School of Engineering and Applied Sciences

B. Tech

Electronics and Communication Engineering

AY: 2020-2024

Syllabus

Department of Electronics and Communication Engineering

SRM University-Andhra Pradesh.

Semester-I					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
EGL 101	Communicative English	3	0	0	3
PHY 101	Engineering Physics	3	0	0	3
PHY 101 L	Engineering Physics Lab	0	0	2	1
EEE 111	Electrical Circuit Analysis	3	0	0	3
EEE 111 L	Electrical Circuit Analysis Lab	0	0	2	1
CSE 105	Introduction to Programming Using C	3	0	0	3
CSE 105 L	Introduction to Programming Using C Lab	0	0	2	1
MAT 112	Single Variable Calculus	3	0	0	3
ISES 101	Industry Specific Employability Skills	1	1	0	1
ECE 111	Electronic Workshop-I with Arduino Uno	0	0	2	1
	TOTAL	**16**	**1**	**8**	**20**

Semester-II					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
ISES 102	Industry Specific Employability Skills-II	1	1	0	1
PHY 102	Solid State Device Physics	3	0	0	3
PHY 102 L	Solid State Device Physics Lab	0	0	2	1
CSE 107	Data Structures	3	0	0	3
CSE 107 L	Data Structures Lab	0	0	2	1
ENV 111	Environmental Science	2	0	0	2
ENV 111 L	Environmental Science Lab	0	0	2	1
CHE 101	Principles of Chemistry	2	0	0	2
CHE 101 L	Principles of Chemistry Lab	0	0	2	1
ECO 121	Principles of Economics	3	0	0	3
MAT 121	Multivariable Calculus	3	0	0	3
ECE 123	Electronic Workshop-II with Raspberry PI	0	0	2	1
ECE 122	Introduction to IOT	0	0	2	1
	TOTAL	**17**	**1**	**12**	**23**

Semester-III					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
ECE 210	Control Systems	3	0	0	3
ECE 211	Digital Electronics	2	1	0	3
ECE 211L	Digital Electronics Lab	0	0	2	1
ECE 216	Electronic Circuits	2	1	0	3
ECE 216 L	Electronic Circuits Lab	0	0	2	1
ECE 212	Signals and Systems	2	1	0	3
ECE 212 L	Signals and Systems Lab	0	0	2	1
ISES 201	Industry Specific Employability Skills-III	1	1	0	1
MAT 131	Differential Equations	3	0	0	3
ECE 215	Electronic Workshop-III on PCB Design	0	0	2	1
CSE 230	Industry Standard Coding Practice-1	0	0	4	1
TOTAL		**13**	**4**	**12**	**21**

Semester-IV					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
ISES 202	Industry Specific Employability Skills-IV	1	1	0	1
MAT 211	Linear Algebra	3	0	0	3
ECE 224	Probability and Random variables	3	0	0	3
ECE 221	Analog Electronics	3	0	0	3
ECE 221 L	Analog Electronics 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 207	Java Programming	3	0	0	3
CSE 207 L	Java Programming Lab	0	0	2	1
CSE 330	Industry Standard Coding Practice-2	0	0	4	1
TOTAL		**19**	**2**	**10**	**24**

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 349	Microprocessors and Microcontrollers	3	0	0	3
ECE 349 L	Microprocessors and Microcontrollers Lab	0	0	2	1
ECE 321	Microwave Theory and Applications	3	0	0	3
ECE 321 L	Microwave Theory and Applications Lab	0	0	2	1
ECE 348	Introduction to AI/ML	3	0	0	3
ECE 348 L	Introduction to AI/ML Lab	0	0	2	1
TE ECE 347 ECE 411 ECE 316	**Technical Elective** Numerical Analysis and Algorithms Embedded systems for design **(VLSI, Embedded Specialization)** Information Theory and Coding **(Signal Processing Specialization / Communication Systems Specialization)**	 3 3 3	 1 0 1	 0 2 0	4
ISES 301	Industry Specific Employability Skills-V	1	1	0	0
CSE 331	Industry Standard Coding Practice-3	0	0	4	1
ECE 310	Internship **(Optional)**	0	0	6	3
	TOTAL	**16**	**1/2**	**12/20**	**21/24**

Semester-VI					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
TE	**Technical Elective**				
ECE 328	Satellite Communication	3	0	0	3/4
ECE 329	Optical Communication **(Communication Systems Specialization)**	3	0	0	
ECE 408	Microcontroller Based Design **(VLSI, Embedded Specialization)**	3	0	2	
ECE 430	Convex Optimization **(Signal Processing Specialization)**	3	1	0	
ECE 318	Antenna Arrays and waveguides	3	0	0	3
ECE 318 L	Antenna Arrays and waveguides Lab	0	0	2	1
ECE 320	VLSI Design	3	0	0	3
ECE 320 L	VLSI Design 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 321	Digital Communication	3	0	0	3
ECE 321 L	Digital Communication Lab	0	0	2	1
ISES 302	Industry Specific Employability Skills-VI	1	1	0	0
OE	**Open Elective**	3/3	0/0	0/2	3/4
	TOTAL	**19**	**1/2**	**8/12**	**22/24**

Semester-VII					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
TE	**Technical Elective**				
ECE 409	RTOS	3	0	2	3/4
ECE 326	Radar Engineering	3	0	0	
ENG 321	Multidisciplinary Design Project / UROP	0	0	6	3
TE	**Technical Elective**				
ECE 325	Digital Image Processing **(Signal Processing Specialization)**	3	1	0	4
ECE 407	VLSI Physical Design **(VLSI, Embedded Systems Specialization)**	3	0	2	
ECE 419	Fundamentals of Wireless Communication **(Communication Systems Specialization)**	3	1	0	
TE	**Technical Elective**				
ECE 406	Detection and Estimation Theory **(Signal Processing Specialization)**	3	1	0	3/4
ECE 405	Error Control Coding **(Communication Systems Specialization)**	3	1	0	
ECE 404	CMOS Analog mixed signal Design **(VLSI, Embedded Systems Specialization)**	3	0	2	
ECE 403	Digital Switching and Multiplexing	3	0	0	
OE	Open Elective	3/3	0/0	0/2	3/4
OE	Open Elective	3/3	0/0	0/2	3/4
	TOTAL	**15**	**0/1**	**6/16**	**19/23**

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 Electives					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
ECE 410	Adaptive Signal Processing	3	0	0	3
ECE 343	Biomedical Signal Processing	3	0	2	4
ECE 337	Speech Processing	3	0	0	3
ECE 346	Basics of Wireless Sensor Networks	3	0	0	3
ECE 340	Communication Network Security	3	0	0	3
ECE 407	VLSI Physical Design	3	0	0	3
ECE 344	Design for Test	3	0	0	3
ECE 345	Biomedical Instrumentation	3	0	0	3
ECE 324	Computer Architecture and Organization	3	0	0	3
ECE 417	Hardware Security	3	0	2	4
ECE 428	Machine Learning	3	0	2	4
ECE 416	Network Control System	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 101	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/REFERENCES

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	3	0	0	3

UNIT I: REVIEW OF NEWTONIAN MECHANICS

Introduction to Vector and Coordinate systems, Kinematics: Equations of motion for constant acceleration, Dynamics: Contact forces, Static friction, kinetic friction and worked examples, Free body force diagram; Applications of Newton's law. Worked examples (i.e. pulley, inclined planes), Momentum and Impulse, Impulse momentum theorem, Center of Mass: Calculation of Center of mass for complex systems, Work and Kinetic Energy Theorem, Motion at Inclined Plane, Conservation of linear and angular momenta,worked example (Fly wheel).

UNIT II: WAVES, OSCILLATIONS, OPTICS

Simple harmonic motion: simple pendulum, compound pendulum, Damped and driven harmonic oscillations, Quality factor; electrical equivalent (LCR circuit), Circular motion in analogy of Simple Harmonic Motion, Longitudinal waves, transverse waves; standing waves, Concept of Electromagnetic waves, Optics: Interference, diffraction (qualitative), Double slit interference and concept of coherence length, Polarization of light (qualitative), Concept of Lasers.

UNIT III: CLASSICAL THERMODYNAMICS

Thermodynamic systems and equilibrium: example of ideal gas, Zeroth law of thermodynamics and concept of temperature, First law of thermodynamics, internal energy and specific heat, Second law of thermodynamics, Entropy, reversibility, Application of 1st and 2nd law of thermodynamics, Concept of work and free energies, Concept of Phases: Example of phase transitions, Black body radiation – Stefan's law.

UNIT IV: REVIEW OF ELECTRO-MAGNETISM

Properties of charge and Coulomb's law, calculation of electric field and potential, Gauss's law (differential and integral form) Application of Gauss's law (line, plane, spherical symmetry). Dielectrics from the concept of dipole movements in material, Fields in parallel plate capacitor with dielectric medium, Biot-Savart Law for magnetic fields, Magnetic field (circular loop). Ampere's circuital law, Examples – Infinite wire and Solenoid, Lenz's Law, Faraday's law, Maxwell's equations.

UNIT V: MATERIAL PROPERTIES

States of Matter: Solid, Liquid, Gases and Plasma, Mechanical Properties of solids: linear elasticity (Hooke's Law). Elastic moduli, Shear stress and strain. Rigidity modulus, Moment of Cantilevers: Young's Modulus, Bulk and surface properties of liquid – Adhesion, Cohesion, Surface Tension, Viscosity of liquids, Stoke's equation, Bernoulli's principle (Quantitative).

TEXTBOOKS/REFERENCES

1. University Physics With Modern Physics with Mastering Physics - D Young, Roger A Freedman And Lewis Ford, XII Edition (2018), Publisher – PEARSON.
2. Physics for Scientist and Engineers - Raymond A. Serway, John W. Jewett XIX Edition (2017), Publisher - Cengage India Private Limited.
3. Concept of Modern Physics - Arthur Besier, Shobhit Mahajan, S Rai, 2017 Edition, Publisher - Tata McGraw Hill
4. Introduction to Electrodynamics – David J. Griffiths; 4th Edition (2012), Publisher - PHI Eastern Economy Editions.
5. Electricity and Magnetism - A S Mahajan and AARangwala, Revised of 1Edition (2001), Publisher - McGraw-Hill.
6. Advanced Engineering Mathematics - Erwin Kreyszig, X Edition (2016), 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 thediameter 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-CurveTo study permeability curve of a given material.

SEMESTER-I

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
EEE 111	Electrical Circuit Analysis	ES	3	0	0	3

UNIT I: BASIC CONCEPTS AND DC CIRCUIT ANALYSIS

Nodes, Paths, Loops, Branches, Resistors in Series and Parallel, Ohm's law, Kirchhoff's Laws, Voltage and Current Division, Ideal and Practical Voltage and Current Source, Dependent Voltage and Current Sources, Source Transformations. Nodal Analysis - Presence of independent and dependent voltage and current sources. The Super node - Presence of independent and dependent voltage and current sources, Mesh Analysis - Presence of independent and dependent voltage and current sources, The Super mesh - Presence of independent and dependent voltage and current sources, Network Reduction Technique using Star – Delta Transformation, Illustrative examples.

UNIT II: DC NETWORK THEOREMS

Introduction to Network Theorems and Techniques, Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Maximum Power Transfer Theorem, Reciprocity Theorem, Milliman's Theorems, Illustrative examples.

UNIT-III: TWO PORT NETWORKS

Introduction to Two Port Networks, Impedance Parameters, Admittance Parameters, Transmission Parameters, Illustrative examples.

UNIT IV: 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, Steady State Analysis of RL and RC Series Circuits with Phasor Diagrams, Steady State Analysis of RL and RC Parallel circuits with Phasor Diagrams. Steady State Analysis of RLC Series and Parallel circuits with Phasor Diagrams. Concepts of Resonance, Definitions of Real Power, Reactive Power, Apparent Power and Power Factor, Illustrative examples.

UNIT V: A.C. NETWORK ANALYSIS AND THEOREMS

Kirchhoff's Laws for A.C. Circuits, A.C. Mesh Current Analysis, A.C.Nodal Analysis, Superposition Theorem for A.C. Circuits, Thevenin's Theorem for A.C.Circuits, Norton's Theorem for A.C. Circuits, Maximum Power Transfer Theorem for A.C. Circuits, Illustrative examples.

TEXTBOOKS/REFERENCES

1. William H Hayt, J E Kemmerly and Steven M Durbin, “Engineering Circuit Analysis”, McGraw Hill, 8thEdition, 2011.
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. Fundamentals of Electric Circuits, Charles K. Alexander and Matthew N.O. Sadiku, McGraw Hill Higher Education, Third Edition, 2005.
5. Introductory Circuit Analysis, Robert L. Boylestad, Twelfth edition, Pearson, 2012.

SEMESTER-I

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
EEE 111 L	Electrical Circuit Analysis Lab	ES	0	0	2	1

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.

TEXTBOOKS/REFERENCES

1. William H Hayt, J E Kemmerly and Steven M Durbin, "Engineering Circuit Analysis", McGraw Hill, 8thEdition, 2011.
2. Circuit Theory Analysis and Synthesis, Abhijit Chakrabarti, Dhanpat Rai & Co. 7th Edition, 2017.
3. Fundamentals of Electric Circuits, Charles K. Alexander and Matthew N.O. Sadiku, McGraw Hill Higher Education, Third Edition, 2005.

SEMESTER-I

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
CSE 105	Introduction to Programming using C	ES	3	0	0	3

UNIT I: INTRODUCTION

Computer systems, hardware and software. Problem solving: Algorithm / Pseudo code, flowchart, program development steps, Computer languages: Machine, symbolic and high-level languages, Creating and Running Programs: Writing, editing (any editor), compiling (gcc), linking and executing in Linux environment, Structure of a C program, identifiers, Basic data types and sizes. Constants, Variables, Arithmetic, relational and logical operators, increment and decrement operators, Conditional operator, assignment operator, expressions, Type conversions, Conditional Expressions, Precedence and order of evaluation, Sample Programs.

UNIT II: SELECTION & DECISION MAKING

if-else, null else, nested if, examples, Multi-way selection: switch, else-if, examples. **ITERATION:** Loops - while, do-while and for, break, continue. Initialization and updating, event and counter controlled loops and examples. **ARRAYS:** Concepts, declaration, definition, storing and accessing elements, One dimensional, two dimensional and multidimensional arrays, Array operations and examples, Character arrays,String manipulations.

UNIT III: MODULAR PROGRAMMING

Functions – Basics, Parameter passing, Storage classes extern, auto, register, static, scope rules, User defined functions, standard library functions, Passing 1-D arrays, 2-D arrays to functions, Recursive functions - Recursive solutions for Fibonacci series, Towers of Hanoi, C Pre-processor, Header files

UNIT IV: POINTERS

Concepts, initialization of pointer variables, Pointers as function arguments, passing by address, Dangling memory, address arithmetic, Character pointers and functions, Pointers to pointers, Pointers and multi-dimensional arrays, Dynamic memory management functions, Command line arguments,

UNTI V:

Structures - Declaration, definition and initialization of structures, accessing structures, Nested structures, arrays of structures, Structures and functions, pointers to structures, self-referential structures, Unions, Typedef, bit-fields, Program applications, Bit-wise operators: logical, shift, rotation, masks, **FILE HANDLING**: Concept of a file, text files and binary files, formatted I/O, I/O operations and example programs.

TEXTBOOKS/REFERENCES

1. The C programming Language by Dennis Richie and Brian Kernighan.
2. Problem Solving and Program Design in C, Hanly, Koffman, 7th ed, PEARSON.
3. Programming in C, Second Edition Pradip Dey and Manas Ghosh, OXFORD Higher Education.
4. Programming in C, A practical approach Ajay Mittal PEARSON.
5. Programming in C, B. L. Juneja, Anith Seth, Cengage Learning.

SEMESTER-I

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
CSE 105 L	Introduction to Programming using C Lab	ES	0	0	2	1

LIST OF EXPERIMENTS

1. Basic C programs
   a. Calculation of the area of triangle.
   b. Find the largest of three numbers using ternary operator.
   c. Swap two numbers without using a temporary variable.
   d. Find the roots of a quadratic equation.
   e. Takes two integer operands and one operator form the user, performs the operation and then prints the result.

2. a. Find the sum of individual digits of a positive integer and find the reverse of the given number
   b. Generate the first n terms of Fibonacci sequence.
   c. Generate all the prime numbers between 1 and n, where n is a value supplied by the user.
   d. Print the multiplication table of a given number n up to a given value, where n is entered by the user.
   e. Decimal number to binary conversion.
   f. Check whether the given number is Armstrong number or not.

3. a. Interchange the largest and smallest numbers in the array.
   b. Sorting array elements.
   c. Addition and multiplication of 2 matrices.

4. a. Function to find both the largest and smallest number of an array of integers.
   b. Liner search.
   c. Replace a character of string either from beginning or ending or at a specified location.

5. a. Reading a complex number
   b. Writing a complex number.
   c. Addition of two complex numbers.
   d. Multiplication of two complex numbers.

6. a. Concatenate two strings.
   b. Append a string to another string.
   c. Compare two strings.
   d. Length of a string.
   e.Find whether a given string is palindrome or not.

7. a. Illustrate call by value and call by reference.
   b. Reverse a string using pointers.

c. Compare two arrays using pointers.

8. a. To find the factorial of a given integer.
   b. To find the GCD (greatest common divisor) of two given integers.
   c. Towers of Hanoi.
9. File Operations (File copy, Word, line and character count in a file).
10. Command line arguments (Merge two files using command line arguments).

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
ISES 101	Industry Standard Employability Skills	HS	1	1	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/REFERENCES

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-I

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 111	Electronic Workshop-I with Arduino Uno	C	1	1	0	1

LIST OF EXPERIMENTS

1. Introduction to Arduino Uno, Nano, Mega and Programming.
2. Arduino and LED, LCD displays.
3. Arduino and Digital Input/Output Devices.
4. Arduino and Analog Devices-I.
5. Arduino and Analog Devices-II.
6. Arduino and Motors/Actuators.
7. Arduino and Wireless Communication.
8. Mini project.
9. Mini project.
10. Mini project.

TEXTBOOKS/REFERENCES

1. Rajesh Singh, Anita Gehlot, and Bhupendra Singh, "Arduino-Based Embedded Systems: Interfacing, Simulation, and LabVIEW GUI ", Taylor and Francis, CRC press, 2018.
2. Jeremy Blum, "EXPLORINGARDUINO®: Tools and Techniques for Engineering Wizardry", Wiley 2nd Edition, 2020.

SEMESTER-II

SEMESTER-II

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ISES 102	Industry Specific Employability Skills-II	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 Allegation, 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/REFERENCES

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-II

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
PHY 102	Solid State Device Physics	BS	3	0	0	3

UNIT I: QUANTUM MECHANICS AND APPLICATION

Light as particle: Photoelectric effect, idea of photon, Wave particle duality Matter waves - De Broglie hypothesis, Postulates of quantum mechanics, Wave function and its physical interpretation, Heisenberg's uncertainty principle-qualitative discussion, Schrodinger's equation, Probability current density, Equation of continuity, and its physical significance, Free particle, Particle in infinitely deep potential well (one - dimension), Step potential, Potential barrier (Qualitative discussion). Particle in three-dimensional rigid box. Barrier penetration and tunneling effect.

UNIT II: ENERGY BANDS AND CHARGE CARRIERS IN SEMICONDUCTORS

Crystal Lattices, Periodic Structures Cubic Lattices its plane and directions, Energy bands: Metals - semiconductors and insulators, direct and indirect semiconductors. Electrons and holes- intrinsic and extrinsic material, Doped materials - n-type material and p-type semiconductor material, Electrons and holes in Quantum wells, The Fermi Level, Electron and hole concentrations at equilibrium, Temperature dependence of carrier concentrations, Electrical conductivity and mobility, Drift and resistance, Effects of temperature and doping on mobility, High-Field effects, The Hall effect, Carrier Lifetime- Direct recombination, Indirect recombination; Trapping. Invariance of the Fermi Level at equilibrium.

UNIT III: EXCESS CARRIERS IN SEMICONDUCTORS

Diffusion and drift of Carriers, Built-in electric Fields, Diffusion and recombination, The continuity equation, Steady state carrier injection; Diffusion length, Fabrication of p-n Junctions, Equilibrium condition of p-n Junctions, the Contact potential, Equilibrium Fermi levels, Space charge and capacitance of p-n a junction. Qualitative description of current flow at a forward biased p-n junctions Carrier injection from metal contact. Reverse-biased p-n junctions; Steady state conditions. Zener breakdown and Avalanche breakdown, Voltage rectifiers. Metal–Semiconductor Junctions: Schottky Barriers, Rectifying Contacts, Ohmic Contacts.

UNIT IV: TRANSISTORS

Bipolar Junction and Field Effect Transistor Operation – (BJT and FET) The Load Line, amplification and Switching, The Junction fabrication BJT and FET, The Metal–Semiconductor FET, The Metal–Insulator–Semiconductor FET Basic Operation and Fabrication, The Ideal MOS Capacitor, MOS capacitance–voltage Analysis, Time-dependent capacitance measurements, Current–voltage characteristics of MOS Gate Oxides, MOS Field-effect Transistor - Output characteristics, Transfer characteristics. Short channel

MOSFET I–V characteristics, Equivalent circuit for the MOSFET. Frequency Limitations of Transistors.

UNIT V: OPTOELECTRONIC DEVICES

Steady State Carrier Generation; Quasi-Fermi Levels, Photoconductive devices, Current and voltage in an illuminated p-n junction, Solar Cells and Photodetectors, Light-emitting diodes, Metastable state, Population inversion and Einstein's A and B coefficient, Basic of semiconductor laser, Population Inversion at a Junction, Emission Spectra for p-n junction Lasers, Materials for Semiconductor Lasers, Fabrications, Heterojunction Lasers.

TEXTBOOKS/REFERENCES

1. Solid State Electronic Devices - Ben G. Streetman and Sanjay Kumar Banerjee, VII Edition (2015), Publisher – PEARSON.
2. Semiconductor Physics and Devices - Donald A. Neamen, DhrubesBiswas,V Edition (2012), Publisher –Mc Graw Hill (Indian).
3. Concept of Modern Physics - Arthur Besier, Shobhit Mahajan, S Rai, 2017 Edition, Publisher - Tata McGraw Hill
4. Optics - Ajay Ghatak, Fifth Edition (2010), Publisher - Mcgraw Hill
5. Fiber optics and Lasers: The two revolutions - A. Ghatak, K. Tyagarajan (2006) Publisher –Macmillan.

SEMESTER-II

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
PHY 102 L	**Solid State Device Physics Lab**	**BS**	**0**	**0**	**2**	**1**

LIST OF EXPERIMENTS

1. Measurement of Planck's constant by Cs photocell.
2. To record the Franck-Hertz characteristic curve for neon emission.
3. Determine charge carrier type and concentration of a given semiconductor using Hall Effect.
4. Four-probe Resistivity Measurement
5. Circuit Simulation Tutorials for p-n diodes (LTspice)
6. Circuit Simulation Tutorials for Zener diodes (LTspice)
7. Circuit Simulation Tutorials for Bipolar Junction Transistor (LTspice)
8. Circuit Simulation Tutorials for MOSFET (LTspice)
9. Determination of the beam quality factor (M-parameter) of a given semiconductor laser
10. To determine the wavelength of a given semiconductor laser lights withthe diffraction patterns by single slit and double slit.
11. **a.** To measure the photo current as a function of the irradiance at constant voltage.
    b. Current-voltage and current-load characteristics of a solar cell as a function of the irradiance.
12. To determine the wavelength of a semiconductor laser using the Michelson interferometer.
13. **a.** Determination the wavelength of He-Ne laser using diffraction grating.
    b. Determination the particle size of a given powder.

TEXTBOOKS/REFERENCES

1. Physics for Scientist and Engineers, Ninth edition (2017) - Raymond A. Serway, John W. Jewett (Publisher - Cengage India Private Limited)
2. Physics laboratory manuals.

SEMESTER-II

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
CSE 107	Data Structures	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 & Algorithms” Tata McGraw Hill.

SEMESTER-II

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
CSE 107 L	Data Structures 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	BS	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.

REFERENCES

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	BS	0	0	2	1

LIST OF LAB 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	Principles of 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 acid base 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	Principles of 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
ECO 121	Principles of Economics	HS	3	0	0	3

UNIT I: INTRODUCTION TO ECONOMICS

Nature and scope of Economics, Principles of Economics, Production Possibility Frontier. Opportunity Costs, Comparative Advantage and Scope for Trade, Demand and Supply curves, Equilibrium, Shift in curve versus movement along the curve, Elasticity of Demand and Supply, Changes in equilibrium in response to policy changes, income, tastes, and supply "shocks"

UNIT II: CONSUMER BEHAVIOR

Consumer preferences and Indifference curve analysis – substitution, Income, and price effect.

UNIT III: PRODUCTION AND COST

Production, Short- run production function and returns to factor – Average-marginal relationship, long – run production function and laws of return to scale- role of technology, Cost function and cost structure of a firm in the short- run, Long run cost function and cost structure.

UNIT IV: TYPES OF MARKETS

Perfect competition including shut-down and break-even points, Monopoly, Monopolistic competition and product differentiation.

UNIT V: EQUILIBRIUM IN THE SHORT, MEDIUM AND LONG RUN

Short-run equilibrium: The Goods market, The money market and General equilibrium (IS-LM) Medium-run equilibrium: The labour market General Equilibrium, (AD-AS)Long-run equilibrium: Introduction to growth, Capital accumulation and growth, Technological progress and growth.

UNIT VI: THE OPEN ECONOMY (INTERNATIONAL TRADE)

Openness in goods and financial markets, the goods market, the financial markets and General equilibrium, Exchange rate regime.

TEXTBOOKS/REFERENCES

1. Principles of microeconomics, N. Gregory Mankiw, Publisher: Cengage Learning fifth edition.
2. Macroeconomics, Oliver Blanchard and David R Johnson, Publisher: Pearson; 6^{th}edition
3. Intermediate Microeconomics: A Modern Approach, Hal R. Varian, Affiliated East-West Press Pvt. Ltd., 8^{th}edition.
4. Principles of Macroeconomics with Course Mate, N. Gregory Mankiw, Cengage India, 6^{th} edition.

SEMESTER-II

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 123	Electronic Workshop-II with Raspberry PI	C	0	0	2	1

LIST OF EXPERIMENTS

1. Introduction to Raspberry Pi and Open-Source physical computing.
2. Wireless Sensor Networks.
3. Internet programming.
4. Familiarization with Arduino/Raspberry Pi and perform necessary software installation.
5. Interface LED/Buzzer with Arduino/Raspberry Pi and write a program to turn ON LED for 1 sec after every 2 sec.
6. To interface Push button/Digital sensor (IR/LDR) with Arduino/Raspberry Pi and write a program to turn ON LED when push button is pressed or at sensor detection.
7. To interface DHT11 sensor with Arduino/Raspberry Pi and write a program to print temperature and humidity readings.
8. To Interface motor using relay with Arduino/Raspberry Pi and write a program to turn ON motor when push button is pressed.
9. To interface Bluetooth with Arduino/Raspberry Pi and write a program to send sensor data to smartphone using Bluetooth.
10. Write a program on Arduino/Raspberry Pi to upload temperature and humidity data to think speak cloud.
11. Write a program to create UDP server on Arduino/Raspberry Pi and respond with humidity data to UDP client when requested.
12. Write a program to create TCP server on Arduino/Raspberry Pi and respond with humidity data to TCP client when requested.

TEXTBOOKS/REFERENCES

1. Raspberry lab manuals.
2. https://www.cisco.com/c/en/us/support/docs/smb/routers/cisco-rv-series-small-business-routers/smb5832-how-to-create-a-basic-voice-network-using-raspberry-pi.html
3. https://beej.us/guide/bgnet/
4. Yuktix WSN Lab Manual.

SEMESTER-II

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 122	Introduction to IoT	C	0	0	2	1

LIST OF EXPERIMENTS

1. Introduction to Cisco Packet Tracer.
2. Building a smart home and monitoring it using Packet Tracer.
3. Setting up a network and configuring wireless security using Packet Tracer.
4. Arduino Toolchain, Cross-compilation, UART communication protocol to gain observability and controllability.
5. Building a demo Music System, Introduction to I2C communications and Master-Slave Operations.
6. Arduino and Ethernet Shields – demo Ethernet and WiFi shield.
7. Python on Raspberry Pi, Graphic User Interface, TkinterLibrary and Interaction.
8. Interaction with online services through the use of public APIs and SDKs using Pi and Python.
9. Explore the use of the Raspberry Pi camera module and the use of a servo.
10. Mini Capstone Project.

TEXTBOOKS/REFERENCES

1. Hakima Chaouchi, "The Internet of Things - Connecting Objects to the Web", John Wiley and Sons Inc., 2010.
2. Ammar Rayes and Samer Salam, "Internet of Things from Hype to Reality - The Road to Digitization", Springer, Second Edition.
3. Cisco Networking Academy.
4. www.arduino.cc
5. www.raspberrypi.org

SEMESTER-III

SEMESTER-III

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 210	Control Systems	C	3	0	0	3

UNIT I: INTRODUCTION TO CONTROL SYSTEMS

Concept of feedback and Automatic control, Effects of feedback, Objectives of control system, Types of Control Systems, Definition of linear and nonlinear systems, Mathematical modelling of Physical Systems –Mechanical Systems, Electrical Systems, Electromechanical systems, Analogous Systems, Transfer function concept, Properties of Transfer function, Block diagram representation of closed loop systems, Block diagram algebra, Signal Flow graphs, Mason's gain formula.

UNIT II: TIME RESPONSE OF FEEDBACK CONTROL SYSTEMS

Need of test signals, Standard test signals, Step response of First Order Systems and its time domain specifications, Step response of Second Order Systems and its time domain analysis-Concept of undamped natural frequency. damping, overshoot, rise time and settling time. Dependence of time domain performance parameters on natural frequency and damping ratio. Effects of Pole and Zeros on transient response, pole dominance, approximation of higher order systems, Error Analysis-Steady state errors in control systems due to step, ramp and parabolic inputs. Concepts of system types and error constants.

UNIT III: STABILITY ANALYSIS

Concepts of stability, Necessary conditions for Stability, Routh stability criterion. Relative stability analysis, Routh stability criterion, Introduction to Root-Locus Techniques. The root locus concepts, Construction of root loci. Introduction to lead. lag and lead-lag compensating networks, compensator design with Root locus.

UNIT IV: FREQUENCY DOMAIN ANALYSIS AND STABILITY

Correlation between time and frequency response, Introduction to polar and inverse polar plots, Nyquist stability criterion, Assessment of relative stability: gain margin and phase margin, Bode Plots, Determination of stability with Bode plots, Experimental determination of transfer function, Compensator design with Bode plots.

UNIT V: CONTROLLER DESIGN

Introduction to Controllers, Properties of Controller, Classification of Controllers, Proportional Control Mode, Integral Control Mode, Derivative Control Mode, Proportional-integral (PI) controller, Proportional-derivative (PD) controller, Proportional-integral-derivative (PID) controller, Tuning rules of Ziegler-Nichols method.

TEXTBOOKS/REFERENCES

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

SEMESTER-III

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 211	Digital Electronics	C	2	1	0	3

UNIT I: DIGITAL FUNDAMENTALS

Number System, Basic logic gates. Boolean algebra, De Morgan's laws, 1's and 2's complements, Minterms and Maxterms, Sum of products and product of sums, Introduction to Karnaugh maps (up to 4 variable) Codes – Binary. BCD, Excess 3. Gray, Alphanumeric codes, Prime Implicants. Essential Prime Implicants.

UNIT II: COMBINATIONAL CIRCUIT DESIGN

Half Adder & Full Adder, Half Subtractor & Full Subtractor, Binary Parallel Adder, Carry look ahead adder, BCD Adder, Encoder, Priority Encoder, Decoder, Multiplexer, Demultiplexer, Magnitude Comparator.

UNIT III: SYNCHRONOUS SEQUENTIAL CIRCUITS

Latches, Flip flops – SR, JK, T, D. Master/Slave FF, operation and excitation tables. Triggering of FF, Analysis and design of clocked synchronous sequential circuits, Design – Moore/Mealy models. State minimization, State assignment, Circuit implementation – Design of Counters, Ripple Counters, Ring Counters, Johnson Counters, Shift Registers, Universal Shift Register. Asynchronous sequential circuits, brief introduction, operation of asynchronous up/down counter.

UNIT IV: 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.

UNIT V: DIGITAL IC FAMILIES

Introduction to Digital Integrated Circuits, Diode- logic (DL) Diode-transistor logic (DTL), Resistor, transistor logic (RTL), Transistor-transistor logic (TTL), Emitter-coupled logic (ECL), Metal-oxide semiconductor (MOS), Complementary Metal-oxide semiconductor (CMOS) their operation and comparison.

TEXTBOOKS/REFERENCES

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”, 7th 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.
8. Anil K. Maini, “Digital Electronics”, Wiley, 2014.

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 216	Electronic Circuits	C	2	1	0	3

UNIT I: CIRCUIT APPLICATIONS with PN JUNCTION DIODEs

Review of Ohm's Law, KCL, KVL, Diode small signal equivalent circuits, Load-Line Analysis, Series and Parallel Diode Configurations, Diode based Logic Gates, Halfwave and Fullwave rectifier circuits with and without Filters, Clippers, Clampers.

UNIT II: BJT BIASING AND SINGLE STAGE AMPLIFIERS

Review of BJT Device Structure and Physical Operation, BJT Current Voltage characteristics, BJT Circuits at DC, Amplifier Basic Principles, Circuit Models for Amplifiers, Introduction to Frequency Response of Amplifiers, Small Signal Models for BJT, BJT Biasing and stability, Analysis of CE,CB, CC Amplifiers.

UNIT III: MOSFET BIASING AND SINGLE STAGE AMPLIFIERS

MOSFET Device Structure and Physical Operation, MOSFET Current Voltage characteristics, MOSFETS Circuits at DC, MOSFET Biasing and stability, Small Signal models for MOSFET, Analysis of CG,CS,CD Amplifiers.

UNIT IV: DIFFERENTIAL AMPLIFIERS AND OPERATIONAL AMPLIFIERS

MOS Current Mirror, Analysis of MOS Differential Pair, Common Mode Rejection Ratio, DC Offset, MOS Differential Amplifier with current mirror load, Op-Amp Introduction, Ideal characteristics, Inverting Amplifier and analysis, Non-Inverting Amplifier and analysis, Summing Amplifier, Buffer, Integrator, Differentiator, DC imperfections.

UNIT V: MULTI-STAGE AMPLIFIERS AND FREQUENCY RESPONSE OF SINGLE STAGE AMPLIFIERS

Cascading of Amplifiers, Low frequency response of CS amplifier, High frequency response of CS amplifier, Millers Theorem, High frequency response of CMOS Differential Amplifier.

TEXTBOOKS/REFERENCES

1. Robert L. Boylestad and Louis Nashelsky, Electronic Devices and Circuit Theory", 11th Ed, Pearson Education.
2. HaytKemmerly, and Durbin, Engineering Circuit Analysis, 8th Edition, McGraw Hill.
3. "Integrated Electronics" by Millman and Halkias, 2nd edition, Tata McGraw Hill, ISBN: 9780074622452.
4. Sedra and Smith, Microelectronic Circuits, 7th edition, Oxford University Press.
5. "Electronic devices and circuits" by David A. Bell, 2008 edition, Oxford University Press, ISBN: 9780195693409.
6. "Pulse, Digital and Switching waveforms" by Millman and Taub, 2011 edition, Tata McGraw Hill, ISBN: 9780071072724.
7. Paul Horowitz and Winfield Hill, The Art of Electonics (2nd Edition), Cambridge

University Press.
8. Schaum's Outline of Electronic Devices and Circuits, (Schaum's Outline Series) by Jimmie.
9. Make Electronics – Learning by Discovery by Charles Platt.
10. Practical Electronics for Inventors by Paul Scherz.
11. Monk, Simon Make your own PCBs with EAGLE from schematic designs to finished boards.

SEMESTER-III

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 216 L	Electronic Circuits Lab	C	0	0	2	1

LIST OF EXPERIMENTS

1. Design and Implementation of Diode based Logic Gates.
2. Design and Implementation of Diode Rectifier Circuits.
3. Design and Implementation of Diode Clipper, Clamper Circuits
4. Design and Analysis of BJT CE Fixed, Self Bias Circuits
5. Design and Frequency Analysis of BJT CE Amplifier
6. Design and Analysis of MOSFET CS Self Bias Circuits
7. Design and Frequency Analysis of MOSFET CS Amplifier ad Buffer Circuit
8. Design and Implementation of Op-Amp based Inverting, Non-inverting, Integrator Applications
9. Design and Implementation of Op-Amp based Summing and Difference Amplifier Applications
10. Design and Analysis of Multisim. OrCAD based BJT, MOSFET, Diff.Amp, Op-Amp, Multi-stage Amplifiers

SEMESTER-III

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 212	Signals and Systems	C	2	1	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: FOURIER SERIES AND FOURIER TRANSFORM

Introduction to Fourier series in continuous time domain, properties of Fourier series, Exponential Fourier series, Discrete Fourier series, Introduction to continuous time Fourier Transform, Properties of Fourier transform, CTFT of periodic signals, Discrete time Fourier transform (DTFT) and its properties, DTFT of periodic signals.

UNIT IV: LAPLACE TRANFORM

Introduction to Laplace transform and region of convergence, Properties of Laplace transform, Inverse Laplace transform, Initial and final value theorems.

UNIT V: Z TRANFORM

Introduction to Z-transform and its region of convergence, Properties of Z-transform, Inverse Z-transform, The unilateral Z-transform.

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.

REFERENCES

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. Time period calculation of continuous time signals.
3. Shifting, scaling and reflection of discrete time signals.
4. Energy and power of signals
5. Fourier series representation of periodic signals
6. Convolution between two discrete time signals
7. Finding of Laplace transform
8. Finding of Z-transforms

SEMESTER-III

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ISES 201	Industry Specific Employability Skills-III	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/REFERENCES

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
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 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-III

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
CSE 230	Industry Standard Coding Practice-I	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/REFERENCES

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 202	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/REFERENCES

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 224	Probability and Random Variables	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 Colored, Linear Time Invariant (LTI) systems with random processes as inputs, Noise equivalent bandwidth.

TEXTBOOKS/REFERENCES

1. Probability, Random variables and Stochastic processes – A Papoulis and Unnikrishnan Pillai, 4th Edition, Mc Grahill Publisher.
2. Communication Systems, Simon Haykin, 4th Edition, John Wiley & Sons.
3. Probability and Random Processes for Electric and Computer Engineers, John A Gubner, 1st Edition, CAMBRIDGE University press.
4. Probability theory, Random variables and Random signal principles, Peebles, 4th Edition, TMH.

SEMESTER-IV

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

UNIT I: FEEDBACK AMPLIFIERS

General Feedback structure, Negative feedback, Feedback amplifier types, Stability problem, Frequency compensation.

UNIT II: 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 III: ACTIVE FILTERS AND TUNED AMPLIFIERS

Filter Transmission, Types and specifications, Filter Transfer function, Butterworth and Chebyshev filters, First order and second order Filter functions, SC filters, Gm-C filters, Tuned Amplifiers.

UNIT IV: OUTPUT STAGES AND POWER AMPLIFIERS

Classification of output stages, Class A output stage, Class B output stage, Class C output stage, Class D power amplifiers.

UNIT V: VOLTAGE REFERENCE CIRCUITS AND DATA CONVERTERS

Voltage reference circuits; Power supplies: ripple removal and regulation, Data converters: sample and hold circuits, ADCs and DACs.

TEXTBOOKS/REFERENCES

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.

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
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, DIF 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: 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, Multistage implementation and polyphase implementation of decimation and interpolation, Digital filter banks, applications of multirate signal processing.

TEXTBOOKS/REFERENCES

1. "Discrete-time signal processing" by A. Oppenheim and R. W. Schafer, Pearson, 2014 edition.
2. "Digital Signal Processing" by J. G. Proakis and D. G. Manolakis, 2007 edition, Pearson India.
3. "Signals and Systems" by Oppenheim, Wilsky and Nawab, Prentice Hall, 2nd edition. ISBN: 9780138147570.

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.

SEMESTER-IV

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

UNIT I: Electrostatics and Magnetostatics

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. Waves in general- various parameters of wave, EM wave propagation in lossy dielectric media, Plane wave in lossless dielectric media, Plane waves in free space, Plane waves in good conductors.

UNIT III: 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. Illustrative Problems.

UNIT IV: TRANSMISSION LINES THEORY AND PARAMETERS

Transmission Lines Types, Parameters, Transmission Line Equations, Primary & Secondary Constants, Expressions for Characteristics Impedance, Propagation Constant, Phase and Group Velocities, Infinite Line Concepts. Losslessness /Low Loss Characterization, istortion - Condition for Distortion lessness and Minimum Attenuation, Loading - Types of Loading, Illustrative Problems.

UNITV: IMPEDANCE MATCHING IN HIGH FREQUENCY TRANSMISSION-LINES

Transmission Lines - II: Input Impedance Relations, SC and OC Lines, Reflection Coefficient, VSWR. UHF Lines as Circuits Elements; $\lambda/4$, $\lambda/2$, $\lambda/8$ Lines - Impedance Transformations, Significance of Z_{min} and Z_{max}, Smith Chart, Configuration and Applications, Single and Double Stub Matching, Illustrative Problems.

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 207	Java Programming	ES	3	0	0	3

UNIT I: INTRODUCTION TO JAVA

An Overview of Java - Data types, Variables and Arrays, operators, expressions, Control statements, Classes, Objects, Constructor, Methods, this reference, static keyword, and final keyword, String handling, Compiling using command line argument; Inheritance – Concept, Member access, Abstract Class, Interface, Creating Multilevel hierarchy- super uses, Packages-access specifiers, using final with inheritance, Polymorphism - Compile time Polymorphism, Method overloading. Constructor overloading; Run time polymorphism. Method overriding, Dynamic method dispatch.

UNIT I: EXCEPTION HANDLING & MULTITHREADING

Fundamentals of exception handling, Uncaught exceptions, using try and catch, Multiple catch blocks, Exception types - Introduction to Object class, Exception class hierarchy, Termination or presumptive models, Built-in exceptions, User defined exceptions, Nested try statements, Throw, Throws, and Finally, Multithreading- Differences between thread-based multitasking and process-based multitasking, Java thread model, Thread life cycle, Creating threads, Thread class, Runnable interface, Thread priorities, Synchronizing threads, Inter-thread communication.

UNIT III: STREAM BASED I/O (JAVA.IO)

Java API, The Stream Classes-Byte streams and Character streams, reading console Input and Writing Console Output, File class, Reading and writing Files, Random access file operations, The Console class, Serialization, Enumerations, auto boxing, generics.

UNIT IV: THE COLLECTIONS FRAMEWORK (JAVA.UTIL) & JDBC

Collection's overview, Collection Interfaces, The Collection classes- Array List, Linked List, Hash Set, Tree Set, Priority Queue, Array Deque and other utility classes, Accessing a Collection via an Iterator, using an Iterator, The For-Each alternative, Map Interfaces and Classes, Comparators, Collection algorithms, String Tokenizer. JDBC – What is database, Table, SQL Syntax-Create, Insert, Select, Drop, Alter, Update, Delete, what is JDBC, JDBC Architecture and Components, JDBC Driver Types, Connections, Statements, Result Set.

UNIT V: GUI PROGRAMMING WITH SWING

Introduction - AWT & Swings, MVC architecture, components, containers, Understanding Layout Managers, Flow Layout, Border Layout, Grid Layout, Card Layout, Grid Bag Layout. Event Handling- The Delegation event model- Events, Event sources, Event Listeners, Event classes, Handling mouse and keyboard events, Adapter classes, Inner classes, Anonymous Inner classes. A Simple Swing Application, Applets – Applets and HTML, Security Issues,

Applets and Applications, passing parameters to applets, Creating a Swing Applet, painting in Swing, A Paint example. Exploring Swing Controls- J Label and Image Icon. J Text Field, The Swing Buttons- J Button, J Toggle Button. J Check Box, J Radio Button, J Tabbed Pane. J Scroll Pane, J List, J Combo Box, Swing Menus, Dialogs.

TEXTBOOKS

1. Java The complete reference, 11th edition, Herbert Schildt, McGraw Hill Education (India) Pvt. Ltd.

REFERENCES

1. Understanding Object-Oriented Programming with Java, updated edition, T. Budd, Pearson Education.
2. An Introduction to programming and OO design using Java, J. Nino and F.A. Hosch, John Wiley & sons.
3. Introduction to Java programming, Y. Daniel Liang, Pearson Education.
4. Object Oriented Programming through Java, P. Radha Krishna, and Universities Press.
5. Programming in Java, S. Malhotra, S. Chaudhary, 2nd edition, Oxford Univ. Press.
6. Java Programming and Object-Oriented Application Development, R. A. Johnson, Cengage Learning.

SEMESTER-IV

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
CSE 207	Java Programming	ES	3	0	0	3

LIST OF EXPERIMENTS

1. Declare a class named Teacher. The class will have all the data members as per your convenient. The class will have constructors. Write a function to read the values of the class variables. The values of the variable will be stored in a FILE (text file). The values will be stored in a structured format of your own choice. Further, read the content of the FILE and display the content in an ordered form (First Name, Last Name). Concept learning:
    - FILE manipulation.
    - Use try catch blocks.
    - Use multiple try catch block.
    - Finally statement Try to have your own Exception.
2. Create three classes named Student, Teacher, Parents. Student and Teacher class inherits Thread class and Parent class implements Runnable interface. These three classes have run methods with statements. The task of the teacher class of the first assignment has to be synchronized. Similarly, the other two classes should have run methods with few valid statements under synchronized.
3. Create two classes named Student and Teacher with required data members. Assume that the information about the Student and Teacher is stored in a text file. Read n and m number of Student and Teacher information from the File. Store the information in Array list of type 1Student and Teacher Array List<Student> and A1rray List<Teacher>. Print the information of Teacher who taught OOPS and Maths. Use Iterator and other functions of util in your program.
4. Watch any of the favorite movie of your choice (any language is fine, preferably English). Create a Text file to store at least 10 meaningful dialogs from the movie and store it in a text file. Process the file to remove the stop words (eg. the, is, was, …….) and create another file to have clean text (word).
5. Write a java program to create Hashtable to act as a dictionary for the word collection. The dictionary meaning of the words, including synonyms, etc., has to be displayed.
6. Declare two classes Student and Teacher. The classes will have the data members and constructors as per your convenience. Write a JAVA program, (i) where the Teacher will enter the marks of the all the students in the database. (ii) Once the marks are entered, the student can view the marks.
7. Create GUI for the above program to upload the dialog FILE, clean the FILE. The GUI should take input from the user for invoking the dictionary for displaying dictionary meaning.
8. Declare a class named Teacher. The class will have all the data members as per your convenient. The class will have constructors. Develop a GUI to read the values of the class variables from the keyboard. Use text field to read the values. Use button to store it in a file one by one. The values will be stored in a structured format of your own choice. Have an option in the GUI to search the name of the students by roll number and display the content in the test field.

9. Create two classes named Student and Teacher with required data members. Read the information about the student and teacher using text fields. Use checkbox to choose the option to feed either teacher information or student information. Store the information about the Student and Teacher in a text file. Read n and m number of Student and Teacher information from the File. Show in the GUI about a Teacher who taught two subjects to a section. Develop at least one of the applications (AWT problem) using swing package.
10. Create a Window based applications using various controls to handle subject registration for exams. Have a List Box to display the subject of semesters. Have one more List box having COURSE CODEs. Have a combo box to select the Semester, which will change the list of course and code in the list boxes. Display the subject registered for the examination on the right side of the window.
11. Declare a class named Teacher. The class will have all the data members as per your convenient. The class will have constructors. Develop a GUI to read the values of the class variables from the keyboard. Use text field to read the values. Use button to store it in a file one by one. The values will be stored in a structured format of your own choice. Have an option in the GUI to search the name of the students by roll number and display the content in the test field. Develop at least one of the applications (AWT problem) using swing package.
12. Create a Window based application for displaying your photo album. Create a Frame and Canvas. Change the border, foreground and background colors of canvas and other controls. Have buttons to start the image show, pause the image show and end the image show. Explore the options to play background music.
13. Create a Window application with menu bar and menu. The frame will also have a text area with scroll bar. In the menu, have File related options. Open a file and its content has to be displayed in the text area.
14. Create a GUI using various controls: (i) to upload the marks of all the students presented in a marks.csv or marks.txt file into the database. (ii) to show the marks of the respective student after uploading the marks into the database. Note: Handle the exception, if the file is not present (or) if the marks are not uploaded in the database.
15. Individual Project. Every student should do a project to achieve all the course outcomes. Based on the course outcomes, the project will be evaluated.

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

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; Classification and operation on signals. Exponential and Trigonometric Fourier series – Problem solving and their relation. Fourier Transform, its properties and relevance to Analog Communication. Convolution – A mathematical tool for analysis of LTI systems and a glimpse of real systems, Distortion less transmission, Ideal vs Practical filters.

UNIT II: LINEAR CONTINUOUS WAVE MODULATION

Baseband vs Carrier Communication, Modulation – A necessity or unnecessary complexity, Amplitude modulation (AM) – Generation, Detection – Rectifier Detector, Envelope Detector, Modulation Index, Power Calculations, DSB-SC – Non-Linear Modulator, Switching Modulator, Coherent Detection and its issues; SSB – Advantages and Disadvantages., Hilbert Transform, Phase Shift Method and Weaver's Method, Synchronization issues; VSB Modulation, Filter Design and Application; Frequency Division Multiplexing.

UNIT III: EXPONENTIAL CONTINUOUS WAVE MODULATION

Angle modulation: Interrelation between Frequency modulation (FM) and Phase modulation (PM), Power of Angle modulated wave; Bandwidth Calculation, Narrowband FM (NBFM) and Wideband FM (WBFM), Generation of NBFM; Band pass Limiter, Direct and Indirect methods of FM generation, Demodulation – Various Techniques and Implementations; PLL, Comparison between FM and AM with respect to channel non-linearities and interference effects; Pre-emphasis and De-emphasis Filter; Super heterodyne receivers.

UNIT IV: PERFORMANCE OF ANALOG MODULATION IN PRESENSE OF NOISE

Probability and sample space; Random variables and Probability Functions – Discrete and Continuous random variables, Transformation of random variables; Statistical Averages – Mean, Median, Expectations, Standard Deviation and popular probability distributions; Random process – Ensemble Average, Co-relation Functions, Ergodicity, Stationary and Gaussian Process; Random Signals, Power Spectrum, superposition and modulation; Noise – Thermal, White, Filtered Noise, Noise Equivalent Bandwidth; Baseband Noise – additive noise and Signal-to-Noise Ratio, Band pass Noise – System Models, Quadrature Components, Envelope and Phase, Linear Continuous Wave Modulation with Noise – Analysis; Angle Modulation with Noise, Analysis; Performance comparison between amplitude and angle modulation..

UNIT V: DIGITAL MODULATION

Introduction to sampling theorem, Pulse Amplitude Modulation (PAM), Pulse Width Modulation (PWM), Pulse Position Modulation (PPM), Pulse Detection and Measurement, Pulse Modulation with Noise.

TEXTBOOKS/REFERENCES

1. B. P. Lathi, Z. Ding, “Modern Digital and Analog Communication Systems”, 4th Edition, Oxford University Press, 2017.
2. A. Bruce Carlson, Paul B. Crilly, “Communication Systems: An Introduction to signals and noise in Electrical Communication”, 5th Edition, McGraw-Hill Education.
3. Herbut Taub and Donald L. Schilling, GoutamSaha, “Principles of Communication Systems”,4thEdition, McGraw Hill Education.
4. Simon Haykin, Michael Moher, “Communication Systems”,5th Edition, Wiley Publishers.

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 349	Microprocessors and Microcontrollers	C	3	0	0	3

UNIT I: 8086 MICROPROCESSOR

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 MICROPROCESSOR

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 microprocessor.

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/REFERENCES

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 349 L	Microprocessors and Microcontrollers 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
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, Z0 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.

REFERENCES

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-V

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-V

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 348	Introduction to AI/ML	C	3	0	0	3

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 Back propagation, Evaluation of error-function derivatives, Efficiency of back propagation, 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/REFERENCES

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.

SEMESTER-V

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 348 L	Introduction to AI/ML Lab	C	0	0	2	1

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 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.0
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-V

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 347	Numerical Analysis and Algorithms	TE	3	0	0	3

UNIT I: INTRODUCTION TO SOLUTION OF ALGEBRAIC AND TRANSCENDENTAL EQUATIONS.

Numbers and their implemented accuracy, Computer Implementation of Arithmetic, Foundations of computational Mathematics, Error propagation and its quantification, Derivation of error formula, Bisection and Iteration method, Newton-Raphson method, Algorithms got finding complex roots, Rate of convergence for different methods.

UNIT II: INTERPOLATION

Finite difference schemes, Polynomial Interpolation, Central difference schemes, Gauss forward and backward scheme, Langrange's Interpolation, Newton Divided difference scheme, Hermite's polynomial and interpolation, Newton Divided difference scheme, Stirling's, Bessel's, Everett's scheme.

UNIT III: NUMERICAL INTEGRATION AND DIFFERENTIATION

Idea of Numerical Integration, Trapezoidal scheme, Simpson's 1/3 and 3/8 scheme, Boole's scheme, Waddle's scheme, Comparison of different schemes, Applications to control theory, Stability of schemes, Error quantification for integration schemes.

UNIT IV: SOLUTION OF DIFFERENTIAL EQUATIONS

Picard's Method, Euler's method, Taylor's Method, Runge-Kutta Methods, Predictor Corrector Methods, Automatic Error Quantification, Stability of solutions, Control methods, Robustness issues.

UNIT V: STATISTICAL COMPUTATION

Curve fitting by method of least squares, Fitting of straight lines, polynomials, exponential curves, Set Theory, Data fitting with Cubic splines, Linear and nonlinear regression, Statistical Quality Control methods, Power spectral density, Gaussian and its applications, Heavy Tail.

TEXTBOOKS/REFERENCES

1. Sastry S. S, "Introductory Methods of Numerical Analysis"

SEMESTER-V

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-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/REFERENCES

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
ISES 301	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/REFERENCES

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

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/REFERENCES

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-VI

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 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-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-VI

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 318	Antenna Arrays and Waveguides	C	3	0	0	3

UNIT I: FUNDAMENTAL OF RADIATION

Definition and functions of an antenna, Comparison between an antenna & transmission line, Radio communication link with transmitting antenna and a receiving antenna, Radiation fundamentals, Radiation from a current element, Radiation from quarter wave monopole and half wave dipoles, Derivation for radiation resistance, application of reciprocity, Directional properties of dipole antennas, antenna feeding methods.

UNIT II: ANTENNA PARAMETERS AND DEFINITIONS

Bandwidth, Beam area, beam width- Half-Power Beam width (HPBW)and First Null Beam width(FNBW), Radiation Intensity, Beam Efficiency, Directivity and directive gain, Radiation resistance, Radiation efficiency, Resolution, Antenna aperture-physical and effective apertures, Effective height, transmission formula, antenna field zones.

UNIT III: ARRAYS OF POINT SOURCES

Antenna Arrays: Point Sources - Definition, Pattern, arrays of 2 Isotropic Sources and its different Cases, Principle of Pattern Multiplication, Uniform Linear Arrays - Broadside Arrays, End fire Arrays, EFA with Increased Directivity, Derivation of their Characteristics and Comparison, BSAs with Non- UNIT form Amplitude Distributions - General Considerations and Binomial Arrays, Illustrative Problems.

UNIT IV: TYPES OF ANTENNAS

Loop Antenna, Slot antenna, Micro-strip (Patch) antennas, Yagi Uda, Log periodic antenna, Helical antenna, Horn antenna and Parabolic reflector antenna.

UNIT V: WAVEGUIDES

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 Rectangular wave guides, Bessel's differential equation and Bessel function, TM and TE waves in Circular wave guides, Rectangular and circular cavity Resonators.

TEXTBOOKS/REFERENCES

1. Antenna Theory – C.A. Balanis, John Wiley & Sons, 3rd Ed., 2005.
2. Antennas and Wave Propagation – K.D. Prasad, Satya Prakashan, Tech India Publications, New Delhi.
3. NPTEL lectures on "Antennas" by Prof. Girish Kumar IIT Bombay.

SEMESTER-VI

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 318 L	Antenna Arrays and Waveguides Lab	C	0	0	2	1

LIST OF EXPERIMENTS

1. Radiation Pattern & Gain of Pyramidal Horn Antenna.
2. Study of various microwave antennas.
3. To study simple dipole antenna and to calculate beam-width, front / back ratio, and gain of the antenna.
4. Radiation Pattern & Gain of Yagi-Uda Antenna.
5. Introduction to Waveguides, Signal Sources - Investigation of Rectangular Waveguides.
6. Measurement of S-parameters of E-plane Tee & H-plane Tee.
7. Study the Characteristics Of Magic Tee.
8. Design of Microstrip patch antenna with the help of CST MWS/Ansys HFSS
9. Design, Fabrication and Testing of Microstrip Components.
10. Study of Spectrum Analyzer/Vector Network Analyzer.

SEMESTER-VI

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

UNIT I: MOS TRANSISTOR & SECOND ORDER EFFECTS

Long-Channel I-V Characteristics, C-V Characteristics, Simple MOS Capacitance Models, Detailed MOS Gate Capacitance Model, Detailed MOS Diffusion Capacitance Model, Non-ideal I-V Effects, Mobility Degradation, Velocity Saturation, Channel Length Modulation, Threshold Voltage Effects, Leakage, Temperature & Geometry Dependence.

UNIT II: THE STATIC CMOS INVERTER

CMOS Inverter, The Static Behavior of CMOS Inverter, Switching Threshold Calculation, Noise Margin Estimation, Performance analysis of CMOS Inverter, The Dynamic Behavior of CMOS Inverter, Computing the Capacitances of CMOS Inverter, Propagation Delay Calculation of CMOS Inverter, First-Order Analysis, Propagation Delay, Power, Energy, and Energy-Delay, Dynamic Power Consumption, Static Power Consumption, Analyzing Power Consumption Using SPICE, Technology Scaling & its Impact on the Inverter Metrics.

UNIT III: COMBINATIONAL MOS LOGIC CIRCUITS

Introduction to MOS, MOS Logic Circuits, Depletion nMOS Loads, CMOS Logic Circuits, Complex Logic Circuits, Pass Transistor Logic, Transmission Gate (TG), TG Based Logic Circuits.

UNIT IV: SEQUENTIAL MOS LOGIC CIRCUITS

Introduction to Sequential Logic, Behavior of Bistable Elements, SR Latch Circuit, Clocked Latch, Flip-Flop Circuit, CMOS D-Latch, Edge Triggered Flip-Flop, Edge Triggered D Flip-Flop.

UNIT V: CMOS FABRICATION & LAYOUT

CMOS Inverter Cross-Section, Introduction to Fabrication Process, CMOS Fabrication Process, Layout Design Rules, Gate Layouts, Stick Diagrams.

TEXTBOOKS/REFERENCES

1. Sung-Mo (Steve) Kang, Yusuf Leblebici, “CMOS Digital Integrated Circuits”, 3rd Edition, MHE, 2002, ISBN-10: 0070530777.
2. Neil H. E Weste, David Harris, Ayan Banerjee, “CMOS VLSI Design - A Circuits and Systems Perspective”, 4th Edition, Addison-Wesley, 2010, ISBN 10: 0-321-54774-8.
3. Jan M. Rabaey, AnanthaChandrakasan and BorivojeNikoli, “Digital Integrated Circuits: A Design Perspective”, 2nd Edition, Pearson, 2003, ISBN-10:0130909963.
4. Kamran Eshraghian, Dougles A. Pucknell&SholehEshraghian, “Essentials of VLSI circuits and systems”, 1st Edition, PHI, 2005, ISBN-10: 9788120327726.

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. HDL to realize combinational circuits
9. HDL to realize sequential circuits.
10. Finite State Machine Design.

SEMESTER-VI

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/REFERENCES

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-VI

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-VI

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

UNIT I: ANALOG TO DIGITAL MODULATIONS

Review of Sampling Theorem; Uniform quantization and its noise analysis; non-uniform quantization, A-law, μ-law; PCM – Generation, Reception, Noise Consideration and Bandwidth Requirement; DM – Generation, Reception and Issues; Adaptive modulation techniques, DPCM and ADM; Performance comparison between PCM, DM, DPCM, DPCM and ADM; Time Division Multiplexing – Significance and Example problems, Channel capacity, Channel coding Theorem.

UNIT II: DIGITAL BASEBAND TRANSMISSION

Line Coding – Classification and Significance; Revisit, Power Spectral Density (PSD) and Autocorrelation Calculation; PSD, Calculation and comparison of various line codes; Pulse Shaping – Nyquist's First Criterion for zero Inter Symbol Interference (ISI), Raised Cosine Pulse, Partial Response Signaling, Duo Binary and modified Duo Binary Pulse, Eye pattern and ISI; Scrambling – Working and Significance.

UNIT III: DIGITAL PASSBAND MODULATION

Binary and M-ary Signaling: Features and Classification; Binary Carrier Modulation: ASK, FSK and PSK – PSD, Features, mathematical representation, demodulation – Coherent and Non-Coherent and comparison to Analog Communication; DPSK – Non-Coherent detection substitute for PSK, Encoding and decoding details; Introduction to Signal Space Representation; Binary Carrier Modulation, Signal Space and BER calculations; M-ary Signaling – ASK, FSK, CP-FSK, MSK., GMSK, QPSK, QAM; Comparison between QAM and MPSK.

UNIT IV: OPTIMAL RECEIVER AND MODERN TECHNOLOGY

Optimum Linear Detector – Matched Filter Design, Transfer Function and optimum impulse function derivation, Performance comparison between various baseband signaling schemes and among various passband binary schemes; Communication Techniques, Multiplexing, various methods; Multiple Access Techniques, OFDMA for 4G LTE; Spread Spectrum Communication, Introduction, FHSS – Bluetooth as an application, DSSS – CDMA as an application.

UNIT V: INTRODUCTION TO INFORMATION THEORY

Information & Entropy, Conditional Entropy & Mutual Information; Shannon's Source Coding Theorem, Huffman Coding and Lempel-Ziv Algorithm; Shannon Hartley Theorem for Channel Capacity, Capacity of Binary Symmetric Channel and Binary Erasure Channel; Channel Coding Theorem, Forward Error Correction, Automatic Repeat Request (ARQ), Linear Block Codes and Cyclic Codes – CRC.

TEXTBOOKS/REFERENCES

1. John G. Proakis, “Digital Communications” 4th edition, McGrawHill, 2000.
2. Simon Haykin, “Communication Systems”, 4th edition, Wiley.
3. Robert G. Gallager, “Principles of Digital Communication” Cambridge University Press, 2008.
4. T. M. Cover, J. A. Thomas, “Elements of Information Theory”, 2nd Edition, Wiley Interscience
5. B.P.Lathi and Z.Ding, “Modern Digital and Analog Communication Systems” 4th Edition, Oxford University Press.
6. B. Carlson, P. B. Crilly, “Communication Systems: An Introduction to Signals and Noise in Electrical Communication”, 5th Edition, McGraw Hill Higher Education.

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
ISES 302	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-VII

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/REFERENCES

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
ENG 321	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-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, Haar transform, 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/REFERENCES

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 407	VLSI Physical Design	TE	3	0	2	4

UNIT I: VLSI DESIGN AUTOMATION TOOLS

Algorithms and system design, Structural and logic design. Transistor level design, Layout design, Verification methods, Design management tools.

UNIT II: PHYSICAL DESIGN OVERVIEW

Layout compaction, placement and routing, Design rules, symbolic layout, Applications of compaction, Formulation methods, Algorithms for constrained graph compaction, Circuit representation, Wire length estimation, Placement algorithms, Partitioning algorithms

UNIT III: FLOOR PLANNING AND ROUTING

Floor planning concepts, Shape functions and floor planning sizing, Local routing, Area routing, Channel routing, global routing and its algorithms.

UNIT IV: SIMULATION AND LOGIC SYNTHESIS

Gate level and switch level modeling and simulation, Introduction to combinational logic synthesis, ROBDD principles, Implementation, construction and manipulation, Two level logic synthesis.

UNIT V: HIGH-LEVEL SYNTHESIS

Hardware model for high level synthesis, Internal representation of input algorithms, Allocation, assignment and scheduling, Scheduling algorithms, Aspects of assignment, High level transformations.

TEXTBOOKS/REFERENCES

1. S.H. Gerez, "Algorithms for VLSI Design Automation", John Wiley ,1998.
2. N.A.Sherwani , "Algorithms for VLSI Physical Design Automation", (3/e), Kluwer,1999..
3. S.M. Sait , H. Youssef, "VLSI Physical Design Automation", World scientific, 1999

LIST OF EXPERIMENTS

1. 8-BIT ADDERS/SUBTRACTORS.
2. MULTIPLIERS.
3. Magnitude Comparator.
4. Linear Feedback Shift Register.
5. Universal Shift Register.
6. 3-bit Arbitrary Counter.
7. Sequency Detector.
8. FIFO and LIFO.
9. FSM Model.
10. Processor.

SEMESTER-VII

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 419	Fundamentals of wireless communication	TE	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-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/REFERENCES

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.

SEMESTER-VII

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 406	Detection and Estimation Theory	TE	3	1	0	4

UNIT I: HYPOTHESIS TESTING

Review of Gaussian variables and processes, ReBayes Risk, Minimum Bayes Risk detector, Minimax and Neyman-Pearson testing, Re Receiver operating characteristics, Co Composite hypothesis testing, Generalized likelihood ratio tests.

UNIT II: SIGNAL DETECTION APPLICATIONS

Detection of deterministic signals, Matched filter and its performance, Detection of random signals, Energy detector and its performance, Detection of signals with unknown parameters and Sinusoid detection example, Det Chernoff and related performance bounds.

UNIT III: RANDOM PARAMETER ESTIMATION

Introduction, Bayesian formulation, Minimum mean squared error estimation, MAP estimation, Linear MMSE estimation, Orthogonality principle, Applications to channel estimation problems.

UNIT IV: MINIMUM VARIANCE UNBIASED ESTIMATION

Introduction, MVUE criterion, Finding MVUE, Sufficient statistics, Neyman-fisher factorization, Rao-Blackwell theorem, Cramer-Rao lower bound, Fisher information matrix, Problems in Cramer-Rao lower bound, Fisher information matrix.

UNIT V: NON-RANDOM PARAMETER ESTIMATION

Least squares estimation, Best linear unbiased estimation, Geometric interpretations, Maximum likelihood Estimation, Efficiency and consistency of estimators and asymptotic properties.

TEXTBOOKS

1. H. L. Van Trees, "Detection, Estimation, and Modulation Theory, Part I," John Wiley, 1968. S. M. Kay, "Fundamentals of Statistical Signal Processing: Detection Theory," Prentice Hall, 1998..
2. S. M. Kay, "Fundamentals of Statistical Signal Processing: Estimation Theory," Prentice Hall, 1993.

REFERENCES

1. H. V. Poor, "An Introduction to Signal Detection and Estimation," Springer, Second Edition,1998.

SEMESTER-VII

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 405	Error Control Coding	TE	3	1	0	4

UNIT I: CHANNEL CAPACITY AND CODING

Introduction, Channel Models, Channel Capacity, Channel Coding, Information Capacity Theorem, The Shannon Limit, Random Selection of Codes, Hamming Distance, Few Points of Information Theory.

UNIT II: BLOCK CODES

The Digital Communication Channel, Introduction To Block Codes, Single Parity Check Codes, Product Codes, Repetition Codes, Hamming Codes, Minimum Distance of Block Codes, Soft - Decision Decoding, Automatic Repeat Request Schemes.

UNIT III: LINEAR CODES

Definition of Linear Codes, Generator Matrices, The Standard Array, Parity - Check Matrices, Error Syndromes, Error Detection and Correction, Shortened And Extended Linear Codes.

UNIT IV: CYCLIC CODES and BCH CODES

Definition Of Cyclic Codes, Polynomials, Generator Polynomials, Encoding Cyclic Codes, Decoding Cyclic Codes, Galois Field, Definition and Construction of Binary BCH Codes, Error Syndromes in Finite Fields, Reed- Solomon Codes.

UNIT V: CONVOLUTION CODES and APPLICATIONS OF ERROR CONTROL CODING

Convolution, Encoding Convolutional Codes, Generator Matrices for Convolutional Codes, Generator Polynomials for Convolutional Codes, Graphical Representation of Convolutional Codes, The Viterbi Decoder, Application of linear block codes, Application of cyclic codes, Application of convolution codes.

TEXTBOOKS

1. Gravano Salvatore, "Introduction to Error Control Codes", Oxford University Press, 1st Ed., 2007. Bose Ranjan, "Information Theory, Coding and Cryptography", Tata McGraw-Hill, 1st Ed., 2007
2. Moon Tood K., "Error Correction Coding - Mathematical Methods and Algorithms", Wiley- Interscience, 1st Ed., 2006.
3. Sklar Bernard, "Digital Communications - Fundamentals and Applications", Pearson Education-LPE, 2nd Ed., 2009.

REFERENCES

1. Glover Lan and Grant Peter,&qout; Digital Communications", Pearson Education-LPE, 1st Ed., 2008.
2. “Error Control Coding”, by Shu Lin and Daniel J. Costello, Jr., second edition, Prentice Hall, 2004

SEMESTER-VII

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 404	CMOS Analog mixed signal design	TE	3	0	2	4

UNIT I: INTRODUCTION TO ANALOG INTEGRATED DESIGN

Models for analog design, body transconductance, **Single-stage Amplifiers** – CS stage, diode connected load, current source load and source degeneration, review of CD and CG stages (all amplifier analysis with body effect), Cascode stage & folded cascode concepts. Design of amplifier from specifications, **Differential Amplifiers** – MOS differential pair, Small signal operation. half circuit analysis common mode response, differential amplifier with active load, common mode gain and CMRR. frequency response of the differential amplifier.

UNIT II: OPERATIONAL AMPLIFIERS

General considerations – performance parameters, One-Stage Op amps – Cascode opamps, Telescopic opamps, folded cascode opamps, Two-Stage Op amps, Gain boosting, Comparison of performance of various opamp topologies, Design of opamps from specifications.

UNIT III: STABILITY IN FEEDBACK SYSTEMS

Review of bode rules, problem of instability, Stability condition, gain-phase crossovers, phase margin, **Frequency compensation**: frequency response of cs amplifier, Miller effect, poles in a system, Pole-splitting, miller compensation, Two stage opamp - compensation techniques, Closed-loop stability, optimal phase margin.

UNIT IV: NOISE

MOSFET noise models, types of noise, thermal, flicker, Representation of noise in circuits, Noise in single stage amplifiers (Common source only). **Integrated Oscillators** : Ring oscillators, LC oscillators – Cross coupled oscillators, VCO.

UNIT V: DATA CONVERTERS

DAC & ADC Specifications, Current Steering DAC, Charge Scaling DAC, Cyclic DAC, Pipeline DAC, Flash ADC, Pipeline ADC, Integrating ADC, Successive Approximation ADC.

TEXTBOOKS/REFERENCES

1. Design of Analog CMOS Integrated Circuits, Behzad Razavi, 2002, Mc GrawHill Edition, ISBN: 0-07-238032-2.
2. CMOS Circuit Design, Layout and Simulation, R. Jacob Baker, Harry W. Li and David E. Boyce, 2002, IEEE Press, ISBN: 81-203-1682-7.
3. CMOS Mixed-signal Circuit Design, R. Jacob Baker, 2009, IEEE Press, ISBN: 978-81-265- 1657-5.
4. Analysis and Design of Analog Integrated Circuits, Paul R. Gray, Paul J. Hurst, Stephen H. Lewis, Robert G. Meyer, "", 4th edition, 2008, Wiley India Private Limited, ISBN:978-8126515691.

5. Fundamentals of Microelectronics, Behzad Razavi, 2nd Edition, 2013, Wiley, ISBN-10: 1118156323

LIST OF EXPERIMENTS

1. Design an Inverter with given specifications*, completing the design flow mentioned below: a. Draw the schematic and verify the following i) DC Analysis ii) Transient Analysis b. Draw the Layout and verify the DRC, ERC c. Check for XX d. Extract RC and back annotate the same and verify the Design e. Verify & Optimize for Time, Power and Area to the given constraint.
2. Design the following circuits with given specifications*, completing the design flow mentioned below: a. Draw the schematic and verify the following i) DC Analysis ii) AC Analysis iii) Transient Analysis b. Draw the Layout and verify the DRC, ERC, LVS.
3. Single stage amplifier.
4. Comparator.
5. Differential amplifier.
6. Opamp.
7. Ring Oscillator.
8. VCO.
9. DAC.
10. ADC.

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/REFERENCES

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/REFERENCES

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

ELECTIVES

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 410	Adaptive Signal Processing	TE	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.

UNITIII: 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/REFERENCES

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 343	Biomedical Signal Processing	TE	3	0	2	4

UNIT I: INTRODUCTION TO BIOMEDICAL SIGNALS

Introduction to Biomedical Signals: The nature of Biomedical Signals, Examples of Biomedical Signals, Objectives and difficulties in Biomedical analysis, Biomedical signal origin & dynamics (ECG, EEG, EMG etc.). Signal Conversion: Simple signal conversion systems, Conversion requirements for biomedical signals, Signal conversion circuits.

UNIT II: FILTERING FOR REMOVAL OF ARTIFACTS

Statistical Preliminaries, Time domain filtering (Synchronized Averaging, Moving Average), Time domain filtering (Moving Average Filter to Integration, Derivative-based operator), Frequency Domain Filtering (Notch Filter), Optimal Filtering: The Weiner Filter, Adaptive Filtering Selecting Appropriate Filter.

UNIT III: DATA COMPRESSION TECHNIQUES

Introduction, Turning point algorithm, AZTEC algorithm, Data reduction algorithms, Correlation, Convolution, Power spectrum estimation. Frequency-domain Analysis: Periodogram, Averaged Periodogram, Blackman-Tukey Spectral Estimator, Daniell's Spectral Estimator, Measures derived from PSD. Frequency domain analysis of the ECG.

UNIT IV: CARDIOLOGICAL SIGNAL PROCESSING

Basic Electrocardiography, ECG data acquisition, ECG lead system, ECG signal characteristics (parameters and their estimation), Power spectrum of the ECG, Analog filters, ECG amplifier, Event Detection: Example events (viz. P, QRS and T wave in ECG), Derivative based Approaches for QRS Detection Pan Tompkins Algorithm for QRS Detection, ECG interpretation, ST segment analyzer, Portable arrhythmia monitor.

UNIT V: NEUROLOGICAL SIGNAL PROCESSING

The brain and its potentials, The electrophysiological origin of brain waves, The EEG signal and its characteristics (EEG rhythms, waves, and transients), Correlation, Analysis of EEG channels: Detection of EEG rhythms, Template matching for EEG, spike and wave detection.

LIST OF EXPERIMENTS

1. Notch filter design.
2. Synchronized averaging.
3. Design derivative-based filter.
4. Design Wiener filter.
5. Use cross-correlation to detect alpha rhythm.
6. Implement the Pan-Tompkins method for QRS detection.
7. The Lehner and Rangayyan method to detect dicrotic notch.
8. ECG Filtering and Frequency Analysis of the Electrogram.
9. Design filters to remove noise from electrocardiogram (ECG) signals and then.
10. design a system to detect life-threatening ventricular arrhythmias.

TEXTBOOKS/REFERENCES

1. Rangaraj M. Rangayyan, Biomedical Signal Analysis: A Case-Study Approach, Publisher: Wiley India; 2009.
2. Eugene N. Bruce, Biomedical Signal Processing and Signal Modeling, Wiley-Inderscience; 1 edition, 2000.
3. John L. Semmlow, Biosignal and Biomedical Image Processing: MATLAB-based applications, CRC; 1 edition, 2004.
4. MetinAkay, Time Frequency and Wavelets in Biomedical Signal Processing, Wiley-IEEE Press; 1 edition, 1997.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 337	Speech Processing	TE	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 346	Basics of Wireless Sensor Networks	OE	3	0	0	3

UNIT I: BASIC CONCEPTS OF WSN

Introduction to Wireless Sensor Network (WSN), Architecture of a WSN, Motivations, Applications, Performance metrics, History and Design factors, Hardware Platform: Motes and hardware parameters, Characteristics of a WSN: Challenges for WSNs, WSN vs Ad Hoc Networks: Topology and structure, Architecture of Sensor Nodes: NI and Crossbow Motes, Physical layer and transceiver design consideration in WSNs.

UNIT II: MEDIUM ACCESS CONTROL PROTOCOLS

Fundamentals of MAC protocols, Introduction to Markov Chain, Issues in designing MAC protocol for WSNs, MAC Protocol Analysis, Classification of MAC Protocols, S-MAC Protocol, B-MAC protocol. The IEEE 802.15.4 MAC protocol and ZigBee standard, Low duty cycle protocols and wakeup concepts, Contention-based protocols - Schedule-based protocols.

UNIT III: ROUTING AND CLUSTERING PROTOCOLS

Issues in designing routing protocols, Classification of routing protocols, Energy-efficient routing, Unicast, Broadcast and multicast, Geographic routing, Analysis of opportunistic routing (Markov Chain), Real Time routing Protocols, Clustering goals, and types, Clustering methods based on machine learning. High-level overview, clustering in WSNs.

UNIT IV: EMBEDDED OPERATING SYSTEMS

Introduction to operating systems for WSNs, Operating System Design Issues, Examples of Operating Systems – TinyOS – Mate – MagnetOS – MANTIS, Introduction and programming in TinyOS, Interfaces and Modules- Configurations and Wiring. Generic Components -Programming in Tiny OS using NesC, Emulator TOSSIM.

UNIT V: APPLICATIONS

Sensor node localization, Time synchronization in WSN, Energy-harvesting, Network lifetime maximization, Energy-balancing phenomenon in WSN, Distributed detection and estimation in WSN, Network topology control, Wireless sensor network toward CPS and IoT Applications, Context-aware pervasive systems using WSN, Open research issues in WSN.

TEXTBOOKS

1. Raghavendra, Cauligi S, Sivalingam, Krishna M., ZantiTaieb, “Wireless Sensor Network”, Springer 1st Ed. 2004 (ISBN: 978-4020-7883-5).
2. Feng Zhao, Leonidas Guibas, “ Wireless Sensor Network”, Elsevier, 1st Ed. 2004 (ISBN: 13- 978-1-55860-914-3).
3. Kazem, Sohraby, Daniel Minoli, TaiebZanti, “Wireless Sensor Network: Technology, Protocols and Application”, John Wiley and Sons 1st Ed., 2007 (ISBN: 978-0-471-74300-2)..
4. Holger Kerl, Andreas Willig, “Protocols and Architectures for Wireless Sensor Network”, John Wiley and Sons, 2005 (ISBN: 978-0-470-09511-9).

REFERENCES

1. B. Krishnamachari, " Networking Wireless Sensors", Cambridge University Press.
2. N. P. Mahalik, "Sensor Networks and Configuration: Fundamentals, Standards, Platforms, and Applications" Springer Verlag.

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

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.
2. William Stallings, Cryptography and Network Security: Principles and Practice, 5/e, Prentice Hall of India, 2011.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 407	VLSI Physical Design	TE	3	0	0	3

UNIT I: VLSI DESIGN AUTOMATION TOOLS

Algorithms and system design, Structural and logic design. Transistor level design, Layout design, Verification methods, Design management tools.

UNIT II: PHYSICAL DESIGN OVERVIEW

Layout compaction, placement and routing, Design rules, symbolic layout, Applications of compaction, Formulation methods, Algorithms for constrained graph compaction, Circuit representation, Wire length estimation, Placement algorithms, Partitioning algorithms.

UNIT III: FLOOR PLANNING AND ROUTING

Floor planning concepts, Shape functions and floor planning sizing, Local routing, Area routing, Channel routing, global routing and its algorithms.

UNIT IV: SIMULATION AND LOGIC SYNTHESIS

Gate level and switch level modeling and simulation., Introduction to combinational logic synthesis, ROBDD principles, Implementation, construction and manipulation, Two level logic synthesis.

UNIT V: HIGH-LEVEL SYNTHESIS

Hardware model for high level synthesis, Internal representation of input algorithms, Allocation, assignment and scheduling, Scheduling algorithms, Aspects of assignment, High level transformations.

TEXTBOOKS/REFERENCES

1. S.H. Gerez, “Algorithms for VLSI Design Automation”, John Wiley ,1998.
2. N.A.Sherwani , “Algorithms for VLSI Physical Design Automation”, (3/e), Kluwer,1999.
3. S.M. Sait , H. Youssef, “VLSI Physical Design Automation”, World scientific, 1999.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 344	Design for Test	TE	3	0	0	3

UNIT I: INTRODUCTION TO TESTING AND FAULT MODELING

Role of testing VLSI circuits, VLSI trends affecting testing, Physical Faults, Stuck-at Faults, Stuck open Faults, Permanent, Intermittent and Pattern Sensitive Faults, Delay Faults, Functional Testing, Structural Testing, Types of Fault Models, Stuck-at Faults, Bridging Faults, cross point faults, Fault Equivalence, Fault Dominance.

UNIT II: TESTABILITY MEASURE, ATPG FOR COMBINATIONAL CIRCUITS

Controllability, Observability, SCOAP measures for combinational and sequential circuits, Path Sensitization Methods, Roth's D- Algorithm, Boolean Difference, PODEM Algorithm, Complexity of Sequential ATPG, Time Frame Expansion.

UNIT III: DESIGN FOR TESTABILITY, FAULT SIMULATION

Ad-hoc, Structured DFT- Scan method, Scan Design Rules, Overheads of Scan Design, partial scan methods, multiple chain scan methods. Fault Simulation algorithm- Serial, Parallel, Deductive and Concurrent Fault Simulation, Boundary Scan Standard- TAP Controller, Test Instructions.

UNIT IV: SELF TEST AND TEST ALGORITHMS

Built-In self-Test, test pattern generation for BIST, Response compaction - Parity checking, Ones counting, Transition Count, Signature analyzer, Circular BIST, BIST Architectures, Testable Memory Design Test Algorithms, Reduced Functional Faults-MARCH and MAT+ algorithm, Test generation for Embedded RAMs.

UNIT V: FAULT DIAGNOSIS

Logical Level Diagnosis, Diagnosis by UUT reduction, Fault Diagnosis for Combinational Circuits, Self-checking design, System Level Diagnosis.

TEXTBOOKS/REFERENCES

1. Michael L. Bushnell, Vishwani D. Agrawal, "Essentials of Electronic Testing for Digital Memory & Mixed Signal VLSI Circuits", Kluwer Academic Publications, 1999.
2. MironAbramovici, Melvin A. Breuer, Arthur D. Friedman, " Digital Systems Testing and Testable Design", 3rd Edition, Jaico Publishing House, 2004
3. Hideo Fujiwara, " Logical testing & design for testability", The MIT Press.
4. Parag.K.Lala "Digital Circuit Testing and Testability" Academic Press.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 345	Biomedical Instrumentation	OE	3	0	0	3

UNIT I: INTRODUCTION TO BIOMEDICAL INSTRUMENTATION

Development of biomedical instrumentation, Biometrics, Man-instrument system, Physiological systems of the body, Problems encountered in measuring a living system, Types of biomedical instruments, Basic transducers principles, Sources of bioelectric potential, Electrode theory.

UNIT II: INSTRUMENTS FOR CARDIOVASCULAR AND RESPIRATORY SYSTEMS

The heart and cardiovascular system, Blood pressure, Characteristics of blood flow, heart sounds, Electrocardiography (ECG), Measurement of blood pressure, Measurement of blood flow and cardiac output, Plethysmography, Measurement of heart sounds, Pacemakers, Defibrillators, The philosophy of the respiratory system, Measurement of lung volume of capacities.

UNIT III: INSTRUMENTS FOR NERVOUS AND SENSORY SYSTEMS MEASUREMENTS

The anatomy of nervous system, Neural communication and organization of brain, Neural receptors and autonomic nervous system, Measurements from the nervous system (EEG, EMG), Psycho physiological measurements, Instruments for testing motor responses, Instrumentation for sensory measurements.

UNIT IV: SOME MORE DIAGNOSTIC INSTRUMENTS

Temperature, glucose, and oxygen measurement, Principles of ultrasonic measurements, Generation of ionizing radiations, Instrumentation for diagnostic X-rays, Instrumentation for the medical use of radioisotopes, Computed tomography (CT), Magnetic resonance imaging (MRI).

UNIT V: SAFETY OF MEDICAL EQUIPMENT

Patient care and monitoring, Interfacing computer with medical instrumentation and other instruments, Effects of electrical current on body, shock hazards, methods of prevention.

TEXTBOOKS

1. Leslie Cromwell *et al*., "Biomedical Instrumentation and Measurements", Prentice-Hall publication, Second Edition, 1980.
2. R.S. Khandpur, "Handbook of biomedical intrumentation", McGraw Hill Education (India), Third edition, 2014.

REFERENCES

1. Robert B. Northrop, "Noninvasive Instrumentation and Measurement in Medical Diagnosis", The biomedical engineering series, CRC Press, 2002.

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/REFERENCES

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 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.

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/REFERENCES

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.

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/REFERENCES

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.