

**ANNA UNIVERSITY COIMBATORE**

**FACULTY OF  
ELECTRONICS & COMMUNICATION  
ENGINEERING**

**BOARD OF STUDIES -ECE**

**M.E. COMMUNICATION SYSTEMS**

**CURRICULUM AND SYLLABI**

**I-IV SEMESTERS**

**REGULATIONS - 2007**

**ANNA UNIVERSITY COIMBATORE**  
**M.E. COMMUNICATION SYSTEMS**  
**CURRICULUM 2007 - FULL TIME MODE**  
**SEMESTER – I**

Code No.	Course Title	L	T	P	M
<b>Theory</b>					
	Applied Mathematics	3	1	0	100
	Advanced Digital Signal Processing	3	0	0	100
	Modern Digital Communication Techniques	3	0	0	100
	Optical Communication Networks	3	1	0	100
	Advanced Radiation Systems	3	0	0	100
	Satellite Communication	3	0	0	100
<b>Practical</b>					
	Communication System Lab I	0	0	4	100
	<b>Total</b>	18	2	4	-

**SEMESTER – II**

Code No.	Course Title	L	T	P	M
<b>Theory</b>					
	Mobile Communication Networks	3	1	0	100
	Multimedia Compression Techniques	3	0	0	100
	Microwave Integrated Circuits	3	1	0	100
	Elective I	3	0	0	100
	Elective II	3	0	0	100
	Elective III	3	0	0	100
<b>Practical</b>					
	Communication System Lab II	0	0	4	100
	<b>Total</b>	18	2	4	-

**SEMESTER – III**

Code No.	Course Title	L	T	P	M
<b>Theory</b>					
	Elective IV	3	0	0	100
	Elective V	3	0	0	100
	Elective VI	3	0	0	100
<b>Practical</b>					
	Project Work (Phase I)	0	0	12	200
	<b>Total</b>	9	0	12	-

**SEMESTER – IV**

Code No.	Course Title	L	T	P	M
	Project Work (Phase II)	0	0	24	400
	<b>Total</b>	0	0	24	-

**LIST OF ELECTIVES**  
**M.E. COMMUNICATION SYSTEMS**  
**SEMESTER II**

<b>Code No.</b>	<b>Course Title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>M</b>
	RF System Design	3	0	0	100
	Advanced Microwave Systems	3	0	0	100
	Communication protocol Engineering	3	0	0	100
	DSP Processor Architecture and programming	3	0	0	100
	Wavelets and Multi-resolution Processing	3	0	0	100
	Network Routing Algorithms	3	0	0	100
	Soft Computing	3	0	0	100
	Digital Communication Receivers	3	0	0	100
	Advanced Microprocessors and Microcontrollers	3	0	0	100
	Digital Image Processing	3	0	0	100
	Internetworking multimedia	3	0	0	100

**LIST OF ELECTIVES**  
**M.E. COMMUNICATION SYSTEMS**  
**SEMESTER III**

<b>Code No.</b>	<b>Course Title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>M</b>
	Electromagnetic Interference and Compatibility in System Design	3	0	0	100
	High Performance Communication Networks	3	0	0	100
	Embedded systems	3	0	0	100
	High Speed Switching Architecture	3	0	0	100
	Linear Algebra	3	0	0	100
	Simulation of Communication Systems and Networks	3	0	0	100
	Communication Network Security	3	0	0	100
	Speech and Audio Signal Processing	3	0	0	100
	Information Theory and Coding	3	0	0	100
	RF MEMS	3	0	0	100
	Special Elective	3	0	0	100

## SEMESTER I

### 07CO 101 APPLIED MATHEMATICS

3 1 0 100

#### UNIT I

#### LINEAR ALGEBRAIC EQUATION AND EIGEN VALUE PROBLEMS

9+3

System of equations- Solution by Gauss Elimination, Gauss-Jordan and LU decomposition method- Jacobi, Gauss-Seidal iteration method- Eigen values of a matrix by Jacobi and Power method.

#### UNIT II

#### WAVE EQUATION

9+3

Solution of initial and boundary value problems- Characteristics- D'Alembert's Solution - Significance of characteristic curves - Laplace transform solutions for displacement in a long string - a long string under its weight - a bar with prescribed force on one end- free vibrations of a string.

#### UNIT III

#### SPECIAL FUNCTIONS

9+3

Bessel's equation - Bessel Functions- Legendre's equation - Legendre polynomials -Rodrigue's formula - Recurrence relations- generating functions and orthogonal property for Bessel functions - Legendre polynomials.

#### UNIT IV

#### RANDOM VARIABLES

9+3

One dimensional Random Variable - Moments and MGF – Binomial, Poisson, Geometrical, Normal Distributions- Two dimensional Random Variables – Marginal and Conditional Distributions – Covariance and Correlation Coefficient - Functions of Two dimensional random variable

#### UNIT V

#### QUEUEING THEORY

9+3

Single and Multiple server Markovian queueing models - Steady state system size probabilities – Little's formula - Priority queues - M/G/1 queueing system – P.K. formula.

$$L + T = 45 + 15 = 60$$

#### REFERENCES:

1. Sankara Rao.K. "Introduction to Partial Differential Equation ", PHI, 1995.
2. Taha. H.A., "Operations Research- An Introduction " 6<sup>th</sup> Edition, PHI, 1997.
3. Jain M.K. Iyengar, S.R.K. & Jain R.K., "International Methods for Scientific and Engineering Computation", New Age International (P) Ltd, Publishers 2003..
4. Kanpur J.N. & Saxena. H.C. "Mathematical Statistics", S.Chand & Co.,New Delhi, 2003.
5. Greweal B.S. "Higher Engineering Mathematics", Khanna Publishers, 2005.

### 07CO102 ADVANCED DIGITAL SIGNAL PROCESSING

3 1 0 100

[Review of discrete-time signals and systems- DFT and FFT, Z-Transform, Digital Filters is recommended]

#### UNIT I

#### DISCRETE RANDOM SIGNAL PROCESSING

9

Discrete Random Processes- Ensemble averages, stationary processes, Autocorrelation and Auto covariance matrices. Parseval's Theorem, Wiener-Khintchine Relation- Power Spectral Density-

Periodogram, Spectral Factorization, Filtering random processes. Low Pass Filtering of White Noise. Parameter estimation: Bias and consistency.

**UNIT II** **9**  
**SPECTRUM ESTIMATION**

Estimation of spectra from finite duration signals, Non-Parametric Methods-Correlation Method , Periodogram Estimator, Performance Analysis of Estimators -Unbiased, Consistent Estimators- Modified periodogram, Bartlett and Welch methods, Blackman –Tukey method. Parametric Methods - AR, MA, ARMA model based spectral estimation. Parameter Estimation -Yule-Walker equations, solutions using Durbin’s algorithm

**UNIT III** **9**  
**LINEAR ESTIMATION AND PREDICTION**

Linear prediction- Forward and backward predictions, Solutions of the Normal equations- Levinson-Durbin algorithms. Least mean squared error criterion -Wiener filter for filtering and prediction , FIR Wiener filter and Wiener IIR filters ,Discrete Kalman filter

**UNIT IV** **9**  
**ADAPTIVE FILTERS**

FIR adaptive filters -adaptive filter based on steepest descent method-Widrow-Hoff LMS adaptive algorithm, Normalized LMS. Adaptive channel equalization-Adaptive echo cancellation-Adaptive noise cancellation- Adaptive recursive filters (IIR). RLS adaptive filters-Exponentially weighted RLS-sliding window RLS.

**UNIT V** **9**  
**MULTIRATE DIGITAL SIGNAL PROCESSING**

Mathematical description of change of sampling rate - Interpolation and Decimation , Decimation by an integer factor - Interpolation by an integer factor, Sampling rate conversion by a rational factor, Filter implementation for sampling rate conversion- Direct form FIR structures, Polyphase filter structures, time-variant structures. Multistage implementation of multirate system. Application to sub band coding - Wavelet transform and filter bank implementation of wavelet expansion of signals.

**L-45 T-15 Total-60**

**REFERENCES:**

1. Monson H.Hayes, Statistical Digital Signal Processing and Modeling, John Wiley and Sons, Inc.,Singapore, 2002.
2. John G.Proakis, Dimitris G.Manolakis, Digital Signal Processing Pearson Education, 2002.
3. John G.Proakis et.al.,’Algorithms for Statistical Signal Processing’, Pearson Education, 2002.
4. Dimitris G.Manolakis et.al.,’Statistical and adaptive signal Processing’, McGraw Hill, Newyork,2000.
5. Rafael C. Gonzalez, Richard E.Woods, ‘Digital Image Processing’, Pearson Education, Inc., Second Edition, 2004.( For Wavelet Transform Topic)

**07CO103 MODERN DIGITAL COMMUNICATION TECHNIQUES** **3 0 0 100**

**UNIT I** **9**  
**COHERENT AND NON-COHERENT COMMUNICATION:**

Coherent receivers – Optimum receivers in WGN – IQ modulation & demodulation – Noncoherent receivers in random phase channels; M-FSK receivers – Rayleigh and Rician channels – Partially coherent receives – DPSK; M-PSK; M-DPSK,-BER Performance Analysis.

**UNIT II** **9**  
**BANDLIMITED CHANNELS AND DIGITAL MODULATIONS:**

Eye pattern; demodulation in the presence of ISI and AWGN; Equalization techniques – IQ modulations; QPSK; QAM; QBOM; -BER Performance Analysis. – Continuous phase modulation; CPM; CPFSK; MSK, OFDM.

**UNIT III**

**9**

**BLOCK CODED DIGITAL COMMUNICATION:**

Architecture and performance – Binary block codes; Orthogonal; Biorthogonal; Transorthogonal – Shannon’s channel coding theorem; Channel capacity; Matched filter; Concepts of Spread spectrum communication – Coded BPSK and DPSK demodulators – Linear block codes; Hamming; Golay; Cyclic; BCH ; Reed – Solomon codes..

**UNIT IV**

**9**

**CONVOLUTIONAL CODED DIGITAL COMMUNICATION:**

Representation of codes using Polynomial, State diagram, Tree diagram, and Trellis diagram – Decoding techniques using Maximum likelihood, Viterbi algorithm, Sequential and Threshold methods – Error probability performance for BPSK and Viterbi algorithm, Turbo Coding.

**UNIT V**

**9**

**SPREAD SPECTRUM SIGNALS FOR DIGITAL COMMUNICATION**

Model of spread Spectrum Digital Communication System-Direct Sequence Spread Spectrum Signals, Error rate performance of the coder, Generation of PN Sequences- Frequency-Hopped Spread Spectrum Signals, Performance of FH Spread Spectrum Signals in an AWGN Channel- Synchronization of Spread Spectrum Systems.

**Total: 45**

**REFERENCES:**

1. M.K.Simon, S.M.Hinedi and W.C.Lindsey, Digital communication techniques; Signalling and detection, Prentice Hall India, New Delhi. 1995.
2. Simon Haykin, Digital communications, John Wiley and sons, 1998
3. Wayne Tomasi, Advanced electronic communication systems, 4<sup>th</sup> Edition Pearson Education Asia, 1998
4. B.P.Lathi Modern digital and analog communication systems, 3<sup>rd</sup> Edition, Oxford University press 1998.
5. John G. Proakis, Digital Communications, 4<sup>th</sup> Edition, McGraw-Hill, New york , 2001

**07CO104 OPTICAL COMMUNICATION NETWORKS**

**3 0 0 100**

**UNIT I**

**9**

**OPTICAL NETWORKING COMPONENTS:**

First- and second-generation optical networks, Components: couplers, isolators, circulators, multiplexers, filters, amplifiers, switches, and wavelength converters.

**UNIT II**

**9**

**SONET AND SDH NETWORKS:**

Integration of TDM signals, Layers, Framing, Transport overhead, Alarms, Multiplexing, Network elements, Topologies, Protection architectures, Ring architectures, Network Management.

**UNIT III**

**9**

**BROADCAST – AND- SELECT NETWORKS:**

Topologies, Single-hop, Multihop, and Shufflenet multihop networks, Media-Access control protocols, Test beds.

**UNIT IV****9****WAVELENGTH-ROUTING NETWORKS:**

Node designs, Issues in Network design and operation, Optical layer cost Tradeoffs, Routing and Wavelength assignment, Wavelength routing test beds.

**UNIT V****9****HIGH CAPACITY NETWORKS:**

SDM, TDM, and WDM approaches, Application areas, Optical TDM Networks: Multiplexing and demultiplexing, Synchronization, Broadcast networks, Switch-based networks, OTDM test beds.

**Total: 45****REFERENCES:**

1. Rajiv Ramaswami and Kumar Sivarajan, Optical Networks: A practical perspective, Morgan Kaufmann, 2<sup>nd</sup> edition, 2001.
2. Vivek Alwayn, Optical Network Design and Implementation, Pearson Education, 2004.
3. Hussein T.Mouftab and Pin-Han Ho, Optical Networks: Architecture and Survivability, Kluwer Academic Publishers, 2002.
4. Biswanath Mukherjee, Optical Communication Networks, McGraw Hill, 1997

**07CO105 ADVANCED RADIATION SYSTEMS****3 0 0 100****UNIT I****9****CONCEPTS OF RADIATION**

Retarded vector potentials – Heuristic approach and Maxwell’s equation approach. Electric vector potential  $F$  for a magnetic current source  $M$ . Duality theorem. The Lorentz gauge condition. Vector potential in Phasor form. Fields radiated by an alternating current element and half wave dipole. Total power radiated and radiation resistance of alternating current element and half wave dipole. Power radiated in the far field. Linear, Elliptical and circular polarization. Development of the Poincare sphere.

**UNIT II****9****ANTENNA ARRAYS**

$N$  element linear arrays – uniform amplitude and spacing- Phased arrays- Directivity of Broadside and End fire arrays. Three dimensional characteristics - Pattern multiplication- Binomial arrays and Dolph-Tchebycheff arrays. Circular array. Mutual coupling in arrays, multidimensional arrays- phased arrays and array feeding techniques.

**UNIT III****9****ANTENNA SYNTHESIS**

Synthesis problem-Line source based beam synthesis methods (Fourier transform and Woodward-Lawson sampling method – Linear array shaped beam synthesis method – Low side lobe, narrow main beam synthesis methods - discretization of continuous sources. Schelkunoff polynomial method

**UNIT IV****9****APERTURE ANTENNAS**

Radiation from apertures - Huygens Principle. Rectangular apertures- techniques for evaluating gain, Circular apertures and their design considerations- Babinet's principle Fraunhofer and Fresnel diffraction. Complimentary screens and slot antennas. Slot and dipoles as dual antennas. Fourier transform in aperture antenna theory.

**UNIT V****9****HORN, MICROSTRIP, REFLECTOR ANTENNAS.**

E and H plane sectoral Horns. Pyramidal horns. Conical and corrugated Horns. Multimode horns. Phase center.

Microstrip antennas – feeding methods. Rectangular patch- Transmission line model – Circular patch

Parabolic Reflector antennas – Prime focus and cassegrain reflectors. Equivalent focal length of Cassegrain antennas. Spillover and taper efficiencies. Optimum illumination.

**Total:45**

**REFERENCES:**

1. Balanis, C.A., “Antenna Theory” Wiley,2003
2. Warren L. Stutzman and Gary A. Thiele,“ Antenna theory and design”John Wiley and sons 1998
3. Jordan, E.C., “ Electromagnetic waves and Radiating systems”. PHI 2003
4. Krauss, J.D., “ Radio Astronomy” McGraw-Hill 1966, for the last unit (reprints available)
5. Krauss, J.D.,, Fleisch,D.A., “Electromagnetics” McGraw-Hill,1999

**07CO106 SATELLITE COMMUNICATION**

**3 0 0 100**

**UNIT I**

**9**

**ORBITAL MECHANICS**

Kepler's laws of motion, Orbits, Orbit Equations, Orbit Description, Locating the Satellite in the Orbit and with Respect to Earth, Orbital Elements-Look Angle Determination and Visibility - Orbital Perturbations, Orbit Determination, Launch Vehicles, Orbital Effects in Communication System - Performance Attitude control; Satellite launch vehicles. spectrum allocations for satellite systems.

**UNIT II**

**9**

**SPACECRAFT SUB SYSTEMS AND EARTH STATION**

Spacecraft Subsystems, Altitude and Orbit Control, Telemetry and Tracking, Power Systems, Communication Subsystems, Transponders, Antennas, Equipment Reliability, Earth Stations, Example of payloads of operating and planned systems.

**UNIT III**

**9**

**SPACE LINKS**

The Space Link, Satellite Link Design - Satellite uplink -down link power Budget, Basic Transmission Theory, System Noise Temp, G/T Ratio, Noise Figure, Downlink Design, Design of Satellite Links for Specified C/N - Microwave Propagation on Satellite-Earth Paths. Interference between satellite circuits, Energy Dispersal, propagation characteristics of fixed and mobile satellite links.

**UNIT IV**

**9**

**MULTIPLE ACCESS TECHNIQUES AND NETWORK ASPECTS**

Single access vs. multiple access (MA). Classical MA techniques: FDMA, TDMA. Single channel per carrier (SCPC) access - Code division multiple access (CDMA). Demand assignment techniques. Examples of MA techniques for existing and planned systems (e.g. the satellite component of UMTS). Mobile satellite network design, ATM via satellite. TCP/IP via satellite - Call control, handover and call set up procedures. Hybrid satellite-terrestrial networks

**UNIT V**

**9**

**SERVICES AND APPLICATIONS**

Fixed and mobile services - Multimedia satellite services - Advanced applications based on satellite platforms - INTELSAT series - INSAT, VSAT, Remote Sensing - Mobile satellite service: GSM. GPS, INMARSAT, Navigation System, Direct to Home service (DTH), Special services, E-mail, Video conferencing and Internet connectivity

**TOTAL : 45**

**REFERENCES:**

1. Dennis Roddy, “Satellite Communications”, 3rd Edition, Mc Graw Hill International Editions, 2001
2. Bruce R.Elbert, “Introduction to Satellite Communication” , Artech House Inc.,1999.
3. Timothy Pratt, Charles W. Bostian, Jeremy Allnutt, “Satellite Communications”, 2<sup>nd</sup> Edition, Wiley, John & Sons, 2002
4. Wilbur L.Pritchard, Hendri G.Snyderhood, Robert A.Nelson, “Satellite Communication Systems Engineering”, 2nd Edition, Prentice Hall, New Jersey, 1993
5. Tri T.Ha, "Digital satellite communication", 2nd Edition, McGraw Hill, New york.1990

**07CO107 COMMUNICATION SYSTEM LABORATORY I**

**0 0 4 100**

1. Antenna Radiation Pattern measurement.
2. Simulation of Modulation and Coding in a AWGN Communication Channel using Simulation Packages.
3. Implementation of Adaptive Filters, periodogram and multistage multirate system in DSP Processor
4. Performance evaluation of Digital Data Transmission through Fiber Optic Link.
5. Study of Spread Spectrum Techniques.
6. Simulation of QMF using Simulation Packages.
7. Implementation of Video Link using Optical Fiber.
8. Implementation of Linear and Cyclic Codes.

**SEMESTER II**

**07C201 MOBILE COMMUNICATION NETWORKS**

**3 1 0 100**

**UNIT I**

**9**

**OPERATION OF MOBILE COMMUNICATION NETWORKS**

Operation of first, second, and third generation wireless networks: cellular systems, medium access techniques, Mobile networks Elementary Principles of cellular Telephony Channel Division Techniques (TDMA, FDMA, CDMA) Cellular Coverage Methods Network Planning and Resource Allocation, Network Dimensioning ,Mobility Management Procedures

**UNIT II**

**9**

**PROPAGATION MODELS AND AIR PROTOCOLS**

Radio propagation models, error control techniques, handoff, power control, Soft handover, Forward link ,Reverse link , common air protocols (AMPS, IS-95, IS-136, GSM, GPRS, EDGE, WCDMA, cdma2000, etc)

**UNIT III**

**9**

**MOBILE NETWORK ARCHITECTURE**

General Architecture definition, Mobile Terminals (MT, SIM) Radio Section (BTS, BSC) Core Network (MSC, G-MSC, VLR, HLR, AuC) User and Control Plane Protocol Stack, MAP & SS#7, the Key Role of Signaling Interfaces and Network Entities Relation The Physical Channel, The Logical Channels Terminal, Call and Network Management Procedures, Network Planning.

**UNIT IV**

**9**

**WIRELESS LOCAL AREA NETWORKS**

Wireless Local Area Networks , General Characteristics of the Hyper LAN System, 802.11 Standard, Basic DCF access scheme DCF Access Scheme with Handshaking, PCF Access Scheme, The 802.11a Standard, Mobile Ad Hoc Networks, Wireless Sensor Networks, Routing Energy Efficiency, Localization, Clustering.

**UNIT V**

**9**

**SECURITY ISSUES IN WIRELESS NETWORKS**

Security in Wireless Networks, Secure routing, Key Pre-distribution and Management, Encryption and Authentication, Security in Group Communication, Trust Establishment and Management, Denial of

Service Attacks, Energy-aware security mechanisms, Location verification, Security on Data fusion.

**L-45 T-15 Total-60**

**REFERENCES:**

1. W. Stallings, "Wireless Communications and Networks", Second Edition Prentice Hall, 2007.
2. V.K. Garg, "IS-95 CDMA and CDMA 2000", Prentice Hall PTR, 2000.
3. T.S. Rappaport, "Wireless Communications: Principles & Practice", Second Edition, Prentice Hall, 2002.
4. Leon-Garcia and I. Widjaja, "Communication Networks, Fundamental Concepts and Key Architectures", McGraw-Hill, 2000.
5. J.Schiller, "Mobile Communications", Addison Wesley, 2000.
6. Fred Halsall, "Multimedia Communications, Applications, Networks, Protocols and Standards", Addison Wesley, 2001.
7. Uyles Black, "Mobile and Wireless Networks", Prentice Hall PTR, 1996.

**07CO202 MULTIMEDIA COMPRESSION TECHNIQUES**

**3 0 0 100**

**UNIT I**

**9**

**INTRODUCTION**

Special features of Multimedia – Graphics and Image Data Representations – Fundamental Concepts in Video and Digital Audio – Storage requirements for multimedia applications -Need for Compression - Taxonomy of compression techniques – Overview of source coding, source models, scalar and vector quantization theory – Evaluation techniques – Error analysis and methodologies

**UNIT II**

**9**

**TEXT COMPRESSION**

Compaction techniques – Huffmann coding – Adaptive Huffmann Coding – Arithmetic coding – Dictionary techniques – LZW family algorithms.

**UNIT III**

**9**

**AUDIO COMPRESSION**

Audio compression techniques -  $\mu$ - Law and A- Law companding. Frequency domain and filtering – Basic sub-band coding – Application to speech coding – G.722 – Application to audio coding – MPEG audio, progressive encoding for audio – Silence compression, speech compression techniques – Formant and CELP Vocoders

**UNIT IV**

**9**

**IMAGE COMPRESSION**

Predictive techniques – DM, PCM, DPCM: Optimal Predictors and Optimal Quantization– Transform Coding – JPEG Standard – Sub-band coding algorithms: Design of Filter banks – Wavelet based compression: Implementation using filters – EZW, SPIHT coders – JPEG 2000 standards.

**UNIT V**

**9**

**VIDEO COMPRESSION**

Video compression techniques and standards – MPEG Video Coding I: MPEG – 1 and 2 – MPEG Video Coding II: MPEG – 4 and 7 – Motion estimation and compensation techniques – H.261 Standard.

**Total: 45**

**REFERENCES:**

1. Khalid Sayood : Introduction to Data Compression, Morgan Kauffman Harcourt India, 2<sup>nd</sup> Edition, 2000.
2. David Salomon : Data Compression – The Complete Reference, Springer Verlag New York Inc., 2<sup>nd</sup> Edition, 2001.
3. Yun Q.Shi, Huifang Sun : Image and Video Compression for Multimedia Engineering - Fundamentals, Algorithms & Standards, CRC press, 2003.
4. Peter Symes : Digital Video Compression, McGraw Hill Pub., 2004.
5. Mark Nelson : Data compression, BPB Publishers, New Delhi, 1998.
6. Mark S.Drew, Ze-Nian Li : Fundamentals of Multimedia, PHI, 1<sup>st</sup> Edition, 2003.

7. Watkinson, J : Compression in Video and Audio, Focal press, London, 1995.
8. Jan Vozer : Video Compression for Multimedia, AP Profes, New York, 1995

**07CO203 MICROWAVE INTEGRATED CIRCUITS**

**3 1 0 100**

**UNIT I** **9**

**TECHNOLOGY OF HYBRID MICS**

Dielectric substrates - thick film technology and materials - thin film technology and materials – methods of testing – encapsulation of devices for MICs – mounting of active devices.

**UNIT II** **9**

**TECHNOLOGY OF MONOLITHIC MICS**

Processes involved in fabrication – epitaxial growth of semiconductor layer – growth of dielectric layer – diffusion-ion implantation – electron beam technology.

**UNIT III** **9**

**ANALYSIS OF MICROSTRIP LINE**

Methods of conformal transformation – numerical method for analysis – hybrid mode analysis – coupled mode analysis- method of images – losses in microstrips.

**UNIT IV** **9**

**COUPLED MICROSTRIPS, SLOT LINE AND COPLANAR WEGUIDES**

Coupled microstrips – even and odd mode analysis – microstrip directional couplers – branch line couplers – periodic branch line couplers – synchronous branch line couplers.

**UNIT V** **9**

**LUMPED ELEMENTS AND NON-RECIPROCAL COMPONENTS**

Design and fabrication using microstrips – flat resistors – flat inductors – interdigital capacitors – sandwich capacitors – ferromagnetic substrates for non-reciprocal devices – microstrip circulators – latching circulators – isolators – phase shifters.

**L-45 T-15 Total-60**

**REFERENCES:**

1. Gupta, K.C, and Amarjit singh – “Microwave Integrated Circuits” – John Wiley and sons – Wiley Eastern Reprint, 1978.
2. Hoffmann, R.K – “Handbook of Microwave Integrated Circuits” – Artech House, 1987.

**07CO204 COMMUNICATION SYSTEM LAB II**

**0 0 4 100**

1. Simulation of Audio and speech compression algorithms
2. Simulation of EZW / SPIHT Image coding algorithm.
3. Simulation of Microstrip Antennas
4. S-parameter estimation of Microwave devices.
5. Study of Global Positioning System.
6. Performance evaluation of simulated CDMA System.
7. Design and testing of a Microstrip coupler.
8. Characteristics of  $\lambda/4$  and  $\lambda/2$  transmission lines.

**LIST OF ELECTIVES  
SEMESTER II**

**07CO11 RF SYSTEM DESIGN**

**3 0 0 100**

**UNIT I** **9**

**RF ISSUES**

Importance of RF design, Electromagnetic Spectrum, RF behaviour of passive components, Chip components and Circuit Board considerations, Scattering Parameters, Smith Chart and applications.

<b>UNIT II</b>	<b>9</b>
<b>RF FILTER DESIGN</b>	
Overview , Basic resonator and filter configuration, Special filter realizations, Filter implementations, Coupled filter.	
<b>UNIT III</b>	<b>9</b>
<b>ACTIVE RF COMPONENTS &amp; APPLICATIONS</b>	
RF diodes, BJT, RF FETs, High electron mobility transistors; Matching and Biasing Networks – Impedance matching using discrete components, Microstripline matching networks, Amplifier classes of operation and biasing networks.	
<b>UNIT IV</b>	<b>9</b>
<b>RF AMPLIFIER DESIGNS</b>	
Characteristics, Amplifier power relations, Stability considerations, Constant gain circles, Constant VSWR circles, Low Noise circuits, Broadband , high power and multistage amplifiers.	
<b>UNIT V</b>	<b>9</b>
<b>OSCILLATORS, MIXERS &amp; APPLICATIONS</b>	
Basic Oscillator model, High frequency oscillator configuration, Basic characteristics of Mixers ; Phase Locked Loops ; RF directional couplers and hybrid couplers ; Detector and demodulator circuits.	

**Total: 45**

**REFERENCES:**

1. Reinhold Ludwig and Powel Bretchko, RF Circuit Design – Theory and Applications, Pearson Education Asia, First Edition, 2001.
2. Joseph . J. Carr, Secrets of RF Circuit Design , McGraw Hill Publishers, Third Edition, 2000.
3. Mathew M. Radmanesh, Radio Frequency & Microwave Electronics, Pearson Education Asia, Second Edition, 2002.
4. Ulrich L. Rohde and David P. NewKirk, RF / Microwave Circuit Design, John Wiley & Sons USA 2000.
5. Roland E. Best, Phase - Locked Loops : Design, simulation and applications, McGraw Hill Publishers 5<sup>TH</sup> edition 2003.

**07CO12 ADVANCED MICROWAVE SYSTEMS**

**3 0 0 100**

<b>UNIT I</b>	<b>9</b>
<b>FIELD ANALYSIS OF PLANAR TRANSMISSION LINES</b>	

Microstrip Transmission Lines – Attenuation – High frequency properties of Microstrip lines. Coupled Microstrip lines – even and odd modes. Strip transmission lines – Coupled strip lines – Fin lines.

<b>UNIT II</b>	<b>9</b>
<b>CIRCUIT THEORY FOR WAVE GUIDE SYSTEMS</b>	

Equivalent voltages and currents – Impedance description of waveguide elements and circuits – one port circuit. Foster’s reactance theorem. N-port circuits. Two port junctions. Excitation of waveguides. Probe coupling in rectangular waveguide. Radiation from linear current elements and current loops. Waveguide coupling by apertures.

<b>UNIT III</b>	<b>9</b>
<b>PERIODIC STRUCTURES AND FILTERS</b>	

Wave analysis of periodic structures. Periodic structures composed of Unsymmetrical two port networks. Terminated Periodic structures. Matching of Periodic structures. Floquet’s theorem and spatial Harmonics. Microwave Filters – Image parameter method. Filter design by insertion loss method. Low pass filter design. Microstrip parallel coupled filter.

<b>UNIT IV</b>	<b>9</b>
<b>MICROWAVE SOLID STATE AMPLIFIERS</b>	

S-parameters - Unilateral design of amplifiers – simultaneous conjugate match. Bilateral design of amplifiers. Amplifier stability. Conditional and unconditional stability criteria. Amplifier power gain. Constant gain circles. Noise temperature concept. Noise factor and noise figure. Noise temperature for

cascaded stages. Constant noise figure circles. Design of single stage microwave amplifiers.

#### **UNIT V**

**9**

#### **MICROWAVES AND OPTICS**

Geometrical optics as a limiting case of wave optics. Ray matrices for paraxial ray optics. Gaussian beams. Generation of Gaussian beams at microwave frequencies. The beam waist. Propagation of Gaussian beams in Homogeneous medium. Transformation of Gaussian beams with lenses.

**TOTAL : 45**

#### **REFERENCES**

1. R.E.Collin, "Foundations for Microwave Engineering", McGraw-Hill, 1992.
2. Ramo, Whinnery and Van Duzer : "Fields and Waves in communication electronics". 3<sup>rd</sup> Edition., Wiley, 1997.
3. David M Pozar," Microwave Engineering", John Wiley & Sons Inc, 2004

### **07CO13 COMMUNICATION PROTOCOL ENGINEERING 3 0 0 100**

#### **UNIT I**

**9**

#### **NETWORK REFERENCE MODEL**

Communication model-software, subsystems, protocol, protocol development methods, Protocol engineering process, Layered architecture, Network services and Interfaces, Protocol functions, OSI model ,TCP/IP protocol suite

#### **UNIT II**

**9**

#### **PROTOCOL SPECIFICATIONS**

Components of protocol, Specifications of Communication service, Protocol entity, Interface, Interactions, Multimedia protocol, Internet protocol, SDL, SDL based protocol- other protocol specification languages

#### **UNIT III**

**9**

#### **PROTOCOL VERIFICATION/VALIDATION**

Protocol verification, Verification of a protocol using finite state machines, Protocol validation, protocol design errors, Protocol validation approaches, SDL based protocol verification and validation

#### **UNIT IV**

**9**

#### **PROTOCOL CONFORMANCE/PERFORMANCE TESTING**

Conformance testing methodology and frame work, Conformance test architectures, Test sequence generation methods, Distributed architecture by local methods, Conformance testing with TTCN, systems with semi controllable interfaces - RIP,SDL based tools for conformance testing, SDL based conformance testing of MPLS Performance testing, SDL based performance testing of TCP and OSPF, Interoperability testing, SDL based interoperability testing of CSMA/CD and CSMA/CA protocol using Bridge, Scalability testing

#### **UNIT V**

**9**

#### **PROTOCOL SYNTHESIS AND IMPLEMENTATION**

Protocol synthesis, Interactive synthesis algorithm, Automatic synthesis algorithm, Automatic synthesis of SDL from MSC, Protocol Re-synthesis; Requirements of protocol implementation, Object based approach to protocol implementation, Protocol compilers, Tool for protocol engineering

**TOTAL : 45**

#### **REFERENCES:**

1. Pallapa Venkataram and Sunilkumar S.Manvi, "Communication protocol Engineering", Eastern Economy edition, 2004
2. Richard Lai and Jirachiefpattana, "Communication Protocol Specification and Verification", Kluwer Publishers, Boston, 1998.
3. Tarnay, K., "Protocol Specification and Testing", Plenum, New York, 1991.
4. Mohamed G. Gouda, "Elements of Network Protocol Design", John Wiley & Sons, Inc. New York, USA, 1998
5. V.Ahuja, "Design and Analysis of Computer Communication networks", McGraw-Hill, London, 1982.
6. G.J.Holtzmann, "Design and validation of Computer protocols", Prentice Hall, New York, 1991.

**07CO14 DSP PROCESSOR ARCHITECTURE AND PROGRAMMING 3 0 0 100**  
**UNIT I** 9  
**FUNDAMENTALS OF PROGRAMMABLE DSPs**

Multiplier and Multiplier accumulator (MAC) – Modified Bus Structures and Memory access in Programmable DSPs – Multiple access memory – Multi-port memory – VLIW architecture- Pipelining – Special Addressing modes in P-DSPs – On chip Peripherals.

**UNIT II** 9  
**TMS320C3X PROCESSOR**

Architecture – Data formats - Addressing modes – Groups of addressing modes- Instruction sets - Operation – Block Diagram of DSP starter kit – Application Programs for processing real time signals – Generating and finding the sum of series, Convolution of two sequences, Filter design

**UNIT III** 9  
**ADSP PROCESSORS**

Architecture of ADSP-21XX and ADSP-210XX series of DSP processors- Addressing modes and assembly language instructions – Application programs –Filter design, FFT calculation.

**UNIT IV** 9  
**ADVANCED PROCESSORS I**

Architecture of TMS320C54X: Pipe line operation, Addressing modes and assembly language instructions  
Introduction to Code Composer studio

**UNIT V** 9  
**ADVANCED PROCESSORS II**

Architecture of TMS320C6X - Architecture of Motorola DSP563XX – Comparison of the features of DSP family processors.

**TOTAL : 45**

**REFERENCES**

1. B.Venkataramani and M.Bhaskar, “Digital Signal Processors – Architecture, Programming and Applications” – Tata McGraw – Hill Publishing Company Limited. New Delhi, 2003.
2. User guides Texas Instrumentation, Analog Devices, Motorola.

**07CO15 WAVELETS AND MUTIRESOLUTION PROCESSING 3 0 0 100**

**UNIT I** 9  
**INTRODUCTION**

Vector Spaces - properties - dot product - basis - dimension, orthogonality and orthonormality - relationship between vectors and signals - Signal spaces - concept of Convergence - Generalised Fourier Expansion.

**UNIT II** 9  
**MULTI RESOLUTION ANALYSIS**

Definition of Multi Resolution Analysis (MRA) – Haar basis - Construction of general orthonormal MRA-Wavelet basis– Continuous time MRA interpretation for the DTWT – Discrete time MRA- Basis functions for the DTWT – PR-QMF filter banks

**UNIT III** 9  
**CONTINUOUS WAVELET TRANSFORM**

Wavelet Transform - definition and properties - concept of scale and its relation with frequency - Continuous Wavelet Transform (CWT) - Scaling function and wavelet functions (Daubechies, Coiflet, Mexican Hat, Sinc, Gaussian, Bi-Orthogonal) - Tiling of time-scale plane for CWT.

**UNIT IV** 9  
**DISCRETE WAVELET TRANSFORM**

Filter Bank and sub band coding principles - Wavelet Filters - Inverse DWT computation by Filter banks -Basic Properties of Filter coefficients - Choice of wavelet function coefficients - Derivations of

**UNIT V**

**9**

**APPLICATIONS**

Signal Compression – Image Compression techniques: EZW-SPHIT Coding - Image denoising techniques: Noise estimation - Shrinkage rules -. Shrinkage Functions - Edge detection and object Isolation, Image Fusion, and Object Detection.

**TOTAL : 45**

**REFERENCES**

1. Rao .R.M and A.S.Bopardikar, "Wavelet Transforms: Introduction to theory and Applications", Pearson Education Asia Pte. Ltd., 2000.
2. Strang G, Nguyen T, "Wavelets and Filter Banks," Wellesley Cambridge Press, 1996
3. Vetterli M, Kovacevic J., "Wavelets and Sub-band Coding," Prentice Hall, 1995
4. Mallat S., "Wavelet tour of Signal Processing", Academic Press, 1996
5. David C.Lay., "Linear Algebra and its applications" Pearson education, 2007.(Unit I only)

**07CO16 NETWORK ROUTING ALGORITHMS**

**3 0 0 100**

**UNIT I**

**9**

**CIRCUIT SWITCHING NETWORKS**

AT & T's Dynamic Routing Network, Routing in Telephone Network-Dynamic Non Hierarchical Routing-Trunk Status Map Routing-Real Time Network Routing, Dynamic Alternative Routing-Distributed Adaptive Dynamic Routing-Optimized Dynamic Routing

**UNIT II**

**9**

**PACKET SWITCHING NETWORKS**

Distance vector Routing, Link State Routing, Inter domain Routing-Classless Interdomain routing (CIDR), Interior Gateway routing protocols (IGRP) - Routing Information Protocol (RIP), Open Shortest Path First (OSPF), Exterior Gateway Routing Protocol (EGRP) - Border Gateway Protocol (BGP), Apple Talk Routing and SNA Routing

**UNIT III**

**9**

**HIGH SPEED NETWORKS**

Routing in optical networks-The optical layer, Node Designs, Network design and operation, Optical layer cost tradeoffs, Routing and wavelength assignment, Architectural variations, Routing in ATM networks-ATM address structure, ATM Routing, PNNI protocol, PNNI signaling protocol, Routing in the PLANET network and Deflection Routing.

**UNIT IV**

**9**

**MOBILE NETWORKS**

Routing in Cellular Mobile Radio Communication networks-Mobile Network Architecture, Mobility management in cellular systems, Connectionless Data service for cellular systems, Mobility and Routing in Cellular Digital Packet Data (CDPD) network, Packet Radio Routing-DARPA packet radio network, Routing algorithms for small, medium and large sized packet radio networks.

**UNIT V**

**9**

**MOBILE AD-HOC NETWORKS (Manet)**

Internet based mobile ad-hoc networking, communication strategies, routing algorithms – Table-driven routing - Destination Sequenced Distance Vector (DSDV), Source initiated on-demand routing- Dynamic Source Routing (DSR), Ad-hoc On- demand Distance Vector (AODV), Hierarchical based routing- Cluster head Gateway Switch Routing (CGSR) and Temporally-Ordered Routing Algorithm (TORA), Quality of Service.

**TOTAL : 45**

**REFERENCES**

1. M. Steen strub, "Routing in Communication networks", Prentice Hall International, NewYork, 1995.
2. "Internetworking Technologies Handbook", Fourth Edition, Inc. Cisco Systems, ILSG Cisco Systems, 2003.
3. William Stallings, "ISDN and Broadband ISDN with Frame Relay and ATM", PHI, New Delhi, 2004.

4. Behrouz A Forouzan, "Data Communications and Networking (3/e), TMH, 2004
5. William Stallings, "High Speed Networks TCP/IP and ATM Design Principles", Prentice Hall International, New York, 1998.
6. Mohammad Ilyas, "The Handbook of Ad hoc Wireless Networks" CRC Press, 2002.
7. Vijay K.Garg, "Wireless Network Evolution: 2G to 3G", Pearson Education, New Delhi, India, 2003.
8. Rajiv Ramaswami and Kumar N.Sivarajan, "Optical Networks",Morgan Kaufmann Publishers,1998.
9. Sumit Kasera and Pankaj sethi, "ATM Networks", Tata McGraw-Hill Publishing Company limited, New Delhi,2001.
10. IEEE Journal on Selected Areas in Communications, Special issue on Wireless Ad-hoc Networks, Vol. 17, No.8, 1999.
11. Scott. M. Corson, Joseph P. Macker, Gregory H. Cirincione, IEEE Internet Computing Vol.3, No. 4, July – August 1999.
12. Alder M.Scheideler.Ch. Annual ACM Symposium on Parallel Algorithms and Architectures, ACM, NewYork 1998.
13. [http://www.cisco.com/univercd/cc/td/doc/cisintwk/ito\\_doc/](http://www.cisco.com/univercd/cc/td/doc/cisintwk/ito_doc/)
14. [www.moment.cs.ucsb.edu](http://www.moment.cs.ucsb.edu)

## **07CO17 SOFT COMPUTING**

**3 0 0 100**

### **UNIT I**

**9**

#### **ARTIFICIAL NEURAL NETWORKS**

Basic concepts-single layer perceptron-Multi layer perceptron-Adaline-Madaline-Learning rules-Supervised learning-Back propagation networks-Training algorithm, Practical difficulties, Advanced algorithms-Adaptive network- Radial basis network-modular network-Applications

### **UNIT II**

**9**

#### **UNSUPERVISED NETWORKS**

Introduction- unsupervised learning -Competitive learning networks-Kohonen self organising networks-Learning vector quantisation - Hebbian learning - Hopfield network-Content addressable nature, Binary Hopfield network, Continuous Hopfield network Traveling Salesperson problem - Adaptive resonance theory –Bidirectional Associative Memory-Principle component Analysis

### **UNIT III**

**9**

#### **FUZZY SYSTEMS**

Fuzzy sets-Fuzzy rules: Extension principle, Fuzzy relation- fuzzy reasoning – fuzzy inference systems: Mamdani model, Sugeno model. Tsukamoto model -Fuzzy decision making- Multiobjective Decision Making,-Fuzzy classification-Fuzzy control methods -Application

### **UNIT IV**

**9**

#### **NEURO-FUZZY MODELLING**

Adaptive Neuro Fuzzy based inference systems – classification and regression trees: decision trees, Cart algorithm – Data clustering algorithms: K means clustering, Fuzzy C means clustering, Mountain clustering, Subtractive clustering – rule base structure identification – Neuro fuzzy control: Feedback Control Systems, Expert Control, Inverse Learning, Specialized Learning, Back propagation through Real – Time Recurrent Learning.

### **UNIT V**

**9**

#### **GENETIC ALGORITHM**

Fundamentals of genetic algorithm-Mathematical foundations-Genetic modeling-Survival of the fittest-crossover-Inversion and Deletion-mutation-reproduction-Generational cycle-rank method-rank space method- Other derivative free optimization-simulated annealing, Random search, Downhill simplex search-Application

**TOTAL : 45**

## **REFERENCES**

1. Jang J.S.R.,Sun C.T and Mizutani E – "Neuro Fuzzy and Soft computing", Pearson education (Singapore) 2004
2. David E.Goldberg : "Genetic Algorithms in Search, Optimization, and Machine Learning", Pearson Education, Asia,1996
3. Laurene Fauseett:"Fundamentals of Neural Networks", Prentice Hall India, New Delhi,1994.

4. Timothy J.Ross:"Fuzzy Logic Engineering Applications", McGrawHill, NewYork,1997.
5. S.Rajasekaran and G.A.Vijayalakshmi Pai "Neural networks,Fuzzy logics,and Genetic algorithms", Prentice Hall of India,2003
6. George J.Klir and Bo Yuan,"Fuzzy Sets and Fuzzy Logic",Prentice Hall Inc., New Jersey,1995

## **07CO18 DIGITAL COMMUNICATION RECEIVERS**

**3 0 0 100**

### **UNIT I**

**9**

#### **REVIEW OF DIGITAL COMMUNICATION TECHNIQUES**

Base band and band pass communication, signal space representation, linear and non- linear modulation techniques, and spectral characteristics of digital modulation.

### **UNIT II**

**9**

#### **OPTIMUM RECEIVERS FOR AWGN CHANNEL**

Correlation demodulator, matched filter, maximum likelihood sequence detector, Optimum receiver for CPM signals, M-ary orthogonal signals, envelope detectors for M-ary and correlated binary signals.

### **UNIT III**

**9**

#### **RECEIVERS FOR FADING CHANNELS**

Characterization of fading multiple channels, statistical models, slow fading, frequency selective fading, diversity technique, RAKE demodulator, coded waveform for fading channel

### **UNIT IV**

**9**

#### **SYNCHRONIZATION TECHNIQUES**

Carrier and symbol synchronization, carrier phase estimation – PLL, Decision directed loops, symbol timing estimation, maximum likelihood and non-decision directed timing estimation, joint estimation.

### **UNIT V**

**9**

#### **ADAPTIVE EQUALIZATION**

Zero forcing algorithm, LMS algorithm, Adaptive decision – feedback equalizer, and equalization of Trellis-coded signals, Kalman algorithm, blind equalizers, and stochastic gradient algorithm, Echo cancellation

**TOTAL : 45**

### **REFERENCES**

1. Heinrich Meyer, Mare Moeneclacy and Stefan.A. Fechtel, "Digital Communication Receivers", Vol I & II, John Wiley, New York, 1997
2. John. G Proakis, "Digital Communication", 4<sup>th</sup> ed., McGraw Hill, New York, 2001
3. E.A. Lee and D.G. Messerschmitt, "Digital Communication", 2<sup>nd</sup> edition, Allied Publishers, New Delhi, 1994
4. Simon Marvin, "Digital Communication Over Fading channel; An unified approach to performance Analysis", John Wiley, New York, 2000
5. Bernard Sklar, "Digital Communication Fundamentals and Applications, Prentice Hall, 1998

## **07CO19 ADVANCED MICROPROCESSORS AND MICRO CONTROLLERS**

**3 0 0 100**

### **UNIT I**

**9**

#### **MICROPROCESSOR ARCHITECTURE**

Instruction set – Data formats – Instruction formats – Addressing modes – Memory hierarchy – register file – Cache – Virtual memory and paging – Segmentation – Pipelining – The instruction pipeline – pipeline hazards – Instruction level parallelism – reduced instruction set – Computer principles – RISC versus CISC – RISC properties – RISC evaluation – On-chip register files versus cache evaluation

### **UNIT II**

**9**

#### **HIGH PERFORMANCE CISC ARCHITECTURE – PENTIUM**

The software model – functional description – CPU pin descriptions – RISC concepts – bus operations – Super scalar architecture – pipe lining – Branch prediction – The instruction and caches – Floating point unit –protected mode operation – Segmentation – paging – Protection – multitasking – Exception and interrupts – Input /Output – Virtual 8086 model – Interrupt processing -Instruction types – Addressing modes – Processor flags – Instruction set -programming the Pentium processor.

<b>UNIT III</b>	<b>9</b>
<b>HIGH PERFORMANCE RISC ARCHITECTURE :ARM</b>	
The ARM architecture – ARM assembly language program – ARM organization and implementation – The ARM instruction set - The thumb instruction set – ARM CPU cores.	
<b>UNIT IV</b>	<b>9</b>
<b>MOTOROLA 68HC11 MICROCONTROLLERS</b>	
Instructions and addressing modes – operating modes – Hardware reset – Interrupt system – Parallel I/O ports – Flags – Real time clock – Programmable timer – pulse accumulator – serial communication interface – A/D converter – hardware expansion – Assembly language Programming	
<b>UNIT V</b>	<b>9</b>
<b>PIC MICRO CONTROLLER</b>	
CPU architecture – Instruction set - Interrupts – Timers – I/O port expansion – I <sup>2</sup> C bus for peripheral chip access – A/D converter – UART	

**Total: 45**

**REFERENCES :**

1. Daniel Tabak , “ Advanced Microprocessors” McGraw Hill.Inc., 1995
  2. James L. Antonakos, “The Pentium Microprocessor “ Pearson Education, 1997.
  3. Steve Furber, ‘ ARM System –On –Chip architecture “Addison Wesley, 2000.
  4. Gene .H.Miller.” Micro Computer Engineering,” Pearson Education, 2003.
  5. John .B.Peatman, “Design with PIC Microcontroller, Prentice hall, 1997.
  6. James L.Antonakos,” An Introduction to the Intel family of Microprocessors “ Pearson Education 1999.
  7. Barry.B.Breg,” The Intel Microprocessors Architecture , Programming and Interfacing “, PHI, 2002.
  8. Valvano "Embedded Microcomputer Systems" Thomson Asia PVT LTD first reprint 2001
- Readings :
- Web links  
[www.ocw.nit.edu](http://www.ocw.nit.edu)  
[www.arm.com](http://www.arm.com)

**07CO20 DIGITAL IMAGE PROCESSING 3 0 0 100**

<b>UNIT I</b>	<b>9</b>
<b>DIGITAL IMAGE FUNDAMENTALS</b>	
Elements of digital image processing systems, Elements of visual perception, psycho visual model, brightness, contrast, hue, saturation, mach band effect, Color image fundamentals -RGB,HSI models, Image acquisition and sampling, Quantization, Image file formats, Two-dimensional convolution, correlation, and frequency responses.	
<b>UNIT II</b>	<b>9</b>
<b>IMAGE TRANSFORMS</b>	
1D DFT, 2D transforms – DFT, DCT, Discrete Sine, Walsh, Hadamard, Slant, Haar, KLT, SVD, Radon, and Wavelet Transform.	
<b>UNIT III</b>	<b>9</b>
<b>IMAGE ENHANCEMENT AND RESTORATION</b>	
Histogram modification and specification techniques, Noise distributions, Spatial averaging, Directional Smoothing, Median, Geometric mean, Harmonic mean, Contra harmonic filters, Homomorphic filtering, Color image enhancement. Image Restoration – degradation model, Unconstrained and Constrained restoration, Inverse filtering, Wiener filtering, Geometric transformations – spatial transformations, Gray-Level interpolation,	
<b>UNIT IV</b>	<b>9</b>
<b>IMAGE SEGMENTATION AND RECOGNITION</b>	
Edge detection. Image segmentation by region growing, region splitting and merging, edge linking, Morphological operators: dilation, erosion, opening, and closing. Image Recognition – Patterns and pattern	

classes, matching by minimum distance classifier, Statistical Classifier. Matching by correlation, Neural network application for image recognition.

#### **UNIT V**

**9**

##### **IMAGE COMPRESSION**

Need for image compression, Huffman, Run Length Encoding, Arithmetic coding, Vector Quantization, Block Truncation Coding. Transform Coding – DCT and Wavelet. Image compression standards.

**Total: 45**

#### **REFERENCES:**

1. Rafael C. Gonzalez, Richard E.Woods, 'Digital Image Processing', Pearson Education, Inc., Second Edition, 2004.
2. Anil K. Jain, 'Fundamentals of Digital Image Processing', Prentice Hall of India, 2002.
3. David Salomon : Data Compression – The Complete Reference, Springer Verlag New York Inc., 2<sup>nd</sup> Edition, 2001
4. Rafael C. Gonzalez, Richard E.Woods, Steven Eddins, ' Digital Image Processing using MATLAB', Pearson Education, Inc., 2004.
5. William K.Pratt, ' Digital Image Processing', John Wiley, NewYork, 2002.
6. Milman Sonka, Vaclav Hlavac, Roger Boyle, 'Image Processing, Analysis, and Machine Vision', Brooks/Cole, Vikas Publishing House, II ed., 1999.
7. Sid Ahmed, M.A., 'Image Processing Theory, Algorithms and Architectures', McGrawHill, 1995.
8. Lim, J.S., 'Two Dimensional Signal and Image Processing', Prentice-Hall, New Jersey, 1990.

#### **07CO21 INTERNETWORKING MULTIMEDIA**

**3 0 0 100**

#### **UNIT I**

**9**

##### **MULTIMEDIA NETWORKING**

Digital sound, video and graphics, basic multimedia networking, multimedia characteristics, evolution of Internet services model, network requirements for audio/ video transform, multimedia coding and compression for text, image, audio and video.

#### **UNIT II**

**9**

##### **BROADBAND NETWORK TECHNOLOGY**

Broadband services, ATM and IP, IPV6, High speed switching, resource reservation, Buffer management, traffic shaping, caching, scheduling, and policing, throughput, delay and jitter performance. Storage and media services, voice and video over IP, MPEG-2 over ATM/IP, indexing synchronization of requests, recording and remote control.

#### **UNIT III**

**9**

##### **RELIABLE TRANSPORT PROTOCOL AND APPLICATIONS**

Multicast over shared media network, multicast routing and addressing, scaling multicast and NBMA networks, Reliable transport protocols, TCP adaptation algorithm, RTP, RTCP. MIME, Peer- to-Peer computing, shared application, video conferencing, centralized and distributed conference control, distributed virtual reality, light weight session philosophy.

#### **UNIT IV**

**9**

##### **MULTIMEDIA COMMUNICATION STANDARDS**

Objective of MPEG- 7 standard, Functionalities and systems of MPEG-7, MPEG-21 Multimedia Framework Architecture, - Content representation, Content Management and usage, Intellectual property management, Audio visual system- H322: Guaranteed QOS LAN systems; MPEG\_4 video Transport across internet.

#### **UNIT V**

**9**

##### **MULTIMEDIA COMMUNICATION ACROSS NETWORKS**

Packet Audio/video in the network environment, video transport across Generic networks- Layered video coding, error Resilient video coding techniques, Scalable Rate control, Streaming video across Internet, Multimedia transport across ATM networks and IP network, Multimedia across wireless networks.

**REFERENCES**

1. Jon Crowcroft, Mark Handley, Ian Wakeman, Internetworking Multimedia, Harcourt Asia Pvt. Ltd. Singapore, 1998.
2. B.O. Szuprowicz, Multimedia Networking, McGraw Hill, Newyork. 1995.
3. Tay Vaughan, Multimedia - Making it to work, 4ed, Tata McGraw Hill , NewDelhi, 2000.
4. K.R.Rao, Zoran S. Bojkovic and Dragorad A. Milovanovic, Multimedia Communication systems, PHI , 2003.

**LIST OF ELECTIVES  
SEMESTER III**

**07CO22 ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY IN SYSTEM DESIGN** **3 0 0 100**

**UNIT I** **9**

**EMI ENVIRONMENT**

EMI/EMC concepts and definitions, Sources of EMI, conducted and radiated EMI, Transient EMI, Time domain Vs Frequency domain EMI, Units of measurement parameters, Emission and immunity concepts, ESD.

**UNIT II** **9**

**EMI COUPLING PRINCIPLES**

Conducted, Radiated and Transient Coupling, Common Impedance Ground Coupling, Radiated Common Mode and Ground Loop Coupling, Radiated Differential Mode Coupling, Near Field Cable to Cable Coupling, Power Mains and Power Supply coupling.

**UNIT III** **9**

**EMI/EMC STANDARDS AND MEASUREMENTS**

Civilian standards - FCC,CISPR,IEC,EN,Military standards - MIL STD 461D/462, EMI Test Instruments /Systems, EMI Shielded Chamber, Open Area Test Site, TEM Cell, Sensors/Injectors/Couplers, Test beds for ESD and EFT, Military Test Method and Procedures (462).

**UNIT IV** **9**

**EMI CONTROL TECHNIQUES**

Shielding, Filtering, Grounding, Bonding, Isolation Transformer, Transient Suppressors, Cable Routing, Signal Control, Component Selection and Mounting.

**UNIT V** **9**

**EMC DESIGN OF PCBs**

PCB Traces Cross Talk, Impedance Control, Power Distribution Decoupling, Zoning, Motherboard Designs and Propagation Delay Performance Models.

**TOTAL : 45****REFERENCES:**

1. Henry W.Ott, "Noise Reduction Techniques in Electronic Systems", John Wiley and Sons, NewYork. 1988.

2. C.R.Paul, "Introduction to Electromagnetic Compatibility" , John Wiley and Sons, Inc, 1992
3. V.P.Kodali, "Engineering EMC Principles, Measurements and Technologies", IEEE Press, 1996.
4. Bernhard Keiser, "Principles of Electromagnetic Compatibility", Artech house, 3rd Ed, 1986.

**07CO23 HIGH PERFORMANCE COMMUNICATION NETWORKS 3 0 0 100**

<b>UNIT I</b>	<b>9</b>
<b>PACKET SWITCHED NETWORKS</b>	
OSI and IP models, Ethernet (IEEE 802.3), Token ring (IEEE 802.5), Wireless LAN (IEEE 802.11) FDDI, DQDB, SMDS: Internetworking with SMDS	
<b>UNIT II</b>	<b>9</b>
<b>ISDN AND BROADBAND ISDN</b>	
ISDN - overview, interfaces and functions, Layers and services - Signaling System 7 (SS7)- Broadband ISDN architecture and Protocols.	
<b>UNIT III</b>	<b>9</b>
<b>ATM AND FRAME RELAY</b>	
ATM: Main features-addressing, signaling and routing, ATM header structure-adaptation layer, management and control, ATM switching and transmission.	
Frame Relay: Protocols and services, Congestion control, Internetworking with ATM, Internet and ATM, Frame relay via ATM.	
<b>UNIT IV</b>	<b>9</b>
<b>ADVANCED NETWORK ARCHITECTURE</b>	
IP forwarding architectures overlay model, Multi Protocol Label Switching (MPLS), integrated services in the Internet, Resource Reservation Protocol (RSVP), Differentiated services	
<b>UNIT V</b>	<b>9</b>
<b>BLUE TOOTH TECHNOLOGY</b>	
The Blue tooth module-Protocol stack Part I: Antennas, Radio interface, Base band, The Link controller, Audio, The Link Manager, The Host controller interface; The Blue tooth module-Protocol stack Part I: Logical link control and adaptation protocol, RFCOMM, Service discovery protocol, Wireless access protocol, Telephony control protocol.	

**TOTAL : 45**

**REFERENCES:**

1. William Stallings,"ISDN and Broadband ISDN with Frame Relay and ATM", 4<sup>th</sup> edition, Pearson education Asia, 2002.
2. Leon Gracia, Widjaja, "Communication networks ", Tata McGraw-Hill, New Delhi, 2000.
3. Jennifer Bray and Charles F.Sturman,"Blue Tooth" Pearson education Asia, 2001.
4. Sumit Kasera, Pankaj Sethi, "ATM Networks ", Tata McGraw-Hill, New Delhi, 2000.
5. Rainer Handel, Manfred N.Huber and Stefan Schroder ,"ATM Networks",3<sup>rd</sup> edition, Pearson education asia,2002.
6. Jean Walrand and Pravin varaiya ,"High Performance Communication networks",2<sup>nd</sup> edition, Harcourt and Morgan Kauffman,London,2000.
7. William Stallings,"High-speed Networks and Internets", 2<sup>nd</sup> edition, Pearson education Asia, 2003.

**07CO24 EMBEDDED SYSTEMS 3 0 0 100**

<b>UNIT I</b>	<b>9</b>
<b>EMBEDDED ARCHITECTURE</b>	
Embedded Computers, Characteristics of Embedded Computing Applications, Challenges in Embedded System Design, Embedded System Design Process - Requirements, Specification, Architectural Design, Designing Hardware and Software Components, System Integration.	
<b>UNIT II</b>	<b>9</b>
<b>EMBEDDED PROCESSOR AND COMPUTING PLATFORM</b>	
ARM processor- processor and memory organization, data operations, flow of control, SHARC processor-memory organization, data operations, flow of control, parallelism with instructions, CPU Bus	

configuration, ARM Bus, SHARC Bus, Memory Devices, Input / Output Devices. Design Example: Alarm Clock.

### **UNIT III**

**9**

#### **NETWORKS**

Distributed Embedded Architecture - Hardware and Software Architectures, Networks for embedded systems- I2C, CAN Bus, SHARC link ports, Ethernet, Myrinet, Internet. Design Example: Elevator Controller.

### **UNIT IV**

**9**

#### **REAL-TIME CHARACTERISTICS**

Clock driven Approach, weighted round robin Approach, Priority driven Approach, Dynamic Versus Static systems, effective release times and deadlines, Optimality of the Earliest deadline first (EDF) algorithm, Off-line Versus On-line scheduling.

### **UNIT V**

**9**

#### **SYSTEM DESIGN TECHNIQUES**

Design Methodologies, Requirement Analysis, Specification, System Analysis and Architecture Design, Quality Assurance, Design Example: Telephone PBX-Ink jet printer- Personal Digital Assistants, Set-top Boxes.

**TOTAL : 45**

### **REFERENCES**

1. Wayne Wolf, Computers as Components: Principles of Embedded Computing System Design, Morgan Kaufman Publishers, 2001.
2. Jane.W.S. Liu Real-Time systems, Pearson Education Asia, 2000
3. C. M. Krishna and K. G. Shin , Real-Time Systems, ,McGraw-Hill, 1997
4. Frank Vahid and Tony Givargi, Embedded System Design: A Unified Hardware/Software Introduction, s, John Wiley & Sons, 2000.

## **07CO25 HIGH SPEED SWITCHING ARCHITECTURE**

**3 0 0 100**

### **UNIT I**

**9**

#### **HIGH SPEED NETWORK**

LAN and WAN network evolution through ISDN to BISDN - Transfer mode and control of BISDN - SDH multiplexing structure - ATM standard; ATM adaptation layers.

### **UNIT II**

**9**

#### **LAN SWITCHING TECHNOLOGY**

Switching concepts; Switch forwarding techniques; switch path control - LAN switching; cut through forwarding; store and forward - virtual LANs.

### **UNIT III**

**9**

#### **ATM SWITCHING ARCHITECTURE**

Switch models - Blocking networks – basic and enhanced banyan networks - sorting networks – merge sorting - rearrangeable networks - full and partial connection networks - nonblocking networks – recursive network – construction and comparison of non-blocking network - switches with deflection routing – shuffle switch - tandem banyan.

### **UNIT IV**

**9**

#### **QUEUES IN ATM SWITCHES**

Internal queuing – Input, output and shared queuing - multiple queuing networks –combined input, output and shared queuing – performance analysis of queued switches.

### **UNIT V**

**9**

#### **IP SWITCHING**

Addressing mode - IP switching types-flow driven and topology driven solutions - IP Over ATM address and next hop resolution – multicasting - IPv6 over ATM.

**Total: 45**

**REFERENCES:**

1. Achille Patavina, Switching Theory: Architectures and performance in Broadband ATM Networks. John Wiley & Sons Ltd., New York. 1998.
2. Christopher Y Metz, Switching protocols & Architectures. McGraw Hill, New York. 1998.
3. Ranier Handel, Manfred N Huber, Stefan Schrodder. ATM Networks-concepts, protocols, applications, 3<sup>rd</sup> Edition, Adisson Wesley, New York, 1999.
4. John A. Chiong: Internetworking ATM for the internet and enterprise networks. McGraw Hill, New York, 1998.

**07CO26 LINEAR ALGEBRA**

**3 0 0 100**

**UNIT I**

**LINEAR EQUATIONS**

**9**

System of linear equations - Row reduction & Echelon forms - Vector equations - The Matrix equation  $Ax=b$  - Solution sets of linear systems - Application of linear systems - Linear Independence - Introduction to linear transformations - The Matrix of linear transformation - Linear modeling in engineering

**UNIT II**

**9**

**MATRIX ALGEBRA**

Matrix operations - Inverse of a matrix - Characteristics of invertible matrices - Partitioned matrices - Matrix factorizations - Subspaces of  $R^n$  - Dimension & rank - Introduction to determinants - Properties of determinants - Cramer's rule

**UNIT III**

**9**

**VECTOR SPACES**

Vector spaces & subspaces - Null spaces, column spaces & linear transformations - Linearly independent sets; Bases - Coordinate systems - Dimension of a vector space - Rank - Change of basis

**UNIT IV**

**9**

**EIGEN VALUES & EIGEN VECTORS**

Eigenvectors & Eigen values - Characteristic equation - Diagonalization - Eigenvectors & linear transformations - Complex Eigen values - Applications to differential equations - Iterative estimates for Eigen values

**UNIT V**

**9**

**ORTHOGONALITY & LEAST SQUARES**

Inner product, length & Orthogonality - Orthogonal sets - Orthogonal projections - Gram - Schmidt process - Least square problems - Inner product spaces - Applications of inner product spaces - Diagonalization of symmetric matrices - Quadratic forms - Singular value decomposition - Applications to image processing

**Total-60**

**REFERENCES:**

1. David C. Lay, "Linear Algebra and its Applications", Pearson Education Asia, New Delhi, 2003
2. Gilbert Strang, "Linear Algebra and its Applications", Brooks/Cole Ltd., New Delhi, Third Edition, 2003
3. Seymour Lipschutz, Marc Lipson, "Schaum's Outline of Linear Algebra", McGraw Hill Trade; New Delhi, Third Edition, 2000
4. Howard A. Anton, "Elementary Linear Algebra", John Wiley & Sons, Singapore, Eighth Edition 2000

**07CO27 SIMULATION OF COMMUNICATION SYSTEMS & NETWORKS**

**3 0 0 100**

**UNIT I**

**9**

**MODELLING OF COMMUNICATION SYSTEM**

Model of speech and picture signals, Pseudo noise sequences, Non-linear sequences, Analog channel model, Noise and fading, Digital channel model - Gilbert model of bursty channels, HF, Troposcatter and satellite channels, Switched telephone channels, Analog and Digital communication system models, Light wave system models.

**UNIT II** **9**  
**SIMULATION OF RANDOM VARIABLES AND RANDOM PROCESS**  
Univariate and multivariate models, Transformation of random variables, Bounds and approximation, Random process models-Markov and ARMA Sequences, Sampling rate for simulation, Computer generation and testing of random numbers

**UNIT III** **9**  
**ESTIMATION OF PERFORMANCE MEASURES**  
Quality of an estimator, estimator for SNR, Probability density functions of analog communication system, BER of digital communication systems, Monte Carlo method and Importance of sampling method, estimation of power spectral density

**UNIT IV** **9**  
**COMMUNICATION NETWORKS**  
Queuing models, M/M/I and M/M/I/N queues, Little formula, Burke's theorem ,M/G/I queue, Embedded Markov chain analysis of TDM systems, Polling, Random access systems

**UNIT V** **9**  
**NETWORK OF QUEUES**  
Queues in tandem, store and forward communication networks, capacity allocation, Congestion and flow chart, Routing model, Network layout and Reliability

**TOTAL : 45**

**REFERENCES**

1. M.C.Jeruchim, Philip Balaban and K.Sam Shanmugan, "Simulation of communication systems", Springer, 2<sup>nd</sup> Edition, 2002.
2. A.M.Law and W.David Kelton, "Simulation Modelling and analysis", 3<sup>rd</sup> Edition, Mc Graw Hill Inc., 1999.
3. J.F.Hayes, "Modeling and Analysis of Computer Communication networks (Applications of Communication Theory)", Plenum Press, 1984.
4. Jerry Banks and John S.Carson and Barry L. Nelson, "Discrete-Event System Simulation", 4<sup>th</sup> Edition, Prentice Hall Inc., 2004.

**07CO28 COMMUNICATION NETWORK SECURITY** **3 0 0 100**

**UNIT I** **9**  
**SYMMETRIC CIPHERS**  
Introduction – Services, Mechanisms and Attacks, OSI security Architecture, Model for network Security; Classical Encryption Techniques- Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Product ciphers , Data Encryption Standard- Block Cipher Principles, Strength of DES, Differential and Linear Crypt Analysis, Block Cipher Design Principles, BlockCipher Modes of Operation,Steganography;

**UNIT II** **9**  
**ADVANCED ENCRYPTION STANDARD AND STREAM CIPHERS**  
Evaluation Criteria for AES, AES Cipher; Contemporary Symmetric Ciphers- Triple DES, Blowfish, RC5- Characteristics of Advanced Symmetric Block Ciphers, Stream ciphers based on LFSRs,RC4 Stream Cipher; Random Number Generation. Traffic Confidentiality, Key Distribution,

**UNIT III** **9**  
**PUBLIC-KEY ENCRYPTION AND HASH FUNCTIONS**  
Public Key Cryptography and Key Management- RSA Algorithm and other public key cryptosystems-, Diffie-Hellman Key Exchange, Elliptic Curve arithmetic, Elliptic Curve Cryptography; Message Authentication and Hash Functions- Authentication Requirements, - MD5 Message Digest Algorithm; Secure Hash Algorithm, RIPEMD 160, HMAC; Digital Signatures and Authentication Protocols- Digital Signature Standards.

**UNIT IV** **9**

## **NETWORK SECURITY PRACTICE**

Authentication Applications- Kerberos, X.509 Authentication Service; Electronic Mail Security- Pretty Good Privacy, S/MIME; IP Security- overview and Architecture, Authentication Header, Encapsulating Security Payload, Combining Security Associations; Web Security- Web Security Considerations, Secure Sockets Layer and Transport Layer Security, Secure Electronic Transaction.

### **UNIT V**

**9**

#### **SYSTEM SECURITY**

Intruders- Intruder Detection, Password Management; Malicious Software- Virus and Related Threats, Virus Counter Measures; Firewalls- Firewall Design Principles, Trusted Systems.

**TOTAL : 45**

### **REFERENCES**

1. William Stallings, "Cryptography and Network Security", 3<sup>rd</sup> Edition. Prentice Hall of India, New Delhi ,2004
2. William Stallings, "Network Security Essentials", 2<sup>nd</sup> Edition. Prentice Hall of India, New Delhi, 2004
3. Charlie Kaufman , "Network Security: Private Communication in Public World", 2<sup>nd</sup> Edition. Prentice Hall of India, New Delhi ,2004

## **07CO29 SPEECH AND AUDIO SIGNAL PROCESSING**

**3 0 0 100**

### **UNIT I**

**8**

Speech production mechanism – Nature of Speech signal – Discrete time modelling of Speech production – Representation of Speech signals – Classification of Speech sounds – Phones – Phonemes – Phonetic and Phonemic alphabets – Articulatory features. Music production – Auditory perception – Anatomical pathways from the ear to the perception of sound – Peripheral auditory system – Psycho acoustics

### **UNIT II**

#### **TIME DOMAIN METHODS FOR SPEECH PROCESSING**

**8**

Time domain parameters of Speech signal – Methods for extracting the parameters Energy, Average Magnitude – Zero crossing Rate – Silence Discrimination using ZCR and energy – Short Time Auto Correlation Function – Pitch period estimation using Auto Correlation Function

### **UNIT III**

#### **FREQUENCY DOMAIN METHOD FOR SPEECH PROCESSING**

**9**

Short Time Fourier analysis – Filter bank analysis – Formant extraction – Pitch Extraction – Analysis by Synthesis- Analysis synthesis systems- Phase vocoder—Channel Vocoder.

#### **HOMOMORPHIC SPEECH ANALYSIS:**

Cepstral analysis of Speech – Formant and Pitch Estimation – Homomorphic Vocoders.

### **UNIT IV**

**10**

#### **LINEAR PREDICTIVE ANALYSIS OF SPEECH**

Formulation of Linear Prediction problem in Time Domain – Basic Principle – Auto correlation method – Covariance method – Solution of LPC equations – Cholesky method – Durbin's Recursive algorithm – lattice formation and solutions – Comparison of different methods – Application of LPC parameters – Pitch detection using LPC parameters – Formant analysis – VELP – CELP.

### **UNIT V**

#### **APPLICATION OF SPEECH & AUDIO SIGNAL PROCESSING**

**10**

Algorithms: Spectral Estimation, dynamic time warping, hidden Markov model – Music analysis – Pitch Detection – Feature analysis for recognition – Music synthesis – Automatic Speech Recognition – Feature Extraction for ASR – Deterministic sequence recognition – Statistical Sequence recognition – ASR systems – Speaker identification and verification – Voice response system – Speech Synthesis: Text to speech, voice over IP.

**TOTAL : 45**

### **REFERENCES:**

1. Ben Gold and Nelson Morgan, Speech and Audio Signal Processing, John Wiley and Sons Inc. , Singapore, 2004
2. L.R.Rabiner and R.W.Schaffer – Digital Processing of Speech signals – Prentice Hall -1978

3. Quatieri – Discrete-time Speech Signal Processing – Prentice Hall – 2001.
4. J.L.Flanagan – Speech analysis: Synthesis and Perception – 2<sup>nd</sup> edition – Berlin – 1972
5. I.H.Witten – Principles of Computer Speech – Academic Press – 1982

<b>07CO30</b>	<b>INFORMATION THEORY AND CODING</b>	<b>3 0 0 100</b>
	<b>UNIT I</b>	<b>5</b>
	Introduction to Probability theory, random variables	
	<b>UNIT II</b>	<b>10</b>
	<b>RANDOM PROCESS</b> :: Classification - Stationarity - Spectral decomposition - Response of linear system to random inputs	
	<b>UNIT III</b>	<b>10</b>
	<b>MEMORYLESS FINITE SCHEMES:</b> Self information measure - Entropy function - Conditional Entropies - Characteristics of Entropy function - Derivation of the noise characteristics of a channel - Mutual information - Redundancy - Efficiency and channel capacity - capacities of channels with symmetric noise structure.	
	<b>UNIT IV</b>	<b>10</b>
	<b>CONTINUOUS CHANNELS:</b> Definitions of different entropies - Mutual information - Maximization of the entropy of a continuous random variable - Entropy maximization problems - Channel capacity under the influence of additive white Gaussian Noise.	
	<b>UNIT V</b>	<b>10</b>
	<b>ELEMENTS OF ENCODING:</b> Separable binary codes - Shannon - Fano encoding - Necessary and sufficient conditions for noiseless coding - Shannon's binary coding - fundamental theorem of discrete noise-less coding - Huffman's code - Gilbert Moore coding - Fundamental theorem of discrete coding in presence of noise - Error-detecting and error-correcting codes - Hamming's single error correcting code.	
		<b>Total: 45</b>

**REFERENCES:**

1. Viterbi A & Omura J.K, "Principles of Digital Communication and Coding", McGraw Hill, 1979.
2. Satyanarayana P.S. "Probability Theory - An Introduction", Dayaram Publications" 1990.
3. Mansuripur.M.A, "Introduction to Information Theory" - Prentice Hall Inc. 1990.
4. Srinath .M.D and Rajasekaran .P.K "An Introduction to Statistical Signal Processing with Application, Prentice Hall, 1993.
5. Joya Thomas, M.Cover "Elements of Information theory", John Wiley, 1991.
6. Richard.B.wells, "Applied Coding and Information Theory for Engineers", Prentice Hall, 1998.

<b>07CO31</b>	<b>RF MEMS</b>	<b>3 0 0 100</b>
	<b>UNIT I</b>	<b>9</b>
	<b>SWITCHING</b>	
	RF MEMS relays and switches: Switch parameters, Actuation mechanisms, Bistable relays and micro actuators, Dynamics of switching operation.	
	<b>UNIT II</b>	<b>9</b>
	<b>COMPONENTS - I</b>	
	MEMS inductors and capacitors: Micromachined inductor, Effect of inductor layout, Modeling and design issues of planar inductor, Gap tuning and area tuning capacitors, Dielectric tunable capacitors.	
	<b>UNIT III</b>	<b>9</b>
	<b>COMPONENTS - II</b>	

MEMS phase shifters: Types. Limitations, Switched delay lines, Micromachined transmission lines, coplanar lines, Micromachined directional coupler and mixer.

**UNIT IV**

**9**

**FILTERS**

Micromachined RF filters: Modeling of mechanical filters, Electrostatic comb drive, Micromechanical filters using comb drives, Electrostatic coupled beam structures.

**UNIT V**

**9**

**ANTENNAS**

Micromachined antennas: Microstrip antennas – design parameters, Micromachining to improve performance, Reconfigurable antennas.

**Total: 45**

**REFERENCES:**

1. V.K.Varadan etal, RFMEMS and their Applications, Wiley, 2003.
2. H.J.DELOS SANTOS : RF MEMS circuit Design for Wireless Communications, Artech House, 2002.
3. G.M.REBEIZ, RF MEMS Theory, Design and Technology, John Wiley, 2003.