GOA UNIVERSITY

FOURTH YEAR OF BACHELOR'S DEGREE COURSE IN ELECTRONICS AND TELECOMMUNICATION ENGINEERING
(REVISED COURSE-2007)
SCHEME OF INSTRUCTION AND EXAMINATION

SEMESTER VII:

Sub code	Subjects	Scheme Of Instruction Hrs/Week			Scheme Of Examination					
					Th. Dur (Hrs)	Marks				
		L	T	P		Th.	S	P	O	Total
7.1	Data Communication	4	0	2	3	100	25	-	50	175
7.2	Microwave and Radar Engineering	4	0	2	3	100	25	-	50	175
7.3	Optical Fiber Communication	4	0	2	3	100	25	-	-	125
7.4	Elective-I	4	0	2	3	100	25	-	50	175
7.5	Elective-II	4	0	0	3	100	25	-	-	125
7.6	Project Seminar	0	0	4	-	-	25	-	50*	75
	Total	20	0	12	-	500	150	-	200	850

* Seminar & orals

SEMESTER VIII:

Sub code	Subjects	Scheme Of Instruction Hrs/Week			Scheme Of Examination					
					Th. Dur (Hrs)	Marks				
		L	T	P		Th.	S	P	O	Total
8.1	Satellite & Television Engineering	4	0	2	3	100	25	-	50	175
8.2	Elective-III	4	0	2	3	100	25	-	50	175
8.3	Elective-IV	4	0	2	3	100	25	-	50	175
8.4	Wireless Communications	4	0	0	3	100	25		50	175
8.5	Project	0	0	10	-	-	50	-	100* *	150
	Total	16	0	16	-	400	150	-	300	850

* * Seminar, demonstration and Oral.
L – Lectures, T-Tutorials, P-Practicals.
Th. Dur. – Duration of Theory Paper

Th – Theory, S – Sessional, P– Practical, O – Oral.

Elective	**Subject Code**	**Subject Name**
I	7.4.1	Embedded Systems
	7.4.2	Operating Systems
	7.4.3	Hardware Description Language
	7.4.4	Virtual Instrumentation
	7.4.5	Wavelets and Multirate Digital Signal Processing
	7.4.6	Electronic Circuits: Design, Simulation and Testing
	7.4.7	Introduction to Java and J2EE
	7.4.8	Optical Computing
	7.4.9	Process Control Instrumentation
II	7.5.1	Mobile Communication Systems
	7.5.2	Artificial Neural Network
	7.5.3	Secure Communications
	7.5.4	Nanoelectronics
	7.5.5	Optical Networking
	7.5.6	Adaptive Signal Processing
III	8.2.1	Consumer Electronics
	8.2.2	Speech Signal Processing
	8.2.3	Mobile Computing
	8.2.4	Introduction to Robotics
	8.2.5	ASIC Design and FPGA
	8.2.6	Microwave Networks and Applications
	8.2.7	Error Control Coding
IV	8.3.1	E-Commerce
	8.3.2	Bio-medical Electronics and Instrumentation
	8.3.3	Digital Image Processing
	8.3.4	Electromagnetic Interference/Electromagnetic Compatibility
	8.35	Ad-hoc Wireless Networks
	8.3.6	Global System for Mobile Communication
	8.3.7	Mobile Phone Programming

7.1 DATA COMMUNICATION

MODULE I

OSI Model: Layered architecture of OSI model, other layered architecture (TCP/IP) (1hr)

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 (3hrs)

Modems: types of modems, scrambler and descrambler, block schematic of modem (1hr)

Network architecture

LAN systems: architecture: bus, ring, tree, star, wireless Ethernet, fast Ethernet, Token ring, FDDI, Bluetooth, wireless LAN

IEEE protocols: 802.2, 802.3, 803.4, 802.5, 802.6, 802.11(only frame format and description for these protocols)

IEEE 802.3 Ethernet:Contention access, CSMA, CSMA/CD (3hrs)

Physical Layer: Interface-RS232, DTE-DCE interface, specifications, Null Modems (2hrs)

MODULE II

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 (3hrs)

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 (3hrs)

Switching**:** switching networks, circuits switching, space division switching, time division switching, packet switching (datagram and virtual circuit [SVC, PVC]), message switching (2hrs)

X.25 protocol**:** X.25 layers, characteristics of X.25 packet format, X.25 operation (2hrs)

MODULE III

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) (4hrs)

Internet protocols: IP protocols, addresses, internet control protocols, OSPF, BGP, mobile IP, IPV6 (2hrs)

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, UDP, wireless TCP and UDP (4hrs)

MODULE IV

Networking Devices: repeaters, bridges, routers, firewall (1hr)

ATM**:** ATM architecture- virtual connection, identifiers, cells, connection establishment and release (2hrs)

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 (3hrs)

Application Layer: DNS, DHCP, TFTP, Telnet, FTP, electronic mail, HTTP (4hrs)

TEXT BOOKS:

1. Data Communication and computer networks-Prakash C. Gupta, PHI)
2. Computer Networks-Andrew S Tanenbaum, PHI

REFERENCE BOOKS:

1. Data Communication & Networking- Behrouz A. Forouzan, Tata Mc-Graw Hill (2^{nd} edition)
2. Data & Computer Communications by William Stalling, PHI [5^{th} edition].
3. Data Communication and Networks by Achyut S Godbole, Tata McGraw

7.2 MICROWAVE & RADAR ENGINEERING

MODULE I

Fundamentals of microwave amplifiers and oscillators:
Beam coupling & Beam coupling coefficient. (1 Hr.)
Power transfer from alternating gap field to density modulated beam. (1 Hr.)
Beam loading, Equivalent circuit of Microwave Amplifier and Oscillator. (1 Hr.)
Noise, Microwave oscillators, analysis of two terminal oscillators circuits. (1 Hr.)
Build-up and limitation of amplitude of oscillation. (1 Hr.)
Klystron: Bunching by velocity modulation, Two – cavity Klystrons, velocity diagram small signal theory of bunching in two Cavity klystrons. (2 Hrs.)
Reflex Klystron: Structure, velocity diagram, Mathematical theory of bunching in Reflex Klystron, Power delivered to the resonator, effect of the repeller voltage upon power delivered to the resonator . (3 Hrs.)

MODULE II

Traveling wave magnetron**:** Structure, Traveling wave Magnetron Resonator, modes of oscillation, mode separation by means of Straps. (3 Hrs.)
Traveling wave tube: Construction and Description, slow wave circuits, Backward - wave Traveling wave tube. (2 Hrs.)

Measurements:
Calorimeter Wattmeter, Bolometer, bolometer mounts and bridges. (1 Hr)
Thermocouples and crystals, Measurement of standing waves, Impedance measurement. (1 Hr.)
Measurement of frequency and wavelength. Microwave bridges, Measurement of Q(by transmission, VSWR measurement.) (1 Hr.)
Microwave semiconductor devices**:** Microwave JFETs, (Physical Structure, Principles of Operation) Gunn - diode (Gunn Effect) (1 Hr.)

Avalanche Transit Time devices**:** IMPATT Diodes (Physical Structures, Negative Resistance),TRAPATT Diodes. (Physical Structure, Principles of Operation) (1 Hr.)

MODULE III

Radar: Principle of operation of radar, maximum unambiguous range, radar range equation, Radar block diagram, radar frequencies, applications of radar. Receiver noise, signal to noise ratio, Probability of Detection & False Alarm, Integration of Radar Pulses.

(2 Hrs)

Radar Cross Section: Radar Cross Section of Targets, Radar Cross section fluctuations. Transmitter power, pulse repetition frequency, system losses. (2 Hrs)

Doppler frequency shift, Continuous wave Radar, FM-CW Radar. Clutter: Sea clutter, Weather clutter, other sources of atmospheric echoes. (1 Hr)

MTI Radar: Principle of operation, block diagram, single & double delay line cancellers, clutter attenuation, blind speeds, staggered PRF's, limitations to MTI performance, non-coherent MTI, MTI from a moving platform. (3 Hrs)

Radar displays: A- Scope , B-Scope, C-Scope, E- Scope, Plan Position Indicator (PPI), RHI Display. (1 Hr)

Antenna for radars: Electronically Steered Phase Array Antenna, advantages of Phased Array Antenna, limitations. (1 Hr)

MODULE IV

Tracking Radar: Different methods of tracking, Sequential lobing, Conical Scanning, amplitude & phase comparison Monopulse Radar, limitations to tracking accuracy, low angle tracking, frequency agility. (2 Hrs)

Tracking in Range: Split Gate Tracker, Precision on-axis tracking, track while scan, automatic tracking with surveillance radar. Pulse compression, FM pulse compression radar, Chirp, phase coding. (2 Hrs)

Radomes: Rigid radomes, air supported radomes, weather effects on radomes, radome wall construction, metallic radomes, rotodomes. (1 Hr)

Secondary Surveillance Radar (SSR): Principle of operation, problems with SSR. (2 Hrs)

Principle of operation of the following radar :Over the horizon radar, surface wave radar, Sky wave radar, Synthetic Aperture Radar (SAR), ground probing radar, carrier free radar, battlefield radar, concept of bistatic & multistatic radar. (3 Hrs)

TEXT BOOKS:

1. Microwave Principles by H.J.Reich, J.G.Skolnik, P.F.Ordung, H.L.Krauss - Affiliated East West Press Ltd.
2. Introduction to Radar Systems (3rd Edition) by Merill Skolnik – Tata McGraw Hill
3. Understanding Radar Systems by Simon Kingsley & Shaun Queegan – Standard Publisher Distributors, New Delhi

REFERENCE BOOKS:

1. Microwave Devices and Circuits by Samuel Y. Liao
2. Radar Handbook by Merill Skolnik – Tata McGraw Hill

7.3 OPTICAL FIBER COMMUNICATION

MODULE I

Overview Of Optical Fiber Communication: Introduction, Historical development, general system, advantages, disadvantages, and applications of optical fiber communication, optical fiber waveguides, Ray theory, cylindrical fiber (no derivations in article 2.4.4). (3 Hrs)

single mode fiber, cutoff wave length, mode filed diameter, graded index fiber structure, (4 Hrs)

Optical Fibers: fiber materials. and fiber fabrication (3 Hrs)

MODULE II

Transmission Characteristics Of Optical Fibers**:** Introduction, Attenuation, absorption, scattering losses, bending loss, dispersion, Intra model dispersion, Inter model dispersion (3 Hrs)

Optical Sources and Detectors- diode, structure, quantum efficiency, modulation of LED's and LASER. (4 Hrs)

.Photo detectors, Photo detector noise, Response time, Photo diodes, comparison of photo detectors. (3 Hrs)

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MODULE III

Fiber Couplers and Connectors: Introduction, fiber alignment and joint loss, single mode fiber joints, fiber splices, fiber connectors and fiber couplers. (2 Hrs)

Optical Receiver Operation: Fundamental Receiver operation, Digital receiver performance calculation, Preamplifier types. (3 Hrs)

coherent detection, burst mode receiver, Analog receivers. (3 Hrs)

WDM Concepts**:** WDM concepts, overview of WDM operation principles. (2 Hrs)

MODULE IV

Optical Amplifiers and Networks – optical amplifiers, basic applications and types, semiconductor optical amplifiers, EDFA. (4 Hrs)

Optical Networks- SONET/SDH rings, SONET/SDH networks . (2 Hrs)

Broadcast and select WDM networks. Wavelength routed networks. (4 Hrs)

TEXT BOOKS:

1. Optical Fiber Communication, Gerd Keiser, 4th Ed., MGH, 2008.
2. Optical Fiber Communications, John M. Senior, Pearson Education. 3rd Impression, 2007.

REFERNECE BOOKS:

1. Optical fiber communication by Oselt, McGraw Hill, 1980.
2. Fiber optics by P.K. Cheo
3. Optical fibers by Okashi
4. An Introduction to optical fibers by H.A. Cherin, Mc Graw Hill, Book Co. 1983
5. Optical communication system by J. Gowar Fiber Optic Communication - Joseph C Palais: 4th Edition, Pearson Education

7.4.1 EMBEDDED SYSTEMS

MODULE I

Different types of microcontrollers. Processor Architecture: Harvard and Princeton, CISC and RISC. The 8051 microcontroller architecture: Hardware, input/output pins, ports and circuits, external memory, counters and timers, serial data input and output, interrupts. (5 hours)

The 8051 instruction set: Data movement instruction: External Data move, Code memory Read-Only-Data moves, Push and Pop opcodes, Data exchanges. Logic operation: Bit and Byte level, Rotate and Swap. The 8051 instruction set: Arithmetic operations: Flags, incrementing, decrementing, addition, subtraction, multiplication and division, decimal arithmetic. Jump instruction: call, subroutine Interrupts and Return. (5 hours)

MODULE II

An 8051 Microcontroller design: A microcontroller design, testing the design, timing subroutines, lookup tables for the 8051, serial data transmission (4 hours)

An 8051 microcontroller Applications: Interfacing of keyboard to 8051 based microcontroller system – Human factors, key switch factors, key configurations, programs for keyboards, a scanning program for small keyboards, interrupt-driven programs for small keyboards, program for a large matrix key. Interfacing LED and LCD – Seven-segment numeric display, intelligent LCD display. Measurement of pulse width and frequency – Measuring frequency, pulse width measurement. Interfacing A/D and D/A Converter – D/A Conversions, A/D Conversions. (6 hours)

MODULE III

Introduction to PIC microcontrollers. CPU architecture and instruction set: Register file structure and addressing modes, CPU registers, instruction set, simple operations. (5 hours)

Features of PIC microcontroller: Interrupt logic, IntService interrupt Service routine, loop time subroutine, RBO/INT external interrupt input, PORTB-Change Interrupts (Pins RB7:RB4), Timer 0,Timer 1, Timer 2, Pulse-Width-Modulated Outputs. I^2C Bus for serial EEPROM, SPI protocol. (5 hours)

MODULE IV

ARM processor: ARM Processor basics, Interrupt scheme, .AMBA: A typical AMBA system, AHB features, components, interconnection. Basic AHB transfers. Burst operation (5 hours)

Introduction to Real Time (RT) Systems : Definitions and Classifications, Programming Structures, Response Latency, Relative speeds, Types of RT systems : Hard, Soft , Firm Real Time Operating Systems (RTOS) : Characteristics of Real-time operating system (RTOS), Kernel Pre-emptibility, Timing, Tasks, Handling Interrupts, Scheduler. (5 hours)

TEXT BOOKS:

1. The 8051 Microcontroller, Architecture, Programming & applications-second edition – Kenneth J. Ayala, Penram International.
2. Design with PIC Microcontrollers – John B. Peatman.
3. Real-time systems development By Rob Williams,
4. ARM System-on-Chip Architecture Steve Furber

REFERENCE BOOKS:

1. Programming and customizing the 8051 microcontroller – Myke Predko.
2. Programming and customizing PIC microcontrollers –Michael predko, Myke Predko
3. PIC-micro microcontroller pocket reference.
4. Embedded systems design By Steve Heath

7.4.2 OPERATING SYSTEMS

MODULE I

Introduction to Operating System: Definition, Basic diagram, Basic elements, Processor registers, instruction execution, interrupts, memory hierarchy, cache memory, I/O communication techniques, OS objectives and functions. (3 hrs)
Multiprocessor system, Multiprogramming System, time sharing system (1 hr)
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 (3 hrs)
Threads Overview, Multithreading modules (1 hr)
Symmetric MultiProcessing (1 hr)
Microkernels architecture and benefits (1 hr)

MODULE II

Concurrency Control: Principles of concurrency, operating system concerns, process interaction, competition amongst processes for resources, cooperation amongst processes by sharing & communication (2 hrs)
Mutual exclusion: Requirements of mutual exclusion, development of Dekker's Algorithm, Peterson's algorithm, interrupt disabling, machine instruction approach (2 hrs)
Semaphores: Mutual exclusion, producer/consumer problem, implementation of semaphores, message passing, readers/writers problem (3 hrs)
Deadlocks: System model, deadlock characterization, methods for handling deadlocks, deadlock prevention, deadlock avoidance, deadlock detection, recovery from deadlock.

(3 hrs)

MODULE III

Memory management: Contiguous Memory allocation, paging, segmentation, segmentation with paging (3 hrs)
Virtual Memory: locality and virtual memory. (1 hr)
Numericals on fetch policy, placement policy, replacement policy, optimal, least recently used, first-in-first-out, clock algorithm for replacement (3 hrs)
File Management: Files, File Management systems, file organization and access, file directories, file sharing, record blocking (3 hrs)

MODULE IV

Scheduling: types of scheduling, scheduling algorithms & numerical on: FIFO, Round Robin, Shortest Process Next, Shortest Remaining Time, Highest Response Ratio Next, Feedback. Comparison amongst all the scheduling algorithms. (3 hrs)

Principles of I/O software: Goals of I/O software (1 hr)

Disk Scheduling & Management: Disk scheduling policies-FCFS, SSTF, SCAN, C-SCAN, LOOK , selection of a disk scheduling algorithm, Disk management, disk formatting, bad blocks. (3 hrs)

Security: The Security environment, Basics of Cryptography, user authentication, attacks from inside the system, attacks from outside the system. (3 hrs)

TEXT BOOKS:

1. Operating Systems: Internal & design principles by William Stallings, Sixth Edition, PHI.
2. Operating systems Concepts by A. Silberschatz, P. Galvin, G. Gagne, Sixth Edition, John Wiley & Sons Pte. Ltd.
3. Modern Operating Systems by Andrew S. Tanenbaum, Second Edition, Pearson education, Prentice Hall

REFERENCE BOOKS:

1. Operating Systems: A concept based approach, by D.M. Dhamdhere, TataMc Graw Hill
2. Operating Systems: Concepts and design by Milan Milenkovic, TataMc Graw Hill
3. Operating Systems: A design oriented approach by Charles Crowley, TataMc Graw Hill

7.4.3 HARDWARE DESCRIPTION LANGUAGES

MODULE I

Basic concepts of hardware description languages. 2 hr.
Basic Language elements in VHDL:-Data Objects, Data Types, Operators, Entities and Architecture Declaration 4 hr
Behavioral style of VHDL modeling. :-Process Statement, IF, Case, Loop, Null, Exit, Wait Assert and Report statements. 4 hrs

MODULE II

Dataflow Modeling in VHDL:-Concurrent Signal Assignment and Sequential signal Assignment ,Conditional and Selected Signal Assignment, Delta Delay 4 hrs.
Structural Modeling in VHDL:-Component Instantiation 2hrs
Generics and Configurations, Attributes, Modeling Delays and Packages
Use of Procedures and functions in VHDL, 2 hrs
Examples of design using VHDL. 2hrs

MODULE III

Syntax and Semantics of Verilog hardware description language. Variable types, arrays and tables in Verilog. 2hrs
Operators, expressions and signal assignments in verilog. 2 hrs
Modules, nets and registers in verilog, 2hrs
Concurrent and sequential constructs of Verilog. 2hrs
Tasks and functions in Verilog, 2hrs

MODULE IV

Examples of design using Verilog HDL. 2hrs
System C Design Methodology. Syntax and semantics of System C. DataTypes in SystemC 4hrs
Examples of Design in System C 2hrs.
Synthesis of logic from hardware description. Design using Xilinx family FPGA 2hrs

TEXTBOOKS:

1. Douglas Perry, "VHDL", McGraw Hill International (NY), 1993, The Institute of Electrical and Electronics Engineers.
2. S. Palnitkar, "Verilog HDL: A Guide to Digital Design and Synthesis", Prentice Hall (NJ, USA), 1996.
3. J. Bhasker, "Verilog HDL Synthesis - A Practical Primer", Star Galaxy Publishing, Allentown, PA) 1998.
4. J.Bhasker :VHDL Primer" PHI.

REFERENCE BOOKS:

1. Stefan Sjoholm & Lennart Lindth,"VHDL for Designers", Prentice Hall.
2. Peter J Ashenden, "The Designer's Guide to VHDL ", Morgan Kaufmann Publishers.
3. "IEEE std 1364-95, Verilog Language Reference Manual", IEEE Press (NY, USA), 1995.
4. Navabi," VHDL Analysis & Modeling of digital systems",1998, McGraw Hill .

7.4.4 VIRTUAL INSTRUMENTATION

MODULE-I

Virtual Instrumentation: Historical perspective, advantages, block diagram and architecture of a virtual instrument, data-flow techniques, graphical programming in data flow (3 hours)

Comparison with conventional programming. Development of Virtual Instrument using GUI. (3 hours)

Real-time systems, Embedded Controller, OPC, HMI/SCADA software, Active X programming. (4 hours)

MODULE II

VI programming techniques: VIS and sub-VIS, loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes. (2 hours)

Local and global variables, string and file I/O, Instrument Drivers, Publishing measurement data in web. (3 hours)

Programming examples (5 hours)

MODULE III

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, Software and hardware installation, Calibration, Resolution, Data acquisition interface requirements. (5 hours)

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. (5 hours)

MODULE IV

VI toolsets, Distributed I/O modules. Application of Virtual Instrumentation: Instrument Control, Development of process database management system. (3 hours)

Simulation of systems using VI, Development of Control system, Industrial Communication, Image acquisition and processing, Motion control. (7 hours)

TEXTBOOKS

1. Gary Johnson, LabVIEW Graphical Programming, Second edition, McGraw Hill, Newyork, 1997.
2. Lisa k. Wells & Jeffrey Travis, LabVIEW for everyone, Prentice Hall, New Jersy, 1997.

REFERENCE BOOKS

1. Kevin James, PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control, Newnes, 2000

7.4.5 WAVELET TRANSFORMS AND MULTIRATE DIGITAL SIGNAL PROCESSING

MODULE I

Fundamentals of multi-rate systems**:** Basic multi rate operations, interconnection of building blocks, poly phase representation, multi stage implementation, applications of multi rate systems, special filters and filter banks. (3 Hrs)

Multirate Filter Banks:
Maximally decimated filt er banks:Errors creatd in the QMF bank alias free QMF system, power symmetric QMF banks,M channel filter banks, poly phase representation, perfect reconstruction systems, alias free filter banks,tree structured filter banks,trans multiplexers. (4 Hrs)

Continuous Wavelet Transform:
Introduction, C-T wavelets, Definition of CWT, The CWT as a correlation. Constant Q-Factor Filtering Interpolation and time frequency resolution, the CWT as an operator, inverse CWT. (3 Hrs)

MODULE II

Introduction To Discrete Wavelet Transform And Orthogonal Wavelet Decomposition**:** Introduction. Approximation of vectors in nested linear vector spaces, (i) example of approximating vectors in nested subspaces of a finite dimensional liner vector space, (ii) Example of approximating vectors in nested subspaces of an infinite dimensional linear vector space. Example MRA. (i) Bases for the approximations subspaces and Harr scaling function, (ii) Bases for detail subspaces and Haar wavelet. (5 Hrs)

MRA, Ortho Normal Wavelets And Their Relationship To Filter Banks**:** Introduction, Formal definition of an MRA. Construction of a general orthonormal MRA, (i) scaling function and subspaces, (ii) Implication of dilation equation and orthogonality, a wavelet basis for MRA. (i) Two scale relations for (t), (ii) Basis for the detail subspace (iii) Direct sum decomposition, Digital filtering interpolation (i) Decomposition filters, (ii) reconstruction, the signal. (5 Hrs)

MODULE III

Alternative Wavelet Representations**:** Introduction, Bi-orthogonal wavelet bases, Filtering relationship for bi-orthogonal filters, Examples of bi-orthogonal scaling functions and wavelets.
2-D wavelets. (4 Hrs)

Non - separable multidimensional wavelets, wavelet packets. (1 Hr)
Wavelets Transform and Data Compression: Introduction, transform coding, DTWT for image compression (2 Hrs)

(i) Image compression using DTWT and run-length encoding. (3 Hrs)

MODULE IV

(i) Embedded tree image coding (ii) compression with JPEG audio compression (iii) Audio masking, (iv) Wavelet based audio coding. (3 Hrs)

Construction Of Simple Wavelets**:** Construction of simple wavelets like Harr and DB1. (3 Hrs)

Other Applications of Wavelet Transforms: Introduction, wavelet de-noising, speckle removal, edge detection and object isolation, Image fusions, Object detection by wavelet transforms of projections. (4 Hrs)

TEXT BOOKS:

1. Wavelet transforms- Introduction to theory and applications, Raghuveer M.Rao and Ajit S. Bapardikar, Person Education, 2000.
2. P.P.Vaidyana han,“Multirate Systems and Filter Banks,"Pearson Education (Asia)Pte.Ltd,2004.

REFERENCE BOOKS:

1. Wavelet transforms, Prasad and Iyengar, Wiley estern, 2001.
2. Wave-let and filter banks, Gilbert Strang and Nguyen Wellesley Cambridge press, 1996
3. Insight into WAVELETS from theory to practice**,** K.P. Soman and K.L. Ramchandran, Eastern Economy Edition, 2008

7.4.6 ELECTRONIC CIRCUITS: DESIGN, SIMULATION AND TESTING

MODULE I

Concept of Electronics Circuit Design: Functional Sections, Components and Devices, Ratings, Specifications,Design equations and selection criterion. (4 hrs)

Approaches to analysis; Introduction to modeling of devices, components and circuits. (3 hrs)

Computation of characteristics of simple devices (p-n junction, MOS capacitor, MOSFET, etc.) (3 hrs)

MODULE II

Simulation of Electronic Circuits: Role of simulation, various circuit elements and their representation (4 hrs)

Introduction to circuit simulator: SPICE, Simulation exercises; design of circuits and performance evaluation using simulation packages. (4 hrs)

Introduction to schematic, Layout and Routing (OrCad). Noise in electronic systems: design of low noise circuits. (2 hrs)

MODULE III

Design considerations and guidelines for automatic insertion of components. (2 hrs)

Electronic Product design: launch process, design management and design process. (3 hrs)

Design guidelines for dual in line package components. (3 hrs)

Surface mounting technology of electronic components. (2 hrs)

MODULE IV

Introduction to industrial design, product design methodology (4 hrs)

product planning and development data collection (4 hrs)

Marketing and management theory. (2 hrs)

ELECTRONIC CIRCUITS : DESIGN LABORATORY

Mini circuit design project based upon following guidelines:

The project should be strictly hardware based. The project can be carried out individually or in a group. The project work involves fabrication, testing and calibration (if required) work of some electronic circuit. The project should be defended by adequate documentation & presentation. A teacher can assign fabrication of trainer kits to the students.

TEXT BOOKS:

1. Electronic Circuit Design: From Concept To Implementation By Nihal Kularatna; Crc Press (Jun 2008)

2. Printed Circuit Boards: Design and Technology, By W.C. Bosshart, Tata McGraw Hill, 1983.
3. Electronic product design for automated manufacturing by Richard Stillwell, Marcel Dekker Inc.
4. Industrial Organization and Engineering Economics, T.R. Banga, S.C. Sharma, Khanna Publishers
5. Noise Reduction Techniques in Electronic Systems, By H.W.Ott. Wiley 1989

REFERENCE BOOKS:

1. Industrial Design and Engg. Design council By Flurschiem CH (springer verlag)
2. Printed Circuit Design. By G.L. Ginsberg. McGraw Hill, 1991
3. Computer aided analysis and electronic circuits, By L.O.Chua and P.M.Lin. Prentice Hall. 1975
4. Analysis and Simulation of Semiconductor Devices, By S. Selberherr, Springer-Verlag 1984
5. Introduction to Electronic Circuit Design By Richard Spencer and Mohammed Ghausi; Prentice Hall

7.4.7 INTRODUCTION TO JAVA AND J2EE

MODULE I

Introduction to JAVA**:**

Java and Java applications; Java Development Kit (JDK)

Byte Code, JVM; Object-oriented programming; Simple Java programs. 2 Hours

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; Type casting; Strings 2 Hours

Control Statements: Selection statements, iteration statements, Jump Statements. 1 Hour

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. 2 Hours

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. 3 Hours

MODULE II

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. 3 Hours

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**.** 3 Hours

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. 4 Hours

MODULE III

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. 4 Hours

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**.** 6 Hours

MODULE IV

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. 5 Hours

Enterprise Java Beans:

Enterprise java Beans; Deployment Descriptors; Session Java Bean, Entity Java Bean; Message-Driven Bean; The JAR File. 5 Hours

TEXT BOOKS:

1. Java - The Complete Reference – Herbert Schildt, 7th Edition, Tata McGraw Hill, 2007.
2. J2EE - The Complete Reference – Jim Keogh, Tata McGraw Hill, 2007.

REFERENCE BOOKS:

1. Introduction to JAVA Programming – Y. Daniel Liang, 6th Edition, Pearson Education, 2007.
2. The J2EE Tutorial – Stephanie Bodoff et al, 2nd Edition, Pearson Education, 2004

7.4.8 OPTICAL COMPUTING

MODULE I

Mathematical and digital image fundamentals:
Introduction, Fourier Transform, discrete Fourier transform, basic diffraction theory. (2 hours)
Fourier transform property of lens , sampling and quantization, image enhancement, image restoration. (3 hours)

Linear Optical Processing:
Introduction,Photographic film, Spatial filtering using binary filters (2 hours)
Holography, Inverse filtering, Deblurring. (3 hours)

MODULE II

Analog optical arithmetic:
Introduction, Halftone processing, Nonlinear Optical Processing, Arithmetic operations. (3 hours)
Recognition using analog optical systems:
Introduction, Matched filter, Joint transform correlation (2 hours)
Phase-only filter, Amplitude Modulated Recognition Filters (2 hours)
Generalized correlation filter, Mellin transform based correlation. (3 hours)

MODULE III

Digital optical computing devices:
Introduction, Nonlinear devices, Integrated optics, Threshold devices (2 hours)
Spatial high modulators, Theta modulation devices. (2 hours)

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 (3 hours)

POSC image processing, Symbolic substitutions, Optical implementation of symbolic substitution, Limitations and challenges. (3 hours)

MODULE IV

Optical matrix processing:

Introduction, Multiplication, Multiplication using convolution, Matrix operation (3 hours)

Cellular logic architecture, Programmable logic array. (2 hours)

Artificial intelligent computations:

Introduction, Neural networks, Associative memory (2 hours)

Optical implementations, Interconnections, Artificial Intelligence. (3 hours)

TEXT BOOK:

1. "Optical Computing : An Introduction**"**, Mohammed A. Karim, John Wiley & Sons.

REFERENCE BOOKS:

1. Optical Signal Processing by Vanderlugnt John Wiley & Sons
2. Signal Processing in Optics - Bradly G Boore, Oxford University Press

7.4.9 PROCESS CONTROL INSTRUMENTATION

MODULE I

Introduction to Process Control:
Introduction; control systems; process control block diagram; servomechanisms; control system evaluation; on off control; analog and digital control; process characteristics. (5 hrs)

Sensors: Sensor time response;
Overview of Thermal sensors-RTD, thermistors, thermocouples;
Overview of Mechanical sensors: strain, motion, pressure, and flow;
Optical sensors: photodectectors, pyrometers, applications: design consideration of all sensors. (5 hrs)

MODULE II

Analog and digital signal conditioning;
Analog signal conditioning: Linearization, Conversion, SCR and TRIAC. (2 hrs)
Final Control:Introduction; final control operation; Signal conversion; (1 hr)
Actuators: electrical, pneumatic, and hydraulic; Control elements: mechanical; electrical; Fluid valves; Control valve type; Control valve sizing; Process instrumentation; (4 hrs)
Discrete state process control:Introduction; defination; characteristics of the system; relay controllers. (3 hrs)

MODULE III

Controller Principles:
Introduction; overview of control system parameters; continous controller modes: proportional, integral, derivative control modes; composite control modes: PI, PD, PID; (4 hrs)

Telemetry: neumatic telemetering system; electronic telemetry system; electrical electronic telemetering system. (2 hrs)
Analog /digital controllers:
Introduction; electronic, pneumatic, digital controller; design considerations. (4 hrs)

MODULE IV

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. (4 hrs)

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. (3 hrs)

Applications of PLC to process control: Traffic generation, water-bottle plant; Microprocessor application in process instrumentation: microprocessor control of a petrol engine, microprocessor based data logger; process loop tuning. (3 hrs)

TEXT BOOKS:

1. Process Control Instrumentation Technology-Curtis D. Johnson, Pearson Education, 7th edition.
2. Principles of Measurement and Instrumentation-Alan S.Morris, EEE, 2nd Edition.
3. .Instrumentation Devices and Systems-Rangan, Sarma, Mani, TMH, New Delhi.
4. 4Industrial Instrumentation and control-SK Singh, TMH, New Delhi.

REFERENCE BOOKS:

1. Automatic process control –Donald P.Eckman
2. Digital control systems-KUO

7.5.1 MOBILE COMMUNICATION SYSTEMS

MODULE I

The Cellular Concept: System Design Fundamentals :
Introduction, frequencies used, Concept of Frequency Reuse, Hexagonal shaped cells, Block diagram of Cellular System, Advantages over Conventional Mobile Communication Systems. (2hrs)
Handoff Strategies: Handoffs, Types of handoff, handoff initiation, delaying handoff, forced handoff, Queuing of Handoffs, Power Difference Handoffs, Mobile assisted Handoff (MAHO) and Soft Handoff, Cellsite Handoff, Intersystem handoff (2hrs)

Co-channel Interference reduction factor, Desired C/I for a normal case in a Omnidirectional Antenna System , Reduction of Co-Channel interference by means of a notch in then tilted antenna pattern (2hrs)
Mobile Radio Propagation : Large Scale Path Loss : Introduction to Radio Wave Propagation, Free Space Propagation Model, The Three Basic Propagation Mechanisms, Ground Reflection (Two Ray) Model, Diffraction, Scattering (2hrs)
Obtain path loss from a point to point prediction model-A general Approach, A point to point Model, Mobile to Mobile propagation (2hrs)

MODULE II

Mobile Radio Propagation : Small Scale Fading and Multipath :
Small Scale Multipath Propagation, Impulse Response of a Multipath Channel (1hr)

Parameters of Mobile Multipath Channels , Types of Small Scale Fading, Rayleigh and Rician Distribution. (2hrs)

Modulation Techniques for Mobile Radio :
Factors that influence the choice of Digital Modulation, Gaussian Pulse Shaping Filter, Gaussian Minimum Shift Keying (GMSK). (1hr)

Equalization, Diversity:
Introduction, Fundamentals of Equalization, Equalizers in a Communication Receiver

(1hr)

Diversity Techniques ,Rake Receiver (2hrs)

Multiple Access Techniques for Wireless Communications :
Introduction, TDMA, Fixed TDM, Classical Aloha, Slotted ALOHA, CSMA, DAMA, PRMA, Reservation TDMA, MACA, Polling, Space Division Multiple Access

(3hrs)

MODULE III

GSM and CDMA:

Global System for Mobile Communication (GSM) **:** GSM Services and Features, GSM System Architecture, GSM Radio Subsystem, GSM Channel Types, Example of a GSM Cell, Frame Structure for GSM. (4hrs)

CDMA Digital Cellular Standard (IS-95) **:** Frequency and Channel Specifications, Forward CDMA Channel, Reverse CDMA Channel. (3hrs)

Capacity of Cellular Systems : Capacity of Cellular CDMA, Capacity of CDMA with Multiple Cells, Capacity of Space Division Multiple Access. (3hrs)

MODULE IV

MIMO Systems:

Multiple Input Multiple Output Antenna Systems (1 hours)

Space Time Codes for MIMO Wireless Communications (2 hours)

Space Division Multiple Access and Smart Antennas (2 hours)

BLAST Architectures (2 hours)

Global Positioning Satellite System (GPSS) (1hr)

Wideband Code Division Multiple Access (W-CDMA), WI-FI (2 hours)

TEXTBOOKS:

1. Wireless Communication : Principles and Practice by Theodore Rappaport , 3rd Edition,
2. Prentice Hall of India
3. Modern Wireless Communications by Simon Haykin, Micheal Moher, Pearson Education

REFERENCE BOOKS :

1. Fundamentals of Wireless Communications by David Tse and Pramod Vishwanathan,
2. Cambridge University Press
3. Mobile Cellular Telecommunications by William Lee, Tata McGraw Hill,2nd edition
4. Mobile Communications by Jochen Schiller, 2nd Edition, Addison Wesley
5. Introduction to Wireless and Mobile Systems by Dharma Prakash Agrawal, Qin Anzeng,

6. Thomson Asia Pvt. Ltd.
7. Space Time Codes and MIMO Systems by Mohinder Janakiraman, Artech House

7.5.2 ARTIFICIAL NEURAL NETWORK

MODULE I

Introduction: Introduction to neural networks, structure of biological neuron, Mc-Culloch Pitts neuron model. 1 hour
logic network realization by using Mc-Culloch Pitts neuron model, Neuron modeling for artificial neuron systems, Neural learning. 1 hour
Single layer network: Concept of linear seperability and non-linear separability, training algorithms- 1 hour
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.. 4 hour
Discriminant functions, Minimum distance classification, Single layer Discrete Perceptron, Single layer Continuous Perceptron, ADALINE. 2 hour
Multicatagory single layer perceptron. 1 hour

MODULE II

Multilayer network I: Error back propagation algorithm or generalized delta rule. 1 hour

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). 2 hours
Pocket algorithm, quick prop algorithm, performance evaluation. 2 hours

Multilayer network II: Adaptive multilayer network, network pruning algorithm.
Marchands algorithm, neural tree, tiling algorithm & problems related to adaptive multiplayer network. 3 hours
Prediction network, radial basis function and its applications, polynomial network.
2 hours

MODULE III

Winner-Take-All network, Hamming Distance classifier, MAXNET 2 hour
Clustering, simple competitive learning algorithm, LQV algorithm. 2 hour
Adaptive resonance theory. 1 hour
Topologically organized network – SOM, SOFM, Kohonen's algorithms, Distance based learning, K-means clustering algorithms, Principal Component Analysis Networks and problems. 5 hours

MODULE IV

Hopefield network: Non-iterative procedures for association, Matrix Association memories, Least square procedures, Optimal linear association memory. 2 hours

Discrete Hopefield networks, Continuous Hopefield networks, Energy functions, Energy minimization, Storage capacity of Hopfield networks. 3 hours
Brain-state-in-a-box network, Bi-directional associative memory and problems. 2 hours
Applications of neural network. 3 hours

TEXTBOOKS:

1. Elements of artificial neural network by Malhotra, Mohan, Ranka, Penram Publications.
2. Introduction to Artificial neural network by Zurada, Jaico Publications.

REFERENCE BOOKS:

1. Introduction to Artificial neural network by Patterson.

7.5.3 SECURE COMMUNICATIONS

MODULE I

Introduction of Secure Network: Key points(service, mechanisms and attacks),OSI security architecture, Security attacks, security services, security mechanisms, a model for network . (2 hrs)

Classical encryption techniques: Symmetric cipher model substitution techniques, Transposition techniques, rotor machines,steganography and numerical on different ciphers. (4 hrs)

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. (4 hrs)

MODULE II

Public-Key Cryptography and RSA:Principles of public-key cryptosystems, RSA algorithm and numerical on RSA. (3hrs)

Key Management; Other Public Key Crypto Systems: Key management, Diffie-Hellman key exchange, ECC Diffie-Hellman key exchange algorithm, numericals.

(3hrs)

Message Authentication and Hash Functions: Authentication requirements, Authentication functions. (2 hrs)

Message authentication codes, Requirements of Hash functions, Security of hash functions & MAC's (2 hrs)

MODULE III

Digital Signature and Authentication Protocol: Digital signature, Authentication protocols, Digital signature standard. (3 hrs)

Authentication Applications:

Kerberos: Kerberos Version 4, Kerberos Version 5. (2 hrs)

X.509 authentication service**:**-Certificates, Authentication Procedures,X.509 Version 3 (3 hrs)

Firewalls: Firewall Design Principles (2 hrs)

MODULE IV

Electronic Mail Security: Pretty good privacy, S/MIME (4 hrs)

IP Security: Overview, IP security architecture, Authentication header, ESP (encapsulating security pay load), Key management. (6 hrs)

TEXT BOOKS:

1. William Stallings, Cryptography and Network Security, 4th edition, Prentice Hall of India, 2008.

REFERENCE BOOKS:

1. C. Kaufman, R. Perlman, and M. Speciner, Network Security: Private Communication in a Public World, 2nd edition, Pearson Education (Asia) Pvt. Ltd., 2002.

7.5.4 NANOELECTRONICS

MODULE I

The region of Nanostructures; The Complexity problem, The challenge initiated by Nanoelectronics: Technological processes for microminiaturization; Methods and limits of microminiaturization in silicon; Microelectronics and Mechanical Systems (MEMS): Integrated Optoelectronics. 4 Hours

Basics of Nanoelectronics, quantization of Action, Charge and Flux; Schrodinger Equation, Electrons in Potential Wells, Photons interacting with electrons in solids. Diffusion Processes. 3 Hours

Basics of Information theory, Biology-inspired concepts; Biological Networks, Neuronal cells on silicon, Modelling of neuronal cells by VLSI, Neuronal networks with local adaptation and Distributed data processing. 3 Hours

MODULE II

Biochemical and quantum – mechanical computers: DNA computer, Quantum Computer. 2 Hours

Parallel Architectures for Nanosystems: Architectural principles, Mono and multiprocessor systems, parallel data processing; Influece of delay time; power dissipation and parallelism.
Architectures for parallel processing in nanosystems. 3 Hours

Soft computing in Nanoelectronics: Methods of soft computing; characteristics of Neural Networks in Nanoelectronics. 3 Hours

Complex Integrated Systems and their properties; Nanosystems as Information – Processing machines, System Design and Interfaces; Evolutionary Hardware, Requirements of Nanosystems. 2 Hours

MODULE III

Integrated switches and Basic circuits: Switches and wiring; Classic Integrated switches and their Basic circuits. 2 Hours

Quantum Electronics: QEDs; examples of QEDs. 2 Hours

Bioelectronics and Molecular Electronics. 2 Hours

Nanoelectronics with Tunneling Devices: Tunneling Element; Technology of RTD; Digital circuit design based on RTDs; Digital circuit design based on RTBT. 4 Hours

MODULE IV

Single Electron Transistor (SET): Principle and circuit design of SET; Comparison between FET and SET circuit designs. 2 Hours

Nanoelectronics with Superconducting Devices: Basics, Superconducting switching Devices, Elementary circuits, Flux Quantum Device, Applications. 3 Hours

Limits of Integrated Electronics: A survey about the limits, Replacement of Technologies; Energy supply and Heat Dissipation; Parameter spread as limiting Effect; Limits due to thermal particle motion, Reliability as limiting Factor; Physical limits. 3 Hours

Final objectives of Integrated Electronic Systems: removal of uncertainties by Nanomachines, uncertainties in Nanosystems, uncertainties in the development of Nanoelectronics. 2 Hours

TEXT BOOKS

1. Nanoelectronics and Nanosystems by K. Goser, P. Glosekotter and J. Dienstuhl – Springer International Edition

REFERENCE BOOKS

1. Nanotechnology by M. Ratner and D. Tatner, Pearson Education.
2. Nanotechnology by M. Wilson ,et al.
3. Nanometer Structures by A. Lakhtakia (ed.), Prentice Hall of India.
4. Nanotechnology by R. Booker, E. Boysen, Wiley-dreamtech India Pvt. Ltd.

7.5.5 OPTICAL NETWORKING

MODULE I

First Generation Optical Networks : (4 hours)
SONET/SDH, Computer Interconnects, Metropolitan Area Networks, Layered Architecture

Broadcast and Select Networks : (6 hours)
Topologies for Broadcast Networks, Media Access Control (MAC) Protocols, Scheduling Protocols.

MODULE II

Wavelength Routing Networks : (7 hours)
The Optical layer, Node Designs, Network design and operation, Routing and Wavelength Assignment.

Virtual Topology Design: (3 hours)
Virtual Topology Design Problems, Combined SONET/WDN, Network Design, Integer Linear Programming formulation, Regular virtual topologies.

MODULE III

Control and Management: (6 hours)
Network Management Functions, Configuration management, Performance Management, Fault Management, Ring Networks , Mesh Networks.

Access Networks : (4 hours)

Network Architecture Overview, Optical Access Network Architecture

MODULE IV

Photonic Packet Switching : (6 hours)
OTDM, Multiplexing and Demultiplexing, Synchronization, Broadcast OTDM Networks, Switch based Networks

Next Generation Optical Internet Networks : (4 hours)
Optical circuit switching, Optical burst switching, MPLS in WDM Networks.

TEXT BOOKS:

1.Optical Networks : A Practical Perspective by Raju Ramaswami, Kumar Sivarajan, Morgan Kauffmann
2.WDM Optical Networks: Concepts, Design and Algorithms by C.Siva Ram Murthy, Mohan Guruswamy, Prentice Hall of India

REFERENCE BOOKS :

1.Optical Networks : Third Generation Transport Systems by Ulysses Black, Pearson Education
2.Optical Communication Networks: Biswajit Mukherjee: TMG 1998.
3. Optical Networking and WDM by Walter Goralski, Tata Mcgraw Hill
4.WDM Technologies : Optical Networks by Achyut G Dutta, Niloy K Dutta, Masahiko Fujiwara.

7.5.6 ADAPTIVE SIGNAL PROCESING

MODULE I

Adaptive Systems: Definition and characteristics; general properties; open- and closed – loop adaptation, Example. 3 Hours

Adaptive Linear Combiner: Input signal and weight vectors; Desired response and error; Performance function; Gradient and minimum mean-square error; Example, Alternative expression of the gradient; Decorrelation of error and input components 3 Hours

Adaptation with Stationary signals: Properties of the quadratic performance surface; Eigen values and the eigen factors of the input correlation matrix; their geometrical significance; Examples. 4 Hours

MODULE II

Searching the Performance Surface: Methods of searching, Gradient Search methods; Gradient Search Algorithm and its solution 2 Hours

Stability and rate of convergence; the learning curve, Gradient Search by Newton's method: Newton's method in multidimensional space; Gradient Search by Steepest Descent method; Comparison of learning curves. 3 Hours

Gradient Estimation and its Effects on Adaptation; Estimation by Derivative measurement: Performance penalty; Derivative measurement and performance penalties by multiple weights; Variance of the gradient estimate; Effects on the weight-vector solution, Excess mean-square error and time constants; Misadjustment; Comparative performance of Newton's and Steepest-Descent methods; Total Misadjustment and other practical considerations 5 Hours

MODULE III

Adaptive Algorithms and structures: The LMS Algorithm; its derivation, Convergence of the Weight vector, Example of Convergence, Learning Curve, Noise in the weight – vector resolution, Misadjustment Performance. 3 Hours

The Z-transform in Adaptive signal Processing: the Z-transform , Right– and Left-handed sequence, Transfer functions, Frequency response, Impulse response and stability, Inverse Z-transform, Correlation functions and Power Spectra, Performance Function; Examples 4 Hours

Other Adaptive Algorithms: The LMS/Newton Algorithm, its properties; Sequential Regression Algorithm; Adaptative Recursive Filters, Random-Search Algorithms 3 Hours

MODULE IV

Lattice Structures, Adaptive lattice Predictor; Adaptive filters with orthogonal signals 2 Hours

Applications: Adaptive Modeling and System Identification, general description; Adaptive modeling of a Multipath Communication Channel, Adaptive modeling in Geophysical Exploration, Adaptive modeling in FIR Digital Filter Synthesis; 3Hours

Inverse Adaptive Modeling, Equalization and Deconvoluion; General description of Inverse Modeling, Examples; Adaptive Equalization of Telephone Channels; Adapting poles and zeros for IIR Digital Filter Synthesis. 3 Hours

Adaptative Control Systems: Adaptive Model Control, Adaptive Inverse Control, Examples; Plant noise and the Filtered-x LMS Algorithm; Inverse Control using the Filtered-x LMS Algorithm 2 Hours

TEXT BOOK:

1. Adaptative Signal Processing B. Widrow and S. D. Stearns, Pearson Education

REFERENCE BOOKS:

1. Digital Signal Processing – A.V. Oppenheim and R. W. Schafer, Prentice Hall India
2. B. C. Kuo, Automatic Control Systems, Prentice Hall India

8.1 SATELLITE AND TELEVISION ENGINEERING

MODULE I

Satellite orbits and inclination: Synchronous orbit, orbital parameters, satellite location with respect to earth, look angles, earth coverage and slant range, eclipse effects, placement in geostationary orbit, station keeping, stabilization. 3 Hour

Satellite subsystems: Power, altitude and orbit control, propulsion, repeaters, antennas, Telemetry, Tracking & Command (TTC), thermal control, structure. 3 Hour

Earth station: Design requirements, subsystems, small earth stations, VSATs, mobile and transportable earth stations. 3 Hour

Applications of satellite communication. 1 Hour

MODULE II

Frequency allocations and spectrum. Link design: Design equations, system noise temperature, C/N and G/T ratio, atmospheric and ionospheric effects, interference effects, earth station parameters. 3 Hour

SCPC system, MCPC System, Multiple Access Techniques: TDMA: Frame structure, burst structure, frame efficiency, super frame, frame acquisition and synchronization, comparison with FDMA, burst time plan, multiple beam (Satellite switched) system, beam hopping TDMA. 3 Hour

Demand Assignment Multiple Access Techniques: DA-FDMA (Spade) system, DA-TDMA, Spread spectrum techniques and CDMA: Direct sequence spread spectrum, PN sequences, DS CDMA, frequency hopping system, FH-SS CDMA, Synchronization.

4 Hours

MODULE III

Basic television system: Sound and picture transmission, scanning methods, interlaced scanning, number of scanning lines, vertical and horizontal resolution, evaluation of bandwidth of baseband signal. 2 Hour

Composite video signal: Video signal levels, need for synchronization, details of synchronizing and equalizing pulses, scanning sequence details. 2 Hour

Television cameras: Principle of working and construction of Vidicon, CCD image sensors, gamma correction. 2 Hour

Signal transmission: AM and FM channel bandwidth, vestigial sideband transmission, VSB correction, VHF and UHF bands. TV transmitter block diagram. 1 Hour

Signal reception: TV receiver block diagram, construction of picture tube and their control circuits, RF tuner, IF amplifier, IF response curve, Trap circuits, sync separators, video detector, AGC and AFC schemes, Audio detector, horizontal and vertical deflection systems, high and Extra High Tension (EHT) circuits. 3 Hour

MODULE IV

Colour television: Principles of additive and subtractive colour mixing, chromaticity diagram, compatibility, luminance, hue and saturation, luminance signal, generation of colour difference signal, polarity of colour difference signal. 1 Hour

Colour television display tubes: Delta gun picture tube, PIL picture tube, Trinitron picture tube, purity and convergence, static and dynamic convergence, automatic degaussing, grey scale tracking, pincushion distortion, S correction. 2 Hour

Colour signal transmission and reception: Frequency interleaving, bandwidth for colour signal transmission, modulation of colour difference signal, generation of chrominance signal. 2 Hour

NTSC colour TV system: I and Q signals, selection of colour subcarrier frequency, NTSC encoder and decoder, limitation of NTSC system. 2 Hour

PAL colour television system: Main features of PAL system, cancellation of phase errors, PAL encoder, PAL decoder, PAL-D. 2 Hour

Introduction to advanced Television Systems: HDTV, LCD TV, Plasma TV, LED TV, NHK, MUSE System, Direct- to- Home TV. 1 Hour

TEXT BOOKS:

1. Satellite communication by D.C. Aggarwal, Khanna publications.
2. Satellite communications by T. Pratt, C.W. Bostian, Wiley and sons.
3. Monochrome and colour television by R.R.Gulati, New Age International Pvt. Limited

REFERENCE BOOKS:

1. Electronic communication systems by W. Tomasi, Pearson Education, Asia.
2. Television and Video Engineering by A.M.Dhake, Tata McGraw Hill publishing Company limited.
3. Satellite communication systems by Dennis Roddy, (third edition), Pearson Education, Asia.
4. Satellite communications, R.M. Gagliardi, CBS Publishers & Distributors, New Delhi
5. The satellite communication applications hand book by Bruce R.Elbert, Artech House Boston, 1997
6. Satellite communication systems engineering by Wilbur L.Pritchard, Hendri G.Suyderhood, Robert A.Nelson, II Edition, Prentice Hall, New Jersey.1993
7. Digital satellite communication by Tri T.Ha, 2nd edition, McGraw Hill, New york.1990.
8. Digital communication satellite / earth station engineering by K.Feher, Prentice Hall Inc, New Jersey, 1983
9. Basic Television & video systems by Grob & Herndon, Glencoe Mc Graw Hill, 6th edition.
10. Television electronics – theory and servicing by Milton Kiver & Milton Kaufman, CBS publishers & distributors, New Delhi.
11. Colour television – theory & practice by R.R. Gulati, New Age International Ltd.
12. Colour television – theory & practice by S.P.Bali, Tata Mc Graw Hill.

8.2.1 CONSUMER ELECTRONICS

MODULE I

Electro acoustical Transducers: Microphones, Loudspeakers, Pick-up characteristics, specifications and applications. 3 hrs

Sound Recording and Reproduction: Principle and Block schematic of disc recording system, magnetic recording system, optical recording system, compact disc and video recording. 4 hrs

Audio Amplifier and subsystems: Audio mixers, tone controls, Graphic equalizers, Features of Hi-Fi and stereo systems, Dolby system, Public Address systems. 3 hrs

MODULE II

Testing, Alignment & Servicing of Television Receivers: Testing &Alignment of TV receivers, TV Wobbuloscope, Video Pattern Generators, Television Test Charts, Marker Generator, Colour bar generator, Vectroscope, Tuners. 3 hrs

Cable Television: Modern cable TV system, cable TV converter, Cable systems, Satellite Television, Direct to home TV, LED TV. 2 hrs

Digital television: Digital Television Systems, Digital TV Signals, Digitized video parameters, tramision of Digital TV Signals, Bit rate reduction. 2 hrs

Projection Television: Basic projection television systems, front and rear projection, LCD & Laser Projection system 2 hrs

High Definition television systems: HDTV Systems, HDTV standards and compatibility. 1 hr

MODULE III

Modern home appliances with electronic control: Microwave oven, washing machine, Air-conditioner, DVD, MP3 player, Digital Camera, Remote control, CVT, Inverters, UPS, Refrigerator, Iron, Kittle, Mobile handset up-gradation and repairing. 4 hrs

Working principle of photocopying, scanner, fax machine, risograph, solar water heater and solar cooling. 2 hrs

Maintenance and safety measures: 1 hrs
Electricity in home: electric lighting, electric heating.
Dangers of Electricity & Safety Precautions. 3 hrs

MODULE IV

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. 3 hrs
Marketing strategy: the meaning & significance of marketing strategy, formulating the marketing strategy.
Techniques and Practices for mass production for reliable production. 3 hrs
Costing: overview of costing and marketing communication.
Entrepreneurship Awareness,Entrepreneural spirit, Entrepreneurship development center.
Introduction to Energy auditing.
Patents: Introduction to patents.
Industrial Discipline. 4 hrs

TEXT BOOKS :

1.Consumer Electronics-Gupta B R.
2.Television Engineering –A M Dhake.
3.Marketing management planning, implementation and control, 2nd edition-V S Ramaswamy, J Namakumari.
4.Electronics for Today and Tomorrow-Tom Duncan.
5.Personal Management &industrial Relations-Dr.M.M.Varma & Aggarwal.

REFERENCE BOOKS:

1.Digital Consumer Electronics Engineering Handbook-Ronald Jurgen.
2.Audio Encyclopedia-Triman.
3.High Quality Sound Recording and Reproduction-Olson.
4.Phillips handbook.
5.Everything You Ever wanted to know about DVD-Jim Taylor

8.2.2 SPEECH SIGNAL PROCESSING

MODULE I

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 (8 hours)

Acoustics of Speech Production:
A Discrete time model based on tube concatenation. (2 hours)

MODULE II

Analysis and Synthesis of Pole Zero Speech Models :
Introduction, All Pole Modeling of Deterministic Signals, Levinson Recursion and its associated properties, Criterion of Goodness. (5 hours)

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. (5 hours)

MODULE III

Filter Bank Analysis Synthesis :
Introduction, Phase Vocoder, Phase Coherence in the Vocoder, Auditory Modelling (3 hours)

Sinusoidal Analysis/Synthesis :

Sinusoidal Speech Models, Estimation of Sinewave parameters. (2 hours)

Frequency Domain Pitch Estimation:
Correlation based pitch estimator, Pitch estimation based on comb filter, Pitch estimation based on Harmonic Sinewave Model. (5 hours)

MODULE IV

Speech Coding :
Introduction, Statistical Models, Scalar Quantization, Vector Quantization, Frequency Domain Coding, Model based Coding. (7 hours)

Speaker Recognition :
Introduction, Spectral Features for Speaker Recognition, Speaker Recognition Algorithms. (3 hours)

TEXTBOOK:

1.Discrete-Time Speech Signal Processing: Principles and Practice by Thomas Quatieri , Prentice Hall

REFERENCE BOOKS :

1. Digital Processing of Speech Signals by L.R.Rabiner, A.W.Schafer, Pearson Education
2. Principles of Computer Speech , I.H.Witten Academic Press.
3. Fundamentals of Speech Recognition by Lawrence Rabiner, Bing Hwang Juang, Prentice Hall
4.Speech and Audio Signal Processing : Processing and Perception of Speech and Music by Ben Gold, Nelson Morgan, John Wiley and Sons

8.2.3 MOBILE COMPUTING

MODULE I

Mobile devices and systems, architectures:

Mobile phones, Digital Music Players, Handheld Pocket Computers, Handheld Devices, Operating Systems, Smart Systems, Limitations of Mobile Devices, Automotive Systems. (5 Hours)

Wireless Medium Access Control And CDMA – Based Communication:

Medium Access Control (2 Hours)

Introduction to CDMA – based Systems (2 hours)

OFDM (1 Hour)

MODULE II

Mobile IP network layer, mobile transport layer:

IP and Mobile IP Network Layers Packet Delivery and Handover Management, Location Management, Registration, Tunneling and Encapsulation, Route Optimization, Dynamic Host Configuration Protocol. (4 hours)

Indirect TCP, Snooping TCP, Mobile TCP, Other Methods of TCP – layer Transmission for Mobile Networks. (2 Hours)

Databases:

Database Hoarding Techniques, Data Caching, Client – Server Computing and Adaptation, Transactional Models (2 Hours)

Query Processing, Data Recovery Process, Issues relating to Quality of Service. (2 Hours)

MODULE III

Data dissemination and broadcasting systems**:**

Communication Asymmetry, Classification of Data – Delivery Mechanisms (2 hours),

Data Dissemination Broadcast Models, Selective Tuning and Indexing Techniques, Digital Audio Broadcasting, Digital video Broadcasting. (2hours)

Data synchronization in mobile computing systems:

Synchronization, Synchronization Protocols (2 hours)

SyncML – Synchronization Language for Mobile Computing, Synchronized Multimedia Markup Language (SMIL). (4 Hours)

MODULE IV

Mobile devices, server and management, wireless LAN, Mobile Internet Connectivity And Personal Area Network:

Mobile agent, Application Server, Gateways, Portals, Service Discovery, Device Management, Mobile File Systems. (2 hours)

Wireless LAN (WiFi) Architecture and Protocol Layers, WAP 1.1 and WAP 2.0 Architectures, Bluetooth – enabled Devices Network, Zigbee. (3 hours)

Mobile application languages – XML, JAVA, J2ME AND JAVACARD, MOBILE operating systems:

Introduction, XML, JAVA, Java 2 Micro Edition (J2ME) (3 hours)

JavaCard. Operating System, PalmOS, Windows CE, Symbian OS, Linux for Mobile Devices. (2 Hours)

TEXT BOOK:

1. Mobile Computing – Raj Kamal, Oxford University Press, 2007.

REFERENCE BOOKS:

1. Mobile Computing: Technology, Applications and Service Creation, Asoke K. Talkukder, Roopa R Yavaga, Tata McGraw Hill, 2005.
2. Mobile Computing Principles: Designing and Developing Mobile Applications with UML and XML, Reza B'Far, 5th Edition, Cambridge University press, 2006.
3. Principles of Mobile Computing – Uwe Hansmann, Lothat Merk, Martin S Nicklous and Thomas Stober, 2nd Edition, Springer International Edition, 2003.

8.2.4 INTRODUCTION TO ROBOTICS

MODULE I

Basic Concepts in (Fundamentals of) robotics: Automation and robotics, robot anatomy, Basic structure of robots, Degree of Freedom. Robot motions, resolution, accuracy and repeatability. 4 hrs

Classification and structure of robotic systems: Point to point and continuous path systems, Grippers, Design of grippers. 2hrs

Drives and Control systems: Hydraulic and pneumatic systems, Control loop of robotic systems, Control approaches utilizing current and voltage amplifiers, Robot joint control design 4hrs

MODULE II

Electromechanical Components for Robots:
Force sensing and control of robots, control of robot movements
stability considerations and trajectory optimization. 3hrs

Robot arm drive units. Revolute and prismatic drives.
Electric drives – DC Servometers, Stepping motors, classification, methods of control and comparison. 2 hrs

Sensors in Robotics: Touch sensors, Force and torque sensors. 1hr
Acoustic sensors, Slip sensors, Proximity & Range sensors 1hr
Potentiometers and optical encoders – resolution and range. 1hr
Absolute position encoders, incremental position encoders, dc tachometers. 1hr
Contact and noncontact sensors. 1hr

MODULE III

Robot Programming: Lead through programming methods, Robot program as a path in space, Motion interpolation, WAIT, SIGNAL and DELAY commands., Branching, Programming the maker robot- The teach pendant, Moving the robot, Teaching Points, Teaching programs. 5hrs

Robot Language : Robot language structure, constants, variables & other data objects, Motion commands, End effectors and sensor commands, Computations & operations, Program control and subroutines, Communications & data processing, Monitor mode commands, VAL II. 5hrs

MODULE IV

Machine Vision: Introduction, Sensing & digitizing function, Imaging devices, Lighting techniques, Image storage, Image processing and analysis, Image data reduction, segmentation, Feature extraction, Object recognition, Training the vision system , Robotic applications 5hrs

Mobile robots**:** Introduction, Key issues for locomotion, Legged mobile robots, Leg configuration and stability, Types, Wheeled mobile robots, Path planning – configuration space, Road map path planning, Cell decomposition path planning, Obstacle avoidance-bug algorithm, Vector field histogram 5hrs

TEXT BOOKS :

1. M.P.Groover, M.Weiss, R.N.Nagel, N.G.Odrey Industrial Robotics Technology, programming and Applications.
2. K.S.Fu, R.C.Gonzalex, C.S.G.Lee: Robotics Control Sensing, Vision and Intelligence, McGraw Hill Book co.
3. Yoram Korean: Robotics for engineers, McGraw Hill Co.
4. Hartenberg and Denavit: Kinematics and Synthesis of linkages, McGraw Hill Book Co.

REFERENCE BOOKS:

1. Roland Siegwart & Illah R. Nourbakhsh: Introduction to Autonomous Mobile Robots, Prentice hall of India.
2. Sabrie Solomon: Sensors & control systems in manufacturing, McGraw Hill Professional Publishing.
3. John J. Craig: Introduction to Robotics, Mechanics & Control, Pearson Education Inc.
4. Mittal: Robotics, John Wiley

8.2.5 ASIC DESIGN AND FPGA

MODULE I

Introduction to ASIC: - Types of ASICs, Design flow and Economics of ASICs
Introduction to FPGA's, Design flow and FPGA economics 2hrs

Programmable Asics: - Antifuse, static RAM, EPROM and EEPROM technology, PREP benchmarks. 4hrs

Programmable ASIC Logic Cells:-Actel ACT -Xilinx LCA - Altera FLEX - Altera MAX 4hrs

MODULE II

Programmable ASIC I/O Cells: - DC output, CMOS complementary output buffer, AC output, A tri-state Bus, DC input, AC input, Metastability, Clock & Power inputs, Xilinx I/O blocks 3hrs

Programmable ASIC Interconnect:-Actel ACT -Xilinx LCA - Xilinx EPLD - Altera MAX 5000 and 7000 - Altera MAX 9000 – Altera FLEX 4hrs

Programmable ASIC Design Software:-Design systems, Logic Synthesis, Half gate ASIC 3hrs

MODULE III

Low Level Design Entry:-Schematic entry - Low level design language - PLA tools - EDIF- CFI design representation 3 hrs

Logic Synthesis: - VHDL and Verilog Synthesis, FSM synthesis. 3hrs

Simulation:-Types, Logic Systems, Cell Models, Delay Models, Static Timing analysis, Formal verification, Switch level and transistor level Simulation 4hrs

MODULE IV

ASIC Construction:- System partitioning, Estimating ASIC Size, Power Dissipation - FPGA partitioning - partitioning methods, Constructive and iterative partitioning, Kernighan-Lin Algorithm, Ratio-Cut Algorithm, Look Ahead algorithm 4hrs

Floor Planning and Placement:- Goals and objective, placement algorithms, Min-Cut algorithm, Eigen-value algorithm, Iterative placement improvement methods, physical design flow 3hrs

Routing: - global routing - detailed routing Left Edge Algorithm- special routing, Clock Routing, Power routing- circuit extraction - DRC. 3hrs

TEXTBOOK

1. M.J.S .Smith, - " Application - Specific Integrated Circuits " - Addison -Wesley Longman Inc.,1997

REFERENCE BOOKS

1. Charles W. Mckay, “Digital Circuits a proportion for microprocessors”, Prentice Hall
2. John F. Wakherly, “ Digital Design: Principles and Practices”, 2nd Edn 1994, Prentice Hall International Edn

8.2.6 MICROWAVE NETWORKS AND APPLICATIONS

MODULE I

Microwave network analysis: Impedance and equivalent voltage and currents, Impedance and admittance matrices, scattering matrix, transmission (ABCD) matrix 5 hours
Microwave Resonators: Series and parallel resonant circuits, transmission line resonators

5 hours

MODULE II

Power dividers and Directional couplers: Basic Properties, T-junction power divider, Wilkinson Power divider, Quadrature Hybrid, 180 degree hybrid 5 hours
Microwave filters: Periodic structures, filter design by image parameter method and insertion loss method, filter transformations. 5 hours

MODULE III

Ferromagnetic components**:** Ferrite isolators, Ferrite phase shifters, Ferrite Circulators -4 hours
Microwave Integrated Circuits**:** Planar transmission lines, lumped elements for MIC, substrates for MIC, Hybrid MIC, Monolithic MIC, Methods of Analysis of planar transmission lines: conformal transformation, variational approach. 6 hours

MODULE IV

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. 7 hours
Microwave systems: Wireless communication systems, radiometer systems, microwave heating, power transfer, biological effects and safety. 3 hours

TEXT BOOKS:

1. Microwave Engineering: David Pozar, Third edition, Wiley India
2. Antenna Theory: Analysis & Design: Constantine Balanis, Second Edition, Wiley India

REFERENCE BOOKS:

1. Striplinelike transmission lines for microwave integrated circuits: Bharathi Bhat, Shiban Koul, John Wiley and Sons
2. Computer aided design of Microwave circuits: K. C. Gupta, Rakesh chadha, Ramesh Garg, Artech House Publishers
3. Microstrip lines and slot lines: Prakash Bhartia, K. C. Gupta, Ramesh Garg, inder Bahl
4. Microwave integrated circuits: K. C. Gupta, Amarjit Singh

8.2.7 ERROR CONTROL CODING

MODULE I

Introduction to Algebra: Groups, Fields, Binary field arithmetic, basic properties of a galios field, Computations using galois field GF(2^m) Arithmetic, Vector spaces, matrices

(4 hrs)
Cyclic Codes: Description of cyclic codes, generator and parity check matrices of cyclic codes, Encoding of cyclic codes. (2 hrs)
Syndrome Computation and error Detection, decoding of cyclic codes. (2 hrs)
Cyclic Hamming Codes, Error- Trapping Decoding. (2 hrs)

MODULE II

Concatenated Coding, Code Decomposition, and Multistage Decoding:
Single-Level Concatenated Codes, Multilevel Concatenated Codes (3 hrs)
A soft-decision Multistage decoding, Decomposition of codes. (2 hrs)
Turbo Coding: Introduction to Turbo Coding (2 hrs)
Distance properties of Turbo Codes. (2 hrs)
Design of Turbo Codes. (1 hr)

MODULE III

Low-Density Parity-Check Codes: Introduction to LDPC Codes, tanner graphs for linear block Codes (2 hrs)
Geometric construction of LDPC codes, Decoding of LDPC Codes (3 hrs)
Code construction by row and column Splitting, breaking cycles in Tanner graphs. (2 hrs)
Construction of Gallager LDPC Codes, Random LDPC Codes, Irregular LDPC Codes

(2 hrs)
Construction of LDPC Codes based on balanced incomplete block designs (1 hr)

MODULE IV

Burst - Error- Correcting Codes:
Decoding of Single-Burst-Error-Correcting cyclic Codes, Single-Burst-Error-Correcting Codes. (3 hrs)
Phased-Burst-Error-Correcting Codes, Burst-and random-Error-Correcting Convolutional codes. (2 hrs)
Burst - Error- Correcting Convolutional Codes:
Bounds on Burst-Error-Correcting Capability, Burst-Error-Correcting Convolutional Codes. (2 hrs)
Interleaved Convolutional Codes, Burst-and-random-Error-Correcting Convolutional Codes. (3 hrs)

TEXT BOOK:

1. Error Control Coding- Fundamentals and Applications -- Shu Lin & Daniel J. Costello, Pearson/Prentice Hall, Second Edition.

REFERENCE BOOKS:

1. Error Control Coding : From Theory to Practice by Peter Sweeney, John Wiley & Sons Ltd.
2. Theory and Practice of Error Control Codes by Blahut, R.E Addison Wesley
3. Introduction to Error Control Codes by Alvatore Gravano, Oxford University Press
4. Fundamentals of Error Correcting Codes by W Cary Huffman & Vera Pless, Cambridge University Press
5. Mathematics of Coding Theory**:** Information**,** Compression**,** Error Correction**,** and Finite Fields by Paul Garrett, Prentice Hall
6. Error Correction Coding : Mathematical methods and Algorithms by Todd K Moon, John Wiley and Sons

8.3.1 ELECTRONIC COMMERCE

MODULE I

Introduction to Electronic Commerce, benefits and limitations, types of Electronic Commerce, reasons for going online, Internet and Networking technologies (3 hr)
Intranet and supply chain management: Supply chain management fundamentals, pull v/s push supply chain models (3 hrs)
Elements of supply chain management, integrating functions in a supply chain (2 hrs)
Electronic data interchange (EDI), benefits of EDI (2 hrs)

MODULE II

Security on the Internet, threats and challenges on the Internet (2 hrs)
Secret key encryption, public key encryption (2 hrs)
Authentication, digital signature, integrity (2 hrs)
Privacy on Internet, Public Key Infrastructure (PKI) (2 hrs)
Client based security, server based security (2 hrs)

MODULE III

HTML: Essential HTML, working with text, presenting and arranging text, working with images, links and lists, creating tables (2 hrs)
Working with frames, multimedia, style sheets, creating Forms and HTML controls (3 hrs)
JavaScript: Essential JavaScript, putting JavaScript to work. (2 hrs)

XML: Essential XML, Data Binding and record sets. (3 hrs)

MODULE IV

Electronic payment systems-Limitations of traditional payment instruments, digital cash, electronic cheques, online credit card based systems (3 hrs)

PayPal, SET (Secure Electronic Transaction) protocol, debit cards, smart cards, preventing double spending. (3 hrs)

Marketing strategies on the web, web design, attracting visitors, virtual societies, advertising (2 hrs)

One-to-one marketing, direct marketing, choosing ISP. (2 hrs)

TEXT BOOKS:

1. The e-Business (R) evolution by Daniel Amor, Pearson education
2. Electronic Commerce- A Manager's guide by Ravi Kalakota, Andrew Whinston, Pearson education
3. Web Commerce Technology Handbook by Daniel Minoli, Emma Minoli, TataMcGraw Hill

REFERENCE BOOKS:

1. Network Security-Private communication in public world by Charlie Kaufman, Radia Perlman, Mike Speliner, Pearson education
2. E-Commerce Strategy, Technologies and approaches by David Whiteley, TataMcGraw Hill
3. HTML-Black Book by Steven Holzner published by dreamTech Press

8.3.2 BIOMEDICAL ELECTRONICS AND INSTRUMENTATION

MODULE I

Nervous system: Nerve fibers, neuron system; heart potentials: bioelectric resting action; Electrodes: basic electrode theory, Nernst equation, biopotential electrodes, biochemical transducers, PH meter, blood gas electrode. (5 hrs)
Introduction to biosensors; Biomedical transducer: tissue blood flow-ultrasonic & laser Doppler, instrument design principles, calibration and standardization of laser Doppler. (5 hrs)

MODULE II

Measuring and monitoring systems: EEG, ECG, EMG with block diagrams,Vector cardiography, Holter monitoring.
Blood pressure monitoring: direct and indirect measurement; thermal array recorders; (5 hrs)
Patient monitoring system; spirometry;
Patient safety :Intensive care system, electric shock hazards,
leakage currents; testing instruments for checking safety parameters of biomedical electronic equipment, blood banking and transfusion medicine. (5 hrs)

MODULE III

Controller and stimulators: Electroneurography;
pacemakers: properties, lead wires and electrodes , synchronous pacemaker; (3 hrs)
Defibrillators:ac and dc ; eye and vision, ear and hearing. Audiometers, EOG ; Block diagram of Heart lung machine; (2 hrs)
surgical diathermy; microwave diathermy; laser therapy, physiotherapy and cryotheraphy. (3 hrs)
Biomedical telemetry:wireless,single channel,multi channel,multipatient.TDM &FDM radiometry. (2 hrs)

MODULE IV

Medical imaging equipments : x-rays ,CT scan ,MRI scan ,Ultrasonic imaging, medical thermography;endoscopy ,laproscopy. (4 hrs)
Nuclear medical imaging: Positron Emission Tomography(PET), Single Positron Emission computed tomography (SPECT), Handling precautions for radioisotopes and biomedical waste. (4 hrs)
Robotic application in medical field; Application of software for medical applications. (2 hrs)

TEXT BOOKS:

1. Biomedical instrumentation – R.S Khandpur.
2. Biomedical instrumentation –Leslie Cromwell.
3. Medical instrumentation – Application & Design– J.G Webster.
4. Systems approach to biomedicine-W.Blesser(McGraw Hill).

REFERENCE BOOKS:

1. Biomedical transducers and instruments-Tatsuo Togawa,Toshiyo Tamura, Ake Oberg.
2. Introduction to medical electronics-S.K Guha(Bharati Bhavan).
3. Biomedical telemetry- C.A Caceress(Academic press).
4. Principles of applied biomedical instrumentation-L. Graddes and L. Baker.
5. A Guide to Patient Care Technology: A Review of Medical Equipment (Hardcover)By Laurence J Street, Publisher: Taylor & Francis

8.3.3 DIGITAL IMAGE PROCESSING

MODULE I

Digital Image Fundamentals And Transforms:
Elements of visual perception – Image sampling and quantization, Basic relationship between pixels - Basic geometric transformations. (4 hrs)

Introduction to Fourier Transform and DFT – Properties of 2D Fourier Transform –

(3 hrs)
FFT – Separable Image Transforms -Walsh – Hadamard – Discrete Cosine Transform, Haar, Slant – Karhunen – Loeve transforms. (3 hrs)

MODULE II

Image Enhancement Techniques:
Spatial Domain methods: Basic grey level transformation – Histogram equalization – Image subtraction – Image averaging. (3 hrs)
Spatial filtering: Smoothing, sharpening filters – Laplacian filters – (4 hrs)
Frequency domain filters : Smoothing – Sharpening filters – Homomorphic filtering. (3 hrs)

MODULE III

Image Restoration:
Model of Image Degradation/restoration process – Noise models . (3 hrs)
Inverse filtering -Least mean square filtering – Constrained least mean square filtering (3 hrs)
Blind image restoration – Pseudo inverse – Singular value decomposition. (4 hrs)

MODULE IV

Image Compression: Lossless compression: Variable length coding – LZW coding – Bit plane coding- predictive coding-DPCM. (3 hrs)
Lossy Compression: Transform coding – Wavelet coding – Basics of Image compression standards: JPEG, MPEG,Basics of Vector quantization. (3 hrs)
Image Segmentation: Edge detection – Thresholding - Region Based segmentation – Boundary representation: chair codes- Polygonal approximation – Boundary segments – boundary descriptors: Simple descriptors-Fourier descriptors - Regional descriptors – Simple descriptors- Texture (4 hrs)

TEXT BOOK:

1. Rafael C Gonzalez, Richard E Woods 2nd Edition, Digital Image Processing - Pearson Education 2003.

REFERENCE BOOKS:

1. William K Pratt, Digital Image Processing John Willey (2001)
2. Image Processing Analysis and Machine Vision – Millman Sonka, Vaclav hlavac, Roger Boyle, Broos/colic, Thompson Learniy (1999).
3. A.K. Jain, PHI, New Delhi (1995)-Fundamentals of Digital Image Processing.
4. Chanda Dutta Magundar – Digital Image Processing and Applications, Prentice Hall of India, 2000

8.3.4 ELECTROMAGNETIC INTERFERENCE/ ELECTROMAGNETIC COMPATIBILITY

MODULE I

Introduction: Electromagnetic environment; concepts of EMI, EMC and definitions. (1 hour)
Practical experiences and concerns; frequency spectrum conservation. (1 hour)
Natural and nuclear sources of EMI: Celestial electromagnetic noise; lighting discharge; electrostatic discharge, (2 hours)
Electromagnetic pulse. EMI from apparatus and circuits: Electromagnetic emissions; noise from relays and switches; nonlinearities in circuits; (3 hours)
passive intermodulation. Cross-talk in transmission lines (1 hour)
transients in power supply lines, Electromagnetic interference. (2 hours)

MODULE II

Probabilistic and statistical physical models: Probability considerations; statistical physical models; modeling of interferences; statistical EMI/EMC models. (5hours)

Open-area test sites: Open-area test site measurements; measurement precautions; open area test site; terrain roughness; normalized site attenuation; measurement of test site imperfections; antenna factor measurement; measurement errors. (5 hours)

MODULE III

Radiated interference measurements: Anechoic chamber; transverse electromagnetic cell; reverberating chamber; Giga-hertz TEM cell; comparison of test facilities. Conducted interference measurements: Characterization of conduction currents/voltages conducted EM noise on power supply lines; conducted EMI from equipment. Immunity to conducted EMI; detectors and measurement. (5 hours)

Pulsed interference immunity: Pulsed EMI immunity; electrostatic discharge; electrical fast transients/burst; electrical surges. (2 hours)

Grounding, shielding & bonding: EMC technology; grounding; shielding; electrical bonding. EMI filters: Characteristics of filters; power line filter design; filter installation; filter evaluation. Cables, connectors and components : EMI suppression cables; EMC connectors; EMC gaskets; isolation transformers; opto-isolators; transientand surgg suppression devices. (3 hours)

MODULE IV

Frequency assignment and spectrum conservation: Frequency allocation and frequency assignment; modulation techniques; spectrum conservation. (5 hours)
EMC standards: Standards for EMI/EMC; MIL-STD-461/462; IEEE/ANSI standards; CISPR/IEC standards; FCC regulations; British standards; VDE standards; Euro norms; EMI/EMC standards in Japan; performance standards - some comparisons.(4 hours)
Special EMI Problems in Medical Electronics (1 hour)

TEXT BOOKS:

1. V Prasad Kodali: Engineering Electromagnetic Compatibility: Principles, Measurements and Technologies;S Chand & Co
2. William D. Kimmel & Daryl D. Gerke: Electromagnetic Compatibility in Medical Equipment: A Guide for Designers and Installers; (Interpharm Press or IEEE Press)

REFERENCE BOOKS:

1. Archambeault, Bruce R., Ramahi, Omar M., Brench, Colin: EMI/EMC Computational Modeling Handbook (2nd Edition); (The Springer International Series in Engineering and Computer Science)
2. William D. Kimmel & Daryl D. Gerke: EMI Suppression Handbook - Communiques from the Trenches; (Seven Mountains Scientific, Inc.)
3. Bruce R. Archambeault , James Drewniak: PCB Design for Real-World EMI Control; (The Springer International Series in Engineering and Computer Science)

8.3.5 ADHOC WIRELESS NETWORKS

MODULE I

Ad Hoc Networks:
Introduction, Issues in Ad hoc wireless networks, Ad hoc wireless internet. (1 hour)

MAC Protocols For Ad Hoc Wireless Networks:
Introduction, Issues in designing a MAC protocol for Ad hoc wireless Networks, Design goals of a MAC protocol for Ad hoc wireless Networks (4 hours)
Classification of MAC protocols, Contention based protocols with reservation mechanisms. (5 hours)

MODULE II

MAC protocols :
Contention - based MAC protocols with scheduling mechanism, MAC protocols that use directional antennas, Other MAC protocols. (4 hours)

Routing Protocols For Ad Hoc Wireless Networks:
Introduction, Issues in designing a routing protocol for Ad hoc wireless Networks (3 hours)

Classification of routing protocols, Table drive routing protocol, On demand routing protocol. (3 hours)

MODULE III

Routing Protocols :
Hybrid routing protocol, Routing protocols with effective flooding mechanisms, Hierarchical routing protocols, Power aware routing protocols. (4 hours)

Transport Layer Protocols For Ad Hoc Wireless Networks:
Introduction, Issues in designing a transport layer protocol for Ad hoc wireless Networks, Design goals of a transport layer protocol for Ad hoc wireless Networks. (3 hours)
Classification of transport layer solutions, TCP over Ad hoc wireless Networks, Other transport layer protocols for Ad hoc wireless Networks. (3 hours)

MODULE IV

Security:
Security in wireless Ad hoc wireless Networks, Network security requirements, Issues & challenges in security provisioning. (2 hours)
Network security attacks, Key management, Secure routing in Ad hoc wireless Networks. (3 hours)

Quality Of Service In Ad Hoc Wireless Networks:
Introduction, Issues and challenges in providing QoS in Ad hoc wireless Networks (2 hours)
Classification of QoS solutions, MAC layer solutions, network layer solutions. (3 hours)

TEXT BOOK:

1. **"**Adhoc Wireless Networks**"**, C. Siva Ram Murthy & B. S. Manoj, Pearson Education, 2nd Edition.

REFERENCE BOOKS:

1. **"**Adhoc wireless Networks**"**, Ozan K. Tonguz and Gianguigi Ferrari, Wiley
2. **"**Adhoc wireless Networking**"**, Xiuzhen Cheng, Xiao Hung, Ding-Zhu Du, Kluwer Academic Publishers.

8.3.6 GLOBAL SYSTEM FOR MOBILE COMMUNICATIONS

MODULE I

GSM Architecture And Interfaces:
Introduction, GSM frequency bands, GSM PLMN, Objectives of a GSM PLMN, GSM PLMN Services, GSM Subsystems (2 hours)
GSM Subsystems entities, GSM interfaces, The radio interface (MS to BSC), Abis interface (BTS to BSC), A interface (BSC to MSC), Interfaces between other GSM entities (2 hours)
Mapping of GSM layers onto OSI layers. (1 hour

Radio link features in GSM systems:
Introduction, Radio link measurements, Radio link features of GSM, Dynamic power control, Discontinuous transmission (DTX), SFH (3 hours)
Future techniques to reduce interface in GSM, Channel borrowing, Smart antenna. (2 hours)

MODULE II

GSM logical channels and frame structure:
Introduction, GSM logical channels, Allowed logical channel combinations, TCH multi frame for TCH/H, CCH multi frame, GSM frame structure. (3 hours)
GSM bursts, Normal burst, Synchronization burst, Frequency correction channel burst, Access burst, Data encryption in GSM, Mobility management, Location registration, Mobile identification. (3 hours)
Speech coding in GSM:
Introduction, Speech coding methods, Speech code attributes, Transmission bit rate, Delay, Complexity, Quality, LPAS, ITU-T standards, Bit rate (2 hours)
Waveform coding, Time domain waveform coding, Frequency domain waveform coding, Vocoders, Full-rate vocoder, Half-rate vocoder. (2 hours)

MODULE III

Messages, Services And Call Flows in GSM :
GSM messages, MS-BS interface, BS to MSC messages on the A interface, MSC to VLR and HLR, GSM call setup by an MS, Mobile-Terminated call, Call release, Handover. Data services. (3 hours)
Data services in GSM :
Introduction, Data internetworking, GSM data services, Interconnection for switched data, Group 3 fax, Packet data on the signaling channel, User-to-user signaling, SMS, GSM GPRS. (2 hours)

Privacy and security in GSM:
Introduction, Wireless security requirements, Privacy of communications, Authentication requirements, System lifetime requirements, Physical requirements, SIM cards (3 hours)
Security algorithms for GSM, Token-based authentication, Token-based registration, Token-based challenge. (2 hours)

MODULE IV

Planning and design of a GSM wireless network:
Introduction, Tele traffic models, Call model, Topology model, Mobility in cellular / PCS networks, Application of a fluid flow model, Planning of a wireless network. (2 hours)
Radio design for a cellular / PCS network, Radio link design, Coverage planning, Design of a wireless system, Service requirements, Constraints for hardware implementation, Propagation path loss, System requirements, Spectral efficiency of a wireless system, Receiver sensitivity and link budget, Selection of modulation scheme, Design of TDMA frame, Relationship between delay spread and symbol rate, Design example for a GSM system. (3 hours)

Management of GSM networks:
Introduction, Traditional approaches to NM, TMN, TMN layers, TMN nodes, TMN interface, TMN management services, Management requirements for wireless networks, Management of radio resources, Personal mobility management, Terminal mobility, Service mobility management, Platform-centered management, SNMP, OSI systems management. (3 hours)
NM interface and functionality, NMS functionality, OMC functionality, Management of GSM network, TMN applications, GSM information model, GSM containment tree. (2 hours)

TEXT BOOK:

1. **"**Principles of Applications of GSM**"**, Vijay K. Garg & Joseph E. Wilkes, Pearson education/ PHI, 1999.

REFERENCE BOOKS:

1. GSM: Evolution towards 3rd Generation Systems, (Editor), Z. Zvonar Peter Jung, Karl Kammerlander Springer; 1st edition 1998
2. GSM & UMTS: The Creation of Global Mobile Communication**,** Friedhelm Hillebrand, John Wiley & Sons; 2001.

8.3.7 MOBILE PHONE PROGRAMMING

MODULE I

Introduction to Mobile Phone Programming **:**
Evolution of Mobile Phones, Networks and Services, Wireless Technologies and Architecture, Mobile Application Deployment. (2 hour)

Python for Symbian Phones **:** Introduction, writing a Python script, A short python Syntax lesson, Overview of Python for S60 modules, Modules and How to program Python for S60 scripts, Creating Stand alone applications, Creating Python extensions in C++. (3 hours)

Symbian:
Introduction, Symbian OS in a nutshell, Wireless Communication Technologies (1 hour)

Windows Mobile Programming :
Introduction, .Net and C# in a Nutshell, .Net Compact Framework, Using the Windows Mobile Control, Network Functionality. (2 hour)

Service Discovery :
Service Discovery in Real Life, Service Discovery in Computer Networks (2 hour)

MODULE II

The Walkie Talkie Application :
Introduction, The Software, Bluetooth IP Integration. (2 hour)

Cooperative Wireless Networking:
Introduction , Challenges, Cooperative Principles in Wireless Networks, Cooperation in Heteregenous Networks. (2 hours)

Cross Layer Protocol Design for Wireless Communication:
Introduction, Crosslayer Protocol design, (1 hour)

Cross Layer Examples for Multimedia Services over Bluetooth:
Introduction, Adaptive Header Compression for Bluetooth (2 hours)

Convergence of Mobile Devices and Wireless Sensor Networks :
Introduction, Classification of Different Convergence forms, First Demonstrator (1 hour)

Using In-built RFID/NFC, Cameras, and 3D Accelerometers as Mobile Phone Sensors
Using RFID/NFC on Mobile Phones, Using Cameras on Mobile Phones, Motion Interfaces using 3D Sensors (2 hours)

MODULE III

Energy Efficiency of Video Decoder Implementations:
Introduction, Mobile Video Applications, Software Interfacing Issues (2 hours)

Optimizing Mobile Software with Built-in Power Profiling **:**
S60 Power Profiling Application, Carbide.c++ Power-Performance Profiling, Energy-Efficient Design Guidelines (3 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 (3 hours)

Android Development :Developing for Android, Developing for Mobile Devices, Android Development Tools (2 hours)

MODULE IV

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 (2 hours)

Intents, Broadcast Receivers, Adapters, and the Internet:
Introducing Intents, Introducing Adapters, Using Internet Resources, Introducing Dialogs, Creating an Earthquake Viewer (2 hours)

Data Storage, Retrieval, and Sharing :
Saving Simple Application Data, Saving and Loading Files, Databases in Android, Introducing Content Providers. (2 hours)

Maps, Geocoding, and Location-Based Services :
Using Location-Based Services, Setting up the Emulator with Test Providers, Finding Your Location, Using the Geocoder, Creating MapBased Activities, Mapping Earthquakes Example
(2 hours)

Peer-to-Peer Communication:
Introducing Android Instant Messaging, Introducing SMS (2 hours)

TEXT BOOKS :

1. Mobile Phone Programming and its Application to Wireless Networking by Frank H.P. Fitzek, Frank Reichert, Springer
2. Professional Android Application Development by Reto Meier, Wiley Publishing Inc.

REFERENCE BOOKS :

1. Android : A Programmer’s Guide by Jerome DiMarzio, McGraw Hill Inc.
2. Symbian OS C++ for Mobile Phones by Richard Harrison, John Wiley & Sons
3. Mobile Phone Programming by Saurabh Jain, BPB Publications
4. Mobile Phones and Mobile Communication by Rich Ling, Polity Press
5. Hello, Android: Introducing Google's Mobile Development Platform by Ed Burnett, Pragmatic Bookshelf
6. Android Application Development: Programming with the Google SDK by Rick Rogers, John Lombardo, Zigurd Mednieks, O'Reilly Media
7. Pro Android: Developing Mobile Applications for G1 and Other Google Phones by Sayed Y Hashimi, Satya Komatineni, Apress Publications

8. Android Essentials by Chris Haseman, Apress Publications

8.4 WIRELESS COMMUNICATION

MODULE I

Introduction to 2G, 2.5G and 3G Wireless Networks. 1 Hour

Three basic Propagation mechanism – reflection, diffraction and scattering. 2 Hours

Impulse response model of Multi path channel, Relationship between Bandwidth and received power. 2 Hours

Small scale multipath measurements, Rayleigh and Ricean Distribution. 1 Hour

Statistical models for multipath fading channels, Clarke's model for flat fading, Spectral shape due to Doppler spread. 2 Hours

Simulation of Clarke and Gans Fading model, Level crossing and Fading statistics, Two ray Raleigh fading model. 2 Hours

MODULE II

Equalization, Diversity and Channel coding, Training a generic adaptive equalizer, Equalizers in Communication receivers, Linear and non linear equalizers, Algorithms for adaptive equalizers. 3 Hours

Diversity techniques, Practical space diversity considerations, Polarization diversity, Interleaving. 2 Hours

Global System for Mobile Communications (GSM): GSM Services and Features, GSM System Architeture, GSM Radio Subsystem, GSM Channel types, Example of a GSM Call, Frame structure for GSM. 3 hours

CDMA Digital Cellular Standard : Frequency and Channel specifications, Forward CDMA Channel, Reverse CDMA Channel 2 hours

MODULE III

Wireless location and tracking using RFID technology: Elements of RFID system, RFID tags, Readers, Antennas and Radio, RFID network, Coupling range and Penetration, Circuit level Design of RFID systems. 4 Hours

Comparison of RFID with Bluetooth and Wi-Fi networks and Zig-Bee. 3 Hours

Implementation RFID in Pharmacy, Healthcare, Library and tracking livestock. Applications. 3 Hours

MODULE IV

Elements of Sensor network, Localization and Sensing models. 1 Hour

Acoustic amplitude sensor, DOA sensor, Performance comparison and Metrics. 1 Hour

Distributed Tracking, Tracking multiple objects, Media Access Control. 2 Hour

Geographic Energy aware routing, Unicast Geographic Routing, Planarizationg Routing Graph, Attribute based Routing, Directed Diffusion, Rumor Routing, Geographic Hash tables. 3 Hour

Ranging Techniques, Range based localization algorithms, Information based sensor tasking, Query, Sensor node hardware, Clustering, Time synchronization. Applications of sensor networks. 3 hours

TEXT BO**OKS :**

4. Wireless Communication Principals and Practice, Theodore Rappaport, Pearson Education.
5. RFID Application, Security and Privacy, Simson Garfienkel and Beth Rosenberg, Pearson Education.
6. Wireless Sensor Networks, An Information Processing Approach, Feng Zhao and Leonides Guibas, Elsevier.

REFERENCE BOOKS :

1. Fundamentals of **Wireless Communication**. David Tse and **Pramod Viswanath** · Cambridge University Press