KUMARAGURU COLLEGE OF TECHNOLOGY
M.E. COMMUNICATION SYSTEMS
CURRICULUM 2013
SEMESTER – I

Code No.	Course Title	L	T	P	C
Theory					
P13MA*T*107	Applied Mathematics for Electronics Engineers (Communication Systems)	3	1	0	4
P13CO*T*101	Microwave Integrated Circuits	3	0	0	3
P13CO*T*102	Advanced Digital Communication Techniques	3	1	0	4
P13CO*T*103	Optical Communication Networks	3	0	0	3
P13AE*T*103	Advanced Signal Processing	3	1	0	4
ET1***	Elective I	3	0	0	3
Practical					
P13CO*P*101	Communication System laboratory	0	0	3	1
Total					**22**

SEMESTER – II

Code No.	Course Title	L	T	P	C
Theory					
P13CO*T*201	Wireless Communication Engineering	3	0	0	3
P13CO*T*202	Coding and Compression Techniques	3	1	0	4
P13CO*T*203	Advanced Radiation Systems	3	0	0	3
ET2***	Elective II	3	0	0	3
ET3***	Elective III	3	0	0	3
ET4***	Elective IV	3	0	0	3
Practical					
P13CO*P*201	Advanced Communication laboratory	0	0	3	1
Total					**20**

SEMESTER – III

Code No.	Course Title	L	T	P	C
Theory					
ET4***	Elective V	3	0	0	3
ET5***	Elective VI .	3	0	0	3
ET6***	Elective VII	3	0	0	3
Practical					
P13CO*P*301	Project Work (Phase I)	0	0	12	6
Total					**15**

SEMESTER – IV

Code No.	Course Title	L	T	P	C
P13CO*P*401	Project Work (Phase II)	0	0	24	12
Total					**12**

TOTAL CREDIT: 69

LIST OF ELECTIVES
M.E. COMMUNICATION SYSTEMS

Code No.	Course Title	L	T	P	C
P13CO*TE*01	RF System Design	3	0	0	3
P13CO*TE*02	Advanced Microwave Systems	3	0	0	3
P13CO*TE*03	Communication Protocol Engineering	3	0	0	3
P13CO*TE*04	Network Routing Algorithms	3	0	0	3
P13CO*TE*05	Simulation of Communication Systems and Networks	3	0	0	3
P13CO*TE*06	Global Positioning Systems	3	0	0	3
P13CO*TE*07	Communication Network Security	3	0	0	3
P13CO*TE*08	Satellite Communication	3	0	0	3
P13CO*TE*09	Internetworking multimedia	3	0	0	3
P13CO*TE*10	Electromagnetic Interference and Compatibility in System Design	3	0	0	3
P13CO*TE*11	High Performance Communication Networks	3	0	0	3
P13CO*TE*12	High Speed Switching Architecture	3	0	0	3
P13CO*TE*13	Digital Communication Receivers	3	0	0	3
P13CO*TE*14	RF MEMs	3	0	0	3
P13CO*TE*15	Space Time Wireless Communication Systems	3	0	0	3
P13CO*TE*16	Spread Spectrum Techniques	3	0	0	3
P13CO*TE*17	Wireless Networks	3	0	0	3
P13CO*TE*18	Advanced Optical Communication	3	0	0	3
P13CO*TE*19	Non Linear Fiber Optics And Signal Processing	3	0	0	3
P13CO*TE*20	Solitons In Optical Communication	3	0	0	3
P13CO*TE*21	Optical waveguide theory	3	0	0	3
P13CO*TE*22	Satellite architecture & communication	3	0	0	3
P13CO*TE*23	Speech and Audio Signal Processing	3	0	0	3
P13CO*TE*24	Research Methodology	3	0	0	3
P13AE*TE*01	Advanced Digital Image Processing	3	0	0	3
P13AE*TE*08	Soft Computing	3	0	0	3
P13AE*TE*09	DSP Processor Architecture and programming	3	0	0	3
P13AE*TE*17	Machine Vision	3	0	0	3
P13AE*TE*18	Machine Learning	3	0	0	3
P13AE*TE*19	Pattern Recognition and Artificial Intelligence	3	0	0	3
P13AE*TE*20	Image Processing & Pattern Recognition	3	0	0	3
P13AE*TE*21	Image and Video Processing	3	0	0	3
P13AE*TE*28	Wavelets and Multi-resolution Processing	3	0	0	3
P13AE*TE*29	Multirate signal processing	3	0	0	3
P13AE*TE*33	Advanced Processors	3	0	0	3
P13AE*TE*37	System Modeling and Simulation	3	0	0	3
P13AE*T*104	Embedded Systems	3	0	0	3
	Special Elective	3	0	0	3

P13MA*T*107 APPLIED MATHEMATICS FOR ELECTRONICS ENGINEERS
(Communication Systems)

L	T	P	C
3	1	0	4

On completion of the course, the students are expected

- To deal with matrix operations and properties of determinants.
- To know the concept of vector spaces.
- To acquire knowledge in the concepts of Graph theory.
- To acquire knowledge in the concepts of Group theory.
- To deal the problems under queuing theory.

UNIT I MATRIX ALGEBRA **09**

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

UNIT II BASIC SET THEORY **09**

Basic Definitions - Venn Diagrams and set operations - Laws of set theory - Principle of inclusion and exclusion - partitions- Relations- Properties of relations - Matrices of relations - Functions - injective, surjective and bijective functions.

UNIT III VECTOR SPACES **09**

Vector spaces & subspaces - Null spaces, column spaces & linear transformations - Linearly independent sets; Bases - Coordinate systems - Dimension of a vector space – Rank - Change of basis- Eigen values & Eigenvectors - Characteristic equation –Diagonalization of symmetric matrices Eigenvectors & linear transformations

UNIT IV PROBABILITY AND RANDOM VARIABLE **09**

Axioms of probability - Conditional probability - Total probability – Baye's theorem - Random variable – Distribution function – properties - Probability function - Probability density function – moments and moment generating function – properties.

UNIT V QUEUEING THEORY **09**

Single and Multiple server - Markovian queueing models – Steady state system size probabilities – Little's formula –M/G/1 queueing system – P-K formula (Derivations excluded for all models).

L+ T: 45+15 = 60**TOTAL: 60**

TEXT BOOK

1. *David C. Lay, **"Linear Algebra and its Applications",** Pearson Education Asia, New Delhi, 2003.*

REFERENCES

1. *Gilbert Strang, **"Linear Algebra and its Applications",** Brooks/Cole Ltd., New Delhi, Third Edition,2003.*

2. *Kenneth.Rosen H., **"Discrete Mathematics and Its Applications",** Tata McGraw Hill, 4^{th} Edition 2002.*

3. *Trembly J.P and Manohar R, **"Discrete Mathematical Structures with Applications to Computer Science",** Tata McGraw–Hill Pub. Co. Ltd, New Delhi, 2003.*

4. *Gross. D & Harris C.M., **"Fundamentals of Queuing Theory",** John Wiley & Sons, 2008.*

5. *Kandasamy P., Thilagavathi K. and Gunavathi K., **"Probability, Statistics and Queuing Theory",** S.Chand and Company Ltd, 2007.*

P13CO*T*101 MICROWAVE INTEGRATED CIRCUITS

L	T	P	C
3	0	0	3

UNIT I TECHNOLOGY OF HYBRID MICS **09**

Microwave integrated circuits, an overview- Rationale for (MICs)-Types of MICs and their Technology-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 TECHNOLOGY OF MONOLITHIC MICS **09**

Processes involved in fabrication – epitaxial growth of semiconductor layer – growth of Dielectric layer – diffusion-ion implantation – Range versus energy relationship- Lattice damage and annealing.

UNIT III ANALYSIS OF MICROSTRIP LINE **09**

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

UNIT IV COUPLED MICROSTRIPS, SLOT LINE AND COPLANAR WAVEGUIDE **09**

Coupled microstrips – even and odd mode analysis – microstrip directional couplers – Branch line couplers – periodic branch line couplers – synchronous branch line couplers- Introduction to Slot line and CoPlanarWave guides.

UNIT V LUMPED ELEMENTS AND NON-RECIPROCAL COMPONENTS **09**

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

TOTAL: 45

TEXT BOOK

1. *Gupta,K.C, and Amarjit Singh, **"Microwave Integrated Circuits",** John Wiley and sons – Wiley Eastern Reprint, 1978.*

REFERENCES

1. *Hoffmann, R.K, **"Handbook of Microwave Integrated Circuits",** Artech House, 1987.*

P13CO*T*102 ADVANCED DIGITAL COMMUNICATION TECHNIQUES

L	T	P	C
3	1	0	4

UNIT I DIGITAL MODULATION SCHEMES **09**

Representation of Digitally Modulated signals, Memory less Modulation Methods, Signaling Schemes with Memory –CPFSK, CPM, Power Spectrum of Digitally Modulated Signals-PSD of a digitally modulated signal with memory, PSD of a linear modulated signal, PSD of a digitally modulated signal with Finite memory, PSD of a digitally modulation scheme with a Markov Structure.

UNIT II OPTIMUM COHERENT RECEIVERS FOR AWGN CHANNEL **09**

Waveform and vector channel Models, Waveform and vector AWGN channel, Optimal Detection and Error Probability for band limited Signaling, Optimal Detection and Error Probability for power limited signaling

UNIT III OPTIMUM NON-COHERENT RECEIVERS FOR AWGN CHANNEL **09**

Noncoherent detection, Noncoherent detection of carrier modulated signals, Optimal Noncoherent detection of FSK modulated signals, Error probability of Orthogonal signaling with Noncoherent detection, Probability of error for envelope detection of correlated binary signals , Differential PSK (DPSK), Optimum receiver for CPM Signals - Optimum Demodulation and detection of CPM

UNIT IV LINEAR BLOCK CODES **09**

Basic Definitions, The General properties of linear block codes, Specific Linear Block codes, Optimum soft decision decoding of linear block codes, Hard decision decoding of linear block codes. Cyclic codes-BCH codes, Reed – Solomon Codes, Low Density Parity Check codes, Coding for channels with burst errors, Combining Codes.

UNIT V CONVOLUTIONAL CODES **09**

Structure of Convolutional codes, Decoding of Convolutional codes- Distance properties of Convolutional codes, Punctured Convolutional codes, Turbo codes and iterative decoding, Trellis Coded Modulation.

L+ T: 45+15 = 60**TOTAL: 60**

TEXT BOOK

1. *John G. Proakis., and Masoud Salehi.* ***"Digital Communication"*** *, McGraw-Hill,International Edition 2008*
2. *M.K.Simon, S.M.Hinedi and W.C.Lindsey,* ***"Digital communication techniques; Signaling and detection"****, prentice Hall India, New Delhi.1995.*

REFERENCES

1. *Simon Haykin,* ***"Digital communications"****, John Wiley and sons, 1998.*
2. *B.P.Lathi* ***"Modern digital and analog communication systems"****, 3rd Edition, Oxford University press 1998.*

P13CO*T*103 OPTICAL COMMUNICATION NETWORKS

L	T	P	C
3	0	0	3

UNIT I OPTICAL SYSTEM COMPONENTS **09**

Light propagation in optical fibers – Loss & bandwidth, System limitations, Non-Linear effects; Solitons; Optical Network Components – Couplers, Isolators & Circulators, Multiplexers & Filters, Optical Amplifiers, Switches, Wavelength Converters.

UNIT II OPTICAL NETWORK ARCHITECTURES **09**

Introduction to Optical Networks; SONET / SDH, Metropoliton-Area Networks, Layered Architecture ; Broadcast and Select Networks – Topologies for Broadcast Networks, Media-Access Control Protocols, Testbeds for Broadcast & Select WDM; Wavelength Routing Architecture.

UNIT III WAVELENGTH ROUTING NETWORKS **09**

The optical layer, Node Designs, Optical layer cost tradeoff, Routing and wavelength assignment,Virtual topology design, Wavelength Routing Testbeds, Architectural variations.

UNIT IV PACKET SWITCHING AND ACCESS NETWORKS **09**

Photonic Packet Switching – OTDM, Multiplexing and Demultiplexing, Synchronisation, Broadcast OTDM networks, Switch-based networks; Access Networks – Network Architecture overview, Future Access Networks, Optical Access Network Architectures; and OTDM networks.

UNIT V NETWORK DESIGN AND MANAGEMENT **09**

Transmission System Engineering – System model, Power penalty - transmitter, receiver, Optical amplifiers, crosstalk, dispersion; Wavelength stabilization ; Overall design considerations; Control and Management – Network management functions, Configuration management, Performance management, Fault management, Optical safety, Service interface.

TOTAL: 45

TEXT BOOK

1. *Rajiv Ramaswami and Kumar N. Sivarajan, "Optical Networks : A Practical Perspective", Harcourt Asia Pte Ltd., Second Edition 2004.*

REFERENCES

1. *C. Siva Ram Moorthy and Mohan Gurusamy,* ***"WDM Optical Networks : Concept, Design and Algorithms"****, Prentice Hall of India, Ist Edition, 2002.*

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.*

5. *P.E. Green, Jr.,* ***"Fiber Optic Networks",*** *Prentice Hall, NJ, 1993*

P13AET103 ADVANCED SIGNAL PROCESSING

L	T	P	C
3	1	0	4

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

UNIT I DISCRETE RANDOM SIGNAL PROCESSING 09

Discrete Random Processes- Ensemble averages, stationary processes, Autocorrelation and Auto covariance matrices- Parameter estimation: Bias and consistency - Parseval's Theorem, White Noise, Power spectrum, Wiener-Khintchine Relation, Filtering random Processes, Spectral Factorization

UNIT II SPECTRUM ESTIMATION

Non-Parametric Methods - Periodogram Estimator, Performance Analysis of Estimators - Unbiased, Consistent Estimators- Modified Periodogram, Bartlett and Welch methods, Blackman –Tukey method. AR, MA, ARMA processes - Yule-Walker equations - Parametric methods of Spectral Estimation

UNIT III LINEAR ESTIMATION AND PREDICTION 09

Linear prediction- Forward and backward predictions, Lattice filter realization, Prony's all pole modeling, Solutions of the Normal equations- Levinson-Durbin recursion - Levinson recursion. Optimum filters- FIR Wiener filter –Causal and Non-causal IIR Wiener filter-Discrete Kalman filter

UNIT IV ADAPTIVE FILTERS 09

FIR adaptive filters -adaptive filter based on steepest descent method- 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 MULTIRATE DIGITAL SIGNAL PROCESSING 09

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, Multistage implementation of multirate system, Direct form FIR filter structures, Polyphase filter structures, Subband Coding, Quadrature Mirror Filters – Condition for perfect reconstruction, Applications of Multirate systems

L:45; T:15
TOTAL: 60

REFERENCES

1. *Monson H.Hayes, **"Statistical Digital Signal Processing and Modeling"**, John Wiley and Sons, Inc., Singapore, 2004*
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, New York, 2000.*

P13CO*P*101 COMMUNICATION SYSTEMS LABORATORY

L	T	P	C
0	0	3	1

LIST OF EXPERIMENTS

1. Antenna Radiation Pattern measurement.
2. Simulation of Modulation techniques in AWGN Communication Channel.
3. Simulation of Channel Coding in AWGN Communication Channel.
4. Implementation of Linear and Cyclic Codes.
5. Implementation of Adaptive Filters
6. Simulation of power spectral estimation methods.
7. Analysis of multistage multirate system using Simulation Packages.
8. Performance evaluation of Digital Data Transmission through Fiber Optic Link using simulation package.
9. Simulation of QMF.
10. Implementation of Linear and Cyclic Codes.

TOTAL: 45 Hours

Software Requirement: MATLAB, CAD FEKO, OPTSIM

SEMESTER-II

P13CO*T*201 WIRELESS COMMUNICATION ENGINEERING

L	T	P	C
3	0	0	3

UNIT I THE WIRELESS CHANNEL **09**

Overview of wireless systems – path loss model for wireless channels – Time and Frequency coherence – Statistical multipath channel models – Capacity of wireless Channel -Capacity of Flat Fading Channel — Channel Distribution Information known – Channel Side Information at Receiver – Channel Side Information at Transmitter and Receiver –Capacity with Receiver diversity – Capacity comparisons – Capacity of Frequency Selective Fading channels

UNIT II DIGITAL MODULATION AND DIVERSITY TECHNIQUES **09**

Fading– Outage Probability– Average Probability of Error — Combined Outage and Average Error Probability – Doppler Spread – Intersymbol Interference.

Realization of Independent Fading Paths – Receiver Diversity – Selection Combining – Threshold Combining – Maximal-Ratio Combining – Equal - Gain Combining – Transmitter Diversity – Channel known at Transmitter – Channel unknown at Transmitter – The Alamouti Scheme.

UNIT III MULTICARRIER MODULATION **09**

Data Transmission using Multiple Carriers – Multicarrier Modulation with Overlapping Subchannels – Mitigation of Subcarrier Fading – Discrete Implementation of Multicarrier Modulation – Peak to average Power Ratio- Frequency and Timing offset – Case study IEEE 802.11a,OFDM,MC CDMA.

UNIT IV MULTIPLE ACCESS TECHNIQUES FOR WIRELESS COMMUNICATION **09**

Spread-Spectrum Principles, Direct-Sequence Spread Spectrum (DSSS) – DSSS System Model – Spreading Codes for ISI Rejection: Random, Pseudorandom, and m-Sequence – Synchronization – RAKE Receivers, Frequency-Hopping Spread Spectrum, Multiuser DSSS Systems, Multiuser FHSS Systems.

UNIT V WIRELESS SYSTEMS AND STANDARDS **09**

Multiple Access – FDMA – TDMA – CDMA – SDMA – Hybrid Techniques, Random Access, Power Cntrol, Downlink (Broadcast) Channel Capacity, Uplink (multiple Access) Channel Capacity, Uplink–Downlink Duality, Multiuser Diversity, MIMO Multiuser Systems.

TOTAL: 45

TEXT BOOK

1. *Andrea Goldsmith,* ***"Wireless Communications",*** *Cambridge University Press, 2005.*

2. *T.S. Rappaport,* ***"Wireless Communications",*** *Pearson Education, 2003.*

REFERENCES

1. *David Tse and Pramod Viswanath,* ***"Fundamentals of Wireless Communication",*** *Cambridge University Press, 2005.*

2. *W.C.Y.Lee,* ***"Mobile Communication Engineering",*** *Mc Graw Hill, 2000.*

3 *A.Paulraj, R.Nabar, D.Gore,* ***"Introduction to Space-Time Wireless Communication",****Cambridge University Press, 2003.*

P13CO*T*202 CODING AND COMPRESSION TECHNIQUES

L	T	P	C
3	1	0	4

UNIT I INTRODUCTION **09**

Multimedia data - features — Storage requirements for multimedia - Need for Compression - Taxonomy of compression – Metrics – Quantitative and Qualitative techniques - Overview of source coding – Scalar quantization - Adaptive - Vector quantization.

UNIT II TEXT COMPRESSION **09**

Characteristics of text data – RLE, Huffmann coding – Adaptive Huffmann Coding – Arithmetic coding — Dictionary techniques – static and adaptive- digram coding – LZW algorithm - GIF, TIF, Digitized documents, JBIG, JBIG2.

UNIT III AUDIO COMPRESSION **09**

Fundamental concepts of digital audio - Audio compression techniques –μ Law and A- Law companding - PCM, DPCM, DM, ADM - sub-band coding – Application to speech coding – G.722 – MPEG audio – MP3 - Model based coding – Channel Vocoders – LPC - Formant and CELP coders.

UNIT IV IMAGE COMPRESSION **09**

Image data representation - Predictive techniques – DPCM: Optimal Predictors and Optimal Quantizers –Transform Coding – JPEG Standard – Sub-band coding – QMF Filters - Wavelet based compression – EZW, SPIHT coders – JPEG 2000 standard – File formats.

UNIT V VIDEO COMPRESSION **09**

Fundamental concepts of video – digital video signal - video formats – video compression techniques and standards - AVI, FLV, MP4, Real media - Motion estimation and compensation Techniques, Block matching- Full search motion estimation methods – MPEG Video Coding : MPEG – 1 and 2, MPEG – 4, 7 and 21 — H.26X Standard - Packet Video.

L+ T: 45+15 = 60**TOTAL: 60**

TEXT BOOK

1. *Khalid Sayood, **" Introduction to Data Compression",** Morgan Kauffman Harcourt India, 2nd Edition, 2000.*

REFERENCES

1. *David Salomon, **" Data Compression – The Complete Reference",** Springer Verlag New York Inc., 2nd Edition, 2001.*

2. *I.E.G. Richardson, **"Video codec design",** John Wiley & Sons Ltd, 2002 Edition.*

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, 1st Edition, 2003.*

7. *Watkinson,J, **" Compression in Video and Audio",** Focal press,London.1995.*

8. *Jan Vozer , **"Video Compression for Multimedia",** AP Profes, NewYork, 1995*

P13CO*T*203 ADVANCED RADIATION SYSTEMS

L	T	P	C
3	0	0	3

UNIT I CONCEPTS OF RADIATION **09**

Retarded vector potentials – Heuristic approach and Maxwell's equation approach. The Lorentz gauge condition. Vector potential in Phasor form. Isotropic Radiator , E and H of a isotropic radiator or point source, Fields radiated by an Alternating current element. Total power radiated and radiation resistance. Radiation from Half wave dipole from assumed current distribution. Power radiated in the far field. Electric vector potential F for a magnetic current source M. Far zone fields due to magnetic source M.

UNIT II ANTENNA ARRAYS **09**

N element linear arrays – uniform amplitude and spacing. Phased arrays. Directivity of Broadside and End fire arrays. Three dimensional characteristics. Binomial arrays and Dolph-Tchebycheff arrays. Circular array. Antenna Synthesis- Line source and Discretization of continuous sources. Schelkunoff polynomial method. Fourier Transform method.

UNIT III APERTURE ANTENNAS **09**

Magnetic current – Duality. Electric and Magnetic current sheets as sources. Huyghens Source. Radiation through an aperture in an absorbing screen. Fraunhoffer and Fresnel diffraction. Cornu Spiral. Complimentary screens and slot antennas. Slot and dipoles as Dual antennas. Babinets principle. Fourier transform in aperture antenna theory.

UNIT IV HORN, MICROSTRIP, REFLECTOR ANTENNAS. **09**

E and H plane sectoral Horns. Pyramidal horns. Conical and corrugated Horns. Microstrip antennas – feeding methods. Rectangular patch- Transmission line model. Parabolic Reflector antennas – Prime focus and Cassegrain reflectors. Equivalent focal Length of Cassegrain antennas. Spillover and taper efficiencies. Optimum illumination.

UNIT V ANTENNA POLARIZATION **09**

Simple relationship involving, spherical triangles. Linear, Elliptical and circular Polarization. Development of the Poincare sphere. Representation of the state of polarization in the Poincare sphere. Random polarization – Stokes parameters.

TOTAL: 45

TEXT BOOK

1. *Jordan, E.C and Balmaian, **"Electromagnetic waves and Radiating systems",** PHI, 2003.*
2. *Balanis, C.A, **"Antenna Theory",** Wiley,2003,*

REFERENCES

1. *Krauss, J.D, **"Radio Astronomy",** McGraw-Hill 1966, for the last unit (reprints Available)*
2. *Krauss, J.D, Fleisch,D.A, **"Electromagnetics"**, McGraw-Hill,1999.*

P13CO*P*201 ADVANCED COMMUNICATION LABORATORY

L	T	P	C
0	0	3	1

LIST OF EXPERIMENTS

1. Simulation of Modulation techniques in fading Channel.
2. Simulation of Channel Coding in fading Channel.
3. Simulation of Audio and Speech compression algorithms
4. Simulation of EZW / SPIHT Image coding algorithm.
5. Radiation pattern analysis of Microstrip Antennas.
6. S-parameter estimation of Microwave devices.
7. Simulation and analysis of Spread Spectrum Techniques: DSSS, OFDM
8. Design and testing of a Microstrip Devices.
9. Simulation and analysis of optical communication system. (Design the transmitter and receiver modules, use of different types and combinations of fibers, location and number of EDFAs deployed are your choice

TOTAL: 45 Hours

Software Requirement: MATLAB, CAD FEKO, OPTSIM

LIST OF ELECTIVES

P13CO*TE*01 **RF SYSTEM DESIGN**

L	T	P	C
3	0	0	3

UNIT I RF ISSUES **09**

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

UNIT II RF FILTER DESIGN **09**

RF diodes, BJT, RF FETs, High electron mobility transistors; Matching and Biasing Networks – Impedance matching using discrete components, Micro-strip line matching networks, Amplifier classes of operation and biasing networks.

UNIT III ACTIVE RF COMPONENTS & APPLICATIONS **09**

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.

UNIT IV RF AMPLIFIER DESIGNS **09**

Characteristics, Amplifier power relations, Stability considerations, Constant gain circles, Constant VSWR circles, Broadband , high power and multistage amplifiers.

UNIT V OSCILLATORS, MIXERS & APPLICATIONS **09**

Basic Oscillator model, High frequency oscillator configuration, Basic characteristics of Mixers ; Phase Locked Loops ; RF couplers Wilkinson divider and Lange coupler ;
Detector and demodulator circuits.

TOTAL: 45

TEXT BOOK

1. *Reinhold Ludwig and Powel Bretchko, **"RF Circuit Design – Theory and Applications"**, Pearson Education Asia, First Edition, 2001.*

REFERENCES

1. *Joseph . J. Carr, **"Secrets of RF Circuit Design"** , McGraw Hill Publishers, Third Edition, 2000.*
2. *Mathew M. Radmanesh, **"Radio Frequency & Microwave Electronics"**, Pearson Education Asia, Second Edition, 2002.*

3 *Ulrich L. Rohde and David P. NewKirk, **"RF / Microwave Circuit Design",** John Wiley & Sons USA 2000.*

4 *Roland E. Best, **"Phase - Locked Loops : Design, simulation and applications",** McGraw Hill Publishers 5TH edition 2003.*

P13CO*TE*02 ADVANCED MICROWAVE SYSTEMS

L	T	P	C
3	0	0	3

UNIT I FIELD ANALYSIS OF PLANAR TRANSMISSION LINES **09**

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.

UNIT II CIRCUIT THEORY FOR WAVE GUIDE SYSTEMS **09**

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.

UNIT III PERIODIC STRUCTURES AND FILTERS **09**

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.

UNIT IV MICROWAVE SOLID STATE AMPLIFIERS **09**

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 MICROWAVES AND OPTICS **09**

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

TEXT BOOK

1. *R.E.Collin, **" Foundations for Microwave Engineering",** McGraw-Hill, 1992.*

REFERENCES

1. *Ramo, Whinnery and Van Duzer , **"Fields and Waves in communication electronics",** 3rd Edition., Wiley, 1997.*

P13CO*TE*03 COMMUNICATION PROTOCOL ENGINEERING

L	T	P	C
3	0	0	3

UNIT I NETWORK REFERENCE MODEL **09**

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 PROTOCOL SPECIFICATIONS **09**

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

UNIT III PROTOCOL VERIFICATION/VALIDATION **09**

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 PROTOCOL CONFORMANCE/PERFORMANCE TESTING **09**

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 PROTOCOL SYNTHESIS AND IMPLEMENTATION **09**

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

TEXT BOOK

1. *Pallapa Venkataram and Sunilkumar S.Manvi, **"Communication protocol Engineering"**, Eastern Economy edition, 2004.*

REFERENCES

1. *Richard Lai and Jirachiefpattana, **"Communication Protocol Specification and Verification"**, Kluwer Publishers, Boston, 1998.*

2. *Tarnay, K., **"Protocol Specification and Testing"**, Plenum, New York, 1991.*

3 *Mohamed G. Gouda, **"Elements of Network Protocol Design"**, John Wiley & Sons, Inc. New York, USA, 1998.*

4 *V.Ahuja, **"Design and Analysis of Computer Communication networks"**, McGraw-Hill, London, 1982.*

P13CO*TE*04 NETWORK ROUTING ALGORITHMS

L	T	P	C
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UNIT I INTRODUCTION 09

ISO OSI Layer Architecture, TCP/IP Layer Architecture, Functions of Network layer, General Classification of routing, Routing in telephone networks, Dynamic Non hierarchical Routing (DNHR), Trunk status map routing (TSMR), real-time network routing (RTNR), Distance vector routing, Link state routing, Hierarchical routing.

UNIT II INTERNET ROUTING 09

Interior protocol : Routing Information Protocol (RIP), Open Shortest Path First (OSPF), Bellman Ford Distance Vector Routing. Exterior Routing Protocols: Exterior Gateway Protocol (EGP) and Border Gateway Protocol (BGP). Multicast Routing: Pros and cons of Multicast and Multiple Unicast Routing, Distance Vector Multicast Routing Protocol (DVMRP), Multicast Open Shortest Path First (MOSPF), MBONE, Core Based Tree Routing.

UNIT III ROUTING IN OPTICAL WDM NETWORKS 09

Classification of RWA algorithms, RWA algorithms, Fairness and Admission Control, Distributed Control Protocols, Permanent Routing and Wavelength Requirements, Wavelength Rerouting-Benefits and Issues, Lightpath Migration, Rerouting Schemes, Algorithms- AG, MWPG.

UNIT IV MOBILE - IP NETWORKS 09

Macro-mobility Protocols, Micro-mobility protocol: Tunnel based : Hierarchical Mobile IP, Intra domain Mobility Management, Routing based: Cellular IP, Handoff Wireless Access Internet Infrastructure (HAWAII).

UNIT V MOBILE AD –HOC NETWORKS 09

Internet-based mobile ad-hoc networking communication strategies, Routing algorithms– Proactive routing: destination sequenced Distance Vector Routing (DSDV), Reactive routing: Dynamic Source Routing (DSR), Ad hoc On-Demand Distance Vector Routing (AODV), Hybrid Routing: Zone Based Routing (ZRP).

TOTAL: 45

TEXT BOOK

1. *M. Steen Strub, **" Routing in Communication network"**, Prentice –Hall International, Newyork, 1995.*

REFERENCES

1. *William Stallings,* ***" High speed networks and Internets Performance and Quality of Service"****, IInd Edition, Pearson Education Asia. Reprint India 2002*

2. *S. Keshav,* ***"An engineering approach to computer networking",*** *Addison Wesley 1999.*

3. *William Stallings,* ***"High speed Networks TCP/IP and ATM Design Principles"****, Prentice-Hall, New York, 1995.*

4. *C.E Perkins,* ***"Ad Hoc Networking"****, Addison – Wesley, 2001.*

5. *Ian F. Akyildiz, Jiang Xie and Shantidev Mohanty,* ***" A Survey of mobility Management in Next generation All IP- Based Wireless Systems"****, IEEE Wireless Communications Aug.2004, pp 16-27.*

6. *A.T Campbell et al.,* ***" Comparison of IP Micromobility Protocols",*** *IEEE WirelessCommunications Feb.2002, pp 72-82.*

7. *C.Siva Rama Murthy and Mohan Gurusamy,* ***" WDM Optical Networks – Concepts, Design and Algorithms"****, Prentice Hall of India Pvt. Ltd, New Delhi –2002.*

P13CO*TE*05 SIMULATION OF COMMUNICATION SYSTEMS AND NETWORKS

L	T	P	C
3	0	0	3

UNIT I MODELLING OF COMMUNICATION SYSTEM **09**

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 SIMULATION OF RANDOM VARIABLES AND RANDOM PROCESS **09**

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 ESTIMATION OF PERFORMANCE MEASURES **09**

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 COMMUNICATION NETWORKS **09**

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 NETWORK OF QUEUES **09**

Queues in tandem, store and forward communication networks, capacity allocation, Congestion and flow chart, Routing model, Network layout and Reliability.

TOTAL: 45

TEXT BOOK

1. *M.C.Jeruchim, Philip Balaban and K.Sam Shanmugam, "**Simulation Of Communication Systems",** Plenum Press, New York,1992.*

REFERENCES

1. *A.M.Law and W.David Kelton, "**Simulation Modelling And Analysis",** Mc Graw Hill Inc., New York ,1991.*
2. *J.F.Hayes, **"Modelling and Analysis of Computer Communication networks",** Plenum Press, New York,1984.*
3. *Jerry Banks and John S.Carson, **"Discrete-event System Simulation",** Prentice Hall Inc., New Jersey,1984.*

P13CO*TE*06 GLOBAL POSITIONING SYSTEMS

L	T	P	C
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UNIT I **09**

History of GPS – BC-4 System – HIRAN – NNSS – NAVSTAR GLONASS and GNSS Systems – GPS Constellation – Space Segment – Control Segment – User Segment – Single and Dual Frequency – Point – Relative – Differential GPS – Static and Kinematic Positioning – 2D and 3D – reporting Anti Spoofing (AS); Selective Availability (SA) – DOP Factors.

UNIT II **09**

Coordinate Systems – Geo Centric Coordinate System – Conventional Terrestrial Reference System – Orbit Description – Keplerian Orbit – Kepler Elements – Satellite Visibility – Topocentric Motion – Disturbed Satellite Motion – Perturbed Motion – Disturbing Accelerations - Perturbed Orbit – Time Systems – Astronomical Time System
– Atomic Time – GPS Time – Need for Coordination – Link to Earth Rotation – Time and Earth Motion Services.

UNIT III **09**

C/A code; P-code; Y-code; L1, L2 Carrier frequencies – Code Pseudo Ranges – Carries Phases – Pseudo Ranges – Satellite Signal Signature – Navigation Messages and Formats – Undifferenced and Differenced Range Models – Delta Ranges – Signal Processing and Processing Techniques – Tracking Networks – Ephemerides – Data Combination: Narrow Lane; Wide Lane – OTF Ambiguity.

UNIT IV **09**

Propagation Media – Multipath – Antenna Phase Centre – Atmosphere in brief – Elements of Wave Propagation – Ionospheric Effects on GPS Observations – Code Delay – Phase Advances – Integer Bias – Clock Error – Cycle Slip – Noise-Bias – Blunders – Tropospheric Effects on GPS Oberservables – Multipath Effect – Antenna Phase Centre Problems and Correction.

UNIT V **09**

Inter Disciplinary Applications – Crystal Dynamics – Gravity Field Mapping – Atmospheric Occulation – Surveying – Geophysics – Air borne GPS – Ground Transportation – Space borne GPS – Metrological and Climate Research using GPS.

TOTAL: 45

TEXT BOOK

1. *B.Hoffman - Wellenhof, H.Lichtenegger and J.Collins, **"GPS: Theory and Practice",** 4th revised edition, Springer, Wein, New york,1997.*

REFERENCES

1. *A.Leick, **"GPS Satellites Surveying",** 2nd edition, John Wiley & Sons,NewYork,1995.*

2. *B.Parkinson, J.Spilker, Jr.(Eds), **"GPS: Theory and Applications",** Vol.I & Vol.II, AIAA, 370 L'Enfant Promenade SW, Washington, DC 20024, 1996.*

3 *A.Kleusberg and P.Teunisen(Eds), **"GPS for Geodesy",** Springer-Verlag, Berlin,1996.*

4 *L.Adams, **"The GPS - A Shared National Asset",** Chair, National Academy Press, Washington, DC, 1995.*

5. *http://www.auslig.gov.au*

6. *http://igscb.jpl.nasa.gov*

7. *http://gibs.leipzig.ifag.de*

8. *http://www.navcen.uscg.mil*

P13CO*TE*07 COMMUNICATION NETWORK SECURITY

L	T	P	C
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UNIT I BASIC SYMMETRIC CIPHERS **09**

OSI security Architecture- Model for network Security, Classical Encryption Techniques-Symmetric Cipher Model-Substitution Techniques-Transposition Techniques-Rotor Machines-Stegnography, Block Ciphers and Data Encryption Standard- Block Cipher Principles-Data Encryption Standard- Strength of DES-Block Cipher Design Principles

UNIT II ADVANCED SYMMETRIC CIPHERS **09**

AES Cipher- Multiple Encryption-Triple DES- Block Cipher Modes of Operation -Stream Ciphers and RC4, Confidentiality using Symmetric Encryption-Placement of Encryption Function, Traffic Confidentiality, Key Distribution and Random Number Generation.

UNIT III PUBLIC-KEY ENCRYPTION AND HASH FUNCTIONS **09**

Public Key Cryptography and RSA- Principles of Public Key Cryptosystems, RSA Algorithm, Key Management - Diffie-Hellman Key Exchange, Elliptic Curve arithmetic, Elliptic Curve Cryptography, Message Authentication and Hash Functions- Authentication Requirements, Authentication Functions, Message Authentication Codes, Hash Functions and MAC algorithms-Secure Hash Algorithm- HMAC, Digital Signatures,Digital Signature Standards.

UNIT IV NETWORK SECURITY AND WEB SECURITY **09**

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

UNIT V SYSTEM SECURITY **09**

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

TOTAL: 45

TEXT BOOK

1. *William Stallings, **"Cryptography and Network Security"**, fourth edition, Prentice Hall of India,New Delhi ,2006*

REFERENCES

1. *Behrouz A. Fourcuzan , **" Cryptography and Network security"** Tata McGraw- Hill,2008.*
2. *William Stallings, **"Network Security Essentials",** 2 ed. Prentice Hall of India, New Delhi, 2004.*

P13CO*TE*08 SATELLITE COMMUNICATION

L	T	P	C
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UNIT I ORBITAL MECHANICS **09**

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 SPACECRAFT SUB SYSTEMS AND EARTH STATION **09**

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 SPACE LINKS **09**

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 MULTIPLE ACCESS TECHNIQUES AND NETWORK ASPECTS **09**

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 SERVICES AND APPLICATIONS **09**

Mixed 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

TEXT BOOK

1. *Dennis Roddy, **"Satellite Communications",** Third Edition, Mc Graw Hill International Editions, 2001.*

REFERENCES

1. *Bruce R.Elbert, "**The Satellite Communication Applications Hand Book", Artech House Boston,1997.*

2. *Wilbur L.Pritchard, Hendri G.Suyderhood, Robert A.Nelson, "**Satellite Communication Systems Engineering", II Edition, Prentice Hall, New Jersey,1993.*

3 *Tri T.Ha, "**Digital Satellite Communication", 2nd Edition, McGraw Hill, New York, 1990.*

4 *Timothy Pratt and Charles W Bostian, " **Satellite Communications", John Wiley and Sons, 1986.*

5. *Emauel Fthenakis, " **Manual of Satllite Communications", McGraw Hill , 1984.*

6. *Ha.W.A, "**Digital Satellite Communications", PHI, 1999.*

7. *Coolen.M, " **Satellite Communication", IEEE Publication, 1999.*

8. *Robert M.Gagliardi , "**Satellite Communication", CBS Publishers, 1991.*

P13CO*TE*09 INTERNETWORKING MULTIMEDIA

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UNIT I INTRODUCTION TO MULTIMEDIA **09**

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 SUBNETWORK TECHNOLOGY **09**

Broadband services, ATM and IP, IPV6, High speed switching, resource reservation, Buffer management, traffic shaping, caching, scheduling, and policing, throughput, delay and jitter performance.

UNIT III MULTIMEDIA NETWORKING APPLICATIONS **09**

MIME, Peer- to-Peer computing, shared application, video conferencing, centralized and distributed conference control, distributed virtual reality, light weight session philosophy.

UNIT IV MULTIMEDIA COMMUNICATION STANDARDS **09**

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 MULTIMEDIA COMMUNICATION ACROSS NETWORKS **09**

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.

TOTAL: 45

TEXT BOOK

1. *Jon Crowcroft, Mark Handley, Ian Wakeman, **"Internetworking Multimedia",** Harcourt Asia Pvt. Ltd. Singapore, 1998.*

REFERENCES

1. *B.O. Szuprowicz,* ***"Multimedia Networking",*** *McGraw Hill, Newyork, 1995.*

2. *Tay Vaughan,* ***"Multimedia - Making it to work",*** *4ed, Tata McGraw Hill , NewDelhi, 2000.*

3. *K.R.Rao, Zoran S. Bojkovic and Dragorad A. Milovanovic,* ***"Multimedia Communication Systems"****, PHI , 2003.*

P13CO*TE*10 ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY IN SYSTEM DESIGN

L	T	P	C
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UNIT I EMI ENVIRONMENT **09**

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 EMI COUPLING PRINCIPLES **09**

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

UNIT III EMI/EMC STANDARDS AND MEASUREMENTS **09**

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 EMI CONTROL TECHNIQUES **09**

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

UNIT V EMC DESIGN OF PCBs **09**

PCB Traces Cross Talk, Impedance Control, Power Distribution Decoupling, Controlling differential mode radiation-Board Layout, Multilayer boards.

TOTAL: 45

TEXT BOOK

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

REFERENCES

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

P13CO*TE*11 HIGH PERFORMANCE COMMUNICATION NETWORKS

L	T	P	C
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UNIT I PACKET SWITCHED NETWORKS **09**

OSI and IP models, Ethernet (IEEE 802.3), Token ring (IEEE 802.5), Wireless LAN (IEEE 802.11) FDDI, DQDB, SMDS: Internetworking with SMDS.

UNIT II ISDN **09**

ISDN - overview, interfaces and functions, ISDN Layers – Physical, Data link and Network layers ISDN services - Signaling System 7 (SS7)..

UNIT III BROADBAND ISDN AND ATM **09**

BISDN: Broadband ISDN standards, services, architecture and Protocol reference model.
ATM: Main features-addressing, signaling and routing, ATM header structure- Adaptation Layer, management and control.

UNIT IV ADVANCED NETWORK ARCHITECTURE **09**

IP forwarding architectures overlay model, Multi Protocol Label Switching (MPLS), integrated services in the Internet, Resource Reservation Protocol (RSVP), Differentiated services.

UNIT V BLUE TOOTH TECHNOLOGY **09**

The Blue tooth module-Protocol stack Part I: Antennas, Simple RF architecture, The Link controller operation, Piconet and scatternet operation, Baseband/Link controller Architectural overview; The Blue tooth module-Protocol stack Part II: Logical link control and adaptation protocol – L2CAP signalling, Service discovery protocol, Wireless access protocol, Telephony control protocol

TOTAL: 45

TEXT BOOK

1. *Jean Walrand and Pravin Varaiya , **"High Performance Communication networks",** 2nd edition, Harcourt and Morgan Kauffman,London,2000.*

REFERENCES

1. *William Stallings, **"ISDN and Broadband ISDN with Frame Relay and ATM",** 4th edition, Pearson education Asia, 2002.*

P13CO*TE*12 HIGH SPEED SWITCHING ARCHITECTURE

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UNIT I HIGH SPEED NETWORK **09**

Introduction- LAN, WAN, Network evolution through ISDN to B-ISDN, Transfer mode and control of B-ISDN, SDH multiplexing structure, ATM standard, ATM adaptation layers.

UNIT II LAN SWITCHING TECHNOLOGY **09**

Switching Concepts, switch forwarding techniques, switch path control, LAN Switching, cut through forwarding, store and forward, virtual LANs

UNIT III ATM SWITCHING ARCHITECTURE **09**

Switch model, ATM,QOS, Blocking networks - basic - and- enhanced banyan networks, sorting networks - merge sorting, re-arrangable networks - full-and- partial connection networks, non blocking networks - Recursive network construction, comparison of non-blocking network, Switching with deflection routing - shuffle switch, tandem banyan

UNIT IV QUEUES IN ATM SWITCHES **09**

Internal Queuing -Input, output and shared queuing, multiple queuing networks – Combined Input, output and shared queuing - performance analysis of Queued switches.

UNIT V IP SWITCHING **09**

Addressing model, IP Switching types - flow driven and topology driven solutions, IP Over ATM address and next hop resolution, multicasting, Photonic switching - Photonic switching architectures.

TOTAL: 45

TEXT BOOK

1. *Achille Pattavina,* ***"Switching Theory: Architectures and performance in Broadband ATM networks ",*** *John Wiley & Sons Ltd, New York. 1998.*

REFERENCES

1. *Christopher Y Metz,* ***" Switching protocols & Architectures",*** *McGraw - Hill Professional Publishing, NewYork.1998.*
2. *Rainer Handel, Manfred N Huber, Stefan Schroder,* ***"ATM Networks - Concepts Protocols, Applications",*** *III Edition, Addison Wesley, New York. 1999.*
3 *John A.Chiong,* ***" Internetworking ATM for the internet and enterprise networks",*** *McGraw Hill, New York, 1998.*
4 *S.Kar and T.Srinivas,* ***"Optical fiber communications, Principles and Practice",*** *Tata Mc Graw Hill, 2002.*

P13CO*TE*13 DIGITAL COMMUNICATION RECEIVERS

L	T	P	C
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UNIT I OPTIMUM RECEIVERS FOR AWGN CHANNEL **09**

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

UNIT II RECEIVERS FOR FADING CHANNELS **09**

Characterization of fading multiple channels, statistical models, slow fading, frequency Selective fading, diversity technique and combining techniques, RAKE demodulator, coded waveform for fading Channel.

UNIT III SYNCHRONIZATION TECHNIQUES **09**

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 IV ADAPTIVE EQUALIZATION **09**

Zero forcing algorithm, LMS algorithm, Adaptive decision feedback equalizer, and Equalization of Trellis-coded signals, Kalman algorithm, blind equalizers, and stochastic Gradient algorithm.

UNIT V MULTIPLE –ANTENNA SYSTEMS **09**

Channel Models for Multiple Antenna Systems- Capacity of MIMO channel- Spread Spectrum signals and Multicode Transmission-Coding for MIMO Channels.

TOTAL: 45

TEXT BOOK

1. *John. G. Proakis, **"Digital Communication",** 4th ed., McGraw Hill, New York, 2001.*

REFERENCES

1. *John G. Proakis., and Masoud Salehi. **"Digital Communication",** McGraw- Hill International Edition, 2008.*
2. *E.A. Lee and D.G. Messerschmitt, **"Digital Communication",** 2nd edition, Allied Publishers, New Delhi, 1994.*
3. *Simon Marvin, **"Digital Communication Over Fading channel; An unified approach to performance Analysis",** John Wiley, New York, 2000.*
4. *Bernard Sklar, **"Digital Communication Fundamentals and Applications"**, Prentice Hall, 1998.*

P13CO*TE*14 **RF MEMS**

L	T	P	C
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UNIT I INTRODUCTION TO MEMS **09**

MEMS AND Microsystems, Miniaturization, Typical products, Micro sensors, Micro actuation, MEMS with micro actuators, Microaccelorometers and Micro fluidics, MEMS materials, Micro fabrication.

UNIT II MECHANICS FOR MEMS DESIGN **09**

Elasticity, Stress, strain and material properties, Bending of thin plates, Spring configurations, torsional deflection, Mechanical vibration, Resonance, Thermo mechanics actuators, force and response time, Fracture and thin film mechanics.

UNIT III ELECTRO STATIC DESIGN AND SYSTEM ISSUES **09**

Electrostatics: basic theory, electro static instability. Surface tension, gap and finger pull up, Electro static actuators, Comb generators, gap closers, rotary motors, inch worms, Electromagnetic actuators, bistable actuators, Electronic interfaces, Feed back systems, Noise, Circuit and system issues.

UNIT IV MEMS APPLICATIONS **09**

Case studies – Capacitive accelerometer, Peizo electric pressure sensor, Microfluidics application, Modeling of MEMS systems, CAD for MEMS.

UNIT V INTRODUCTION TO OPTICAL AND RF MEMS **09**

Optical MEMS, - System design basics – Gaussian optics, Matrix operations, resolution. Case studies, MEMS scanners and retinal scanning display, Digital Micro mirror devices. RF Mems – design basics, case study – Capacitive RF MEMS switch, Performance issues.

L:45 **TOTAL: 45**

TEXT BOOK

1. *Stephen Santuria*, "***Microsystems Design****", Kluwer Publishers, 2000.*
2. *N. P. Mahalik*, "***MEMS***", *Tata McGraw hill, 2007.*

REFERENCES

1. *Nadim Maluf, "**An Introduction to Micro electro mechanical system design**", Artech House, 2000.*
2. *Mohamed Gad-el-Hak, editor,"**The MEMS Handbook**", CRC press Baco Raton, 2000.*
3 *Tai Ran Hsu, "**MEMS & Micro systems Design and Manufacture**", Tata McGraw hill, New Delhi, 2002.*
4 *Liu, "**MEMS**", Pearson education, 2007.*

P13CO*TE*15 SPACE TIME WIRELESS COMMUNICATION SYSTEMS

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On completion of the course, the students are expected

- To understand the MIMO channel characteristics
- To understand capacity of MIMO channel and special diversity.
- To acquire knowledge in the concepts of Space Time coding.
- To acquire knowledge in the concepts of ST OFDM , Multiuser detection
- To know the limitations of MIMO channel.

UNIT I MULTIPLE ANTENNA PROPAGATION AND ST CHANNEL CHARACTERIZATION **09**

Wireless channel, Scattering model in macrocells, Channel as a ST random field, Scattering functions, Polarization and field diverse channels, Antenna array topology, Degenerate channels, reciprocity and its implications, Channel definitions, Physical scattering model, Extended channel models, Channel measurements, sampled signal model, ST multiuser and ST interference channels, ST channel estimation

UNIT II CAPACITY OF MULTIPLE ANTENNA CHANNELS AND SPATIAL DIVERSITY **09**

Capacity of frequency flat deterministic MIMO channel: Channel unknown to the transmitter, Channel known to the transmitter, capacity of random MIMO channels, Influence of ricean fading, fading correlation, XPD and degeneracy on MIMO capacity, Capacity of frequency selective MIMO channels, Diversity gain, Receive antenna diversity, Transmit antenna diversity, Diversity order and channel variability, Diversity performance in extended channels, Combined space and path diversity ,Indirect transmit diversity, Diversity of a space-time-frequency selective fading channel.

UNIT III MULTIPLE ANTENNA CODING AND RECEIVERS **09**

Coding and interleaving architecture, ST coding for frequency flat channels, ST coding for frequency selective channels, Receivers(SISO,SIMO,MIMO),Iterative MIMO receivers, Exploiting channel knowledge at the transmitter: linear pre-filtering, optimal pre-filtering for maximum rate, optimal pre-filtering for error rate minimization, selection at the transmitter, Exploiting imperfect channel knowledge.

UNIT IV ST OFDM, SPREAD SPECTRUM AND MIMO MULTIUSER DETECTION **09**

SISO-OFDM modulation, MIMO-OFDM modulation, Signaling and receivers for MIMO-OFDM,SISO-SS modulation, MIMO-SS modulation, Signaling and receivers for MIMO-SS.MIMO-MAC,MIMO-BC, Outage performance for MIMO-MU,MIMO-MU with OFDM,CDMA and multiple antennas

UNIT V ST CO-CHANNEL INTERFERENCE MITIGATION AND PERFORMANCE LIMITS IN MIMO CHANNELS **09**

CCI characteristics, Signal models, CCI mitigation on receive for SIMO,CCI mitigating receivers for MIMO,CCI mitigation on transmit for MISO, Joint encoding and decoding, SS modulation, OFDM modulation, Interference diversity and multiple antennas, Error performance in fading channels, Signaling rate vs PER vs SNR, Spectral efficiency of ST doing/receiver techniques, System Design, Comments on capacity

L+ T: 45+0 = 45 **TOTAL: 45**

TEXT BOOK

1. *A. Paulraj, Rohit Nabar, Dhananjay Gore., "**Introduction to Space Time WirelessCommunication Systems**", Cambridge University Press, 2003*

REFERENCES

1. *Sergio Verdu " **Multi User Detection** " Cambridge University Press, 1998*
2. *Andre Viterbi " **Principles of Spread Spectrum Techniques** " Addison Wesley 1995*

P13CO*TE*16 SPREAD SPECTRUM TECHNIQUIES

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UNIT I PERFORMANCE CHARACTERIZATION OF DIGITAL DATA TRANSMISSION 09

Detection of binary signals in AWGN - Quadrature multiplexed signalling schemes - Signalling through band limited channels - Equalization of digital data transmission system - Realization imperfections - Degradations in performance. Communication in the presence of pulse noise jamming - Low probability detection scheme - Direct Sequence Spread Spectrum (DSSS) and Frequency Hop Spread Spectrum Systems and examples of Spread Spectrum Systems.

UNIT II SPREAD SPECTRUM SYSTEMS 09

Direct sequence spread spectrum methods employing BPSK, QPSK and MSK - Frequency Hop spread spectrum methods - Coherent slow frequency Hop technique - Non coherent slow and fast frequency Hop spread spectrum techniques - Hybrid DS/FH spread spectrum - Complex envelope representation of spread spectrum systems.

UNIT III BINARY SHIFT REGISTER SEQUENCES FOR SPREAD SPECTRUM SYSTEMS 09

Definition - PN sequence generator fundamentals - Maximal length sequences - Properties, Power spectrum and Polynomial tables for maximal length sequences - Gold codes - Rapid Acquisition systems - Non-linear code generators.

UNIT IV SYNCHRONIZATION OF SPREAD SPECTRUM SYSTEMS 09

Optimal tracking of wideband signals - Early-late tracking loops - Code tracking loops for FHSS - Optimum synchronization techniques - Multiple dwell and sequential detectors - Synchronization using a matched filter - Synchronization by estimating the received spreading code.

UNIT V PERFORMANCE OF SPREAD SPECTRUM SYSTEM **09**

SS Systems communications models - Performance without coding under AWGN and different jamming environments - spread spectrum systems performances with forward error correction - Block coding - Convolutional coding and specific error correcting codes - Inter leaving - Random coding bounds.

L+ T: 45+0 = 45 **TOTAL: 45**

TEXT BOOK

1. *Ziemer R E and Peterson R L, "**Digital Communication and Spread Spectrum Systems",** Macmillan Publishing Co., 1985.*

REFERENCES

1. *Dixon R C, "**Spread Spectrum Systems"**, Wiley Interscience, 1976.*
2. *Holms J K, "**Coherent Spread Spectrum Systems",** Wiley Interscience, 1982.*

P13CO*TE*17 **WIRELESS NETWORKS**

L	T	P	C
3	0	0	3

UNIT I PHYSICAL AND WIRELESS MAC LAYER ALTERNATIVES **09**

Wired transmission techniques: design of wireless modems, power efficiency, out of band radiation, applied wireless transmission techniques, short distance base band transmission, VWB pulse transmission, broad Modems for higher speeds, diversity and smart receiving techniques, random access for data oriented networks, integration of voice and data traffic.

UNIT II WIRELESS NETWORK PLANNING AND OPERATION **09**

Wireless networks topologies, cellular topology, cell fundamentals signal to interference ratio calculation, capacity expansion techniques, cell splitting, use of directional antennas for cell sectoring, micro cell method, overload cells, channels allocation techniques and capacity expansion FCA, channel borrowing techniques, DCA, mobility management, radio resources and power management securities in wireless networks. .

UNIT III WIRELESS WAN **09**

Mechanism to support a mobile environment, communication in the infrastructure, IS-95 CDMA forward channel, IS – 95 CDMA reverse channel, pallert and frame formats in IS – 95, IMT – 2000; forward channel in W-CDMA and CDMA 2000, reverse channels in W-CDMA and CDMA-2000, GPRS and higher data rates, short messaging service in GPRS mobile application protocols.

UNIT IV WIRELESS LAN **09**

Historical overviews of the LAN industry, evolution of the WLAN industry, wireless home networking, IEEE 802.11. The PHY Layer, MAC Layer, wireless ATM, HYPER LAN, HYPER LAN – 2.

UNIT V WPAN ANDGEOLOCATION SYSTEMS **09**

IEEE 802.15 WPAN, Home RF, Bluetooth, interface between Bluetooth and 802.11, wireless geolocation technologies for wireless geolocation, geolocation standards for E.911 service.

TOTAL: 45

TEXT BOOK

1. *Kaveh Pahlavan, Prashant Krishnamoorthy,* ***Principles of Wireless Networks****, - A united approach - PearsonEducation,2002.*
2. *Jochen Schiller,* ***Mobile Communications****, Person Education – 2003, 2nd Edn.*

REFERENCES

1. *X.Wang and H.V.Poor,* ***Wireless Communication Systems****, Pearson education, 2004.*
2. *M.Mallick,* ***Mobile and Wireless design essentials****, Wiley Publishing Inc. 2003.*
3. *P.Nicopolitidis, M.S.Obaidat, G.I. papadimitria, A.S. Pomportsis,* ***Wireless Networks****, John Wiley & Sons, 2003*

P13CO*TE*18 ADVANCED OPTICAL COMMUNICATION

L	T	P	C
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UNIT I FIBER OPTIC GUIDES **09**

Light wave generation systems, system components, optical fibres, SI, GI, fibres, modes, Dispersion in fibres, limitations due to dispersion, Fiber loss, non linear effects. Dispersion shifted and Dispersion flattened fibres.

UNIT II OPTICAL TRANSMITTERS AND RECEIVERS **09**

Basic concepts, LED's structure spectral distribution, semiconductor lasers, gain coefficients, modes, SLM and STM operation, Transmitter design, Receiver PIN and APD diodes design, noise sensitivity and degradation, Receiver amplifier design.

UNIT III LIGHT WAVE SYSTEM **09**

Coherent, homodyne and heterodyne keying formats, BER in synchronous – and asynchronous – receivers, sensitivity degradation, system performance, Multichannel, WDM, multiple access networks, WDM components, TDM, Subcarrier and Code division multiplexing.

UNIT IV AMPLIFIERS **09**

Basic concepts, Semiconductor laser amplifiers, Raman – and Brillouin – fiber amplifiers, Erbium doped – fiber amplifiers, pumping phenomenon, LAN and cascaded in-line amplifiers.

UNIT V DISPERSION COMPENSATION **09**

Limitations, Post- and Pre- compensation techniques, Equalizing filters, fiber based gratings, Broad band compensation, soliton communication system, fiber soliton, Soliton based communication system design, High capacity and WDM soliton system.

TOTAL: 45

TEXT BOOK

1. *G.P. Agarwal,* ***"Fiber optic communication systems",*** *2nd Ed, John Wiley & Sons, New York, 1997.*

REFERENCES

1. *Franz & Jain,* ***"Optical Communication Systems",*** *Narosa Publications,NewDelhi,1995.*
2. *G. Keiser,* ***"Optical fiber communication systems",*** *McGraw-Hill, New York, 2000.*
3. *Franz & Jain,* ***"Optical communication, Systems and components",*** *Narosa Publications,New Delhi, 2000.*

P13CO*TE*19 NON LINEAR FIBER OPTICS AND SIGNAL PROCESSING

L	T	P	C
3	0	0	3

UNIT I NONLINEAR PHENOMENA IN OPTICAL MATERIALS **09**

Optical power, wave length dependent nonlinearity, First, Second and Third order effects, Refractive index dependence on optical power, Chirping, Pulse compression, Solitons, Photon mixing, Faraday and Kerr effects, Optical phase conjugation.

UNIT II SCATTERING **09**

Raman and Brillonin scattering, Four photon mixing, Parametric process, Stokes line generation.

UNIT III SPATIAL FILTERING AND FILTERING SYSTEM **09**

Types of spatial filters, optical signal processing and filter generation, read out module, orientation and sequential search, applications of optical spatial filter.

UNIT IV ACOUSTO-OPTIC DEVICES AND POWER SPECTRUM ANALYSIS **09**

Acousto-optic cells, spatial light modulators, Raman – Nath and Bragg mode, basic spectrum analyzer, aperture weighting, dynamic range and SNR, photo detector, geometric considerations, radiometer.

UNIT V HOMODYNE AND HETERODYNE SPECTRUM ANALYSERS **09**

Overlapping of waves, photo detector size, optimum photo detector size for 1D and 2D structure, Optical radio, spatial and temporal frequencies. Distributed and local oscillator. Dynamic range comparison of heterodyne and power spectrum analysers.

TOTAL: 45

TEXT BOOK

1. *Govind P.Agarwal, **" Nonlinear Fiber Optics",** AT&T – Academic Press, 1989*

REFERENCES

1. *Vanderlught, **"Optical Signal Processing",** John Wiley & Sons, New York, 1992.*
2. *P.K. Das, **"Optical Signal Processing Fundamentals",** Narosa Publishing New Delhi,1991.*
3 ***"Signal Processing wing optics"** Bradley G. Boone, Oxford University Press, 1998.*

P13CO*TE*20 SOLITONS IN OPTICAL COMMUNICATION

L	T	P	C
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UNIT I INTRODUCTION **09**

Elastic properties of dielectric fiber, Loss dispersion, birefringence, Non-Linear properties – Kerr, Raman and Brillouin effects, Non Linear SchrÖdinger equation and a solitary wave solution. Parameters for Soliton transmission.

UNIT II INVERSE SCATTERING TRANSFORM AND PERTURBATION METHODS **09**

Lax theory – Inverse Scattering transforms – Soliton solutions – Perturbation methods – Conservation Laws – Stability.

UNIT III SOLITON RESHAPING AND TRANSMISSION CONTROL **09**

Reshaping schemes – Lie transformation – guiding centre soliton – Soliton transmission control: The Gordon Haus limit, Guiding filter, Soliton control in frequency and time domains, Synchronization techniques.

UNIT IV INTERACTION BETWEEN SOLITONS **09**

Two soliton interaction in the same element, suppression, Soliton interaction in different channels: Wavelength division multiplexing, Briefringence effects and polarization division multiplexing.

UNIT V SOLITON TRANSMISSION EXPERIMENTS AND APPLICATIONS **09**

Reshaping of solitons in Erbium doped fiber amplifiers and Raman amplifiers, long distance soliton transmission. Soliton laser, Optical soliton switching. Spatial soliton application.

TOTAL: 45

TEXT BOOK

1. *Akira Hazegawa and Yuji Kodama, **"Solitons in Optical Communication",** Oxford University Press Inc, Oxford, 1995.*

REFERENCES

1. *Iannone Engenio, Matera Francesco, Mecozzi Antonio & Settembre Marina, **"Non Linear Optical Communication Networks",** John Wiley and Sons, New York, 1998.*

2. *Govind P.Agarwal, **"Non Linear fiber Optics",** Academic Press, New York, 1995.*

P13CO*TE*21 OPTICAL WAVEGUIDE THEORY

L	T	P	C
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UNIT I UNIFORM PLANE WAVES 09

Plane wave propagation, reflection, scattering and absorption. Plane wave dispersion, Ray optics, Reflection at interfaces, Goos – Hanchen shift, Wave propagation in lossy media.

UNIT II DIELECTRIC FILMS 09

Film modes, guided modes of the symmetrical slab waveguide, filed solutions for guided modes, guided mode absorption, scattering, slabs and films with graded index.

UNIT III PLANAR WAVEGUIDES 09

Film lenses and lens guides, strip guides, strip loaded film guides, Rib guides. Modes of planar slab guides, planar guides with graded index profile, channel waveguides, periodic wave guides.

UNIT IV CLADDED CORE FIBERS 09

Ray picture, field solutions, guided modes for unlimited cladding, leaky modes, guided modes attenuation. Single and multimode fibers.

UNIT V GRADED INDEX FIBERS 09

Ray analysis, filed solutions for modes in parabolic profile, multimode graded index fibers, variational analysis, single mode operation, Delay difference and impulse responses.

TOTAL: 45

TEXT BOOK

1. *Snyder & Love **"Optical Waveguide Theory",** Chapman and Hall, New York, 1983.*

REFERENCES

1. *H.G. Unger, **"Planar Optical Waveguides and Fibers",** Oxford University press, Oxford, 1980.*
2. *Tamir. T, **"Guided Wave Optoelectronics",** Springer Verlag, Berlin, 1990.*
3. *G.Cancellieri, **"Single Mode Optical Fibers",** Pergramon press, New York, 1991.*
5. *D.Marcuse, **"Light transmission optics",** Von Nostrand Publication, New York, 1972.*
6. *D.Marcuse, **"Theory of Dielectric Waveguides",** Von Nostrand Publication, New York, 1975.*
7. ***"Guided – Wave photonics",** A. Bruce Buckman Oxford University Press, 1992.*

P13CO*TE*22 SATELLITE ARCHITECTURE & COMMUNICATION

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UNIT I SATELLITE MISSION AND ORBITS 09

Mission Overview – Planning – Analysis _ Operations - Orbital Mechanics – Orbit Perturbations – Special orbits – Space Environment, Spacecraft configuration.

UNIT II SPACECRAFT CONFIGURATION AND SPACECRAFT POWER SYSTEM 09

Spacecraft Bus – Payload – Requirements and constraints – Initial configuration decisions and Trade-offs – Spacecraft configuration process – Broad design of Spacecraft Bus – Subsystem layout-Power sources – Energy storage – Spacecraft Power management – Power distribution.

UNIT III SPACECRAFT ATTITUDE AND ORBIT CONTROL SYSTEM (AOCS) 09

Coordinate system – AOCS requirements – Environment effects – Attitude stabilization – Attitude sensors – Actuators – Design of control algorithms.

UNIT IV PROPULSION SYSTEMS, STRUCTURES AND THERMAL CONTROL 09

Systems Trade-off – Mono-propellant systems – Thermal consideration – System integration design factors – Pre-flight test requirements – System reliability Configuration design of Spacecraft structure – Structural elements – Material selection – Environmental Loads – Structural fabrication –Orbital environments - Average temperature in Space – Transient temperature evaluation – Thermal control techniques – Temperature calculation for a spacecraft – Thermal design and analysis program structure – Thermal design verification – Active thermal control techniques.

UNIT V SATELLITE TELEMETRY, TRACKING AND TELECOMMAND 09

Base Band Telemetry system – Modulation – TT & C RF system – Telecomm and system

TOTAL: 45

TEXT BOOK

1. ***"Space Mission Analysis and Design (Third Edition)"*** *by James R.Wertz and Wiley J.Larson – 1999.*

REFERENCES

1. *James R.Wertz* ***"Spacecraft Attitude Determination and Control****", Kluwer Academic Publisher, 1988.*
2. *Marcel J.Sidi* ***"Spacecraft Dynamics and Control",*** *Cambridge University press, 1997.*
3. *Lecture notes on* ***" Satellite Architecture",*** *ISRO Satellite Centre Bangalore – 560 017*

P13CO*TE*23 SPEECH AND AUDIO SIGNAL PROCESSING

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UNIT I MECHANICS OF SPEECH **09**

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 **09**

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 **09**

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 LINEAR PREDICTIVE ANALYSIS OF SPEECH **09**

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 **09**

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

TEXT BOOK

1. *Ben Gold and Nelson Morgan, **"Speech and Audio Signal Processing",** John Wiley and Sons Inc. , Singapore, 2004.*

REFERENCES

1. *L.R.Rabiner and R.W.Schaffer,* ***"Digital Processing of Speech signals"****, Prentice Hall -1978.*

2. *Quatieri,* ***"Discrete-time Speech Signal Processing",*** *Prentice Hall, 2001.*

3 *J.L.Flanagan,* ***" Speech analysis: Synthesis and Perception",****2nd edition, Berlin,1972.*

4 *I.H.Witten,* ***" Principles of Computer Speech"****, Academic Press,1982.*

P13CO*TE*24 **RESEARCH METHODOLOGY**

L	T	P	C
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UNIT I RESEARCH CONCEPTS **06**

Concepts, meaning, objectives, motivation, types of research, approaches, research (Descriptive research, Conceptual, Theoretical, Applied & Experimental).

Formulation of Research Task – Literature Review, Importance & Methods, Sources, quantification of Cause Effect Relations, Discussions, Field Study, Critical Analysis of Generated Facts, Hypothetical proposals for future development and testing, selection of Research task.

UNIT II MATHEMATICAL MODELING AND SIMULATION **06**

Concepts of modeling, Classification of Mathematical Models, Modeling with Ordinary differential Equations, Difference Equations, Partial Differential equations, Graphs, Simulation, Process of formulation of Model based on Simulation..

UNIT III EXPERIMENTAL MODELING **06**

Definition of Experimental Design, Examples, Single factor Experiments, Guidelines for designing experiments. Process Optimization and Designed experiments, Methods for study of response surface, determining optimum combination of factors, Taguchi approach to parameter design.

UNIT IV ANALYSIS OF RESULTS **06**

Parametric and Non-parametric, descriptive and Inferential data, types of data, collection of data (normal distribution, calculation of correlation coefficient), processing, analysis, error analysis, different methods, analysis of variance, significance of variance, analysis of covariance, multiple regression, testing linearity and non-linearity of model.

UNIT V REPORT WRITING **06**

Types of reports, layout of research report, interpretation of results, style manual, layout and format, style of writing, typing, references, tables, figures, conclusion, appendices.

TOTAL: 45

TEXt BOOK

1. *R. Panneerselvam, **"Reseach Methodology",** PHI 2004.*

REFERENCES

1. *Douglas Montgomary, **"Design of Experiments, Statistical Consulting Services",** 1990.*
2. *Douglas H. W. Allan, **"Statistical Quality Control: An Introduction for Management",** Reinhold Pub Corp, 1959.*
3. *Cochran and Cox, **"Experimental Design, John Willy & Sons",** 2nd Edition , May 1992*
4. *S. S. Rao, **"Optimization Theory and Application",** Wiley Eastern Ltd., New Delhi,1996.*
5. *C. R. Kothari, **"Research Methodology",** New Age Publishers, 2005.*

P13AE*TE*01 ADVANCED DIGITAL IMAGE PROCESSING

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UNIT I IMAGE REPRESENTATION AND TRANSFORMS **09**

Image representation - Gray scale and color Images, image sampling and quantization. Two dimensional orthogonal transforms - DFT, FFT, Haar transform, KLT, DCT.

UNIT II IMAGE ENHANCEMENT AND RESTORATION **09**

Filters in spatial and frequency domains, histogram-based processing, homomorphic filtering. Image Restoration - PSF, circulant and block-circulant matrices, deconvolution, restoration using inverse filtering, Wiener filtering and maximum entropy-based methods.

UNIT III MORPHOLOGICAL OPERATIONS AND EDGE DETECTION **09**

Edge detection - Non parametric and model based approaches, LOG filters, localization problem. Mathematical morphology - binary morphology, dilation, erosion, opening and closing, duality relations, gray scale morphology, applications such as hit-and-miss transform, thinning and shape decomposition.

UNIT IV TEXTURE ANALYSIS AND COMPUTER TOMOGRAPHY **09**

Computer tomography - parallel beam projection, Radon transform, and its inverse, Back projection operator, Fourier-slice theorem, CBP and FBP methods, ART, Fan beam projection. Image texture analysis - co-occurrence matrix, measures of textures, statistical models for textures - Hough Transform, boundary detection, chain coding and segmentation, thresholding methods.

UNIT V IMAGE COMMUNICATION **09**

JPEG, MPEGs and H.26x standards, packet video, error concealment.

TOTAL: 45

TEXT BOOK

1. *Rafael C. Gonzalez and Richard E. Woods, **"Digital Image Processing**", Pearson education, 2nd Edition,2002.*

REFERENCES

1. *A. K. Jain, **"Fundamentals of digital image processing",** Prentice Hall of India, 1989.*
2. *R.M. Haralick, and L.G. Shapiro, **"Computer and Robot Vision",** Vol-1, Addison Wesley, Reading, MA, 1992.*
3. *R. Jain, R. Kasturi and B.G. Schunck, **"Machine Vision",** McGraw-Hill International Edition, 1995.*
4. *W. K. Pratt, **"Digital Image Processing",** Prentice Hall, 1989.*

P13AE*TE*08 **SOFT COMPUTING**

L	T	P	C
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UNIT I ARTIFICIAL NEURAL NETWORKS **09**

Supervised learning Neural networks-Introduction, Perception- Adaline, Back propagation- Multi layer perception- Unsupervised learning and other Neural networks-Introduction, Competitive learning networks, Kolonen self organizing networks, Learning vector quantization, Hebbian learning, Hopfield network , Content addressable nature, Binary Hopfield network, Continuous-valued Hopfield network , Travelling Salesperson problem.

UNIT II FUZZY SET THEORY **09**

Fuzzy sets, Basic definitions and terminology, Member function formulation & parameterization, Fuzzy rules , fuzzy reasoning - Extension principle, Fuzzy relation, Fuzzy inference systems: Mamdani model, Sugeno model. Tsukamoto model, Input space partitioning, Fuzzy modeling.

UNIT III OPTIMIZATION **09**

Derivative based optimization-Descent methods, Method of steepest descent, Classical Newtons method, Step-size determination; Derivative free optimization- Genetic algorithm, Simulated annealing, Random search, Downhill search.

UNIT IV ADVANCED NEURO-FUZZY MODELLING **09**

Classification and regression trees:decision tress, Cart algorithm – Data clustering algorithms: K means clustering, Fuzzy C means clustering, Mountain clustering, Subtractive clustering – rule base structure , Input space partitioning, rule based organization, focus set based rule combination; Neuro fuzzy control: Feedback Control Systems, Expert Control, Inverse Learning, Specialized Learning, Back propagation through Real –Time Recurrent Learning.

UNIT V GENETIC ALGORITHM **09**

Fundamentals of genetic algorithm- Basic concepts, creation of offsprings, Working principle , Encoding – Binary, Octal , Hex, Permutation, Value and tree, Reproduction-Roulette-wheel selection, Boltzman selection, Tournament selection, Rank selection, Steady state selection, Crossover single site, Two point, Multi point, Uniform and matrix, Crossover rate, Inversion , Deletion and duplication ,Deletion and Regeneration, Segregation, Crossover, Mutation, Generational cycle.

TOTAL: 45

TEXT BOOK

1. *Jang J.S.R.,Sun C.T and Mizutani E, **"Neuro Fuzzy and Soft computing",** Pearson education (Singapore) 2004.*

REFERENCES

1. *S.Rajasekaran and G.A.Vijayalakshmi Pai,* ***"Neural networks,Fuzzy logics,and Genetic algorithms",*** *Prentice Hall of India,2003.*

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.*

P13AE*TE*09 DSP PROCESSOR ARCHITECTURE AND PROGRAMMING

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UNIT I FUNDAMENTALS OF PROGRAMMABLE DSPs **09**

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

UNIT II TMS320C5X PROCESSOR **09**

Architecture – Assembly language syntax - Addressing modes – Assembly language Instructions - Pipeline structure, Operation – Block Diagram of DSP starter kit – Application Programs for processing real time signals.

UNIT III TMS320C3X PROCESSOR **09**

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 – Introduction to code composer studio

UNIT IV ADSP PROCESSORS **09**

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

UNIT V ADVANCED DSP PROCESSORS **09**

Architecture of TMS320C54X: Pipe line operation, Code Composer studio - Architecture of TMS320C6X - Architecture of Motorola DSP563XX – Comparison of the features of DSP family processors**.**

TOTAL: 45

TEXT BOOK

1. *B.Venkataramani and M.Bhaskar,* ***"Digital Signal Processors – Architecture, Programming and Applications",*** *Tata McGraw – Hill Publishing Company Limited, New Delhi, 2003.*

REFERENCES

1. *User guides Texas Instrumentation, Analog Devices, Motorola.*

P13AE*TE*17 **MACHINE VISION**

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UNIT I MACHINE VISION **09**

Introduction – Machine vision –Relationship to other fields –Image definitions levels of computation- Binary image processing – Thresholding Geometric properties – position –orientation –Run length encoding -Binary algorithms – Definitions - Component labeling –Size filter –Euler number –Region boundary –Area perimeter – compact Distance measures- Distance transforms – Medial axis – Thinning expanding and shrinking –morphological operators.

UNIT II REGIONS **09**

Regions and Edges - Regions segmentation – Automatic thresholding, Limitations of Histogram methods – Region representation – array representation - Hierarchical representation - Split and merge – region merging –Removing weak edges –Region splitting - split and merge – Region growing.

UNIT III EDGE DETECTION **09**

Gradient – Steps in edge deduction –Roberts operator –sober operator – pewit operator –Comparison Second derivative operator, Laplacian operator, Second derivative Image approximation – Gaussian edge Detection –Canny edge detector –Subpixel location estimation –Edge detector performance-methods of Evaluating performance – Figure of merit –Sequential methods – Line detection.

UNIT IV OPTICS SHADING **09**

Optics – lens equation –Image resolution –Depth of Field view volume –Exposure- shading – Image Inductance –Illumination – Reflector –Surface orientation –shape from shading depth –Stereo imaging –Cameras in arbitrary position and orientation –Stereo matching –Edge matching – Region correlation shape from X – Range imaging – structural lighting – Imaging Radar- Active vision.

UNIT V DYNAMIC VISION & OBJECT RECOGNITION **09**

Change detection –Difference pictures – Static segmentation and matching –object recognition – system components – complexity of object recognition – object representation -observer -centered – object centered representations – feature detection –recognition strategies – classification – Matching Feature indexing - verification – Temperature matching –morphological approach – symbolic – analogical methods.

TOTAL: 45

TEXT BOOK

1. *Ramesh Jain, Rangachar Kasturi and Brian G. Schunck, **"Machine Vision",** McGraw Hill International Edition, 2006.*
2. *Anil K. Jain, **"Fundamentals of Digital Image Processing",** PHI, 2006*

REFERENCES

1. *Gregory A Baxes, **"Digital Image Processing",** John Wiley & Sons, 1994.*
2. *W.K. Pratt, **"Digital Image Processing",** John Wiley and Sons, 2001.*

P13AE*TE*18 **MACHINE LEARNING**

L	T	P	C
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UNIT I INTRODUCTION **09**

Learning Problems – Perspectives and Issues – Concept Learning – Version Spaces and Candidate Eliminations – Inductive bias – Decision Tree learning – Representation – Algorithm – Heuristic Space Search.

UNIT II NEURAL NETWORKS AND GENETIC ALGORITHMS **09**

Neural Network Representation – Problems – Perceptrons – Multilayer Networks and Back Propagation Algorithms – Advanced Topics – Genetic Algorithms – Hypothesis Space Search – Genetic Programming – Models of Evalution and Learning

UNIT III BAYESIAN AND COMPUTATIONAL LEARNING **09**

Bayes Theorem – Concept Learning – Maximum Likelihood – Minimum Description Length Principle – Bayes Optimal Classifier – Gibbs Algorithm – Naïve Bayes Classifier – Bayesian Belief Network – EM Algorithm – Probability Learning – Sample Complexity – Finite and Infinite Hypothesis Spaces – Mistake Bound Model.

UNIT IV INSTANT BASED LEARNING **09**

K- Nearest Neighbour Learning – Locally weighted Regression – Radial Bases Functions – Case Based Learning.

UNIT V ADVANCED LEARNING **09**

Learning Sets of Rules – Sequential Covering Algorithm – Learning Rule Set – First Order Rules – Sets of First Order Rules – Induction on Inverted Deduction – Inverting Resolution – Analytical Learning – Perfect Domain Theories – Explanation Base Learning – FOCL Algorithm – Reinforcement Learning – Task – Q Learning – Temporal Difference Learning

TOTAL: 45

TEXT BOOK

1. *Tom M. Mitchell,* ***"Machine Learning",*** *New Delhi: McGraw-Hill Science/Engineering/ Math, 1997.*

REFERENCES

1. *Ethem Alpaydin,* ***" Introduction to Machine Learning (Adaptive Computation and Machine Learning)",*** *New Delhi: The MIT Press ,2004.*
2. *T. Hastie, R. Tibshirani and J. H. Friedman,* ***"The Elements of Statistical Learning",*** *New York: Springer, 2001.*

P13AE*TE*19 PATTERN RECOGNITION AND ARTIFICIAL INTELLIGENCE

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UNIT I PATTERN CLASSIFIER **09**

Overview of pattern recognition -Discriminant functions-Supervised learning –Parametric estimation- Maximum likelihood estimation –Bayesian parameter estimation- Perceptron algorithm-LMSE algorithm – Problems with Bayes approach –Pattern classification by distance functions-Minimum distance pattern classifier

UNIT II UNSUPERVISED CLASSIFICATION **09**

Clustering for unsupervised learning and classification - Clustering concept-C-means algorithm-Hierarchical clustering procedures- Graph theoretic approach to pattern clustering - Validity of clustering solutions.

UNIT III STRUCTURAL PATTERN RECOGNITION **09**

Elements of formal grammars-String generation as pattern description - recognition of syntactic description- Parsing-Stochastic grammars and applications - Graph based structural representation.

UNIT IV FEATURE EXTRACTION AND SELECTION **09**

Entropy minimization - Karhunen-Loeve transformation-feature selection through functions approximation- Binary feature selection.

UNIT V RECENT ADVANCES **09**

Neural network structures for Pattern Recognition –Neural network based Pattern associators-Unsupervised learning in neural Pattern Recognition-Self organizing networks-Fuzzy logic-Fuzzy classifiers-Pattern classification using Genetic Algorithms.

TOTAL: 45

TEXT BOOK

1. *R.O Duda, P.E Hart and Strok, **"Pattern Classification",** Wiley, 2001.*

REFERENCES

1. *Robert J. Sehalkoff, **"Pattern Recognition: Statistical, Structural and Neural Approaches",** John Wiley & Sons Inc., 2007.*
2. *Tou Gonzales, **"Pattern Recognition Principles",** Wesley Publication Company, 2000.*
3 *Morton Nadier and P. Eric Smith, **"Pattern Recognition Engineering",** John Wiley & Sons, 2000.*
4 *IEEE Transaction on Pattern Recognition Technique, 2006.*
5. *IEEE Engineering Medicine and Biology Magazine, 2006*

P13AE*TE*20 IMAGE PROCESSING AND PATTERN RECOGNITION

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UNIT I IMAGE REPRESENTATION **09**

Principles of digital aerial photography- Sensors for aerial photography - camera mounts - quantization, Image Basis Function, Two dimensional DFT, Discrete cosine Transform, Walsh- transform, wavelet transform, principal component analysis.

UNIT II IMAGE ENHANCEMENT AND RESTORATION **09**

Edge Detection, Thresholding, Half toning, Median filtering, Histogram Equalization, Homomorphic PSFs for Different forms of Blur- Defocused lens with circular aperture- Uniform Motion Blur, Long atmospheric Blur.

UNIT III IMAGE COMPRESSION **09**

Transform coding, Predictive compression methods, Vector quantization, Hierarchical and Pr compression methods, JPEG, Video coding, Motion Estimation, MPEG-Lossless compression, coding, Run length coding and Arithmetic coding.

UNIT IV IMAGE ANALYSIS **09**

Segmentation, Thresholding, Edge based and Region based – shape representation and description based and Region based texture- statistical texture description – syntactic texture description.

UNIT V PATTERN RECOGNITION **09**

Linear Discriminant Analysis- Baye's classifier – Neural net- Feed forward, unsupervised learning, nets- fuzzy system-optimization techniques in Recognition-Genetic algorithm- Simulated annealing.

TOTAL: 45

TEXT BOOK

1. *Gonzalez R. C. and Woods R.E.,* ***"Digital Image Processing",*** *Prentice Hall, 2002*
2. *Jain A.K.,* ***"Fundamentals of Digital Image Processing",*** *Prentice Hall, 1989.*
3. *William K. Pratt,* ***"Digital Image Processing",*** *John Wiley, 2001.*

REFERENCES

1. *Sonka M,* ***"Image Processing, Analysis and Machine vision",*** *Vikas Publishing Home (Thomson) 2001*
2. *Schalkoff R.J.,* ***"Digital Image Processing & Computer vision",*** *John Wiley sons, 1989.*
3. *Dudar R.O., and Hart P.E.,* ***"Pattern classification and scene Analysis",*** *2002.*

P13AE*TE*21 IMAGE AND VIDEO PROCESSING

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UNIT I IMAGE AND VIDEO ACQUISITION **09**

Image Scanning - Sampling and Interpolation - Video Sampling and Interpolation - Image and Video Rendering and Assessment - Image Quantization - Half toning and Printing – Perceptual Criteria for Image Quality Evaluation.

UNIT II IMAGE AND VIDEO ENHANCEMENT AND RESTORATION **09**

Basic Linear and Non Linear Filtering with Applications to Image Enhancement and Image Analysis - Morphological Filtering for Image Enhancement and Detection - Basic Methods for Image Restoration and Identification.

UNIT III MULTICHANNEL IMAGE RECOVERY **09**

Multi-frame Image Restoration - Iterative Image Restoration - Motion Detection and Estimation - Video Enhancement and Restoration - Reconstruction from Multiple Images - 3-D Shape Reconstruction from Multiple Views - Images Sequence Stabilization - Mosaicking and Superresolution.

UNIT IV IMAGE AND VIDEO ANALYSIS **09**

Image Representations and Image Models - Computational Models of Early Human Vision - Multiscale Image Decompositions and Wavelets - Random Field Models - Image Modulation Models - Image Noise Models - Color and Multispectral Image Representation and Display.

UNIT V IMAGE AND VIDEO ANALYSIS **09**

Image and Video Classification and Segmentation - Statistical Methods for Image Segmentation - Multiband Techniques for Texture Classification and Segmentation - Video Segmentation - Adaptive and Neural Methods for Image Segmentation - Edge and Boundary Detection in Images - Gradient and Laplacian-Type Edge Detection - Diffusion-Based Edge Detectors.

TOTAL: 45

TEXT BOOK

1. *A.L. Bovik, "**Handbook of Image and Video Processing",** Academic Press, 2000.*
2. *Ling Guan, Sun-Yuan Kung, Jan Larsen, "**Multimedia Image and Video Processing",** CRC Press, 2001.*

REFERENCES

1. *Stefan Winkler, "**Digital Video Quality - Vision Models and Metrics"**, John Wiley and Sons Ltd.*

P13AE*TE*28 WAVELETS AND MULTI-RESOLUTION PROCESSING

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UNIT I INTRODUCTION **09**

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

UNIT II MULTI RESOLUTION ANALYSIS **09**

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

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UNIT III CONTINUOUS WAVELET TRANSFORM **09**

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 DISCRETE WAVELET TRANSFORM **09**

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 - Mallat's algorithm for DWT - Lifting Scheme: Wavelet Transform using Polyphase matrix Factorization – Geometrical foundations of lifting scheme - Lifting scheme in Z –domain

UNIT V APPLICATIONS **09**

Image Compression using DWT – Sequential / Progressive - JPEG 2000 standard - Image denoising - Edge detection and object Isolation and Object Detection - Image Fusion -Wavelet Packets- Multiwavelets - Non linear wavelets – Ridgelets – Curvalets – Contourlets.

TOTAL: 45

TEXT BOOK

1. *C. Sidney Burvus, Ramesh A.Gopinath haito , "**Introduction to wavelets and wavelet Transform",** Prentice Hall International, 1995.*

REFERENCES

1. *Gilbert Strang,* ***"Linear Algebra and its Applications****", 3rd edition.*
2. *J.C. Goswami, A.K. Chan,* ***"Fundamentels of wavelets",*** *John wiley and sons, 1999.*
3 *Strang G, Nguyen T,* ***"Wavelets and Filter Banks,"*** *Wellesley Cambridge Press,1996.*
4 *Vetterli M, Kovacevic J,* ***"Wavelets and Sub-band Coding,"*** *Prentice Hall, 1995.*
5. *Mallat S.,* ***"Wavelet Signal Processing",*** *Academic Press, 1996.*

P13AE*TE*29 MULTIRATE SIGNAL PROCESSING

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UNIT I FUNDAMENTALS OF MULTIRATE SYSTEMS **09**

Sampling theorem - sampling at sub nyquist rate - Basic Formulations and schemes-Multirate operations- Decimation and Interpolation - Digital Filter Banks –Interconnection of Building Blocks- Decimation with transversal filters – Interpolation with transversal filters – Polyphase representation -Decimation with Polyphase filters – Interpolation with polyphase filters – Decimation and Interpolation with Rational sampling factors

UNIT II MAXIMALLY DECIMATED FILTER BANKS **09**

Quadrature mirror filter banks -Errors in the QMF bank- Perfect reconstruction (PR) QMF Bank - Design of an alias free QMF Bank - Biorthogonal and linear phase filter banks – Transmuliplexer filter banks. .

UNIT III PERFECT RECONSTRUCTION FILTER BANKS **09**

Paraunitary PR Filter Banks- Filter Bank Properties induced by paraunitarity - Two channel FIR paraunitary QMF Bank- Linear phase PR Filter banks- Necessary conditions for Linear phase property- Quantization Effects: -Types of quantization effects in filter banks. - coefficient sensitivity effects, dynamic range and scaling.

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UNIT IV FILTER BANKS WITH POLYPHASE STRUCTURE

Fundamental polyphase structures – polyphase QMF banks – General two channel polyphase filter banks – General M-channel polyphase filter banks – Paraunitary polyphase filter banks – DFT polyphase filter banks. Application: Digital audio.

UNIT V COSINE MODULATED FILTER BANKS **09**

Cosine Modulated pseudo QMF Bank- Alias cancellation- Elimination of Phase distortion- Closed form expression- Cosine modulated PR Systems-Sub band coding of speech and Image signals

TOTAL: 45

TEXT BOOK

1. *Vaidyyanathan P P, "Multirate Systems and Filter Banks", Prentice Hall Inc., 2011.*
2. *Fliege N J, "Multirate Digital Signal Processing", John Wiley and sons, 1994.*

REFERENCES

1. *J.G. Proakis. D.G. Manolakis. "Digital Signal Processing: Principles. Algorithms and Applications", 3rd Edn.Prentice Hall India, 1999.*

2. *Sanjit K Mitra, "Digital Signal Processing-A Computer Based Approach", Tata McGraw Hill, 2003.*

3. *R.E. Crochiere. L. R. "Multirate Digital Signal Processing", Prentice Hall. Inc.1983.*

P13AE*TE*33 ADVANCED PROCESSORS

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UNIT I MICROPROCESSOR ARCHITECTURE **09**

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.

UNIT II HIGH PERFORMANCE CISC ARCHITECTURE – PENTIUM **09**

The software model – functional description – CPU pin descriptions – Addressing modes – Processor flags – Instruction set – Bus operations – Super scalar architecture – Pipe lining – Branch prediction – The instruction and caches – Floating point unit– Programming the Pentium processor.

UNIT III HIGH PERFORMANCE CISC ARCHITECTURE – PENTIUM INTERFACE **09**

Protected mode operation – Segmentation – paging – Protection – multitasking – Exception and interrupts - Input /Output – Virtual 8086 model – Interrupt processing.

UNIT IV HIGH PERFORMANCE RISC ARCHITECTURE: ARM **09**

The ARM architecture – ARM assembly language program – ARM organization and implementation – The ARM instruction set - The thumb instruction set .

UNIT V SPECIAL PURPOSE PROCESSORS **09**

Altera Cyclone Processor – Audio codec – Video codec design – Platforms – General purpose processor – Digital signal processor – Embedded processor – Media Processor – Video signal Processor – Custom Hardware – Co-Processor.

TOTAL: 45

TEXT BOOK

1. *Daniel Tabak, **"Advanced Microprocessors",** McGraw Hill.Inc., 1995.*
2. *James L. Antonakos, **"The Pentium Microprocessor",** Pearson Education, 1997.*

REFERENCES

1. *Steve Furber, **"ARM System –On –Chip Architecture",**Addison Wesley, 2000.*
2. *Gene .H.Miller, **" Micro Computer Engineering",** Pearson Education, 2003.*
3. *Barry.B.Brey, **"The Intel Microprocessors Architecture , Programming and Interfacing",** PHI, 2002.*
4. *Valvano, "**Embedded Microcomputer Systems**" Thomson Asia PVT LTD first reprints, 2001.*
5. *Iain E.G.Richardson, **"Video Codec Design",** John Wiley & sons Ltd, U.K, 2002.*

P13AE*T*104 **EMBEDDED SYSTEMS**

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UNIT I EMBEDDED ARCHITECTURE **09**

Embedded Computers, Characteristics of Embedded Computing Applications, Embedded system design process- Requirements, Specification, Architectural Design, Designing Hardware and Software Components, System Integration, Unified modeling language (UML), Formalism for System Design- Structural Description, Behavioral Description, Design Example: Model Train Controller.

UNIT II EMBEDDED PROCESSOR AND COMPUTING PLATFORM **09**

ARM processor- processor and memory organization, Data operations, Flow of Control, TI C55X Digital Signal processor- Processor and Memory organization, Addressing modes, Data operations, Flow of Control, CPU Bus configuration, ARM Bus, SHARC Bus-Design Example : Alarm Clock..

UNIT III NETWORKS **09**

Distributed Embedded Architecture- Hardware and Software Architectures, Networks for embedded systems- I2C, CAN Bus, SHARC link ports, Ethernet, Myrinet, Internet, Network-Based design- Communication Analysis, system performance Analysis, Hardware platform design, Allocation and scheduling, Design Examples: Elevator Controller, Ink jet printer-Hardware Design and Software Design, Personal Digital Assistants, Set-top Boxes.

UNIT IV REAL-TIME CHARACTERISTICS **09**

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, challenges in validating timing constraints in priority driven systems, Off-line Versus On-line scheduling.

UNIT V REAL TIME OPERATING SYSTEM **09**

Operating system services-Process Management-Memory Management-Device and File Management- I/O sub systems- Interrupt routines in RTOS environment- RTOS –Services-Design using RTOS-Principles-Saving of memory and power, Functions and types of RTOSes-RTOS μcos-II.

TOTAL: 45

TEXT BOOK

1. *Wayne Wolf, **"Computers as Components: Principles of Embedded Computing System Design",** Morgan Kaufman Publishers, 2001.*

2. *Rajkamal, **"Embedded System Architecture – Programming and Design"**, Tata McGraw-Hill, Fifth reprint, 2010.*

REFERENCES

1. *Jane.W.S. Liu , **"Real-Time systems",** Pearson Education Asia, 2000.*

2. *C. M. Krishna and K. G. Shin, **"Real-Time Systems",** McGraw-Hill, 1997.*

3. *Frank Vahid and Tony Givargi**, "Embedded System Design: A Unified Hardware/Software Introduction",** John Wiley & Sons, 2000.*