistry, D. L. Nelson and M. M. Cox, (2017) 7th edition, W.H. Freeman & Company.
3. Biochemistry: D. Voet and J.G. Voet (2011), 4th edition, Wiley
4. Biochemistry, J M Berg and J.L. Tymoczko, G. J. Gatto Jr., L Stryer (2015), 8th edition, W.H. Freeman & Company

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
PHY 224	Introduction to Optics	OE	3	0	0	3

UNIT I: PHYSICAL OPTICS

The propagation of light and Rayleigh scattering, Laws of reflection and refraction, Fermat's principle, The electromagnetic approach of light propagation. The Fresnel equations. Total internal reflection and evanescent waves. Optical properties of metals, Interaction of light and matter. Stokes treatment of reflection and refraction, Photons and the laws of reflection and refraction, Tutorial 1, Tutorial 2, Tutorial 3.

UNIT II: GEOMETRICAL OPTICS

Prisms: dispersion and reflection properties, Planar and aspherical mirrors, Thick lenses and lens systems, Newton formula, lateral magnification, Analytical ray tracing and development of Matrix methods, Matrix analysis of system of two thin lenses, Unit and Nodal planes, Matrix analysis of mirror systems, Monochromatic aberrations – Spherical aberration, Coma, Astigmatism, Field curvature, Distortion, Chromatic aberrations, Thin achromatic doublets, GRIN Systems and optical glasses, Tutorial 4, Tutorial 5, Tutorial 6.

UNIT III: INTERFERENCE OF LIGHT

Coherence and Interference of Light Waves by Division of Wave Front, Interference pattern and intensity distribution, Fresnel Biprism and Interference with white light, Displacement of fringes, Interference by a plane parallel film illuminated by a plane wave and Cosine law, High reflectivity from deposited thin film and reflection by a periodic structure, Interference by a plane parallel film when illuminated by a point source, Interference by a film with two nonparallel reflecting surfaces Color of Thin Films and Newton's Rings. The Michelson Interferometer, Multiple reflections from a plane parallel film, Fabry–Perot etalon and resolving power of Fabry–Perot interferometer, Tutorial 7, Tutorial 8, Tutorial 9.

UNIT IV: DIFFRACTION OF LIGHT

Fraunhofer diffraction - single-slit diffraction pattern, Two-slit Fraunhofer diffraction pattern, N-slit Fraunhofer diffraction pattern, The Diffraction Grating and its resolution, The Fresnel diffraction integral, and Fraunhofer approximation. Fraunhofer Diffraction by a Long Narrow Slit, Rectangular Aperture and Circular Aperture, Array of Identical Apertures and Spatial Frequency Filtering. The free propagation of a spherical wave - Fresnel diffraction, half-period zones. Diffraction at circular apertures, the Zone plate. Diffraction of a plane wave by a long narrow slit and transition to the Fraunhofer region. Tutorial 10, Tutorial 11, Tutorial 12.

UNIT V: POLARIZATION OF LIGHT

The Nature of Polarized Light, Types of polarization - plane, circular Elliptical Polarization, Polarizers, Malus's Law of Polarization, Dichroism, Dichroic Crystals and Polaroid, Birefringence, Ordinary and extraordinary light, Birefringent Crystals and Birefringent Polarizers. Polarization by Reflection, The Fresnel Equations and Brewster's Law of Polarization, Circular Polarizers, Half and full wave plates, Theory of Optical Activity and Polarimetry, Induced Optical Effects—Optical Modulators, The Faraday Effect, The Kerr and Pockels Effects. Tutorial 13, Tutorial 14, Tutorial 15.

TEXTBOOKS/REFERENCES

1. Introduction to Geometrical and Physical Optics, B. K. Mathur, 7 Edition, 1967, Gopal Printing.
2. Fundamentals of Optics, Francis Jenkins, Harvey White, 4 edition, 2017 McGraw Hill Education.
3. A Textbook on Light, K G Mazumdar and B Ghosh, 3rd revised Edition, 2010, Sreedhar Publication, India.
4. Optics, Eugene Hecht, 5th Global Edition, 2017, Pearson Education Limited.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
HIS 100	Idea of India	OE	4	0	0	4

UNIT I: THE NATION AND ITS MANY ROOTS

What is a Nation? –Theories of Nationalism, The many names of India: India, India, Aryavarta or Bharat, Mother India: Iconising a Nation

UNIT II: UNEARTHING THE PAST

The Evolutionary Past: Interbreeding Vs Replacement Theory, Out of Africa Theory, what is a civilization? Theories of Civilization, Indus Valley Civilization

UNIT III: STORIES OF GODS AND PEOPLE

The Emergence of Myths, Myth Vs Reality, Vedic Age in India, Tribes, Caste and Battles.

UNIT IV: POLITY AND GOVERNANCE

Religion, Economy and the State –Asoka, Chankya and the Buddha, Land the Economy: Exploring the Arthasastra, Social Order and the State: Through the Epics, Two millennia of pluralism: Jews, Christians and other religions in India.

UNIT V: TOWARDS UNDERSTANDING THE NATION

The Mughals in India, Multiple Identities – the same heritage, The Past as a Signifier

TEXTBOOKS

1. Y. N.Harari, A Brief History of Humankind, Harper, 2015.
2. Upinder Singh, A History of Ancient and Early Medieval India, Pearson, 2009.
3. Romila Thapar, Early India: From the Origins to AD 1300, University of California Press, 2004.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
MAN 001	Mandarin	OE	3	0	0	3

COURSE DESCRIPTION

This course is the first semester of four that forms an introduction to standard Mandarin Chinese and is designed for students with no previous background in spoken or written Mandarin. Students in this course focus on learning essential vocabulary, practicing pronunciation, and understanding simple grammatical structures. This knowledge prepares students to effectively communicate in Mandarin on a limited range of topics related to everyday situations and examine how culture and language interact. In-class activities and course assignments aim to assist students as they develop the oral proficiency and confidence necessary to initiate simple conversations. Out-of-classroom experiences such as cultural activities or guided interactions with native speakers supplement formal classroom instruction and provide ample opportunities for practical engagement.

TEXTBOOK & COURSE MATERIALS

1. A Course in Contemporary Chinese Volume 1 《當代中文課程 1》by the Mandarin Training Center at National Taiwan Normal University. Publisher: Sanctum Books; First Indian edition (31 March 2021)
2. Supplementary vocabulary & cultural materials

METHOD OF INSTRUCTION

This course is delivered through a series of classroom instruction sessions, activities, homework, in-class practice, and non-classroom structured activities. All four skills of language learning (listening, speaking, reading, and writing) will be covered, with a particular focus on communication skills necessary in Chinese culture.

PART 2: OUTCOMES

1. This course will help student master Mandarin pronunciation, basic reading and writing skills, and to develop the ability to participate in simple, practical conversations on everyday topics.
2. In this course, students will learn to greet, to introduce themselves, to communicate with other people in Mandarin Chinese, and have basic knowledge and ability in Mandarin Chinese.

STUDENT LEARNING OUTCOMES

1. By the completion of this course, students will be able to:
2. Use Mandarin Chinese to confidently communicate on a range of topics related to everyday situations such (e.g. to introduce themselves, discuss family, hobbies, likes and dislikes).
3. Recognize and write approximately 150 Chinese characters.
4. Read and write simple sentences in Chinese.
5. Demonstrate listening comprehension in a number of simple circumstances

KNOWLEDGE OUTCOMES

1. This course is designed to assist students to acquire and demonstrate knowledge about:

2. Essential vocabulary, pronunciation, and grammatical structures.
3. Understand how Chinese culture and Mandarin Chinese interact.
4. The differences and similarities between Chinese and the student's native language.

SKILLS OUTCOMES

1. This course is designed to assist students in acquiring or enhancing the following skills:
2. Basic communication skills in Mandarin Chinese.
3. Competency with the Pinyin-Chinese phonetics system.
4. Ability to read and write Chinese characters.
5. Confidence to initiate simple conversations with other people.

PART 3: TOPIC OUTLINE/SCHEDULE

WEEK 01: INTRODUCTION, GREETING.

1. Introduction of Mandarin Chinese & Pinyin (the Chinese phonetic system)
2. Greetings in normal and polite ways.

WEEK 02: LEARNING TO INTRODUCE PEOPLE.

1. Basic sentences with "是shi"
2. Answering question with "什麼shéme"
3. Way to ask questions with A-not-A and "嗎ma" in Chinese

WEEK 03: LEARNING TO DISCUSS LIKES/DISLIKES.

1. Answering question in Chinese (Affirmative and Negative answers with "不bù")
2. Modification Marker "很hěn"
3. Contrastive question with "呢ne"

WEEK 04: LEARNING TO TALK ABOUT PEOPLE IN MY FAMILY MEMBERS AND THEIR NAMES.

1. Asking question with "幾jǐ"
2. Basic sentences with "有yǒu"

WEEK 05: LEARNING TO DESCRIBE PEOPLE, PLACES, AND POSSESSIONS.

1. Possessive word "的de"
2. Modifier Marker "的de"

WEEK 06: LEARNING TO TALK ABOUT THE NUMBER OF PEOPLE IN A FAMILY, PARTIAL EXAM.

1. Totality "都dōu"
2. Measure word "個ge" and "張zhāng"
3. Partial exam for Oral & writing

WEEK 07: LEARNING TO DESCRIBE LIKES/DISLIKES (E.G., SPORTS AND MOVIES).

1. Time words & Hobbies
2. To go do something with "去qù"
3. Placement of time words

WEEK 08: LEARNING TO EXPRESS WHAT TWO GROUPS HAVE IN COMMON.

1. Topic sentences
2. Word order in sentences (Chinese sentence orders, difference between English and Chinese)
3. The word order of Adverbs "也yě", "都dōu" and "常cháng"

WEEK 09: LEARNING TO POLITELY ASK OTHERS OPINIONS AND MAKE SIMPLE SUGGESTIONS.

1. Asking question with "怎麼樣zěnmeyàng"
2. Particles with "吧ba" and "啊a"

WEEK 10: LEARNING TO FORM CHOICE QUESTIONS, FINAL EXAM

1. Asking choice question with "還是háishì"
2. Making sentences with "覺得juéde"
3. Final exam for Oral & writing

PART 4: GRADING POLICY
EVALUATION CRITERIA
The grade for this course will be based on the following table.

Percentage (%)	**Evaluation Area**
60	Classroom performance (including performance of the basic conversation, participation in class activities, quizzes, and / or homework)
10	Partial Exam – Oral
10	Partial Exam – Writing
10	Final Exam – Oral
10	Final Exam – Writing
100	Total Points Possible

LATE WORK POLICY
Be sure to pay close attention to deadlines—there will be no make up assignments or quizzes, or late work accepted without a serious and compelling reason and instructor approval.

GRADING SCALE
Final grades assigned for this course will be based on the percentage of total points earned and are assigned as follows:

Letter Grade	Corresponding Percentage Points	Performance
A	93-100%	Excellent Work
A-	90-92%	Nearly Excellent Work
B+	87-89%	Very Good Work
B	83-86%	Good Work
B-	80-82%	Mostly Good Work
C+	77-79%	Above Average Work
C	73-76%	Average Work
C-	70-72%	Mostly Average Work
D+	67-69%	Below Average Work
D	60-66%	Poor Work
F	0-59%	Failing Work

PART 5: COURSE POLICIES

ATTEND CLASS

Students are expected to attend all regularly scheduled classes and come prepared to participate fully in class activities. Students are further expected to be on time for all classes. Arriving late for class or an activity is disrespectful of both the instructor and fellow students.

PARTICIPATE

The participation grade will depend on both the quality and the quantity of student's comments and questions and shall account for a portion of the total course grade.

BUILD RAPPORT

If you find that you have any trouble keeping up with assignments or other aspects of the course, make sure you let your instructor know as early as possible. As you will find, building rapport and effective relationships are key to becoming an effective professional. Make sure that you are proactive in informing your instructor when difficulties arise during the semester so that they can help you find a solution.

COMPLETE ASSIGNMENTS

Assignments must be submitted by the given deadline or special permission must be requested from instructor before the due date. Extensions will not be given beyond the next assignment except under extreme circumstances.

All discussion assignments must be completed by the assignment due date and time. Late or missing discussion assignments will affect the student's grade

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
TLC 102	Teaching and Learning	OE	3	0	0	3

UNIT I: INTRODUCTION TO TEACHING AND LEARNING

Teaching Methodologies, Understanding the Learners, Learning Theories -Behaviourism, Cognitivism, Constructivism. Innovative Instructional Methods.

UNIT II: TEACHER VS STUDENT CENTRIC INSTRUCTION

Introduction to teacher centric instruction, Passive Learning- Direct Instruction, Lecture Mode and Demonstration Mode, Active Learning- Learning by doing, Interactive Mode and Seminar Mode, Learners Generations – Introduction and needs of current generation learners.

UNIT III: TEACHING METHODOLOGIES

Meaningful Learning, Zone of Proximal Development, Flipped Classroom, Deep Planning Methods, Peer Learning Method, Gagne's 9 Events of Instruction.

UNIT IV: LEARNING STRATEGIES

John Dewey's Experiential Learning, Albert Bandura's Social Learning Theory, Howard Gardner's Multiple Intelligence Theory, Ubiquitous Learning Theory.

UNIT V: ACTIVE-COOPERATIVE LEARNING TECHNIQUES

Project Based Learning, Enquiry Based Learning, Case Studies – Concept and Analysing, Role Play Method, Collaborative Learning Methods.

TEXTBOOKS/REFERENCES

1. Driscoll, M. P., & Burner, K. J. (2005). Psychology of learning for instruction.
2. VanGundy, A. B. (2008). 101 activities for teaching creativity and problem solving. John Wiley & Sons.
3. https://ocw.metu.edu.tr/pluginfile.php/9013/mod_resource/content/1/driscoll-ch10%20(1).pdf
4. https://journals.healio.com/doi/abs/10.3928/00220124-20090522-07
5. https://marcprensky.com/writing/Prensky%20-%20Ch2-Digital%20Game-based%20Learning.pdf
6. https://files.eric.ed.gov/fulltext/EJ1153685.pdf
7. https://files.eric.ed.gov/fulltext/EJ1127696.pdf

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
EGL 333	Thing Theory	OE	4	0	0	4

UNIT I: THEORETICAL FOUNDATIONS
Martin Heidegger – The Thing, Bill Brown and his work, Timothy Morton – Hyper objects, Ian Bogost – Alien Phenomenology.

UNIT II: THEORY & POPULAR CULTURE
Jane Benett – Vibrant Matter, Karin Knorr Cetina – Sociality with Objects, Understanding Consumerism, Remo Bodei – The Life of Things, the Love of Things.

UNIT III: APPLICATIONS
Sumathi Ramaswamy – Terrestrial Lessons, Victorian Studies, The History of the World in 100 Objects.

UNIT IV: LITERARY READINGS
Poetry Robert Frost, William Carlos Williams, Objects in Works of Fantasy, Detective Fiction.

UNIT V: VISUAL CULTURE
Animation Movies, Photography, Advertising and Consumerism, NFTs.

TEXTBOOKS/REFERENCES

1. Brown, Bill (ed). *Things*. University of Chicago Press, 2004.
2. Daston, Lorraine (ed). *Things that Talk: Object Lessons from Art and Science*. Zone Books (MIT Press), 2004.
3. Edwards, Elizabeth, and Janice Hart (eds). *Photographs Objects Histories: On the Materiality of Images*. Routledge, 2004.
4. Cetina, Karin Knorr. "Sociality of Objects: Social Relations in Postsocial Knowledge Societies" in *Theory, Culture and Society* 14 (1997), 4.
5. Daly, Suzanne.*The Empire Inside: Indian Commodities in Victorian Domestic Novels*. University of Michigan Press, 2011

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
COM 108	Investment Analysis	OE	3	0	0	3

UNIT I: FUNDAMENTALS OF INVESTMENTS

Meaning of Investment, Objectives of investment, Investment, and speculation, Features of a good investment, Investment Process, Elements of Investment, Investment Avenues, Scope, and Importance of investment management.

UNIT II: INVESTMENTS AVENUES

Types of Investment: Features - Physical and Financial forms of Investments **-** Bank Products, Bonds, Stocks - Features of Equity, Preference Shares, Debenture, Investment in Real Estates, Important features of Investment in Real Estate.

UNIT III: SECURITIES MARKET

Primary Market - Factors to be considered to enter the Primary Market, Modes of raising funds, Secondary Market- Major Players in the secondary market, Functioning of Stock Exchanges, Trading and Settlement Procedures.

UNIT IV: VALUATION OF SECURITIES

Bond and its features, Types, Determinants of interest rates, Bond Valuation, Bond Duration. Valuation of Preference Shares, Equity shares- Valuation, Dividend Valuation models.

UNIT V: MACRO-ECONOMIC AND INDUSTRY ANALYSIS

Fundamental Analysis - E I C Framework, Economy, Industry and Company Analysis - Financial Statement Analysis, Ratio Analysis. Technical Analysis – Theories - Dow Theory, Elliot Wave Theory. Charts-Types, Trend and Trend Reversal Patterns. Moving averages, ROC, RSI, and Market Indicators.

TEXTBOOKS

1. Bodie, Zvi, Alex Kane, and Alan J. Markus, Investments (2005), McGraw Hill, (Sixth Edition) or a Later Edition.
2. Prasanna Chandra, Investment Analysis and Portfolio Management, 2nd Edition, Tata McGraw Hill, New Delhi.
3. Punithavathy Pandian, Security Analysis and Portfolio Management, Vikas Publication, New Delhi.

REFERENCES

1. Curley, Anthony J., and Bear, Robert M., Investment Analysis and Management (1999), Harper & Row, New York.
2. Fischer, D.E. and Jordan, R.J. Security Analysis and Portfolio Management. Pearson Education.
3. Fuller, Russel J., and Farrell, Jr., James L., *Modern Investments and Security Analysis (1987),* New York: McGraw-Hill Book Company.
4. Kevin. S. Security Analysis and Portfolio Management (2019), 2nd Edition, Prentice Hall of India, New Delhi.
5. V K Bhalla, Investment Management: Security Analysis and Portfolio Management (2019), 19th Edition, S Chand, New Delhi

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
BBA 304	Human Resource Management	OE	4	0	0	4

UNIT I: INTRODUCTION TO HUMAN RESOURCE MANAGEMENT
Meaning, Function, Significance & Challenges of HRM, HR Policies, Introduction to Human Resource Planning, Various Methods of HRP, Forecasting and HR Effectiveness – Case Study Analysis.

UNIT II: RECRUITING, SELECTING & SOCIALIZING INTRODUCTION
Recruitment Policy, Issues, sources of people, selection process & tests, Socialization, Internal Mobility, Career Planning – Case Study Analysis.

UNIT III: TRAINING & DEVELOPING
Workforce and Organizational Development Concept, need, method, importance & evaluation of training & development; principle of learning; Introduction to and Interventions in OD – Case Study Analysis.

UNIT IV: PERFORMANCE AND COMPENSATION MANAGEMENT SYSTEM
Definition, importance, objectives, components and methods of performance management system, Principal compensation issue, job evaluation, pay-structure, individual & group incentives – Case Study Analysis.

UNIT V: SOCIAL SECURITY AND LABOUR WELFARE
Concept of Social Security and Industrial Relations, Workers Participation in Management Significance, and various social security legislations in India – Case Study Analysis.

TEXTBOOKS

1. "Managing Human Resources" by Bohlander and Snell Thomson Publications.
2. "HumanResource Management" Gary Dessler and Biju Varkkey Pearson Publications.

REFERENCES

1. Human Resource Management, Gary Dessler, Pearson Education.
2. Human Resource Management, Casio Jaico Publishing House.
3. Human Resource Management, Ivancevich McGraw Hill.
4. The Management of People at Work Dale S.Beach Tata McGraw-Hill.
5. Personnel Management, CB Memoria, Himalaya Publishing House.
6. Human Resource Management Mizra S.Saiyadain Tata McGraw Hill.
7. Human Resource Management, VSP Rao Excell Books.
8. Human Resource Management, P.Subba Rao,Him

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
IDEA 104	Dream-Discover-Disrupt	OE	3	0	0	3

MODULE 1: VENTURE IDEATION.
MODULE 2: MARKETING.
MODULE 3: CUSTOMER SEGMENTATION.
MODULE 4: CUSTOMER DISCOVERY.
MODULE 5: SOLUTION DESIGN.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
HIS 005	Introduction to Gender	OE	4	0	0	4

UNIT I: THE NATION AND ITS MANY ROOTS

What is a Nation? –Theories of Nationalism, The many names of India: India, Hindia, Aryavarta or Bharat, Mother India: Iconising a Nation

UNIT II: UNEARTHING THE PAST

The Evolutionary Past: Interbreeding Vs Replacement Theory, Out of Africa Theory, what is a civilization? Theories of Civilization, Indus Valley Civilization

UNIT III: STORIES OF GODS AND PEOPLE

The Emergence of Myths, Myth Vs Reality, Vedic Age in India, Tribes, Caste and Battles.

UNIT IV: POLITY AND GOVERNANCE

Religion, Economy and the State –Asoka, Chankya and the Buddha, Land the Economy: Exploring the Arthasastra, Social Order and the State: Through the Epics, Two millennia of pluralism: Jews, Christians and other religions in India.

UNIT V: TOWARDS UNDERSTANDING THE NATION

The Mughals in India, Multiple Identities – the same heritage, The Past as a Signifier

TEXTBOOKS

1. Y. N.Harari, A Brief History of Humankind, Harper, 2015.
2. Upinder Singh, A History of Ancient and Early Medieval India, Pearson, 2009.
3. Romila Thapar, Early India: From the Origins to AD 1300, University of California Press, 2004

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
IDEA 102	Design Thinking	OE	3	0	0	3

UNIT I: INTRODUCTION TO DESIGN THINKING

Design Thinker's mindset, what is Design Thinking and why is it popular? Innovative thinking, what is a wicked problem and how can we solve it? The design thinking stages overview.

UNIT II: DESIGN THINKING - EMPATHISE

Power of Empathy, Probes for context mapping, Power of stories in building empathy for the target group, User Research methods -Qualitative user research, best practices of qualitative user research, best practices of qualitative user research. Conducting ethical user research. Basics of recruiting participants for user research.

UNIT III: DESIGN THINKING – DEFINE/REDEFINE THE CHALLENGE

Define problem, Frame insights, Understand context.

UNIT IV: DESIGN THINKING – IDEATE

Brainstorm and ideate, Divergence to Convergence, Creative confidence.

UNIT V: DESIGN THINKING – PROTOTYPE & TEST

Prototype to product, Prototyping methods, Heuristic Evaluation, Project 1 (in teams)- Applying Design thinking, Empathy & Ideation, principles & tools. Project 2 (in teams)- Applying Design thinking/Innovation principles and approach using specific tools. Storytelling -Role of Storytelling in Design thinking.

INSTRUCTIONAL METHOD

1. The course delivery method will be through online platforms (Zoom is preferred due to the breakout rooms options) depend upon the requirement of content and need of students. This will be an experiential learning throughout the course.
2. The internal evaluation will be done based on continuous evaluation of students in the hands-on workshop assignments and classroom.
3. Practical examination will be conducted at the end of semester for evaluation of performance of students in their given projects and also through questionnaire-based exam.

ELECTIVES

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 324	Computer Architecture and Organization	OE	3	0	0	3

UNIT I: OVERVIEW OF REGISTER TRANSFER AND ALU DESIGN
Register transfer language, Register transfer, Bus and memory transfer, Arithmetic micro-operations, Logic micro-operations, Shift micro operations, Arithmetic logic shift unit.

UNIT II: ARITHMETIC UNIT
Addition and subtraction of signed numbers, Design of fast adders, Multiplication of positive numbers, Integer division, Floating point numbers and operations.

UNIT III: COMPUTER DESCRIPTION
Instruction codes, Computer registers, Computer instructions, Instruction cycle, Memory-references instructions, Input-output and interrupt, Complete computer description.

UNIT IV: CHANNEL CODING
Fundamental concepts, Execution of a complete instruction, Hardwired control, Micro programmed control, Pipelining operation, Superscalar operation.

UNIT V: MEMORY ORGANIZATION
Memory hierarchy, Main memory, Cache memory, Virtual memory, Modes of data transfer, Direct memory access.

TEXTBOOKS/REFERENCE

1. Carl Hamacher, ZvonkoVranesic, SafwatZaky, Computer Organization, 5/e, McGraw-Hill, 2002.
2. Morris Mano, Computer System Architecture, 3/e, Pearson Education, 2000.
3. William Stallings, Computer Organization and Architecture, 6/e, Pearson Education Asia, 2000.
4. David A. Patterson, John L. Hennessy, Computer Organization and Design: The hardware / software interface, 3/e, Morgan Kaufmann, 2002.
5. John P. Hayes, Computer Architecture and Organization, 3/e, McGraw-Hill, 1998.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 419	Fundamentals of wireless communication	OE	3	1	0	4

UNIT I

Mobile radio propagation, Free space propagation model, Ground reflection model, Large scale path loss, small scale fading and multipath propagation, Impulse response model of a multipath channel, parameters of a mobile multipath channel, Multipath delay spread, Doppler spread, coherence bandwidth.

UNIT II

Digital communication through fading multipath channels, Frequency nonselective, Slowly fading channels, Frequency selective, Slowly fading channels, Calculation of error probabilities, Tapped delay line model, The RAKE receiver performance.

UNIT III

Diversity techniques for mobile wireless radio systems concept of diversity branch and signal paths, combining methods, Selective diversity combining, Pre-detection and post detection combining, switched combining, Maximal ratio combining, Equal gain combining.

UNIT IV

Cellular concept, frequency reuse, Cochannel interference, adjacent channel interference, Power control for reducing interference, improving capacity in cellular systems, Cell splitting, sectoring, Hand off strategies, Channel assignment strategies, Call blocking in cellular networks.

UNIT V

Fundamental concepts of spread spectrum systems, Pseudo noise sequence, performance of direct sequence spread spectrum systems, Analysis of direct sequence spread spectrum systems, The processing gain and anti-jamming margin, Frequency hopped spread spectrum systems, Time hopped spread spectrum systems, Synchronization of spread spectrum systems.

TEXTBOOKS/REFERENCE

1. Rappaport Thoedore S., Wireless Communications, Principles and Practice, 2/e, Prentice Hall of India, 2003.
2. Haykin, S., Moher M., Modern Wireless Communications,1/e, Pearson Education, 2011.
3. Kamilo Feher, Wireless Digital Communications, 1/e, Prentice Hall of India, 1995.
4. Lee W.C.Y., Mobile Cellular Telecommunication, 2/e, Tata McGraw Hill, 2002.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 410	Adaptive Signal Processing	OE	3	0	0	3

UNIT I: ADAPTIVE SYSTEMS

Definition and Characteristics; areas of application; general properties, open- and closed-loop adaptation; applications of closed-loop adaptation. Adaptive Linear Combiner: General description, Input signal and weight vectors; desired response and error, The performance function; gradient and minimum mean-square error, Alternative expression of the gradient; decorrelation of error and input components.

UNIT II: PROPERTIES OF THE QUADRATIC PERFORMANCE SURFACE

Normal form of the input correlation matrix; eigenvalues and eigenvectors of the input correlation matrix, geometrical significance of eigenvectors and eigenvalues; (i) Searching the Performance Surface, Methods of searching the performance surface; basic ideas of gradient search methods, A simple gradient search algorithm and its solution; stability and rate of convergence the learning curve; gradient search by Newton's Method; Newton's Method in multidimensional space. gradient search by the Method of Steepest Descent; comparison of learning curves.

UNIT III: GRADIENT ESTIMATION AND ITS EFFECT ON ADAPTATION

Gradient component estimation by derivative measurement, the performance penalty; derivative measurements and performance penalties with multiple weights, variance of the gradient estimate; effects on the weight-vector solution, excess mean-square error and time constants, Mis adjustment; comparative performance of Newton's and Steepest-Descent Methods, Total mis adjustment and other practical considerations.

UNIT IV: OTHER ALGORITHMS

Derivation of the LMS algorithm; convergence of the weight vector, An example of convergence; learning curve, noise in the weight-vector solution; mis adjustment; performance, normalized and other LMS-based adaptive filters, Discrete Kalman filter; recursive least squares algorithm.

UNITV: APPLICATIONS

Applications: Adaptive Modeling and System Identification: General description, adaptive modeling of a multipath communication channel, adaptive modeling in FIR digital filter synthesis, Adaptive Interference Cancellation: Concept of adaptive noise cancelling, stationary noise-cancelling solutions; effects of signal components in the reference input, Term Project: Matlab implementation of the various learning algorithms with applications.

TEXTBOOKS/REFERENCE

1. B. Widrow and S. D. Stearns, Adaptive Signal Processing, Pearson Education Asia, 1985.
2. M. H. Hayes, Statistical Digital Signal Processing and Modeling, John Wiley, 2002.
3. S. Haykin, Adaptive Filter Theory, 4th edition, Pearson Education Asia, 2002.
4. T Adali, S Haykin, Adaptive Signal Processing, Wiley-India, 2010.
5. Selected papers on adaptive signal processing and applications.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 416	Network Control System	TE	3	0	2	4

UNIT I
Introduction to the world of networks, how internet was developed and current state of networking.

UNIT II
Making sense of Internet based linkages, Innovations in the changed nature of linear and nonlinear, System with Internet based linkages.

UNIT III
Issues of communication delays and propagation problems, A new kind of robustness and remote activity.

UNIT IV
A new kind of estimation of delay problems, Optimal control in the presence of delay.

UNIT V
Numerical simulations of network-based control and integration of NS-2/NS-3 with Matlab/Scilab, Hardware interfaces.

TEXTBOOKS/REFERENCE

1. Networked Embedded Sensing and Control, edited by P. J. Antsaklis and P. Tabuada, Springer 2006.
2. Graph Theory, by R. Diestel, Springer, 2000.
3. Algebraic Graph Theory, by C. Godsil and G. Royle, Springer, 2001

LIST OF EXPERIMENTS

1. Introduction to Linux and C programming environment/Pointers.
2. Introduction to Network Programming.
3. Client and Server programs.
4. Processing multiple clients on a single server.
5. Using UDP in network programs
6. Programming Peer-To-Peer Networks.
7. Programming using udp chat server/client
8. Writing a simple c client to fetch html webpages.
9. Writing a small DNS program over network.
10. Small routing demonstration in C.
11. Consensus implementation in C using sockets

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 330	Communication Electronics	TE	3	0	0	3

UNIT I

Elements of a communication system, Types of communications, electromagnetic spectrum, Examples of a few communication systems, Issues involved, differential amplifier modulator, Low level and high-level AM, Diode AM detector filter SSB modulator, Crystal lattice filter, phasing SSB modulator, Synchronous detector, varactor FM modulator, Reactance FM modulator.

UNIT II

VCO FM modulator, FET phase modulator, Foster-Seeley FM discriminator, Ratio detector, pulse averaging discriminator, Comparison of various FM demodulators problems based on frequency modulation scheme, CW transmitter, AM transmitter, FM transmitter, SSB transmitter frequency multipliers.

UNIT III

TRF radio receiver, Superheterodyne receiver, Selectivity, sensitivity, fidelity, RF section, mixer, IF section, Image frequency, dual conversion, AGC, Squelch, SSB transceiver, frequency synthesizer, Special features in communication receiver, Software defined radio.

UNIT IV

Video and television signals, television broadcasting, TV channels, cable channels, picture elements, TV scanning picture qualities, Indian TV standards, Video signal, frame and field frequencies, horizontal and vertical scanning frequencies, Synchronization, blanking signal, 6/7 MHz TV broadcast channel, Construction of composite video signal, blanking time, front and back porch, Video signal frequencies, vertical detail, DC component, Colour information basic operation of TV camera, Vidicon, plumbicon, single tube colour camera, Interlaced scanning pattern, raster distortions, sync pulses.

UNIT V

RGB video signals, colour addition. Colour matrix, I and Q signals, Chrominance modulation, negative transmission,VSB transmission, FM sound signal, Tricolour picture tubes, decoding the picture information, Y signal matrix, functional blocks of TV receiver, Video detector and amplifier, sound IF section, synch separator, Vertical synch integrator, horizontal sync, Producing luminance image in colour TV receiver, Chroma section, colour killer circuit. Colour TV standards, digital TV fundamentals.

TEXTBOOKS/REFERENCES

1. Louis E Frenzel, Communication Electronics: Principles and Applications, 3/e, McGraw Hill Int. Singapore, 2001.
2. George Kennedy, Bernard Davis, Electronic Communication Systems, 4/e, Tata McGraw Hill, 2000.
3. Bernard Grob, Basic Television and Video Systems, 6/e, McGraw Hill, Singapore, 2000.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 340	Communication Network Security	TE	3	0	2	4

UNIT I: DATA ENCRYPTION

Security attacks, Security mechanisms, Symmetric cipher model, Substitution techniques, Steganography, AES structure, Multiple encryption and triple DES,Cipher block chaining model, Pseudorandom number generation using a block cipher.

UNIT II: PUBLIC KEY CRYPTOGRAPHY AND RSA

Principles of public-key cryptosystems. RSA algorithm, EIGamal., Cryptosystem, Elliptic curve cryptography, Pseudorandom number generation based on an asymmetric cypher.

UNIT III: CRYPTOGRAPHIC DATA INTEGRITY ALGORITHMS

Cryptographic hash functions and its applications, Hash functions based on cipher block chaining, Secure hash algorithm, Message authentication functions and message authentication codes, Security of MACs, HMAC, DAA, CMAC, Authenticated encryption, Pseudorandom number generation using hash function and MACs.

UNIT IV: TRANSPORT LAYER SECURITY

Web security issues, Secure sockets layer, Transport layer security, HTTPS, IEEE wireless LAN security, Wireless transport layer security, WAP end-to-end security.

UNIT V: IP SECURITY

IP security overview, IP security policy, encapsulating security pay load, Combining security associations, Internet key exchange, Cryptographic suites.

TEXTBOOKS/REFERENCES

1. David Salomon, Elements of Computer Security, 1/e, Springer, 2000.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 331	Digital Design with Verilog	TE	3	0	0	3

UNIT I: INTRODUCTION TO VERILOG

Verilog as HDL, Levels of design description, concurrency, Simulation and synthesis, Functional verification, System tasks, programming language interface (PLI). Module, simulation and synthesis tools. Test benches, Language constructs and conventions.

UNIT II: GATE LEVEL AND BEHAVIORAL MODELING

Introduction, AND gate primitive, Other gate primitives, illustrative examples, Tri-state gates, array of instances of primitives, Design of flip-flops with gate primitives, delays, Strengths and contention resolution, net types, Design of basic circuits, Behavioral modeling: introduction, operations and assignments, Functional bifurcation, initial construct, Always construct, examples, assignments with delays, Wait construct, multiple always blocks, Designs at behavioral level, Blocking and non-blocking assignments, Case, if, assign, repeat.

UNIT III: DATA FLOW LEVEL AND SWITCH LEVEL MODELING

Introduction, continuous assignment structures, Delays and continuous assignments, Assignment to vectors, operators, Switch level modeling: introduction, Basic transistor switches, CMOS switch, Bi-directional gates, time delays with switch primitives, Instantiations with strengths and delays, Strength contention with trireg nets.

UNIT IV: DIGITAL DESIGN WITH STATE MACHINE CHARTS

State machine charts, Derivation of SM charts, Realization of SM charts, Implementation of the dice game, Alternative realizations for SM charts using microprogramming.

UNIT V: DESIGNING WITH FPGAS AND CPLDS

Xilinx 3000 Series FPGAs, Designing with FPGAs, using a one-hot state assignment, Altera complex programmable logic devices (CPLDs), Altera FLEX 10K Series CPLDs, Verilog Models: Static RAM memory, A simplified 486 bus model, Interfacing memory to a microprocessor bus, UART design.

TEXTBOOKS/REFERENCES

1. T.R. Padmanabhan, B. Bala Tripura Sundari, Design through Verilog HDL, Wiley Student Edition, 2004.
2. Stephen. Brown, ZvonkoVranesic, Fundamentals of Logic Design with Verilog, 3/e, Tata McGraw Hill, 2005.
3. Michael D. Ciletti, Advanced Digital Design with Verilog HDL, Prentice Hall of India, 2005.
4. J. Bhaskar, A Verilog Primer, BS Publications, 2003.
5. Charles H Roth, Lizy Kurian John, Digital Systems Design using VHDL, 2/e, Cengage Learning, 2012.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 332	Digital System Design	OE	3	0	0	3

UNIT I: REVIEW OF LOGIC DESIGN FUNDAMENTALS

Combinational logic, Boolean algebra and algebraic simplification, Karnaugh maps, Designing with NAND and NOR gates, Hazards in combinational circuits, Flip-flops and latches, Mealy sequential circuit design, Design of a Moore sequential circuit, Sequential circuit timing.

UNIT II: INTRODUCTION TO VHDL

Computer-Aided design, Hardware Description Languages, VHDL description of combinational circuits, VHDL modules, sequential statements and VHDL processes, Modeling flip-flops using VHDL processes, Processes using wait statements, Transport and inertial delays, VHDL data types and operators, VHDL libraries.

UNIT III: DESIGN EXAMPLES FOR DIGITAL CIRCUITS

Multiplexers, BCD to 7-segmentdisplay decoder, BCD adder,32-Bit adders, Shift-and-add multiplier, Array multiplier, Modeling registers and counters using VHDL processes.

UNIT IV: INTRODUCTION TO PROGRAMMABLE LOGIC DEVICES

Brief overview of programmable logic devices, Simple programmable logic devices (SPLDs), Complex programmable logic devices (CPLDs), Field-programmable gate arrays (FPGAs), State machine charts, Derivation of SM charts.

UNIT V: DESIGNING WITH FIELD PROGRAMMABLE GATE ARRAYS

Implementing functions in FPGAs, implementing functions using shannon's decomposition, Carry chains in FPGAs, Cascade chains in FPGAs, FPGAs and one-hot state assignment, FPGA capacity: Maximum gates versus usable gates, Design translation (Synthesis), Mapping, placement, routing.

TEXTBOOKS/REFERENCES

1. Charles H. Roth Jr., Lizy Kurian John, Digital System Design using VHDL, 2/e, Cengage Learning, 2008.
2. Stephen Brown and ZvonkoVranesic, Fundamentals of Digital Logic with VHDL Design, 3/e, McGraw-Hill Higher Education, 2008.
3. S.Trimberger, Field Programmable Gate Array Technology, 1/e, Kluwer Academic Publications, 1994.
4. J. Bhasker, A VHDL Primer, 3/e, Prentice Hall of India, 2009.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 333	DSP Processors and Architectures	OE	3	0	0	3

UNIT I: COMPUTATIONAL ACCURACY IN DSP IMPLEMENTATIONS

Number formats for signals and coefficients in DSP systems, Dynamic range and precision, Sources of error in DSP implementations, A/D conversion errors, DSP computational errors, D/A conversion errors, Compensating filter.

UNIT II: ARCHITECTURES FOR PROGRAMMABLE DSP DEVICES

Basic architectural features, DSP computational building blocks, Bus architecture and memory, Data addressing capabilities, Address generation module, Programmability and program execution, Speed issues, Features for external interfacing.

UNIT III: EXECUTION CONTROL AND PIPELINING

Hardware looping, interrupts, stacks, Relative branch support, pipelining and performance, Pipeline depth, interlocking, branching effects, Interrupt effects, pipeline programming models, Programmable Digital Signal Processors: Commercial digital signal-processing devices, Data addressing modes of TMS320C54XX processors, Memory space, program control, Instructions and programming, On-chip peripherals, interrupts and pipeline operation of TMS320C54XX processors.

UNIT IV: IMPLEMENTATIONS OF BASIC DSP ALGORITHMS

The Q-notation, FIR filters, IIR filters, interpolation filters, decimation filters, PID controller, adaptive filters, 2-D signal processing, An FFT algorithm for DFT computation, A butterfly computation, Overflow and scaling, Bit- reversed index generation, An 8-point FFT implementation on the TMS320C54XX, computation of the signal spectrum.

UNIT V: INTERFACING MEMORY AND I/O PERIPHERALS TO PROGRAMMABLE DSP DEVICES

Memory space organization, External bus interfacing signals, Memory interface, parallel I/O interface, Programmed I/O, interrupts and I/O, Direct memory access (DMA), A multichannel buffered serial port (McBSP), McBSP programming, CODEC interface circuit, COURSE CODEC programming, A COURSE CODEC-DSP interface example.

TEXTBOOKS/REFERENCES

1. Avtar Singh, S. Srinivasan, Digital Signal Processing, Cengage Learning, 2.
2. Phil Lapsley, DSP Processor Fundamentals: Architectures and Features, IEEE Press, 1997.
3. Sen M. Kuo, Real-Time Digital Signal Processing, 2/e, Wiley Student Edition, 2010.
4. B. Venkata Ramani, M. Bhaskar, Digital Signal Processors, Architecture, Programming and Applications, Tata Mc Graw Hill, 2004.
5. Jonatham Stein, Digital Signal Processing, Wiley Student Edition, 2005.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 334	EMI and EMC Techniques	OE	3	0	0	3

UNIT I: INTRODUCTION, NATURAL AND NUCLEAR SOURCES OF EMI / EMC
Electromagnetic environment, History, concepts, Practical experiences and concerns, Frequency spectrum conservations, An overview of EMI / EMC, Natural and nuclear sources of EMI.

UNIT II: EMI FROM APPARATUS, CIRCUITS AND OPEN AREA TEST SITES
Electromagnetic emissions, Noise from relays and switches, Non-linearities in circuits, Passive inter modulation, Cross talk in transmission lines, Transients in power supply lines, Electromagnetic interference (EMI),Open area test sites and measurements.

UNIT III: RADIATED AND CONDUCTED INTERFERENCE MEASUREMENTS AND ESD
Anechoic chamber, TEM cell, GH TEM Cell, Characterization of conduction currents /voltages, Conducted EM noise on power lines, Conducted EMI from equipment, Immunity to conducted EMI detectors and measurements. ESD, Electrical fast transients/bursts. Electrical surges.

UNIT IV: GROUNDING, SHIELDING, BONDING AND EMI FILTERS
Principles and types of grounding, Shielding and bonding, Characterization of filters, Power lines filter design.

UNIT V: CABLES, CONNECTORS, COMPONENTS AND EMC STANDARDS
EMI suppression cables, EMC connectors, EMC gaskets, Isolation transformers, Opt isolators, National / international EMC standards.

TEXTBOOKS/REFERENCES

1. Kodali, Engineering Electromagnetic Compatibility, 2/e, IEEE Press, 2000.
2. Clayton R Paul, Introduction to Electromagnetic Compatibility, John Wiley and Sons, 2010.
3. Electromagnetic Interference and Compatibility IMPACT series, IIT Delhi. (Modules1- 9).

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 335	Modern Digital Signal processing	OE	3	0	0	3

UNIT I: LINEAR ALGEBRA

Vectors, linear independence, vector spaces and basis vectors, matrices, matrix inverse, the determinant and trace, linear equations, special matrix forms, quadratic and hermitian forms, eigen values and eigen vectors. Discrete Time Random Process: Introduction, Random Variables: Ensemble averages, jointly distributed random variables, joint moments, independent, uncorrelated orthogonal random variables, linear mean square estimation, Gaussian random variables. Random processes: Ensemble averages, Gaussian processes, stationary processes, auto covariance and auto correlation matrices, ergodicity, white noise, power spectrum, filtering random processes, special types of random processes (ARMA, MA, AR Harmonic processes).

UNIT II: OPTIMUM FILTERS

FIR Wiener Filter: Filtering, linear prediction, noise cancellation, lattice representation for the FIR Wiener filter, causal linear prediction.

UNIT III: ADAPTIVE FILTERS

FIR Adaptive Filters: Steepest descent adaptive filter, LMS algorithm, convergence of LMS algorithm, normalized LMS, application: Noise cancellation. Other LMS based adaptive filters, gradient adaptive lattice filter, joint process estimator, channel equalization, adaptive recursive filters. Recursive Least squares: Exponentially weighted RLS, sliding window RLS.

UNIT IV: SPECTRUM ESTIMATION

Non-Parametric Methods: Periodogram, performance of the periodogram, modified periodogram, Bartlett's method: periodogram averaging. Blackman-Tukey approach: periodogram smoothing. Performance comparisons, minimum variance spectrum estimation, maximum entropy method.

UNIT V: SPECTRUM ESTIMATION

Parametric Methods: AR, MA, ARMA spectrum estimation techniques: Frequency estimation: Eigen decomposition of the autocorrelation matrix, Pisarenko harmonic decomposition, music, other eigen decomposition methods. Principal components spectrum estimation: Bartlett frequency estimation, minimum variance frequency estimation, autoregressive frequency estimation.

TEXTBOOKS

1. Monson H. Hayes, Statistical Digital Signal Processing and Modeling, 1/e, Wiley Student Edition, 1996.
2. Proakis, J. Gard, D.G.Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, 4/e, Pearson Education, 2006.

REFERENCES

1. D. G. Manolakis, Vijay Ingle, Statistical and Adaptive Signal Processing, 1/e, Artech Book House, 2009.
2. A.V. Oppenheim, R.W.Schafer, Discrete Time Signal Processing, 2/e, Prentice Hall of India, 1999.
3. S.J. Orfanidis, Optimum Signal Processing, 2/e, McGraw Hill, 1989

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 336	Radar Signal Processing	OE	3	0	0	3

UNIT I: INTRODUCTION

History and applications of radar, basic radar functions, elements of a pulsed radar, signal processing concepts and operations, basic radar signal processing. Sampling and quantization of pulsed radar signals: domains and criteria for sampling radar signals, sampling in the fast time domain, sampling in the slow time: selecting the PRI, sampling the Doppler spectrum, sampling in the spatial and angle dimensions, quantization, I/ Q imbalance and digital I/Q.

UNIT II: RANGE PROCESSING

Introduction, the waveform matched filter, matched filtering of moving targets, the ambiguity function, the pulse burst waveform.

UNIT III: RADAR WAVEFORMS

Frequency modulated pulse compression waveforms, range side lobe control for FM waveforms, the stepped frequency waveform, phase modulated pulse compression waveforms, cost as frequency codes.

UNIT IV: DOPPLER PROCESSING

Alternate forms of the doppler spectrum, moving target indication (MTI), pulse doppler processing, pulse pair processing, additional doppler processing issues, clutter mapping and moving target detector, MTI for moving platforms: Adaptive displaced phase center antenna processing.

UNIT V: DETECTION FUNDAMENTALS

Radar detection as hypothesis testing, threshold detection in coherent systems, threshold detection of radar signals, introduction to CFAR detection, spatial filtering. **Beamforming:** Adaptive beamforming.

TEXTBOOKS/REFERENCES

1. N. Levanon, and E. Mozeson, Radar Signals, 1/e, Wiley-Inderscience, 2004.
2. P. Z. Peebles, Radar Principles, 1/e, Wiley Student Edition, 2004.
3. M. I. Skolnik, Introduction to Radar Systems, 3/e, Tata McGraw Hill, 2001.
4. F. E. Nathanson, Radar Design Principles, 1/e, Prentice Hall India, 1999.
5. Mark A. Richards, Principles of Modern Radar – Basic Principles, Yesdee, 2012

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 341	Radar Systems	OE	3	0	0	3

UNIT I: INTRODUCTION TO RADAR

Radar equation, radar block diagram and operation. Radar frequencies, applications, prediction of range, Minimum detectable signal, receiver noise, Probability density function, false alarm, Signal to noise ratio, integration of radar pulses, Transmitter power, PRF, range ambiguities, Radar antenna parameters, System lossless and propagation effects, Radar cross section of simple targets.

UNIT II: CW RADAR AND FMCW RADAR

Doppler effect, CW radar, Sign of radial velocity, CW radar with non-zero IF receiver, FMCW radar, FMCW altimeter, multiple frequency CW radar, MTI radar- principle, MTI radar with power amplifier and power oscillator transmitter, Delay line cancellers, blind speeds, double cancellation, Staggered PRFs, range gated Doppler filter, Moving target detector, non-coherent MTI-pulse Doppler radar, MTI verses pulse Doppler radar.

UNIT III: TRACKING RADAR

Introduction, Sequential lobbing, Conical scanning, mono pulse tracking radar, Phase comparison mono pulse, Low range tracking, comparison of trackers, Tracking in range.

UNIT IV: RADAR RECEIVER AND MATCHED FILTER

Radar receiver, receiver noise, noise figure, Duplexers, radar displays, receiver protectors, Matched filter receiver, derivation of the matched filter frequency response, Output signal from matched filter, Matched filter from non-white noise, Detection criterion, I-Q detector, Special Purpose Radars-Synthetic aperture radar (SAR), Phased array radars, MST radar, ECM, and ECCM.

UNIT V: RADAR NAVIGATIONAL AIDS

Navigational Aids: Direction Finder, VOR, ILS and Hyperbolic Navigation Loran, Decca, Omega. Introduction to the Radar Clutter, Surface clutter radar equation, Sea clutter, detection of targets in clutter.

TEXTBBOOKS/REFERENCES

1. MerillSkolnik, Introduction to Radar Systems, 3/e, Tata McGraw Hill, 2001.
2. Laurie Tetley and David Calcutt, Electronic Navigation Systems, 3/e Butterworth Heinemann Publishers, 2010.
3. Byron Edde, Radar: Principles, Technology, Applications,1/e, Pearson Education, 1993.
4. Simon Kingsley, Shaun Quegan, Understanding Radar Systems, 1/e, SciTech, 1999.
5. M A Richards, J A Scheer, W. A. Holm, Principles of Modern Radar-Basic Principles, 1/e, Yesdee, 2010.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 337	Speech Processing	OE	3	0	0	3

UNIT I: INTRODUCTION

Speech signal, signal processing, digital speech processing. **Digital Models for Speech Signals:** Process of speech production, acoustic theory of speech production, lossless tube models, digital models for speech signals, hearing and auditory perception.

UNIT II: TIME-DOMAIN METHODS FOR SPEECH PROCESSING

Time-dependent processing of speech, short-time energy and average magnitude, short-time average zero-crossing rate, speech vs. silence discrimination, pitch period estimation using the autocorrelation function. **Digital Representation of the Speech Waveform:** Instantaneous quantization, adaptive quantization, general theory of differential quantization, delta modulation, differential PCM, comparison of systems.

UNIT III: SHORT-TIME FOURIER ANALYSIS

Fourier transform interpretation, linear filtering interpretation, filter-bank summation method of short-time synthesis, spectrographic displays, analysis-synthesis systems. **Homomorphic Speech Processing:** Homomorphic systems for convolution, complex cepstrum of speech, pitch detection, formant estimation, homomorphic vocoder.

UNIT IV: LINEAR PREDICTIVE CODING OF SPEECH

Basic principles of linear predictive analysis, computation of the gain for the model, solution of the LPC equations, relations between the various speech parameters, synthesis of speech from linear predictive parameters, applications of LPC parameters.

UNIT V: DIGITALSPEECH PROCESSING FOR MAN-MACHINE COMMUNICATIONS BY VOICE

Voice response systems, speaker recognition systems, speech recognition systems. **Speech Enhancement in Noise:** Single channel speech enhancement methods, beamforming with microphone array speech, distortion measurement.

TEXTBOOKS

1. Rabiner L.R., Schafer R.W., Digital Processing of Speech Signals, 1/e, Prentice Hall of India, 1978.

REFERENCES

1. Thomas F. Quatieri, Discrete-Time Speech Signal Processing, Principles and Practice, Pearson Education, 2002.
2. Ian McLaughlin, Applied Speech and Audio Processing with MATLAB examples, Cambridge University Press, 2010.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 338	Statistical Theory of Communication	OE	3	0	0	3

UNIT I

System theory, stochastic processes, representation of stochastic processes, likelihood and sufficiency.

UNIT II: DETECTION THEORY

Hypothesis testing, decision criteria, multiple measurements, multiple hypothesis testing, CFAR detection, Wald's test.

UNIT III: DETECTION OF SIGNALS IN NOISE

Detection of known signals in noise(correlation receiver), detection of known signals in colored noise, detection of known signals in noise (maximum SNR criterion), detection of signals with unknown parameters.

UNIT IV: ESTIMATION THEORY

Estimation of parameters, random parameters(Bayesian estimates), estimation of non-random parameters, properties of estimators, linear mean-square estimation.

UNIT V: ESTIMATION OF WAVEFORMS

Linear MMSE estimation of waveforms, estimation of stationary processes (Weiner filter), estimation of nonstationary processes (Kalman filter), relationship between Weiner and Kalman filter.

TEXTBOOKS

1. M.D. Srinath, P.K. Rajasekaran, R. Viswanathan, Statistical Signal Processing with Applications, Prentice Hall of India, 1999.

REFERENCES

1. Steven M. Kay, Fundamentals of Statistical Signal Processing – Vol-I Estimation Theory, Pearson Education, 1999.
2. Steven M. Kay, Fundamentals of Statistical Signal Processing – Vol-II Detection Theory, Pearson Education, 2000.
3. H.V. Poor, An Introduction to Signal Detection and Estimation, 2/e, Spring Verlag, 1994.
4. M. Mansuripur, Introduction to Information Theory, Prentice Hall, 1987.
5. John G. Proakis, Dimitris Manolakis, Digital Signal Processing, 4/e, Pearson Education, 2007.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 339	Wireless Networks	OE	3	0	0	3

UNIT I: INTRODUCTION

FDMA, TDMA, spread spectrum, multiple access, SDMA, packet radio, packet radio protocols, CSMA protocols, reservation protocols. **Introduction to Wireless Networks:** Introduction, difference between wireless and fixed telephone networks, development of wireless networks, traffic routing in wireless networks.

UNIT II: WIRELESS DATA SERVICES

CDPD, ARDIS, RMD, common channel signaling, ISDN, BISDN and ATM, SS7, SS7 user part, signaling traffic in SS7. **Mobile IP And Wireless Access Protocol:** Mobile IP, operation of mobile IP, co-located address, registration, tunneling, WAP architecture, overview, WML scripts, WAP service, WAP, session protocol, wireless transaction, wireless datagram protocol.

UNIT III: WIRELESS LAN TECHNOLOGY

Infrared LANs, spread spectrum LANs, narrow bank microwave LANs, IEEE 802 protocol architecture, IEEE 802 architecture and services, 802.11 medium access control, 802.11 physical layer. **Bluetooth:** Overview, radio specification, base band specification, links manager specification, logical link control and adaptation protocol, introduction to WLL technology.

UNIT IV: MOBILE DATA NETWORKS

Introduction, data oriented CDPD network, GPRS and higher data rates, short messaging service in GSM, mobile application protocol.

UNIT V: WIRELESS ATM AND HIPER LAN

Introduction, wireless ATM, HIPERLAN, adhoc networking and WPAN.

TEXTBOOKS

1. William Stallings, Wireless Communication and Networking, 2/e, Pearson Education, 2005.
2. Theodore S. Rappaport, Wireless Communications, Principles and Practice, 2/e, Prentice Hall of India, 2002.

REFERENCES

1. Kaveh Pahlaven, P. Krishna Murthy, Principles of Wireless Networks, 1/e, Pearson Education, 2002.
2. Kamilo Feher, Wireless Digital Communications, 1/e, Prentice Hall of India, 1999

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 417	Hardware Security	OE	3	0	2	4

UNIT I: INTRODUCTION TO HARDWARE SECURITY

Overview and layers of a Computing System, Hardware Security vs. Hardware Trust, Attacks, Vulnerabilities, and Countermeasures, Conflict Between Security and Test/Debug, Quick Overview of Electronic Hardware, System on Chip (SoC) Design and Test, Printed Circuit Board (PCB): Design and Test, Hands-on Experiment: Reverse Engineering Attacks.

UNIT II: HARDWARE ATTACKS: ANALYSIS, EXAMPLES, AND THREAT-I

HARDWARE TROJANS-Hardware Trojan Structure, Modeling and examples, Hardware Trojans in FPGA Designs, Hardware Trojans Taxonomy, Countermeasures Against Hardware Trojans, Hands-on Experiment: Hardware Trojan Attacks, **ELECTRONICS SUPPLY CHAIN-**Security Concerns, Trust Issues, Potential Countermeasures.

UNIT III: HARDWARE ATTACKS: ANALYSIS, EXAMPLES, AND THREAT-II

Hardware IP Piracy and Reverse Engineering: Hardware Intellectual Property (IP), Security Issues in IP-Based SoC Design, Security Issues in FPGA, Hands-on Experiment: Reverse Engineering and Tampering.

Side-Channel Attacks: Background on Side-Channel Attacks, Power Analysis Attacks, Electromagnetic (EM) Side-Channel Attacks, Fault Injection Attacks, Timing Attacks, Hands-on Experiment: Side-Channel Attack.

UNIT IV: COUNTERMEASURES AGAINST HARDWARE ATTACKS-I HARDWARE SECURITY PRIMITIVES

Preliminaries, Common Hardware Security Primitives, **Physical Unclonable Function-**PUF Preliminaries, PUF Classifications, PUF Quality Properties, Common PUF Architectures, PUF Applications, **True Random Number Generator-**TRNG Preliminaries. TRNG Quality Properties, Common TRNG Architectures, TRNG Applications. Design for Anti-Counterfeit, Primitive Designs With Emerging Nano devices. Hands-on Experiment: Hardware Security Primitives (PUFs and TRNGs).

UNIT V: COUNTERMEASURES AGAINST HARDWARE ATTACKS-II

Security and Trust Assessment, and Design for Security, Hardware Obfuscation Methods, PCB Authentication and Integrity Validation, System Level Attacks & Countermeasures.

TEXTBOOKS/REFERENCES

1. Swarup Bhuniaand Mark Tehranipoor, " Hardware Security: A Hands-on Learning Approach", 2019 Elsevier.
2. Debdeep Mukhopadhyay and Rajat Subhra Chakraborty ,"Hardware Security: Design, Threats ,and Safeguards", CRC Press.
3. Ahmad-Reza Sadeghi and David Naccache(eds.):Towards Hardware-intrinsic Security: Theory and Practice, Springer.
4. Ted Huffmire et al:Hand book of FPGA Design Security, Springer.

LIST OF EXPERIMENTS

1. Review of combinational, sequential circuits, fsm design examples in verilog hdl and/or cadence.
2. Design of combinational trojans
3. Design of sequential trojans.
4. Vending machine design or the combinational lock design example, mount any of the hardware trojans.
5. Demonstration of logic obfuscation techniques.
6. Demonstration of dpa attack and counter measures.
7. Puf circuit design and demonstration.
8. Trng circuit design and demonstration.