School of Engineering and Applied Sciences

B. Tech Electronics and Communication Engineering

Syllabus

AY: 2019-2023

Department of Electronics and Communication Engineering
SRM University-AP, Andhra Pradesh

Department of Electronics and Communication Engineering
SRM University, Andhra Pradesh
Curriculum
AY: 2019-2023

Semester I

CODE	COURSE NAME	CREDIT	L - T - P
ENL101 (HS)	Communicative English	3	3-0-0
PHY101 (BS)	Engineering Physics	2	2-0-0
PHY 101 (BS)	Engineering Physics Lab	1	0-0-2
ENG 111 (ES)	Basic Electronics	3	3-0-0
ENG 111L (ES)	Basic Electronics lab	1	0-0-2
CSE 101 (ES)	Basic Computer Science and Programming	3	3-0-0
CSE 101 (ES)	Basic Computer Science and Programming lab	1	0-0-2
MAT 111 BS	Single Variable Calculus	3	3-0-0
CDC 101	Soft Skills-1	1	1-0-0
	Total	18	15-0-6

Semester-II

CODE	COURSE NAME	CREDIT	L - T – P
CDC 102	Soft skills-2	1	1-0-0
ECE XXX (MJ)	Engineering Circuit Analysis	3	3-0-0
CSE 223 (TE)	Data Structures and algorithms using C	3	3-0-0
CSE 223 (TE)	Data Structures and algorithms using C lab	1	0-0-2
ECO 221 (HS)	Economics	3	3-0-0
MAT 121 (BS)	Multivariable Calculus	3	3-0-0
EVS 101 (ES)	Environmental Science	2	2-0-0
EVS 101 (ES)	Environmental Science lab	1	0-0-2
CHE 101 (ES)	Principles of Chemistry	2	2-0-0
CHE 101 (ES)	Principles of Chemistry lab	1	0-0-2

	Total	21	16-0-10

Semester – III

CODE	COURSE NAME	CREDIT	L - T – P
HS	Humanities/Social Studies Elective	3	3-0-0
MAT XXX (BS)	Differential Equations	3	3-0-0
ECE 211 (ECEC)	Digital Electronics	4	3-0-2
ECE 212 (ECEC)	Signals and Systems	4	3-0-2
CDC	Soft skills-III	1	1-0-0
EEE XXX (MJ)	Electrical Technology	3	2-0-2
	Total	18	15-0-6

Semester – IV

CODE	COURSE NAME	CREDIT	L - T – P
CDC	Soft Skills-IV	1	1-0-0
MAT XXX (BS)	Linear Algebra	3	3-0-0
MAT 221 (BS)	Probability and Statistics for Engineers	3	3-0-0
ECE 221 (ECEC)	Analog Electronics	3	3-0-0
ECE 221 (ECEC)	Analog Electronics lab	1	0-0-2
EEE (ECEC)	Control Systems	3	3-0-0
ECE 222 (ECEC)	Digital Signal Processing	3	3-0-0
ECE 222 (ECEC)	Digital Signal Processing lab	1	0-0-2
ECE 223 (ECEC)	Electromagnetics and Wave propagation	4	4-0-0
	Total	22	20-0-4

Semester – V

CODE	COURSE NAME	CREDIT	L - T - P
ECE 311 (ECEC)	Analog Communication	3	3-0-0
ECE 311 (ECEC)	Analog Communication lab	1	0-0-2
ECE 312 (ECEC)	Linear Integrated Circuits and Applications	3	3-0-0
ECE 312 (ECEC)	Linear Integrated Circuits and Applications lab	1	0-0-2
ECE 313 (ECEC)	Microprocessors and Interfacing	3	3-0-0
ECE 313 (ECEC)	Microprocessors and Interfacing lab	1	0-0-2
ECE 314 (ECEC)	Transmission lines and waveguides	4	4-0-0
ECE (TE)	Technical Elective	3	3-0-0
OE	Open Elective	3	3-0-0
CDC	Soft Skills - V	P/F	1-0-0
	Total	22	20-0-6

Semester VI

CODE	COURSE NAME	CREDIT	L - T – P
ECE 321 (ECEC)	Microwave theory and Applications	3	3-0-0
ECE 321 (ECEC)	Microwave theory and Applications lab	1	0-0-2
ECE 322 (ECEC)	VLSI Design	3	3-0-0
ECE 322 (ECEC)	VLSI Design lab	1	0-0-2
ECE 323 (ECEC)	Digital Communication	3	3-0-0
ECE 323 (ECEC)	Digital Communication lab	1	0-0-2
ENG 321	Multidisciplinary Design Project / UROP	3	0-0-6
OE	Open Elective	3	3-0-0
ECE (TE)	Technical Elective	3	3-0-0
	Total	21	15-0-12

Semester VII

CODE	COURSE NAME	CREDIT	L - T – P
ECE (TE)	Technical Elective	3	3-0-0
OE	Open Elective	3	3-0-0
OE	Open Elective	3	3-0-0
OE	Open Elective	3	3-0-0
OE	Open Elective	3	3-0-0
OE	Open Elective	3	3-0-0
	Total	18	18-0-0

Semester VIII

CODE	COURSE NAME	CREDIT	L - T – P
ECEP	Capstone Project	12	0-0-24
	Total	12	0-0-24

SEMESTER – I

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
ENL101 (HS)	Communicative English	C	3	0	0	3

Course Objectives

1. Introduction to Communication is designed to help students with the principles and practice of effective oral communication skills.
2. This course will help students through formal and informal speaking activities.
3. Strategies for effective communication in social, business, and professional situations are examined.
4. In all speaking assignments, articulation and the best way to frame ideas will be covered.
5. The course objectives are for students to demonstrate an understanding of the value of rhetorical speaking skills; Paraphrase and cite research correctly; write and speak well-developed, clear, unified ideas with appropriate college-level language choices; Demonstrate a growing understanding of critical thinking in speaking, writing and in public situations.

Course Outcomes

At the end of the course, student will be able to

1 Apply composition skills to craft clear and well-structured communications
2 Composition: Communicate with clear and precise style
3 Connotation: Understand and use connotations, tone, and style.
4 Organization: Effectively organize communications.
5 Professionalism: follow established guidelines to present yourself and your work products professionally.
6 Thesis: Formulate a well-defined thesis
7 Use evidence and argument along with knowledge of your audience to present information in an engaging and persuasive way.
8 Audience: Tailor oral and written work by considering the situation and perspective of the people receiving it.
9 Confidence: Present views and work with an appropriate level of confidence.
10 Critique: Actively and critically engage with texts and other forms of communication.
11 Evidence based: Identify and appropriately structure the information needed to support an argument effectively.
12 Medium: describe, analyze, and utilize distinctive characteristics of communicative and expressive mediums at the level of form and structure.

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.

List of practical experiments:

1 Writing Journal 1
2 Essay on Images
3 Oral Presentation
4 Writing Journal 2
5 Essay on Community

Books of Study

1. Communication: Principles for a Lifetime. Beebe, Beebe and Ivy, 6th Edition, Pearson Publishing.

Books of Reference

1. Qualitative Communication Research Methods (2011) Bryan C. Taylor and Thomas R. Lindlof. Sage Publications, New Delhi, India, 3rd Edition.
2. The Fundamentals of Small Group Communication (2008) Scott A. Myers and Carolyn M. Anderson. Sage Publications, New Delhi, India.

SEMESTER - I

Code	Title	Core/ Elective	L-T-P	Credits
PHY 112	Engineering Physics	C	2-0-0	2

Course Objectives:

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

UNIT I: INTRODUCTION TO VECTOR ALGEBRA

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

UNIT II: ELECTROSTATICS

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

UNIT III: DIELECTRICS AND POLARIZATION

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

UNIT IV: MAGNETOSTATICS

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

UNIT V: INTRODUCTION TO ELECTRODYNAMICS

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

Books of Study:

1. MIT-- 8.02X online course material.
2. Introduction to Electrodynamics (4rd Edition) - David J. Griffiths (Publisher - PHI Learning, Eastern Economy Editions, 2012).
3. Electricity and Magnetism (Reprints 2007, 1st Edition 2001), A. S.Mahajan, A. A. Rangwala, (Publisher - McGraw-Hill Education)

Books of Reference:

1. Electricity and magnetism Edward M Purcell, David J Morin, 3rd edition, Cambridge University, 2013
2. Classical Electrodynamics (3rd Edition) - John David Jackson. (Publisher – Wiley)

SEMESTER - I

Code	Title	Core/ Elective	L-T-P	Credits

PHY 112	**Engineering Physics Lab**	**C**	**0-0-2**	**1**

List of Experiments:

Code	Title	Core/ Elective	L-T-P	Credits
ENG 111	Basic Electronics	C	3-0-0	3

Course Objectives:

The course aims at introducing the Basic Electronic Device and Circuit concepts for all first year Engineering students. Students will get an understanding and appreciation of fundamental concepts, analyzing and designing simple Electronic Circuits for practical applications with devices such as Diodes, BJT, MOSFETs, etc.

Course Outcomes:

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

1 Get thorough understanding of fundamental concepts behind operation of basic Electronic devices and circuits in day to day applications
2 Analyze and design simple circuits with basic electronic devices
3 Analyze and design simple electronic circuits.

4 Have a project based learning through a course project as part of the evaluation and can learn to make a PCB

Unit I: BASIC CIRCUITS AND DIODES

Ohm's law, Kirchhoff's current and voltage laws.

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

Unit II: BIPOLAR JUNCTION TRANSISTOR

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

Unit III: FIELD EFFECT TRANSISTOR

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

Unit IV: OPERATIONAL AMPLIFIERS

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

Unit V: DIGITAL LOGIC FUNDAMENTALS

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

Books of Study:

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

Books of References:

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

Code	Title	Core/ Elective	L-T-P	Credits
ENG 111	**Basic Electronics Lab**	**C**	**0-0-2**	**1**

List of Experiments:

1. Verification of Kirchhoff's laws (KCL, KVL).
2. Study of I-V characteristics of PN junction diode.
3. Design of half-wave rectifier using PN junction diode with and without capacitor filter.
4. Design of positive and negative clipping circuits using PN junction diodes.
5. Study of current and voltage gain characteristics of a NPN transistor in common-emitter configuration.
6. Drain characteristics of common source JFET.
7. Design of inverting and non-inverting amplifier circuits using op-amp IC 741.
8. Study of integrator and differentiator circuits using op-amp IC 741.
9. Design of Schmitt Trigger Using IC 741.
10. Study of function of digital logic gates (AND, NOT, OR, NAND, NOR).

Code	Title	Core/ Elective	L-T-P	Credits
CSE 101	Introduction to Computer Science and Programming	**C**	**3-0-0**	**3**

Objectives:
1. The course is designed to get the basic knowledge in Python.
2. Decision making and functions in python.
3. Helps to learn File handling and basics OOPs concept in python.

Outcomes:
1. Describe the Numbers, Math functions, Strings, List, Tuples and Dictionaries in Python.
2. Express different Decision Making statements and Functions.
3. Interpret object oriented programming in Python
4. Understand and summarize different File handling operations

UNIT I: Introduction to Python

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

UNIT II: Functions

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

UNIT III: Tuples and Lists

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

UNIT IV: Classes and Inheritance

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

UNIT V: Computational Complexity

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

Books of Study

2. Introduction to Computation and Programming using Python, by John Guttag, PHI Publisher, Revised and Expanded version (Referred by MIT)

Books of References

1. Python Programming using problem solving Approach by ReemaThareja, Oxford University, Higher EducationOxford University Press; First edition (10June2017), ISBN-10: 0199480173
2. Data Structures and Algorithms in Python by Michael T Goodrich and RoberttoThamassia, Micheal S Goldwasser, Wiley Publisher(2016)

3. Fundamentals of Python first Programmes by Kenneth A Lambert, Copyrighted material Course Technology Inc. 1st edition(6th February 2009)

Code	Title	Core/ Elective	L-T-P	Credits
CSE 101	Introduction to Computer Science and Programming lab	**C**	**0-0-2**	**1**

List of practical experiments:

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

SEMESTER-I

Code	Title	Core/ Elective	L-T-P	Credits
MAT 112	Single Variable Calculus	C	3-0-0	3

UNIT I: DERIVATIVES AND DIFFERENTIATION

Limit, Continuity and limits of quotients, Derivatives and its geometrical Interpretation, Derivative as a function and calculating derivative, Leibnitz notation and higher derivatives, Trigonometric functions, Linear Approximations, Product and quotient rules, Chain rule, Implicit differentiation, Inverse, exponential and logarithm functions.

UNIT II: APPROXIMATIONS AND THEIR APPLICATIONS

Measurement error of linear approximation, Quadratic approximation, Newton's method, 1 and 2nd derivative test, Limits and asymptotic, Max min problems, Related application in real-life problems.

UNIT III: THE INTEGRAL AND INTEGRATION THEORY

Mean Value Theorem, Differentials and anti-derivatives, Differential equations, The definite integral, First and Second Fundamental Theorem of Calculus.

UNIT IV: DIFFERENT INTEGRATION TECHNIQUES AND APPLICATION OF CALCULUS

Areas and Volumes, Average value, Probability, Numerical Integration, Integrals of Trigonometric Power, Trigonometric substitution, Partial fractions, Integration by Parts, Arc length and Surface area.

UNIT V: POLAR CO-ORDINATE SYSTEMS AND INFINITE SERIES

Parametric curves, Polar co-ordinates, L'Hospital's rule, Improper Integrals, Infinite Series, Taylor's series.

Books of Study:

1. R. G. Bartle and D. R. Sherbert, Introduction to Real Analysis, Third edition, Wiley India , 2005.
2. S. R. Ghorpade and B. V. Limaye, An Introduction to Calculus and Real Analysis,
3. Michael Spivak, Calculus, Third Edition, Cambridge University, 2008.

Books of Reference:

1. G. B. Thomas, Jr. and R. L. Finney, Calculus and Analytic Geometry, 3rd Ed., Pearson Education India 9th Edition 1999
2. P.M. Fitzpatrick, Advanced Calculus, 2nd Edition, AMS Indian Edition, 2010.

SEMESTER - I

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
CDC-101	Soft Skills-1	C	2	0	0	1

Course Objectives:

The most conspicuous perceptual error is the thought that personality is confined to physical appearance alone. Personality is a complete package of an individual's identity; it is infact a person's reality. The development of one's personality is essential for having an impressive image both in the personal & professional areas to create an electrifying impact and a lasting impression.

Course Outcomes:

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

1. Crack placement interviews and competitive exams.

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).

Books of Reference:

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

SEMESTER - II

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
CDC-102	Soft Skills-2	Mandatory	1	0	0	1

Course Objectives:
The most conspicuous perceptual error is the thought that personality is confined to physical appearance alone. Personality is a complete package of an individual's identity; it is infact a person's reality. The development of one's personality is essential for having an impressive image both in the personal & professional areas to create an electrifying impact and a lasting impression.

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

1 Develop Positive attitude and Self Motivated attitude.
2 Develop Lateral thinking skills and understand its importance.
3 To work in a Team dynamics.

UNIT I: MOTIVATION

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

UNIT II: CREATIVITY & INNOVATION

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

UNIT III: CRITICAL & LATERAL THINKING

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

UNIT IV: TEAM DYNAMICS

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

Unit V: MINI PROJECT

Individual projects on topics provided by faculties.

TEAM DYNAMICS

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

SEMESTER-II

SUBJECT CODE	SUBJECT TITLE	Core/ Elective	L-T-P	Credits
ECE 121	Engineering Circuit Analysis	C	3-0-0	3

Course Objectives:

Course Outcomes:

Unit -1
Circuit Analysis Nodes, Paths, Loops, Branches, Resistors in Series and Parallel, Voltage and Current Division, Ideal and Practical Voltage and Current Source, Source Transformations, Nodal Analysis, The Supernode, Mesh Analysis, The Supermesh--with Independent and dependent Voltage and Current Sources. Network Reduction Technique using Star – Delta Transformation. Illustrative examples.

Unit -2
Network Theorems Superposition Theorem, Thevinin's Theorem, Norton's Theorem, Maximum Power Transfer Theorem, Reciprocity Theorem, Millman's Theorems--with Independent and Dependent Voltage and Current Sources. Illustrative examples.

Unit-3
Two Port Networks One Port Networks, Admittance Parameters, Impedance Parameters, Hybrid Parameters and Transmission Parameters. Illustrative examples.

Unit -4
Circuit Dynamics and Forced Response Step Response of a Series RL, RC (First Order System) and RLC Circuit (Second Order System) under DC Source Excitation--Time Constant, Rise Time, Peak Time, Peak Overshoot/Undershoot and Settling Time. Principle of Duality. Illustrative examples.

Unit-5
Single-phase AC circuits Basic Concepts Related to Generation of Sinusoidal AC Voltage, Definitions of Average Value, Root Mean Square Value, Form Factor and Peak Factor. Steady State Analysis of Pure R, L, C Circuits, RL, RC and RLC circuits with Phasor Diagrams under AC Excitation. Concepts of Resonance, Definitions of Real Power, Reactive Power, Apparent Power and Power Factor. Illustrative examples.

Books of Study:

1. Electrical Engineering Fundamentals, Vincent Del Toro, Pearson, 2016.
2. Circuit Theory Analysis and Synthesis, Abhijit Chakrabarti, Dhanpat Rai & Co. 7th Edition, 2017.

Books of Reference:

1. Introduction to Electric Circuits , Richard C.Dorf and James A.Svobada ,Wiley India Private Limited ,Sixth Edition ,2007
2. A Textbook of Electrical Technology, B.L.Theraja and A K Theraja , S Chand and Co.Ltd ., 2000

SEMESTER - II

SUBJECT CODE	SUBJECT TITLE	Core/ Elective	L-T-P	Credits
CSE 223	Data Structures and Algorithms	C	3-0-2	4

Course Objectives:

1. The objective of the course is to teach programming (with an emphasis on problem solving) and introduce elementary data structures.
2. The student should, at a rudimentary level, be able to prove correctness (loop invariants, conditioning, etc) and analyze efficiency (using the `O' notation).

Course Outcomes:

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

1. Select appropriate data structure to specific problem. Implement specific operations like searching, sorting, insertion, traversing and deletion on various data structure problems.
2. Solve both linear and nonlinear data structure problems.
3. Design and analyse the complexity of the given problems.

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.

UNIT V

Sorting and Searching techniques – Bubble sort, selection sort, Insertion sort, Quick sort, merge sort, Heap sort, Radix sort, implementation using C. Linear and binary search methods, implementation using C, Hashing techniques and hash functions.

Books of Study:

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

Books of 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.
4. Gilberg and Forouzan, “Data Structure- A Pseudo code approach with C” by Thomson publication

SEMESTER - II

SUBJECT CODE	SUBJECT TITLE	Core/ Elective	L-T-P	Credits
CSE 223	Data Structures and Algorithms lab	C	0-0-2	1

List of Practical Experiments:

SEMESTER - II

SUBJECT CODE	SUBJECT TITLE	CORE/ELECTIVE	CREDITS			
			L	T	P	C
ECO 121 HS	Principles of Economics	Elective	3	0	0	3

Course Objectives:

This course will provide you with a basic understanding of the principles of microeconomics. At its core, the study of economics deals with the choices and decisions we make to manage the scarce resources available to us. Microeconomics is the branch of economics that pertains to decisions made at the individual level, such as the choices individual consumers and companies make after evaluating resources, costs, and tradeoffs

Course Outcomes:

At the end of the course, student will be able to

1 Analyse relevant economic concepts and economic models which inform the study of microeconomics.
2 Apply the principles of microeconomics associated with supply and demand in determining market equilibrium and the effects of price controls and elasticity.
3 Apply the principles of microeconomics associated with production and consumption in determining the behavior of individuals and producers in successful markets and situations where markets fail or contribute to income inequality.
4 Analyze market structures and apply theoretical concepts of perfect competition to identify the behavior of monopolies and imperfect competition.
5 Analyze resource markets to understand the decision-making of resource allocation and interrelationships among key markets in the economy

UNIT I: Introduction

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

Books of Study:

1. Principles of microeconomics, N. Gregory Mankiw, Publisher: Cengage Learning 5th edition.
2. Macroeconomics, Oliver Blanchard and David R Johnson, Publisher: Pearson; 6thedition.

Books of Reference:

1. Intermediate Microeconomics: A Modern Approach, Hal R. Varian, Affiliated East-West Press Pvt. Ltd., 8thedition.
2. Principles of Macroeconomics with CourseMate, N. Gregory Mankiw, Cengage India, 6thedition.

SEMESTER - II

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
MAT 121	Multi-variable Calculus	C	3	0	0	3

UNIT I: Vector and Matrices

Vectors, Dot product, Determinants; cross product, Matrices; inverse matrices, Square systems; equations of planes, Parametric equations for lines and curves, Velocity, acceleration, Kepler's second law

UNIT II: Partial Derivatives

Level curves; partial derivatives; tangent plane approximation, Max-min problems; least squares, Second derivative test; boundaries and infinity, Differentials; chain rule, Gradient; directional derivative; tangent plane, Lagrange multipliers,Non-independent variables, Partial differential equations

UNIT III: Double integral and line integrals in the plane

Double integrals, Double integrals in polar coordinates; applications, Change of variables, Vector fields and line integrals in the plane, Path independence and conservative fields, Gradient fields and potential functions, Green's theorem, Flux; normal form of Green's theorem, Simply connected regions

Unit IV: Triple integrals in 3D

Triple integrals in rectangular and cylindrical coordinates, Spherical coordinates; surface area, Vector fields in 3D; surface integrals and flux, Divergence theorem: applications and proof.

Unit V: Surface integral in 3D

Line integrals in space, curl, exactness and potentials, Stokes' theorem, Topological considerations, Maxwell's equations.

Books of Study:

1. Edwards, Henry C., and David E. Penney. Multivariable Calculus. 6th ed. Lebanon, IN: Prentice Hall, 2002.
2. G. B. Thomas, Jr. and R. L. Finney, Calculus and Analytic Geometry, 9th Edn., Pearson Education India, 1996.

Books of Reference:

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

SEMESTER - II

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
EVS 101	Environmental Science	C	2	0	0	2

Course Objectives:

1. To provide an integrated, quantitative and interdisciplinary approach to the study of environmental systems.

Course Outcomes:

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

1 How to find sustainable solutions to various environmental issues?
2 Understand the ecological systems and different material cycles
3 Recognize the role of policies/laws on environmental conservation

UNIT I

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

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

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

Unit IV

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

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

Books of Study:

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.

Books of Reference:

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

SEMESTER - II

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
EVS 101	Environmental Science lab	C	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

Subject Code	Subject Name	Core/ Elective	L-T-P	Credits
CHE 101	Principles of Chemistry	C	2-0-0	2

Course Objectives:

1. The objective of this course is to provide a basic understanding of various states of matter (gas, liquid, and solids) and the chemical bonding within.
2. To help the students to understand various fundamental concepts when they are dealing respective core engineering subjects.
3. Along the way, students learning focus on sustainability, where priority is given to environmentally friendly materials.

Course Outcomes:

At the end of the course, student will be able to

1. Distinguish the types of bonding and predict the structure, electronic and magnetic properties of molecules
2. Classify the types of chemical reactions based on reaction energetics and kinetics. Also, interprets stability of materials based on the temperature, pressure and concentration variables.
3. Gain in-depth knowledge on crystalline materials and their applications in electronic devices.
4. Identify the types of polymers and familiar with industrial applications of common synthetic and biodegradable polymers.
5. Know the storage mechanism of various electrochemical cells and their applications namely electronic and e-mobility.

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, sp^2, sp^3, sp^3d, d^2sp^3. Shapes of molecules (VSEPR Theory):$BeCl_2$,CO_2,BF_3,H_2O,NH_3, CH_4,PCl_5,XeF_2,SF_6,XeF_4.Molecularorbitaltheory:Linear combination of atomic orbitals (LCAO Method), bond order, homo(H_2,O_2,N_2) 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.

UNIT IV: 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.

Books of Study:

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.

Books of References:

1. J. Bard and L.R. Faulkner, Electrochemical methods –Fundamentals and applications, 2nd Ed., John Wiley and Sons, 2001.
2. Jain P.C. & Monika Jain, Engineering Chemistry, Dhanpat Roy & Sons, 2015.

SEMESTER - II

Subject Code	Subject Name	Core/ Elective	L-T-P	Credits
CHE 101	**Principles of Chemistry lab**	**C**	**0-0-2**	**1**

List of practical 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 - III

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
HS	HS Elective	E	3	0	0	3

SEMESTER - III

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
MAT	Differential Equations	C	3	0	0	3

Course Objectives:

This introductory course on ordinary differential equations (**ODEs**) covers the theory, solution techniques, and applications surrounding linear and non-linear first and second-order differential equations, including systems of equations.

Course Outcomes:

At the end of the course, student will be able to

1 Model some elementary physical situations by writing an appropriate differential equation.
2 Be able to solve first order simple, linear, and separable equations
3 Solve higher order differential equations using characteristic roots, undetermined coefficients, and the Laplace transform.
4 Understand the qualitative nature of the solution to the linear and non-linear systems of equations.

UNIT-1:

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-2:

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-3:

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-4:

Series Solutions of ODEs: Introduction to power series method, Legendre's equation & polynomials, Frobenius Method, Bessel's Equations & Functions.

UNIT-5:

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.

Books of Study:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, Wiley-India.

Books of Reference:

1. Mary L. Boas, Mathematical Methods in Physical Sciences, 3rd Edition, Wiley-India.
2. G. F. Simmons, Differential Equation with Applications and Historical Notes, TATA McGraw Hill.
3. S. Vaidyanathan, Advanced Applicable Engineering Mathematics, CBS Publishers.

SEMESTER - III

Subject Code	Subject Name	Core/ Elective	L-T-P	Credits
EEE 201	Electrical Technology	C	3-0-0	3

Course Objectives:

Course Outcomes:

Unit -1

Circuit Analysis Nodes, Paths, Loops, Branches, Resistors in Series and Parallel, Voltage and Current Division, Ideal and Practical Voltage and Current Source, Source Transformations, Nodal Analysis, The Supernode, Mesh Analysis, The Supermesh--with Independent and dependent Voltage and Current Sources. Network Reduction Technique using Star – Delta Transformation. Illustrative examples.

Unit -2

Network Theorems Superposition Theorem, Thevinin's Theorem, Norton's Theorem, Maximum Power Transfer Theorem, Reciprocity Theorem, Millman's Theorems--with Independent and Dependent Voltage and Current Sources. Illustrative examples.

Unit-3

Two Port Networks One Port Networks, Admittance Parameters, Impedance Parameters, Hybrid Parameters and Transmission Parameters. Illustrative examples.

Unit -4

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

Unit-5

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

Books of Study:

1. Electrical Engineering Fundamentals, Vincent Del Toro, Pearson, 2016.
2. Circuit Theory Analysis and Synthesis, Abhijit Chakrabarti, Dhanpat Rai & Co. 7th Edition, 2017.

Books of Reference:

1. Introduction to Electric Circuits , Richard C.Dorf and James A.Svobada ,Wiley India Private Limited ,Sixth Edition ,2007
2. A Textbook of Electrical Technology, B.L.Theraja and A K Theraja , S Chand and Co.Ltd ., 2000.

SEMESTER - III

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
ECE 211	Digital Electronics	Core	3	0	0	3

Course Objectives:

The course aims at introducing the Digital logic devices and their applications for Electrical, Electronics and Computer science Engineering students. Students will get an understanding and appreciation of fundamental logic concepts, analyzing and designing combinational and sequential logic circuits for practical applications with logic devices at IC level.

Course Outcomes:

At the end of the course, student will be able to

1. Perform conversions among decimal, binary, octal, BCD & hexadecimal number systems.
2. Analyze, design and apply combinational and sequential logic circuits such as adders, multiplexers, decoders, counters and registers.
3. Design and utilize memory devices such as RAM, ROM, PROM, etc
4. Design an ALU and data path for a given register transfer requirements using gates and components.

Unit I: DIGITAL FUNDAMENTALS

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

Unit II: COMBINATIONAL CIRCUIT DESIGN

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

Unit III: SYNCHRONOUS SEQUENTIAL CIRCUITS

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

Unit IV: ASYNCHRONOUS SEQUENTIAL CIRCUITS

Stable and Unstable states, output specifications, cycles and races, state reduction, race free assignments, Hazards, Essential Hazards, Pulse mode sequential circuits, Design of Hazard free circuits.

Unit V: MEMORY DEVICES

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

Books of Study:

1. M. Morris Mano, "Digital Design", 5th Edition, Pearson Education (Singapore) Pvt. Ltd., New Delhi, 2014.

Books of Reference:

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

SEMESTER - III

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
ECE 211	Digital Electronics	Core	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
    a) Half-Adder/Subtractor
    b) Full-Adder/Subtractor
    c) Multiplexers/De Multiplexers
    d) 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, Jhonson 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)
11. FSM Based Design Project.

SEMESTER - III

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
ECE 212	Signals and Systems	C	3	0	0	3

Course Objectives:

1. This course aims to help the students to understand the basics of signals and systems both in time and transform domains.
2. Upon successful completion of the course, the students will use the mathematical skills to solve problems involving convolution, filtering, modulation and sampling.

Course Outcomes:

At the end of the course, student will be able to

1. Understand the mathematical representation of continuous and discrete time signals and systems.
2. Develop input/output relationship for linear shift invariant system; understand the convolution operator for continuous and discrete time system
3. Understand and resolve the signals in frequency domain using Fourier series and Fourier transforms.
4. Understand the limitations of Fourier transform; Understands the necessity of Laplace and Z transform

Unit I: SIGNALS CLASSIFICATION, TRANSFORMATIONS, REPRESENTATION

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

Unit II: SYSTEMS: CLASSIFICATION AND TIME DOMAIN ANALYSIS

Classification of systems: linear-nonlinear, time-invariant/time-variant, memory, causal, continuous-time/discrete-time. LTI System properties: causality, memory, stability, and invertibility. Impulse response, linear convolution and discrete-time convolution, graphical method to solve convolution.

Unit III: CONTINUOUS & DISCRETE TIME SYSTEMS: FREQUENCY DOMAIN ANALYSIS

Introduction to Laplace transform and region of convergence, properties of Laplace transform, inverse Laplace transform, initial and final value theorems. Introduction to Z-transform and its region of convergence, properties of Z-transform, inverse Z-transform, the unilateral Z-transform.

Unit IV: CONTINUOUS & DISCRETE TIME SIGNALS: FOURIER ANALYSIS

Introduction to sampling and reconstruction, aliasing. Continuous time Fourier transform (CTFT), properties of CTFT, convolution property, CTFT of periodic signals. Discrete time Fourier transform (DTFT) and its properties, DTFT of periodic signals.

Unit V: DISCRETE FOURIER TRANSFORM AND FFT

Introduction to discrete Fourier transform (DFT) and its relation to DTFT, properties of DFT, inverse DFT, convolution using DFT. Computation of DFT using fast Fourier transform (FFT), decimation in time FFT, decimation in frequency FFT.

Books of Study:

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.

Books of Reference:

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

SEMESTER - III

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
ECE 212	Signals and Systems lab	C	0	0	2	1

List of Experiments:

SEMESTER-III

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
ES	Soft Skills-III	C	1	0	0	1

Course Objectives:

A grasp over numeric skills enable an individual to apply the mathematical techniques to situations that call for the interpretation or evaluation of quantitative information. The logical ability is sharpened through the practice of quantitative reasoning. Emotional intelligence on the other hand enables the development of intra and interpersonal relationship skills. Both these disciplines are aimed at enhancing the professional and personal effectiveness of the students.

Course Outcomes:

By the end of the course, students will be able to

1 Get equipped with basic numerical ability
2 Apply numerical competence to real life problems
3 Operational strategy using logic and reasoning.
4 Execute a new model integrating quantitate aptitude
5 Get equipped with basic English grammar

UNIT I: QUANTITATIVE REASONING

Number properties, Percentage, Ratio and proportion, Profit and loss, Simple and compound interest, Averages, Speed, Time and work, Powers and roots, Linear equations, Quadratic equations, Pipes, cisterns.

UNIT II: VERBAL REASONING

Proposition, Premise: Syllogism: Verbal Analogies, Verification of truth of the statement, Assertion and reason, Situation reaction test, Decision making, Alpha-numerical sequence puzzle

UNIT III: VERBAL ABILITY

Preposition, Articles, Adverbs, Adjectives, Conjunctions and Parallel Structures

UNIT IV: DATA ANALYSIS AND INTERPRETATION

Statistics: Average, Median, Mode, Range, Standard deviation,

Books of Study:

1. R.S. Agarwal, A Modern Approach to Verbal & Non Verbal Reasoning, S. Chand Publication
2. P. Anand, Quantitative Aptitude, Wiley, 2015

SEMESTER – IV

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
CDC	Soft Skills - IV	C	1	0	0	1

Course Objective: A grasp over numeric skills enable an individual to apply the mathematical techniques to situations that call for the interpretation or evaluation of quantitative information. The logical ability is sharpened through the practice of quantitative reasoning. Emotional intelligence on the other hand enables the development of intra and interpersonal relationship skills. Both these disciplines are aimed at enhancing the professional and personal effectiveness of the students. Verbal ability enhances the communication prowess and enables efficiency in competitive exams.

UNIT I: QUANTITATIVE REASONING

Speed, Time and work, Powers and roots, Pipes, cisterns.Problems on Clock, Calendar and Cubes, Height and Distance, Logarithms

UNIT II:
NON-VERBAL REASONING
Alpha-numerical sequence puzzle, Symbols and their relationships, Blood Relations, Seating Arrangement, Coding-Decoding, Input- Output, test Direction Sense Test,

UNIT III
DATA ANALYSIS AND INTERPRETATION
Graphical and Numerical Methods for Describing Data, Interpretation of data in tables and graphs, Permutations and Venn diagrams, Counting Methods, Probability.

UNIT IV
VERBAL ABILITY
Conditionals, Tense Forms, Verb Forms,

UNIT V
VERBAL ABILITY
Phrasal Verbs, Cohesion and Coherence

TEXT BOOK:

1. R.S. Agarwal, A Modern Approach to Verbal & Non Verbal Reasoning, S. Chand Publication
2. P. Anand, Quantitative Aptitude, Wiley, 2015

SEMESTER - IV

Subject Code	Subject Name	Core/ Elective	L-T-P	Credits
MAT 131	**Linear Algebra**	**C**	**3-0-0**	**3**

Course Objectives:

1. To emphasize the topics that will be useful in other disciplines, including systems of equations, vector spaces, determinants, eigenvalues, similarity, and positive definite matrices.
2. To make students understand the central ideas of linear algebra like solving linear equations performing matrix algebra, calculating determinants, finding eigenvalues and eigenvectors

Course Outcomes:

At the end of the course, student will be able to

1 Solving systems of linear equations is a basic tool of many mathematical procedures used for solving problems in science and engineering
2 The main aim of this course is to make students understand the central ideas of linear algebra like solving linear equations
3 performing matrix algebra, calculating determinants, finding eigenvalues and eigenvectors

UNIT I

Vector Space: Elimination, LU factorization, null-spaces and other subspaces, bases and dimensions, vector spaces, complexity

UNIT II

Factorization: Orthogonality, projections, least-squares, QR, Gram–Schmidt, orthogonal functions

UNIT III

Matrices: Eigenvectors, determinants, similar matrices, Markov matrices, ODEs, symmetric matrices, definite matrices,

UNIT IV

Iterative methods: Defective matrices, SVD and principal-components analysis, sparse matrices and iterative methods, complex matrices, symmetric linear operators onfunctions.

UNIT V

Applications: Matrices from graphs and engineering.

Books of Study:

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

Books of Reference:

1. S. Axler, Linear Algebra Done Right, 2nd Edn., UTM, Springer, Indian edition, 2010.
2. G. Schay, Introduction to Linear Algebra, Narosa, 1997.

SEMESTER - IV

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
MAT 221	Probability and Statistics for Engineers	C	3	0	0	3

Course Objectives:

1. To introduce students an idea of concept of Probability theory and Random Variables, an important mathematical tool for signal processing and communication systems.
2. To introduce the concept of random process and show its applications in communication.

Course Outcomes:
After doing this course the students will be able to

1. Appreciate the importance of probability and statistics in the field of communication and signal processing.
2. Model the channel noise and understand its effect on information that is being transmitted over the channel.

Unit-I
Review of basic probability theory
Definition and axioms of probability, probability spaces, joint and conditional probabilities, Independent events, Total probability theorem – Bayes' theorem.

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

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

Unit-IV
Random Processes: Time domain analysis
Introduction to the concept of random process, Classification of random processes, Stationary random processes, Ergodic random processes, Correlation functions and their properties, Gaussian and Poisson random process, Sample t-tests, analysis of statistical means.

Unit-V

Random Processes: Frequency domain analysis

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

Books of Study:

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

Books of Reference:

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

SEMESTER - IV

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
ECE 221	Analog Electronics	C	3	0	0	3

Course Objectives:

1. To give the idea about fundamental properties of semiconductors.
2. To prepare students to perform the analysis of any analog electronic circuit.
3. To empower students to understand the design and working of BJT/FET amplifiers, oscillators and operational amplifier.
4. To prepare students for advanced courses in communication system circuit design.

Course Outcomes:

After successful completion of this course the students will be able to

1. Develop the ability to understand and design the circuits based on BJT and FET.
2. Able to design amplifier circuits using FET and BJT also will be able to understand the Frequency response of the amplifiers.
3. Understand the effect of positive and negative feedback on different parameters of Amplifiers.
4. Develop the skill to design, build and trouble shoot the analog circuits.

UNIT – I: BJT Biasing and Single Stage Amplifiers

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

UNIT – II: MOSFET Biasing and Single Stage Amplifiers

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

UNIT – III: Differential Amplifiers and Frequency Response of single stage Amplifiers

MOS Current Mirror, Analysis of MOS Differential Pair, Common Mode Rejection Ratio, DC Offset, MOS Differential Amplifier with current mirror load Low frequency response of CS amplifier, High frequency response of CS amplifier, Millers Theorem, High frequency response of CMOS Differential Amplifier.

UNIT-IV: Feedback Amplifiers

General Feedback structure, Negative feedback, Feedback amplifier types, stability problem, frequency compensation.

UNIT–V: 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.

Books of Study:

1. Microelectronic Circuits: Theory and Applications, Adel S. Sedra and K . C. Smith, 7th edition, Oxford University Press.

Books of References:

1. Bezhad Rizavi "*Fundamentals of Microelectronics"*, Wiley, (2006)
2. Integrated Electronics, Jacob Millman, Christos C Halkias, McGraw Hill
3. EducationElectronic Devices and Circuits theory– Robert L. Boylestead, Louis Nashelsky, 11th Edition, 2009, Pearson.

SEMESTER-IV

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
ECE 221	Analog Electronics lab	C	0	0	2	2

List of Experiments:

SEMESTER - IV

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
EEE 212	Control Systems	C	3	0	0	3

Course Objectives:

Course Outcomes:

Unit 1
Introduction to Control Systems
Introduction, Types of Control Systems, Effect of Feedback Systems, Modelling of Physical Systems, Transfer functions. Block diagrams and Signal Flow graphs.

Unit 2
Time Response of feedback control systems
Standard test signals, Unit step response of First and Second order Systems. Time response specifications, Time response specifications of second order systems, steady state errors and error constants.

Unit 3
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.

Unit 4
Frequency domain analysis and stability
Correlation between time and frequency response, Bode Plots, Experimental determination of transfer function. Introduction to polar and inverse polar plots, Bode plots Stability in Frequency Domain: Nyquist stability criterion, assessment of relative stability: gain margin and phase margin. Introduction to lead, lag and lead-lag compensating networks. Design of closed loop systems using compensation techniques in time domain and frequency domain. Brief idea of proportional, derivative and integral controllers.

Unit 5
State Space Analysis of Continuous Systems
Concepts of state, state variables and state model, derivation of state models from block diagrams, Diagonalization- Solving the Time invariant state Equations- State Transition Matrix and it's Properties Concepts of Controllability and Observability.

Books of Study:

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

Books of Reference:

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

SEMESTER - IV

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
ECE 222	Digital Signal Processing	C	3	0	0	3

Course Objective:

The course aims at providing the solid basis in analyzing LTI systems in time and frequency domain. It also introduces analog and digital filters which are the fundamental entities in digital signal processing systems. All these concepts will be understood by active laboratory participation.

Course Outcomes:
After this course the students will be able to

1. Analyze and determine the response of an LTI system in both time and frequency domain
2. Know what are different kind of analog filters to be used as anti-aliasing filters and smoothing filters along with thorough understanding and comparison.
3. Design of IIR and FIR digital filters that operate on discrete-time signals. This also involves deriving digital filters from analog prototypes along with filter transformations.
4. Multi-rate signal processing will be introduced along with few implementation techniques. Learners will get though understanding with MATLAB implementations.

Unit I Introduction and Time Domain Processing

Review of signals and systems, differences between analog and digital signal processing, filtering in time domain: linear convolution, circular convolution. Linear correlation and circular correlation; auto correlation and cross correlation of signals.

Unit II Frequency Domain Processing

Discrete Fourier transform (DFT), methods to compute DFT: Cooley-Tukey FFT algorithm, properties of FFT, decimation in time and decimation in frequency algorithms to compute DFT using FFT. Rader's and Bluestein's FFT algorithms.

Unit III Analog Filters

Transfer function, design of Butterworth, elliptic, Chebyshev, and Bessel filters. Filter order and roll-off rate, Lowpass, Highpass, bandpass and bandstop filters. Higher order filters, linear phase and its importance, phase delay and group delay of the filters.

Unit IV Digital Filters

Finite impulse response (FIR) filters. Infinite Impulse Response (IIR) filters. Realization of digital filters: canonical form, direct form-I, form-II methods. Converting analog filters to digital filers: bilinear transformation. All-pass filter and inverse filter.

Unit V Multi-rate Signal Processing

Decimation, Interpolation, sampling rate conversion of non-integer factors; multi stage implementation and polyphase implementation of decimation and interpolation. Introduction to sub-band coding and multi-resolution analysis.

Books of Study:

1. "Digital Signal Processing" by Tarun Kumar Rawat, Oxford Higher Education, 2017 edition.
2. "Discrete-time signal processing" by A. Oppenheim and R. W. Schafer, Pearson, 2014 edition.

Books of Reference:

1. "Principles of Signal Processing and Linear Systems" by B P Lathi, Oxford University Press, 2009 edition.
2. "Digital Signal Processing" by J. G. Proakis and D. G. Manolakis, 2007 edition, Pearson India.

SEMESTER - IV

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
ECE 222	Digital Signal Processing lab	C	0	0	2	1

SEMESTER-IV

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
ECE 223	Electromagnetic Wave propagation	C	4	0	0	4

Course Objective:

1. To introduce students with different coordinate systems.
2. To familiarize the students with the different concepts of electrostatic, magneto static and time varying electromagnetic systems.
3. To expose the students to the ideas of electromagnetic waves and structure of transmission line.

Course Outcomes:

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

1. Define and recognize different co-ordinate systems to describe the spatial variations of the physical quantities dealt in electromagnetic field theory as they are functions of space and time. Apply different techniques of vector calculus to understand different concepts of electromagnetic field theory.
2. Explain fundamental laws governing electromagnetic fields and evaluate the physical quantities of electromagnetic fields (Field intensity, Flux density etc.) in different media using the fundamental laws.

   Determine the electromagnetic force exerted on charged particles, current elements, working principle of various electric and electromagnetic energy conversion devices are based on this force.

Unit-I: Electromagnetic Boundary Conditions

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

Unit-II: Time varying Electromagnetic fields

Faradays law, Displacement current, Maxwell's equations (final form), Time varying fields – Maxwell's equations, Time harmonic fields – Maxwell's equations.

Unit-III: Electromagnetic Wave propagation

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

Unit-IV: Power Consideration of EM Wave:

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

Unit-V: Modern applications of EM waves:

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

Books of Study:

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

Books of Reference:

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 - V

Subject Code	Subject Title	Core/ Elective	L-T-P	Credits
ECE 311	Analog Communication	C	3-0-0	3

Course Objectives:

The course aims at providing the basic knowledge about the legacy communication systems the simple but insightful methods behind various modes of communication, their implementation and how they made sense in the context of the old systems. It also develops mathematical models for description as well analysis of the various modes of communication.

Course Outcomes:

After this course the students will be able to,

1. Use their knowledge of Fourier Transform in the context of various communication systems and in their consequent understanding of the working of those systems.
2. Differentiate between various modulation schemes and determine their suitability to any application.
3. Apply the knowledge of various mathematical tools required for noise analysis of different modulation schemes – AM, FM and PM in particular.
4. Appreciate the various nuances of Analog Communication and differentiate in from Digital Communication, as well as take the first steps towards digital communication.

Unit I: INTRODUCTION: Signals and Spectra

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

Unit II: LINEAR CONTINUOUS WAVE MODULATION

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

Unit III: EXPONENTIAL CONTINUOUS WAVE MODULATION

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

Unit IV: PERFORMANCE OF ANALOG MODULATION IN PRESENSE OF NOISE

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

Unit V: DIGITAL MODULATION

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

Books of Study:

1. "Communication Systems: An Introduction to signals and noise in Electrical Communication", by A. Bruce Carlson, Paul B. Crilly, Fifth Edition, McGraw-Hill Education.
2. "Communication Systems", by Simon Haykin, Michael Moher, Fifth Edition, Wiley Publishers.

Books of Reference:

1. "Principles of Communication Systems" by Herbut Taub and Donald L. Schilling, Goutam Saha, Fourth Edition, McGraw Hill Education

SEMESTER – V

Subject Code	Subject Title	Core/ Elective	L-T-P	Credits
ECE 311	Analog Communication lab	C	0-0-2	1

List of Experiments:

SEMESTER-V

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
ECE 312	Linear Integrated Circuits and Applications	C	3	0	0	3

Course Objectives:

1. To apply operational amplifiers in linear and nonlinear applications.
2. To acquire the basic knowledge of special function ICs.
3. To use SPICE software for circuit design.

Course Outcomes:

After this course students will be able to

1. Design and analyse the various linear application of op-amp.
2. Design and analyse the various non-linear application of op-amp.
3. Design and analyse filter circuits using op-amp.
4. Design and analyse oscillators and multivibrator circuits using op-amp
5. Design and analyse the various application of 555 timer.
6. Analyse the performance of oscillators and multivibrators using PSPICE.

UNIT-I BJT biasing and Single Stage Amplifiers

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

UNIT – II: MOSFET Biasing and Single Stage Amplifiers

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

UNIT – III: Differential Amplifiers and Frequency Response of single stage Amplifiers

MOS Current Mirror, Analysis of MOS Differential Pair, Common Mode Rejection Ratio, DC Offset, MOS Differential Amplifier with current mirror load, Low frequency response of CS amplifier, High frequency response of CS amplifier, Millers Theorem, High frequency response of CMOS Differential Amplifier.

UNIT-IV: Feedback Amplifiers, Signal Generators and wave shaping circuits

General Feedback structure, Negative feedback, Feedback amplifier types, stability problem, frequency compensation. Basic principles of sinusoidal oscillators, op-amp RC oscillator, Wein Bridge oscillator, MOSFET Crystal oscillators, Bistable multivibrators, 555 timer IC and applications

UNIT – V: Power Amplifiers and Active Filters

Classification of output stages, Class A output stage, Class B output stage, Class AB output stage, Class C output stage, Class D and S power amplifiers. Filter Transmission, Types and specifications, Filter Transfer function, Butterworth and Chebyshev filters, First order and second order Filter functions.

Books of Study:

1. Microelectronic Circuits: Theory and Applications, Adel S. Sedra and K . C. Smith, 7th Edition, Oxford University press

Books of References:

1. Bezhad Rizavi "*Fundamentals of Microelectronics"*, Wiley, (2006)
2. Integrated Electronics, Jacob Millman, Christos C Halkias, McGraw Hill Education
3. Electronic Devices and Circuits theory– Robert L. Boylestead, Louis Nashelsky, 11th Edition, 2009, Pearson.

SEMESTER–V

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
ECE 312	Linear Integrated Circuits and Applications lab	C	0	0	2	3

SEMESTER-V

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
ECE 313	Microprocessor and Interfacing	C	3	0	0	3

Course Objectives:
The purpose of this course is to impart knowledge of microprocessor architecture and programming, interfacing and coprocessors which gives foundation to advanced microprocessor architecture and microcontrollers.

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

1. To study and understand the architecture of 8085 microprocessor
2. To study and understand the architecture of 8086 microprocessor
3. To learn and understand design aspects of I/O and interfacing devices.
4. To study about communication and bus interfacing.

Unit-I
Introduction to 8085 Microprocessor
Introduction to Microprocessors, Microcomputers, Internal architecture and functional and signal description of 8085 microprocessor, Instruction set and timing diagrams of 8085 µP.

Unit-II
Programming the 8085 Microprocessor:
Assemble language programming requirements, Programming techniques: Looping, Counting and Indexing, Counter and timing delays, Stack and subroutines, Code conversion, BCD arithmetic, 16-bit data operations, Interrupts and interrupt service routines.

Unit-III
8086 Microprocessor, Architecture and Instruction set:
Introduction, Pipelining, Memory segmentation, Memory banking, Architecture, Flag register, Addressing modes, Instruction set, Assembler directives, Assembly language programming, Interrupts, Minimum mode with timing diagram, Maximum mode with timing diagram, Macros, Simple programs involving: logical, branch and call instructions, sorting , string manipulations.
Unit-IV
Microcontroller:
Introduction to microcontroller, Architecture, Flag register, Memory organization, Internal RAM, SFRs, Addressing modes, Instruction set, Short, long and absolute jumps operations, Boolean-bit wise operations, Assembly level programs.

Unit-V
I/O and Memory interface:

LCD, Keyboard, External memory RAM, ROM interface; ADC, DAC interface to 805, Serial port communication, UART: External communication interfaces - RS232, USB.

Books of Study:

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.

Books of Reference:

1. Introduction to Embedded Systems, Shibu K.V, MHE, 2009.
2. The 8051 Microcontrollers, Architecture and Programming and Applications - K.Uma Rao, Andhe Pallavi, Pearson, 2009.

SEMESTER - V

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
ECE 313	Microprocessor and Interfacing lab	C	0	0	2	1

List of Experiments:

SEMESTER-V

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
ECE 314	Transmission lines and Waveguides	C	4	0	0	4

Course Objectives:

The course aims at introducing the high-frequency RF transmission lines, rectangular and circular waveguides and cavity resonators for Electronics and Communication Engineering students. Students will also learn the design techniques of double-stub and single-stub impedance matching network, bandpass filter, band elimination filter, low-pass and high-pass filters at RF frequencies.

Course Outcomes:

At the end of the course, students will be able to
1. Understand the analytical theory of transmission line at Radio-frequency
2. Graphically design single- and double- stub impedance matching circuit using Smith Chart
3. Analyze and design low-pass, high-pass, bandpass and band stop filters at Radio-frequency
4. Analyze the mode configurations of rectangular and circular waveguides along with the cavity resonators

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

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

UNIT III IMPEDANCE MATCHING IN HIGH FREQUENCY LINES
Impedance matching: Quarter wave transformer – Impedance matching by stubs – Single stub and double stub matching – Smith chart – Solutions using Smith chart – Single and double stub matching using Smith chart.

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

UNIT V WAVE GUIDES AND CAVITY RESONATORS

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

Books of Study:

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

Books of References:

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

SEMESTER - V

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
CDC	Soft skills-V	C	1	0	0	1

UNIT I
RESUME WRITING
The difference between resume and CV, Types of resume, Inclusions in a resume, Technicalities of a resume.

UNIT II
COVER LETTER
Resume Vs Cover Letter, Types of cover letter, Structure of cover letter, Content of cover letter

UNIT III
BUSINESS WRITING
Four types of Business Writing: Instructional, Informational, Persuasive and Transactional

UNIT IV
CREATING A PERSONAL BRAND
Creating a communication strategy based on:
Who are you?
What do you offer?
What makes you unique?

UNIT V
PRACTICE SESSIONS& ASSESSMENTS

SEMESTER - VI

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
ECE 321	Microwave Theory and Applications	C	3	0	0	3

Course Objectives:

The course aims at introducing Microwave theory, techniques and applications with practical lab experiments to Electronics and Communication engineering students. Students will learn the theory of microwave network analysis, scattering matrix and parameters for various waveguide and planar components. Students will also learn the design techniques of passive and active microwave components. Moreover, students will get an understanding of Antenna fundaments and microwave tubes along with microwave solid state devices.

Course Outcomes:

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

1. Understand the techniques of microwave network analysis, scattering matrix and parameters, stripline and microstrip transmission line technology and dielectric resonators
2. Design techniques of microwave passive components such as power dividers, couplers, filters and phase shifters
3. Theory and design techniques of microwave active devices and components such as microwave transistors, Schottky diode, PIN diode, Varactor diode, low-noise amplifiers, power amplifiers, microwave oscillators, microwave mixers
4. Understand the Antenna theory fundamentals
5. Comprehend the theory of Gunn diode, and microwave tubes such as Reflex Klystrons.

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. Micro strip Lines– Introduction, Z_0 Relations, Effective Dielectric Constant, Losses, Q factor. Cavity Resonators– Introduction, Rectangular and Cylindrical Cavities, Dominant Modes and Resonant Frequencies, Q factor and Coupling Coefficients. Related Problems.

Unit-III

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

Unit-IV

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

Unit-V

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

Books of Study:

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.

Books of Reference:

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

SEMESTER – VI

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
ECE 321	Microwave Theory and Applications lab	C	0	0	2	1

List of Experiments:

SEMESTER-VI

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
ECE 322	VLSI Design	C	3	0	0	3

Course Objectives:

1. To learn basic CMOS Circuits.
2. To learn CMOS process technology.
3. To learn techniques of chip design using programmable devices.
4. To learn the concepts of designing VLSI Subsystems

Course Outcomes:
After this course students will be able to

1. Identify the various IC fabrication methods.
2. Express the Layout of simple MOS circuit using Lambda based design rules.
3. Apply the Lambda based design rules for subsystem design
4. Differentiate various FPGA architectures.
5. Design an application using Verilog HDL.

Unit I: VLSI Design Flow

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

Unit II: MOS Transistor

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

Unit III: Combinational Circuit Design

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

Unit IV: Sequential MOS Logic Circuitry

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

Unit V: CMOS Processing Technology

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

Books of Study:

1. Jan Rabaey, Anantha Chandrakasan, B.Nikolic, "Digital Integrated Circuits: A Design Perspective", Second Edition, Prentice Hall of India, 2003.
2. M.J. Smith, "Application Specific Integrated Circuits", Addisson Wesley, 1997.

Books of Reference:

1. N.Weste, K.Eshraghian, "Principles of CMOS VLSI Design", Second Edition, Addision Wesley 1993
2. R.Jacob Baker, Harry W.LI., David E.Boyee, "CMOS Circuit Design, Layout and Simulation", Prentice Hall of India 2005 3. A.Pucknell, Kamran Eshraghian, "BASIC VLSI Design", Third Edition, Prentice Hall of India, 2007.

SEMESTER-VI

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
ECE 322	VLSI Design lab	C	0	0	2	1

List of Experiments:

SEMESTER-VI

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
ECE 323	Digital Communication	C	3	0	0	3

Course Objectives:

1. To understand the key modules of digital communication systems with emphasis on digital modulation techniques.
2. To get introduced to the concept and basics of information theory and the basics of source and channel coding/decoding.

Course Outcomes:

After this course students will be able to

1. Apply the knowledge of statistical theory of communication and explain the conventional digital communication system.
2. Apply the knowledge of signals and system and evaluate the performance of digital communication system in the presence of noise.
3. Apply the knowledge of digital electronics and describe the error control codes like block code, cyclic code.
4. Describe and analyse the digital communication system with spread spectrum modulation.
5. Design as well as conduct experiments, analyse and interpret the results to provide valid conclusions for digital modulators and demodulator using hardware components and communication systems using CAD tool.

Unit I INTRODUCTION

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

Unit II CHARACTERISATION OF COMMUNICATION SIGLAS AND SYSTEMS

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

Unit III RECEIVER FOR DIGITAL MODULATION

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

Unit IV CHANNEL CODING

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

Unit V DESIGN OF DIGITAL COMMUNICAITO SYSTEMS

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

Books of Study:

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

Books of Reference:

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

SEMESTER-VI

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
ECE 323	Digital Communication lab	C	0	0	2	14

List of Experiments:

Specialization Electives of
Electronics and Communication Engineering

Electives for ECE with Specialization of Embedded Systems

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
ECE XXX	Computer Architecture and Organization	E	3	0	0	3

Course Objectives:

Course Outcomes:

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

Central Processing Unit: 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.

Books of Study:

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Computer Organization, 5/e, McGraw-Hill, 2002.
2. Morris Mano, Computer System Architecture, 3/e, Pearson Education, 2000.

Books of Reference:

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

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
ECE XXX	Digital Switching and Multiplexing	E	3	0	0	3

Course Objectives:

Course Outcomes:

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, signalling 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.

Books of Study:

1. Viswanathan, Thiagarajan, Bhatnagar, Manav, Telecommunication Switching Systems and Networks, 2/e, Prentice Hall of India, 2015.

Books of Reference:

1. John C. Bellamy, Digital Telephony, 3/e, Wiley Student Edition, 1999.
2. J E Flood, Telecommunications Switching, Traffic and Networks, Pearson Education, 2004.
3. Gokhale, Introduction to Telecommunications, 2/e, Cengage Learning, 20
4. Robert G. Winch, Telecommunication Transmission Systems, 2/e, Tata McGraw Hill, 2004.

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
ECE XXX	Communication Network Security	E	3	0	2	4

Course Objectives:

Course Outcomes:

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 payload, combining security associations, internet key exchange, cryptographic suites.

Books of Study:

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

Books of Reference:

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

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
ECE XXX	Data Communication	E	3	0	0	0

Course Objectives:

Course Outcomes:

Unit I

Introduction: Uses of computer networks, network hardware, network software, references models, example networks.

Unit II

Physical Layer: The theoritical Basis for data communication, guided transmission media, the public switched telephone network, cable television.

Unit III

Data Link Layer: Data link layer design issues, error detection and correction, elementary data link protocols, sliding window protocols, example data link protocols.

Unit IV

Network Layer: Store and forward packet switching, routing algorithms, congestion control algorithms, internetworking, the network layer in the internet.

Unit V

Application Layer: DNS-the domain name system, electronic mail, the world wide web, multimedia.

Books of Study:

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

Books of Reference:

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

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
ECE XXX	Introduction to Embedded systems	E	3	0	0	3

Course Objectives:

Course Outcomes:

Unit I

Introduction to Embedded Computing: Introduction, characteristics of embedding computing applications, concept of real time systems, challenges in embedded system design, design process, requirements, specifications, architecture design, designing of components, system integration.

Unit II

Embedded System Architecture: CISC and RISC instruction set architectures, basic embedded processor architecture (CISC examples, RISC example, DSP processors), Harvard architecture, memory system architecture: Caches, virtual memory, memory management unit and address translation, I/O sub-system, busy-wait I/O, DMA, interrupt driven I/O, co-processors and hardware accelerators, processor performance enhancement, pipelining, super-scalar execution.

Unit III

Designing Embedded Computing Platform: CPU bus, bus protocols, bus organisation, Memory Devices and their Characteristics: RAM, ROM, EEPROM, flash memory, I/O Devices: Timers and counters, watchdog timers, interrupt controllers, DMA controllers, A/D and D/A converters. Component interfacing, interfacing protocols, Firewire, USB, IrDA, Designing with Processors: System architecture, hardware design, FPGA based design, development environment, debugging techniques, debugging challenges.

Unit IV

Programming Embedded Systems: Components of embedded programs, models of program, multi-tasking and task scheduling, timing specifications, run-time exception handling, analysis and optimization of execution time, analysis and optimization of energy and power, analysis and optimization of program size, program validation and testing.

Unit V

Operating System: Basic features of an operating system, Kernel features, polled loops system, co-routines, interrupt-driven system, multi-rate system, processes and threads, context switching, scheduling, task assignment, inter-process communication, Real-time Memory Management: Process stack management, dynamic allocation, synchronous and

asynchronous I/O, Interrupt handling, device drivers, example real-time OS: VxWorks, RT-Linux, PSOS.

Books of Study:

1. Wayne Wolf, Computers as Components: Principles of Embedded Computing System Design, 2/e, Elsevier, 2008.
2. Peter Marwedel, Embedded System Design, 1/e, Springer, 2010.

Books of Reference:

1. Tim Wilmshurst, Designing Embedded Systems with PIC Microcontrollers, 1/e, Newnes, 2007.
2. Andrew N. Sloss, Dominic Symes, Chris Wright, ARM System Developer's Guide, 1/e, Elsevier, 2004.

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
ECE XXX	Microcontrollers and Applications	E	3	0	0	0

Course Objectives:

Course Outcomes:

Unit I
Overview of Architecture and Microcontroller Resources: Introduction to microcontroller, resources in advanced and next generation microcontrollers, 8051microcontroller architecture, internal and external memories and interface, internal RAM, and SFRs, counters and timers, synchronous serial-cum, asynchronous serial communication, interrupts and priorities.

Unit II
8051 Family Microcontrollers Instruction Set: Basic assembly language programming, data transfer instructions, data and bit- manipulation instructions, arithmetic instructions, instructions for logical operations on the test among the registers, program flow control instructions, interrupt control flow.

Unit III
Real Time Control: Interrupt handling structure of MCU, interrupt latency and interrupt deadline, multiple sources of the interrupts, non-maskable interrupt sources, enabling or disabling of the sources, polling mode and priority assignment, interrupt interval and density constraints, real time control, timers, programmable timers, free running counter and real time control.

Unit IV
Systems Design: Keypad and keyboard interfacings, keyboard-cum-display controller (8279), alphanumeric devices, display systems and its interfaces, printer interfaces, interfacing with the flash memory, analog input interfacing, ADC interfacing with microcontroller.

Unit V
16/32 - Bit Microcontrollers: Introduction to 16/32 bit microcontrollers, 80196 architecture and memory organization, ARM 32 bit MCUs, ARM programming model and addressing modes, ARM thumb programming model, ARM and Thumb instruction set

Books of Study:

1. Raj Kamal, Microcontrollers: Architecture, Programming, Interfacing and System Design, 2/e, Pearson Education, 2005.
2. Kenneth. J. Ayala, The 8051 Microcontroller, 3/e, Cengage Learning, 2004.

Books of Reference:

1. Ajay V. Deshmukh, Microcontrollers: Theory and Applications, Tata McGraw Hill, 2005.

2. Mazidi and Mazidi, The 8051 Microcontroller and Embedded Systems, 2/e, Pearson Education, 2007.

Electives for ECE with specialization of Signal processing

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
ECE XXX	Statistical Theory of Communication	E	3	0	0	3

Course Objectives:

Course Outcomes:

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

Unit II
Detection Theory: Hypothesis testing, decision criteria, multiple measurements, multiple hypothesis testing, CFAR detection, Wald's test.

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

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

Unit V
Estimation of Waveforms: Linear MMSE estimation of waveforms, estimation of stationary processes (Weiner filter), estimation of nonstationary processes (Kalman filter), relationship between Weiner and Kalman filter.

Books of Study:

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

Books of Reference:

1. Steven M. Kay, Fundamentals of Statistical Signal Processing – Vol-I Estimation Theory, Pearson Education, 1999.
2. Steven M. Kay, Fundamentals of Statistical Signal Processing – Vol-II Detection Theory, Pearson Education, 2000.

3. H.V. Poor, An Introduction to Signal Detection and Estimation, 2/e, Spring Verlag, 1994.
4. M. Mansuripur, Introduction to Information Theory, Prentice Hall, 1987.
5. John G. Proakis, Dimitris Manolakis, Digital Signal Processing, 4/e, Pearson Education, 2007.

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
ECE XXX	Modern Digital Signal Processing	E	3	0	0	0

Unit I

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

Unit II

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

Unit III

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

Unit IV

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

Unit V

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

Books of Study:

1. Monson H. Hayes, Statistical Digital Signal Processing and Modeling, 1/e, Wiley Student Edition, 1996.

2. Proakis, J. Gard, D.G.Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, 4/e, Pearson Education, 2006.

Books of Reference:

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

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
ECE XXX	Digital Image Processing	E	3	0	0	0

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 transform, 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. **Image 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.

Books of Study:

1. R.C. Gonzalez, R.E. Woods, Digital Image processing, 3/e, Pearson Education, 2009.

Books of Reference:

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

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
ECE XXX	Speech Processing	E	3	0	0	0

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

Digital Speech 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.

Books of Study:

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

Books of Reference:

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.

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
ECE XXX	Radar Signal Processing	E	3	0	0	0

Unit I

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

Unit II

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

Unit III

Radar Waveforms: Frequency modulated pulse compression waveforms, range side lobe control for FM waveforms, the stepped frequency waveform, phase modulated pulse compression waveforms, costas 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.

Books of Study:

1. Mark Richards, Fundamentals of Radar Signal Processing, 2/e, Tata McGraw Hill Publications, 2014.

Books of Reference:

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.

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
ECE XXX	DSP Processors and Architectures	E	3	0	0	0

Unit I

Computational Accuracy in DSP Implementations: Number formats for signals and coefficients in DSP systems, dynamic range and precision, sources of error in DSP implementations, A/D conversion errors, DSP computational errors, D/A conversion errors, compensating filter.

Unit II

Architectures for Programmable DSP Devices: Basic architectural features, DSP computational building blocks, bus architecture and memory, data addressing capabilities, address generation module, programmability and program execution, speed issues, features for external interfacing.

Unit III

Execution Control and Pipelining: Hardware looping, interrupts, stacks, relative branch support, pipelining and performance, pipeline depth, interlocking, branching effects, interrupt effects, pipeline programming models. Programmable Digital Signal Processors: Commercial digital signal-processing devices, data addressing modes of TMS320C54XX processors, memory space, program control, instructions and programming, on-chip peripherals, interrupts and pipeline operation of TMS320C54XX processors.

Unit IV

Implementations of Basic DSP Algorithms: The Q-notation, FIR filters, IIR filters, interpolation filters, decimation filters, PID controller, adaptive filters, 2-D signal processing. An FFT algorithm for DFT computation, a butterfly computation, overflow and scaling, bit-reversed index generation, an 8-point FFT implementation on the TMS320C54XX, computation of th signal spectrum.

Unit V

Interfacing Memory and I/O Peripherals to Programmable DSP Devices: Memory space organization, external bus interfacing signals, memory interface, parallel I/O interface, programmed I/O, interrupts and I/O, direct memory access (DMA). A multichannel buffered serial port (McBSP), McBSP programming, CODEC interface circuit, COURSE CODEC programming, A COURSE CODEC-DSP interface example.

Books of Study:

1. Avtar Singh, S. Srinivasan, Digital Signal Processing, Cengage Learning, 2

2. Phil Lapsley, DSP Processor Fundamentals: Architectures and Features, IEEE Press, 1997.

Books of Reference:

1. Sen M. Kuo, Real-Time Digital Signal Processing, 2/e, Wiley Student Edition, 2010.
2. B. Venkata Ramani, M. Bhaskar, Digital Signal Processors, Architecture, Programming and Applications, Tata Mc Graw Hill, 2004.
3. Jonatham Stein, Digital Signal Processing, Wiley Student Edition, 2005.

Technical Electives (For all ECE students)

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
ECE XXX	Digital Design with Verilog	E	3	0	0	0

Unit I

Introduction to Verilog: Verilog as HDL, levels of design description, concurrency, simulation and synthesis, functional verification, system tasks, programming language interface (PLI), module, simulation and synthesis tools, test benches. Language constructs and conventions.

Unit II

Gate Level and Behavioral Modeling: Introduction, AND gate primitive, other gate primitives, illustrative examples, tri-state gates, array of instances of primitives, design of flip-flops with gate primitives, delays, strengths and contention resolution, net types, design of basic circuits, behavioral modeling: introduction, operations and assignments, functional bifurcation, initial construct, always construct, examples, assignments with delays, wait construct, multiple always blocks, designs at behavioral level, blocking and non blocking assignments, case, if, assign, repeat.

Unit III

Data Flow Level and Switch Level Modeling: Introduction, continuous assignment structures, delays and continuous assignments, assignment to vectors, operators. Switch level modeling: introduction, basic transistor switches, CMOS switch, bi-directional gates, time delays with switch primitives, instantiations with strengths and delays, strength contention with trireg nets.

Unit IV

Digital Design with State Machine Charts: State machine charts, derivation of SM charts, realization of SM charts, implementation of the dice game, alternative realizations for SM charts using microprogramming.

Unit V

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

Books of Study:

1. T.R. Padmanabhan, B. Bala Tripura Sundari, Design through Verilog HDL, Wiley Student Edition, 2004.
2. Stephen. Brown, Zvonko Vranesic, Fundamentals of Logic Design with Verilog, 3/e, Tata McGraw Hill, 2005.

Books of References:

1. Michael D. Ciletti, Advanced Digital Design with Verilog HDL, Prentice Hall of India, 2005.
2. J. Bhaskar, A Verilog Primer, BS Publications, 2003.
3. Charles H Roth, Lizy Kurian John, Digital Systems Design using VHDL, 2/e, Cengage Learning, 2012.

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
ECE XXX	Radiating Systems	E	3	0	0	0

Unit I

Frequency Independent Antennas, Antenna Miniaturization:
Introduction, theory, equiangular spiral antennas, log-periodic antennas, fundamental limits of electrically small antennas. **Travelling Wave Antennas:** Long wire, v antenna, rhombic antenna.

Unit II

Aperture Antennas: Introduction, field equivalence principle: Huygens principle, radiation equations, directivity, rectangular apertures, circular apertures design considerations, Babinet's principle.

Unit III

Horn Antennas: E plane sectoral horn, H plane sectoral horn, pyramidal horn. **Reflector Antennas:** Plane reflector, corner reflector, parabolic reflector.

Unit IV

Microstrip Antennas: Introduction, rectangular patch, circular patch, quality factor, bandwidth and efficiency, input impedance, coupling, circular polarization, arrays and feed networks.

Unit V

Antenna Measurements: Introduction, antenna ranges, radiation patterns, gain measurements, directivity measurements, radiation efficiency, impedance measurements, current measurements polarization, measurements, scale model measurements.

Books of Study:

6. Constantaine A. Balanis, Antenna Theory Analysis and Design, 3/e, Wiley Student Edition, 2012.
7. E. C. Jordan, K. G. Balmain, Electromagnetic Waves and Radiation Systems, 2/e, Prentice Hall of India, 1999.

Books of Reference:

1. John D Kraus, Ronald J Marhefka, Ahmad S Khan, Antennas, 3/e, Tata McGraw Hill, 2006.
2. F. E. Terman, Pettit, Electronic and Radio Engineering, 4/e, McGraw Hill, 1955.

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
ECE XXX	Fundamentals of Wireless Communication	E	3	0	0	0

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, coherence time, time dispersion and frequency selective fading, frequency dispersion and time selective fading, concepts of level crossing rate and average fade duration.

Unit II

Digital communication through fading multipath channels, frequency non selective, slowly fading channels, frequency selective, slowly fading channels, calculation of error probabilities, tapped delay line model, the RAKE receiver performance.

Unit III

Diversity techniques for mobile wireless radio systems concept of diversity branch and signal paths, combining methods, selective diversity combining, pre-detection and post detection combining, switched combining, maximal ratio combining, equal gain combining.

Unit IV

Cellular concept, frequency reuse, cochannel interference, adjacent channel interference, power control for reducing interference, improving capacity in cellular systems, cell splitting, sectoring, hand off strategies, channel assignment strategies, call blocking in cellular networks.

Unit V

Fundamental concepts of spread spectrum systems, pseudo noise sequence, performance of direct sequence spread spectrum systems, analysis of direct sequence spread spectrum systems, the processing gain and anti-jamming margin, frequency hopped spread spectrum systems, time hopped spread spectrum systems, synchronization of spread spectrum systems.

Books of Study:

1. Rappaport Thoedore S., Wireless Communications, Principles and Practice, 2/e, Prentice Hall of India, 2003.

Books of References:

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

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
ECE XXX	EMI and EMC Techniques	E	3	0	0	0

Unit I

Introduction, Natural and Nuclear sources of EMI / EMC: Electromagnetic environment, history, concepts, practical experiences and concerns, frequency spectrum conservations, an overview of EMI / EMC, natural and nuclear sources of EMI.

Unit II

EMI from Apparatus, Circuits and Open Area Test Sites: Electromagnetic emissions, noise from relays and switches, non-linearities in circuits, passive inter modulation, cross talk in transmission lines, transients in power supply lines, electromagnetic interference (EMI), open area test sites and measurements.

Unit III

Radiated and Conducted Interference Measurements and ESD:
Anechoic chamber, TEM cell, GH TEM Cell, characterization of conduction currents /voltages, conducted EM noise on power lines, conducted EMI from equipment, immunity to conducted EMI detectors and measurements. ESD, Electrical fast transients/bursts, electrical surges.

Unit IV

Grounding, Shielding, Bonding and EMI Filters: Principles and types of grounding, shielding and bonding, characterization of filters, power lines filter design.

Unit V

Cables, Connectors, Components and EMC Standards: EMI suppression cables, EMC connectors, EMC gaskets, isolation transformers, opt isolators, national / international EMC standards.

Books of Study:

1. V.P. Kodali, Engineering Electromagnetic Compatibility, 2/e, IEEE Press, 2000.

Books of References:

1. Clayton R Paul, Introduction to Electromagnetic Compatibility, John Wiley and Sons, 2010.
2. Electromagnetic Interference and Compatibility IMPACT series, IIT Delhi. (Modules1- 9).

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
ECE XXX	Optical Communication	E	3	0	0	0

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.

Books of Study:

1. Gerd Keiser, Optical Fiber Communications, 4/e, Tata McGrawHill, 2008.

Books of References:

1. D. K. Mynbaev, Gupta, Scheiner, Fiber Optic Communications, Pearson Education, India, 2005.
2. S. C. Gupta, Text Book on Optical Fibre Communication and its Applications, Prentice Hall of India, 2005.
3. John M. Senior, Optical Fiber Communications, 2/e, Prentice Hall of India, 2002.

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
ECE XXX	Digital System Design	E	3	0	0	0

Unit I

Review of Logic Design Fundamentals: Combinational logic, boolean algebra and algebraic simplification, Karnaugh maps, designing with NAND and NOR gates, hazards in combinational circuits, flip-flops and latches, mealy sequential circuit design, design of a moore sequential circuit, sequential circuit timing.

Unit II

Introduction to VHDL: Computer-Aided design, Hardware Description Languages, VHDL description of combinational circuits, VHDL modules, sequential statements and VHDL processes, modeling flip-flops using VHDL processes, processes using wait statements, transport and inertial delays, VHDL data types and operators, VHDL libraries.

Unit III

Design Examples for Digital Circuits: Multiplexers, BCD to 7-segment display decoder, BCD adder, 32-Bit adders, shift-and-add multiplier, array multiplier, modeling registers and counters using VHDL processes.

Unit IV

Introduction to Programmable Logic Devices: Brief overview of programmable logic devices, simple programmable logic devices (SPLDs), complex programmable logic devices (CPLDs), field-programmable gate arrays (FPGAs), state machine charts, derivation of SM charts.

Unit V

Designing with Field Programmable Gate Arrays: Implementing functions in FPGAs, implementing functions using shannon's decomposition, carry chains in FPGAs, cascade chains in FPGAs, FPGAs and one-hot state assignment, FPGA capacity: Maximum gates versus usable gates, design translation (Synthesis), mapping, placement, routing.

Books of Study:

1. Charles H. Roth Jr., Lizy Kurian John, Digital System Design using VHDL, 2/e, Cengage Learning, 2008.

Books of References:

1. Stephen Brown and Zvonko Vranesic, Fundamentals of Digital Logic with VHDL Design, 3/e, McGraw-Hill Higher Education, 2008.
2. S.Trimberger, Field Programmable Gate Array Technology, 1/e, Kluwer Academic Publications, 1994**.**
3. J. Bhasker, A VHDL Primer, 3/e, Prentice Hall of India, 2009.

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
ECE XXX	RADAR Systems	E	3	0	0	0

Unit I

Introduction to Radar: Radar equation, radar block diagram and operation, radar frequencies, applications, prediction of range, minimum detectable signal, receiver noise, probability density function, false alarm, signal to noise ratio, integration of radar pulses, transmitter power, PRF, range ambiguities, radar antenna parameters, system lossless and propagation effects. Radar cross section of simple targets.

Unit II

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

Unit III

Tracking Radar: Introduction, sequential lobing, conical scanning, monopulse tracking radar, phase comparison monopulse, low range tracking, comparison of trackers, tracking in range.

Unit IV

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

Unit V

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

Books of Study:

1. Merill Skolnik, Introduction to Radar Systems, 3/e, Tata McGraw Hill, 2001.
2. Laurie Tetley and David Calcutt, Electronic Navigation Systems, 3/e Butterworth Heinemann Publishers, 2010.

Books of References:

1. Byron Edde, Radar: Principles, Technology, Applications,1/e, Pearson Education, 1993.
2. Simon Kingsley, Shaun Quegan, Understanding Radar Systems, 1/e, SciTech, 1999.
3. M A Richards, J A Scheer, W. A. Holm, Principles of Modern Radar-Basic Principles, 1/e, Yesdee, 2010.

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
ECE XXX	Communication Electronics	E	3	0	0	0

Unit I

Elements of a communication system, types of communications, electromagnetic spectrum, examples of a few communication systems, issues involved, differential amplifier modulator, low level and high level AM, diode AM detector filter SSB modulator, crystal lattice filter, phasing SSB modulator, synchronous detector, varactor FM modulator, reactance FM modulator.

Unit II

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

Unit III

TRF radio receiver, superheterodyne receiver, selectivity, sensitivity, fidelity, RF section, mixer, IF section, image frequency, dual conversion, AGC, squelch, SSB transceiver, frequency synthesizer, special features in communication receiver, software defined radio.

Unit IV

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

Unit V

RGB video signals, color addition, color matrix, I and Q signals, chrominance modulation, negative transmission, VSB transmission, FM sound signal, tricolor picture tubes, decoding the picture information, Y signal matrix, functional blocks of TV receiver, video detector and amplifier, sound IF section, synch separator, vertical synch integrator, horizontal sync,

producing luminance image in colour TV receiver, chroma section, color killer circuit, colour TV standards, digital TV fundamentals.

Books of Study:

1. Louis E Frenzel, Communication Electronics: Principles and Applications, 3/e, McGraw Hill Int. Singapore, 2001.

Books of References:

1. George Kennedy, Bernard Davis, Electronic Communication Systems, 4/e, Tata McGraw Hill, 2000.
2. Bernard Grob, Basic Television and Video Systems, 6/e, McGraw Hill, Singapore, 2000.

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
ECE XXX	Satellite Communication	E	3	0	0	0

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.

Books of Study:

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.

Books of References:

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

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
ECE XXX	Wireless Networks	E	3	0	0	0

Unit I

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

Unit II

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

Unit III

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

Unit IV

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

Unit V

Wireless ATM and HIPER LAN: Introduction, wireless ATM, HIPERLAN, adhoc networking and WPAN.

Books of Study:

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

Books of Reference:

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