SECOND YEAR: ELECTRONICS AND TELECOMMUNICATION ENGINEERING

SCHEME OF INSTRUCTION AND EXAMINATION

(RC 2016-17)

SEMESTER – III

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P#	Th Dur (Hrs)	Marks					
						Th	S	TW	P	O	Total
ETC/ECE 3.1	Applied Mathematics-III	4	--	--	3	100	25	--	--	--	125
ETC/ECE 3.2	Economics and Management	4	--	--	3	100	25	--	--	--	125
ETC/ECE 3.3	Algorithms for Data Structures	3	1	2	3	100	25	25	--	--	150
ETC/ECE 3.4	Electronic Devices and Circuits –I	3	1	2	3	100	25	--	25	--	150
ETC/ECE 3.5	Digital System Design	3	1	2	3	100	25	--	25	--	150
ETC/ECE 3.6	Electrical Circuits and Systems	3	1	2	3	100	25	--	--	25	150
	TOTAL	**20**	**4**	**8**		**600**	**150**	**25**	**50**	**25**	**850**

A candidate is considered to have successfully fulfilled the requirement of a semester, provided he/ she submits to the department a certified journal reporting the experiments conducted during the semester.

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SECOND YEAR: ELECTRONICS AND TELECOMMUNICATION ENGINEERING

SCHEME OF INSTRUCTION AND EXAMINATION
(RC 2016-17)

SEMESTER – IV

| Subject Code | Name of the Subject | Scheme of Instruction Hrs/Week | | | Scheme of Examination | | | | | | |
		L	T	P#	Th Dur (Hrs)	Th	S	TW	P	O	Total
ETC/ECE 4.1	Probability Theory and Random Processes	4	--	--	3	100	25	--	--	--	125
ETC/ECE 4.2	Signals and Systems	3	1	--	3	100	25	--	--	--	125
ETC/ECE 4.3	Electromagnetic Fields and Waves	4	--	2	3	100	25	25	--	--	150
ETC/ECE 4.4	Electronic Devices and Circuits –II	3	1	2	3	100	25	--	25	--	150
ETC/ECE 4.5	Linear Integrated Circuits	3	1	2	3	100	25	--	25	--	150
ETC/ECE 4.6	Microprocessors and Interfacing	3	1	2	3	100	25	--	--	25	150
	TOTAL	**20**	**4**	**8**		**600**	**150**	**25**	**50**	**25**	**850**

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THIRD YEAR: ELECTRONICS AND TELECOMMUNICATION ENGINEERING

SCHEME OF INSTRUCTION AND EXAMINATION
(RC 2016-17)

SEMESTER – V

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P#	Th Dur (Hrs)	Marks					
						Th	S	TW	P	O	Total
ETC/ECE 5.1	Digital Signal Processing	3	1	2	3	100	25	25	--	--	150
ETC/ECE 5.2	Transmission Lines and Antennas	3	1	--	3	100	25	--	--	--	125
ETC/ECE 5.3	Control Systems Engineering	3	1	--	3	100	25	--	--	--	125
ETC/ECE 5.4	Embedded Systems	3	1	2	3	100	25	--	25	--	150
ETC/ECE 5.5	VLSI Design and Technology	4	--	2	3	100	25	--	25	--	150
ETC/ECE 5.6	Analog Communication	4	--	2	3	100	25	--	--	25	150
	TOTAL	**20**	**4**	**8**		**600**	**150**	**25**	**50**	**25**	**850**

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THIRD YEAR: ELECTRONICS AND TELECOMMUNICATION ENGINEERING

SCHEME OF INSTRUCTION AND EXAMINATION

(RC 2016-17)

SEMESTER – VI

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P#	Th Dur (Hrs)	Marks					
						Th	S	TW	P	O	Total
ETC/ECE 6.1	Electronic System Design and Manufacturing	4	--	2	3	100	25	25	--	--	150
ETC/ECE 6.2	High Performance Computing Architectures	4	--	2	3	100	25	--	--	--	125
ETC 6.3	Digital Communication	3	1	--	3	100	25	--	--	25	150
ETC/ECE 6.4	Industrial Automation and Instrumentation	3	1	2	3	100	25	--	25	--	150
ETC/ECE 6.5	Operating Systems	3	1	--	3	100	25	--	--	--	125
ETC/ECE 6.6	Communication Networks	3	1	2	3	100	25	--	25	--	150
	TOTAL	20	4	8		600	150	25	50	25	850

A candidate is considered to have successfully fulfilled the requirement of a semester, provided he/ she submits to the department a certified journal reporting the experiments conducted during the semester.

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FINAL YEAR: ELECTRONICS AND TELECOMMUNICATION ENGINEERING

SCHEME OF INSTRUCTION AND EXAMINATION

(RC 2016-17)

SEMESTER – VII

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P#	Th Dur (Hrs)	Marks					
						Th	S	TW	P	O	Total
ETC/ECE 7.1	Microwave Engineering	4	--	2	3	100	25	--	--	--	125
ETC/ECE 7.2	Introduction to Soft Computing	3	1	2	3	100	25	--	25	--	150
ETC/ECE 7.3	Mobile Communication	3	1	-	3	100	25	--	--	--	125
ETC/ECE 7.4	Elective – I	3	1	2	3	100	25	--	--	25	150
ETC/ECE 7.5	Elective – II	3	1	2	3	100	25	--	--	25	150
ETC/ECE 7.6	Project	--	--	4	--	--	--	--	--	25	25
	TOTAL	**16**	**4**	**12**		**500**	**125**	**--**	**25**	**75**	**725**

A candidate is considered to have successfully fulfilled the requirement of a semester, provided he/ she submits to the department a certified journal reporting the experiments conducted during the semester.

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FINAL YEAR: ELECTRONICS AND TELECOMMUNICATION ENGINEERING

SCHEME OF INSTRUCTION AND EXAMINATION

(RC 2016-17)

SEMESTER – VIII

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P#	Th Dur (Hrs)	Marks					
						Th	S	TW	P	O	Total
ETC 8.1	Information Theory and Coding	3	1	2	3	100	25	--	25	--	150
ETC/ECE 8.2	Advanced Communication	3	1	2	3	100	25	--	--	--	125
ETC/ECE 8.3	Elective – III	3	1	2	3	100	25	--	--	25	150
ETC/ECE 8.4	Elective – IV	3	1	2	3	100	25	--	--	25	150
ETC/ECE 8.5	Project *	--	--	8	--	--	--	75	--	75	150
	TOTAL	**12**	**4**	**16**		**400**	**100**	**75**	**25**	**125**	**725**

* Term Work in Project is a separate Head of Passing

A candidate is considered to have successfully fulfilled the requirement of a semester, provided he/ she submits to the department a certified journal reporting

the experiments conducted during the semester.

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LIST OF ELECTIVES FOR SEMESTER - VII

ELECTIVE 1		ELECTIVE 2	
Subject Code	**Name of the Subject**	**Subject Code**	**Name of the Subject**
ETC/ECE 7.4.1	Digital VLSI	ETC/ECE 7.5.1	Analog VLSI
ETC/ECE 7.4.2	Image Processing	ETC/ECE 7.5.2	Adaptive Signal Processing
ETC/ECE 7.4.3	Technical Writing and Professional Ethics	ETC/ECE 7.5.3	Numerical Methods and Approximation
ETC/ECE 7.4.4	Introduction to Robotics	ETC/ECE 7.5.4	Advanced Control Systems
ETC/ECE 7.4.5	Introduction to GPU Computing	ETC/ECE 7.5.5	Introduction to MEMS
ETC/ECE 7.4.6	Computer Networks	ETC/ECE 7.5.6	Process Control Instrumentation
ETC/ECE 7.4.7	Introduction to Device Drivers	ETC/ECE 7.5.7	Secure Communications
ETC/ECE 7.4.8	Virtual Instrumentation	ETC/ECE 7.5.8	Introduction to ARM architecture
ETC/ECE 7.4.9	Wavelets and Multirate Digital Signal Processing	ETC/ECE 7.5.9	Electronic Circuits: Design, Simulation and Testing
ETC/ECE 7.4.10	Electronic Material Science	ETC/ECE 7.5.10	Artificial Neural Network
ETC/ECE 7.4.11	Microwave Networks and Applications	ETC/ECE 7.5.11	Introduction to RF Design
ETC/ECE 7.4.12	Distributed Operating Systems	ETC/ECE 7.5.12	Introduction to Databases
ETC 7.4.13	Introduction to Java	ETC/ECE 7.5.13	Power Electronics

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LIST OF ELECTIVES FOR SEMESTER - VIII

ELECTIVE 3		ELECTIVE 4	
Subject Code	Name of the Subject	Subject Code	Name of the Subject
ETC/ECE 8.3.1	Testing and Fault Tolerance	ETC/ECE 8.4.1	System on Chip
ETC/ECE 8.3.2	E-Commerce	ETC/ECE 8.4.2	Mobile Phone Programming
ETC/ECE 8.3.3	Speech Processing	ETC/ECE 8.4.3	Optical Computing
ETC/ECE 8.3.4	Entrepreneurship	ETC/ECE 8.4.4	Advanced Mobile Networks
ETC/ECE 8.3.5	Mobile Robotics	ETC/ECE 8.4.5	Underwater Robotics
ETC/ECE 8.3.6	Advanced Computer Networks	ETC/ECE 8.4.6	Radar System Engineering
ETC/ECE 8.3.7	Motors and Drives	ETC/ECE 8.4.7	Optical Networking
ETC/ECE 8.3.8	Wireless Communication	ETC/ECE 8.4.8	Wireless Sensor Networks
ETC/ECE 8.3.9	Audio and Video Engineering	ETC/ECE 8.4.9	Consumer Electronics
ETC/ECE 8.3.10	Mobile Computing	ETC/ECE 8.4.10	Electromagnetic Interference/Electromagnetic Compatibility
ETC/ECE 8.3.11	Nanoelectronics	ETC/ECE 8.4.11	Introduction to Deep Neural Networks
ETC/ECE 8.3.12	Biomedical Electronics and Instrumentation	ETC/ECE 8.4.12	Medical Imaging
ETC/ECE 8.3.13	Introduction to Artificial Intelligence	ETC/ECE 8.4.13	Statistical Theory of Communication
ETC 8.3.14	Error Control Coding		

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FE 2.4: FUNDAMENTALS OF ELECTRONICS AND TELECOMMUNICATION ENGINEERING

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
FE 2.4	Fundamentals of Electronics and Telecommunication Engineering	3	--	2	3	100	25	--	--	--	125

Course Objectives:

The subject aims to provide the student with:
1. An understanding of discrete semiconductor devices and their applications.
2. An introduction to operational amplifier and its basic configurations.
3. An introduction to Boolean algebra and logic gates.
4. An introduction to SCR, transducers, PLC, and basic communication system.
5. The basic understanding of PCB fabrication process.

Course Outcomes:

The student after undergoing this course will be able to:
1. Demonstrate the use of diode and Zener diode in simple circuits and compare their performance.
2. Explain the working of a BJT, JFET and MOSFET and compare basic BJT configurations.
3. State typical parameters of an op-amp, and design basic amplifier circuits using op-amps.
4. Enlist the fundamental logic gates, Boolean laws and justify the use of NAND and NOR gates as Universal gates.
5. Explain the working of SCR, simple transducers and PLC.
6. Differentiate between PLC, microprocessor and microcontroller.
7. Distinguish between AM and FM communication system.
8. Explain the PCB fabrication process.

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UNIT - 1 (12 Hours)

Diodes and Circuits: Structure of Atom, classifications of solid materials on the basis of conductivity, atomic bonds, energy band theory, semiconductors, p-n junction basics, p-n junction diode, Zener diode, breakdown mechanism in diodes, light emitting diode.

Diode Applications: Half-wave, Full-wave and Bridge Rectifiers; PIV; DC and r.m.s voltages, Derivation of Ripple Factor. Voltage Regulation using Zener diodes.

UNIT - 2 (12 hours)

Bipolar Junction Transistor (BJT): Transistor Construction; Transistor Operation; Common-Base Configuration; Transistor Amplifying Action; Common-Emitter Configuration; Common-Collector Configuration; Limits of Operation.

DC Biasing: Operating Point; Fixed-Bias Circuit; Emitter-Stabilized Bias Circuit; Voltage-Divider Biasing.

Field Effect Transistors: Construction and Characteristics of JFETs; Transfer Characteristics; Depletion-Type MOSFET; Enhancement- Type MOSFET; CMOS.

UNIT - 3 (12 hours)

OP-AMP (741): Pin diagram, ideal op-amp, practical op-amp, equivalent circuit of op-amp, open loop configuration of op-amp, closed loop configuration of op-amp (basic concept of voltage gain and bandwidth - inverting and non inverting amplifiers).

Digital Electronics: Introduction, Positive and negative logic, logic operations and operators, logic gates, universal gates, Boolean algebra.

Power Semiconductor Device: SCR basic symbol, construction and operation.

UNIT - 4 (12 hours)

Transducer: Basic concept of Thermistor, LVDT, strain gauge, LDR,
Block diagram of programmable logic controller (PLC). PCB fabrication procedure
Definitions and difference between, microprocessor and microcontroller.

Communication Systems: Block Diagram of basic communication system, Need for modulation, basic concepts of amplitude modulation and frequency modulation.

Recommended Reading:

1. Boylestad and L. Nashelsky; Electronic Devices and Circuits; PHI.
2. A. Mottershead; Electronic Devices and Circuits; PHI.
3. Ramakant A. Gayakwad; Op-Amps and Linear Integrated Circuits; PHI.
4. George Kennedy; Electronic Communication Systems; Tata McGraw Hill.
5. David Bates and Albert Malvino; Electronic Principles; McGraw-Hill Higher Education.
6. N.N.Bhargava; Basic Electronics and Linear Circuits; Tata McGraw-Hill.

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7. Vijay Baru, Rajendra Kaduskar, Sunil Gaikwad; Basic Electronics Engineering; Dreamtech Textbooks.
8. Walter C. Bosshart; Printed Circuit Boards; Tata Mcgraw Hill.

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. P-N Junction Diode Characteristics
2. Half-wave, Full-wave and Bridge Rectifiers
3. Zener diode characteristics and Zener diode as a voltage regulator
4. Transistor Common - Emitter Configuration Characteristics
5. FET Characteristics
6. Inverting configuration of OPAMP using 741 IC
7. Non-Inverting configuration of OPAMP using 741 IC
8. Verification of truth-tables of basic logic gates
9. Verification of De' Morgan's laws
10. NAND and NOR as Universal gates
11. Silicon-Controlled Rectifier (SCR) Characteristics
12. Transducer Characteristics
13. PCB fabrication
14. AM System
15. FM System

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ETC/ECE 3.1   APPLIED MATHEMATICS - III

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 3.1	Applied Mathematics-III	4	--	--	3	100	25	--	--	--	125

Course Objectives :

The subject aims to provide the student with:

1. Mathematics fundamental necessary to formulate, solve and analyze engineering problems.
2. An understanding of Fourier Series and Laplace Transform to solve real world problems.
3. An understanding of Linear Algebra through matrices.
4. An understanding of Complex integration.

Course Outcomes:

The student after undergoing this course will be able to:
1. Solve problems in engineering domain related to Linear Algebra using matrices.
2. Analyze and solve engineering problems using Laplace Series.
3. Analyze and solve engineering problems using Fourier Series.
4. Solve engineering problems using Complex Integration.

UNIT - 1 (16 hours)

Matrices: Types of matrices, Determinant, adjoint, inverse of matrix, elementary transformation,

Elementary matrices, Rank of matrix, Reduction to normal form, canonical form. Rank using elementary transformation, Linear independence end dependence. System of the form AX=0 and AX=B, their solutions.

Eigen values, Eigen vectors with properties. Cayley Hamilton theorem with Applications. Minimal polynomial, Diagonalisation.

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UNIT - 2 (16 hours)

Laplace Transforms: Definition. Existence conditions, Properties, Laplace transform of periodic functions, Laplace transform of Dirac-Delta function,

Inverse Laplace Transform, Convolution theorem, Application of Laplace transforms in solving linear differential equations with initial conditions and system of linear simultaneous differential equations.

UNIT - 3 (16 hours)

Fourier Series: Fourier Series, Fourier series of Periodic functions, Trigonometric Series, Euler's formulas, Dirichlets condition, Even and Odd functions, Half range series, Parseval's Identity.

Wave equation derivation and solution using separation of variable method. Derivation and solution of one dimensional heat equation using separation of variable method.

UNIT - 4 (16 hours)

Complex Integration, Cauchy's Integral theorem and its application. Integral formula for simply and multiply connected domains and its applications.

Taylors and Laurents' series and their application. Singular points.

Liouvilles theorem with applications. Residue theorem and applications.

Contour Integration. Boundary value problems.

Recommended Readings:

1. B.S. Grewal; Higher Engineering Mathematics; Khanna Publishers.
2. Erusing Kreyszig; Advanced Engineering Mathematics; New International Ltd.
3. J. Brown and R. Churchill; Complex Variables and Its applications; McGraw-Hill Higher Education.
4. Frank Ayres; Theory and Problems of Matrices; Schaum Outline Series.
5. K.P. Gupta; Special Functions; Krishna Prakashan Media.
6. H.S. Kasana; Complex Variables (Theory and Applications); - PHI.
7. Srimanta Pal, Subodh C. Bhunia; Engineering Mathematics; Oxford University Press.

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ETC/ECE 3.2 ECONOMICS AND MANAGEMENT

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 3.2	Economics and Management	4	--	--	3	100	25	--	--	--	125

Course Objectives:

The subject aims to provide the student with:

1. An understanding of demand and supply.
2. An understanding of Game theory and Break even analysis.
3. An understanding of the role of Communication Function in organizations.
4. An understanding of the complexity of managing in a global world.

Course Outcomes:

The student after undergoing this course will be able to:
1. Explain economics using demand and supply.
2. Apply the concepts of Game theory and Break even analysis.
3. Explain the role of Communication Function in organizations.
4. Apply managerial concepts to solve complex problems related to global issues.

UNIT - 1 (16 hours)

Introduction and General Concepts: Demand and Supply- Demand curve, Supply curve, Market Equilibrium.

National Income Terms: GDP, Real v/s Nominal GDP, Net Domestic Product, GNP, National Income, Per capita income, Disposable Income, Price Index, Inflation.

Foreign Exchange – Functions of forex market, transactions in the forex market, Determination of exchange rates, Exchange rate systems.

Estimation/Forecasting of Demand Meaning, Importance, Methods – trend, exponential smoothing, regression analysis.

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UNIT - 2 (16 hours)

Econometrics – What is econometrics? Methodology of Econometrics.

Game Theory – Introduction to game theory, payoff matrix, Nash equilibrium, dominant and dominated strategies, maximin strategies and mixed strategies.

Break even Analysis. **Working Capital Management –** Determinants of working capital, financing of working capital, dangers of excessive and shortage of working capital.

UNIT - 3 (16 hours)

Preparation of Income statement, Balance sheet, Fund Flow statement, Understanding and analyzing them using financial ratios – liquidity, leverage and profitability ratios.

Capital Budgeting - Different Methods of Evaluation of Projects- Payback Period, Discounted Cash Flow methods- Net Present Value, Internal Rate of Return. Mergers, Takeovers and Acquisitions.

UNIT - 4 (16 hours)

General Principles of Management – Different schools of management, functions of a manager.

Nature of Objectives, MBO Process Organization, Formal and Informal Organization, Organizational levels and the Span of Management, Factors Determining an Effective Span Matrix Organization.

Strategic Business Unit.

Motivation: Motivation and Motivators, The Carrot and The Stick Maslow's, Theory of Needs Herzberg's Theory Vroom's expectancy theory, McGregor's Theory X and Theory Y.

Communication:

Communication Function in organizations, Basic Communication Process, Communication in an Organization, Barriers in Communication.

Toward Effective communication Controlling.

Basic control process Critical Control points and Standards Requirements for Effectives Controls.

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Recommended Readings:

1. R. L. Varshney and K L Maheswari; Managerial Economics; Nineteenth, Revised and Enlarged Edition; Sultan Chand and Sons Publications.
2. Heinz Weihrich and Harold Koontz; Management, A Global Perspective; Tenth Edition; McGraw-Hill, Inc, International Editions 1994.
3. Peterson, Lewis; Managerial Economics; P.H.I.
4. Prasanna Chandra; Fundamentals of Financial Management; Third Edition; Tata McGraw-Hill, New Delhi.
5. Richard M. Lynch and Robert W. Williamson; Accounting for Management, Planning and Control; Third Edition; Tata McGraw-Hill, New Delhi.
6. Damodar N. Gujarati; Basic Econometrics; Fourth edition; TATA Mc GRAW-HILL edition.

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ETC/ECE 3.3 ALGORITHMS FOR DATA STRUCTURES

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 3.3	Algorithms for Data Structures	3	1	2	3	100	25	25	--	--	150

Course Objectives:

The subject aims to provide the student with:

1. An ability to use data structures as the foundational base for computer solutions to engineering problems.
2. An understanding of the different logical relationships among various data items.
3. Ability to understand the generic principles of computer programming as applied to sophisticated data structures.
4. An ability to plan, design, execute and document sophisticated technical programs to handle various sorts of data structures.

Course Outcomes:
The student after undergoing this course will be able to:

1. Analyze algorithms for time and space complexity.
2. Design algorithms using principles of recursion.
3. Demonstrate the use of data structures like linked lists , stacks and queues.
4. Demonstrate the use of complex data structures like trees and graphs.
5. Apply the knowledge of data structures to a given problem.
6. Illustrate searching, sorting and hashing techniques.

<u>UNIT - 1</u>   (12 hours)

Structures, Unions, Files, Macros, Strings, Pointers, Arrays.

Analysis of Algorithms: Pseudo code for expressing algorithms, time complexity and space complexity, O-notation, Omega notation and theta notation.

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Recursion: Recursive definitions and Processes, Writing Recursive Programs, Efficiency in Recursion,
Towers of Hanoi problem.

UNIT - 2 (12 hours)

Linked Lists: Abstract Data Types, Dynamic Representation, Structure of linked lists (nodes and pointers to linked lists), Insertion and Deletion of Nodes, Circular linked lists, Doubly linked lists,

Building a linked list implementation, Array implementation of linked lists, Comparison of Dynamic and Array Representations.

Stacks: Basic Stack Operations, Linked list implementation of Stacks, Array implementation of Stacks.

Queues: Basic Queue Operations, Linked list implementation of Queues, Array implementation of Queues, Circular Queues, Priority Queues.

UNIT - 3 (12 hours)

Trees: Binary Trees: Terms associated with binary trees, Strictly binary, Complete binary, Almost complete binary tree, Operations on binary tree, Representation of trees, Tree Traversals, Properties and Terms associated with trees, Introduction to Balanced Trees, Representation of Balanced trees, Operations on Trees.

Graphs: Concept of linear graphs, Directed and undirected graphs, Degree-indegree, outdegree, C Representation of graphs, Adjacency matrix, Adjacency list, connected components, Spanning trees, Graph Traversals.

UNIT - 4 (12 hours)

Applications of different data structures, Application of Graphs, Shortest Path Algorithm.
Sorting Techniques: Bubble Sort, Selection Sort, Insertion Sort, Radix Sort, Heap Sort
Searching techniques, Linear Search Binary Search, Tree search,
Hashing Techniques: Definition of Hashing, Linear Hashing, Chaining, Collision Handling Mechanisms.

Recommended Readings:

1. Yedidya Langsam, Moshej Augenstein, Aaron M. Tenenbaum; Data Structure Using C & C++; Prentice Hall of India.
2. K. R. Venugopal, Sudeep R. Prasad; Programming with C; Tata MacGraw Hill.
3. Yeshwant Kanitkar; Data Structures using C++; BPB Publications.

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4. Ellis Horowitz and Sartaj Sahni; Fundamentals of Data Structures; Galgotia Publications.
5. Jean Paul Tremblay and Paul G. Sorenson; An introduction to data structures with applications; Tata McGraw Hill.
6. Ellis Horowitz and Sartaj Sahni; Fundamentals of Computer Algorithms; Galgotia Publications.

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments. Term Work marks to be awarded based on the assessment of the experiments conducted.)

1. Structures
2. Unions
3. Strings and Arrays
4. Pointers
5. Files
6. Recursion
7. Towers of Hanoi Problem
8. Linked Lists
9. Stacks
10. Queues
11. Trees
12. Graphs
13. Sorting techniques
14. Searching techniques
15. Hashing

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ETC/ECE 3.4 ELECTRONIC DEVICES AND CIRCUITS - I

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 3.4	Electronic Devices and Circuits - I	3	1	2	3	100	25	--	--	25	150

Course Objectives:

The subject aims to provide the student with:

1. An understanding of energy band theory for semiconductor device operation.
2. Ability to design circuits using diodes like rectifiers, filters, regulators.
3. Ability to perform transistor modeling and analysis of circuits.
4. An understanding of multi stage and large signal amplifier.

Course Outcomes:
The student after undergoing this course will be able to:

1. Interpret the energy band diagram for semiconductors.
2. Explain the theory of p-n junction diodes.
3. Compare the characteristics of p-n, p-i-n, tunnel and schottky barrier diodes.
4. Design rectifier, clipper and clamper circuits.
5. Analyze BJT biasing for various configurations.
6. Analyze BJT models for various configurations.
7. Analyze multi stage and large signals BJT amplifiers.

UNIT - 1   (12 hours)

Energy Band Theory of Crystals - Insulators, Semiconductors and Metal. Conduction in semiconductors: electrons and holes, conductivity of semiconductors, carrier concentration in intrinsic semiconductors, donor and acceptor impurities, charge densities in semiconductors, Fermi level in semiconductors, diffusion, carrier lifetime, continuity equation, hall effect.

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Semiconductor Diode Characteristics- Qualitative theory of the PN junction, PN junction as a diode, band structure of an open circuited p-n junction, Quantitative theory of the p-n diode currents, The Volt-Ampere characteristic, The Temperature dependence of p-n characteristics.

UNIT - 2 (12 hours)

Piecewise linear diode characteristics, transition and diffusion capacitance, p-n diode switching times, Tunnel, p-i-n and schottky barrier diodes and their characteristics.

Rectifiers & Filters: Half wave, full wave, L, C, LC, multiple LC, CLC analysis. Clippers and clampers, Harmonic components in rectifier circuits.

UNIT - 3 (12 hours)

Transistor DC biasing. Bias stabilization for typical transistor biasing circuits.

BJT transistor modelling, Amplification in the ac domain, input and output impedance, current and voltage gain, hybrid and re equivalent model, BJT small signal analysis for all configurations, approximate and complete hybrid equivalent model. Miller's theorem

UNIT - 4 (12 hours)

Multistage Amplifiers-direct, RC-coupled and transformer coupled, Darlington pair, Cascade and Cascode.

Large Signal Amplifiers: Class A, B, C, D, complementary symmetry and push-pull amplifiers.

Recommended Readings:

1. J. Millman, C. Halkias & Satyabrata Jit; Electronic Devices and Circuits; McGraw Hill.
2. R. Boylestad & L. Nashelsky; Electronic Devices and Circuits; PHI.
3. A. Mottershead; Electronic Devices and Circuits; PHI.
4. B.G. Streetman; Solid State Electronic Devices, PHI.
5. S. M. Sze; Physics of Semiconductor Devices Wiley Publication.
6. Garud & Jain; Electronic Devices & Linear circuits; Tata McGraw Hill.
7. J.B Gupta; Electronic Devices and Circuits; S. K. Kataria & Sons.

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. PN junction as a diode
2. Hall effect
3. Rectifiers
4. Filters
5. Clippers
6. Clampers

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7. Transistor DC biasing
8. RC-coupled
9. Transformer coupled,
10. Darlington pair
11. Cascade and Cascode
12. Class A
13. Class B, complementary symmetry
14. Push-pull amplifiers
15. Class C

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ETC/ECE 3.5 DIGITAL SYSTEM DESIGN

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 3.5	Digital System Design	3	1	2	3	100	25	--	--	25	150

Course Objectives :

The subject aims to provide the student with:

1. An understanding of various Number Systems & Codes along with Boolean algebra.
2. An ability to solve Boolean algebra problems.
3. An ability to design combinational and sequential circuits.
4. An understanding of various digital Logic families.

Course Outcomes:

The student after undergoing this course will be able to:
1. Convert the numbers from one radix to another and perform arithmetic operations using the 1's and 2's compliments.
2. Solve Boolean Expressions using Boolean algebra, K-maps and VEM and implement them using logic gates.
3. Design any given combinational circuits.
4. Explain different flip flops, registers and their applications.
5. Design sequential circuits and state machines.
6. Design synchronous and asynchronous counter circuits.
7. Explain arithmetic circuits like adders and multipliers and their applications.
8. Compare the characteristics of Digital Logic families.

UNIT - 1   (12 hours)

Number Systems & Codes: Decimal, Binary, Hexadecimal, Octal systems; Interconversions, Signed & Unsigned Binary numbers, Complements, Binary Arithmetic: Addition & Subtraction using 1's & 2's complements.

Binary Codes-Decimal codes (BCD, Excess-3, 8421, 2421), Error Detection codes (Parity generation & Detection), Reflected code, Alphanumeric codes (EBCDIC, ASCII), Study of Binary logic with logic gates.

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Boolean Algebra: Postulates & Theorems, Boolean functions and their Algebraic manipulation, Canonical & Standard forms, Minterms & Maxterms.
Simplification of Boolean functions: K-maps, POS & SOP simplification and their inter conversions, NAND & NOR implementation, Plotting & Reading of K-map using VEM.

UNIT - 2 (12 hours)

Combinational Logic: Design Procedure for Combinational logic circuits, Design & Analysis of Half Adder, Full Adder, Subtractor, Code Conversion, binary Parallel Adder, Look-ahead Carry generator, Decimal Adder (BCD Adder), Magnitude Comparator, Decoders, Combinational logic implementation, Demultiplexers, Encoders, Multiplexers, Boolean function implementation with multiplexers. Design of Seven-segment display, Parity generator, checker.

Flip-flops: Basic flip-flop circuit, Clocked RS flip-flop, D flip-flop, JK flip-flop, T flip-flop, Triggering of flip-flops, Master Slave flip-flop, Edge triggered flip-flops: their schematic symbols, truth table & Excitation table, conversion between different types of flip flops.

UNIT - 3 (12 hours)

Sequential Circuits: Design procedure for sequential circuits using state diagrams, state table, state equations, state reduction and assignment, Circuit implementation, Moore & Mealy Machine. Finite state machine.

Design and analysis of counters, Modulo Counters, Synchronous, Ripple and ring counters (Switch tail, Johnson), Application of counters, Timing Sequences, Word time generation, timing signals.
Registers: SISO, SIPO, PISO, PIPO, Register with parallel load, Shift registers, Universal shift register.

UNIT - 4 (12 hours)

Design of Arithmetic circuits – Adders: Carry Save, Carry Look Ahead, Carry Select Adder delta delay. Multipliers: Wallace Tree, Braun Multiplier, Restoring and Non Restoring Dividers.

Digital Logic Families:
Characteristics of Digital ICs, TTL-Operation of TTL NAND gate, Active pull-up, Open Collector output, Wired AND, three state (or tri-state) output, Schottky TTL, ECL.
Characteristics of MOSFET's, CMOS Inverter, NAND and NOR, CMOS to TTL and TTL to CMOS interfacing.

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Recommended Readings:

1. M. Morris Mano; Digital Logic and Computer Design; PHI.
2. Anand Kumar; Fundamentals of Digital Circuits; PHI.
3. D. Leach, A. P. Malvino, G. Saha; Digital Principles & Applications; Tata McGraw-Hill.
4. R. P Jain; Modern Digital Electronics;Tata McGraw-Hill.
5. William Fletcher; An Engineering Approach to Digital Design; PHI.
6. Thomas Floyd; Digital Fundamentals - A Systems Approach; Pearson Education.
7. Robert Morris & John Miller; Designing with TTL integrated circuits; McGraw-Hill.
8. Neil H. E. Weste; Principles of CMOS VLSI Design; Addison-Wesley Publishing Company.

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. Truth Table and Logic Gates
2. Half Adder, Full Adder
3. Half Subtractor, full Subtractor
4. Combinational Circuit Implementation
5. Multiplexer
6. Demultiplexer
7. Encoder
8. Decoder
9. SR & JK Flip-Flop
10. T & D Flip-Flop
11. Synchronous Counters
12. Asynchronous Counters
13. SISO, SIPO Shift register
14. PISO, PIPO Shift register
15. Universal Shift Register

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ETC/ECE 3.6 ELECTRICAL CIRCUITS AND SYSTEMS

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 3.6	Electrical Circuits and Systems	3	1	2	3	100	25	--	25	--	150

Course Objectives :

The subject aims to provide the student with:

1. Ability to analyze linear electrical networks and perform Time domain analysis of electrical circuits.
2. An understanding of graph theory and its application for circuit analysis.
3. Ability to synthesize an electrical circuit and model a circuit into any equivalent Two port network.
4. An understanding of the Construction and working of various types of attenuators, motors and bridges.

Course Outcomes:

The student after undergoing this course will be able to:

1. Analyze voltages and currents in circuits using various network analysis techniques and theorems.
2. Determine response of passive circuits using time domain analysis and Laplace Transforms.
3. Calculate various two port network parameters for electrical circuits.
4. Synthesize an electrical circuit from characteristic circuit equation.
5. Design T, pi, Lattice and Bridged-T attenuator circuits.
6. Explain the construction and working of the different types of motors.
7. Explain the different types of bridges.

UNIT - 1   (12 hours)

Network Classification: Distributed and lumped, passive and active, time variable and time invariant, symmetrical and asymmetrical networks.

Network Analysis: Mesh and nodal analysis, super-node and super-mesh analysis.

Network Theorems (AC and DC analysis): Thevenin's, Maximum power transfer, Norton's, Superposition, Compensation, Reciprocity and Tellegen's theorem.

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UNIT - 2 (12 hours)

Graph Theory: Basic definitions, Duality, Matrices associated with network graphs: Incidence, Tieset, Cutset matrices. Applications to mesh and nodal analysis.

Time- domain analysis: Network equations in time- domain, first and second order circuits, Initial condition. Analysis of transient and steady state response to step, ramp, impulse, exponential, sinusoidal input; Application of Laplace transform to analysis of networks for different inputs (sinusoidal, step, ramp, impulse, sinusoidal).

UNIT - 3 (12 hours)

Two Port Networks: Characterization in terms of Z,Y,H and ABCD parameters, Equivalent circuits; interrelationship between the two port parameters; input, output ,characteristic impedance and image impedances of two ports. Introduction to S parameters.

Elements of Network Synthesis: Positive real functions, Reactance functions, R, L and RC functions (Foster method and Caver method).

Attenuators – Classification, Analysis and design of T, pi, Lattice and Bridged-T attenuator.

UNIT - 4 (12 hours)

Construction and working of DC motors, stepper motors, servo motors, synchro motors, single phase Induction motors

Review of DC Bridges: Wheatstone bridge, Wein Bridge, errors and precautions in using bridges.

AC Bridges: Measurement of inductance-Maxwell's bridge, Anderson Bridge. Measurement of capacitance- Schearing Bridge. Kelvin Bridge, Q-meter

Recommended Readings:

1. A. Sudhakar & P. Shyamohan; Circuits & Networks- Analysis and Synthesis; Tata McGraw-Hill.
2. M.E. Van Valkenburg; Network Analysis; Pearson Education.
3. B. L. Theraja; A Textbook of Electrical Technology; S. Chand & Company.
4. A. K. Sawhaney; A Course in Electrical and Electronic measurements & Instrumentation; Dhanpat Rai & Sons.
5. D. Roy Choudhary; Networks & systems; New Age International Publishers.
6. F. F. Chuo; Network Analysis and Synthesis;Wiley Eastern.
7. A. Chakrabarti; Circuit theory (analysis and synthesis); Dhanpat Rai Publishing Company.
8. K. L. Kishore; Electronic Measurements & Instrumentations; Pearson Education.

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List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. Verification of Mesh and Nodal analysis
2. Verification of Super-node and Super-mesh analysis
3. Verification of Superposition Theorem
4. Verification of Thevenin's Theorem
5. Verification of Norton's theorem
6. Verification of Maximum power transfer theorem
7. To measure input impedance and output impedance of a given two port network
8. To design a T attenuator which attenuate given signal to the desired level
9. To design a ∏ attenuator which attenuate given signal to the desired level
10. DC motors, stepper motors, servo motors
11. Synchro motors, single phase Induction motors
12. Wheatstone bridge
13. Wein Bridge
14. Schearing Bridge
15. Kelvin Bridge

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ETC/ECE 4.1 PROBABILITY THEORY AND RANDOM PROCESSES

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 4.1	Probability Theory and Random Processes	4	--	--	3	100	25	--	--	--	125

Course Objectives :

The subject aims to provide the student with:

1. The mathematics fundamental necessary to formulate, solve and analyze engineering problems.
2. An understanding of Probability Theory and Random Variables.
3. An understanding of Tests of Hypotheses and Analysis of Variance.
4. An understanding of Stochastic Processes.

Course Outcomes:

The student after undergoing this course will be able to:
1. Analyze and solve engineering problems using Probability Theory.
2. Analyze and solve engineering problems using Random Variables.
3. Apply Tests of Hypothesis and Analysis of Variance for solving engineering problems.
4. Analyze engineering problems by modeling them as Stochastic Processes.

UNIT - 1   (16 hours)

Introduction to Probability Theory and Random Variables.
Introduction - Sample Space and Events, Probabilities defined on Events, Conditional Probabilities, Independent Events, Total Probability Theorem, Bayes'Theorem and its Applications.
Random Variables, Discrete and Continuous Random Variables, Probability Distribution, Expectation, Variance, Cumulative Distribution Function, Moment Generating Function, Functions of a Random Variable and their Distribution, Expectation and Variance of functions of a random variable.
Some Important Probability Distributions and their Mean, Variance and Moments –
Bernoulli Distribution, Binomial Distribution, Geometric Distribution Poisson Distribution,

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Uniform Distribution, Exponential Distribution, Gamma Distribution and Normal Distribution.

UNIT - 2 (16 hours)

Higher Dimensional Random Variables Introduction, Discrete and Continuous Two Dimensional Random Variables- Joint Probability Distribution, Marginal Distributions, Independence of Random Variables, Covariance and Correlation, Uncorrelated Random Variables.
Real Valued Functions of Two Dimensional Random Variables and their Probability Distributions, Conditional Probability Distribution and Conditional Expectation, Computing Probabilities and Expectations by Conditioning.
Moment Generating Function of Sums of Independent Random Variables.

UNIT - 3 (16 hours)

Tests of Hypothesis and Analysis of Variance (ANOVA) Sampling Theory, Random Samples, Sampling Distributions, Statistical Decisions and Statistical Hypotheses, Tests of Hypothesis and Significance, Level of Significance, One-Sided and Two-sided Hypotheses, Two-Tailed and One-Tailed Tests.
Tests of Hypothesis for Large samples – Tests of hypothesis on the Mean, Tests of Hypothesis on the equality of Two Means, Tests of Hypothesis on a Proportion, Tests of Hypothesis on the Equality of Two Proportions, Tests of Hypothesis on a Standard Deviation, Tests of Hypothesis on the Equality of Two Standard Deviations.
Tests of Hypotheses for Small Samples – Test of Hypothesis on the Mean for a Normally Distributed Population, Tests of Hypothesis on the equality of Two Means for Normally Distributed Populations, Tests of Hypothesis on the Variance of a Normally Distributed Population, Tests of Hypothesis on Equality of Variances of two Normally Distributed Populations, Testing for Goodness of Fit, Tests for Independence of Attributes.
Analysis of Variance (ANOVA) – One-Way and Two- Way Classification Analysis of Variance.

UNIT - 4 (16 hours)

Stochastic Processes
Introduction, State Space, Higher Order Joint Distributions of a Stochastic Process, Independence of a Stochastic Process, Auto – Correlation Function, Auto – Covariance, Correlation Coefficient, Cross –Correlation Function, Cross- Covariance, Cross- Correlation Coefficient, Strict Sense Stationary Process, Wide Sense Stationary Process, Jointly Wide Sense Stationary Process, Evolutionary Process, Ergodicity in Mean and Auto - Correlation Function.
Markov Chains – Introduction, Transition Probabilities, Homogeneous Markov Chains, One-Step and n-Step Transition Probability Matrix , Initial Distribution, Probability Mass Function of the Random Variables of a Markov Chain, Joint Distribution of a Markov Chain,

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Chapman-Kolmogorov Equations, Absorbing States, Communication between States, Irreducible Markov Chains, Steady State Vector.

Poisson Processes – Introduction, Counting processes, Definition of Poisson Process, Sum of Two Independent Poisson Processes, Inter-Arrival and Waiting Time Distributions for a Poisson Process, Applications of Poisson Processes.

Recommended Readings:

1. S. Ross; A first Course in Probability; Sixth Edition; Pearson Education.
2. W. W. Hines, D. C. Montgomery, D. M. Goldsman, C. M. Borror; Probability and Statistics in Engineering.
3. T. Veerajan; Probability, Statistics and Random Processes; Second Edition; Tata McGraw- Hill.
4. K. S. Trivedi; Probability and Statistics with Reliability, Queuing and Computer Science Applications; Prentice Hall.
5. M. R. Spiegel and H. J. Stephens; Statistics, Third Edition, Schaum's Outlines.
6. S. Ross; Introduction to Probability Models; Seventh Edition; Academic Press.

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ETC/ECE 4.2 SIGNALS AND SYSTEMS

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 4.2	Signals and Systems	3	1	--	3	100	25	--	--	--	125

Course Objectives:

The subject aims to provide the student with:

1. Understanding of time-domain representation and analysis of signals and systems.
2. An ability to perform frequency-domain representation and analysis using Fourier tools.
3. An ability to perform frequency-domain representation and analysis using Laplace transform and Z transforms.
4. An understanding of sampling, aliasing and Signal reconstruction.

Course Outcomes:

The student after undergoing this course will be able to:
1. Classify different types of signals and systems.
2. Illustrate the properties of continuous-time and discrete-time systems.
3. Analyze Continuous-time (CT) and discrete-time (DT) systems in time-domain using convolution.
4. Analyze CT and DT systems in Frequency domain using tools like CTFS, CTFT, DTFS and DTFT.
5. Explain the concepts of Sampling, aliasing and Signal reconstruction.
6. Analyze CT and DT systems using Laplace transforms and Z Transforms.

<u>UNIT - 1</u> (12 hours)

Introduction: Definitions and concept of different types of signals; continuous time and discrete time signals; transformation of independent variable; exponential and sinusoidal signal; unit impulse and unit step functions.
Systems: continuous time and discrete time system and basic system properties. Linear time invariant (LTI) systems: Introduction, Discrete time LTI system, the

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convolution sum, continuous time LTI systems, the convolution integral, Impulse and step response.

UNIT - 2 (12 hours)

Fourier Series: introduction; response of LTI system to complex exponential; Fourier series representation of continuous-time periodic signals; convergence of the Fourier series; Parseval's relation.
Fourier series representation of discrete time periodic signals; properties of discrete-time
Fourier Series: Properties: linearity, time shifting, time reversal, time scaling, conjugation and conjugate symmetry, frequency shifting, convolution, multiplication.

UNIT - 3 (12 hours)

Continuous-Time Fourier Transform: Representation of aperiodic signals: Fourier transform of aperiodic signals and their properties; linearity, time shifting, differentiation, integration, conjugation and conjugate symmetry, time ,frequency scaling, duality, Parseval's relation, convolution.
Discrete-Time Fourier Transform: Representation of aperiodic signals; Fourier transform of aperiodic signals.
Sampling: Introduction; representation of continuous time signals by its samples; sampling theorem; reconstruction of a signal from its samples using interpolation; the effects of undersampling; aliasing; Discrete-time processing of continuous-time signals; sampling of discrete- time signals.

UNIT - 4 (12 hours)

The Laplace transform: introduction; Laplace transforms; the region of convergence; inverse Laplace transform; Analysis and characterization of LTI system using the Laplace transform. Unilateral Laplace transforms.
The Z-transform: introduction; Z-transform; the region of convergence; the inverse Z-transform; properties of Z-transform: linearity, time shifting, scaling ,time reversal, conjugation, convolution analysis and characterization of LTI system using Z-transforms.

Recommended Readings:

1. A. V. Oppenheim, A.S.Willsky; Signals and systems; PHI.
2. S. Haykins , B. V. Veen; Signals and Systems; Wiley India.
3. D. G. Rao, S. Tunga; Signals and systems; Pearson Education.
4. R. E. Ziemer, W.H Trantor, Fannin; Signal and Systems; D.R. Pearson education, Asia.
5. I. Nagrath, J. Sharan, R. Rajan, S. Kumar; Signal and Systems; Tata McGraw Hill.

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ETC/ECE 4.3 ELECTROMAGNETIC FIELDS AND WAVES

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
					Th Duration (Hrs)	Marks					
		L	T	P		Th	S	TW	O	P	Total
ETC/ECE 4.3	Electromagnetic Fields and Waves	4	--	2	3	100	25	25	--	--	125

Course Objectives :

The subject aims to provide the student with:

1. An understanding of different coordinate systems.
2. Ability to perform analysis for Electrostatics and Magnetostatic fields.
3. An understanding of the Electromagnetic wave equation and its solution for application in real world problems.
4. An ability to handle design issues in Guided waves.

Course Outcomes:

The student after undergoing this course will be able to:
1. Transform between coordinate systems.
2. Solve problems related to Electrostatics and Electric fields.
3. Analyze working of Electrostatic and Magnetostatic fields.
4. Solve problems related to Electromagnetic wave equations.
5. Explain the working of Propagation of plane waves.
6. Explain the propagation of Guided waves.

UNIT -1   (16 hours)

System of Coordinates: Cartesian, cylindrical and spherical coordinate system, transformation from cartesian to cylindrical and spherical coordinate system, Divergence of a vector field, Curl of a vector, Stoke's theorem. Conservative and non-conservative fields, Helmholtz's theorem.

Electrostatics: Coulomb's Law, Electric Field Intensity due to point charges and distributed charges.

Electric Flux density, Electric flux, Postulates of the electrostatic field, Gauss's law and its applications, **Electric Potential:** Electrical potential due to point charges and distributed charges.

Energy in electrostatic field, Energy due to point and distributed charges.

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Boundary Value Problems: Poisson's equations for the electrostatic field, Laplace's equation for the electrostatic field, Solution methods, Solution by direct integration.

UNIT - 2 (16 hours)

Interface Conditions: Interface conditions between two dielectrics, Interface conditions between dielectrics and conductors.
Capacitance: Parallel plate capacitor, Capacitance of infinite structures.
Conduction and Convection Current Density: Convection current and convection current density, Conduction current and Conduction current density, Power dissipation and Joule's law, The continuity equation.
The Static Magnetic Field: Magnetic Field, Magnetic Field Intensity, Magnetic Flux Density and Magnetic Flux, Postulates of static Magnetic field, Magnetic Vector potential, Magnetic Scalar potential, Magnetic Dipole, Biot Savart Law, Ampere's circuital Law. Behaviour of Magnetic Materials, Diamagnetic and Ferromagnetic materials.
Magnetic Circuits: Magnetomotive force, Magnetic reluctance, Forces in the magnetic field. Energy stored in the magnetic field.

UNIT - 3 (16 hours)

Magnetostatic energy in terms of fields. Time varying Electric and Magnetic fields: Faraday's Law, Lenz's Law, Electromotive force, Eddy currents. Maxwell's Equations: Continuity equation for time varying fields, Displacement current density, Generalized Ampere's Law, Maxwell's equations in differential, integral and time harmonic representation.
Interface Conditions for Electromagnetic Field: Interface condition for the electric field, interface condition for the magnetic field.
Electromagnetic Wave Equation and its Solution: Electromagnetic waves, Time dependent wave equation, Time Harmonic Wave Equation, Solution of the wave equation for uniform plane waves in free space, perfect dielectrics.
Poynting's Theorem: Poynting vector, Complex Poynting vector, Electromagnetic power density.
Propagation of Plane waves in Materials.

UNIT - 4 (16 hours)

Propagation of plane waves in lossy dielectrics, low loss dielectrics and conductors, Concept of Phase and Group velocity. Polarization of Plane Waves: Concept of Polarization, Linear, Elliptical and Circular Polarization.
Reflection and Transmission of Plane Waves: Reflection and Transmission at a General Dielectric Interface with Normal Incidence, Standing Waves,
Guided Waves: Waves between parallel planes; Transverse electric (TE) waves, Transverse magnetic (TM) waves; Characteristics of TE and TM waves; Transverse electromagnetic (TEM) waves; Velocities of propagation.

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Recommended Readings:

1. M. Sadiku; Elements of Electromagnetics, 4th edition; Oxford University Press.
2. E. C. Jordan, K. G. Balmain; Electromagnetic Waves & Radiating Systems; PHI.
3. J. D. Kraus; Electromagnetics 5th Edition; McGraw Hill.
4. N. Ida; Engineering Electromagnetics, 2nd Edition; Springer International Edition.
5. J. Edminister; Theory and Problems in Electromagnetics; Schaum Series, McGraw Hill.
6. D. K. Cheng; Field and Wave Electromagnetics, Second Edition; Pearson Education.
7. W. H. Hayt, J. A. Buck; Engineering Electromagnetics, Seventh Edition; Tata McGraw Hill Edition.

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments. Term Work marks to be awarded based on the assessment of the experiments conducted.)

1. Divergence and Curl of a vector
2. Stoke's theorem
3. Helmholtz's theorem
4. Coulomb's Law
5. Boundary value problems
6. Capacitance
7. Energy in electrostatic field
8. Interface conditions between dielectrics and conductors
9. Biot Savart Law, Ampere's circuital Law
10. Maxwell's Equations
11. Poynting's theorem
12. Propagation of Plane waves in free space
13. Propagation of Plane waves in Materials
14. TE & TM waves
15. TEM waves

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ETC/ECE 4.4 ELECTRONIC DEVICES AND CIRCUITS - II

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 4.4	Electronic Devices and Circuits - II	3	1	2	3	100	25	--	--	25	150

Course Objectives:
The subject aims to provide the student with:

1. An understanding of feedback mechanism and its application in amplifier and oscillator circuits.
2. Ability to design RC differentiator, integrator, Multivibrator and Schmitt trigger circuits.
3. Ability to perform analysis of JFET and MOSFET biasing circuits.
4. An understanding of power devices and Oscilloscope.

Course Outcomes:
The student after undergoing this course will be able to:
1. Analyse the different configurations of negative feedback in amplifier circuits.
2. Design different types of oscillator circuits.
3. Design RC Differentiator and Integrator circuits.
4. Design different types of Multivibrator circuits.
5. Analyze JFET and MOSFET biasing for various configurations.
6. Explain the construction and working of Power Electronic and Opto-electronic Devices.
7. Explain the working of PUT, LED, LCD and CRO.

UNIT - 1   (12 hours)

Principle of negative feedback in amplifiers, voltage series, voltage shunt, current series, current shunt types of feedback. Typical transistor circuit effect of negative feedback on input and output impedance, voltage and current gains, bandwidth, noise and distortion.
Principle of positive feedback, concept of feedback and stability in electronic circuits, the Nyquist Criterion, Gain and Phase Margin, Sinusoidal Oscillators, Barkhausen criterion, various types of oscillators – RC, Clapps, Wein Bridge, Colpitt, Hartley, Tuned LC.

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UNIT - 2 (12 hours)

Steady state response of RC differentiator & integrating circuits to square wave, BJT as a switch, Junction & Diffusion Capacitance of a BJT, Improving switching times.
Analysis & Design of Basic BJT Monostable Multivibrator, BJT Bistable Multivibrator, BJT Astable Multivibrator and BJT Schmitt trigger.

UNIT - 3 (12 hours)

FET BIASING: (JFETs and Depletion –type FET) -Fixed-Bias, Self-Bias and Voltage-Divider Bias Configurations(both n- and pchannel); Enhancement-Type MOSFETs-Feedback Biasing Arrangement, Voltage –Divider Biasing Arrangement.
Sampling Gates: UJT, JFET and MOSFET Sampling gate, Sample & Hold circuits. Transistor bootstrap ramp generator.

UNIT - 4 (12 hours)

Power diode, SCR, Diac, Triac, SCS, GTO, Light activated SCR.
UPS, Normally ON and Normally OFF configurations,
Photo diode, Photoconductive cells, IR emitters, Solar Cells, Phototransistor, Opto-isolator, PUT, LCD and LED.
Working of CRO and measurements using CRO.

Recommended Readings:

1. J. Millman, C. Halkias, Satyabrata Jit, Electronic Devices and Circuits, McGraw Hill.
2. R. Boylestad, L. Nashelsky; Electronic Devices and Circuits, PHI.
3. P. S. Bimbhra; Power Electronics – Khanna Publishers.
4. David Bell; Solid State Pulse Circuits; Oxford University Press.
5. Garud, Jain; Electronic Devices & Linear circuits; Tata McGraw Hill.
6. J.B Gupta; Electronic Devices and Circuits; S. K. Kataria & Sons.
7. A. Mottershead; Electronic Devices and Circuits; PHI.
8. Mohd. Rasheed; Power Electronic Circuits, Devices and Applications; Pearson Education.

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. Voltage series, voltage shunt, current series, current shunt types of feedback
2. RC & LC oscillator
3. Clapps oscillator
4. Wein Bridge oscillator
5. Colpitt oscillator

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6. Hartley oscillator
7. Steady state response of RC differentiator & integrating circuits
8. Design of Basic BJT Monostable Multivibrator
9. Design of Basic BJT Bistable Multivibrator
10. Design of Basic BJT Astable Multivibrator
11. Design of BJT Schmitt trigger
12. Fixed- Bias, Self-Bias and Voltage-Divider Bias Configuration for FET
13. Sample & Hold circuits
14. SCR
15. Measurements using CRO

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ETC/ECE 4.5 LINEAR INTEGRATED CIRCUITS

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 4.5	Linear Integrated Circuits	3	1	2	3	100	25	--	--	25	150

Course Objectives :

The subject aims to provide the student with:

1. An understanding of the basic principles, configurations and practical limitations of op-amps.
2. Ability to design op-amp circuits, Voltage regulators, A/D and D/A converters.
3. An understanding of the basic principles of VCO and PLL.
4. Ability to design circuits using 555 timer IC.

Course Outcomes:

The student after undergoing this course will be able to:
1. Analyze the working of differential amplifier configurations.
2. Design amplifiers, filters, comparator, oscillator, multivibrator and arithmetic circuits using Op-amp.
3. Design fixed and variable voltage regulator circuits for given applications.
4. Design Analog to Digital and digital to analog converters using Op-amp.
5. Explain the working of Voltage controlled oscillator and phased locked loop.
6. Design timing circuits using IC 555.

<u>UNIT - 1</u> (12 hours)

Basics of Op-Amp: Differential amplifiers, ac and dc analysis, FET differential amplifier, constant current bias, current mirror circuit, op-amp parameters, definitions, measurements.
Functional block diagram and working specification of IC741, equivalent circuit of Op-amp and voltage transfer curve, open loop inverting, non-inverting, differential amplifier. Disadvantages of open loop op-amp

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Basics of Op-Amp: Frequency response and methods of frequency compensation, offset compensation, closed loop inverting and non-inverting amplifiers, voltage follower.

Applications of op-amp: Differentiator, integrator, summing scaling and averaging amplifier.

UNIT - 2 (12 hours)

Applications of Op-Amp: Instrumentation amplifier, V-I & I-V converter, precision rectifier, log and antilog amplifier.

Op-Amps as comparators, zero crossing detectors, Schmitt trigger, comparator characteristics, limitations of comparator, sample and hold circuit.

Applications of Op-Amp: Advantages of active filter, Butterworth low pass, high pass, band pass, band reject filter, design problems.

Square wave generator, triangular wave generator, Wien bridge oscillator, Phase shift oscillators, design problems.

UNIT - 3 (12 hours)

Voltage Regulators: Specifications, functional block diagrams of IC 723, Design of IC 723 as

High and low voltage regulators.

Specifications, three terminal regulators-IC78XX, 79XX, LM309, LM317 voltage regulator and tracking regulator, principles and working of switching mode regulators.

Introduction to resolution and accuracy in convertors, quantization error.

ADC and DAC: Principle of successive approximation, successive approximation ADC.

Binary weighted resistors and R-2R resistor ladder design problems, specifications, functional block diagrams of 0809 & 0808.

UNIT - 4 (12 hours)

Voltage controlled oscillator IC566: block diagram of IC566.

PLL: Basic principles of phase-locked loop and block diagram, transfer characteristics of PLL, lock range and capture range (no derivations).

Applications of PLL as frequency multiplier, AM demodulation, FM demodulation, Study of PLLIC565 and design problems.

IC 555: Functional block diagram and specification, modes of IC555, applications of IC555 as monostable and astable multivibrator, design problems, modification for 50% duty cycle

Applications of IC 555 as VCO, missing pulse detector, frequency divider, PWM, IC 8038 and its applications in waveforms generation.

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Recommended Readings:

1. R. Gayakwad; Op-Amps and linear integrated circuits; Prentice Hall of India Pvt. Ltd.
2. K. R. Botkar; Integrated Circuits; Khanna Publishers.
3. J. Millman, C. Halkias; Integrated Electronics: Analog and Digital Circuits System; McGraw Hill.
4. S. Franco; Design with operational amplifiers and analog integrated circuits; McGraw Hill.

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. Current mirror circuit
2. Open loop inverting and non-inverting circuit
3. Application of op-amp: Differentiator, Integrator
4. Application of op-amp: Summing, Scaling and Averaging amplifier
5. Application of op-amp: Instrumentation amplifier
6. Application of op-amp: Op-amps as comparator
7. Application of op-amp: Square wave generator, triangular wave generator
8. Application of op-amp: Active filter
9. Application of op-amp: oscillator
10. Application of op-amp: ADC & DAC
11. Design of Voltage Regulators
12. Design of Voltage controlled oscillator IC566
13. Design of phase-locked loop
14. Applications of IC 555
15. IC 8038

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ETC/ECE 4.6 MICROPROCESSORS AND INTERFACING

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
					Th Duration (Hrs)	Marks					
		L	T	P		Th	S	TW	O	P	Total
ETC/ECE 4.6	Microprocessors and Interfacing	3	1	2	3	100	25	--	--	25	150

Course Objectives:
The subject aims to provide the student with:
1. An in-depth understanding of the Intel 8085 architecture and programming model.
2. An ability to write Assembly language programs for a given task.
3. An understanding of different types of memories, peripheral IC's like 8255, 8259 and 8251and their interfacing with the processor.
4. An ability to interface various I/O devices with the processor.

Course Outcomes:
The student after undergoing this course will be able to:
1. Describe the architecture and explain the working of each block in 8085 processor.
2. Analyze the instruction set of 8085 processor.
3. Analyze the timing sequence of various instructions.
4. Create Assembly language programs for a given task.
5. Explain the basic programmable ICs like 8255, 8259 and 8251.
6. Design interfacing of memories and various I/O devices with the processor.

UNIT - 1   (12 hours)

Introduction of Microcomputer System: CPU, I/O devices, clock, memory, bus architecture, tri-state logic, address bus, data bus and control bus.

Semiconductor Memories: Development of semiconductor memory, internal structure and decoding, memory read and write timing diagrams, RAM, ROM, EPROM, EEPROM, DRAM.

Architecture of 8-bit Microprocessor: Intel 8085A microprocessor, Pin description and internal architecture.

Operation and Control of Microprocessor: Timing and control unit, op-code fetch machine cycle, memory read/write machine cycles, I/O read/write machine Cycles, interrupt acknowledge machine cycle.

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UNIT - 2 (12 hours)

Instruction Set: Addressing modes; Data transfer, arithmetic, logical, branch, stack and machine control groups of instruction set, Subroutines, parameter passing to subroutines. Writing, Assembling & Executing A Program, Debugging The Programs, Decision Making, Looping, Stack & Subroutines, Developing Counters And Time Delay Routines, Code Conversion, BCD Arithmetic And 16-Bit Data Operations.

UNIT - 3 (12 hours)

Interfacing: Interfacing of memory chips, address allocation technique and decoding; Interfacing of I/O devices, LEDs, and toggle-switches as examples, memory mapped and isolated I/O structure.

Programmable Peripheral Interface: Intel 8255, pin configuration and block diagram, modes of operation, programming; ADC and DAC chips, stepper motor their interfacing and programming.

UNIT - 4 (12 hours)

Interrupts: Interrupt structure of 8085A microprocessor, processing of vectored and non-vectored interrupts, Handling multiple interrupts, and programming.

Programmable Interrupt Controller: Intel 8259, Block diagram, Interrupt operation, programming.

Serial I/O Concepts, SID and SOD, Intel 8251A programmable communication Interface, pin configuration, internal block diagram, programming.

Recommended Readings:

1. Gaonkar R. S.; "Microprocessor Architecture, Programming and Applications"; 5th Ed.; Penram International; 2007.
2. Hall D. V.; "Microprocessor and Interfacing-Programming and Hardware"; 2nd Ed.; Tata McGraw-Hill Publishing Company Limited; 2008.
3. Stewart J; "Microprocessor Systems- Hardware, Software and Programming"; Prentice Hall International Edition; 1990.
4. Short K. L.; "Microprocessors and Programmed Logic"; 2nd Ed.; Pearson Education; 2008.
5. Manual on 8-bit Processors 808; Intel.
6. Manual on Peripheral Devices; Intel.

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List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. Writing programs using Data Transfer and arithmetic
2. Writing programs using logical and branch instructions
3. Writing Subroutines and passing parameters to subroutines
4. Developing Counters and Time Delay Routines
5. Developing programs for Code Conversion
6. Developing programs for BCD Arithmetic
7. Developing programs for 16-Bit Data Operations
8. Interfacing of memory chips
9. Interfacing of I/O devices: LEDs and toggle-switches
10. Interfacing Intel 8255
11. Interfacing ADC and DAC chips
12. Interfacing Stepper motor
13. Interrupt Programming
14. Interfacing Intel 8259
15. Interfacing Intel 8251

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ETC/ECE 5.1 DIGITAL SIGNAL PROCESSING

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 5.1	Digital Signal Processing	3	1	2	3	100	25	25	--	--	150

Course Objectives:

The subject aims to provide the student with:
1. Ability to perform frequency domain analysis of LTI systems.
2. Ability to compute Discrete Fourier Transform and Fast Fourier Transform of a time domain signal.
3. Ability to design Infinite Impulse Response Filters and Finite Impulse Response filters.
4. An understanding of sampling rate conversion and its applications.

Course Outcomes:

The student after undergoing this course will be able to:
1. Perform frequency domain analysis of LTI systems.
2. Analyze phase response of LTI system.
3. Compute DFT and FFT of a signal.
4. Analyze the effect of causality in designing practical filters.
5. Explain the advantages and disadvantages of IIR and FIR Filter.
6. Design IIR Filter and FIR filter.
7. Explain the need and applications of sampling rate conversion.

UNIT - 1 (12 hours)

Sampling of continuous time signals: Periodic sampling; Frequency domain representation of sampling; Reconstruction of a band limited Signal from its samples; Discrete-time processing of Continuous time signals;
Continuous time processing of discrete time signals; changing the sampling rate using discrete time processing.
Transform analysis of LTI systems: Introduction, Frequency response of LTI systems, system functions for systems characterized by linear constant coefficient difference,
Frequency response for rational system functions, relationship between magnitude and phase, All-pass systems, minimum phase systems, Linear systems with generalized linear phase; systems with linear phase.

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UNIT - 2   (12 hours)

The Discrete Fourier transform: Introduction, Representation of periodic sequences: The Discrete Fourier Series, Properties of the Discrete Fourier series, Fourier transform of periodic signals; sampling the Fourier transform, Discrete Fourier transform, Properties of Discrete Fourier Transform, Linear Convolution using the DFT. Computation of the Discrete Fourier transform, efficient computation of DFT, Decimation-in-time FFT (in-place computations), Decimation-in-frequency FFT (in-place computations).

UNIT - 3   (12 hours)

Structures for discrete-time systems: Block diagram representation of linear constant-coefficient difference equations; Signal flow graph representation; Basic structures of IIR systems: Direct, cascade, parallel; Transposed forms; Basic network structures for FIR systems: Direct Cascade, Structures for linear-phase FIR systems, causal generalized linear-phase systems.

Filter design techniques: Design of Discrete-time IIR filters from continuous-time filters; Filter design by impulse invariance, bilinear transformation, Examples of bilinear transformation design, Butterworth, Chebyshev filter design.

UNIT - 4   (12 hours)

Design of FIR filters by windowing: Properties of commonly used windows, incorporation of generalized linear phase, the Kaiser window filter design method
Examples of FIR filter design by the Kaiser Window methods
Optimum approximations of FIR filters; optimal type I low pass filters, optimum type II low pass filters. Characteristics of optimum FIR filters, Examples of equiripple approximation: lowpass filter.
Multirate Signal Processing: Interchange filtering and down sampling/up sampling; Polyphase decompositions; Polyphase implementation of decimation filters, Polyphase implementation of interpolation filters.

Recommended Readings:

1. A. V. Oppenheim, R. W. Schafer; Discrete-Time Signal Processing; Pearson
2. J. G. Proakis, D. G. Manolakis; Digital Signal Processing: Principles, Algorithms, and Applications ; Pearson
3. S Salivahanan; Digital Signal Processing, 3rd Ed.; McGraw Hill Education

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. To plot the magnitude and phase response of various signals.
2. To study the frequency response of second order resonator, notch filter, averaging filter, comb filter and allpass systems.

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3. To observe the effect of a linear and non-linear phase response on signals.
4. To find and plot the DTFT of signals
5. To study the effect of linear and circular convolution on signal
6. To find and plot DFT of signal
7. To design a butterworth filter using impulse invariance method and bilnear transformation
8. To design a chebyshev filter using impulse invariance method and bilnear transformation
9. To deisgn a FIR filter using windowing
10. To deisgn a FIR filter using frequency sampling method.

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ETC/ECE 5.2 TRANSMISSION LINES & ANTENNAS

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 5.2	Transmission Lines & Antennas	3	1	--	3	100	25	--	--	--	125

Course Objectives:

The subject aims to provide the student with:

1. An understanding of Transmission Lines under different Terminal Conditions.
2. An understanding of Transmission Lines at Radio Frequency and Matching of Transmission Lines under different loads.
3. An understanding of the Antenna Concepts and Parameters.
4. An understanding of Antenna Arrays and Analysis of Field Patterns.

Course Outcomes:

The student after undergoing this course will be able to:

1. Analyze the working of Transmission Lines under different Terminal Conditions.
2. Analyze the Transmission Lines at Radio Frequency.
3. Estimate proper Matching of Transmission Lines using Smith Chart.
4. Analyze the working of different types of antennas.
5. Compute radiation pattern and Directivity for different types of field Patterns.

UNIT - 1   (12 hours)

Transmission-Line Theory: A line of cascaded T-sections (line constants: Z, Y, characteristic impedance Z_o, propagation constant).

The transmission line-general solution; physical significance of the equations, infinite line, Wavelength, velocity of propagation.

The distortion less line, Reflection on a line not terminated in Z_o (Voltage and current-phasors), Reflection coefficient, Input and transfer impedance, Open- and short-circuited lines.

UNIT - 2   (12 hours)

The Line At Radio Frequencies: Introduction, Constants for the line of zero dissipation (Lossless Lines), Voltages and currents on the dissipation less line (Voltage and Current phasors on the line for various terminations);

Standing waves, nodes, standing wave ratio (SWR), Directional Coupler.

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Input-impedance of the dissipation less line: Input impedance of open- and short circuited lines, Power and Impedance measurement on lines, Reflection losses on the unmatched line.

The quarter-wave line, half-wave line, eighth-wave line.

The Smith circle diagram, Applications of the Smith chart; matching with the Smith chart.

UNIT - 3 (12 hours)

Basic Antenna Concepts: Antenna Parameters, Antenna Aperture and Aperture Efficiency, Effective Height, Maximum Effective Aperture of a Short Dipole and a Linear Half-Wave Antenna, Friss transmission formula.

Point Sources, Power patterns, Power theorem, radiation intensity, different power patterns (Unidirectional and bi-directional cosine, sine, sine-squared, cosine squared and (cosine) ^{n}.

The short electric dipole: Retarded vector potential, fields and radiation resistance, Radiation resistance of a half wave dipole and half wave antennas.

UNIT - 4 (12 hours)

Various forms of Antenna arrays, Arrays of point sources: Isotropic point sources of: (i) same amplitude and phase (ii) same amplitude but opposite phase (iii) same amplitude and in phase quadrature (iv) equal amplitude and any phase (v) unequal amplitude and any phase.

Patterns multiplication: Radiation pattern of four and eight isotropic elements fed in phase.

Linear array: Linear array with n isotropic point sources with equal amplitude and spacing; Broadside case; End-fire case, End fire array with increased directivity, scanning array.

Loop antenna: Field of a small loop, field pattern of circular and square loop

Helical Antenna: Geometry, Transmission and radiation modes, Practical design considerations.

Construction and Characteristics of: Horn antennas (Rectangular and Conical), Reflector antennas: Corner, paraboloidal, Cassegrain feed, Lens antennas, Yagi-Uda array, V- and Rhombic-antenna.

Patch or Microstrip Antennas, Rectangular patch, square patch.

Recommended Readings:

1. J.D. Ryder; Networks, Lines and Fields; PHI.
2. J.D. Kraus; Antennas and Wave Propagation; McGraw Hill Education.
3. K. D. Prasad; Antenna & Wave Propagation; Satya Prakashan
4. E.C. Jordan, K. G. Balmain; Electromagnetic Waves & Radiating Systems; PHI.
5. George Kennedy; Electronic Communication Systems, 3rd Edition; Tata McGraw Hill
6. Ramo & Whinnery; Fields and Waves in Communication Circuits; John Wiley & Sons.

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ETC/ECE 5.3 CONTROL SYSTEMS ENGINEERING

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 5.3	Control Systems Engineering	3	1	--	3	100	25	--	--	--	125

Course Objectives:

The subject aims to provide the student with:
1. An understanding of basic control system components, signal flow graphs and transfer functions.
2. An ability to evaluate stability of any given system model.
3. An ability to perform frequency domain stability analysis.
4. An ability to design compensators and controllers for a given application.

Course Outcomes:

The student after undergoing this course will be able to:
1. Differentiate between open and close loop system.
2. Analyze the signal flow graph and models representing systems and determine its transfer function.
3. Compute transient and steady state response of stable control systems.
4. Predict the stability of system by using root locus and Routh-Hurwitz criteria.
5. Predict the stability of system by using Nyquist criterion, bode plot and polar plot.
6. Analyze the systems using state space variables.
7. Design a compensator in time domain and in frequency domain.
8. Select appropriate controller for a given control application.

<u>UNIT - 1</u>   (12 hours)

Introduction to control systems: Types of control systems, Examples of Control systems, basic concept of open-loop and closed-loop control systems;

Mathematical modeling and representation of mechanical (translational & rotational) and electrical systems.

Conversion of mechanical to analogous electrical systems (force-voltage and force- current analogy);

Block diagrams; Signal flow graphs and transfer functions.

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UNIT - 2   (12 hours)

Standard Test Inputs, Transient response of first and second order systems; Type -0, -1 and -2 control systems. Steady state error and error co-efficient; Effects of proportional, derivative and integral systems.

Stability: Stability concept, Routh-Hurwitz criteria; Root-locus techniques.

UNIT - 3   (12 hours)

State space variable Analysis: Concept of state, state variable and state model. State space representation of continuous time LTI system.

Frequency-domain analysis: Correlation between time and frequency response, Polar-plots, Bode-plots, Nyquist-plots; Relative stability using Nyquist-plot.

UNIT - 4   (12 hours)

Compensators: Concept of compensators; types of compensators; Design of Cascade compensator in time domain- Lead, Lag and Lead-Lag compensation;

Design of Cascade compensator in frequency; domain -Lead, Lag and Lead-Lag compensation.

Introduction to Controllers: PI, PD and PID controllers. Ziegler–Nichols rules for tuning PID Controllers.

Recommended Readings:

1. M. Gopal; Control Systems-Principles and Design; Tata Mc Graw Hill
2. K. Ogata; Modern Control Engineering; PHI
3. I. J. Nagrath and M. Gopal; Control Systems Engineering; The New Age International
4. A. Nagoor Kani; Control Systems; RBA Publications, Chennai
5. D. Roy Choudhry; Modern Control Engineering; PHI
6. Salivahanan S.; Control Systems Engineering; Pearson Education

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ETC/ECE 5.4 EMBEDDED SYSTEMS

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 5.4	Embedded Systems	3	1	2	3	100	25	--	--	25	150

Course Objectives:

The subject aims to provide the student with:
1. An understanding of architecture and programming of 8051 microcontroller.
2. An ability to interface external devices with 8051.
3. An understanding of architecture and programming of PIC18 microcontroller.
4. An ability to interface external devices with PIC18.

Course Outcomes:

The student after undergoing this course will be able to:
1. Describe the features of 8051 and PIC18 microcontroller.
2. Select appropriate microcontroller for different applications.
3. Interface microcontroller with hardware for a given application.
4. Write and execute assembly language programs for a given application.
5. Design and implement microcontroller based applications.

UNIT - 1 (12 hours)

8051 architecture: Overview of 8051 Family, Data types and directives , Flag bits, PSW register, Register banks and stacks, Addressing modes, Assembly language programming ,JUMP ,LOOP and CALL instructions, Arithmetic instructions, Logic instruction ,Bit instructions , I/O port programming , Bit manipulation instructions.

UNIT - 2 (12 hours)

Interrupts and Interfacing: Timer/Counter basics and   programming , Serial communication basics and programming , 8051 connection to RS232, basics of interrupts and programming timer interrupts, external hardware interrupts and serial communication interrupts, Interrupt Priority , Interfacing of LCD,ADC, Stepper motor, Keyboard, DAC and External memory to 8051 .

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UNIT - 3 (12 hours)

PIC 18 Architecture: Block diagram, WREG, PIC File Register, Using Instructions with the default Access bank, PIC Status Register, PIC Data Format & Directives, Introduction to PIC Assembly language Programming, The Program Counter and Program ROM space in the PIC, Harvard and RISC Architecture in the PIC, Branch Instructions & Looping, Call Instructions & Stack, PIC 18 Time Delay and Instruction Pipeline, PIC I/O Port programming, I/O Bit Manipulation Programming.

UNIT - 4 (12 hours)

Arithmetic, Logic Instructions and Programs, Bank Switching: Addressing Modes, Look-up Table and Table Processing. PIC 18 Timer Programming in Assembly: Programming Timers 0,1,2 and 3, Counter Programming, Timers 2 & 3,PIC 18 Serial Programming in Assembly, PIC18 Interrupts, Interrupt Programming in Assembly, PortB-Change Interrupt, CCP Programming: Compare Mode Programming, Capture Mode Programming, PWM Programming, SPI Bus Protocol.

Recommended Readings:

1. Muhammad Ali Mazidi, Janice Gillispie Mazidi; The 8051 Microcontroller and Embedded systems; Pearson Education
2. Muhammad Ali Mazidi, Rolind D. Mckinlay, Danny Causey; PIC Microcontroller and Embedded Systems Using Assembly & C for PIC18; Pearson Education
3. Kenneth J. Ayala; The 8051 Microcontroller, Architecture, Programming & applications, second edition; Penram International.
4. Barry B. Brey; Applying PIC18 Microcontrollers: Architecture, Programming, and Interfacing using C and Assembly; Prentice Hall

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1) Using 8051
   i. Basic Programs
   ii. Using Branch Instructions
   iii. Using Call Instructions
   iv. Generating Time delays
   v. I/O Programming
   vi. Timer Programming
   vii. Serial Port Programming
   viii. Interrupt programming
2) Using PIC 18
   i. Basic Programs

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ii. Using Branch Instructions
iii. Using Call Instructions
iv. Generating Time delays
v. I/O Programming
vi. Timer Programming
vii. Serial Port Programming
viii. Interrupt programming

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ETC/ECE 5.5 VLSI DESIGN AND TECHNOLOGY

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 5.5	VLSI Design And Technology	4	--	2	3	100	25	--	--	25	150

Course Objectives:

The subject aims to provide the student with:

1. An in depth knowledge of the MOSFET operation and the ability to derive the threshold voltage & current equations.
2. An understanding of the theory of CMOS Inverter and Switching characteristics and the capability to write SPICE programs for various circuits.
3. The capability to design combinational circuits in CMOS logic and draw Layouts for the same and design circuits using VHDL.
4. An understanding of the various processes involved in VLSI technology and chip fabrication and the various methods of testing circuits.

Course Outcomes:

The student after undergoing this course will be able to:

1. Calculate the threshold voltage for a given MOSFET and obtain the value of Drain current for any given biasing condition.
2. Analyze the effects of narrow channel and short channel on device characteristics.
3. Calculate the voltage parameters and noise margin of a CMOS Inverter and also explain its switching characteristics.
4. Write the SPICE program for modeling MOSFET circuits.
5. Implement complex combinational functions in CMOS logic and draw the Layout for the same.
6. Design simple Combinational and Sequential circuits using VHDL.
7. Explain the various MOSFET fabrication processes and explain the Design for Testability methods.
8. Compute the Test pattern which will detect faults in a given circuit.

<u>UNIT - 1</u>   (16 hours)

MOS transistors: Structures, MOS system under external bias, operation of MOS transistor (MOSFET),

MOS transistors: Threshold voltage MOSFET current-voltage characteristics (CGA), channel length modulation, substrate bias effect.

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Measurements of parameters – KN, VTP & γ. Short channel effects, Narrow channel effects. Latch up and its prevention. MOSFET capacitances.

UNIT - 2 (16 hours)

Modeling of MOS transistor circuits using SPICE. (Level 1 model equations).
MOS Inverters: Static load MOS Inverters.
CMOS inverter design: operation, DC characteristics, calculation of VIL, VIH, VTH, VOH and VOL. Noise margins power and area considerations.
Switching Circuit Characteristics: Rise, fall and delay time, gate delays, transistor sizing, static and dynamic power dissipations CMOS logic gate design: Fan in and fan out.

UNIT - 3 (16 hours)

MOS transistor switches: CMOS logic- Inverter, NOR, NAND and combinational logic, Compound gates, Multiplexers, Transmission gates, Latches and Registers.
Implementation of Boolean Expressions using transmission gates and CMOS logic.
NOR, NAND layouts (Euler paths).
Complex logic gates and their layouts (Euler paths),
MOSIS layout design rules (full-custom mask layout designs), stick diagrams. Layout editors (Magic/Micro Wind) and circuit extraction.
Introduction to VHDL language. VHDL Programs and test benches for Adder, Subtractor, Decoder, Encoder, Multiplexer, Demultiplexer, Flip Flops, Registers and Counters.

UNIT - 4 (16 hours)

Silicon semiconductor technology: Wafer processing, oxidation, epitaxy, deposition, etching, Photo-Lithography, Ion-implantation and diffusion. Silicon gate process. Chemical Vapor Deposition.
Basic CMOS technology: n-well and p-well CMOS process. Silicon on insulator
Testing: Test procedure, Design for Testability (DFT) Scan – Based test, Boundary- Scan design, Built in self-test (BIST).Automatic Test-Pattern generation (ATPG),   fault models, fault simulation.

Recommended Readings:

1. Sung-Mo (Steve) Kang , Yusuf Leblebici; CMOS Digital Integrated Circuits Analysis & Design; McGraw-Hill Education
2. Neil Weste, David Harris; CMOS VLSI Design: A Circuits and Systems Perspective; Pearson
3. Jan M. Rabaey; Digital Integrated Circuits – A Design perspective; Pearson Education
4. Bhaskar; VHDL Primer; PHI
5. Stephen Brown, Zvonco Vranesic; Fundamentals of Digital logic with VHDL design; McGraw-Hill Education
6. Wayne Wolf; Modern VLSI design (Systems on Silicon); PHI

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List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. SPICE program for Inverter VTC.
2. SPICE program for parameter measurement KN, VTP & γ.
3. SPICE program for NAND gate.
4. SPICE program for NOR gate.
5. SPICE program for channel length modulation effect.
6. SPICE program for Transmission Gate.
7. VHDL programs for Combinational circuits.
8. VHDL programs for sequential circuits.
9. MAGIC layout for Inverter and parameter extraction in SPICE.
10. MAGIC layout for NAND and parameter extraction in SPICE.
11. MAGIC layout for XOR and parameter extraction in SPICE.
12. MAGIC layout for XNOR and parameter extraction in SPICE.
13. MAGIC layout for Boolean function f = ((A+B)(C+D)) 'and parameter extraction in SPICE .
14. MAGIC layout for Boolean function f=((AB)+(CD)) 'and parameter extraction in SPICE
15. MAGIC layout for 2x1 MUX in Transmission Gates.

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ETC/ECE 5.6 ANALOG COMMUNICATION

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 5.6	Analog Communication	4	--	2	3	100	25	--	25	--	150

Course Objectives:

The subject aims to provide the student with:
1. An understanding of basic analog communication systems and their components.
2. An ability to solve problems related to design of analog modulation schemes.
3. The capability to design simple analog modulation systems.
4. An understanding of effect of noise on analog communication systems.

Course Outcomes:

The student after undergoing this course will be able to:
1. Assess and calculate key frequency and time domain design parameters for analog modulation schemes.
2. Design block level and circuit level systems for analog modulation and demodulation.
3. Quantitatively assess the impact of noise in analog communication systems.
4. Design block-level systems for super heterodyne receiver with auxiliary circuits and pulse modulation and demodulation circuits.

UNIT - 1 (16 hours)

Amplitude modulation: DSB-FC, DSB-SC, SSB, modulation and demodulation. Spectrum, power and efficiency. Implementation of amplitude modulators and demodulators. DSBSC-Balanced modulator, coherent detection of DSBSC, squaring loop detection. SSB-SC- Phase Shift and Third method of generation. Coherent detection of SSBSC.

Carrier acquisition – Phase locked loop, in DSB-SC and in SSB-SC. Signal multiplexing: FDM and TDM. AM Broadcasting: Radio transmitter and Receiver.

UNIT - 2 (16 hours)

Angle modulation: FM and PM signals, Relationship between frequency and phase modulation. Tone modulated FM. Arbitrary modulated FM. Spectrum of FM and PM, Implementation of angle modulators and demodulators: Direct method using FET, Armstrong method of generation. Slope detector, Foster-Seelay Discriminator, Ratio detector. FM broadcasting, FM stereo broadcasting.

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UNIT - 3   (16 hours)

Sources of Noise: Shot noise, resistor noise. Calculation of noise in linear systems. Noise bandwidth. Noise temperature, Noise figure, measurement of noise figure. Narrowband noise.

Effect of noise in DSB-SC, Effect of noise in SSB-SC.

Noise in FM: AM FM receiving system, calculation of SNR, comparison of AM and FM, pre-emphasis and de-emphasis. Noise in phase modulation.

UNIT - 4   (16 hours)

Pulse modulation schemes: PAM, PPM and PWM, Generation and detection.

Transmitter and Receiver systems: AM and FM modulation and demodulation circuits, AM and FM transmitter receiver circuits, The phase locked loop. TRF and super heterodyne receivers, solid state circuits and design considerations for RF amplifiers, mixers, IF amplifiers, AGC, AFC, Amplitude limiter.

Recommended Readings:

1. George Kennedy; Electronic Communication Systems; Tata McGraw Hill
2. John G. Proakis , Masoud Salehi; Fundamentals of Communication Systems, 2nd Ed.; Pearson Education
3. Wayne Tomasi; Electronic Communications systems, 3rd Ed.; Pearson Education
4. Upamanyu Madhow; Introduction to Communication Systems; Cambridge University Press
5. R. P. Singh, S. Sapre; Communication systems: Analog and Digital, 3rd Ed.; Tata McGraw Hill
6. Dennis Roddy, John Coolen; Electronic communication system, 4th Ed.; Pearson Education
7. Simon Haykin; An Introduction To Analog And Digital Communications; John Wiley & Sons
8. Taub, Schilling, Saha; Principles of communication systems, 3rd Ed.; Tata McGraw Hill

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. DSB-FC AM Generation and demodulation
2. DSB-SC Generation and Demodulation
3. SSB AM Generation and Demodulation
4. FM generation and demodulation
5. AM/FM transmission and reception
6. RF amplifiers, mixers and IF amplifiers
7. PAM, PWM, PPM generation and detection
8. Effect of Noise in DSB-FC
9. Effect of Noise in DSB-SC
10. Effect of Noise in SSB
11. Effect of Noise in FM
12. AGC/AFC

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ETC/ECE 6.1 ELECTRONIC SYSTEM DESIGN AND MANUFACTURING

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 6.1	Electronic System Design and Manufacturing	4	--	2	3	100	25	25	--	--	150

Course Objectives:

The subject aims to provide the student with:

1. An introduction to the interference in electronic circuits.
2. An understanding of the effect of shield on circuits and filtering circuits for electronic systems.
3. An introduction to EMC compliance of passive components.
4. An understanding noise sources and their effects on electronic circuits and systems.
5. An understanding of rules for PCB layout.

Course Outcomes:

The student after undergoing this course will be able to:

1. Explain EMC regulations for military and commercial standards.
2. Design shielding circuits to prevent capacitive and inductive coupling.
3. Design filtering circuits for electronic systems.
4. Explain EMC compliance of capacitor and conductor.
5. Calculate S/N ratio and noise factor for various electronic circuits.
6. Explain ESD protection in equipment design.
7. Explain procedure for PCB layout and stackup.

<u>UNIT - 1</u>   (16 hours)

Electromagnetic Compatibility: Introduction, Noise and Interference, Designing for Electromagnetic Compatibility, Engineering Documentation and EMC, United States' EMC Regulations, European Union's EMC Requirements, Military Standards.

Cabling of Electronic Systems: Capacitive coupling, effect of shield on capacitive coupling, inductive coupling, effect of shield on inductive coupling, effect of shield on magnetic coupling, magnetic coupling between shield and inner conductor, shielding to prevent magnetic radiation, shielding a receptor against magnetic fields, coaxial cable versus shielded twisted pair, ribbon cables.

Grounding of Electronic Systems: Signal grounds, single-point ground systems, multipoint-point ground systems, hybrid grounds.

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UNIT - 2 (16 hours)

Balancing & Filtering in Electronic Systems: Balancing, power line filtering, power supply decoupling, decoupling filters, high frequency filtering, and system bandwidth.

EMC Compliance of Passive Components: Capacitors: Electrolytic Capacitors, Film Capacitors, Mica and Ceramic Capacitors, Feed-Through Capacitors, Paralleling Capacitors. Conductors: Inductance and resistance of Round and Rectangular Conductors.

UNIT - 3 (16 hours)

Intrinsic Noise Sources: Thermal Noise- Characteristics, Equivalent Noise Bandwidth, Shot Noise, Contact Noise, Popcorn Noise, Addition of Noise Voltages, Measuring Random Noise.

Active Device Noise: Noise Factor, Measurement of Noise Factor - Single-Frequency Method, Noise Diode Method, Calculating S/N Ratio and Input Noise Voltage from Noise Factor, Noise Voltage and Current Model, Measurement of V_n and I_n , Calculating Noise Factor and S/N Ratio from V_n-I_n, Optimum Source Resistance, Noise Factor of Cascaded Stages, Noise Temperature

Bipolar Transistor Noise: Transistor Noise Factor, V_n-I_n for Transistors.
Field-Effect Transistor Noise: FET Noise Factor, V_n-I_n Representation of FET Noise.
Noise in Operational Amplifiers: Methods of specifying Op-Amp Noise, Op-Amp Noise Factor.

UNIT - 4 (16 hours)

Protection Against Electrostatic Discharges (ESD): Static generation, human body model, static discharge, ESD protection in equipment design.

PCB Layout and Stackup: General PCB layout considerations: Partitioning, Keep out zones, critical signals, and system clocks. PCB-to-Chassis ground connection.
Return Path Discontinuities: Slots in Ground/Power Planes, Split Ground/Power Planes. PCB Layer stackup: One- and Two-Layer boards, multilayer boards, general PCB design procedure.

Recommended Readings:

1. Henry W. Ott; Electromagnetic Compatibility Engineering; John Wiley & Sons.
2. W Bosshart; Printed Circuit Boards - Design & Technology, 1st Edition; Tata McGraw Hill
3. Clayton R. Paul; Introduction to Electromagnetic Compatibility, 2nd Edition; Wiley.
4. Chetan Kathalay; A Practical Approach to Electromagnetic Compatibility -With Introduction to CE Marking (EMC SERIES), 2nd Ed.; EMC Publications.
5. Mark I. Montrose; Printed Circuit Board Design Techniques for EMC Compliance: A Handbook for Designers, 2nd Ed.; Wiley
6. Howard W. Johnson, Martin Graham; High Speed Digital Design: A Handbook of Black Magic,1st Ed. ; Pearson Education

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Term Work:

Term work shall consist of following assignments (or related work)

1. Noise and Interference.
2. United States' EMC Regulations.
3. European Union's EMC Requirements.
4. Inductive coupling.
5. Capacitive coupling.
6. Capacitors.
7. Conductors.
8. Intrinsic Noise Sources.
9. Noise Factor.
10. Transistor Noise Factor.
11. FET Noise Factor.
12. Static discharge.
13. ESD protection in equipment design.
14. Multilayer Boards.
15. General PCB Design Procedure.

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. Selection of a mini project.
2. Understanding Datasheet of the components.
3. Soldering.
4. Schematic Design.
5. Layout Design.
6. Fabrication of PCB.
7. Component mounting and soldering on PCB.
8. Inspection and testing of PCB.
9. Calibration.
10. Rework/ Repairs.

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ETC/ECE 6.2 HIGH PERFORMANCE COMPUTING ARCHITECTURES

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 6.2	High Performance Computing Architectures	4	--	2	3	100	25	--	--	--	125

Course Objectives:

The subject aims to provide the student with:
1. An ability to write Verilog Hardware Descriptor Language programs.
2. An ability to program FPGA's with Verilog.
3. A detailed introduction to general purpose graphical processing units.
4. An ability to write CUDA programs for performing matrix multiplication.

Course Outcomes:

The student after undergoing this course will be able to:
1. Write programs to design circuits using Verilog Hardware Description Language.
2. Explain in detail the architecture of popular High Performance FPGA's.
3. Implement and test digital circuits on FPGAs.
4. Explain the key features and advantages of parallel computation.
5. Explain the architecture of GPU's and GPGPUs.
6. Write CUDA programs for performing Matrix Multiplication.

UNIT - 1 (16 hours)

Hardware Descriptor Languages: Emergence of HDLs, Design Flow using HDLs, Importance of HDLs.
Hierarchical Modeling Concepts: Modules, Instances.
Data Types: Nets, Registers, Vectors, Arrays, Integer, Real, and Time, Memories, Parameters, Strings. Modules and Ports.
Gate Level Modeling: Design of Ripple Carry Adder, Shift Register using DFF, Multiplexer, Demultiplexer, Decoder, Encoder.

UNIT - 2 (16 hours)

Dataflow Modeling: Continuous assignment (assign) statement, assignment delay, implicit assignment delay, and net declaration delay for continuous assignment statements.

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Define expressions, operators, and operands. Operator types for all possible operations—arithmetic, logical, relational, equality, bitwise, reduction, shift, concatenation, and conditional.

Behavioral Modeling: Structured procedures, always and initial. Blocking and non-blocking procedural assignments. Conditional statements using if and else. Multiway branching, using case, casex, and casez statements, Looping statements such as while, for, repeat, and forever. Definition of sequential and parallel blocks.

UNIT - 3   (16 hours)

Tasks and functions in Verilog, Finite State Machine using Verilog.
Examples of design using Verilog HDL.
FPGA's: Design Flow for Designing with FPGA, Design simulation, Design synthesis,
Key Architecture features of high performance FPGAs: Xilinx Virtex 5, VIRTEX II Pro and VIRTEX 4 with PowerPC and Altera Cyclone FPGA with NIOS II.
Implementation of Hardware Multiplier, ALU, Adder/Subtractor on FPGA.

UNIT - 4   (16 hours)

Introduction to GPU: GPUs as Parallel Computers, Architecture of a modern GPU, Why More Speed or Parallelism, Parallel Programming Languages and Models Overarching Goals, Evolution of Graphics Pipelines; the Era of Fixed-Function Graphics Pipelines, Evolution of Programmable Real-Time Graphics, Unified Graphics and Computing Processors, GPGPU, An Intermediate Step, GPU Computing Scalable GPUs Recent Developments, Future Trends.
Introduction to CUDA: Data Parallelism CUDA Program Structure, a Matrix-Matrix Multiplication Example.

Recommended Reading:

1. S. Palnitkar; Verilog HDL: A Guide to Digital Design and Synthesis; Prentice Hall
2. J. Bhasker; Verilog HDL Synthesis - A Practical Primer; Star Galaxy Publishing
3. David B Kirk, Wen Mei W Hwu; Programming Massively Parallel Processors: A Hands- On Approach; Elsevier India Private Limited
4. Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar; Introduction to Parallel Computing, 2nd Ed.; Pearson Education

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. Verilog Program for Full Adder
2. Verilog Program for Ripple Carry Adder using Gate Level Modeling
3. Verilog Program for MUX/DEMUX using DataFlow Modeling
4. Verilog Program for DECODER/ENCODER
5. Verilog Program for JKFF/SRFF/DFF/TFF
6. Verilog Program for UP/Down Counter using Behavioral Modeling
7. Verilog Program for FSM
8. Verilog Program for RAM
9. Verilog Program for Shift Register.
10. ALU on Xilinx/Altera FPGA

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11. Hardware Multiplier on Xilinx/Altera FPGA.
12. Counter on FPGA
13. Fast Fourier Transform (FFT) Calculation using Verilog.
14. CUDA program for Matrix Multiplication.

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ETC 6.3 DIGITAL COMMUNICATION

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC 6.3	Digital Communication	3	1	--	3	100	25	--	25	--	150

Course Objectives:

The subject aims to provide the student with:
1. An introduction to digital modulation systems, the underlying mathematical models and the process of converting analog signal to digital.
2. An ability to analyze digital modulation schemes on different performance metrics.
3. An understanding of requirements and issues for optimal receiver design for digital signals.
4. An overview of traffic engineering and different telecommunication switching systems.

Course Outcomes:

The student after undergoing this course will be able to:
1. Evaluate the benefits of digital modulation schemes over analog for a given application.
2. Explain Phase/amplitude/frequency shift keying and quadrature amplitude modulation techniques.
3. Analyze the performance of baseband digital modulation techniques in terms of error rate and spectral efficiency.
4. Select the blocks in design of digital communication system for error and interference free communication.
5. Explain OFDM scheme and implement using FFT.
6. Explain different telecommunication switching systems.
7. Calculate traffic capacity and blocking probability for given performance parameters.

UNIT - 1 (12 hours)

Introduction to digital communication: Analog communication v/s Digital Communication, Elements of digital communication system, Communication channels and their characteristics.

Mathematical models for communication channels: Additive noise channel, linear filter channel, linear time variant filter channel.

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Sampling: Sampling Theorem, Natural Sampling, Flat-top sampling, Signal Recovery through holding, Equalization.

Digital Representation of Analog Signal: Quantization of Signals, Quantization Error, Mid-rise & Mid-tread quantizers, Uniform & Non-uniform quantizers, Companding- µ-Law and A-Law.

Pulse digital modulation techniques: Pulse code modulation, Line coding, Differential Pulse Code Modulation, Delta modulation, Adaptive delta modulation.

UNIT - 2   (12 hours)

Digital modulation and transmission:
Phase shift keying: Binary Phase Shift Keying, Differential Phase Shift Keying, Differential Encoded Phase Shift Keying, Quadrature Phase Shift Keying, M-ary Phase Shift Keying
Frequency Shift Keying: Binary Frequency Shift Keying, M-ary Frequency Shift Keying, Minimum Shift Keying. Gaussian Minimum Shift Keying.
Amplitude Shift keying: Quadrature Amplitude Shift Keying.
Quadrature Amplitude-Modulated Digital Signals: Geometric Representation of QAM Signals, Demodulation and Detection of QAM Signals, Probability of Error for QAM
Pulse shaping to reduce Inter-channel and Inter-symbol interference: Duobinary Encoding, Nyquist criterion, Regenerative repeater.

UNIT - 3   (12 hours)

Optimal reception of digital signal: A baseband signal receiver: Peak Signal to RMS Noise Output Voltage Ratio, Probability of Error. Optimum Threshold: Maximum Likelihood Detector and Bayes Receiver, probability of error.

Optimum receiver for both baseband and passband: Calculation of Optimum Filter transfer function, Optimum Filter realization using Matched Filter, probability of error of the Matched Filter, Optimum Filter realization using Correlator.

Optimal coherent reception: PSK, FSK and QPSK, Signal space representation and probability of error. Comparison of modulation systems.

Multicarrier Modulation and OFDM: Orthogonal Frequency-Division Multiplexing, Modulation and Demodulation in an OFDM System, An OFDM System implemented via the FFT Algorithm, Spectral characteristics of OFDM Signals, Peak-to-Average power ratio in OFDM Systems, Applications of OFDM.

UNIT - 4   (12 hours)

Switching Systems: Classification of switching systems, simple telephone communication, Basics of a switching system, signaling tones, principles of common control, touch tone dial telephone, Centralized SPC and Distributed SPC.
Time Division Switching: Basic Time Division Space Switching, Basic Time Division Time Switching, Time multiplexed Space Switching, Time Multiplexed Time Switching.
Traffic Engineering: Network Traffic Load & Parameters, Grade of Service & Blocking Probability, Incoming Traffic & Service Time Characterization.

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Recommended Readings:

1. John G Proakis, Masoud Salehi; Fundamentals of Communication Systems, 2nd Ed.; Pearson Education
2. K Vishwanathan; Telecommunication Switching Systems & Networks, 2nd Ed; Prentice Hall of India.
3. Taub, Schilling, Saha; Principles of Communication Systems, 3rd Edition, Tata McGraw Hill Publishing Company.
4. R. P. Singh, S. Sapre; Communication systems: Analog and Digital, 3rd Ed.; Tata McGraw Hill
5. Bernard Sklar; Digital Communications : Fundamental & Applications, 2nd Edition; Pearson Education
6. Simon Haykins; Communication Systems, 3rd Edition, John Wiley & Sons.
7. K. Sam Shanmughan; Digital and Analog Communication Systems; John Wiley & Sons Pvt.

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ETC/ECE 6.4 INDUSTRIAL AUTOMATION AND INSTRUMENTATION

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 6.4	Industrial Automation and Instrumentation	3	1	2	3	100	25	--	--	25	150

Course Objectives:
The subject aims to provide the student with:
1. An understanding of the principle and working of the Data acquisition systems, CRO and different types of transducers.
2. Introduction to Virtual Instrumentation using LABVIEW.
3. Introduction to the automation systems using the programmable logic controllers.
4. An understanding of the different types of industrial interfacing standards.

Course Outcomes:
The student after undergoing this course will be able to:
1. Explain the principle and working of the CRO, DSO and Data acquisition systems.
2. Design and simulate virtual instruments for sensors and data acquisition using appropriate software.
3. Evaluate between different types of transducers for a given application.
4. Design and simulate various industrial control applications using the programmable logic controllers.
5. Explain the different types of industrial communication standards.

<u>UNIT - 1</u>   (12 hours)

Electronic Voltmeter: Non-integrating type: Ramp type, Staircase Ramp, Continuous balance, Successive Approximation. Integrating type: Potentiometer Integrating, Dual Slope Integrating Voltmeter. Sensitivity & Resolution of a DVM.

Oscilloscope: Block diagram, Classification of CROs, CRT control circuits, delay lines, multiple trace CRO, Time base circuits, synchronizing circuits, Digital storage oscilloscope. CRO probes: Active & Passive probes, Compensation for probes.

Virtual Instrumentation: Historical perspective, advantages, block diagram, Virtual instruments examples, the front panel, Sub VIs.

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Data Acquisition systems (DAS): Basic block diagram of DAS, objective of DAS, Components of a DAQ system, types of signals, signal conditioning of inputs, importance of instrumentation and isolation amplifier, Signal grounding and measurements, DAQ hardware configuration, Digital and Analog I/O considerations.

UNIT - 2 (12 hours)

Temperature Measurement Transducers: Resistance Temperature Detectors, Thermistors, Thermocouples.
Displacement Transducers: Basic displacement measurement scheme, different types of displacement transducers: Strain Gauge, Linear Variable Differential Transformer, Capacitive, Inductive, Piezoelectric, and Potentiometer.
Pressure Transducers: Inductive, Resistive and Capacitive transducers for measuring pressure.
Velocity Transducers: Basic principle of measuring velocity, Tachogenerator.
Flow measurement transducers: Turbo magnetic Flow meter, Electromagnetic Flow meter.
Optical transducers: Photoresistor, Photodiode, Phototransistor.

UNIT - 3 (12 hours)

Programmable Logic Controllers (PLC): PLC Advantages & Disadvantages, Overall PLC System, CPU & Programmable Monitors, PLC input & Output Modules (Interfaces).
General PLC Programming Procedure: Proper Construction of PLC Ladder diagrams, Process Scanning considerations.
Basic PLC Programming: Programming ON-OFF inputs to produce ON-OFF outputs, Concepts of latching, interlocking, jogging outputs via ladder programming.
PLC Timer Functions: PLC timer functions, Examples of timers and Industrial process timing applications.
PLC Counter functions: PLC Counters, Examples of Counter Functions, Industrial applications.
PLC data handling instructions: Move, Conditional Jump, Call Subroutine instructions.
Selecting a PLC: Factors to be considered while selecting a PLC.

UNIT - 4 (12 hours)

SCADA systems: Introduction and brief history of SCADA, Modern SCADA systems, SCADA software, Remote terminal units.
Data logger basics, Advantages of data loggers, anatomy of a data logger, types of data loggers, factors to be considered in selecting a datalogger.
Basic standards: RS-232 and RS-485, Electrical signal characteristics, Interface mechanical characteristics, Functional description of the interchange circuits.
Modbus: General overview, Modbus protocol structure.
Fieldbus: Introduction, General Fieldbus architecture, Basic requirements of Fieldbus standard.

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Recommended Readings:

1. H. S. Kalsi; Electronic Instrumentation; Tata McGraw Hill.
2. Robert H. Bishop; Learning with LABVIEW 7 Express; Pearson Education.
3. John Webb, Ronal Weiss; Programmable Logic Controllers: Principles & Applications, 5th Edition; Prentice Hall of India.
4. Deon Reynders , Steve Mackay , Edwin Wright; Practical Industrial Data Communications: Best Practice Techniques; Newnes , An imprint of Elsevier
5. Clarke, G., Reynders, D., Wright, E.; Practical Modern SCADA Protocols DNP3, 60870.5 and Related Systems, 1st Edition, Newnes , An imprint of Elsevier

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. Fault simulation using CRO trainer
2. Virtual Instruments ,Sub VIS
3. Loops using LABVIEW
4. Structures using LABVIEW
5. Arrays and Clusters using LABVIEW
6. Displacement Transducers
7. Pressure Transducers
8. Flow Transducers
9. Temperature Transducers
10. Data Acquisition using LABVIEW
11. Ladder program to implement latching, interlocking.
12. Ladder program to implement jogging.
13. Ladder program to implement timing applications.
14. Ladder program to implement counting applications
15. Ladder program to implement data handling instructions
16. Implement any of the above ladder programs using the SCADA software.

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ETC/ECE 6.5 OPERATING SYSTEMS

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 6.5	Operating Systems	3	1	--	3	100	25	--	--	--	125

Course Objectives:

The subject aims to provide the student with:

1. An ability to describe control structures and techniques used in a typical operating system for process management.
2. The knowledge of approaches to deal with deadlocks and mechanisms to ensure the orderly execution of processes to maintain data consistency.
3. An ability to describe ways to manage memory, and implement virtual memory.
4. A general understanding of file management aspects of an operating system and various disk scheduling policies.
5. A capability to describe the implementation of OS concepts in Linux.

Course Outcomes:

The student after undergoing this course will be able to:

1. Summarize the objectives of an Operating System.
2. Compare multiprocessor, multiprogramming and time sharing systems.
3. Draw Gantt chart and calculate the waiting time for a given set of processes, for various CPU scheduling algorithm.
4. Write pseudo codes to solve the classic problems of Process Synchronization.
5. Solve problems related to Resource Allocation in case of Deadlocks.
6. Enlist the advantages and disadvantages of various memory management strategies.
7. Illustrate the page replacement Algorithms.
8. Describe the Linux implementation of user and programmer interfaces.

<u>UNIT - 1</u>   (12 hours)

OS objectives and functions: Multiprocessor system, Multiprogramming System, time sharing system.

Process description & control: Process, process states, creation & termination of processes, two & five model process model, processor modes, suspended process, process description, OS control structures, process control structures, process location, process attributes, process control , Threads overview, Multithreading modules

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Microkernels architecture and benefits.

CPU Scheduling: Basic concepts: CPU – I/O Burst Cycle, CPU Scheduler, Preemptive Scheduling, Dispatcher, Scheduling criteria, Scheduling Algorithms: FCFS, SJF, Priority, RR, Multilevel Queue Scheduling, Multilevel Feedback queue Scheduling, Algorithm Evaluation.

UNIT - 2 (12 hours)

Concurrency Control: Principles of concurrency, operating system concerns, process interaction, competition amongst processes for resources, cooperation amongst processes by sharing & communication.

Process Synchronization: Background, The Critical – Section Problem, Synchronization Hardware, Semaphores, classic problems of Synchronization: The Bounded Buffer Problem, the Readers-Writers Problem, The Dining-Philosophers Problem, Monitors.

Deadlocks: System model, deadlock characterization, methods for handling deadlocks, deadlock prevention, deadlock avoidance, deadlock detection, recovery from deadlock.

UNIT - 3 (12 hours)

Memory: Memory Hierarchy, Cache Memory.

Memory management: Address Binding, Logical vs Physical Address Space, Swapping, Contiguous Memory Allocation, Paging, Segmentation, Segmentation with paging.

Virtual Memory: Background, Demand Paging, Page Replacement: Basic Scheme, FIFO, Optimal, LRU, Allocation of frames, Thrashing: cause of Thrashing.

File Management: Files, File Management systems, file organization and access, file directories, file sharing, record blocking.

UNIT - 4 (12 hours)

Disk Scheduling & Management: Disk scheduling policies-FCFS, SSTF, SCAN, C-SCAN, LOOK , selection of a disk scheduling algorithm, Disk management, disk formatting, bad blocks.

The Linux Case Study: Design Principles, Kernel Modules, Process Management, Scheduling, Memory Management: Management of physical Memory, virtual memory, Execution and loading of user programs, Interprocess Communication.

Recommended Readings:

1. William Stallings; Operating Systems: Internal & design principles, 6th Edition; PHI.
2. A. Silberschatz, P. Galvin, G. Gagne; Operating systems Concepts, 6th Edition, John Wiley & Sons Pte. Ltd.
3. Andrew S. Tanenbaum; Modern Operating Systems, 2nd Edition; Pearson education
4. D.M. Dhamdhere; Operating Systems: A concept based approach; TataMc Graw Hill
5. Milan Milenkovic; Operating Systems: Concepts and design; TataMcGraw Hill

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ETC/ECE 6.6 COMMUNICATION NETWORKS

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 6.6	Communication Networks	3	1	2	3	100	25	--	--	25	150

Course Objectives:
The subject aims to provide the student with:
1. An introduction to the layered architecture of OSI model.
2. An understanding of the functions of the data link layer and its protocols.
3. An introduction to the network and transport protocols.
4. An introduction to various networking and internetworking devices and protocols used in application layer.

Course Outcomes:
The student after undergoing this course will be able to:
1. Explain the functions of the various layers of OSI model.
2. Implement the various line coding techniques.
3. Explain the various flow and error control techniques.
4. Design a multistage switch as well as distinguish between various switching techniques like Datagram approach, SVC, PVC.
5. Compare the data link protocols like HDLC, BISYNC, X.25 with respect to their working, frame formats and their applications.
6. Explain the need for internet protocols, routing algorithms and tackling the various problems which may occur in data networks.
7. Explain the various devices like repeaters, bridges, routers, firewalls with respect to real life examples.
8. Explain the application and working of ATM, ISDN and other protocols used at application layer.

UNIT - 1 (12 hours)

OSI Model: Layered architecture of OSI model, other layered architecture (TCP/IP).
Data communication concepts: parallel and serial transmission, asynchronous and synchronous transmission, line coding-NRZ, RZ, AMI, HDB3, B8ZS, Block Codes
Characteristics of transmission lines in time domain, crosstalk.
Modems: Types of modems, scrambler and descrambler, block schematic of modem network architecture.

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LAN systems: Architecture: bus, ring, tree, star, wireless Ethernet, fast Ethernet, token ring, FDDI, Bluetooth, wireless LAN. Ethernet: Contention access, CSMA, CSMA/CD
Physical Layer: Interface-RS232, DTE-DCE interface, specifications, Null Modems.

UNIT - 2 (12 hours)

Data Link Layer: Frame design consideration, flow control, error control (stop and wait mechanism, sliding window), sequence numbering of frames, piggybacking acknowledgement, applications of data link protocols.
Data link protocols: BISYNC, transmission frames, protocol operation, HDLC, flow and error control in HDLC, framing in HDLC, transparency in HDLC, HDLC protocol operations, comparison of BISYNC and HDLC.
Switching: Switching networks, Circuits Switching, Space Division Switching, Time Division Switching, Packet Switching (datagram and virtual circuit [SVC, PVC]), Message Switching.
X.25 protocol: X.25 layers, characteristics of X.25 packet format, X.25 operation.

UNIT - 3 (12 hours)

Network Layer: Services, virtual circuits and datagram subnet, routing algorithms (shortest path, flooding, flow based, distance vector, link state), congestion control, choke packets, load shedding, jitter control, flow specifications, traffic shaping (leaky bucket and token bucket algorithm).
Internet protocols: IP protocols, addresses, internet control protocols, OSPF, BGP, mobile IP, IPV6.
Transport protocols: services, address, establishment of connection, releasing a connection, multiplexing, flow control and recovery, crash recovery, internet transport protocols (TCP and UOP), TCP protocol, TCP header, connection management, TCP congestion control, TCP transmission policy, timer management.

UNIT - 4 (12 hours)

Networking Devices: Repeaters, Bridges, Routers, Firewall.
ATM: ATM architecture- virtual connection, identifiers, cells, connection establishment and release.
ISDN: IDN,ISDN,ISDN channels(B,D,H), ISDN interfaces, functional groupings, ISDN protocols architecture-physical layer, data link layer, network layer, ISDN addressing, broadband ISDN.
Application Layer: DNS, DHCP, TFTP, Telnet, FTP, electronic mail, HTTP**.**

Recommended Readings:

1. Behrouz A. Forouzan; Data Communication & Networking, 2nd edition; Tata Mc-Graw Hill
2. Prakash C. Gupta; Data Communication and computer networks; PHI

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3. William Stalling; Data & Computer Communications, 5th edition; PHI
4. Achyut S Godbole; Data Communication and Networks; Tata McGraw.
5. Andrew S. Tanenbaum; Computer Networks; PHI

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. To write and execute program for NRZ-L code.
2. To write and execute program for NRZ-I code.
3. To write and execute program for RZ code.
4. To write and execute program for Manchester Coding.
5. To write and execute program for Differential Manchester Coding.
6. To share data/files between two PC's within same or different network.
7. To create a VLAN in a switch and transfer one port at a time, and verify its functionality.
8. To create a VLAN in a switch and transfer range of ports in it, and verify its functionality.
9. To connect two switches together by trunking to transfer data.
10. To transfer data between two different networks using Routers.

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ETC/ECE 7.1 MICROWAVE ENGINEERING

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 7.1	Microwave Engineering	4	--	2	3	100	25	--	--	--	125

Course Objectives:

The subject aims to provide the student with:
1. An understanding of microwave waveguides, passive & active devices, tubes and network analysis.
2. An ability to design microwave matching networks.
3. An ability to perform microwave measurements.
4. An understanding of RADARs and its applications.

Course Outcomes:

The student after undergoing this course will be able to:
1. Explain different types of waveguides and their respective modes of propagation.
2. Analyze typical microwave networks using impedance, admittance, transmission and scattering matrix representations.
3. Design microwave matching networks using L section, single and double stub and quarter wave transformer.
4. Explain working of microwave passive circuits such as isolator, circulator, Directional couplers, attenuators etc.
5. Describe and explain working of microwave tubes and solid state devices.
6. Perform measurements on microwave devices and networks using power meter and VNA.
7. Explain the operation of RADAR systems and recite their applications.

<u>UNIT - 1</u> (16 hours)

Review of Transmission lines: Distributed elements concept, Telegrapher's equations, lossless and lossy lines, line impedance and junction, Smith Chart. General solutions for TEM, TE and TM waves.

Waveguides: Rectangular, circular, coaxial cable and modes of propagation. Introduction to stripline and microstripline.

Microwave networks: N-port microwave networks, impedance, admittance, transmission and scattering matrix representations, reciprocal and lossless networks, network matrices transformations.

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UNIT - 2 (16 hours)

Impedance matching and tuning: L-section impedance matching, single and double stub matching, Quarter wave transformer.

Microwave passive circuits: Waveguide cavity resonators. Principles of E-plane Tee, H-plane Tee, hybrid Tee, isolator, circulator, directional couplers, attenuators and phase shifters. Microstrip: Design of Wilkinson power divider.

UNIT - 3 (16 hours)

Microwave tubes: Limitations of conventional tubes in the microwave frequency ranges. Working principles of Klystron amplifier, Reflex klystron oscillator, Magnetrons, Traveling wave tubes.
Microwave solid-state devices: Characteristics of microwave bipolar transistors and FET, GUNN Diode, IMPATT Diode, PIN Diode.
Microwave measurements: fundamentals of power meter, transmission measurements and reflection measurements. Vector network analyzer: Basic vector measurements, architecture, calibration, material property measurements using VNA.

UNIT - 4 (16 hours)

Radar: Principle of operation of radar, maximum unambiguous range, radar range equation, Radar block diagram, radar frequencies, and applications of radar. Probability of Detection & False Alarm. Radar Cross Section of Targets. Continuous wave Radar, FM-CW Radar.
MTI Radar: Principle of operation, block diagram. Blind speeds, staggered PRF's.
Tracking Radar: Different methods of tracking, Sequential lobing, Conical Scanning, amplitude & phase comparison Monopulse Radar.

Recommended Readings:

1. D. M. Pozar; Microwave Engineering, 3rd Ed.; John Wiley & Sons Inc
2. H.J.Reich, J.G.Skolnik, P.F.Ordung, H.L.Krauss; Microwave Principles; Affiliated East West Press Ltd.
3. R. E. Collin; Foundations for Microwave Engineering, 2nd Ed; Wiley-IEEE Press
4. Merill Skolnik; Introduction to Radar Systems, 3rd Edition; Tata McGraw Hill
5. S. M. Liao; Microwave devices and Circuits, 3rd Ed.; Prentice Hall of India
6. Ananjan Basu; An Introduction to Microwave Measurements; CRC Press

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List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. Characterization of E-Plane, H-Plane and Magic(Hybrid) Tee
2. Characterization of microwave Isolator and Circulator
3. Characterization of Microwave directional couplers
4. Characterization of Microwave attenuators
5. Characterization of Microwave phase shifters
6. Design of Wilkinson power divider
7. VI Characteristics of GUNN Diode
8. Study of PIN diode as a microwave switch
9. Operating modes of Klystron microwave source
10. Microwave measurements using a Vector Network Analyzer
    a. Return loss
    b. Insertion Loss
    c. Bandwidth
    d. Smith Chart
11. Study of a FM-CW radar
12. Impedance matching using Smith Chart
13. Operation of Vector Signal Generator and Analyzer

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ETC/ECE 7.2 INTRODUCTION TO SOFT COMPUTING

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 7.2	Introduction To Soft Computing	3	1	2	3	100	25	--	--	25	150

Course Objectives:
The subject aims to provide the student with:
1. An understanding of soft computing techniques and their applications in real life problems.
2. An introduction to artificial neural networks and their training methodologies.
3. An introduction to Fuzzy systems and Fuzzy operators.
4. An introduction to Evolutionary Algorithms and optimization techniques.

Course Outcomes:
The student after undergoing this course will be able to:
1. Explain different soft computing approaches and their applications.
2. Explain the architectures of different types of artificial neural networks.
3. Design systems using Fuzzy logic and controllers.
4. Evaluate and Apply appropriate optimization algorithm for a given problem.

UNIT - 1 (12 hours)

Soft Computing: Soft Computing versus Hard Computing, Soft-Computing Systems. Artificial Intelligence: Problem Solving in AI, Logic in Artificial Intelligence. Soft-Computing Techniques: Artificial Neural Networks, Fuzzy Systems, Evolutionary Algorithm, Hybrid Systems. Expert Systems: Expert System Design, High-End Planning and Autonomous Systems. Types of Problems: Classification, Functional Approximation, Optimizations. Machine Learning: Historical Database, Data Acquisition, Pattern Matching.

Introduction to Neural Networks: Introduction to neural networks, structure of biological neuron, Mc-Culloch Pitts neuron model, Neuron modeling for artificial neuron systems, Neural learning. Single layer network: Concept of linear separability and non-linear separability.

Training: Training algorithms- Hebbian learning rule, perceptron learning rule, Delta learning rule, Widrow-Hoff learning rule related problems.

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UNIT - 2 (12 hours)

Setting of parameter values and design considerations: Initialization of weights, Frequency of weight updates, Choice of learning rate, Momentum, Generalizability, Network size, Sample size, Non-numeric inputs.

Prediction network, radial basis function and its applications, Winner-Take-All network, Clustering, simple competitive learning algorithm, LVQ algorithm, Adaptive resonance theory, Self-Organizing Maps.

Hopfield network, Brain-state-in-a-box network, Bi-directional associative memory and problems, Applications of neural network.

UNIT - 3 (12 hours)

Fuzzy Inference Systems: Fuzzy Systems, Fuzzy Logic, Membership Functions: Gaussian Membership Functions, Triangular Membership Function, Sigmoidal Membership Function, Other Membership Functions.

Fuzzy Logical Operators: AND Operator, Realization of Min and Product, OR Operator, Realization of Max, NOT Operator, Implication.

More Operations: Aggregation, Realization of Sum and Max, Defuzzification, Fuzzy Inference Systems: Fuzzy Inference System Design, The Fuzzy Process, Type-2 Fuzzy Systems, Other Sets, Sugeno Fuzzy Systems, Fuzzy Controller.

UNIT - 4 (12 hours)

Evolutionary Algorithms, Genetic Algorithms: Concept, Solution, Initial Population, Genetic Operators, Fitness Function, Stopping Condition.

Fitness Scaling, Selection, Mutation, Crossover, Other Genetic Operators, Algorithm Working, Diversity, Grammatical Evolution, Other Optimization Techniques: Particle Swarm Optimization, Ant Colony Optimizations, Metaheuristic Search, Traveling Salesman Problem.

Recommended Readings:

1. Anupam Shukla, Ritu Tiwari, Rahul Kala; Real Life Applications of Soft Computing; CRC Press
2. Kishan Mehrotra, Chilukuri Mohan, Sanjay Ranka; Elements of artificial neural network; Penram Publications.
3. J. Zurada; Introduction to Artificial neural network; Jaico Publications.
4. Timothy J. Ross; Fuzzy Logic with Engineering Applications, 3rd Ed.; Wiley-India Edition
5. Satish Kumar; Neural Networks, A Classroom Approach; Mc Graw Hill Education
6. D. Patterson; Artificial neural networks; Prentice Hall
7. J.Harris; An Introduction to Fuzzy Logic Applications; Spinger
8. Rajasekaran, G. A. Vijayalakshmi Pai; Neural Networks, Fuzzy Logic and Generic Algorithm, PHI Learning Pvt.Ltd.

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List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. Hebbian learning rule
2. perceptron learning rule
3. Delta learning rule
4. Widrow-Hoff learning rule
5. Radial basis function network
6. Learning vector quantization
7. Self-Organizing maps
8. Recurrent neural networks
9. Fuzzy inference system
10. Genetic algorithm
11. Particle Swarm Optimization
12. Ant Colony Optimizations
13. Traveling Salesman Problem.

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ETC/ECE 7.3 MOBILE COMMUNICATION

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 7.3	Mobile Communication	3	1	--	3	100	25	--	--	--	125

Course Objectives:
The subject aims to provide the student with:
1. An understanding of the cell theory and the different types of handoffs.
2. An ability to calculate the Co-channel Interference reduction factor, received power at the mobile using the different types of propagation models, parameters of the mobile multipath channels and classify the different types of fading channels.
3. An understanding of the different types of equalization and diversity techniques.
4. An understanding of the GSM and CDMA standards for mobile communication.

Course Outcomes:
The student after undergoing this course will be able to:
1. Model a cellular system to study its performance.
2. Determine the Co-channel Interference reduction factor in a cellular system.
3. Calculate the received power using the different types of propagation models.
4. Evaluate the parameters of the mobile multipath channels and classify the different types of fading channels.
5. Differentiate between types of equalizers.
6. Explain the different types of diversity techniques.
7. Explain GSM and CDMA technology.
8. Evaluate processing gain, Jamming to Signal ratio for Spread Spectrum System.

UNIT - 1 (12 hours)

The Cellular Concept: Introduction, Block diagram of Cellular System, Concept of Frequency Reuse, Hexagonal shaped cells.

Handoff Strategies: Handoffs, Types of handoff, handoff initiation, delaying handoff, forced handoff, Power Difference Handoffs, Mobile assisted Handoff (MAHO) and Soft Handoff, Cellsite Handoff, Intersystem Handoff.

Co-channel Interference Reduction Factor, Desired C/I for a normal case in an Omnidirectional Antenna System. Reduction of Co-Channel interference by means of a notch in the tilted antenna pattern.

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Mobile Radio Propagation, Large -Scale Path Loss: Introduction to Radio Wave Propagation, Free Space Propagation Model, The Three Basic Propagation Mechanisms, Reflection, Ground Reflection (Two Ray) Model, Diffraction, Scattering: Radar cross section model.

UNIT - 2 (12 hours)

Mobile Radio Propagation: Small -Scale Fading and Multipath:
Small- Scale Multipath Propagation, Impulse Response Model of a Multipath Channel: Relationship between bandwidth and received power, Small-scale multipath measurements. Parameters of Mobile Multipath Channels, Types of Small -Scale Fading, Rayleigh and Ricean Distribution. Statistical models for multipath fading channels: Clarke's model for flat fading, Level crossing and fading statistics, Two Ray-Rayleigh fading model.

UNIT - 3 (12 hours)

Equalization: Introduction, Fundamentals of Equalization, Training A Generic Adaptive Equalizer, Equalizers in a communications Receiver, Linear Equalizers, Nonlinear Equalization ,Algorithms for adaptive equalization: Zero Forcing Algorithm, Least Mean Square Algorithm, Recursive least squares algorithm.
Diversity Techniques: Practical Space Diversity Considerations, Polarization Diversity, Frequency Diversity, Time Diversity, RAKE Receiver.
MIMO Systems: Multiple Input Multiple Output Antenna Systems, Alamouti Space Time Codes for MIMO Wireless Communications.

UNIT - 4 (12 hours)

Global System for Mobile Communication (GSM): GSM Services and Features, GSM System Architecture, GSM Radio Subsystem, GSM Channel Types, Example of a GSM Call, Frame Structure for GSM.
Spread Spectrum techniques & CDMA: Advantages, Process Gain, Jam Margin, J/S ratio, Multipath Fading and its avoidance, PN Sequences, Techniques: Direct Sequence (DSSS) & Frequency Hopping (FHSS), The Near Far Problem ,DS-CDMA & FH-SS CDMA .

CDMA Digital Cellular Standard (IS-95): Frequency and Channel Specifications, Forward CDMA Channel, Reverse CDMA Channel.

Recommended Readings:

1. William Lee; Mobile Cellular Telecommunications; Tata McGraw Hill,
2. Theodore Rappaport; Wireless Communication : Principles and Practice, 2nd Ed.; Pearson Education
3. Mohinder Janakiraman; Time Codes and MIMO Systems;, Artech House
4. Taub, Schilling, Saha; Principles of communication systems, 3rd edition; Tata McGraw hill publishing company
5. David Tse and Pramod Vishwanathan; Fundamentals of Wireless Communications; Cambridge University Press
6. Jochen Schiller; Mobile Communications, 2nd Edition; Addison Wesley

ETC 8.1 INFORMATION THEORY AND CODING

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC 8.1	Information Theory And Coding	3	1	2	3	100	25	--	--	25	150

Course Objectives:

The subject aims to provide the student with:
1. An understanding of information theoretic behavior of a communication system.
2. A perspective of problems associated with channel capacity of the different types of the communication channels.
3. An ability to calculate the efficiency of the source using the various source coding techniques.
4. An understanding of various channel coding techniques.

Course Outcomes:

The student after undergoing this course will be able to:
1. Determine the marginal, joint and conditional entropy of a communication system.
2. Calculate the mutual information of the communication channel.
3. Calculate the entropy of second order Markov source.
4. Evaluate the channel capacity of the different types of the communication channels.
5. Encode the data using various source coding techniques and determine their efficiencies.
6. Code and decode the data using the various channel coding techniques.
7. Compare error rates in coded and un-coded transmission.

<u>UNIT - 1</u> (12 hours)

Information Theory: Information content, unit of information, Entropy, Entropy of binary source, rate of information, Joint entropy and conditional entropy. Mutual Information and channel capacity: Noise free channel, Channel with independent input and output, Symmetric channel, Binary symmetric channel (BSC), Binary erasure channel (BEC), cascaded channels, repetition of signals, extension of the Zero Memory Sources. Sources with finite memory: Markov sources. Extension of Binary Channels.

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UNIT - 2 (12 hours)

Shannon's Theorem, Capacity of Gaussian channel: Shannon-Hartley Theorem, Bandwidth –S/N Tradeoff, Shannon Limit.

Source Coding: Coding efficiency, Shannon's first fundamental theorem, Lossless coding algorithm, Kraft's inequality, Variable length source coding: Shannon –Fano coding, Huffman coding, (D-ary compact codes), Lempel-Ziv (LZ) coding, Lossy data compression: Rate distortion theory.

UNIT - 3 (12 hours)

Error Control Coding: Types of codes, Error Probability with Repetition in the Binary Symmetric Channel, Parity Check bit for error detection, Hamming distance.

Linear Block Codes, Syndrome and error detection, standard array and syndrome decoding for error correction, Probability of undetected error for linear block codes.

Single Parity Check Bit Code, Repeated Codes, Hadamard Code, Hamming Codes, Reed Muller codes, dual codes.

Cyclic Codes: Algebraic Structure of cyclic codes ,Binary cyclic code properties, Encoding in systematic form, Circuit for dividing polynomials, Systematic encoding with an (n-k) stage shift register, error detection with an (n-k) stage shift register, Golay Code, BCH Codes.

UNIT - 4 (12 hours)

Burst Error Correction: Block Interleaving, Convolutional Interleaving, Reed Solomon (RS) Code, Concatenated Codes.

Convolutional Coding: Code Generation, Generator Matrix, code tree, State and Trellis Diagrams for Convolutional codes, types of Convolutional codes, their realizations, catastrophic encoders. Decoding Convolutional Code: using code tree, decoding in the presence of noise, Sequential decoding, The Viterbi algorithm.

Comparison of Error rates in coded and uncoded transmission, Introduction to Turbo Codes, Turbo Decoding, Automatic Repeat request, Performance of ARQ systems.

Recommended Readings:

1. Herbert Taub, Donald Schilling, Goutam Saha; Principles of Communication Systems; Tata McGraw Hill
2. R. P. Singh, S. Sapre; Communication systems: Analog and Digital, 3rd Ed.; Tata McGraw Hill
3. J.Das, S. K. Mullick, P. K. Chatterjee; Principles of Digital Communication; John Wiley
4. Bernard Sklar; Digital Communications : Fundamental & Applications, 2nd Edition; Pearson Education
5. Ranjan Bose; Information Theory, Coding & Cryptography, 2nd Edition; Tata McGraw Hill Publishing Company Limited.

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List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. MATLAB program that takes in channel transition probability matrix and computes the Mutual Information
2. MATLAB program to compute the channel capacity of the BSC channel
3. MATLAB program to compute the channel capacity of the BEC channel
4. MATLAB program to compute the channel capacity of the cascaded BSC channel
5. MATLAB program to compute the channel capacity of the BSC channel with the two repetition of inputs
6. Simulate binary Huffman code in MATLAB. Find average length, entropy and coding efficiency of the code.
7. Simulate binary Shannon-Fano code in MATLAB. Find average length, entropy and coding efficiency of the code.
8. Simulate binary Lempel-Ziv code in MATLAB. Find average length, entropy and coding efficiency of the code.
9. MATLAB program to encode messages for a forward error correction system with a given Linear block code.
10. MATLAB program to perform Linear Block encoding and decoding.
11. MATLAB program to encode and decode messages for a system with Cyclic Redundancy code.
12. MATLAB program to Reed-Solomon encoding and decoding.
13. MATLAB program to perform Convolutional encoding.
14. MATLAB program to perform Convolutional decoding using Viterbi algorithm.
15. MATLAB Study of Turbo codes.

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ETC/ECE 8.2 ADVANCED COMMUNICATION

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 8.2	Advanced Communication	3	1	2	3	100	25	--	--	--	125

Course Objectives:

The subject aims to provide the student with:

1. In depth understanding about the science behind the orbiting satellites, satellite orbital mechanics and their parameters, satellite subsystems and earth station equipment.
2. Conceptual knowledge of factors affecting the satellite link design, multiple access schemes, Global Positioning systems and VSAT systems.
3. Coverage of the basic concepts of ray and mode theory of light propagation through optical fibers, fiber impairments, fiber joints and connectors.
4. Knowledge of construction and working of Optical Sources and Photo-detectors, WDM concepts and Optical Networks.

Course Outcomes:

The student after undergoing this course will be able to:

1. Explain the orbits of satellites, satellite launch mechanism, satellite hardware and Earth station design.
2. Describe the concepts of signal propagation effects, frequency and noise considerations which affect satellite link design.
3. Investigate various multiple access techniques used for satellite communication.
4. Describe the fundamentals underlying the operation of VSAT systems and GPS.
5. Recognize and classify the structures of Optical fiber and types and discuss the channel impairments like absorption losses, attenuation, scattering and dispersion.
6. Examine various optical sources and photo-detectors and discuss their principle and performance parameters.
7. Explain principle of working and components of WDM optical systems.

<u>UNIT - 1</u>   (12 hours)

Satellite Orbits: Advantages and disadvantages of Satellite communications, Satellite Communication System, Kepler's Laws of planetary motion, Types of orbits-based on altitude, eccentricity, orbital plane, description of satellite orbit, location of satellite with respect to earth, orbital elements, Look angles, earth coverage and slant range, eclipse effects, orbital perturbations, placing of satellite in geostationary orbit, Station keeping and Satellite Stabilization.

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Satellite Subsystems: Electric power supply, Altitude and Orbit Control, Propulsion Subsystem, Communication Subsystem (Repeaters/Transponders), Antenna Subsystems, Telemetry-Tracking-Command and Monitoring, Thermal Control Subsystem, Structure Subsystem.

Earth Station: Types of Earth Station, Design Considerations and Earth system sub-systems.

Applications of satellite communications: Satellite Television, Satellite Telephony, Earth observation (Remote Sensing), weather forecast, scientific studies.

UNIT - 2 (12 hours)

Satellite Link Design: Link design equations, system noise temperature, C/N and G/T Ratio, Uplink design, complete Link design, Frequency considerations, Propagation considerations, interference related problems, earth station parameters.

Multiple Access: Frequency Division Multiple access, Time Division Multiple access, TDMA Frame, Burst and Superframe structure, FDMA v/s TDMA, Satellite switched TDMA, Beam Hopping TDMA, Space division Multiple Access.

VSAT satellite systems: VSAT concept, VSAT/ Wireless local loop networks. VSAT network architectures, multiple access methods, Applications of VSAT networks.

Global positioning Satellite systems: GPS segments, Working principle, GPS signal structure, GPS Positioning services and positioning modes, Trilateration method.

UNIT - 3 (12 hours)

Overview of optical fiber communication: Optical spectral bands, key elements of optical fiber systems, advantages, disadvantages and applications of optical fiber communication.

Optical fiber waveguides: Ray theory transmission: Total internal reflection, acceptance angle, numerical aperture, skew rays. Optical fiber modes and configurations, single mode fibers, graded index fiber structures, cut-off wavelength, mode-field diameter.

Transmission characteristics of optical fibers: Attenuation, material absorption, linear scattering, bending loss, chromatic dispersion, intermodal dispersion.

Optical fiber joints and connectors: Fiber to fiber joints, fiber misalignments, Fiber splices: fusion and mechanical, fiber connectors: cylindrical ferrule and expanded beam.

UNIT - 4 (12 hours)

Optical Sources: Energy bands, direct and indirect bandgap.
LED structures: edge emitter LEDs and surface emitter LEDs, Quantum efficiency and LED power, modulation of LED.
Laser diodes: absorption, emission of radiation, population inversion, laser diode modes and threshold conditions, Fabry-Perot Laser diode, distributed feedback Laser diode. (4 Hours)

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Photo-detectors: PN photodiode, PIN photodiode, Avalanche Photodiode, Quantum efficiency, responsivity, cut-off wavelength.

WDM concepts and components: Operational principles and standards of WDM. Passive optical couplers: 2x2 fiber coupler, Star Coupler, Mach-Zehnder Interferometer Multiplexers. Optical Isolator and circulator. Basics of Grating, Fiber Bragg grating & applications.

Optical Networks: SONET/SDH transmission formats and speeds, SONET/SDH Rings, SONET/SDH Networks.

Recommended Readings:

1. D. C. Agarwal; Satellite Communications, 6th Edition, Khanna Publishers
2. Timothy Pratt, Charles Bostian, Jeremy Allnutt; Satellite Communications, 2nd Edition, Wiley Publications
3. Anil K Maini, Varsha Agarwal; Satellite Communications; Wiley Publications.
4. Gerd Keiser; Optical Fiber Communication, 4th Edition, McGraw Hill Publications.
5. John M Senior; Optical Fiber Communications, 5th Edition, Pearson Education.

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

(SATELLITE COMMUNICATION)

1. Setting up communication link and study of change in uplink and downlink frequency.
2. Establishing audio-video satellite link between Transmitter and Receiver
3. Study of Frequency Hopping (FHSS) Modulation and Demodulation
4. Study of Direct Sequence (DSSS) Modulation and Demodulation
5. Study of PN sequence generation
6. Tele-commands transmission and reception via Satellite
7. Calculation of C/N ratio and S/N ratio of satellite link
8. Study of GPS data like longitude, latitude using GPS receiver
9. Simulation of different aspects of satellite communication systems on MATLAB
10. Study of Satellite Tool kit (STK) from Analytics Graphics(evaluation version) and its application in Satellite Communication systems

(OPTICAL FIBER COMMUNICATION)

1. Establishing 650nm fiber optic analog and digital link
2. Study of intensity modulation technique using analog input signal and digital input signal.
3. Measurement of Numerical Aperture of different fiber cables
4. Measurement of power emitted by LED

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5. Attenuation and coupling losses in optical fiber
6. Transmission characteristics of LED and LASER diode.
7. Operational characteristics of Photodiode as a photo-detector.
8. Simulation of different aspects of optical fiber communication systems on MATLAB or any open source simulator.

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Syllabus Electives

ETC/ECE 7.4.1 DIGITAL VLSI

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 7.4.1	Digital VLSI	3	1	2	3	100	25	--	25	--	150

Course Objectives:

The subject aims to provide the student with:
1. An in-depth knowledge of the MOS Transistors, Transmission Gates and MOS inverters.
2. An ability to estimate the resistances, capacitances and inductances associated with MOS circuits and their impact on device performance.
3. The capability to apply Graph theory to MOS circuits, and understanding of CMOS logic gate design.
4. An understanding of design strategies, CMOS testing and ability to program using Verilog HDL.

Course Outcomes:

The student after undergoing this course will be able to:
1. Explain the operation of MOS Transistor as a switch and compare its working to a transmission gate.
2. Analyze the CMOS Inverter and compute the VIL, VIH, VOH and VOL equations.
3. Estimate the Resistance, capacitance and Inductance associated with MOS circuit.
4. Derive expressions for the different types of power dissipations involved in CMOS Gate.
5. Apply Graph Theory to MOS circuits and represent graphs using Matrices.
6. Implement any given Boolean Function in CMOS Logic Gate.
7. Write the Verilog program for Digital Circuits.
8. Explain design strategies, verification and CMOS testing.

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UNIT - 1 (12 hours)

Introduction To MOS Circuits: MOS transistors, MOS transistor switches, CMOS logic, circuit and system representations, MOS transistor theory – Introduction, MOS device design equations, The Complementary MOS Inverter - DC Characteristics, Static Load MOS Inverters, the Differential Inverter, the Transmission Gate, the Tri State Inverter, Bipolar Devices.

UNIT - 2 (12 hours)

Circuit Characterization and Performance Estimation: Introduction, resistance estimation, capacitance estimation, inductance, switching characteristics CMOS-gate transistor sizing, power dissipation, sizing routing conductors, charge sharing, design margining, and reliability.

UNIT - 3 (12 hours)

Graphs: Representation of graphs using matrices; Paths, connectedness; circuits, cutsets, trees; Fundamental circuit and cutset matrices; Voltage and current spaces of a directed graph and their complementary orthogonality. Stick Diagrams & Layouts.

CMOS Circuit and Logic Design: CMOS logic gate design, basic physical design of simple gate, CMOS logic structures, clocking strategies, I/O structures.

UNIT - 4 (12 hours)

Systems Design and Design Method: Design strategies, CMOS chip design options, design methods, design capture tools, design verification tools, CMOS testing – Manufacturing test principles, design strategies for test, chip level test techniques, system level test techniques.
Syntax and Semantics of Verilog: Variable types, arrays and tables. Operators, expressions and signal assignments. Modules, nets and registers, concurrent and sequential constructs. Tasks and functions. Examples of design using Verilog.

Recommended Readings:

1. N. Weste , K. Eshranghian; Principles of CMOS VLSI Design; Addison Wesley
2. Jacob Backer, Harry W. Li, David E. Boyce; CMOS Circuit Design, Layout and Simulation; Prentice Hall of India
3. L. Glaser, D. Dobberpuhl; The Design and Analysis of VLSI, Circuits; Addison Wesley
4. C. Mead, L. Conway; Introduction to VLSI Systems; Addison Wesley
5. Randel & Geiger; VLSI Analog and Digital Circuit Design Techniques; McGraw-Hill
6. Sabih H. Gerez; Algorithms for VLSI design automation; John Wiley & Sons
7. William M. Penny, Lillian Lau; MOS Integrated Circuits- Theory, Fabrication, Design and System Applications of MOS LSI; Van Nostrand Reihold Company.
8. Sung Ms Kang, Yusuf Lablebici; CMOS Digital Integrated Circuits Analysis & Design; Tata Mc-Graw Hill.
9. S. Palnitkar; Verilog HDL: A Guide to Digital Design and Synthesis; Prentice Hall
10. J. Bhaskar; Verilog HDL Synthesis - A Practical Primer; Star Galaxy Publishing

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List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. SPICE program to Plot the VI Characteristics of NMOS and PMOS.
2. SPICE program to plot the VTC of Static Load and CMOS Inverter.
3. SPICE program to examine effect of Transistor Sizing on the Switching Characteristics.
4. SPICE program to estimate Resistance and Capacitance in MOS circuit.
5. Layout for Transmission gate and CMOS Inverter.
6. Layout of Complex Boolean Function.
7. Layout of NAND and NOR Gates.
8. Verilog code for MUX and Demux.
9. Verilog program for Counter
10. Verilog Program for RAM
11. Verilog Program for ALU.
12. Verilog program for Hardware Multiplier.
13. Verilog Program for Finite State Machine.
14. Verilog code for GENERIC Ripple carry Adder.
15. Verilog Code for parallel to Serial Converter.

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ETC/ECE 7.4.2 IMAGE PROCESSING

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 7.4.2	Image Processing	3	1	2	3	100	25	--	25	--	150

Course Objectives:

The subject aims to provide the student with:
1. An understanding of basics of visual perception, effects of image sampling and quantization.
2. An ability to apply relevant filters for enhancing images.
3. An understanding of image degradation and restoration process.
4. An ability to apply the various edge detection algorithms to segment image into different regions.

Course Outcomes:

The student after undergoing this course will be able to:
1. Explain the effects of variation in sampling and quantization parameters on image quality.
2. Perform different transformations on images and observe the subjective changes in image quality.
3. Perform smoothing and sharpening operations on image using spatial-domain filters.
4. Analyze the image in frequency domain by taking various transforms and perform smoothing and sharpening in frequency domain.
5. Explain the various noise models and different types of degradations which affect an image during the acquisition process.
6. Apply various filtering techniques on degraded images to restore it.
7. Apply edge detection techniques to separate regions in images.
8. Explain the process of reconstruction of an image from projections.

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UNIT - 1 (12 hours)

Elements of visual perception: Light and electromagnetic spectrum, image sensing and acquisition, image sampling and quantization, basic relationship between pixels: neighbors, connectivity, distance measures, and arithmetic & logic operations.

Image enhancement: Translation, Rotation, Concatenation.

Basic transformations: Image negatives, Log Power-law, Contrast-stretching, Intensity-level slicing, Bit-plane slicing.

Histogram processing: Histogram equalization, Histogram equalization and Perspective Transformation.

UNIT - 2 (12 hours)

Spatial filtering: Smoothing, sharpening filters: Laplacian filters, Unsharp masking and highboost filtering.

Introduction to Fourier Transform and DFT: Properties of 2D Fourier Transform, FFT, Separable Image Transforms, Walsh, Hadamard, Discrete Cosine Transform, Haar, Slant – Karhunen – Loeve transforms.

Frequency domain filters: (High pass and low pass) Ideal, Butterworth, Gaussian; Homomorphic filtering.

UNIT - 3 (12 hours)

Image Restoration: Image degradation/restoration process, noise models, restoration in the presence of noise only- spatial filtering, periodic noise reduction by frequency domain filtering. Linear position invariant degradations, estimating the degradation function, Inverse filter, Wiener filter.

Image Compression: Lossless and Lossy Coding, Block Transform Coding, predictive coding, JPEG, MPEG.

UNIT - 4 (12 hours)

Edge detection: Detection of point, line, discontinuities. Gradient Operators, Laplacian, LoG Filters, Global Processing via Hough Transform.

Mathematical morphology: Binary Morphology, Dilation, Erosion, Opening and Closing, Duality Relations, Gray Scale Morphology, Hit-and-Miss Transform, Thinning and Shape Decomposition.

Computer Tomography: Radon transform, Back-Projection Operator, Fourier-slice theorem, CBP and FBP methods.

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Recommended Readings:

1. Rafael C. Gonzalez and Richard E. Woods; Digital Image Processing; Pearson
2. Anil K. Jain; Fundamentals of Digital Image Processing; Prentice Hall of India
3. W. K. Pratt; Digital image processing, Prentice Hall.
4. Sonka, Hlavac, Boyle; Image Processing: Analysis and Machine Vision; Thomson

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. To observe the effects on sampling and quantization on image.
2. To perform image transformation (negative, Power-law, Log, anti-log) on images.
3. To perform contrast stretching on images
4. To perform histogram equalization on images
5. To smoothen an image by using spatial filtering
6. To sharpen an image by using spatial filtering
7. To observe the effects of convolution of filter on images due to aliasing
8. To filter images through ideal frequency domain filters
9. To filter images by using Butterworth, Gaussian filters
10. To observe the effect of degradation function and various noise on images
11. To restore a degraded image by using inverse and wiener filter

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ETC/ECE 7.4.3 TECHNICAL WRITING AND PROFESSIONAL ETHICS

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 7.4.3	Technical Writing and Professional Ethics	3	1	2	3	100	25	--	25	--	150

Course Objectives:
The subject aims to provide the student with:
1. An ability to write technical documents.
2. An ability to communicate information through verbal and visual methods.
3. An understanding of importance of ethics, safety and risks.
4. An understanding of corporate structure and ethics.

Course Outcomes:
The student after undergoing this course will be able to:
1. Plan, Draft and write technical documents.
2. Design verbal and visual documents for effective communication.
3. Write correspondence letters and reports.
4. Explain the importance of ethics in work and work place.
5. Assess safety and risks involved in decisions.
6. Explain issues related to loyalty, rights and corporate ethics.

UNIT - 1 (12 hours)

Understanding the Technical Communication Environment: Introduction to Technical Communication. Understanding ethical and legal considerations.
Writing Technical Documents: Planning, Drafting, Revising, Editing, Proof reading.
Writing Collaboratively: Advantages and Disadvantages of Collaboration, Managing Projects, Conducting Meetings, Using Social Media and Other Electronic Tools in Collaboration Gender and Collaboration, Culture and Collaboration.
Planning the Document: Analyzing Your Audience and Purpose. Researching Your Subject. Organizing Your Information.

UNIT - 2 (12 hours)

Developing and Testing the Verbal and Visual Information: Communicating Persuasively, Emphasizing Important Information, Writing Correct and Effective Sentences, Designing Print and Online Documents, Creating Graphics, Reviewing, Evaluating, and Testing Documents and Websites.

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Learning Important Applications: Writing Correspondence, Writing Job-Application Materials, Writing Proposals, Writing Informational Reports, Writing Recommendation Reports, Writing Lab Reports, Writing Definitions, Descriptions, and Instructions, Making Oral Presentations.

Skimming Your Sources and Taking Notes, Documenting Your Sources, Editing and Proofreading Your Documents, Guidelines for Multilingual Writers (ESL).

UNIT - 3 (12 hours)

Senses of 'Engineering Ethics': Variety of moral issues, Types of inquiry, Moral dilemmas, Moral Autonomy, Kohlberg's theory, Gilligan's theory, Consensus and Controversy, Professions and Professionalism, Professional Ideals and Virtues, Uses of Ethical Theories, Engineering as Experimentation, Engineers as responsible Experimenters, Research Ethics, Codes of Ethics, Industrial Standards, A Balanced Outlook on Law, The Challenger Case Study.

Safety and Risk: Assessment of Safety and Risk, Risk Benefit Analysis, Reducing Risk, The Government Regulator's Approach to Risk, Chernobyl Case Studies and Bhopal.

UNIT - 4 (12 hours)

Collegiality and Loyalty: Respect for Authority, Collective Bargaining, Confidentiality, Conflicts of Interest, Occupational Crime, Professional Rights, Employee Rights, Intellectual Property Rights (IPR), Discrimination.

Multinational Corporations: Business Ethics, Environmental Ethics, Computer Ethics, Role in Technological Development, Weapons Development, Engineers as Managers, Consulting Engineers, Engineers as Expert Witnesses and Advisors, Honesty, Moral Leadership, Sample Code of Conduct.

Recommended Reading:

1. Mike Markel; Technical Communication, 11th Edition; Bedford/St. Martin's
2. Meenakshi Raman , Sangeeta Sharma; Technical Communication: English Skills for Engineers; Oxford University Press
3. Mike Martin , Roland Schinzinger; Ethics in Engineering; McGraw Hill, New York
4. Charles E Harris, Michael S Pritchard, Michael J Rabins; Engineering Ethics Concepts and Cases; Thompson Learning
5. Caroline Whitbeck; Ethics in Engineering Practice and Research; Cambridge University Press

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. Writing Lab Reports
2. Presentation on interpretation of a technical paper
3. Writing a technical paper

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4. Writing a technical papers through peer collaboration
5. Designing presentations on technical content
6. Designing website/blog on technical content
7. Writing Informational Reports
8. Writing Recommendation Report
9. Writing Definitions, Descriptions, and Instructions
10. Safety and risk assessment case studies
11. Writing a Patent application

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ETC/ECE 7.4.4 INTRODUCTION TO ROBOTICS

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 7.4.4	Introduction to Robotics	3	1	2	3	100	25	--	25	--	150

Course Objectives:

The subject aims to provide the student with:
1. An understanding of all the subsystems and components of a robot.
2. An ability to solve problems related to kinematics of a robot.
3. An ability to design and program simple robotic platforms.
4. An ability to perform image processing techniques for robotic applications.

Course Outcomes:

The student after undergoing this course will be able to:
1. Describe the subsystems of robot system and explain the anatomy and working of basic robot configurations.
2. Evaluate different robot actuator drive systems and end effectors for given application.
3. Evaluate different sensors used and integrate them in robotic systems.
4. Analyze anatomy of simple robots and compute kinematic solutions.
5. Explain control strategies used in robotic systems.
6. Evaluate motion planning strategies for a given application.
7. Explain image acquisition and processing techniques used in robotics.
8. Design simple image processing and servoing system for robotic application.

UNIT - 1 (12 hours)

Basic Concepts in (Fundamentals of) robotics: Automation and robotics, Robot applications.

Different classifications of robot: By application, by coordinate system, by actuation system, by control method and by programming method.

Robot anatomy: links and joints, Joint notation scheme. Degree of Freedom. Robot resolution, accuracy and repeatability. Concept of workspace.

Actuator and Drive systems: Pneumatic and hydraulic systems. Electric: Relation between torque and voltage. AC and DC Servo motors, Stepper motors, BLDC motors. Electronic control of motors.

Robot End Effectors: Grippers and Tools.

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UNIT - 2 (12 hours)

Sensors in Robotics: Sensor classification, Touch sensors, Force and Torque sensors, Accelerometers and Gyroscopes, LIDAR, Acoustic sensors, Slip sensors, Proximity & Range sensors: Light and Ultrasonic. Optical encoders: absolute and relative, Resolvers and DC tachometers.

Transformations: Pose of rigid body, Coordinate transforms, Homogeneous Transform, DH parameters.

Kinematics: Forward and Inverse kinematics. The Jacobean matrix. Concept of Statics and Dynamics.

UNIT - 3 (12 hours)

Robot Control: Control techniques. Transfer function and state space representation. Analysis of a Robot joint. Feedback control, Stability and performance. Joint Controller.

Motion Planning: Joint space and Cartesian space planning, Position and orientation trajectories.

UNIT - 4 (12 hours)

Computer Vision: image acquisition, The Imaging Transformation, Camera transformation and calibrations, Image processing (spatial and frequency domain analysis), Image enhancements, histogram Equalization, Image Segmentation, Image Feature Extraction.

Visual Servoing: Vision-Based Control, Position-Based Visual Servoing, Image-Based Visual Servoing.

Recommended Reading:
1. John J. Craig; Introduction to Robotics, Mechanics & Control; Pearson Education Inc.
2. S. K. Saha; Introduction to Robotics, 2nd Ed.; McGrawHill
3. Peter Corke; Robotics, Vision and Control; Springer.
4. M. P. Groover, M. Weiss, R. N. Nagel, N. G. Odrey; Industrial Robotics Technology: programming and Applications; McGrawHill
5. K. S. Fu, R. C. Gonzalex, C. S. G. Lee; Robotics Control Sensing, Vision and Intelligence; McGraw Hill Book co.
6. Mittal & Nagrath; Robotics and Control; McGrawHill

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. Electronic Control of a DC Servo motor
2. Electronic Control of a Stepper motor
3. Electronic control of BLDC motor
4. Interfacing of proximity and range sensors to Arduino/R-Pi
5. Interfacing of Accelerometers and Gyroscopes sensors to Arduino/R-Pi
6. Interfacing of force sensors to Arduino/R-Pi
7. Forward kinematics of a Robot arm (Hardware/Matlab or Simulation Software)
8. Inverse kinematics of a Robot Arm (Hardware/Matlab or Simulation Software)

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9. Programming a robot arm for straight line, circular and curved paths (Hardware or Simulation Software)
10. Programming a robot arm for pick and place operation. (Hardware or Simulation Software)
11. Programming a robot arm: Loops, branches and subroutines (Hardware or Simulation Software)
12. Programming a robot arm: external events (Hardware or Simulation Software)
13. Image Processing
14. Image Feature Extraction
15. Image-Based Visual Servoing

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ETC/ECE 7.4.5 INTRODUCTION TO GPU COMPUTING

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 7.4.5	Introduction to GPU Computing	3	1	2	3	100	25	--	25	--	150

Course Objectives:

The subject aims to provide the student with:
1. Ability to write a GPU kernel function.
2. An understanding of using different memories of GPU in a CUDA program.
3. Ability to synchronize multiple threads of a program.
4. Applying the GPU resources for computationally intensive algorithms.

Course Outcomes:

The student after undergoing this course will be able to:
1. Analyze and compare the performance of CPU and GPU for a sample computationally intensive program.
2. Write a GPU kernel function.
3. Compare the performance improvements by using different GPU memories
4. Apply Synchronization techniques for different threads of a GPU program.
5. Analyze the thread warping in CUDA program.
6. Write CPU program for different computationally intensive applications.
7. Compare the effect of using I/O strategies to boost performance.

UNIT - 1 (12 hours)

Introduction to CPU and GPU computing: Basics of C, matrix multiplication using CPU.
Introduction: GPUs as Parallel Computers, Architecture of a Modem GPU, Why More Speed or Parallelism, Parallel Programming Languages and Models Overarching Goals, Evolution of Graphics Pipelines; the Era of Fixed-Function.

Introduction to CUDA: Data Parallelism CUDA Program Structure, A Matrix-Matrix Multiplication Example, Device Memories and Data Transfer, Kernel Functions and Threading; Function declarations, Kernel launch, Predefined variables, Runtime API.CUDA Thread Organization, Using blockIdx and threadIdx

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UNIT - 2 (12 hours)

CUDA Memories: Importance of Memory Access Efficiency, CUDA Device Memory Types, A Strategy for Reducing Global Memory Traffic Memory as a Limiting Factor to Parallelism, Global Memory Bandwidth, Dynamic Partitioning of SM Resources, Data Prefetching, Instruction Mix, Thread Granularity, Measured Performance, Synchronization, Shared memory, Matrix Transpose.

UNIT – 3 (12 hours)

Synchronization and Transparent Scalability, Thread Assignment, Thread Scheduling and Latency Tolerance, Atomic instructions, warping, Advanced GPU-accelerable algorithms, CUDA libraries and tools, Reduction, Prefix sum, Stream compaction.

UNIT - 4 (12 hours)

Advanced GPU accelerable algorithms: sorting (quicksort), GPU-accelerated Fast Fourier Transform, cuFFT (FFT library) IO strategy, CUDA streams, CUDA events, how it all works: virtual memory, command buffers, Pinned host memory, Managed memory.

Recommended Readings:

1. David B Kirk; Wen Mei W Hwu; Programming Massively Parallel Processors: A Hands-On Approach; Elsevier India Private Limited
2. Shane Cook; CUDA Programming: A Developer's Guide to Parallel Computing with GPUs (Applications of GPU Computing); Morgan Kaufmann
3. Jason Sanders, Edward Kandrot; CUDA by Example: An Introduction to General-Purpose GPU Programming ; Addison-Wesley Professional
4. Duane Storti, Mete Yurtoglu; CUDA for Engineers: An Introduction to High-Performance Parallel Computing; Addison Wesley
5. Nicholas Wilt; The CUDA handbook ; Pearson Education

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. Write a C program to perform matrix multiplication.
2. Write a helloworld GPU kernel function
3. Write a cuda program to print the block ID and thread ID
4. Write a cuda program to use register memory
5. Write a cuda program to perform matrix transpose
6. Write a cuda program to perform matrix multiplication
7. Write a cuda program to perform matrix multiplication using tiles
8. Write a cuda program to perform prefix sum
9. Write a cuda program to perform quicksort
10. Write a cuda program to perform FFT

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ETC/ECE 7.4.6 COMPUTER NETWORKS

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 7.4.6	Computer Networks	3	1	2	3	100	25	--	25	--	150

Course Objectives:

The subject aims to provide the students with:
1. An introduction to key components of any data network.
2. An understanding of the hierarchical addressing of devices and how this allows communication between networks.
3. An understanding IP addressing and Variable Length Subnet Mask (VLSM).
4. An ability to configure devices, apply address and VLANs in a network topology.
5. An introduction of Wireless LAN technology.

Course Outcomes:

The student after undergoing this course will be able to:
1. Explain the hierarchical model of computer data network.
2. Explain the role and operation of different networking devices.
3. Explain IPv4, IPv6 and TCP/IP protocols.
4. Configure IP networks with help of subnets.
5. Implement VLSM networks.
6. Configure Routers while selecting appropriate routing protocol.
7. Configure inter-VLAN routing on a router to enable communication between end-user devices on separate VLANs.
8. Configure and verify basic wireless LAN access.

UNIT - 1   (12 hours)

Internetworking basics: Types of networks, Line configuration, Modes of transmission, Topology; OSI reference model; Ethernet networks; Ethernet Cabling.

Three layer Hierarchical model: Core layer, Distribution layer, Access layer.

Networking devices: Hubs, Switches, Routers, Repeaters, Bridges.

UNIT - 2   (12 hours)

TCP/IP model: 4 layers protocols; IP addressing: class A, B, C, D, E, Private IP Addresses; IPV4 Address types: Unicast, broadcast, multicast; IP Subnetting: Subnet masks, Classless Inter-Domain Routing (CIDR), Subnetting Class C Addresses, Subnetting Class B Addresses,

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Subnetting Class A Addresses.

Variable Length Subnet Masks (VLSM): VLSM Design, Implementing VLSM Networks.

IPv6: Benefits and Uses; Addressing; Working; IPv6 Routing Protocols: RIPng, EIGRPv6, OSPFv3; Migrating to IPv6.

UNIT - 3 (12 hours)

Router Fundamentals: Internal Components, Ports, Router Boot Sequence; Command-Line Interface (CLI): Overview of Router Modes; Router Administrative Configurations: Hostnames, Banners, Setting passwords, recovering passwords; Router Interfaces: Configuring an IP Address on an interface, Bringing up an interface, Serial Interface Commands; Viewing, Saving Erasing and Changing Configurations.

IP Routing: Routing Basics; IP Routing Process; Configuring IP Routing: Static Routing: Manual, Default Routing; Dynamic Routing: Routing Protocols Basics, Distance-Vector Routing Protocols, Routing Information Protocol (RIP), Enhanced Interior Gateway Routing Protocol (EIGRP), Open Shortest Path First (OSPF); Introduction to Access Control Lists (ACLs): Standard, Extended; Network Address Translation (NAT).

UNIT - 4 (12 hours)

Layer 2 Switching; Switching services; Types of switches; Spanning Tree Protocols (STP); Configuring Catalyst Switches: Basic Commands, Port security; Virtual LANs (VLANs): VLAN Basics, Routing between VLANs, Configuring VLANs; VLAN Trunking Protocol (VTP): Modes of operation, Configuring VTP.

Wireless LAN: Basic Wireless Devices; Wireless Topologies: Independent Basic Service Set (Ad Hoc), Basic Service Set (BSS), Infrastructure Basic Service Set; Wireless Standards. Wireless Security.

Recommended Reading:

1. Behrouz A. Forouzan; Data Communication & Networking, 2nd edition; Tata Mc-Graw Hill
2. Cisco CCNA Routing And Switching ICND2 200-101 : Official Cert Guide; Cisco Press
3. Jim Geier; Wireless LANs, 2nd Edition; Sams Publishing
4. Todd Lammle ; CCNA Routing and Switching Study Guide: Exams 100-101, 200-101, and 200-120; Wiley
5. James Macfarlane; Network Routing Basics: Understanding IP Routing in Cisco Systems; Wiley
6. Thomas Albert Maufer; IP Fundamentals: What Everyone Needs to Know About Addressing and Routing ; Prentice Hall
7. Pejman Roshan , Jonathan Leary; 802.11 Wireless LAN Fundamentals; Cisco Press

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List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. Creating a network topology and assigning IP addresses.
2. Exploring User, Privileged and Configuration Modes of Router.
3. Setting the Hostname, Descriptions, IP Address and Clock Rate to Router.
4. Configuring Router using Telnet and console ports.
5. Configure Router using Static and default routing.
6. Configure Router using RIP, OSPF and EIGRP.
7. Configure ACLs on a router for blocking a host or a network.
8. Configure Port Security on a Switch.
9. Creating and managing VLANs on a switch.
10. Using STP and VTP on a Switch.

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ETC/ECE 7.4.7 INTRODUCTION TO DEVICE DRIVERS

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 7.4.7	Introduction to Device Drivers	3	1	2	3	100	25	--	25	--	150

Course Objectives:

The subject aims to provide the student with:
1. An Ability to write, load and debug kernel modules.
2. An understanding of concurrency and race conditions.
3. An understanding of memory allocation for large buffers using kernel function.
4. An understanding of block device drivers.

Course Outcomes:

The student after undergoing this course will be able to:
1. Explain the relation and differences between kernel and device driver.
2. Configure, compile, and install a Linux kernel/kernel module from sources.
3. Identify the possibilities of race condition and solve it by using different approaches like semaphores, mutexes.
4. Compare the differences in user memory and kernel memory.
5. Navigate and read the Linux kernel sources.
6. Experiment with the Linux kernel internal services needed by devices drivers, including memory mapping, kernel memory allocation, interrupt handling, timekeeping, and scheduling.
7. Design and implement a kernel module.
8. Modify, or design and implement a device driver.

UNIT - 1 (12 hours)

An Introduction to Device Drivers: The Role of the Device Driver, Splitting the Kernel, Classes of Devices and Modules, Security Issues, Version Numbering.

Building and Running Modules: Setting Up Your Test System, the Hello World Module, Kernel Modules versus Applications, Compiling and Loading, the Kernel Symbol Table, Preliminaries, Initialization and Shutdown, Module Parameters, Doing It in User Space.

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Char Drivers: The Design of scull, Major and Minor Numbers, Some Important Data Structures, Char Device Registration, open and release, scull's Memory Usage, read and write, playing with the New Devices.

Debugging Techniques: Debugging Support in the Kernel, Debugging by Printing, Debugging by Querying, Debugging by Watching, Debugging System Faults.

UNIT - 2 (12 hours)

Concurrency and Race Conditions: Pitfalls in scull, Concurrency and Its Management, Semaphores and Mutexes, Completions, Spinlocks, Locking Traps, Alternatives to Locking.

Advanced Char Driver Operations: ioctl, Blocking I/O, poll and select, Asynchronous Notification, Seeking a Device, Access Control on a Device File.

Time, Delays, and Deferred Work: Measuring Time Lapses, Knowing the Current Time, Delaying Execution, Kernel Timers, Tasklets, Workqueues.

UNIT - 3 (12 hours)

Allocating Memory: The Real Story of kmalloc, Lookaside Caches, get_free_page and Friends, vmalloc and Friends, Per-CPU Variables, Obtaining Large Buffers.

Communicating with Hardware: I/O Ports and I/O Memory, Using I/O Ports, An I/O Port Example, Using I/O Memory.

Interrupt Handling: Preparing the Parallel Port, Installing an Interrupt Handler, Implementing a Handler, Top and Bottom Halves, Interrupt Sharing, Interrupt-Driven I/O.

UNIT - 4 (12 hours)

Data Types in the Kernel: Use of Standard C Types, Assigning an Explicit Size to Data Items, Interface-Specific Types, Other Portability Issues, Linked Lists.

Memory Mapping and DMA: Memory Management in Linux, The mmap Device Operation, Performing Direct I/O, Direct Memory Access.

Block Drivers: Registration, The Block Device Operations, Request Processing, Some Other Details.

Recommended Readings:

1. Jonathan Corbet, Alessandro Rubini, Greg Kroah-Hartman; Linux Device Drivers, 3rd Edition; O'Reilly Media
2. Daniel P. Bovet; Understanding the Linux Kernel, 3rd Edition; O'Reilly Media

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List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. Write a simple hello world module
2. Write a scull driver with a majority and minority numbers
3. write a program using illustrating a lock condition and use a semaphore to prevent the race condition
4. Write char driver using ioctl
5. Write a char driver with work queues
6. Write a program using kmalloc to allocate a large buffer.
7. Write a driver program to communicate with a I/O.
8. Write an interrupt handler in a char driver to service the interrupts.
9. Using mmap write a driver program to allocate memory.
10. Write a block driver program and register it.

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ETC/ECE 7.4.8 VIRTUAL INSTRUMENTATION

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 7.4.8	Virtual Instrumentation	3	1	2	3	100	25	--	25	--	150

Course Objectives:
The subject aims to provide the student with:
1. An introduction to Virtual Instrumentation.
2. An understanding of the Virtual Instrumentation programming techniques.
3. An understanding of the data acquisition techniques using LABVIEW.
4. An understanding of the Applications of Virtual Instrumentation.

Course Outcomes:
The student after undergoing this course will be able to:
1. Explain the concepts and principles of Virtual Instrumentation.
2. Design and simulate virtual instruments using the arrays, loops, clusters.
3. Design and simulate virtual instruments for sensors and data acquisition using LABVIEW software.
4. Explain the different applications of virtual Instrumentation.

UNIT - 1 (12 hours)

Virtual Instrumentation: Historical perspective, advantages, block diagram and Architecture of a virtual instrument, data-flow techniques, graphical programming in data flow. Comparison with conventional programming. Development of Virtual Instrument using GUI. Real-time systems, Embedded Controller, OPC, HMI/SCADA software, Active X programming.

UNIT - 2 (12 hours)

VI programming techniques: VIS and sub-VIS, loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes.
Local and global variables, string and file I/O, Instrument Drivers, Publishing measurement data in web. Programming examples.

UNIT - 3 (12 hours)

Data acquisition basics: Introduction to data acquisition on PC, Sampling fundamentals, Input/Output techniques and buses. ADC, DAC, Digital I/O, counters and timers, DMA,

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Software and hardware installation, Calibration, Resolution, Data acquisition interface requirements.

VI Chassis requirements. Common Instrument Interfaces: current loop, RS232C/RS485, GPIB, Bus Interfaces: USB, PCMCIA, VXI, SCSI, PCI, PXI, Firewire. PXI system controllers, Ethernet control of PXI. Networking basics for office and Industrial applications, VISA and IVI.

UNIT - 4 (12 hours)

VI toolsets, Distributed I/O modules. Application of Virtual Instrumentation: Instrument Control, Development of process database management system.

Simulation of systems using VI, Development of Control system, Industrial Communication, Image acquisition and processing, Motion control.

Recommended Readings:

1. Gary Johnson; LabVIEW Graphical Programming, 2nd edition; McGraw Hill
2. Lisa k. Wells, Jeffrey Travis; LabVIEW for everyone; Prentice Hall
3. Kevin James; PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control; Newnes

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. Virtual Instruments ,Sub VIS
2. Loops using LABVIEW
3. Structures using LABVIEW
4. Arrays and Clusters using LABVIEW
5. Data Acquisition using LABVIEW
6. Development of Control system using LABVIEW
7. Industrial Communication using LABVIEW
8. Image acquisition and processing using LABVIEW
9. Motion control using LABVIEW

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UNIT - 2 (12 hours)

Piecewise constant approximation - the Haar wavelet, Building up the concept of dyadic Multiresolution Analysis (MRA), Relating dyadic MRA to filter banks, Elements of multirate systems and two-band filter bank design for dyadic wavelets.

UNIT - 3 (12 hours)

Families of wavelets: Orthogonal and biorthogonal wavelets, Daubechies' family of wavelets in detail, vanishing moments and regularity. Conjugate Quadrature Filter Banks (CQF) and their design, Dyadic MRA more formally; Data compression - fingerprint compression standards, JPEG-2000 standards.

The Uncertainty Principle, and its implications: the fundamental issue in this subject - the problem and the challenge that Nature imposes. The importance of the Gaussian function: the Gabor Transform and its generalization; time, frequency and scale - their interplay.

UNIT - 4 (12 hours)

The Continuous Wavelet Transform (CWT),Condition of admissibility and its implications, Application of the CWT in wideband correlation processing, Journey from the CWT to the DWT: Discretization in steps, Discretization of scale - generalized filter bank., Discretization of translation - generalized output sampling, Discretization of time/ space (independent variable) - sampled inputs.

Recommended Readings:

1. Howard L. Resnikoff, Raymond O. Wells; Wavelet Analysis: The Scalable Structure of Information; Springer
2. Raghuveer M.Rao , Ajit S. Bapardikar; Wavelet transforms- Introduction to theory and applications; Person Education
3. P. P. Vaidyanathan; Multirate Systems and Filter Banks; Pearson Education
4. L. Prasad, S.S. Iyengar; Wavelet Analysis with Applications to Image Processing.; CRC Press
5. G. Strang, T. Nguyen; Wavelets and filter banks; Wellesley-Cambridge Press
6. K.P. Soman and K.L. Ramchandran; Insight into Wavelets from theory to practice; Prentice Hall

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. Signal analysis using DFT
2. Signal analysis using STFT
3. Haar wavelet for signal analysis
4. Two-channel filter bank

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5. Perfect reconstruction of signals
6. Conjugate Quadrature filter bank
7. The uncertainty principle
8. Gabor transformations
9. Discretization of wavelets from Continuous time wavelets
10. Discrete wavelet transform

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ETC/ECE 7.4.10 ELECTRONIC MATERIAL SCIENCE

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
					Th Duration (Hrs)	Marks					
		L	T	P		Th	S	TW	O	P	Total
ETC/ECE 7.4.10	Electronic Material Science	3	1	2	3	100	25	--	25	--	150

Course Objectives:
The subject aims to provide the student with:
1. An understanding of semiconductor physics.
2. An ability to solve problems on semiconductor device junctions.
3. An ability to analyze and solve problems on optoelectronics devices.
4. An understanding of wafer and IC manufacturing process.

Course Outcomes:
The student after undergoing this course will be able to:
1. Explain intrinsic and extrinsic semiconductor.
2. Explain density of states and Fermi energy level of semiconductor.
3. Solve numerical on semiconductor device junctions.
4. Explain I-V characteristics of semiconductor device junctions.
5. Explain working of optoelectronics devices.
6. Solve numerical on optoelectronics devices.
7. Compare Czochralski and float zone method of ingot formation.
8. Explain steps involved in manufacturing of IC devices and semiconductor wafer.

<u>UNIT - 1</u>   (12 hours)

Introduction to chemical bonding and development of band gap: Introduction and types of semiconductors. Explanation of density of states, Fermi energy, and band occupancy. Problem set on bonding, density of states, and Fermi statistics. Intrinsic semiconductors, carrier concentration, mobility, temperature dependence. Problem set on intrinsic semiconductors. Extrinsic semiconductors. Dopant types and materials. Conductivity, Fermi energy position, temperature dependence. Problem set on extrinsic semiconductors.

<u>UNIT - 2</u>   (12 hours)

Metal-semiconductor junctions: Schottky vs. Ohmic junctions. Band gap diagrams. I-V characteristics. Problem set on metal-semiconductor junctions. p-n junctions. Equilibrium and under bias (forward and reverse). Band diagrams. I-V characteristics. Junction

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breakdown. Heterojunctions. Problem set on p-n junctions. Transistors-BJT, JFET, MOSFET. Transistor action. Basics of BJT and JFET. Channel formation in MOSFET. I-V behaviour. Depletion and inversion layer calculation. Problem set on transistors.

UNIT - 3 (12 hours)

Optoelectronic materials: Introduction. LEDs, LASERs, photodetectors, solar cells. Problem set on optical properties. Problem set on optoelectronic devices.
Introduction to semiconductor manufacturing: History, overview of process flow, manufacturing goals. Scaling. Wafer manufacturing. Si ingot preparation. Poly to single crystal conversion. Czochralski vs. float zone method.

UNIT - 4 (12 hours)

IC device manufacturing overview: Thermal oxidation. Doping. Lithography. Etching and growth. Metallization and growth. Process and device evaluation. Yield monitoring and control. Devices and IC formation. IC circuit logic and packaging.

Recommended Readings:

1. S.O. Kasap; Principles of Electronic Materials and Devices, 3rd Edition; McGraw-Hill.
2. S.M. Sze; Semiconductor devices: Physics and Technology, 2nd Edition; Wiley
3. S.M. Sze; VLSI technology; 2nd Edition; McGraw-Hill Education
4. B.G. Streetman, S. Banerjee; Solid State Electronic Devices, 6th Edition; PHI
5. C. Kittel; Introduction to solid state physics, 8th Edition; Wiley
6. Peter van Zant; Microchip Fabrication, 5th Edition; McGraw-Hill
7. G.S. May, C.J. Spanos; Fundamentals of semiconductor manufacturing and process control; Wiley-IEEE press

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. V-I characteristics of metal semiconductor junctions.
2. V-I characteristics of p-n junction.
3. V-I characteristics of Heterojunctions.
4. Characteristics of BJT.
5. Characteristics of FET.
6. Characteristics of MOSFET.
7. Characterization of LED
8. Characterization of LASERs
9. Characterization of photodetectors.
10. Characterization of Solar cells.

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ETC/ECE 7.4.11 MICROWAVE NETWORKS AND APPLICATIONS

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 7.4.11	Microwave Networks and Applications	3	1	2	3	100	25	--	25	--	150

Course Objectives:

The subject aims to provide the student with:
1. An understanding of Microwave networks.
2. An understanding of power division in microwave components.
3. An understanding of the working of microwave integrated circuits.
4. An understanding of working of microwave antennas & microwave systems.

Course Outcomes:

The student after undergoing this course will be able to:
1. Explain the working of Microwave networks.
2. Analyze the working of 3-port and 4-port microwave devices.
3. Examine the power division in microwave components.
4. Analyze the working of microwave integrated circuits, microwave antennas & microwave systems.

UNIT - 1 (12 hours)

Microwave network analysis: Impedance and equivalent voltage and currents, Impedance and admittance matrices, scattering matrix, transmission (ABCD) matrix
Microwave Resonators: Series and parallel resonant circuits, transmission line resonators.

UNIT - 2 (12 hours)

Power dividers and Directional couplers: Basic Properties, T-junction power divider, Wilkinson Power divider, Quadrature Hybrid, 180 degree hybrid.
Microwave filters: Periodic structures, filter design by image parameter method and insertion loss method, filter transformations.

UNIT - 3 (12 hours)

Ferromagnetic components: Ferrite isolators, Ferrite phase shifters, Ferrite Circulators.
Microwave Integrated Circuits: Planar transmission lines, lumped elements for MIC,

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substrates for MIC, Hybrid MIC, Monolithic MIC, Methods of Analysis of planar transmission lines: conformal transformation, variational approach.

UNIT - 4 (12 hours)

Microstrip Antennas: Introduction: Basic characteristics, feeding methods, methods of Analysis, Rectangular patch, Circular Patch, Quality factor, bandwidth and efficiency, input impedance, coupling, array and feed networks.

Microwave systems: Wireless communication systems, radiometer systems, microwave heating, power transfer, biological effects and safety.

Recommended Readings:

1. D. M. Pozar; Microwave Engineering, 3rd Ed.; John Wiley & Sons Inc
2. Constantine Balanis; Antenna Theory: Analysis & Design, 2nd Edition; Wiley India.
3. Bharathi Bhat, Shiban Koul; Striplinelike transmission lines for microwave integrated circuits; John Wiley and Sons.
4. K. C. Gupta, Rakesh Chadha, Ramesh Garg; Computer aided design of Microwave circuits; Artech House Publishers.
5. Prakash Bhartia, K. C. Gupta, Ramesh Garg, Inder Bahl; Microstrip lines and slot lines; Artech House Publishers
6. K. C. Gupta, Amarjit Singh; Microwave integrated circuits; Wiley

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. Study of Microwave Components
2. Characteristics of Reflex Klystron
3. Study of E-plane waveguide
4. Study of H-plane waveguide
5. Study of Magic Tee waveguide
6. Study of Isolator and circulator
7. Design of Wilkinson power divider using IE3D
8. Design of 90^0 Hybrid coupler using IE3D
9. Design of 180^0 Hybrid coupler using IE3D
10. Design of step impedance Low Pass filter

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ETC/ECE 7.4.12 DISTRIBUTED OPERATING SYSTEMS

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 7.4.12	Distributed Operating Systems	3	1	2	3	100	25	--	25	--	150

Course Objectives:

The subject aims to provide the student with:
1. An introduction to distributed operating systems fundamentals.
2. An understanding of synchronization and process/processors in distributed operating systems.
3. An understanding file systems used in distributed operating systems.
4. An introduction to practical distributed operating systems through case studies.

Course Outcomes:

The student after undergoing this course will be able to:
1. Explain the features and fundamental concepts of distributed operating systems.
2. Explain inter distributed OS communication protocols and models.
3. Explain synchronization approaches and its issues in distributed OS.
4. Explain threads and scheduling in distributed OS.
5. Design and implement distributed file systems.
6. Implement distributed operating systems on physical machines.

UNIT - 1 (12 hours)

Introduction to distributed operating systems: What is a distributed operating system? Goals, Hardware Concepts, Software Concepts, Design Issues, Communication in distributed systems.
Layered Protocols, Asynchronous Transfer Mode Networks, the Client-Server Model, Remote Procedure Call, Group Communication.

UNIT - 2 (12 hours)

Synchronization in Distributed Systems: Clock Synchronization, Mutual Exclusion, Election Algorithms, Atomic Transactions, Deadlocks in Distributed Systems.
Processes and Processors in Distributed Systems: Threads, System Models.

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UNIT - 3 (12 hours)

Processes and Processors in Distributed Systems (contd.): Processor Allocation, Scheduling in Distributed Systems.

Distributed File Systems: Distributed File System Design, Distributed File System Implementation, Trends in Distributed File Systems.

UNIT - 4 (12 hours)

Case Study of Distributed Systems:

Case study 1: AMOEBA

Introduction, Objects and capabilities, Process management, Memory management, Communication, Amoeba Servers.

Case study 2: Distributed Computing Environment

Introduction, Threads, RPC, Time Service, Directory Service, Security Service.

Recommended Readings:

1. A.S. Tanenbaum; Distributed Operating Systems; Pearson Education
2. G. Coulouris, J. Dollimore, T. King Berg; Distributed Systems: Concepts and Design; Addison Wesley
3. M. Singhal, N. G. Shivaratri; Advanced Concepts in Operating Systems ; TMH

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. Installation and commissioning of a distributed operation system
2. Study of inter DOS communication strategies
3. Study of synchronization algorithms
4. Implementation of simple program utilizing threads on DOS
5. Study of Scheduling schemes in DOS
6. Implementation of distributed file system in DOS
7. Implementation of Distributed Computing Environment
8. Study of remote procedure calls in DOS
9. Study of Time Service ,Directory Service and Security Service

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ETC 7.4.13 INTRODUCTION TO JAVA

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC 7.4.13	Introduction to Java	3	1	2	3	100	25	--	25	--	150

Course Objectives:

The subject aims to provide the student with:

1. An understanding of the basic features of Java language like Data Types, Operators, Control Statements and Classes.
2. The ability to implement the object oriented programming features e.g., different types of inheritance, using Java.
3. An ability to apply Java programming paradigms like exception handling and multi-threaded programming.
4. A basic understanding of String Object and ways to handle strings using methods of String Class.
5. An introduction to Java's Event Handling Mechanism.

Course Outcomes:

The student after undergoing this course will be able to:

1. Write programs using basic features of Java like operators, control statements and arrays.
2. Demonstrate the use of Classes, Object, packages and Interfaces using Java
3. Illustrate the use of exception handling for run-time error management using Java.
4. Employ multithreading in a java program for maximum utilization of the CPU by minimizing idle time.
5. Instantiate a String Object and perform different String operations.
6. Exhibit the use of the Collections framework for management of groups of objects.
7. Discuss the concept of event handling and apply concept of Inner Classes to streamline the event handling code.

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UNIT - 1 (12 hours)

Introduction to JAVA: Java and Java applications; Java Development Kit (JDK) Byte Code, JVM; Object-oriented programming; Simple Java programs. Data types and other tokens: Boolean variables, int, long, char, operators, arrays, white spaces, literals, assigning values; Creating and destroying objects; Access specifiers. Operators and Expressions: Arithmetic Operators, Bitwise operators, Relational operators, The Assignment Operator, The ? Operator; Operator Precedence; Logical expression; Typecasting; Strings.

Control Statements: Selection statements, iteration statements, Jump Statements.

Classes, Inheritance, Exceptions, Applets:
Classes: Classes in Java; Declaring a class; Class name; Super classes; Constructors; Creating instances of class; Inner classes.
Inheritance: Simple, multiple, and multilevel inheritance; Overriding, overloading.
Exception handling: Exception handling in Java.
The Applet Class: Two types of Applets; Applet basics; Applet Architecture; An Applet skeleton; Simple Applet display methods; Requesting repainting; Using the Status Window; The HTML APPLET tag; Passing parameters to Applets; getDocumentbase() and getCodebase(); ApletContext and showDocument(); The AudioClip Interface; The AppletStub Interface; Output to the Console.

UNIT - 2 (12 hours)

Multi-Threaded Programming, Event Handling: Multi-Threaded Programming: What are threads? How to make the classes threadable; Extending threads; Implementing runnable; Synchronization; Changing state of the thread; Bounded buffer problems, read-write problem, producer-consumer problems.

Event Handling: Two event handling mechanisms; The delegation event model; Event classes; Sources of events; Event listener interfaces; Using the delegation event model; Adapter classes; Inner classes.

Swings: Swings: The origins of Swing; Two key Swing features; Components and Containers; The Swing Packages; A simple Swing Application; Create a Swing Applet; Jlabel and ImageIcon; JTextField;The Swing Buttons; JTabbedpane; JScrollPane; JList; JComboBox; JTable.

UNIT - 3 (12 hours)

JAVA 2 Enterprise Edition Overview, Database Access: Overview of J2EE and J2SE. The Concept of JDBC; JDBC Driver Types; JDBC Packages; A Brief Overview of the JDBC process; Database Connection; Associating the JDBC/ODBC Bridge with the Database; Statement Objects; ResultSet; Transaction Processing; Metadata, Data types; Exceptions.

Servlets: Background; The Life Cycle of a Servlet; Using Tomcat for Servlet Development; A simple Servlet; The Servlet API; The Javax.servlet Package; Reading Servlet Parameter; The Javax.servlet.http package; Handling HTTP Requests and Responses; Using Cookies; Session Tracking.

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UNIT - 4 (12 hours)

JSP, RMI: Java Server Pages (JSP): JSP, JSP Tags, Tomcat, Request String, User Sessions, Cookies, Session Objects.

Java Remote Method Invocation: Remote Method Invocation concept; Server side, Client side.

Enterprise Java Beans: Enterprise java Beans; Deployment Descriptors; Session Java Bean, Entity Java Bean; Message-Driven Bean; The JAR File.

Recommended Readings:

1. Herbert Schildt; Java - The Complete Reference, 7th Edition; Tata McGraw Hill
2. Jim Keogh; J2EE - The Complete Reference; Tata McGraw Hill
3. Y. Daniel Liang; Introduction to JAVA Programming, 6th Edition; Pearson Education
4. Stephanie Bodoff et al; The J2EE Tutorial, 2nd Edition; Pearson Education

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. Introduction to Eclipse
2. Programming Flow Control using Java
3. Classes and methods
4. Inheritance
5. Packages and Interfaces
6. Exception Handling
7. Multithreading
8. Interthread Communication
9. String Handling
10. Event Handling

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ETC/ECE 7.5.1 ANALOG VLSI

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 7.5.1	Analog VLSI	3	1	2	3	100	25	--	25	--	150

Course Objectives:
The subject aims to provide the student with:
1. An ability to analyze MOSFET based Single Stage Amplifiers and Differential Amplifiers.
2. An understanding of Frequency Response of Amplifiers and Noise Considerations.
3. An understanding of Feedback in Analog Circuits.
4. An understanding of MOSFET based Current Mirrors, OPAMPS, Oscillator and PLL.

Course Outcomes:
The student after undergoing this course will be able to:
1. Obtain the Small Signal Equivalent circuit of Single Stage Amplifiers and Determine the Gain, input impedance and output impedance.
2. Analyze the Differential Amplifiers and derive the differential gain.
3. Explain the Frequency response of Amplifiers.
4. Represent Noise in circuit, obtain Noise Figure and explain its effect on performance.
5. Explain Feedback in circuits and the Various Topologies.
6. Analyze the Current Mirror circuit and obtain its small signal equivalent.
7. Design of Single Stage OPAMP circuit.
8. Explain the working of Oscillators and PLL.

<u>UNIT - 1</u> (12 hours)

Single-Stage amplifiers: Basic concepts, Common-Source Stage, Source Follower, Common- Gate Stage, Cascode Stage, Choice of device models.

Differential amplifiers: Single –ended & differential operations, basic differential pair, Common mode response, Differential pair with MOS loads, Gilbert cell.

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UNIT - 2 (12 hours)

Passive & Active Current Mirrors: Basic current mirrors, Cascode Current mirrors, Active current mirrors.

Frequency Response of Amplifiers: General Considerations, Common Source Stage, Source Followers, Common-gate Stage, Cascode Stage, Differential Pair.

Noise: Statistical Characteristics of noise, Types of noise, Representation of noise in circuits, Noise in single stage amplifiers, Noise in differential pairs, Noise Bandwidth.

UNIT - 3 (12 hours)

Feedback: General Considerations, Feedback topologies, Effect of loading, Effect of feedback on Noise.

Operational amplifiers: General considerations, One stage op amps, Two stage op-amps, Gain boosting, comparison, Common mode feedback, Input range limitations, slew rate, Power supply rejection, Noise in op-amps.

UNIT - 4 (12 hours)

Oscillators: General considerations, Ring oscillators, LC oscillators, Voltage controlled oscillators.

Phase locked loops: Simple PLL, Charge-pump PLL's, Nonlinear effects in PLL, Delay locked loops, Applications.

Recommended Readings:

1. Behzad Razavi; Design of Analog CMOS Integrated Circuits; Tata Mc-Graw Hill.
2. R. Jacob Baker, Harry W. Li, David E. Boyce; CMOS Circuit Design, Layout, and Simulation, 3rd Ed.; Wiley-Blackwell
3. Paul R. Gray and Robert G.Meyer; Analysis and Design of Analog Integrated Circuits; John Wiley & Sons.
4. Mohammed Ismail, Terri Fiez; Analog VLSI signal and Information Processing; McGraw-Hill International

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. Design of Common Source Amplifier using SPICE.
2. SPICE program for Differential Amplifier.
3. SPICE program for Cascode Amplifier.
4. SPICE program for Gilbert Cell.
5. SPICE program to plot the Frequency response of Amplifier.
6. SPICE program for Cascode Current Mirror.
7. Design of single stage OPAMP using SPICE.
8. SPICE program for dual Stage OPAMP.

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9. SPICE program for LC Oscillator.
10. SPICE program for Ring Oscillator.
11. SPICE program for VCO.
12. SPICE program to illustrate the working of PLL.

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ETC/ECE 7.5.2 ADAPTIVE SIGNAL PROCESSING

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 7.5.2	Adaptive Signal Processing	3	1	2	3	100	25	--	25	--	150

Course Objectives:

The subject aims to provide the student with:
1. An understanding of statistical characterization of random variables and processes.
2. An introduction to the modeling of random processes.
3. The ability to derive Weiner-Hopf Equations for application in Wiener filtering problems.
4. The knowledge of different nonparametric models of spectral estimation.
5. An understanding of FIR adaptive filters based on the method of steepest descent and their applications.

Course Outcomes:

The student after undergoing this course will be able to:
1. Characterize random variables and processes using their ensemble averages and/or joint moments.
2. Describe different methods of modeling random processes.
3. Derive the Weiner-Hopf equations for application in filtering problems.
4. Compare different methods for estimating the power spectrum of wide sense stationary random processes.
5. Develop FIR adaptive filters based on the method of steepest descent and compare their performance.

UNIT - 1 (12 hours)

Random Variables: Definitions, Ensemble Averages, Jointly Distributed Random Variables, Joint Moments, Independent, Uncorrelated and Orthogonal Random Variables, Linear Mean Square Estimation, Parameter Estimation: Bias and Consistency

Random Processes: Definitions, Ensemble Averages, Stationary Processes, the Autocovariance and Autocorrelation Matrices, Ergodicity, White Noise, The Power Spectrum.

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UNIT - 2   (12 hours)

Filtering Random Processes, Spectral factorization, Special Types of Random Processes: ARMA processes, AR processes, MA processes.

Stochastic Signal Modelling: ARMA models, AR and MA models, Applications in Power Spectrum Estimation.

UNIT - 3   (12 hours)

Wiener Filtering: Introduction, the FIR Wiener filter, Filtering, Linear Prediction, Noise Cancellation.

Spectrum Estimation: Nonparametric models – The Periodogram, Performance of the Periodogram, The Modified Periodogram, Periodogram Averaging (Bartletts Method).

UNIT - 4   (12 hours)

Adaptive Filtering: FIR Adaptive Filters – The Steepest Descent Adaptive Filter, The LMS Algorithm and its convergence, Normalized LMS, Application: Noise Cancellation, Channel Equalization.

Recommended Readings:

1.   Monson H. Hayes; Statistical Digital Signal Processing and Modeling; Wiley India
2.   Simon Haykin; Adaptive Filter Theory; Prentice Hall
3.   Dmitris Manolakis, Vinay Ingle, Stephen Kogon; Statistical and Adaptive Signal Processing; Artech House
4.   B. Widrow; S. Stearns; Adaptive Signal Processing; Prentice Hall

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1.   Bias and consistency of a random variable using MATLAB
2.   Generation of random processes
3.   Autocorrelation of a random process using MATLAB
4.   Estimate the power spectrum of a random process using MATLAB
5.   ARMA model for a random process using Modified Yule-Walker Equations using MATLAB
6.   Estimate the power spectrum of a random process produced by filtering white Gaussian noise and compare it to the true value of power spectrum using MATLAB
7.   MATLAB program to design a Wiener Filter to estimate a random process in presence of zero mean uncorrelated white noise.
8.   MATLAB program to perform adaptive linear prediction using the LMS algorithm

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ETC/ECE 7.5.3 NUMERICAL METHODS AND APPROXIMATION

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 7.5.3	Numerical Methods and Approximation	3	1	2	3	100	25	--	25	--	150

Course Objectives:

The subject aims to provide the student with:
1. An understanding of sources of errors and problems in computation for very large data set.
2. An understanding of different numerical methods used for the solution of engineering problems.
3. An ability to develop algorithm for the numerical methods.
4. An ability to implement a particular method for a realistic engineering problem.

Course Outcomes:

The student after undergoing this course will be able to:
1. Solve non-linear equations, simultaneous linear algebraic equations, eigenvalue problems, using numerical methods.
2. Apply curve fitting to experimental data.
3. Calculate a definite integral using appropriate numerical method.
4. Evaluate a derivative at a value using appropriate numerical method.
5. Solve a differential equation using an appropriate numerical method.
6. Use C or other software tools to compute the solutions of engineering problems using appropriate numerical methods.

UNIT - 1 (12 hours)

Introduction, Approximation and errors of computation: Approximation and errors in computation, Taylor's series, Newton's finite differences (forward, backward, central and divided differences) Difference, shift, differential operators, Uses and importance of computer programming in numerical methods.

Solutions of nonlinear Equations: Bisection method, Newton Raphson method, Regula Falsi method, Secant method, fixed point iteration method, Rate of convergence and comparisons of these methods.

UNIT - 2 (12 hours)

Solution of system of linear algebraic equations: Gauss elimination method with pivoting strategies, Gauss Jordan method, LU Factorization.

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Iterative methods (Jacobi, Gauss Seidal method), Eigen value and Eigen vector using Power method.

Interpolation: Newton's Interpolation(forward, backward), Central difference interpolation: Stirling's Formula, Bessel's formula, Lagrange's interpolation, Least square method of fitting linear and non-linear curve for discrete data and continuous function, Spline interpolation(cubic spline).

C programs for all above methods.

UNIT - 3   (12 hours)

Numerical Differentiation and Integration: Numerical differentiation formulae, Newton-Cote general Quadrature formula, Trapezoidal, Simpson's 1/3, 3/8 rule, Romberg integration, Gaussian integration (Gaussian- Legendre Formula 2 point and 3 point).

Solution of ordinary differential equations: Euler's and modified Euler's method, Runge Kutta methods for 1st and 2nd order ordinary differential equations, solution of boundary value problem by finite difference method and shooting method.

C programs for all above methods.

UNIT - 4   (12 hours)

Numerical solution of partial differential equation: Classification of partial differential equation (Elliptic, parabolic and Hyperbolic), Solution of Laplace equation (standard five point formula with iterative method), Solution of Poisson equation (finite difference approximation), Solution of Elliptic equation by Relaxation method, Solution of one dimensional Heat equation by Schmidt method. C programs for the methods.

Recommended Readings:

1. E. Balaguruswamy; Numerical Methods; TMH.
2. Dr. B. S. Grewal; Numerical methods in Engineering & Science, 7th Edition; Khanna Publication
3. V. Rajaraman; Computer Oriented Numerical methods; PHI
4. S. S. Sastry; Introduction methods of numerical analysis; PHI
5. Robert J. Schilling, Sandra I. Harries; Applied Numerical Methods for Engineers using MATLAB and C, 3rd Edition; Thomson Brooks
6. John H. Mathews, Kurtis Fink; Numerical Methods Using MATLAB, 3rd Edition; Prentice Hall publication

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

   1. Generate difference table
   2. Bisection method, Newton Raphson method, Secant method
   3. Gauss elimination, Gauss Jordan method
   4. Finding largest Eigen value and corresponding vector by Power method

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5. Lagrange's interpolation
6. Curve fitting by least square method
7. Differentiation by Newton's finite difference method
8. Integration using Simpson's 3/8 rule
9. Solution of 1st order differential equation using RK-4 method
10. Partial differential equation(Laplace equation)

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ETC/ECE 7.5.4 ADVANCED CONTROL SYSTEMS

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 7.5.4	Advanced Control Systems	3	1	2	3	100	25	--	25	--	150

Course Objectives:

The subject aims to provide the student with:
1. An introduction to digital control system.
2. An ability to perform analysis and design using state space model.
3. An understanding of nonlinear control problems.

Course Outcomes:

The student after undergoing this course will be able to:
1. Design controllers for plants using the state variable model based approach.
2. Analyze control systems using state variable methods.
3. Evaluate z domain representation of digital control systems.
4. Explain the concepts of nonlinear control and stability criteria.

<u>UNIT - 1</u>   (12 hours)

Digital Control Systems: Industrial and embedded control, digital computer as compensator, basic computer-control scheme, signal conversion principles, digital implementation of analog compensators, formulation of direct digital control design problem, z-transform, closed loop sampled data systems, s-plane to z-plane mapping, transform design of digital controls.

<u>UNIT - 2</u>   (12 hours)

Control system analysis using state variable methods: Introduction, matrices, state variable representation, conversion of state variable models to transfer functions, conversion of transfer functions to canonical state variable models, solution of state equations, concepts of controllability and observability, equivalence between transfer function and state variable representations.

<u>UNIT - 3</u>   (12 hours)

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Control system design using state variable methods: State variable feedback structure, pole-placement design using state feedback, state feedback with integral control, critique of pole-placement state feedback control, observer based state feedback control, digital control design using state feedback, optimal control problem.

UNIT - 4 (12 hours)

Nonlinear control system: Introduction, common nonlinear system behaviors, nonlinearities in control systems, describing function fundamentals, functions of common nonlinearities, stability analysis by describing function method, concept of phase plane analysis, construction of phase portraits, system analysis of phase plane, Lyapunov Stability.

Recommended Readings:

1. M. Gopal; Control Systems-Principles and Design,3rd Ed.; Tata Mc Graw Hill
2. K. Ogata; Modern Control Engineering; PHI
3. Norman S. Nise; Control Systems Engineering, 6th Edition; Wiley & Sons

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. Study of z-transform in Matlab/Scilab
2. Z-transform transfer function representation and inter conversion from s to z plane in Matlab/Scilab
3. State variable representation in Matlab/Scilab
4. Conversion of state variable models to transfer functions and vice versa in Matlab/Scilab
5. State variable model controller design using Matlab/Scilab
6. Non-linear control system in Matlab/Scilab
7. Digital PI, PD,PID controller implementation in Matlab/Scilab
8. State variable representation of PI, PD and PID controller in Matlab/Scilab

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ETC/ECE 7.5.5 INTRODUCTION TO MEMS

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 7.5.5	Introduction to MEMS	3	1	2	3	100	25	--	25	--	150

Course Objectives:

The subject aims to provide the student with:

1. An overview of Microsystems and their applications in various branches of Engineering medical science and basic sciences.
2. An understanding of the principles and applications of the Microsystems and Microactuators.
3. An understanding of the different materials used in the MEMS technology.
4. An ability to analyze the various techniques and parameters used in the microsystem fabrication.
5. An understanding of the microsystem packaging techniques.

Course Outcomes:

The student after undergoing this course will be able to:

1. Explain the applications of MEMS in various branches of Engineering medical science and basic sciences.
2. Explain the principles and operation of the different microsensors and microactuators.
3. Analyze the various techniques and parameters   in the microsystem fabrication.
4. Explain the microsystem packaging techniques.

<u>UNIT - 1</u>   (12 hours)

Basic device technology: depletion region and diffusion capacitance, junction breakdown, breakdown voltage enhancement in pn junction. Thermal properties and second breakdown phenomenon, calculation of reverse leakage current. IC technology: Lithography, diffusion, ion implantation, oxidation and epitaxial growth.

MEMS and Microsystems: Applications, Multidisciplinary nature of MEMS. The effects of miniaturization and scaling.

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UNIT - 2 (12 hours)

Working principles of Microsystems: Micro sensors -Biomedical sensors and biosensors, Optical sensors, pressure sensors.

Microactuation: Actuation using piezoelectric crystals, Actuation using Electrostatic forces, (Parallel plate, Comb drive actuators) MEMS with Micro actuators: Micro grippers, micro motors, micro valves, micro pumps, micro accelerometers, Microfluidics.

UNIT - 3 (12 hours)

Materials for MEMS: Substrates and wafers, silicon as substrate material, Single crystal silicon and wafers, crystal structure, The Miller Indices, Mechanical properties of Silicon, Silicon Compounds, Silicon Piezoresistors, Gallium Arsenide, Quartz, polymers for MEMS, Packaging materials. Microsystem fabrication – Environment for Microfabrication, Photolithography, Ion implantation, Diffusion, Oxidation, Chemical vapour deposition, Sputtering, Epitaxy, Etching.

UNIT - 4 (12 hours)

Overview of Micro manufacturing: Bulk micro manufacturing, Surface micro machining Microsystems Design - Design considerations – Selection of signal transduction ,Process design, Design of a silicon die for a micro pressure sensor, Microsystem packaging, The three levels of micro system packaging ,interfaces in micro system packaging, Signal mapping and transduction RF MEMS and optical MEMS components.

Recommended Readings:

1. Tai-Ran Hsu; MEMS and Microsystems, Design and Manufacture; TMH
2. Mark Madou; Fundamentals of Micro fabrication; CRC Press
3. Julian W Gardner; Microsensors: Principles and Applications; John Wiley & Sons
4. Sze S. M.; Semiconductor Sensors; McGraw-Hill
5. Nadim Maluf; An Introduction to Micro Electro Mechanical System Design; Artech House
6. Chang Liu; Foundations of MEMS; Pearson Education Inc.
7. M. H. Bao; Micro Mechanical Transducers, Volume 8, Handbook of Sensors and Actuators; Elsevier
8. Chang C. Y., Sze S. M.; VLSI Technology; McGraw

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. Microsensors
2. Microactuators
3. Materials for MEMS
4. The Miller Indices
5. Microsystem fabrication

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6. Micro manufacturing
7. Microsystem Design
8. Microsystem packaging

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ETC/ECE 7.5.6 PROCESS CONTROL INSTRUMENTATION

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 7.5.6	Process Control Instrumentation	3	1	2	3	100	25	--	25	--	150

Course Objectives:

The subject aims to provide the student with:

1. An understanding of various Industrial Process Control Mechanisms.
2. Theoretical and practical training in the operation and maintenance of automated process control.
3. An understanding of various devices to measure physical processes in Industries.
4. An overview of Industrial Controller modes.

Course Outcomes:

The student after undergoing this course will be able to:

1. Explain Process Control Instruments used in Industry.
2. Evaluate appropriate sensor for given application.
3. Design at block system level a complete instrumentation system for a given application.
4. Evaluate Actuators and other control elements for an instrumentation system.
5. Evaluate controllers on different performance metrics.
6. Design Ladder Programming logic for controlling different processes in industries.

UNIT - 1   (12 hours)

Introduction to Process Control: Introduction; control systems; process control block diagram; servomechanisms; control system evaluation; on off control; analog and digital control; process characteristics.
Sensors: Sensor time response. Overview of Thermal sensors: RTD, thermistors, thermocouples. Overview of Mechanical sensors: Strain, motion, pressure, and flow.
Optical sensors: Photodetectors, pyrometers, applications: design consideration of all sensors.

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UNIT - 2   (12 hours)

Analog and digital signal conditioning; Analog signal conditioning: Linearization, Conversion, SCR and TRIAC. Final Control: Introduction; final control operation; Signal conversion.
Actuators: Electrical, pneumatic, and hydraulic; Control elements: mechanical; electrical; Fluid valves; Control valve type; Control valve sizing; Process instrumentation.
Discrete state process control: Introduction; definition; characteristics of the system; relay controllers.

UNIT - 3   (12 hours)

Controller Principles: Introduction; overview of control system parameters; continuous controller modes: proportional, integral, derivative control modes; composite control modes: PI, PD, PID; Telemetry: pneumatic telemetering system; electronic telemetry system; electrical electronic telemetering system.
Analog /digital controllers: Introduction; electronic, pneumatic, digital controller; design considerations.

UNIT - 4   (12 hours)

Computer in process control: Data logging; supervisory control; computer-based controller; digital controller for a turbine and generator. Introduction to process loops; simple control schemes for level, flow, temperature as applied to reactor, heat exchanger. Overview of signal recorders: chart recorder, fiber optic recorder, magnetic recorder, UV Recorder, printing processes: Risograph, laser printers; Process control networks: Modbus communication RS485/RS422.
Applications of PLC to process control: Traffic generation, water-bottle plant;
Microprocessor/microcontroller application in process instrumentation: Microprocessor/microcontroller control of a petrol engine, microprocessor/ microcontroller based data logger; process loop tuning.

Recommended Readings:

1. Curtis D. Johnson; Process Control Instrumentation Technology, 7th Edition; Pearson Education
2. Alan S. Morris; Principles of Measurement and Instrumentation, 3rd Ed.; Butterworth-Heinemann
3. C. Rangan, G. Sarma, V. Mani; Instrumentation Devices and Systems, TMH
4. S. K. Singh; Industrial Instrumentation and control; TMH
5. Donald P. Eckman; Automatic process control; Wiley
6. B. C. Kuo; Digital control systems; Oxford University Press

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List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. Study of Temperature Transducers.
2. Study of Optical Transducers.
3. Pneumatic Actuator.
4. SCR Characteristics.
5. Nozzle Flapper System.
6. PID Controller using MATLAB SIMULINK.
7. Feedforward and Feedback PID Controller.
8. Demonstration of Water Bottling Plant using PLC.
9. Water Level Indicator using PLC.
10. Motor Speed Control using PLC.
11. Conveyor Belt using PLC.
12. Traffic Light Control using PLC.

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ETC/ECE 7.5.7 SECURE COMMUNICATIONS

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 7.5.7	Secure Communications	3	1	2	3	100	25	--	25	--	150

Course Objectives:

The subject aims to provide the student with:
1. An introduction to communications security and encryption.
2. An ability to apply appropriate encryption algorithm to a problem.
3. An introduction to firewall designs and IP security.
4. An introduction to authentication protocols.

Course Outcomes:

The student after undergoing this course will be able to:
1. Explain the different aspects of security in communication.
2. Explain classical encryption and block cipher algorithms.
3. Choose appropriate encryption algorithm for a given application.
4. Explain authentication functions, protocols and applications.
5. Explain firewall design principles and IP security.

UNIT - 1 (12 hours)

Introduction of Secure Network: Key points (service, mechanisms and attacks), OSI security architecture, Security attacks, security services, security mechanisms, a model for network.
Classical encryption techniques: Symmetric cipher model substitution techniques, Transposition techniques, rotor machines, steganography and numerical on different ciphers.
Block Ciphers and DES (Data Encryption Standards): Block cipher principles, Data encryption standards, strength of DES, Block cipher design principles, Block cipher modes of operation, problems on DES.

UNIT - 2 (12 hours)

Public-Key Cryptography and RSA: Principles of public-key cryptosystems, RSA algorithm and numerical on RSA.
Key Management; Other Public Key Crypto Systems: Key management, Diffie-Hellman key exchange, ECC Diffie-Hellman key exchange algorithm, numericals.

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Message Authentication and Hash Functions: Authentication requirements, Authentication functions. Message authentication codes, Requirements of Hash functions, Security of hash functions & MACs.

UNIT - 3 (12 hours)

Digital Signature and Authentication Protocol: Digital signature, Authentication protocols, Digital signature standard.
Authentication Applications: Kerberos: Kerberos Version 4, Kerberos Version 5. X.509 authentication service:-Certificates, Authentication Procedures, X.509 Version 3
Firewalls: Firewall Design Principles.

UNIT - 4 (12 hours)

Electronic Mail Security: Pretty good privacy, S/MIME.
IP Security: Overview, IP security architecture, Authentication header, ESP (encapsulating security pay load), Key management.

Recommended Readings:

1. William Stallings; Cryptography and Network Security, 4th Edition; Prentice Hall of India
2. C. Kaufman, R. Perlman, M. Speciner; Network Security: Private Communication in a Public World, 2nd Edition; Pearson Education (Asia) Pvt. Ltd

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. Implementation of classical encryption techniques
   a. Substitution cipher
   b. Transposition cipher
   c. Steganography
2. Implementation of DES block cipher
3. Implementation of RSA algorithm
4. Implementation of Hash functions
5. Study of Kerberos authentication application
6. Configuration of a firewall
7. Implementation of PGP protocol
8. Case study : Tor and VPN

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ETC/ECE 7.5.8 INTRODCUTION TO ARM ARCHITECTURE

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Th	S	TW	O	P	Total
ETC/ECE 7.5.8	Introduction to Arm Architecture	3	1	2	3	100	25	--	25	--	150

Course Objectives:
The subject aims to provide the student with:
1. The ability to understand the architecture and assembly instructions of ARM7TDMI processor and its internal functioning.
2. An in-depth understanding about instruction set and assembly level programming in ARM and THUMB State.
3. An understanding of how coprocessors are interfaced with ARM core and the VFP coprocessor implementation in particular.
4. An understanding of the details of AMBA bus, caches and Memory Management.

Course Outcomes:
The student after undergoing this course will be able to:
1. Describe the architecture of ARM7TDMI processor.
2. Write embedded software using ARM7TDMI assembly instructions.
3. Design embedded systems with ARM7 architecture.
4. Design embedded systems with Vector floating point processers and their interface with ARM.
5. Apply AMBA bus architecture, various HW peripherals in SoCs in embedded system designs.

<u>UNIT - 1</u>   (12 hours)

ARM architecture and Processor fundamentals: Types of computer Architectures, ISA's and ARM History, RISC and ARM Design, architectural inheritance, ARM Programmer's model, memory system, memory formats and data types, ARM core data flow model, Processor modes, registers: General purpose and Program status, flags, Overview of Endianness, unaligned access support.
Pipelines: ARM 3 and 5 stage Pipeline, hazards, efficiency, ARM family attribute comparison. Exceptions, interrupts and vector table, Core extensions, Jazelle extension ARM Development tools.
ARM7TDMI S block, core and functional diagrams, memory interface, bus Interface signals and bus cycle types.

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UNIT - 2 (12 hours)

ARM7TDMI assembly instructions and modes: Conditional execution, addressing modes: data processing operands, memory access operands, Load and store operands, Stack operations, Shift Operations.

ARM Instruction set: Branch, data processing, comparison, SIMD, Multiply, miscellaneous data processing, status register transfer, load store, coprocessor, exception-generating instructions. Elementary assembly level programs.

Thumb state: Thumb Programmers model, Thumb exceptions, Implementation and applications. Thumb Instruction set in brief.

UNIT - 3 (12 hours)

Exception handling: ARM processor exceptions and modes, vector table, exception priorities, link offset registers. Interrupt handling: Assigning interrupts, interrupt latency, IRQ and FIQ exceptions, basic interrupt stack design, Interrupt handling schemes: non-nested, nested, reentrant and prioritized simple interrupt handler.

ARM7TDMI Exception and abort model, instructions to improve exception handling.

Caches: Memory hierarchy and cache memory, caches and memory management units, basic architecture of cache memory, set associativity. Relationship between cache and main memory, Cache policy.

UNIT - 4 (12 hours)

ARM Coprocessor Interface: Coprocessor availability, interface signals, handshaking, connecting coprocessors.

Vector Floating Point Processor (VFP) architecture: Overview, floating point model, registers, floating-point exceptions, compliance with IEEE 754 standard, VFP and ARM interactions.

Advanced Microcontroller Bus Architecture (AMBA): Overview, Typical AMBA Based Microcontroller, AHB bus features, components, bus interconnection, AHB Bus transfers, APB bus transfers, APB Bridge.

Recommended Readings:

1. ARM Architecture Reference Manual
2. Andrew N. Sloss, Dominic Symes, Chris Wright; ARM System Developers Guide, Designing and Optimizing System Software; Elsevier
3. Steve Furber; ARM System-on-Chip Architecture, 2nd Edition; Pearson
4. ARM7TDMI-S Technical Reference Manual, ARM Inc.

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List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. Writing programs using Data Transfer and arithmetic
2. Writing programs using logical and branch instructions
3. Writing Subroutines and passing parameters to subroutines
4. Developing Counters and Time Delay Routines
5. Developing programs for Code Conversion
6. Developing programs for BCD Arithmetic
7. Developing programs for 16-Bit Data Operations
8. Interfacing of I/O devices: LEDs and toggle-switches
9. Interfacing Stepper Motor
10. Interfacing ADC and DAC chips
11. Interfacing LCD
12. Programming PWM Module
13. Programming RTC Module
14. Programming I2C/ SPI Interface

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ETC/ECE 7.5.9 ELECTRONIC CIRCUITS: DESIGN, SIMULATION AND TESTING

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 7.5.9	Electronic Circuits: Design, Simulation and Testing	3	1	2	3	100	25	--	25	--	150

Course Objectives:

The subject aims to provide the student with:
1. An understanding of overall design process of electronic systems.
2. An introduction to device data sheets and associated application notes.
3. An introduction to simulation of electronic circuits using available circuit simulation tools.
4. An understanding of how to design PCB layout of a given circuit using layout design tools.

Course Outcomes:

The student after undergoing this course will be able to:
1. Design an electronic system following the data sheet information for basic electronic components.
2. Simulate electronic circuits using software tools.
3. Design, develop and fabricate layout of PCB using PCB layout design tools.
4. Develop, evaluate, and implement total design process and develop prototypes which require little or no debugging.
5. Explain industrial design and product design methodologies.

<u>UNIT - 1</u>   (12 hours)

Concept of Electronics Circuit Design: Functional Sections, Components and Devices, Ratings, Specifications, Design equations and selection criterion.
Approaches to analysis; Introduction to modelling of devices, components and circuits.
Computation of characteristics of simple devices (p-n junction, MOS capacitor, MOSFET, etc.)

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UNIT - 2 (12 hours)

Simulation of Electronic Circuits: Role of simulation, various circuit elements and their representation.
Introduction to circuit simulator: SPICE, Simulation exercises; design of circuits and performance evaluation using simulation packages.
Introduction to schematic, Layout and Routing (OrCad/Eagle etc.).

Noise in electronic systems: Design of low noise circuits.

UNIT - 3 (12 hours)

Design considerations and guidelines for automatic insertion of components.
Electronic Product design: launch process, design management and design process.
Design guidelines for dual in line package components. Surface mounting technology of electronic components.

UNIT - 4 (12 hours)

Introduction to industrial design: product design methodology product planning and development data collection Marketing and management theory.

Recommended Readings:

1. Nihal Kularatna; Electronic Circuit Design: From Concept To Implementation; CRC Press
2. W. Bosshart; Printed Circuit Boards - Design & Technology, 1st Edition; Tata McGraw Hill
3. Richard Stillwell; Electronic product design for automated; Marcel Dekker Inc.
4. T.R. Banga, S.C. Sharma; Industrial Organization and Engineering Economics; Khanna Publishers
5. H. W. Ott; Noise Reduction Techniques in Electronic Systems; Wiley
6. Flurschiem C. H.; Industrial Design in Engineering; Springer Verlag
7. G. L. Ginsberg; Printed Circuit Design; McGraw Hill
8. L. O. Chua and P. M. Lin; Computer aided analysis and electronic circuits; Prentice Hall
9. S. Selberherr; Analysis and Simulation of Semiconductor Devices; Springer-Verlag
10. Richard Spencer, Mohammed Ghausi; Introduction to Electronic Circuit Design; Prentice Hall

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List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. Assemble electronic circuit using circuit simulation software.
2. Simulate and test the RC, LC and RLC based electronic circuit using circuit simulation software and perform transient analysis.
3. Simulate and test a diode, transistor or MOSFET based electronic circuit using circuit simulation software.
4. Find the frequency response of RC, diode or transistor based electronic circuit using simulation software.
5. Design of low noise circuits using circuit simulator.
6. Design a PCB layout of an Electronic circuit using software.
7. Place route and generate the layout of given circuit using manual or auto routing using PCB layout design.
8. Fabricate and test a simple circuit on PCB.

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ETC/ECE 7.5.10 ARTIFICIAL NEURAL NETWORK

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 7.5.10	Artificial Neural Network	3	1	2	3	100	25	--	25	--	150

Course Objectives:

The subject aims to provide the student with:
1. An introduction to important neural processing paradigms, and learning rules.
2. An introduction to foundations of trainable decision making networks for classification of linearly separable and linearly non-separable classes of patterns.
3. An understanding of different artificial neural networks that use Unsupervised Learning algorithms to extract features from available data.
4. The basic knowledge of associative models of artificial neural networks.

Course Outcomes:

The student after undergoing this course will be able to:
1. Describe the correspondence between a biological and artificial neuron.
2. Realize logic gates using McCulloch-Pitts model of Artificial Neural Networks
3. Distinguish between linear separable and non-separable pattern Classification
4. Compare different supervised and unsupervised learning rules.
5. Design single and multilayer perceptron networks for simple applications.
6. Design associative neural networks for simple applications.

<u>UNIT - 1</u> (12 hours)

Introduction: Introduction to neural networks, structure of biological neuron, Mc-Culloch Pitts neuron model.
Logic network realization by using Mc-Culloch Pitts neuron model, Neuron modelling for artificial neuron systems, Neural learning.
Single layer network: Concept of linear seperability and non-linear separability, training algorithms-
Hebbian learning rule, perceptron learning rule, Delta learning rule, Widrow-Hoff learning rule, co-relation learning rules, winner take all and outstar learning rules, and related problems.
Discriminant functions, Minimum distance classification, Single layer Discrete Perceptron, Single layer Continuous Perceptron, ADALINE. Multicatagory single layer perceptron.

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UNIT - 2 (12 hours)

Multilayer network I: Error back propagation algorithm or generalized delta rule.
Setting of parameter values and design considerations (Initialization of weights, Frequency of weight updates, Choice of learning rate, Momentum, Generalizability, Network size, Sample size, Non-numeric inputs).
Pocket algorithm, quick prop algorithm, performance evaluation.
Multilayer network II: Adaptive multilayer network, network pruning algorithm.
Marchands algorithm, neural tree, tiling algorithm & problems related to adaptive multiplayer network.
Prediction network, radial basis function and its applications, polynomial network.

UNIT - 3 (12 hours)

Winner-Take-All network, Hamming Distance classifier, MAXNET.
Clustering, simple competitive learning algorithm, LQV algorithm.
Adaptive resonance theory.
Topologically organized network: SOM, SOFM, Kohonen's algorithms, Distance based learning, K-means clustering algorithms, Principal Component Analysis Networks and problems.

UNIT - 4 (12 hours)

Hopefield network: Non-iterative procedures for association, Matrix Association memories, Least square procedures, optimal linear association memory.
Discrete Hopefield networks, Continuous Hopefield networks, Energy functions, Energy minimization, Storage capacity of Hopfield networks.
Brain-state-in-a-box network, Bi-directional associative memory and problems.
Applications of neural network.

Recommended Readings:

1. Kishan Mehrotra, Chilukuri Mohan, Sanjay Ranka; Elements of artificial neural network; Penram Publications.
2. J. Zurada; Introduction to Artificial neural network; Jaico Publications
3. D. Patterson; Artificial neural networks; Prentice Hall

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. Write a MATLAB program to generate activation functions used in Artificial Neural Networks.
2. Generate logic functions using McCulloch-Pitts neuron model.
3. Classify the given two-dimensional input patterns using Hebbian rule.
4. Write a MATLAB program for pattern classification using perceptron network.
5. Develop a MATLAB program to perform the following using Adaline.
   a. Adaptive prediction

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  b. System Identification

  c. Adaptive Noise Cancellation

6. Write a MATLAB program to obtain the weights for given patterns using hetero associative neural nets.

7. Design a recurrent auto associative net to store a given vector.

8. Introduction to MATLAB Neural Network Toolbox

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ETC/ECE 7.5.11 INTRODUCTION TO RF DESIGN

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 7.5.11	Introduction to RF Design	3	1	2	3	100	25	--	25	--	150

Course Objectives:

The subject aims to provide the student with:
1. An introduction to passive components used in RF design and their characteristics.
2. An ability to design high frequency and low noise amplifiers for RF applications.
3. An ability to design RF subsystems such as mixers, oscillators and PLL's.
4. An introduction to various RF architectures used in modern cellular networks.

Course Outcomes:

The student after undergoing this course will be able to:
1. Design matching networks using passive elements and appropriate topology.
2. Apply concepts of MOS device physics, transmission lines, VSWR, Smith chart to RF design.
3. Design high frequency amplifiers with due considerations to bandwidth, rise time and delay.
4. Design low noise amplifiers, power amplifiers, Mixers, VCO's, PLL's and frequency synthesizers for RF applications.
5. Explain the effects of different types of noise in RF design.
6. Explain the RF architectures of modern cellular communication networks such as GSM, CDMA and UMTS.

<u>UNIT - 1</u>   (12 hours)

Introduction: RF systems – basic architectures, Transmission media and reflections, Maximum power transfer.
Passive RLC Networks: Parallel RLC tank, Q, Series RLC networks, matching, Pi match, T match.
Passive IC Components: Interconnects and skin effect, Resistors, capacitors, Inductors Review of MOS Device Physics.

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UNIT - 2   (12 hours)

Distributed Systems: Transmission lines, reflection coefficient,
The wave equation, examples, Lossy transmission lines, Smith charts – plotting gamma
High Frequency Amplifier Design: Bandwidth estimation using open-circuit time constants, Bandwidth estimation using short-circuit time constants, Risetime, delay and bandwidth, Zeros to enhance bandwidth, Shunt-series amplifiers, tuned amplifiers, cascaded amplifiers.

UNIT - 3   (12 hours)

Noise: Thermal noise, flicker noise review, Noise figure.
LNA Design: Intrinsic MOS noise parameters, Power match versus noise match, Large signal performance, design examples & Multiplier based mixers.
Mixer Design: Subsampling mixers. Gilbert Cell. RF Power Amplifiers: Class A, AB, B, C amplifiers, Class D, E, F amplifiers, RF Power amplifier design examples.
Voltage controlled oscillators: Resonators, Negative resistance oscillators.

UNIT - 4   (12 hours)

Phase locked loops: Linearized PLL models, Phase detectors, charge pumps, Loop filters, PLL design examples.
Frequency synthesis and oscillators: Frequency division, integer-N synthesis, Fractional frequency synthesis.
Phase noise: General considerations, Circuit examples.
Radio architectures: GSM radio architectures, CDMA, UMTS radio architectures.

Recommended Readings:

1. Thomas H. Lee; The Design of CMOS Radio-Frequency Integrated Circuits; Cambridge University Press
2. Behzad Razavi; RF Microelectronics; Prentice Hall

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. Impedance matching using Pi and T networks
2. Measurement of reflection coefficients and VSWR using Smith Chart
3. Design of high frequency amplifiers:
    a. Series-Shunt
    b. Cascaded
    c. Tuned
4. Design of LNA
5. Design of Mixers (Gilbert cell etc.)
6. Design of RF power amplifiers
    a. Class A
    b. Class AB
    c. Class D,E,F
7. Design of VCO
8. Design of PLL
9. Design of Frequency synthesizers

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ETC/ECE 7.5.12 INTRODUCTION TO DATABASES

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 7.5.12	Introduction to Databases	3	1	2	3	100	25	--	25	--	150

Course Objectives:

The subject aims to provide the student with:

1. An introduction to the data models of a database system and basic principles of the relational model of data.
2. The knowledge of the most important features of Structured Query Language, relational algebra and relational calculus.
3. An understanding of modeling concepts of the Entity-Relationship (ER) model
4. A basic knowledge of theory related to evaluation of relational schemas for design quality.
5. An introduction to concurrency control techniques that are used to ensure the noninterference property of concurrently executing transactions.

Course Outcomes:

The student after undergoing this course will be able to:

1. Define a database and describe the main characteristics of a database system.
2. Discuss data models and define the concept of schemas and instances.
3. Describe the types of interfaces and languages that are typically provided by a DBMS.
4. Discuss relational constraints and how these can be handled.
5. Review the basic data types in SQL, illustrate various SQL commands used for performing various tasks like retrieve, insert, delete and update on schemas and tables and demonstrate the use of Assertions, Triggers and Views in SQL.
6. Illustrate the relational algebra operations.
7. Explain the concept of Entities and Attributes and demonstrate the use of E-R Diagrams.
8. Define a functional dependency and discuss normal forms and normalization using functional dependencies.
9. Discuss concurrency control techniques based on locking protocols.

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UNIT - 1 (12 hours)

Introduction: General Introduction to database systems; Database-DBMS distinction, Approaches to building a database. Implications of the Database Approach.
Data Modelling: Data models, Schemas and Instances Three-schema architecture of a database. Database Languages and Interfaces.
E/R Model Conceptual data modelling - motivation, Entities, Entity types, various types of attributes, Relationships, Relationship types, E/R diagram notation, Extended ER Diagram Examples.

UNIT - 2 (12 hours)

Relational Data Model: Concept of relations, Schema-instance distinction, Keys, referential integrity and foreign keys.
Relational Algebra Operators: Selection, Projection, Cross product, various types of joins, Division, Example queries, Tuple Relational Calculus.
Domain relational Calculus: Converting the database specification in E/R notation to the relational schema.
SQL Introduction: Data definition in SQL, Table, key and foreign key definitions, Update behaviors.
Querying in SQL: Basic select- from- where block and its semantics, Nested queries - correlated and uncorrelated, Notion of aggregation, Aggregation functions group by and having clauses, Embedded SQL.
Views: Specification of views in SQL, Embedded SQL & Dynamic SQL
Security mechanism with related Commands.
Other Relational languages: QBE (Query-By-Example)
Relational Database Design: Pitfalls, Functional dependencies, Closure of set of FD's, Closure of attribute set, Canonical cover keys.

UNIT - 3 (12 hours)

Dependencies and Normal forms: Importance of a good schema design, Problems encountered with bad schema designs, Motivation for normal forms
Normal Forms: 1NF, 2NF, 3NF and BCNF, Domain key Normal form DKNF, Multi-valued dependencies and 4NF, Join dependencies and definition of 5NF.
Query Processing: Measures of query cost selection, Translating SQL queries into Relational algebra, Sorting.
Join, Nested Loop Join, Block Nested Loop Join, Merge Join, Hybrid-Hash Join.
Using Heuristics in Query Optimization: Query tree Query graph, Converting query trees into Query evaluation plan.

UNIT - 4 (12 hours)

Transaction processing and Error recovery: Concepts of transaction processing, ACID properties, Schedules and Recoverability, Serializability of Schedules.
Concurrency Control: Concurrency control, Locking based protocols for CC.

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Recommended Readings:

1. R. Elmasri, S. Navathe; Fundamentals of Database Systems, 6th Edition, Pearson
2. Abraham Silberschatz, Henry F. Korth; Database System Concepts, 3rd Edition; McGraw Hill
3. C. J. Date; An Introduction to Data Base Systems; Pearson Education
4. Desai B.; An Introduction to Database Concepts; Galgotia Publications

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. Introduction to SQL
2. Creating a database
3. Creating a table with constraints
4. Altering a table
5. Adding a record to the database
6. Updating (Modify) a table
7. Generating a subquery
8. Deleting records
9. Sorting (Order by) records
10. Set Operations

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ETC/ECE 7.5.13 POWER ELECTRONICS

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 7.5.13	Power Electronics	3	1	2	3	100	25	--	25	--	150

Course Objectives:

The subject aims to provide the student with:
1. An introduction to various power semiconductor devices, their characteristics and operation.
2. An understanding of Thyristor protection, Thyristor firing circuits and Thyristor commutation techniques.
3. An introduction to AC-DC and DC-DC converters and their operation.
4. An introduction to inverter topologies, AC voltage controllers and cycloconverters.

Course Outcomes:

The student after undergoing this course will be able to:
1. Explain the construction and characteristics of power semiconductor devices and fundamental of Thyristor.
2. Explain the different triggering circuits for Thyristor and their applications
3. Analyze, operate and design AC-DC and DC-DC converters
4. Analyze and operate serial and parallel inverters
5. Apply knowledge of power semiconductor devices and Thyristor in SMPS, UPS and HVDC Transmission.

UNIT - 1 (12 hours)

Power Semiconductor Devices: Construction and characteristics of Power diodes, Power Transistors, Power MOSFET, Insulated Gate Bipolar transistors (IGBTs). Power electronic converters and applications.

Introduction to Thyristor family: Structure, Symbol, V.I. Characteristics of SCR.
Transistor analogy Thyristor Turn-on methods, switching characteristics of Thyristor during Turn on & Turn OFF Thyristor commutations. Thyristor Gate characteristics.
Thyristor protection: over voltage protection, suppression of over voltages, over current protection, di/dt protection, dv/dt protection, gate protection, snubber circuits. Mounting of Thyristor, series and parallel operation of Thyristor.

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UNIT - 2 (12 hours)

Thyristor commutations. Thyristor trigger circuits: RC firing circuits (half wave & Full wave) Ramp triggering, Ramp and pedestal trigging.
Other members of Thyristor Family: DIAC, TRIAC, PUT, IGBT & GTO: structure, characteristics, applications
AC to DC converters: Principle of phase control, single phase half-wave Thyristor rectifier with RL load and RLE load. Effect of Free-wheeling diode. Single phase full-wave mid-point & bridge Thyristor converters.

UNIT - 3 (12 hours)

DC to DC converters (choppers): principle of operation, Control Schemes: Constant frequency scheme, variable frequency scheme, and step up choppers.
Choppers classification: Class A, B, C, D, & E.
Basic DC-DC converter (switch regulator) topologies: Principle, operation and analysis for Step-down (Buck), Step-up (Boost), Step up/down (Buck- Boost), Continuous conduction and Discontinuous conduction operation
AC Voltage Controllers: Types, integral cycle control, Single Phase Voltage controllers with R and RL Load.

UNIT - 4 (12 hours)

Inverters: parallel inverter: Basic Parallel inverter, modified parallel inverter. Series inverter: Basic series inverter, modified series inverter. Single phase voltage source inverters: half bridge & full bridge (mathematical analysis) MC Murray –Bedford half bridge and full bridge inverter. Three phase inverter for 1800 and 1200 mode operations.
DC motor speed control: – principle of speed control, phase controlled converters.
AC Drives: Speed control by static voltage control, variable voltage variable frequency control.
Cycloconverters: Principle of cycloconverter operation.
Some Applications: Switched mode Power supply, UPS, HVDC transmission.

Recommended Readings:

1. P. S. Bhimbra; Power Electronics; Khanna Publications
2. M. D. Singh, K. B. Khanchandani; Power electronics, 2nd Ed.; TMH
3. V. Jagannathan; Introduction to Power Electronics; Prentice Hall of India
4. Mohammed H. Rashid; Power Electronics circuits, Devices & applications; Prentice Hall
5. M. S. Berde; Thysistor Engineering; Khanna Publications
6. P.C. Sen; Power Electronics; McGraw-Hill Education
7. Vedam Subramanyam; Power Electronics –Devices, Converters and Applications, 2nd Ed.; New Age International Publishers Pvt. Ltd

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List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. Study of SCR characteristics
2. UJT based SCR firing circuit
3. Application of TRIAC for AC Phase control
4. Study of complementary commutation circuit
5. Study of auxiliary commutation circuit
6. Study of DC chopper
7. Study of Single phase half controlled converter
8. Study of Single phase full controlled converter
9. Study of series inverter
10. Study of parallel inverter

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ETC/ECE 8.3.1 TESTING AND FAULT TOLERANCE

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 8.3.1	Testing and Fault Tolerance	3	1	2	3	100	25	--	25	--	150

Course Objectives:

The subject aims to provide the student with:
1. An understanding of basic theory and techniques for testing digital circuits and systems.
2. An ability to test combinational and sequential logic circuits.
3. An ability to perform fault simulation and detect faults.
4. An understanding of different techniques in Built in Self-Test (BIST).

Course Outcomes:

The student after undergoing this course will be able to:
1. Generate tests for combinational circuits.
2. Perform functional testing of sequential circuits.
3. Apply design for testability (DFT) techniques to digital design.
4. Use the fault tolerant methods to increase the reliability (fault tolerance) for system design.
5. Explain the fundamentals of reliability, accelerated tests such as burn-in, tem cycling.
6. Apply test techniques such as Iddq test, at speed test and delay.

UNIT - 1 (12 hours)

Introduction to Testing: Basic concepts (Diagnosis, Reliability, fault tolerance), fault models.

Combinational circuit test generation: Truth table methods, Algebraic methods (Boolean Difference), Path Sensitization Methods (D- algorithm, FAN, PODEM Algorithm, Critical path test).

Fault Collapsing: Fault Equivalence and Dominance, Multiple faults, Special circuits test generation for sequential circuits.

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UNIT - 2   (12 hours)

Functional Testing of Sequential Circuits: (Checking Sequences and machine identification, Path Sensitization methods, Asynchronous Circuits, Delay faults and hazards).
PODEM Algorithm for Combinational circuits test.
Fault Simulation: Combinational and Sequential Circuits.

UNIT - 3   (12 hours)

Random Testing: Comparison Testing and Hybrid Testing.
Test Compaction: Transition Count Test, Linear feedback Shift Register (LFSR) Testing.
Design for Testability: Test Pattern Generation for BIST, Generic off-line BIST Architecture, Specific BIST Architecture, MBIST, LBIST.

UNIT - 4   (12 hours)

Fault Tolerant Digital Systems: Measure of fault tolerance, Reliability, MTBF, MTBR, MTTF, Redundancy Techniques (TMR), Fault Tolerant Systems (Dual Systems).
Accelerated Test: Temperature Stress test (Burn-in, Temperature Cycling), Voltage stress test, Electro Static discharge (ESD) test.

Recommended Readings:

1. Hideo Fujiwara; Logical testing & design for testability; MIT Press.
2. Mike Tien Chienlee; High level Test Synthesis of Digital VLSI circuits; Artech House
3. Vishwani D. Agarval, Michael L. Bushnell; Essentials of Electronic Testing for Digital, Memory & Mixed Signal VLSI Circuit; Springer India

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

Programs for implementing following Algorithms:

1. D-Algorithm(Roth)
2. PODEM
3. FAN
4. Serial Fault Simulation
5. Parallel Fault Simulation
6. Deductive Fault Simulation
7. Concurrent Fault Simulation
8. Critical path Testing
9. Linear Feedback Shift Register
10. Built-in Logic Block pattern Generation

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ETC/ECE 8.3.2 ELECTRONIC COMMERCE

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 8.3.2	Electronic Commerce	3	1	2	3	100	25	--	25	--	150

Course Objectives:

The subject aims to provide the student with:
1. An introduction to E-Commerce fundamentals, technologies and models.
2. An ability to plan and implement E-commerce platforms.
3. An understanding of security aspects of E-Commerce.
4. An introduction to Electronic payment systems.

Course Outcomes:

The student after undergoing this course will be able to:
1. Evaluate different e-commerce technologies and models.
2. Plan and implement basic E-Commerce platforms.
3. Evaluate security aspects of E-Commerce platforms.
4. Implement security technologies in E commerce platforms.
5. Evaluate right electronic payment system for a given e commerce model.

UNIT - 1 (12 hours)

Overview of E-Commerce technology: What is E-commerce? Types of E-commerce technologies, Types of E-Business models and markets, Types of E-Commerce providers and vendors.

UNIT - 2 (12 hours)

Designing and building E-commerce websites: hands on. E-Commerce website creation. Managing e-commerce website development.

Implementing and managing e-Commerce websites: Strategies, techniques and tools. Implementing e-commerce databases.

UNIT - 3 (12 hours)

E-Commerce security: Types of security technologies, protocols for public transport of private information. Building an E-commerce trust infrastructure. The Digital ID system. Securing and managing storefront for e-business.

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UNIT - 4   (12 hours)

Electronic payment technologies: Payment technology issues, Electronic payment methods through smart cards, Electronic payment systems, Digital currencies

International E-commerce solutions.

Recommended Readings:

1. Pete Loshin, John Vacca; Electronic Commerce, 4th Edition; Charles River Media (Laxmi Publications)
2. Ravi Kalakota, Andrew Whinston; Electronic Commerce- A Manager's guide; Pearson education.
3. Daniel Minoli, Emma Minoli; Web Commerce Technology Handbook; TataMcGraw Hill.
4. Charlie Kaufman, Radia Perlman, Mike Speliner; Network Security-Private communication in public world; Pearson education.

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. Case study of different E Commerce platform
2. Building a user friendly web site for E-Commerce
3. Setting up a web server
4. Implementation of security aspects for web site
5. Implementing a database for E-Commerce web site
    a. SQL
    b. JDBC
    c. ODBC
    d. XML
    e. CORBA
6. Implantation of SSL for E-Commerce website
7. Case study of different electronic payments systems
8. Study of digital currencies (like BitCoin, ZCoin)
9. Case study of UPI and BHIM payment system

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ETC/ECE 8.3.3 SPEECH PROCESSING

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 8.3.3	Speech Processing	3	1	2	3	100	25	--	25	--	150

Course Objectives:
The subject aims to provide the student with:
1. An understanding of production and classification of speech signals.
2. An understanding of Modeling of speech signals.
3. An understanding of speech analysis and synthesis techniques.
4. An understanding of speech coding and speaker recognition techniques.

Course Outcomes:
The student after undergoing this course will be able to:
1. Explain the production and classification of speech signals.
2. Analyze the Modeling of speech signals.
3. Examine the speech analysis and synthesis techniques.
4. Analyze the speech coding and speaker recognition techniques.

UNIT - 1   (12 hours)

Production and Classification of Speech Signals: Introduction, Anatomy and Physiology of Speech production, Spectrographic Analysis of Speech, Categorization of speech sounds, **Prosody**: The Melody of speech, Speech Perception.
Acoustics of Speech Production: A discrete time model based on tube concatenation.

UNIT - 2   (12 hours)

Analysis and Synthesis of Pole Zero Speech Models: Introduction, All Pole Modelling of Deterministic Signals, Levinson Recursion and its associated properties, Criterion of Goodness.
Homomorphic Signal Processing: Introduction, Concept, Homomorphic system for convolution, Complex spectrum of speech like sequences, Short time homomorphic analysis of periodic sequences, Short term speech analysis, Analysis/Synthesis structures.

UNIT - 3   (12 hours)

Filter Bank Analysis Synthesis: Introduction, Phase Vocoder, Phase Coherence in the Vocoder, Auditory Modelling.

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Sinusoidal Analysis/Synthesis: Sinusoidal Speech Models, Estimation of Sinewave parameters.

Frequency Domain Pitch Estimation: Correlation based pitch estimator, Pitch estimation based on comb filter, Pitch estimation based on Harmonic Sinewave Model.

UNIT - 4   (12 hours)

Speech Coding: Introduction, Statistical Models, Scalar Quantization, Vector Quantization, Frequency Domain Coding, Model based Coding.
Speaker Recognition: Introduction, Spectral Features for Speaker Recognition, Speaker Recognition Algorithms.

Recommended Readings:

1. Thomas Quatieri; Discrete-Time Speech Signal Processing: Principles and Practice; Prentice Hall.
2. L. R. Rabiner, A. W. Schafer; Digital Processing of Speech Signals; Pearson Education.
3. I. H. Witten; Principles of Computer Speech; Academic Press.
4. Lawrence Rabiner, Bing Hwang Juang; Fundamentals of Speech Recognition; Prentice Hall.
5. Ben Gold, Nelson Morgan; Speech and Audio Signal Processing: Processing and Perception of Speech and Music; John Wiley and Sons

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. Program to Generating a sin wave signal
2. Program to compare two sine waves with different frequencies
3. Program to generate square wave
4. Program to add sin and square wave
5. Program to concatenate speech signals
6. Program for Concatenating into Stereo file
7. Program for Stereo to Mono conversion
8. Resonating Frequency using spectrum Analyzer
9. Resonating Frequency in mixed frequency signal
10. Resonating Frequency using Autocorrelation

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ETC/ECE 8.3.4 ENTREPRENEURSHIP

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 8.3.4	Entrepreneurship	3	1	2	3	100	25	--	25	--	150

Course Objectives:
The subject aims to provide the student with:
1. Requisite knowledge so that they can take up entrepreneurship as their career.
2. An understanding of qualities and requirements of an entrepreneur.
3. An ability to understand the requirements of Project identification, formulation and implementation.
4. An understanding of breakeven analysis.
5. An understanding of the complexity of managing in a global world.

Course Outcomes:
The student after undergoing this course will be able to:
1. Explain the skills for project identification, formulation and implementation.
2. Explain the essential qualities and requirements of an entrepreneur.
3. Apply the concepts of breakeven analysis.
4. Apply managerial concepts to solve complex problems related to global issues.

<u>UNIT - 1</u>   (12 hours)

Entrepreneurship Development: Meaning, objectives, scope & philosophy, type of entrepreneurs, factors affecting entrepreneurship, entrepreneurial qualities, major motives influencing an Entrepreneur, need for promotion of entrepreneurship & small business, linkage between entrepreneurship and economic development, Entrepreneurship Support System.

Identification of Business Opportunities- SWOT Analysis, Environmental Screening- features, why, significance of environmental screening, Identification of business opportunities.

Small Scale Industry: Definition; Characteristics; Need and rationale: Objectives; Scope; role of SSI in Economic Development. Advantages of SSI, Steps to start an SSI – Government policy towards SSI; Different policies of S.S.I

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UNIT - 2 (12 hours)

Project identification- assessment of viability, formulation, Evaluation, financing, field-study and collection of information, preparation of project report, demand analysis, material balance and output methods, benefit cost analysis, discounted cash flow, internal rate of return and net present value methods. Guidelines by Planning Commission for Project report, network Analysis, Errors of Project Report, Project Appraisal.

Project Planning and control:
The financial functions, cost of capital approach in project planning and control. Economic evaluation, risk analysis, capital expenditures. Profit planning and programming, planning cash flow, capital expenditure and operations. Control of financial flows.

UNIT - 3 (12 hours)

Financing and Accounting: Need – Sources of Finance, Term Loans, Capital Structure, Financial Institution, management of working Capital, Costing, Break Even Analysis.

Preparation of balance sheets and assessment of economic viability, decision making, expected costs, planning and production control, quality control. Marketing, industrial relations. Sales and purchases, advertisement, wages and incentive, inventory control, preparation of financial reports, accounts and stores studies.

UNIT - 4 (12 hours)

Introduction to Production Management: Types of production systems, production planning and control, functions of production manager & materials management.

Introduction to Human Resource Management: Manpower planning, recruitment, selection, placement & induction, training & development, compensation.

Laws concerning entrepreneur viz, partnership laws, business ownership, income taxes and workman compensation act.

Role of various national and state agencies which render assistance to small scale industries.

Recommended Readings:

1. Havinal Veerbhadrappa; Management and Entrepreneurship; New Age International
2. Forbat John; Entrepreneurship; New Age International.
3. Prasanna Chandra; Fundamentals of Financial Management, 3rd Edition; Tata McGraw-Hill
4. C. B Gupta; Management: Theory and Practice; 7th Edition; Sultan Chand & Sons.
5. P. C. Tripathi, P. N. Reddy; Principles of Management, 2nd Edition; Tata McGraw Hill

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List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. SWOT Analysis
2. Policies of S.S.I
3. Project identification
   a. Assessment of viability
   b. Formulation and evaluation
   c. Finance
   d. Field-study and collection of information
   e. Preparation of project report
   f. Demand analysis
   g. Benefit cost analysis
4. Project planning
   a. Economic evaluation
   b. Risk analysis
   c. Capital expenditures
   d. Profit planning and programming
   e. Planning cash flow and operations
5. Break even analysis
6. Preparation of balance sheets
7. Preparation of financial reports
8. Manpower planning
9. Laws concerning entrepreneur

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ETC/ECE 8.3.5 MOBILE ROBOTICS

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 8.3.5	Mobile Robotics	3	1	2	3	100	25	--	25	--	150

Course Objectives:
The subject aims to provide the student with:
1. An understanding of kinematics of mobile robots.
2. Ability to select appropriate sensors and image processing technique for perception.
3. An ability to solve localization problems for mobile platforms.
4. An ability to implement SLAM models and navigation algorithms.

Course Outcomes:
The student after undergoing this course will be able to:
1. Evaluate forward kinematics of mobile robots.
2. Evaluate different sensors for a given application of mobile robots.
3. Explain different image processing techniques used as part of perception system
4. Explain the challenges of localization for mobile platforms.
5. Evaluate localization strategies and select appropriate one for given application
6. Implement basic SLAM techniques.
7. Evaluate navigation and path planning algorithms and implement for a given application.
8. Design simple mobile robots and implement sensing, localization and navigation algorithms on them.

UNIT - 1 (12 hours)

Introduction to mobile robots, Classification and applications. Locomotion: Key issues, Legged, wheeled and aerial mobile robots.

Mobile robot kinematics: Kinematic Models and Constraints: Representing robot position, Forward kinematic models, Wheel kinematic constraints, Robot kinematic constraints.
Mobile Robot Maneuverability. Mobile Robot Workspace. Path and trajectory considerations.

UNIT - 2 (12 hours)

Perception: Sensors for Mobile Robots: Sensor classification, Characterizing sensor performance, Representing uncertainty, Wheel/motor sensors, heading sensors,

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Accelerometers, Inertial measurement unit, Ground beacons, Active ranging, Motion/speed sensors, and Vision sensors.

Fundamentals of Image Processing: Image filtering, Edge detection, computing image similarity. Feature Extraction. Feature Extraction Based on Range Data.

UNIT - 3 (12 hours)

Mobile Robot Localization: The Challenge of Localization: Noise and Aliasing, Localization-Based Navigation Versus Programmed Solutions. Belief Representation.
Map Representation.
Probabilistic Map-Based Localization: Introduction, The robot localization problem, the ingredients of probabilistic map-based localization. Classification of localization problems.
Examples of Localization Systems: Landmark-based navigation, globally unique localization, Positioning beacon systems, Route-based localization.

UNIT - 4 (12 hours)

Autonomous Map Building: SLAM: The simultaneous localization and mapping problem, Mathematical definition of SLAM, Extended Kalman Filter (EKF) SLAM.

Planning and Navigation: Path Planning, Obstacle avoidance: Bug algorithm, Vector field histogram, The bubble band technique, Curvature velocity techniques, Dynamic window approaches, The Schlegel approach to obstacle avoidance, Nearness diagram, Gradient method.

Recommended Reading:

1. Roland Siegwart, Illah R. Nourbakhsh, and Davide Scaramuzza; Introduction to Autonomous Mobile Robots, 2nd Ed.; MIT Press.
2. Dieter Fox, Sebastian Thrun, and Wolfram Burgard; Probabilistic Robotics; MIT Press.

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments

1. Differential drive wheeled robot
2. Omni drive wheeled robot
3. Bi-pedal robot
4. Multiple legged robot
5. Wheel/motion sensors
6. Solid state IMU
7. Range sensors
8. Image processing using OpenCV
9. Implementation of localization algorithms [Matlab]
10. Implementation of SLAM algorithms [Matlab]
11. Implementation of Obstacle avoidance algorithms
12. Introduction to ROS
13. Implementation of wheeled robot using ROS

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ETC 8.3.6 ADVANCED COMPUTER NETWORKS

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 8.3.6	Advanced Computer Networks	3	1	2	3	100	25	--	25	--	150

Course Objectives:

The subject aims to provide the student with:
1. An introduction to modern networking paradigms.
2. An introduction to software defined networking and virtualization concepts.
3. An ability to apply software defined networking and virtualization concepts.
4. An introduction to cloud computing and internet of things networking.

Course Outcomes:

The student after undergoing this course will be able to:
1. Explain the modern networking architectures and their advantages.
2. Explain the need for high performance networking architectures.
3. Evaluate the feasibility of software defined networks and network virtualization for a given scenario.
4. Explain the architecture vis a vis data and control plane of SDN.
5. Apply SDN concepts using platforms such as OpenFlow and OpenDaylight.
6. Implement network virtualization techniques such as VLAN and VPN.
7. Explain the features and architecture of cloud computing and Internet of Things.

UNIT - 1   (12 hours)

Elements of modern networking: Networking ecosystem and architectures, Ethernet, Wi-Fi, Cloud computing and IoT.

Requirements and Technology: Types of networks and traffic, Data demand, QoS and QoE, Routing, Congestion control, SDN and NFV, Modern networking elements.

UNIT - 2   (12 hours)

Software Defined Networks: Network requirements, SDN approach.

SDN Data Plane and Open Flow. SDN control plane architecture. OpenDaylight.

Data Centre networking.

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UNIT - 3   (12 hours)

Network Function virtualization: Background and motivation, Virtual machines, NFV concepts, benefits and requirements. NFV architecture, NFV infrastructure.
Network virtualization: VLAN, VPN, Network virtualization example and architecture. Software defined infrastructure.

UNIT - 4   (12 hours)

Modern Network architecture: Cloud computing: basic concepts, cloud services, cloud deployment models, cloud architecture.
Internet of things: Components, Architecture. Implementation examples.

Recommended Readings:

1. William Stallings; Foundations of Modern Networking, 1st Ed.; Pearson Education India
2. Thomas D. Nadeau and Ken Gray; SDN: Software Defined Networks; O'Reilly
3. Paul Goransson, Chuck Black; Software Defined Networks: A Comprehensive Approach, 1st Edition; Morgan Kaufmann

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. Setup of a Software Defined Network
2. Open Flow protocol
3. Open Daylight protocol
4. Virtual Machine
5. Network function virtualization demonstration
6. Setup VLAN
7. Setup VPN
8. Setup Basic Cloud Computing model
9. Setup basic cloud based service
10. Setup internet of things

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ETC/ECE 8.3.7 MOTORS AND DRIVES

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 8.3.7	Motors and Drives	3	1	2	3	100	25	--	25	--	150

Course Objectives:
The subject aims to provide the student with:
1. An understanding of construction and principal of operations of DC and AC motors.
2. An understanding of control strategies used for speed, power and torque control of different AC and DC motors.

Course Outcomes:
The student after undergoing this course will be able to:
1. Explain the working of permanent magnet, brushless and stepper DC motors.
2. Explain the working of single phase and 3 phase AC motors.
3. Explain the construction of different types of AC and DC motors.
4. Explain different control strategies used to control speed, power and torque of AC and DC motors.
5. Choose appropriate DC or AC motor for a given application.
6. Choose appropriate control strategy for a given application.
7. Analyze an application and calculate the appropriate motor characteristics to suit that application.

UNIT - 1 (12 hours)

D.C Motors: Working Principle of DC motors, predetermination of external characteristic of DC motors. Starting of DC motors, speed control methods.

Permanent Magnet Brushless DC Motors: Constructional features, principle of operation, Commutation in DC motors, Difference between mechanical and electronic commutators, Hall sensors, Optical sensors. Multiphase Brushless motor, Square wave permanent magnet brushless motor drives, Torque and emf equation, Torque-speed characteristics, and Controllers-Microprocessor based controller.

UNIT - 2 (12 hours)

Stepping Motors: Principle of operation, modes of excitation, torque production in stepping motors, Drive systems and circuit for open loop control, closed loop control of stepping motor.

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A.C. Motors: Construction of three phase Induction Motor, flux and mmf waves, rotating mmf and torque, development of equivalent circuit model, power across air gap, torque and power output, torque-slip characteristics, condition for maximum power output.

UNIT - 3 (12 hours)

Single phase induction motors: construction, rotating field theory, performance analysis and circuit model for single winding machines, split phase motors- resistance, capacitance split phase motors, capacitor start and two value capacitor motors, shaded pole motors, comparison of single phase and three phase motors.

Drives: General concept of Electric drives, Classification of electric drives, Advantages of electric drives, components of electric drives, choice of electric drives, Selection of motor power rating.

Braking: Types of braking, dynamic braking, counter current braking, Regenerative Braking of DC and AC motors.

UNIT - 4 (12 hours)

Control of DC Drives: Basic parameters, operating modes, motoring modes, Braking modes, schemes for DC motor speed control, Ward Leonard method, buck boost control, single phase, three phase fully controlled, half controlled DC drives, chopper controlled DC motor drives.

Control of AC Motor Drives: Basic parameters, speed control of induction motor drives, Induction Motor torque production, speed torque characteristics with variable voltage operation, variable frequency operation, constant voltage /frequency operation.

Recommended Reading:
1. R. Krishnan; Electric Motor Drives – Modeling, Analysis and Control; Prentice-Hall of India
2. B.K. Bose; Modern Power Electronics and AC drives; Prentice-Hall of India
3. Gopal K. Dubey; Fundamentals of Electric Drives, 2nd Ed.; Narosa Publishing House
4. I. J. Nagrath and D. P. Kothari; Electric Machines; Tata McGraw Hill
5. Kenjo T.; Stepping motors and their microprocessor control; Clarendon Press, Oxford
6. Miller, T.J.E.; Brushless permanent magnet and reluctance motor drives; Clarendon Press, Oxford
7. Kenjo T. and Naganori S.; Permanent Magnet and brushless DC motors; Clarendon Press, Oxford
8. Nisit K. De, Prashanta K. Sen; Electric Drives; Prentice-Hall of India
9. Mohammed A EL-Sharakawi; Electric Drives; Vikas Publishing house.

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List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. Open loop and closed loop speed control of DC motor
2. Speed control using hall sensor and optical sensor
3. Torque-speed analysis of DC motor
4. Closed loop speed control of Brushless DC motor
5. Torque – speed analysis of BLDC motor
6. Open loop control of Stepper motor
7. Torque analysis of stepper motor
8. Torque, speed and power analysis of AC 3 phase motor
9. Torque, speed and power analysis of AC 1 phase motor
10. Braking techniques for AC and DC motors
11. Control of DC drives
12. Control of AC drives

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ETC/ECE 8.3.8 WIRELESS COMMUNICATION

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 8.3.8	Wireless Communication	3	1	2	3	100	25	--	25	--	150

Course Objectives:

The subject aims to provide the student with:
1. An understanding of IEEE 802.11x protocols and their features.
2. An understanding of IEEE 802.15.4 and ZigBee protocols and their features.
3. An understanding of Bluetooth and Bluetooth Low energy protocol and their features.
4. An ability to use IEEE 802.11x, ZigBee and Bluetooth communication protocols in given application.

Course Outcomes:

The student after undergoing this course will be able to:
1. Differentiate between different protocols under IEEE 802.11x protocol family
2. Explain in detail MAC layer, framing techniques and security features of IEEE 802.11x protocol.
3. Explain in detail PHY layer features of IEEE 802.11x protocol.
4. Evaluate suitability of ZigBee, IEEE 802.11 and Bluetooth protocols for given application.
5. Explain in detail the ZigBee protocol and advantages, disadvantages and application.
6. Explain the Bluetooth protocol structure and advantages, disadvantages and application.
7. Explain the difference in Bluetooth protocol at module and at host.
8. Explain the features of Bluetooth low energy protocol.

UNIT - 1 (12 hours)

Overview of 802.11 Networks: IEEE 802 Network Technology Family Tree, 802.11 Nomenclature and Design, 802.11 Network Operations.

802.11 MAC Fundamentals: Challenges for the MAC, MAC Access Modes and Timing, Fragmentation and Reassembly, Frame Format.

802.11 Framing in Detail: Data Frames, Control Frames, Management Frames, Frame Transmission and Association and Authentication States.

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Security: Wired Equivalent Privacy (WEP), Cryptographic Background to WEP, WEP Cryptographic Operations, Problems with WEP, Dynamic WEP. The Extensible Authentication Protocol .The Temporal Key Integrity Protocol (TKIP).

UNIT - 2 (12 hours)

802.11 Physical Layer Overview, Physical-Layer Architecture, the Radio Link, RF Propagation with 802.11, RF Engineering for 802.11.

The Frequency-Hopping (FH) PHY, Frequency-Hopping Transmission, Gaussian Frequency Shift Keying (GFSK), FH PHY Convergence Procedure (PLCP, Frequency-Hopping PMD Sub layer, Characteristics of the FH PHY.

The Direct Sequence PHYs: DSSS and HR/DSSS (802.11b): Direct Sequence Transmission, Differential Phase Shift Keying (DPSK), the "Original" Direct Sequence PHY, Complementary Code Keying, High Rate Direct Sequence PHY.

802.11a and 802.11j: 5-GHz OFDM PHY: Orthogonal Frequency Division Multiplexing (OFDM), OFDM as Applied by 802.11a, OFDM PLCP, OFDM PMD, Characteristics of the OFDM PHY.

UNIT - 3 (12 hours)

Introduction to ZigBee, ZigBee vs. Bluetooth and Wi-Fi. ZigBee: frequency of operation and data rates, device types and roles, networking topologies.

ZigBee and IEEE 802.15.4 standards: CSMA-CA, beacon and non-beacon networking, data transfer methods, data verification, addressing.

ZigBee applications: security systems, meter reading, irrigation, light control and HVAC. Applications in industrial automation, healthcare and other applications.

ZigBee and IEEE 802.15.4 networking layers: PHY specifications, ZigBee MAC layer, NWK layer, Security.

UNIT - 4 (12 hours)

Bluetooth: Overview, the protocol stack, security, applications and profiles.

Bluetooth module: Radio: introduction, frequency hopping, modulation, symbol timing, power emission and control, simple RF architecture Baseband: Bluetooth device address, masters, slaves and piconet, system timing, physical links: SCO and ACL, Bluetooth packet structure, packet types and packet construction, logical channels, frequency hopping.

Bluetooth host: logical link control: multiplexing using channels, L2cap signaling, establishing and configuring connection. RFCOMM: serial ports and UART, types, RFCOMM Frame types connecting and disconnecting.

Introduction to Bluetooth low energy.

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Recommended Reading:

1. Matthew S. Gast; 802.11 Wireless Networks: The Definitive Guide, 2nd Edition; O'Reilly Media
2. Shahin Farahani; ZigBee Wireless Networks and Transceivers; Newnes
3. Jennifer Bray, Charles F. Sturman; Bluetooth : Connect Without Cables, 1st Ed.; Prentice Hall
4. Kevin Townsend , Carles Cufí , Akiba , Robert Davidson; Getting Started with Bluetooth Low Energy: Tools and Techniques for Low-Power Networking; O'Reilly Media

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. Study of IEEE 802.11 MAC and PHY layers [NS2 / Matlab]
2. Study of ZigBee hardware modules.
3. One to one communication using ZigBee
4. One to Many communication using ZigBee
5. Mesh networking using ZigBee
6. Implementation of simulated intruder alert system using ZigBee
7. Implementation of simulated irrigation system using ZigBee
8. Implementation of any simulated industrial application using ZigBee
9. Study of Bluetooth hardware modules.
10. Implementation of simulated intruder alert system using Bluetooth
11. Implementation of simulated irrigation system using Bluetooth
12. Implementation of any simulated industrial application using Bluetooth
13. Implementation of any application using Bluetooth low energy

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ETC/ECE 8.3.9 AUDIO AND VIDEO ENGINEERING

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 8.3.9	Audio and Video Engineering	3	1	2	3	100	25	--	25	--	150

Course Objectives:
The subject aims to provide the student with:
1. An understanding of transmission and reception of signal in color television system.
2. An introduction to digital television and display systems.
3. An introduction to different standards of compression adopted by digital television.
4. An understanding of audio- video recording and acoustics.

Course Outcomes:
The student after undergoing this course will be able to:
1. Explain the Chromaticity diagram , color signal transmission and modulation
2. Compare NTSC, PAL and SECAM system.
3. Explain working of digital TV transmitter and receiver system.
4. Explain the working principles of advanced TVs (LED, LCD, TFT, Plasma TV, HDTV).
5. Explain the working of acoustic chamber and cordless Microphone system.
6. Evaluate different TV systems for a given application.
7. Apply TV system and acoustics knowledge to setup Audio-Video recording and playback facilities.

UNIT - 1 (12 hours)

Fundamentals of Color Television: Color TV systems, fundamentals, mixing of colors, color perception, chromaticity diagram.
NTSC, PAL, SECAM systems, Color TV transmitter, (high level, low level), colour TV Receivers, remote control.

UNIT - 2 (12 hours)

Digital TV and Display Devices: Introduction to Digital TV, Digital TV signals and parameters, Digital TV Transmitters, MAC signals, advanced MAC signal transmission, Digital TV receivers, Basic principles of Digital Video compression techniques, MPEG Standards. Digital TV recording techniques. Display devices: LED, LCD, TFT, Plasma.

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UNIT - 3 (12 hours)

High Definition Television (HDTV) Standards: HDTV standards and systems, HDTV transmitter and receiver/encoder, Digital TV satellite Systems, video on demand, CATV, direct to home TV, set top box with recording facility, conditional access system (CAS), 3D TV systems, Digital broadcasting.

Advanced TV Systems: IP Audio and Video, IPTV systems, Mobile TV, Video transmission in 3G mobile System, IPod (MPEG4 Video player), Digital Video Recorders, Personal Video Recorders, Wi-Fi Audio.

Video Transmitter and Receivers: Video Projectors, HD Video projectors, Video Intercom systems, Video door phones.

UNIT - 4 (12 hours)

Fundamentals of Audio-Video Recording and Acoustics: Methods of sound recording & reproduction, optical recording, CD recording, audio standards. Digital Sound Recording, CD/ DVD player, MP3 player, Blue Ray DVD Players, MPEG, MP3 Player.

Fundamentals of Acoustics: Studio acoustics & reverberation, Public address system for auditorium, Acoustic chambers, Cordless microphone system, special types of speakers & microphones, Digital Radio Receiver Satellite radio reception.

Recommended Reading:
1. A. M. Dhake; Television and Video Engineering, 2nd Edition, TMH Publication.
2. Keith Jack; Video Demystified: A Handbook for the Digital Engineer, 5th Edition; Penram International Publication.
3. R. G. Gupta; Audio Video Systems: Principles, Maintenance and Troubleshooting; TMH Publication
4. S. P. Bali; Color Television: Theory and Practice; Tata McGraw Hill Publications.
5. Bernard Grobb, Charles Herndon; Basic TV and Video Systems, 6th Edition; McGraw Hill Publication.
6. Michael Robin, Michael Poulin; Digital Television Fundamentals, 2nd Edition; McGraw Hill
7. Marcelo S. Alencar; Digital Television Systems; Cambridge University Press.
8. John Arnold, Michael Frater, Mark Pickering; Digital Television: Technology and Standards; John Wiley Publications.
9. Walter Fischer; Digital Video and Audio Broadcasting technology, 3rd Edition; Springer

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. Voltage waveform analysis for color TV.
2. Study of direct to home TV and set top box.
3. Study of Wi-Fi TV / IPTV system
4. Fault finding in Digital TV using pattern generator.

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5. Study of Digital TV and different standards.
6. Simulation of video, Audio and Image compressing techniques (Software Assignments)
7. Study of Audio system: CD, DVD players and MP3 player.
8. Configuration of PA system with chord less microphone
9. Directivity pattern of Microphones / Loud speakers
10. Study/building an AM and FM receiver.
11. Study of characteristics of various amplifier systems used in audio and video systems.

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ETC/ECE 8.3.10 MOBILE COMPUTING

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 8.3.10	Mobile Computing	3	1	2	3	100	25	--	25	--	150

Course Objectives:

The subject aims to provide the student with:
1. An introduction to mobile computing and its applications.
2. An introduction to wireless mobile technologies and standards.
3. An introduction to Voice and multimedia communication in wireless mobile networks.
4. An overview of various security aspects in mobile networks.

Course Outcomes:

The student after undergoing this course will be able to:
1. Explain mobile computing, its advantages and architecture.
2. Compare emerging technologies in mobile computing.
3. Evaluate 3G, wireless LAN and 3rd Generation networks on suitability for mobile computing.
4. Explain Intelligent networks and their architecture.
5. Explain voice over IP and IP multimedia subsystems architectures.
6. Explain the security aspects of mobile computing.
7. Explain the features and advantages of next generation networks.

UNIT - 1 (12 hours)

Mobile Computing architecture: Introduction, Architecture for mobile computing, 3 tier architecture, Design consideration for mobile computing, mobile computing through internet.

Mobile computing through telephony: Multiple access Procedures, Satellite communication systems, Mobile computing through telephone, IVR application. Voice XML.

Emerging Technologies: Bluetooth, RFID, WiMAX, IPv6 and mobile IP.

UNIT - 2 (12 hours)

CDMA and 3G: Introduction, Spread Spectrum technology. CDMA v/s GSM. 3rd Generation Networks. Applications on 3G.

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Wireless LAN: Introduction, Advantages, Standards, Architecture, Mobility Security. Deploying Wireless LAN, Mobile Ad-Hoc networks and Sensor Networks. Wireless in vehicular environment. WLL, HiperLAN. Wifi v/s 3G.

UNIT - 3 (12 hours)

Intelligent Networks and Interworking: Introduction, Fundamentals of call processing, Intelligence in networks, SS#7 signalling, IN conceptual model, Soft switch, Programmable networks, Technologies and Interfacing for IN, SS7 security, VPN.

Voice over IP: Introduction, H.323 framework, Session Initiation Protocol, Real Time Protocol, Convergence technologies, Call routing, VoIP applications, Mobile VoIP, Voice over WiLAN.

UNIT - 4 (12 hours)

IP Multimedia subsystems: Introduction, IMS and its Evolution, Advantages, Architecture, Protocols, IMS networks, Call flow, Charging, Service creation, Policy management, Security.

Security Issue in Mobile Computing: Introduction, Information security, Security techniques and algorithms, Security protocols, Public key infrastructure.

Next Generation Networks: Narrowband to broadband, All IP and B3G networks, OFDM, FAMA/DAMA, MPLS, Wireless Asynchronous transfer mode, multimedia broadcast service. Multiple play.

Recommended Readings:

1. Asoke K. Talkukder, Roopa R. Yavaga; Mobile Computing: Technology, Applications and Service Creation, 2nd Edition; Tata McGraw Hill
2. Raj Kamal; Mobile Computing; Oxford University Press
3. Reza B'Far; Mobile Computing Principles: Designing and Developing Mobile Applications with UML and XML, 5th Edition; Cambridge University press
4. Uwe Hansmann, Lothat Merk, Martin S Nicklous and Thomas Stober; Principles of Mobile Computing, 2nd Edition; Springer International Edition

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. Study of spread spectrum technology
2. Study of satellite communication
3. Configuration of wireless LAN
4. Study of SS#7 protocol
5. Configuration of virtual private network
6. Configuration of VoIP link
7. Study of OFDM
8. Study of MPLS routing
9. Study of encryption algorithms

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ETC/ECE 8.3.11 NANOELECTRONICS

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 8.3.11	Nanoelectronics	3	1	2	3	100	25	--	25	--	150

Course Objectives:

The subject aims to provide the student with:
1. An introduction to quantum mechanics of electron.
2. An introduction to single electron and few electron phenomena and devices.
3. An understanding on quantum well, quantum wires and quantum dots.

Course Outcomes:

The student after undergoing this course will be able to:
1. Explain top down and bottom up approach in nanoelectronics.
2. Derive Schrodinger time dependent equation for free particle.
3. Explain concept of quantum transport, quantum well and tunneling effect.
4. Describe the spin dependent electron transport in magnetic devices.
5. List advantages and disadvantages of carbon nanotubes.
6. Explain the influence of capacitance and energy on tunneling.
7. Explain density of states of electrons in nano structure.
8. List the fabrication techniques used for nano technology.

UNIT - 1 (12 hours)

Introduction to Nanoelectronics: Top down approach, bottom up approach and Nanotechnology potential. Comparison of classical and Quantum systems. Light as a wave, light as quantum particle. Electron as a particle and electron as a wave.

Quantum mechanics of electron: General postulates of quantum mechanics. Time dependent Schrodinger's equation. Analogies between quantum mechanics and classical electromagnetics. Probabilistic current density, Multiple Particle system, Spin and angular momentum.

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UNIT - 2 (12 hours)

Free and confined electrons: Free electron Gas theory of metals. Fermi level and chemical Potential. Partially confined electrons, electrons confined to atom. Quantum dots, wires and wells.

Band theory of solids: Electrons in a periodic potential, Kronig-Penny model of band structure. Band theory of solids, Graphene and carbon nanotubes.

UNIT - 3 (12 hours)

Tunnel junction: Tunneling through a Potential barrier. Potential energy profiles for material interfaces. Applications of Tunneling.
Coulomb Blockade: Coulomb Blockade in a Nano capacitor, Tunnel junction, Coulomb Blockade in a quantum dot circuit. Single-Electron transistor, Other SET and FET structures.
Particle statistics and density of states: Density of states, classical and quantum statistics.

UNIT - 4 (12 hours)

Model of semiconductor quantum well, quantum wires: Semiconductor heterostructures and quantum wells. Quantum wires and nanowires. Quantum Dots and Nanoparticles. Fabrication techniques for nanostructures.

Nanowires, Ballistic transport, and spin transport: Classical and semi classical transport, Ballistic transport, Carbon nanotubes and nanowires, Transport of spin and Spintronics.

Recommended Readings:

1. George W. Hanson; Fundamentals of Nanoelectronics; Pearson
2. K. Goser, P. Glosekotter, J. Dienstuhl; Nanoelectronics and Nanosystems; Springer International Edition
3. M. Ratner, D. Tatner; Nanotechnology; Pearson Education.
4. M. Wilson, et al.; Nanotechnology: Basic Science and Emerging Technologies; Chapman and Hall/CRC
5. A. Lakhtakia (ed.); Nanometer Structures; Prentice Hall of India.
6. R. Booker, E. Boysen; Nanotechnology; Wiley-Dreamtech India Pvt. Ltd.

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List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. Spin and angular momentum of electron.
2. Coulomb Blockade in a Nano capacitor
3. Single-Electron Transistor
4. Density of states
5. Semiconductor heterostructures.
6. Quantum well.
7. Classical and semi classical transport.
8. Carbon nanotubes
9. Quantum Dots and Nanoparticles
10. Study of Spintronics.

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ETC/ECE 8.3.12 BIOMEDICAL ELECTRONICS AND INSTRUMENTATION

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 8.3.12	Biomedical Electronics and Instrumentation	3	1	2	3	100	25	--	25	--	150

Course Objectives:

The subject aims to provide the student with:
1. An introduction to human physiological system which is very important with respect to electronic design considerations.
2. The knowledge of the principles of operation and design of biomedical electronics & instruments.
3. An understanding of medical diagnosis and therapy techniques.
4. An ability to solve electronic engineering problems related to medical field.

Course Outcomes:

The student after undergoing this course will be able to:
1. Describe physiology of heart, lung, blood circulation and nervous system.
2. Evaluate different biosensors, biochemical transducer used for measuring different biological parameters of human system
3. Define safety parameters and measures to be taken while designing biomedical Equipment
4. Explain different measuring and monitoring systems such as ECG, EEG, EMG.
5. Explain different medical assistance/techniques and therapeutic equipment's
6. Categorize different imaging systems based on their application, advantages and disadvantages for a given problem

UNIT - 1 (12 hours)

Cell and its structure: Resting and Action Potential, Nervous system: Nerve fibres, neuron system; heart potentials, eye and vision, ear and hearing, Cardiovascular system, respiratory system.

Basic components of a biomedical system: Transducers, selection criteria, Piezoelectric, ultrasonic transducer, temperature measurements, temperature sensors.

Electrodes: basic electrode theory, Nernst equation, biopotential electrodes, biochemical transducers.

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Patient safety: Intensive care system, electric shock hazards, leakage currents; testing instruments for checking safety parameters of biomedical electronic equipment.

UNIT - 2   (12 hours)

Measuring and monitoring systems: EEG, ECG, EMG with block diagrams, Vector Cardiography, Holter monitoring.
Pacemakers: properties, lead wires and electrodes, synchronous pacemaker; rate responsive pacing.
Defibrillators: AC and DC, Blood pressure monitoring: direct and indirect measurement.

UNIT - 3   (12 hours)

Controller and stimulators: Electroneurography; spirometry; Audiometers, Block diagram of heart-lung machine.
Surgical diathermy; physiotherapy equipment: microwave diathermy; laser therapy, ultrasonic therapy unit, cryotherapy.
Biomedical telemetry: Wireless, single channel, multi-channel.
X-Rays: X ray diagnostic methods, Production of X-ray, Use of X-ray imaging.

UNIT - 4   (12 hours)

Computed Tomography: Basic principles, system components, Medical applications and safety precautions.

Ultrasound: Functional block diagram of basic pulse echo system for diagnostic purposes, A-SCAN, M-SCAN, B-SCAN, Application of ultrasound imaging.

Radio Nuclide Imaging: Principles, radiation detectors, schematic functional diagram and components of gamma camera, Medical applications, safety precautions.

Magnetic Resonance Imaging: Basic principles, Schematic functional diagram of MRI scanner with its sub systems.
Medical applications, safety precautions.

Recommended Readings:

1. R. S. Khandpur; Handbook of Biomedical Instrumentation; McGraw Hill Education
2. Leslie Cromwell; Biomedical Instrumentation and Measurements; Prentice Hall India
3. J. G. Webster; Medical Instrumentation – Application & Design; John Wiley & Sons
4. W. Blesser; Systems approach to biomedicine; McGraw Hill
5. Tatsuo Togawa, Toshiyo Tamura, P. Ake Oberg; Biomedical transducers and instruments; CRC Press
6. S. K. Guha; Introduction to medical electronics; Bharati Bhavan
7. C. A. Caceress; Biomedical telemetry; Academic press
8. L. Geddes and L. Baker; Principles of applied biomedical instrumentation; Wiley-Blackwell
9. Laurence J. Street; A Guide to Patient Care Technology: A Review of Medical Equipment; Taylor & Francis.

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List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. Study characteristics of temperature sensors – thermistor, thermocouple and RTD
2. Blood pressure Measurement
3. Monitoring of EEG
4. Monitoring of ECG
5. Monitoring of EMG
6. Measurement of pulse rate(Finger plethesmography)
7. Surgical Diathermy – Cutting, Coagulation, Fulguration
8. Defibrillator
9. Study of Heart lung Machine
10. Study of Holter Machine

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ETC/ECE 8.3.13 INTRODUCTION TO ARTIFICIAL INTELLIGENCE

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 8.3.13	Introduction to Artificial Intelligence	3	1	2	3	100	25	--	25	--	150

Course Objectives:
The subject aims to provide the student with:
1. An introduction to Artificial Intelligence techniques for building well-engineered and efficient intelligent systems.
2. An understanding of the basic issues of knowledge representation and blind and heuristic search, as well as an understanding of other topics such as minimax, resolution, etc. that play an important role in AI programs.
3. An introduction to predicate logic, symbolic reasoning and filter structures.
4. Introduction to natural language processing, expert systems and artificial neural networks.

Course Outcomes:
The student after undergoing this course will be able to:
1. Define a problem in terms of its characteristics and identify the design issues.
2. Implement different search techniques used for problem solving.
3. Understand the fundamentals of knowledge representation.
4. Demonstrate working knowledge of reasoning in the presence of incomplete and/or uncertain information.

UNIT - 1 (12 hours)

Introduction to AI and Techniques.
Problems, Problem Spaces and Search: Defining the Problem, Production Systems, Problem characteristics, Production System Characteristics, Design Issues.
Problem Solving: Heuristic Search Techniques, Hill Climbing, Best First Search, A*, OR graphs, Problem Reduction - AND-OR-Graph, AO* Means Ends Analysis.

UNIT - 2 (12 hours)

Knowledge Representation: Representation and Mapping, Approaches to knowledge representation.
Predicate Logic: Representing simple facts and logic, Representing instance and ISA relationship, Computable functions and predicates, Resolution.

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Symbolic reasoning under uncertainty: Introduction to non-monotonic Reasoning, Logic for non-monotonic reasoning.
Weak slot and filter structures: Semantic nets, Frames.
Strong Slot and Filter Structures: Conceptual dependency, Scripts.

UNIT - 3   (12 hours)

Game Playing: MiniMax Search Procedure, Adding alpha-beta cut offs.
Planning: Overview, An example domain: Blocks world, Components of a planning system.
Goal Stack Planning: Non –linear Planning, Hierarchical Planning.
Introduction to natural language processing.

UNIT - 4   (12 hours)

Learning: Inductive learning, Learning Decision Trees.
Types of learning: Rote learning, Learning by taking advice, Learning in problem solving, Version Space.
Expert Systems: Representing and using domain knowledge, Expert System Shells, Knowledge Acquisition Explanation. Introduction to Neural Networks.

Recommended Readings:

1. Elaine Rich, Kevin Knight; Artificial Intelligence, TMH
2. Struart Russell, Peter Norvig; Artificial Intelligence: a Modern Approach; Pearson
3. Nils J. Nillson; Artificial Intelligence: A new Synthesis; Harcourt Asia
4. Patrick Winston; Artificial Intelligence; Pearson Education
5. Ivan Brakto ;Prolog Programming for Artificial Intelligence; Pearson Education
6. Efraim Turban; Decision Support Systems and Intelligent Systems, Prentice Hall
7. George F. Luger; Artificial Intelligence : Structures and strategies for complex problem solving; Pearson education

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. Implement Water Jug Problem
2. Implement Missionaries and Cannibals problem
3. Implement Tic tac toe problem
4. Unification Problem
5. 8 queens problem
6. Maze problem
7. Expert system
8. Cryptarithmetic problem
9. To check whether a well formed formula is valid, satisfiable or unsatisfiable.

The programs could be written using Lisp, C/C++ or Python

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ETC 8.3.14 ERROR CONTROL CODING

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC 8.3.14	Error Control Coding	3	1	2	3	100	25	--	25	--	150

Course Objectives:

The subject aims to provide the student with:

1. An understating of Concepts of Galois Fields.
2. Knowledge of various coding techniques.
3. Mathematical and computational skills required in coding theory.
4. Ability to decode and correct the errors in the communication systems.

Course Outcomes:

The student after undergoing this course will be able to:
1. Design and generate codes using the knowledge of Galois field.
2. Encode the data using various coding techniques.
3. Decode and correct the errors in the received code.

UNIT - 1 (12 hours)

Introduction to Algebra: Groups, Fields, Construction of fields, Binary field arithmetic.
Basic properties of a Galois field, Primitive field elements. Minimal polynomial, Computations using Galois field GF (2m) Arithmetic: Realization & Implementation., Vector spaces, matrices.
Revisiting linear block and cyclic codes: Generator and parity check matrices, Implementation of encoder & decoder. Hamming code systematic, standard array and syndrome decoding, Non-systematic hamming code.

UNIT - 2 (12 hours)

Hamming codes; Weight enumerators and the MacWilliams identities; Perfect codes.
Introduction to BCH codes: encoding & decoding of BCH codes, Implementation of error correction in BCH codes, Non-binary BCH codes. Idempotent and Mattson-Solomon polynomials. Reed-Solomon codes, Justeen codes, MDS codes, Alterant, Goppa and generalized BCH codes.

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Decoding of BCH codes: Berlekamp's decoding algorithm, Massey's minimum shift register synthesis technique and its relation to Berlekamp's algorithm. A fast Berlekamp - Massey algorithm, Peterson-Gorenstein-Zierler decoder.

UNIT - 3 (12 hours)

Spectral properties of cyclic codes, generation of cyclic codes in frequency domain.
Convolution codes; Wozencraft's sequential decoding algorithm, Fann's algorithm and other sequential decoding algorithms; Viterbi decoding algorithm, stack algorithm-ZJ algorithm method.
Trellis Coded Modulation: Introduction to TCM, concept of coded modulation, mapping by set partitioning, Ungerboeck's TCM design rules, TCM example.

UNIT - 4 (12 hours)

Low-Density Parity-Check Codes: Introduction to LDPC Codes, tanner graphs for linear block codes, Geometric construction of LDPC codes, Decoding of LDPC Codes. Code construction by row and column Splitting, breaking cycles in Tanner graphs. Construction of Gallager LDPC Codes, Random LDPC Codes, Irregular LDPC Codes. Construction of LDPC Codes based on balanced incomplete block designs.

Recommended Readings:

1. Shu Lin, Daniel J. Costello; Error Control Coding- Fundamentals and Applications, 2nd Ed.; Pearson/Prentice Hall, Second Edition
2. Bernard Sklar; Digital Communications : Fundamental & Applications, 2nd Edition; Pearson Education
3. Ranjan Bose; Information Theory, Coding & Cryptography, 2nd Edition; Tata McGraw Hill Publishing Company Limited.
4. Peter Sweeney; Error Control Coding: From Theory to Practice; John Wiley & Sons Ltd.
5. F. J. MacWilliams, N. J. A. Sloane; The theory of error correcting codes; North Holland
6. R.E. Blahut; Theory and Practice of Error Control Codes, Addison Wesley
7. Alvatore Gravano; Introduction to Error Control Codes; Oxford University Press
8. W. Cary Huffman, Vera Pless; Fundamentals of Error Correcting Codes; Cambridge University Press
9. Paul Garrett; Mathematics of Coding Theory: Information, Compression, Error Correction, and Finite Fields; Prentice Hall
10. Todd K. Moon; Error Correction Coding : Mathematical methods and Algorithms; John Wiley and Sons

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. Program to generate GF (2m) field elements.
2. Program to generate Mattson –Solomon polynomial.

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3. program to encode and decode data using cyclic code
4. Program to generate BCH code.
5. Program to decode data using Peterson-Gorenstein-Zierler decoder.
6. Program to generate Reed Solomon code.
7. Program to generate Goppa code.
8. program to generate Justen code
9. program to generate alternate code
10. Program to decode data using Wozencraft's   sequential decoding algorithm.
11. Program to encode and decode LDPC code

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ETC/ECE 8.4.1 SYSTEM ON CHIP

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 8.4.1	System on Chip	3	1	2	3	100	25	--	25	--	150

Course Objectives:

The subject aims to provide the student with:
1. An introduction to system on Chip Technology.
2. An introduction to inter and intra chip communication in SOC design.
3. An ability to write system C code for a given task.
4. An understanding on synthesis, simulation and co-verification of SOC.

Course Outcomes:

The student after undergoing this course will be able to:
1. Explain the typical challenges faced in SOC technology.
2. Explain Parameterized SOC design.
3. List the advantages and disadvantages of Block based design over timing driven design methodology.
4. Explain the timing diagram of 8 beat incrementing burst for read operation on AMBA AHB.
5. Implement System C code for half adder.
6. Explain the use of optical interconnects for intra-chip communication in SOC design.
7. Explain System, Block level verification and hardware/software co-verification of SOC design.
8. Compare event based and cycle based simulation.

UNIT - 1 (12 hours)

System on Chip: Technology, Challenges, System On a Chip (SOC) components.
SOC Design: System Design Flow, Waterfall vs. Spiral, Top down vs. Bottom up approach. The Specification Problem: Specification Requirements, Types of Specifications, System Design Process.
Design Methodology: Timing-Driven Design, Block based Design, Platform based Design. Parameterized Systems-on-a-Chip.

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UNIT - 2 (12 hours)

System-on-a-chip Peripheral Cores, SoC interconnect centric Architectures: Introduction to AMBA Bus, AMBA AHB arbitration, AHB Operation, AHB Control signal, AHB transfer timing diagram (read, write, incrementing and burst type transfer). AMBA APB state diagram and APB transfer timing diagram. System level design representations and modelling languages (System C).

UNIT - 3 (12 hours)

Intra-chip communication. Graph partitioning algorithms. Task time measurement. Interconnect latency modelling. Back annotation of lower level timing to high-level models.

UNIT - 4 (12 hours)

Synthesis of SOC components. System Level: System design, System verification. Block Level verification: Block IP, Block level verification. Simulation: Functional Simulation, Testbench Wrappers, Hardware/Software Co-verification. SOC components: emulation, co-simulation, Physical Verification.

Recommended Readings:

1. Wayone Wolf; Modern VLSI Design: SOC Design; Prentice Hall
2. Prakash Rashnikar, Peter Paterson, Lenna Singh; System-On-A-Chip Verification methodology & Techniques; Kluwer Academic Publishers.
3. Alberto Sangiovanni Vincentelli; Surviving the SOC Revolution: A Guide to Platform-based Design; Kluwer Academic Publishers.

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. System C code to implement Half adder
2. System C code to implement Full adder
3. System C code to implement Flip flops
4. System C code to implement Subtractor
5. System C code to implement Multiplexer
6. System C code to implement Decoder
7. System C code to implement Counter
8. System C code to implement Encoder
9. System C code to implement Registers
10. System C code to implement Demultiplexer

ETC/ECE 8.4.2 MOBILE PHONE PROGRAMMING

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 8.4.2	Mobile Phone Programming	3	1	2	3	100	25	--	25	--	150

Course Objectives:

The subject aims to provide the student with:
1. An introduction to android programming and app development.
2. An understanding of android application and OS architecture.
3. An ability to write programs for android OS.
4. An ability to design user interfaces for android applications.

Course Outcomes:

The student after undergoing this course will be able to:
1. Explain features of Android OS and application development environment.
2. Write basic android applications.
3. Build user interfaces for android applications.
4. Write android applications utilizing hardware sensors.
5. Write android applications utilizing audio and camera sensors.
6. Write android applications incorporating location based services.

UNIT - 1 (12 hours)

Google Android: Background, an Open Platform for Mobile Development, Native Android Applications, Android SDK Features, Introducing the Open Handset Alliance, Introducing the Development Framework.
Android Development: Developing for Android, Developing for Mobile Devices, Android Development Tools.

Creating Applications and Activities: What Makes an Android Application?, Introducing the Application Manifest, Using the Manifest Editor, The Android Application Life Cycle, Understanding Application Priority and Process States, Externalizing Resources, A Closer Look at Android Activities.

UNIT - 2 (12 hours)

Building User Interfaces: Fundamental UI design, Android UI fundamentals, Introducing Layouts, Fragments, Creating new views and Introducing adapters.

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Intents, Broadcast Receivers, Adapters, and the Internet: Introducing Intents, Introducing Adapters, Using Internet Resources, Introducing Dialogs, Creating an Earthquake Viewer.

Data Storage, Retrieval, and Sharing: Saving Simple Application Data, Saving and Loading Files, Databases in Android, Introducing Content Providers.

UNIT - 3 (12 hours)

Hardware Sensors: Using Sensors and sensor manager, Monitoring a device's movement and orientation. Introduction to environment sensors.

Maps, Geocoding, and Location-Based Services: Using Location-Based Services, Setting up the Emulator with Test Providers, Finding Your Location, Using the Geocoder, Creating Map Based Activities, Mapping Earthquakes Example.

UNIT - 4 (12 hours)

Audio Video and Camera: Playing audio and video, Manipulating raw audio, using camera for pictures and video.

Bluetooth, Wi-Fi and NFC: Using Bluetooth, Managing Network and Wi-Fi, Wi-Fi Direct, NFC.

Peer-to-Peer Communication: Introducing Android Instant Messaging, Introducing SMS.

Recommended Readings:

1. Reto Meier; Professional Android Application Development; Wiley Publishing Inc.
2. Frank H.P. Fitzek, Frank Reichert; Mobile Phone Programming and its Application to Wireless Networking; Springer.
3. Jerome DiMarzio; Android: A Programmer's Guide; McGraw Hill Inc.
4. Saurabh Jain; Mobile Phone Programming; BPB Publications.
5. Rich Ling; Mobile Phones and Mobile Communication; Polity Press.
6. Ed Burnett; Hello, Android: Introducing Google's Mobile Development Platform; Pragmatic Bookshelf.
7. Rick Rogers, John Lombardo, Zigurd Mednieks; Android Application Development: Programming with the Google SDK; O'Reilly Media.
8. Sayed Y Hashimi, Satya Komatineni; Pro Android: Developing Mobile Applications for G1 and Other Google Phones; Apress Publications.
9. Chris Haseman; Android Essentials; Apress Publications.

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. User interfaces
2. To do list application
3. Writing widgets
4. Earthquake monitor
5. Device movement and orientation

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6. Location based services
7. Audio
8. Video
9. Bluetooth
10. NFC
11. Wi-Fi Direct
12. Instant Messaging and SMS

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ETC/ECE 8.4.3 OPTICAL COMPUTING

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 8.4.3	Optical Computing	3	1	2	3	100	25	--	25	--	150

Course Objectives:

The subject aims to provide the student with:
1. Understanding of mathematical and image processing fundamentals for optical computing.
2. An Introduction to Analog Optical Arithmetic and systems.
3. An understanding of Digital Optical Computing Devices and Processing.
4. An understanding of Optical Computing using Matrix operations and Artificial Intelligence.

Course Outcomes:

The student after undergoing this course will be able to:
1. Apply techniques of enhancement and restoration to a given image.
2. Apply Spatial Filtering for Optical Processing of Image.
3. Apply Analog Arithmetic for Optical Processing.
4. Perform recognition using Analog Optical systems.
5. Explain the Digital Optical Computing Devices.
6. Explain POSC system and its application to image processing.
7. Apply Matrix operations for Optical Computing.
8. Explain Artificial Intelligent Computations.

UNIT - 1 (12 hours)

Mathematical and digital image fundamentals: Introduction, Fourier Transform, discrete Fourier transform, basic diffraction theory.
Fourier transform property of lens, sampling and quantization, image enhancement, image restoration.
Linear Optical Processing: Introduction, Photographic film, Spatial filtering using binary filters. Holography, Inverse filtering, Deblurring.

UNIT - 2 (12 hours)

Analog optical arithmetic: Introduction, Halftone processing, Nonlinear Optical Processing, Arithmetic operations.

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Recognition using analog optical systems: Introduction, Matched filter, Joint transform correlation Phase-only filter, Amplitude Modulated Recognition Filters, Generalized correlation filter, Mellin transform based correlation.

UNIT - 3 (12 hours)

Digital optical computing devices: Introduction, Nonlinear devices, integrated optics, Threshold devices. Spatial high modulators, Theta modulation devices.

Shadow-casting and symbolic substitution: Introduction, Shadow casting system and Design algorithm, POSC logic operations, POSC multiprocessor, Parallel ALU using POSC, Sequential ALU using POSC

POSC image processing, Symbolic substitutions, Optical implementation of symbolic substitution, Limitations and challenges.

UNIT - 4 (12 hours)

Optical matrix processing: Introduction, Multiplication, Multiplication using convolution, Matrix operation.

Cellular logic architecture, Programmable logic array. Artificial intelligent computations: Introduction, Neural networks, Associative memory.

Optical implementations, Interconnections, Artificial Intelligence.

Recommended Readings:

1. Mohammed A. Karim; Optical Computing: An Introduction; John Wiley & Sons.
2. Anthony VanderLugt; Optical Signal Processing; Wiley
3. Bradly G. Boore; Signal Processing in Optics; Oxford University Press.

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. Image enhancement and Image restoration.
2. Spatial Filtering for Optical Processing of Image.
3. Inverse filtering.
4. Deblurring.
5. Matched filter.
6. Joint transform correlation Phase-only filter.
7. Amplitude Modulated Recognition Filters.
8. Generalized correlation filter.
9. POSC image processing
10. Multiplication using convolution.
11. Matrix operation
12. Neural networks for optical computing.

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ETC/ECE 8.4.4 ADVANCED MOBILE NETWORKS

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 8.4.4	Advanced Mobile Networks	3	1	2	3	100	25	--	25	--	150

Course Objectives:

The subject aims to provide the student with:
1. An understanding of limitations to performance of wireless channel and methods to overcome the same.
2. A thorough understanding of MIMO systems and their performance characteristics.
3. An understanding of OFDM scheme and its advantages and limitations.
4. Introduction to cognitive radio and software defined radio systems.

Course Outcomes:

The student after undergoing this course will be able to:
1. Describe code division multiplexing techniques and its uplink and downlink subsystems.
2. Evaluate capacity of and model AWGN channels.
3. Evaluate performance of MIMO systems.
4. Explain Singular value decomposition based MIMO systems.
5. Evaluate performance of SVD MIMO systems.
6. Explain OFDM schemes and evaluate their performance in AWGN channel.
7. Explain concepts of Cognitive radio and the importance techniques such as spectrum sensing.
8. Explain SDR architectures and their applications.

UNIT - 1 (12 hours)

Review of Spread spectrum technique and CDMA: CDMA Near-Far Problem, RAKE Receiver, Multi-User CDMA Downlink, Multi-User CDMA Uplink and Asynchronous CDMA. Wideband CDMA.

Capacity of wireless channel: AWGN channel capacity, Resources of AWGN channel, linear time invariant Gaussian channel, Capacity of fading channels.

UNIT - 2 (12 hours)

Introduction to MIMO: MIMO System Model and Zero-Forcing Receiver, MIMO MMSE receiver.

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Introduction to SVD: SVD based Optimal MIMO Transmission and Capacity, SVD based Optimal MIMO Transmission and Capacity, OSTBCs and Introduction to V-BLAST Receiver, MIMO beamforming.

UNIT - 3 (12 hours)

OFDM and Multi-Carrier Modulation, IFFT Sampling for OFDM, OFDM Schematic and Cyclic Prefix, OFDM Based Parallelization and OFDM Example, Introduction to MIMO-OFDM.
Impact of Carrier Frequency Offset (CFO) in OFDM, PAPR in OFDM Systems, Introduction to SC-FDMA.

UNIT - 4 (12 hours)

Cognitive Radio: Introduction. Spectrum management. Applications of cognitive radio. Cognitive radio network design. Hardware and system design consideration.
Spectrum sensing: white space detection: energy sensing, coherent detection, cyclostationary and autocorrelation based detection.
Software defined radio as a platform for cognitive radio: hardware and software architecture, SDR development and design. Applications of SDR.

Recommended Reading:

1. David Tse and Pramod Vishwanathan; Fundamentals of Wireless Communications; Cambridge University Press
2. Andrea Goldsmith; Wireless Communications; Cambridge University Press.
3. Theodore Rappaport; Wireless Communications: Principles and Practice; Prentice Hall.
4. Ezio Biglieri; MIMO Wireless Communications; Cambridge University Press.
5. John G Proakis; Digital Communications; McGraw Hill
6. Bruce A. Fette; Cognitive Radio Technology, 2nd Edition; Academic Press
7. Ezio Biglieri, Andrea J. Goldsmith, Larry J. Greenstein, Narayan B. Mandayam, H. Vincent Poor; Principles of Cognitive Radio, 1st Ed.; Cambridge University Press
8. Ekram Hossain, Vijay K. Bhargava; Cognitive Wireless Communication Networks, Springer

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. Modelling of a AWGN channel [MATLAB/SIMULINK]
2. Capacity of a AWGN Channel – BER Analysis [MATLAB/SIMULINK]
3. Capacity of a Fading Channel – BER Analysis [MATLAB/SIMULINK]
4. MIMO channel modelling and Performance evaluation [MATLAB/SIMULINK]
5. Simulation of SVD based MIMO system [MATLAB/SIMULINK]
6. Simulation of V-BLAST system [MATLAB/SIMULINK]

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7. Simulation of MIMO Beamforming [MATLAB/SIMULINK]
8. Simulation of OFDM system [MATLAB/SIMULINK]
9. Simulation of MIMO-OFDM system [MATLAB/SIMULINK]
10. PAPR analysis OFDM system [MATLAB/SIMULINK]
11. Simulation of SC-FDMA system [MATLAB/SIMULINK]
12. Simulation and modelling of SC-FDMA system [MATLAB/SIMULINK]
13. Study of software defined radio
14. Spectrum sensing using SDR

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ETC/ECE 8.4.5 UNDERWATER ROBOTICS

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 8.4.5	Underwater Robotics	3	1	2	3	100	25	--	25	--	150

Course Objectives:
The subject aims to provide the student with:
1. An understanding of different types of underwater robotic platforms and their applications.
2. An introduction to different mechanical aspects of designing of an underwater vehicle.
3. An understanding of electrical and control aspects of underwater vehicle.
4. An ability to design small underwater vehicles for simple tasks.

Course Outcomes:
The student after undergoing this course will be able to:
1. Describe common types of modern underwater vehicles and the major challenges involved in their design.
2. Explain how the properties of water present new challenges in designing underwater vehicles.
3. Select appropriate building materials to use for design of a small ROV or AUV.
4. Determine the required thrust required to propel a vehicle underwater.
5. Explain the working of propellers and design simple electric thruster systems.
6. Budget for power required for all basic systems necessary in an underwater vehicle.
7. Describe different control and navigation strategies used in underwater vehicles.

UNIT - 1 (12 hours)

Introduction: Types of underwater vehicles, applications of underwater vehicles and technology. Case study of underwater vehicle operations.

Design methodology for underwater vehicles: establishing performance requirements, identifying constraints, listing vehicle systems, generating concept design, fabrication and conducting water trials.

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Review of physical properties of water: chemical, electrical, mechanical, acoustic, optical and thermal. Review of properties of water column: Light, temperature, salinity and density.

UNIT - 2 (12 hours)

Structures and materials: Structural performance criteria: strength and stiffness, weight, compatibility with underwater environment. Good structural shapes for underwater vehicles: good shapes for pressure hulls and canisters, frames and fairings. Good structural materials: metals, plastics. Other useful materials.

Buoyancy and stability: brief review of buoyancy. Design for optimal buoyancy. Stability of vehicle under water and surface. Ballast systems.

UNIT - 3 (12 hours)

Basics of moving a vehicle under water: forces on underwater vehicles. Estimating thrust requirements. Review of DC motors. Introduction to propellers and their classification. Simple design of thruster system. Thruster placement criteria and guidelines.

Electrical power budget for underwater vehicles: power for propulsion and other systems. Sample power budget. Electrical power sources: batteries, battery performance, contemporary battery choices.

Transmission and distribution of electrical power: wires, cables and connectors, fuses, tethering. Power distribution systems: case study.

UNIT - 4 (12 hours)

Underwater vehicle modelling: general equations of motion, kinematics, hydrodynamics and hydro statics, actuators and sensors.

Review of Control systems: Linear versus nonlinear control. Linear control: frequency domain and time domain optimal control.

Control system: Trajectory tracking, Path following, Cooperative strategies.

Navigation: Introduction to Navigation: an historical perspective, Problem formulation, Introduction to estimation theory: Kalman filtering. Dead reckoning navigation systems, acoustic-range based navigation.

Localization: Single Range Localization, Terrain and Geomagnetic based navigation.

Case studies.

Recommended Reading:

1. Steven W. Moore, Harry Bohm and Vickie Jensen; Underwater Robotics: Science, Design and Fabrication; Marine Advanced Technology Edu.
2. Antonelli Gianluca; Underwater Robots, 3rd Ed.; Springer Tracts in Advanced Robotics

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3. Robert D. Christ and Robert L. Wernli Sr; The ROV Manual: A User Guide for Remotely Operated Vehicles, 2nd Edition; Butterworth-Heinemann

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. Study of an autonomous underwater vehicle
2. Study of DC motors and their control
3. Study of a simple electric propulsion system and thrust estimation
4. Study of different battery chemistries and their performance characteristics
5. Implementation of trajectory following algorithm [Matlab]
6. Implementation of simple Kalman filter sensor system
7. Study of solid state IMU
8. Study of underwater acoustic sensor and range estimation
9. Study of depth sensor
10. Study of GPS module
11. Implementation of small ROV
12. Implementation of Autonomous ROV

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ETC/ECE 8.4.6 RADAR SYSTEM ENGINEERING

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 8.4.6	Radar System Engineering	3	1	2	3	100	25	--	25	--	150

Course Objectives:

The subject aims to provide the student with:
1. An understanding of Working of Radar using Radar equations.
2. An understanding of Classification of Radars.
3. An understanding of Different types of tracking techniques.
4. An understanding of Radar applications.

Course Outcomes:

The student after undergoing this course will be able to:
1. Explain the Working of Radar using Radar equations.
2. Analyze the Target detection techniques.
3. Explain the applications of Radar.
4. Analyze the Different types of tracking techniques.

UNIT - 1 (12 hours)

The radar range equation: Radar fundamentals. Derivation of range equation, the search radar equation, jamming and radar range with jamming, radar clutter and radar range with clutter. Radar range with combined interferences sources.

The theory of target detection: Noise and false alarms. Detection of one sample of signal with noise, integration of pulse trains, detection of fluctuating targets, CFAR, Optimum and matched filter Theory. Loss factors in detection.

UNIT - 2 (12 hours)

Targets and interference: Definition of radar cross section. Radar cross section of simple and complex objects, spatial distribution of cross section. Bistatic cross section.

CW and FM Radar: Doppler Effect. CW and FMCW Radar, Airborne Doppler Navigation, Multi frequency CW Radar.

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UNIT - 3 (12 hours)

MTI Radar: Delay lines and line cancellers, subclutter Visibility. MTI using range gates and filters, pulse Doppler radar. Non-coherent MTI radar. Application of Digital signal processing to radar system.

Tracking Radar: Different types of tracking techniques. Tracking in range. Tracking in Doppler. Search Acquisition radar. Comparison of Trackers.

UNIT - 4 (12 hours)

Pulse compression: Ambiguity diagram, range resolution, need for pulse compression, Linear frequency modulation pulse compression, Binary Phase-coded pulse compression, Generic compressed signal, comparison of pulse compression waveforms.

Radar Imaging using synthetic Aperture Radar, Height finding radars. Airborne Radars, Secondary surveillance Radars.

Recommended Readings:

1. David K. Barton; Modern radar system analysis; Artech house
2. Fred E. Nathanson; Radar Design Principles; McGraw Hill
3. Cook C. E., Bernfield M.; Radar signals; Academic press
4. Merill Skolnik; Introduction to Radar Systems, 3rd Edition; Tata McGraw Hill

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. Introduction to RADAR (Radio Detection And Ranging)
2. Analysis OF RADAR Range Equation.
3. Analysis of Radar Signal to Noise Ratio against target detection range for different values of target Radar cross section.
4. Analysis of Radar Signal to Noise Ratio against target detection range for different values of Radar peak value.
5. Determination of the velocity of the object moving in the Radar range
6. Understanding the principle of Doppler radar of time and frequency measurement with the help of moving pendulum.
7. Study of the object counting with the help of Radar.
8. Study the effect of different types of materials on Radar receiving or detection.

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ETC/ECE 8.4.7 OPTICAL NETWORKING

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 8.4.7	Optical Networking	3	1	2	3	100	25	--	25	--	150

Course Objectives:

The subject aims to provide the student with:
1. An introduction to optical networks architecture, protocols and infrastructure.
2. An ability to design, maintain and troubleshoot optical networks.
3. An understanding of optical network control and management techniques.
4. An introduction to next generation optical networks and their advantages.

Course Outcomes:

The student after undergoing this course will be able to:
1. Explain optical network architecture and underlying protocols.
2. Evaluate different topologies & access, routing, scheduling protocols.
3. Design virtual optical network topologies.
4. Identify and manage faults in any optical network.
5. Explain the concepts of packet switching in optical networks.
6. Explain the features, architectures and advantages of next generation optical networks.

UNIT - 1 (12 hours)

First Generation Optical Networks: SONET/SDH, Computer Interconnects, Metropolitan Area Networks, Layered Architecture**.**
Broadcast and Select Networks: Topologies for Broadcast Networks, Media Access Control (MAC) Protocols, Scheduling Protocols.

UNIT - 2 (12 hours)

Wavelength Routing Networks: The Optical layer, Node Designs, Network design and operation, Routing and Wavelength Assignment.
Virtual Topology Design: Virtual Topology Design Problems, Combined SONET/WDN, Network Design, Integer Linear Programming formulation, Regular virtual topologies.

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UNIT - 3 (12 hours)

Control and Management: Network Management Functions, Configuration management, Performance Management, Fault Management, Ring Networks, Mesh Networks.
Access Networks: Network Architecture Overview, Optical Access Network Architecture.

UNIT - 4 (12 hours)

Photonic Packet Switching: OTDM, Multiplexing and Demultiplexing, Synchronization, Broadcast OTDM Networks, Switch based Networks.
Next Generation Optical Internet Networks: Optical circuit switching, Optical burst switching, MPLS in WDM Networks.

Recommended Readings:

1. Raju Ramaswami, Kumar Sivarajan,; Optical Networks: A Practical Perspective; Morgan Kauffmann
2. C. Siva Ram Murthy, Mohan Guruswamy; WDM Optical Networks: Concepts, Design and Algorithms; Prentice Hall of India.
3. Ulysses Black; Optical Networks: Third Generation Transport Systems; Pearson Education.
4. Biswajit Mukherjee; Optical Communication Networks; McGraw Hill
5. Walter Goralski; Optical Networking and WDM; Tata Mcgraw Hill.
6. Achyut G. Dutta, Niloy K. Dutta, Masahiko Fujiwara; WDM Technologies: Optical Networks; Elsevier

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

Recommended to use simulation software's such as Optinet

1. Performance Evaluation of different Optical network topologies
2. Performance Evaluation of MAC protocols
3. Performance Evaluation of Scheduling protocols
4. Performance Evaluation of routing techniques
5. Design of a optical network
6. Design of virtual topologies
7. Fault simulation and troubleshooting
8. Multiplexing and demultiplexing
9. WDM
10. Optical switching
11. MPLS in optical networks

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ETC/ECE 8.4.8 WIRELESS SENSOR NETWORKS

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 8.4.8	Wireless Sensor Networks	3	1	2	3	100	25	--	25	--	150

Course Objectives:

The subject aims to provide the student with:
1. An introduction to wireless sensor network architectures, hardware and applications.
2. An understanding of protocol stack used in wireless sensor networks.
3. An understanding of different strategies used for routing, synchronization, localization etc.

Course Outcomes:

The student after undergoing this course will be able to:
1. Explain all the components and subsystems of a wireless sensor networks.
2. Evaluate the trade-off associated with WSN for a given application.
3. Explain the Phy, MAC and network layer protocols of WSN.
4. Explain the different time synchronization, localization and power management strategies used in WSN.
5. Explain the security challenges and applications of WSN.
6. Select appropriate protocols and strategies for use in WSN for a given application.

UNIT - 1 (12 hours)

Introduction to WSN: Applications of WSN. WSN hardware – Sensing subsystem, processor subsystem, communication interfaces. Node examples.

WSN software: Functional aspects of operating systems. Examples of OS for nodes.

Medium access control: Overview, wireless MAC protocols, Characteristics of MAC protocols in sensor networks.

Contention-free MAC protocols: Characteristics, traffic-adaptive medium access, Y-MAC.

UNIT - 2 (12 hours)

Contention-based MAC protocols: Power aware multi-access with signalling, Sensor MAC, Timeout MAC, Pattern MAC, Routine enhanced MAC, Data Gathering MAC.

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Hybrid MAC: Zebra MAC, Mobility adaptive hybrid MAC.

Network Layer: Introduction, routing metrics, flooding and gossiping, data centric routing algorithms, proactive routing algorithms, on-demand routing algorithms, hierarchical routing, location based routing algorithms and QoS based routing.

UNIT - 3 (12 hours)

Power Management: Local power management aspects, dynamic power management.

Time synchronization: The synchronization problem. Reasons and challenges in time synchronization. Basics of time synchronization. Time synchronization protocols: reference broadcasts using global sources, lightweight tree based synchronization, timing sync protocol, flooding time synchronization protocol, reference broadcast synchronization, time diffusion synchronization protocol, mini sync and tiny sync.

UNIT - 4 (12 hours)

Localization: Introduction, ranging techniques: ToA, TDoA, AoA, RSSI. Range based localization. Range-free localization. Event driven localization.

Security: Challenges of security in wireless sensor networks. Security attacks in sensor networks, protocols and mechanisms for security.

Recommended Reading:

1. Waltenegus W. Dargie ; Christian Poellabauer; Fundamentals of Wireless Sensor Networks: Theory and Practice; Wiley-Blackwell
2. Feng Zhao, Leonidas J. Guibas,; Wireless Sensor Networks: An Information Processing Approach; Morgan Kaufmann
3. Kazem Sohraby, Daniel Minoli and Taieb Znati; Wireless Sensor Networks: Technology, Protocols, and Applications; Wiley-Blackwell
4. Holger Karl and Andreas Willig; Protocols and Architectures for Wireless Sensor Networks; Wiley-Interscience

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. Study of hardware for wireless sensor node [Arduino/raspberry pi]
2. Study of operating system for wireless sensor node [tinyOS etc.]
3. Performance evaluation of Contention-free MAC protocols [Matlab/NS2]
4. Performance evaluation of Contention-based MAC protocols [Matlab/NS2]
5. Performance evaluation of Hybrid MAC protocols [Matlab/NS2]
6. Performance evaluation of flooding and gossiping routing protocols [Matlab/NS2]
7. Performance evaluation of data centric routing protocols [Matlab/NS2]

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8. Performance evaluation of proactive routing algorithms [Matlab/NS2]
9. Performance evaluation of location based routing algorithms [Matlab/NS2]
10. Performance evaluation of flooding time synchronization protocols [Matlab/NS2]
11. Performance evaluation of reference broadcast synchronization protocols [Matlab/NS2]
12. Performance evaluation of Range based localization protocols [Matlab]
13. Performance evaluation of Range free localization protocols [Matlab]

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ETC/ECE 8.4.9 CONSUMER ELECTRONICS

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 8.4.9	Consumer Electronics	3	1	2	3	100	25	--	25	--	150

Course Objectives:

The subject aims to provide the student with:
1. An understanding of basic characteristics of sound, microphones, loudspeakers, sound recording with its reproduction and public address systems.
2. An understanding of signal generation to test various sections of TV receiver.
3. An introduction to various electronic household and office appliances.
4. An understanding of the concepts and techniques in marketing.

Course Outcomes:

The student after undergoing this course will be able to:
1. Evaluate the choice of appropriate microphones and loudspeakers for recording and reproduction of sound for various environmental surroundings.
2. Design block level and circuit level systems for sound recording and reproduction.
3. Explain the construction and working of the different types of electronic household and office appliances.
4. Identify major risks associated with the circuits in electrical appliances and strategies to mitigate those risks.
5. Develop, evaluate, and implement marketing management in a variety of business environments.

UNIT - 1 (12 hours)

Electro acoustical Transducers: Microphones, Loudspeakers, Pick-up characteristics, specifications and applications.
Sound Recording and Reproduction: Principle and Block schematic of disc recording system, magnetic recording system, optical recording system, compact disc and video recording.
Audio Amplifier and subsystems: Audio mixers, tone controls, Graphic equalizers, Features of Hi-Fi and stereo systems, Dolby system, Public Address systems.

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UNIT - 2 (12 hours)

Testing, Alignment & Servicing of Television Receivers: Testing and Alignment of TV receivers, TV Wobbuloscope, Video Pattern Generators, Marker Generator, Colour bar generator, Vectroscope.
Cable Television: Modern cable TV system, signal processing, Cable TV converter, Satellite Television, Direct broadcast satellite TV.
Digital Television System, Three-dimensional (3D) TV, stereoscopic effect with the aid of special glasses, autostereoscopic methods.
Projection Television: Laser Projection system, LCD projection system.
High Definition television systems: HDTV Systems, HDTV standards and compatibility.

UNIT - 3 (12 hours)

Modern home appliances with electronic control: Microwave oven, washing machine, Air-conditioner, Digital video disc (DVD) player , Blu –Ray Disc, MP3 player, Digital Camera, Remote control, Inverters, UPS, Refrigerator, Iron, Kittle.

Working principle of photocopying, scanner, fax machine, Risograph, solar cell panels and solar water heater. Maintenance and safety measures.

Electricity in home: electric lighting, electric heating, Dangers of Electricity & Safety Precautions**.**

UNIT - 4 (12 hours)

Marketing planning: Importance of marketing planning, steps involved in marketing planning process scanning the marketing environment and spotting the business opportunities, setting the market objectives.
Marketing strategy: the meaning & significance of marketing strategy, formulating the marketing strategy. Techniques and practices for mass production for reliable production.
Costing: overview of costing and marketing communication.
Entrepreneurship Awareness. Introduction to Energy auditing.
Patents: Introduction to patents.

Recommended Readings:

1. Gupta B. R.; Consumer Electronics; S.K. Kataria & Sons
2. R. G. Gupta; Audio and Video Systems: Principles, Maintenance and Troubleshooting; Tata McGraw-Hill
3. S. P. Bali; Consumer Electronics; Pearson
4. V. S. Ramaswamy, J. Namakumari; Marketing management planning, implementation and control, 2nd Edition; McMillan
5. Tom Duncan; Electronics for Today and Tomorrow; Hodder Education
6. R. G. Gupta; Television engineering and video systems; Tata McGraw-Hill
7. H. S. Kalsi; Electronic Instrumentation; Tata McGraw Hill

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List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. Determination of frequency response of microphone.
2. Determination of frequency response of loudspeaker.
3. Determination of frequency response of crossover networks.
4. To study the working of a microwave oven.
5. Study of Semi-Automatic Washing machine trainer &Fault finding.
6. To study the various components of a Fully Automatic Washing Machine.
7. To study Risograph machine.
8. To study the basic operation of facsimile.
9. To study the various components of sound mixer.
10. To Study Fault simulation and step-by-step Fault finding of B/W TV.
11. To study the basic operation of TV pattern generator
12. To identify and understand different sections and components of mobile phone unit such as ringer section, dialer section, receiver section, transmitter section, etc.
13. To study the basic operation of photocopying machine.
14. To study the various components of Iron and kittle.

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ETC/ECE 8.4.10 ELECTROMAGNETIC INTERFERENCE / ELECTROMAGNETIC COMPATIBILITY

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 8.4.10	Electromagnetic Interference /Electromagnetic Compatibility	3	1	2	3	100	25	--	25	--	150

Course Objectives:
The subject aims to provide the student with:
1. An understanding of EMC standards.
2. An understanding of EMC measurements.
3. An understanding of filtering and shielding.
4. An understanding of CE marking.

Course Outcomes:
The student after undergoing this course will be able to:
1. Explain the different types of EMC standards.
2. Measurement of Conducted Emission, Radiated Emission, Conducted Immunity and Radiated Immunity in a test setup.
3. Design EMC compliant circuits for PCBs.
4. Analyze the methods of grounding and cabling.
5. Explain the CE marking.

<u>UNIT - 1</u>　　　　　　　　(12 hours)

Introduction to EMI/EMC: Problem of EMI, effects of EMI, need for EMC, realization of EMC, EMC tests and measurement, elements of EMI, coupling mechanisms, EMI victims.

EMC standards: Contents of EMC standards, types of EMC standards, civilian EMC standards, military EMC standards, introduction to EMC testing.

Indian EMC standards: Indian standards based on IEC.

Conducted emission measurement: Test setup, measurement instrumentation, EMI receiver, receiver stages in detail, units of measurement, conducted emission limits laboratory test setup, EUT configuration,　measurement procedure, discontinuous emission or clicks, measurement of clicks, low frequency conducted emission: harmonics, low frequency conducted emission : flicker, test reports.

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UNIT - 2 (12 hours)

Radiated emission measurement: Basic test setup, measurement instrumentation, units of measurement, frequency range of measurement, limits, measurement site, measurement procedure, disturbance power measurement, near field emission measurement, test reports.

Conducted immunity/susceptibility testing: General test setup, electrical fast transients / burst (eft/b), surge testing, conducted susceptibility – continuous wave (CW), electrostatic discharge test, evaluation of test results, test reports.

Radiated immunity/susceptibility testing: General test set-up, shielded enclosures, antennas and radiating systems, signal generators and amplifiers, measuring equipment, ancillary equipment, severity levels and frequency ranges, RF electromagnetic field immunity test, magnetic field immunity test, evaluation of test results and test reports.

Uncertainty in EMC testing: Some definitions, uncertainty during emission measurement, uncertainty during immunity testing.

UNIT - 3 (12 hours)

Filtering: Filter types, filter impedance, power line filters, basic elements of filters, power line filter design, other filter components, transient suppression in relays and motors, multistage power line filters, ferrite beads, filters for DC lines, filtered pin connectors, filter installation, filter performance evaluation.

Shielding: Mechanism of radiation, shielding mechanisms, choice of shield material, shielding and equipment enclosures, penetrations and apertures, leakages at seams, shielding for connector openings, ensuring shielding effectiveness over openings –a summary, shielding of plastic enclosures, shields for cables.

PCB design for EMC: Need for EMC design at PCB level, printed circuit board (PCB), board zoning, aspects of a good PCB design, common impedance coupling in PCBs, general considerations for a PCB, multilayer board and high speed PCB design, multilayer concepts, power and ground planes, plane resonance, cavity resonance between planes, fringing fields and their reduction, openings and discontinuities in ground plane, optimizing anti-pad design, routing traces close to antipads, issues with a split plane, traces crossing and changing layers, connection of devices to planes, placement of decoupling capacitors, advantages of multiple decaps, position of devices, layer stacking in boards, high density interconnect (HDI) technology, board segregation, onboard connectors.

UNIT - 4 (12 hours)

Grounding and bonding: Purpose of grounding, standards regarding safety ground, equipment and system grounding, types of grounding, reducing common ground impedance coupling, grounding of cable shields, grounding of faraday shielded transformers, earth pits, electrical bonding.

Cable selection and routing: Cable coupling mechanisms, cable classes, type of cables for a particular class, cable segregation, reducing common mode (CM) coupling, reducing differential mode (DM) coupling, cable routing in an electronics control panel, running cables in an installation, shape of cable ways.

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CE marking: The European union background, EU institutional structure, type of legislative actions, CE marking and other marks, essential requirements of CE marking, the new approach to conformity, EU directives, harmonized European standards, the global approach to conformity, notified bodies, the CE marking procedure, modules prescribed by some directives, CE marking -some examples, contents of the declaration of conformity (DOC), contents of the technical documentation, affixing the CE marking, products imported from third countries, market surveillance.

Recommended Readings:

1. Chetan Kathalay; A Practical Approach to Electromagnetic Compatibility -With Introduction to CE Marking (EMC SERIES), 2nd Ed.; EMC Publications.
2. Henry W. Ott; Electromagnetic Compatibility Engineering; John Wiley & Sons.
3. Clayton R. Paul; Introduction to Electromagnetic Compatibility, 2nd Edition; John Wiley & Sons
4. Mark I. Montrose; Printed Circuit Board Design Techniques for EMC Compliance: A Handbook for Designers, 2nd edition; Wiley-IEEE Press
5. Bernhard Keiser; Principles of Electro-magnetic Compatibility; Artech House, Inc.

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. To Study Conducted emission measurement
2. To Study Radiated emission measurement
3. To Study Conducted immunity/susceptibility testing
4. To Study Radiated immunity/susceptibility testing
5. To Study Filtering
6. To Study Shielding
7. To Study PCB design for EMC
8. To Study Grounding and bonding
9. To Study Cable selection and routing
10. To Study CE marking

ETC/ECE 8.4.11 INTRODUCTION TO DEEP NEURAL NETWORKS

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Th	S	TW	O	P	Total
ETC/ECE 8.4.11	Introduction to Deep Neural Networks	3	1	2	3	100	25	--	25	--	150

Course Objectives:

The subject aims to provide the student with:
1. An introduction to the basic concepts of applied mathematics needed to understand various paradigms in deep learning.
2. A solid understanding of the most important general principles of machine learning.
3. The knowledge of modern deep learning technologies and approaches.
4. The basic understanding of recurrent neural network for the processing of temporal sequences.

Course Outcomes:

The student after undergoing this course will be able to:
1. Apply the concepts mathematics in the context of artificial intelligence.
2. Apply optimization and training methodologies for deep machine learning.
3. Determine hyper parameters for learning algorithms.
4. Implement deep neural networks for given applications.
5. Demonstrate the use of convolutional and recurrent neural networks for optimization of feed forward deep network models.

UNIT - 1 (12 hours)

Introduction to Deep Learning, Applications.
Applied Math and Machine Learning Basics: Linear Algebra: Scalars, Vectors, Matrices and Tensors, Multiplying Matrices and Vectors, Identity and Inverse Matrices, Linear Dependence and Span, Norms, Special Kinds of Matrices and Vectors, Eigen-decomposition, Singular Value Decomposition, The Moore-Penrose Pseudoinverse, The Trace Operator, The Determinant, Example: Principal Components Analysis.

Numerical Computation: Overflow and Underflow, Poor Conditioning, Gradient-Based Optimization, Constrained Optimization, Example: Linear Least Squares.

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UNIT - 2 (12 hours)

Machine Learning Basics: Learning Algorithms, Capacity, Overfitting and Underfitting, Hyperparameters and Validation Sets, Estimators, Bias and Variance, Supervised Learning Algorithms, Unsupervised Learning Algorithms, Stochastic Gradient Descent.
Deep Networks: Modern Practices: Deep Feedforward Networks, Example: Learning XOR, Back-Propagation and Other Differentiation Algorithms.

UNIT - 3 (12 hours)

Optimization for Training Deep Models: How Learning Differs from Pure Optimization, Challenges in Neural Network Optimization, Basic Algorithms, Parameter Initialization Strategies, Algorithms with Adaptive Learning Rates.
Convolutional Networks: The Convolution Operation, Motivation, Pooling, Convolution and Pooling as an Infinitely Strong Prior, Variants of the Basic Convolution Function, Structured Outputs, Data Types, Efficient Convolution Algorithms, Random or Unsupervised.

UNIT - 4 (12 hours)

Sequence Modeling: Recurrent and Recursive Nets, Unfolding Computational Graphs, Recurrent Neural Networks, Bidirectional RNNs, Encoder-Decoder Sequence-to-Sequence Architectures, Deep Recurrent Networks, Recursive Neural Networks
The Challenge of Long-Term Dependencies, Echo State Networks, Leaky Units and Other Strategies for Multiple Time Scales, The Long Short-Term Memory and Other Gated RNNs, Optimization for Long-Term Dependencies, Explicit Memory.

Recommended Readings:

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville; Deep Learning; MIT Press
2. Daniel Groupe; Deep Learning Neural Networks Design and Case Studies; World Scientific
3. Li Deng, Dong Yu; Deep Learning Methods and Applications; Microsoft Research
4. Nikhil Buduma, Nicholas Locascio; Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms; O'Reilly Media
5. John D. Kelleher, Brian Mac Namee, Aoife D'Arcy; Fundamentals of Machine Learning for Predictive Data Analytics: Algorithms, Worked Examples, and Case ; MIT Press
6. Josh Patterson, Adam Gibson; Deep Learning: A Practitioner's; O'Reilly Media

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. Supervised Learning Algorithms
2. Unsupervised Learning Algorithms
3. Feedforward back propagation Networks
4. Deep Feedforward Networks
5. Optimization for Training Deep Models
6. Algorithms with Adaptive Learning rates
7. Convolutional Networks

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8. Bidirectional Recurrent Neural Networks
9. Deep Recurrent Neural Networks
10. Recursive Neural Networks

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ETC/ECE 8.4.12 MEDICAL IMAGING

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 8.4.12	Medical imaging	3	1	2	3	100	25	--	25	--	150

Course Objectives:
The subject aims to provide the student with:
1. An introduction to X-ray and computer tomography imaging.
2. An introduction to Ultrasound techniques for medical imaging.
3. An understanding of nuclear medicine.
4. An introduction to nuclear imaging techniques and safety considerations thereof.

Course Outcomes:
The student after undergoing this course will be able to:
1. Describe interaction of radiation and matter and medical imaging informatics.
2. Demonstrate knowledge of X-ray physics, related math and the precautions while working with X-rays.
3. Explain working of ultrasound techniques.
4. Explain Magnetic resonance imaging technique and its application.
5. Describe different nuclear imaging techniques and its effects.
6. Define safety parameters and methods for radiation protection in diagnostic X-ray imaging and in nuclear medicine.

UNIT - 1 (12 hours)

Introduction to medical imaging, Interaction of radiation and matter, Image quality, medical imaging informatics.
Diagnostic Radiology: X-ray Production, X-ray tubes and X-ray generators, Radiography, Mammography.

UNIT - 2 (12 hours)

Computed Tomography, X-ray Dosimetry in projection imaging and computed tomography.
Magnetic Resonance Basics: Magnetic field, Nuclear magnetic characteristics, tissue contrast, image acquisition.
Ultrasound: Ultrasound transducers, ultrasound beam properties, image data acquisition, Doppler ultrasound, ultrasound image quality and artefacts.

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UNIT - 3 (12 hours)

Nuclear Medicine: Radioactivity and nuclear transformation, Radionuclide Production, Radiopharmaceuticals and internal dosimetry.
Radiation detection and measurement, Nuclear imaging – Scintillation Camera, Emission Tomograghy.

UNIT - 4 (12 hours)

Radiation Biology: Interaction of radiation with tissue, Molecular and cellular response to radiation, Radiation effects.
Radiation Protection: Sources of Exposure to ionizing radiation, Personnel Dosimetry, radiation detection equipment in radiation safety, fundamental principles and methods of exposure control, structural shielding of imaging facilities, radiation protection in diagnostic and interventional X-ray imaging , Radiation protection in nuclear medicine, prevention of errors, management of radiation safety program.

Recommended Readings:

1. Jerrold T. Bushberg, J. Anthony Seibert, Edwin M. Leidholdt, Jr. John M. Boone; The Essential Physics of Medical Imaging, 3rd Edition; Lippincott Williams and Wilkins
2. Nadine Barrie Smith, Andrew Webb; Introduction to Medical Imaging-Physics, Engineering and clinical application; Cambridge Text in Biomedical Engineering
3. Paul Suetens; Fundamentals of Medical Imaging, 2nd Edition, Cambridge University Press
4. J. G. Webster; Medical Instrumentation – Application & Design; John Wiley & Sons
5. Kirk Shung, Michael B, Smith, Benjamin M W Tsui; Principles of medical imaging; Academic press
6. Zhong Hicho, Manbir Singh; Fundamentals of Medical imaging; John Wiley
7. Peter Josefell, Edward Sudney; Nuclear Medicine introductory Text; William Blackwell Scientific Publishers London
8. G.T. Herman; Imaging reconstruction from projections - Implementation and applications; Topics in Applied Physics vol.32 Springer Verlag

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments.)

1. Study of X ray tubes
2. Study of X ray Generators
3. X ray imaging
4. X ray image acquisition
5. X ray image enhancement
6. Ultrasound transducers
7. Doppler ultrasound
8. Ultrasound image acquisition
9. Ultrasound image enhancement
10. Study of nuclear imaging
11. Nuclear imaging image acquisition
12. Nuclear imaging image enhancement

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ETC/ECE 8.4.13 STATISTICAL THEORY OF COMMUNICATION

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	O	P	Total
ETC/ECE 8.4.13	Statistical Theory Of Communication	3	1	2	3	100	25	--	25	--	150

Course Objectives:

The subject aims to provide the student with:
1. An understanding of coding methods in communication.
2. An understanding of communication channel and measurements of channel parameters.
3. An understanding of noises and noise measurement in communication.
4. An understanding of Radar system.

Course Outcomes:

The student after undergoing this course will be able to:
1. Analyze the coding methods.
2. Calculate channel capacity for communication channel.
3. Analyze various noises in the communication system.
4. Estimate unknown parameters in communication systems.

UNIT - 1 (12 hours)

Information Measure: Fundamental problem of communication. Definition and properties of discrete entropy, Joint and conditional entropies. Entropy in the continuous case. Noiseless coding; the problem of unique decipherability, instantaneous codes, Kraft-McMillan inequality. The noiseless coding theorem. Construction of optimal codes (Huffman's method).

UNIT - 2 (12 hours)

Noisy Coding. The discrete memory less channel. Mutual information and channel capacity. Classification of channels. Calculation of channel capacity. Decoding schemes. Shannon's fundamental theorem. Capacity of a band limited Gaussian channel.

UNIT - 3 (12 hours)

Optimum Linear systems. Digital communication in presence of additive white Gaussian Noise. The correlation Receiver. Matched Filter for Additive Non-White Gaussian Noise: The pre-whitening approach. Linear Estimation using least mean square error criterion:

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Wiener filter, testing of statistical hypothesis. Likelihood ratio tests Bayes, Neyman-Pearson and mini-max test, probability of error. Receiver operating characteristics, optimum reception of known binary signals in Gaussian noise.

UNIT - 4 (12 hours)

Parameter Estimation: Estimation of Unknown Parameters, Random and Deterministic; ML, MSE and MAP estimates. Applications to RADAR: Block Diagram of a pulsed RADAR system, The RADAR Equation, Detection of steady point targets, estimation of the range and velocity of steady point targets.

Recommended Readings:

1. J. B. Thomas; Statistical Theory of Communication; Wiley
2. M. B. Srinath, P. K. Rajasekaran; An Introduction to Statistical Signal Processing with Applications; Wiley
3. R.B. Ash; Information Theory; Wiley
4. D. J. Sakrison; Communication Theory; Wiley
5. H. L. Vantrees; Detection, Estimation and modulation Theory; Wiley

List of Experiments:
(At least 8 experiments should be conducted from the list of experiments.)

1. Signal Sampling and reconstruction
2. Time Division Multiplexing
3. AM Modulator and Demodulator
4. FM Modulator and Demodulator
5. Pulse Code Modulation and Demodulation
6. Delta Modulation and Demodulation
7. Line coding schemes
8. FSK, PSK and DPSK schemes (Simulation)
9. Error control coding schemes - Linear Block Codes (Simulation)
10. Communication link simulation
11. Equalization – Zero Forcing & LMS algorithms(simulation)

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