AFFILIATED INSTITUTIONS

ANNA UNIVERSITY, CHENNAI 600 025

REGULATIONS - 2013

M.E. OPTICAL COMMUNICATION

I TO IV SEMESTERS CURRICULA AND SYLLABI (FULL TIME)

SEMESTER I

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	MA7158	Applied Mathematics for Communication Engineers	3	1	0	4
2	AP7101	Advanced Digital Signal Processing	3	1	0	4
3	CU7102	Advanced Digital Communication Techniques	3	0	0	3
4	OC7101	Optical Waveguide Theory	3	0	0	3
5	OC7102	Advanced Optical Communication systems	3	0	0	3
6		Elective I	3	0	0	3
PRACTICAL						
7	OC7111	Fiber Optics Laboratory	0	0	4	2
		TOTAL	**18**	**2**	**4**	**22**

SEMESTER II

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	OC7201	Non-linear Fiber Optics and Signal Processing	3	0	0	3
2	OC7202	Fiber Optic Networking	3	0	0	3
3	OC7203	Radio Over Fiber Systems	3	0	0	3
4		Elective II	3	0	0	3
5		Elective III	3	0	0	3
6		Elective IV	3	0	0	3
PRACTICAL						
7	OC7211	Optical Networking Laboratory	0	0	4	2
		TOTAL	**18**	**0**	**4**	**20**

SEMESTER III

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	OC7301	Optical Switching Architectures and Protocols	3	0	0	3
2	E5	Elective V	3	0	0	3
3	E6	Elective VI	3	0	0	3
PRACTICAL						
4	OC7311	Project Work (Phase I)	0	0	12	6
		TOTAL	**9**	**0**	**12**	**15**

SEMESTER IV

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
PRACTICAL						
1	OC7411	Project Work (Phase II)	0	0	24	12
		TOTAL	**0**	**0**	**24**	**12**

TOTAL NO.OF CREDITS : 69

LIST OF ELECTIVES

ELECTIVE I

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
1.	AP7103	Advanced Microprocessor and Microcontroller	3	0	0	3
2.	OC7001	MEMS	3	0	0	3
3.	CU7001	Real Time Embedded Systems	3	0	0	3
4.	OC7002	Mixed Signal VLSI	3	0	0	3

ELECTIVE II

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
1.	NC7102	Communication Networks Modeling and Simulation	3	0	0	3
2.	CU7003	Digital Communication Receivers	3	0	0	3
3.	AP7301	Electro Magnetic Interference and Compatability	3	0	0	3
4.	CU7004	Detection and Estimation theory	3	0	0	3
5.	CU7005	Cognitive Radio	3	0	0	3

ELECTIVE III

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
1.	OC7003	Digital Speech Signal Processing	3	0	0	3
2.	NC7002	Multimedia Compression Techniques	3	0	0	3
3.	DS7201	Advanced Digital Image Processing	3	0	0	3
4.	CU7006	Wavelet Transforms and Applications	3	0	0	3
5.	DS7101	DSP Processor Architecture and Programming	3	0	0	3

ELECTIVE IV

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
1.	NC7001	Network Routing Algorithms	3	0	0	3
2.	NC7201	Communication Network Security	3	0	0	3
3.	NC7202	Wireless Adhoc and Sensor Networks	3	0	0	3
4.	NE7007	Network Management	3	0	0	3
5.	CU7007	Internetworking Multimedia	3	0	0	3

ELECTIVE V

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
1.	OC7004	Integrated Optics	3	0	0	3
2.	OC7005	High Speed Photonics and Opto Electronics	3	0	0	3
3.	AP7005	Quantum Electronics	3	0	0	3
4.	OC7006	Laser Communications	3	0	0	3

ELECTIVE VI

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
1.	AP7014	Optical Computing	3	0	0	3
2.	AP7007	Fiber Optic Sensors	3	0	0	3
3.	OC7007	Broad Band Access Networks	3	0	0	3
4.	OC7008	Optical devices and Circuits	3	0	0	3

MA7158 APPLIED MATHEMATICS FOR COMMUNICATION ENGINEERS L T P C
3 1 0 4

OBJECTIVES:

- To develop the ability to use the concepts of Linear algebra and Special functions for solving problems related to Networks.
- To formulate and construct a mathematical model for a linear programming problem in real life situation;
- To expose the students to solve ordinary differential equations by various techniques.

OUTCOMES:

- To achieve an understanding of the basic concepts of algebraic equations and method of solving them.
- To familiarize the students with special functions and solve problems associated with Engineering applications.

UNIT I LINEAR ALGEBRA 12

Vector spaces – norms – Inner Products – Eigen values using QR transformations – QR factorization - generalized eigenvectors – Canonical forms – singular value decomposition and applications - pseudo inverse – least square approximations --Toeplitz matrices and some applications.

UNIT II LINEAR PROGRAMMING 12

Formulation – Graphical solution – Simplex method – Two phase method - Transportation and Assignment Models

UNIT III ORDINARY DIFFERENTIAL EQUATIONS 12

Runge Kutta Methods for system of IVPs, numerical stability, Adams-Bashforth multistep methop, solution of stiff ODEs, shooting method, BVP: Finite difference method, orthogonal collocation method, orthogonal collocation with finite element method, Galerkin finite element method.

UNIT IV TWO DIMENSIONAL RANDOM VARIABLES 12

Joint distributions – Marginal and Conditional distributions – Functions of two dimensional random variables – Regression Curve – Correlation**.**

UNIT V QUEUEING MODELS 12

Poisson Process – Markovian queues – Single and Multi-server Models – Little's formula - Machine Interference Model – Steady State analysis – Self Service queue.

TOTAL: 45+15:60 PERIODS

REFERENCES:

1. Richard Bronson, Gabriel B.Costa, "Linear Algebra", Academic Press, Second Edition, 2007.
2. Richard Johnson, Miller & Freund, "Probability and Statistics for Engineers", 7th Edition, Prentice – Hall of India, Private Ltd., New Delhi (2007).
3. Taha H.A., "Operations Research: An introduction", Pearson Education Asia, New Delhi, Ninth Edition, 2012.
4. Donald Gross and Carl M. Harris, "Fundamentals of Queueing Theory", 2nd edition, John Wiley and Sons, New York (1985).
5. Moon, T.K., Sterling, W.C., Mathematical methods and algorithms for signal processing, Pearson Education, 2000.

AP7101 ADVANCED DIGITAL SIGNAL PROCESSING L T P C
3 1 0 4

OBJECTIVES:

The purpose of this course is to provide in-depth treatment on methods and techniques in

- Discrete-time signal transforms, digital filter design, optimal filtering
- Power spectrum estimation, multi-rate digital signal processing
- DSP architectures which are of importance in the areas of signal processing, control and communications.

OUTCOMES:

Students should be able to:

- To design adaptive filters for a given application
- To design multirate DSP systems.

UNIT I DISCRETE RANDOM SIGNAL PROCESSING 9

Weiner Khitchine relation - Power spectral density – filtering random process, Spectral Factorization Theorem, special types of random process – Signal modeling-Least Squares method, Pade approximation, Prony's method, iterative Prefiltering, Finite Data records, Stochastic Models.

UNIT II SPECTRUM ESTIMATION 9

Non-Parametric methods - Correlation method - Co-variance estimator - Performance analysis of estimators – Unbiased consistent estimators - Periodogram estimator - Barlett spectrum estimation - Welch estimation - Model based approach - AR, MA, ARMA Signal modeling - Parameter estimation using Yule-Walker method.

UNIT III LINEAR ESTIMATION AND PREDICTION 9

Maximum likelihood criterion - Efficiency of estimator - Least mean squared error criterion - Wiener filter - Discrete Wiener Hoff equations - Recursive estimators - Kalman filter - Linear prediction, Prediction error - Whitening filter, Inverse filter - Levinson recursion, Lattice realization, Levinson recursion algorithm for solving Toeplitz system of equations.

UNIT IV ADAPTIVE FILTERS 9

FIR Adaptive filters - Newton's steepest descent method - Adaptive filters based on steepest descent method - Widrow Hoff LMS Adaptive algorithm - Adaptive channel equalization - Adaptive echo canceller - Adaptive noise cancellation - RLS Adaptive filters - Exponentially weighted RLS - Sliding window RLS - Simplified IIR LMS Adaptive filter.

UNIT V MULTIRATE DIGITAL SIGNAL PROCESSING 9

Mathematical description of change of sampling rate - Interpolation and Decimation - Continuous time model - Direct digital domain approach - Decimation by integer factor - Interpolation by an integer factor - Single and multistage realization - Poly phase realization - Applications to sub band coding - Wavelet transform and filter bank implementation of wavelet expansion of signals.

L +T= 45+15=60 PERIODS

REFERENCES:

1. Monson H. Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley and Sons Inc., New York, 2006.
2. Sophoncles J. Orfanidis, "Optimum Signal Processing ", McGraw-Hill, 2000.
3. John G. Proakis, Dimitris G. Manolakis, "Digital Signal Processing", Prentice Hall of India, New Delhi, 2005.
4. Simon Haykin, "Adaptive Filter Theory", Prentice Hall, Englehood Cliffs, NJ1986.
5. s. kay," Modern Spectrum Estimation Theory and Application", Prentice Hall, Englehood Cliffs, NJ1988.
6. P. P. Vaidyanathan, "Multirate Systems and Filter Banks", Prentice Hall, 1992.

CU7102 ADVANCED DIGITAL COMMUNICATION TECHNIQUES L T P C
3 0 0 3

OBJECTIVES:

- To understand the basics of signal-space analysis and digital transmission.
- To understand the coherent and noncoherent receivers and its impact on different channel characteristics.
- To understand Orthogonal Frequency Division Multiplexing.
- To understand the different block coded and convolutional coded digital communication systems.
- To understand the different Equalizers.

UNIT I COHERENT AND NON-COHERENT COMMUNICATION 9

Coherent receivers – Optimum receivers in WGN – IQ modulation & demodulation – Noncoherent receivers in random phase channels; MFSK receivers – Rayleigh and Rician channels – Partially coherent receivers – DPSK; M-PSK; M-DPSK--BER Performance Analysis. Carrier Synchronization- Bit synchronization.

UNIT II EQUALIZATION TECHNIQUES 9

Band Limited Channels- ISI – Nyquist Criterion- Controlled ISI-Partial Response signals- Equalization algorithms – Viterbi Algorithm – Linear equalizer – Decision feedback equalization – Adaptive Equalization algorithms.

UNIT III BLOCK CODED DIGITAL COMMUNICATION 9

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

UNIT IV CONVOLUTIONAL CODED DIGITAL COMMUNICATION 9

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

UNIT V OFDM 9

Generation of sub-carriers using the IFFT; Guard Time and Cyclic Extension; Windowing; OFDM signal processing; Peak Power Problem: PAP reduction schemes- Clipping, Filtering, Coding and Scrambling.-

TOTAL: 45 PERIODS

OUTCOMES:

Upon Completion of the course, the students will be able to

- Develop the ability to understand the concepts of signal space analysis coherent and non-coherent receivers.
- Comprehend the generation of OFDM signals and the processing of the signals.
- Possess knowledge on different block codes and convolutional codes.
- Conceptually appreciate different Equalization techniques.

REFERENCES:

1. M.K.Simon, S.M.Hinedi and W.C.Lindsey, Digital communication techniques; Signalling and detection, Prentice Hall India, New Delhi. 1995.
2. Simon Haykin, Digital communications, John Wiley and sons, 1998
3. Bernard Sklar., 'Digital Communications', second edition, Pearson Education, 2001.
4. John G. Proakis., 'Digital Communication', 4 th edition, Mc Graw Hill Publication, 2001
5. Theodore S.Rappaport., 'Wireless Communications', 2nd edition, Pearson Education, 2002.
6. Stephen G. Wilson., 'Digital Modulation and Coding', First Indian Reprint, Pearson Education, 2003.
7. Richard Van Nee & Ramjee Prasad., 'OFDM for Multimedia Communications' Artech House Publication, 2001.

OC7101 OPTICAL WAVEGUIDE THEORY L T P C
3 0 0 3

UNIT I UNIFORM PLANE WAVES 9

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 9

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 9

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 9

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

UNIT V GRADED INDEX FIBERS 9

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 PERIODS

REFERENCES:

1. Snyder & Love “Optical Waveguide Theory”, Chapman and Hall, New York, 1983.
2. H.G. Unger, Planar Optical Waveguides and Fibers, Oxford University press, Oxford, 1980.
3. Tamir. T, Guided Wave Optoelectronics, Springer Verlag, Berlin, 1990.
4. G.Cancellieri, Single Mode Optical Fibers, Pergramon press, New York, 1991.
5. Kapany, N.S. and Burke T.T, Optical Wave guides, Academic press, New York, 1972.
6. D.Marcuse, Light transmission optics, Von Nostrand Publication, New York, 1972.
7. D.Marcuse, Theory of Dielectric Waveguides, Von Nostrand Publication, New York, 1975.

OC7102 ADVANCED OPTICAL COMMUNICATION SYSTEMS L T P C
3 0 0 3

UNIT I MODULATION SCHEMES 9

Noise sources, channel impairments, and optical transmission system, Advanced modulation formats, OFDM, polarization multiplexing, constrained coding, and coherent detection: - Multilevel modulation schemes - Orthogonal frequency-division multiplexing (OFDM) - Polarization multiplexing - Constrained (line or modulation) coding, and Coherent detection.

UNIT II ERROR CORRECTION TECHNIQUES 9

Forward error correction (FEC):a. Linear block codes and cyclic codes,b. BCH and RS codes, c. Concatenated codes, Turbo- and turbo-product codes, and LDPC codes. Coded modulation schemes: Multilevel coding. Bit-interleaved coded modulation, and Coded OFDM, Advanced chromatic dispersion compensation:- Signal pre-distortion compensation, . Post-detection compensation: feed-forward equalizer (FFE), decision - feedback equalizer (DFE), maximum-likelihood sequence estimation (MLSE) or Viterbi equalizer (VE), turbo equalization (TE);

UNIT III COMPENSATION TECHNIQUES 9

Optical-phase conjugation based on highly-nonlinear fibers (HNLFs) and periodically-poled LiNbO3 (PPLN), and Compensation of chromatic dispersion by OFDM. Advanced PMD compensation:a. Optical compensation techniques,b. Electrical compensation techniques (FFE, DFE, VE, TE), and OFDM based techniques in PMD compensation. (vii)

UNIT IV NONLINEARITY MANAGEMENT 9

Compensation of intrachannel and interchannel nonlinearities, Compensation of nonlinear phase noise, Digital back-propagation method, and Turbo equalization.,Spatial-Domain-Based Multiplexing and Modulation.

UNIT V OPTICAL CHANNEL ESTIMATION 9

(ix) Optical channel capacity,. Channel Capacity Preliminaries. Calculation of information Capacity, Information Capacity of Systems with Direct Detection,. Information Capacity of Multilevel Systems with Coherent Detection. Capacity of Optical OFDM Systems,. Channel Capacity of Optical MIMO MMF Systems,. Channel Capacity of Hybrid FSO – RF Channels ,Parametric processes and applications:. Parametric amplifiers,. All-optical regeneration, Wavelength conversion, and. Multibanded switching.(xi)

TOTAL: 45 PERIODS

REFERENCES:

1. M. Cvijetic, I. B. Djordjevic, Advanced Optical Communication Systems and Networks. Artech House, in print (to appear in Dec. 2012).
2. I.B.Djordjevic, W. Ryan and B. Vasic, Coding for Optical Channels. Springer, Mar.2010
3. W. Shieh and I. Djordjevic, OFDM for Optical Communications. Elsevier/Academic Press, Oct. 2009.

OC7111	FIBER OPTICS LABORATORY	L	T	P	C
		0	0	4	2

1. Fiber Connectorization / Splicing and Loss Characterization
2. Characterisation of Glass and Plastic Optical Fibers – Measurement of Numerical Aperture and Attenuation, OTDR Principle
3. DC Characteristics of LEDs and PiN Photodiodes – Determination of Source Conversion Efficiency and Detector Responsivity
4. P-I Characteristics of Laser Diode Sources – Threshold Current Determination and Study of Temperature Effects
5. Gain Characteristics of APDs – Determination of Threshold Voltage and Average gain estimation
6. Analog Transmission Characteristics of a Fiber Optic Link – Determination of Operating Range and System Bandwidth for Glass and lastic fiber links
7. Determination of Capacity of a Digital Fiber Optic Link – Maximum Bit Rate estimation for Glass and Plastic fiber links
8. Spectral Characterisation of Optical Sources – Determination of Peak Emission Wavelength and Spectral Width
9. Rise-time and Power budget Estimation of Fiber Optic Link Using Simulation
10. Study of linear and non-linear effects in Optical Waveguides Using Simulation

TOTAL: 60 PERIODS

LAB REQUIREMENTS:

1. MM/SM Glass and plastic fiber patch chords with ST/SC/E2000 connectors
2. LEDs and LDs with ST / SC / E2000 receptacles – 650 / 850 nm
3. PiN PDs and APDs with ST / SC / E2000 receptacles – 650 / 850 nm
4. Stabilized current sources, Signal generators, Pulse generators, Oscilloscopes
5. Optical power meters and Spectrum Analyzers
6. WDM modules

OC7201 NON LINEAR FIBER OPTICS AND SIGNAL PROCESSING L T P C
3 0 0 3

UNIT I NONLINEAR PHENOMENA IN OPTICAL MATERIALS 9

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 9

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

UNIT III SPATIAL FILTERING AND FILTERING SYSTEM 9

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 9

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 9

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 analyzers.

TOTAL: 45 PERIODS

REFERENCES:

1. Govind P.Agarwal, Nonlinear Fiber Optics, AT&T – Academic Press, 1989.
2. Vanderlught, Optical Signal Processing, John Wiley & Sons, New York, 1992.
3. P.K. Das, Optical Signal Processing Fundamentals, Narosa Publishing NewDelhi,1991.
4. Signal Processing wing optics Bradley G. Boone, Oxford University Press, 1998.

OC7202 FIBER OPTIC NETWORKING L T P C
3 0 0 3

UNIT I OPTICAL SYSTEM COMPONENTS AND NETWORK DESIGN 9

Optical System Components – Couplers, Isolators & Circulators, Multiplexers & Filters, Optical Amplifiers, Switches, Wavelength Converters; Transmission System Engineering – System model, Power penalty - transmitter, receiver, Optical amplifiers, crosstalk, dispersion; Wavelength stabilization; Overall design considerations.

UNIT II OPTICAL NETWORK ARCHITECTURES 9

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

UNIT III WAVELENGTH ROUTING NETWORKS 9

WDM Network Elements; WDM Network Design - Cost tradeoffs, Virtual Topology Design, Routing and wavelength assignment, Statistical Dimensioning Models.

UNIT IV PACKET SWITCHING AND ACCESS NETWORKS 9

Photonic Packet Switching – OTDM, Multiplexing and De-multiplexing, Synchronisation, Header Processing, Buffering, Burst Switching, Testbeds; Access Networks.

UNIT V NETWORK MANAGEMENT AND SURVIVABILITY 9

Control and Management – Network management functions, Configuration management, Performance management, Fault management, Optical safety, Service interface; network Survivability- Protection in SONET / SDH and IP Networks, Optical layer Protection, Interworking between layers.

TOTAL: 45 PERIODS

REFERENCES:

1. Rajiv Ramaswami and Kumar N. Sivarajan, “Optical Networks : A Practical
2. Perspective”, Harcourt Asia Pte Ltd., Second Edition 2006.
3. C. Siva Ram Moorthy and Mohan Gurusamy, “WDM Optical Networks : Concept, Design and Algorithms”, Prentice Hall of India, Ist Edition, 2002.
4. P.E. Green, Jr., “Fiber Optic Networks”, Prentice Hall, NJ, 1993.
5. Biswanath Mukherjee, “Optical WDM Networks”, Springer, 2006.

OC7203 RADIO OVER FIBER SYSTEMS L T P C
3 0 0 3

UNIT I INTRODUCTION TO RADIO OVER FIBER 9

Radio Over Fiber – applications, advantages, limitations, Microwave properties of optical links, Direct modulated optical links, Direct modulated optical links, external modulators, types, modulation transfer in microwave fiber optic links.

UNIT II ANALOG FIBER OPTIC LINKS 9

Sub carrier Optical fiber transmission systems, Fiber optic transmission of 64-QAM, 256- QAM signals, Capacity of coaxial and fiber optic links, LASER diode and Photodiode nonlinearities.

UNIT III COMPONENTS FOR ROF SYSTEMS 9

Analog modulation of LASER diode, LASER diode fundamentals, Rate equation analysis, Intensity modulation, Frequency modulation, Low cost LASER diode driver, LASER diode noise and their influence on link performance.

UNIT IV ROF TECHNOLOGY FOR THE CELLULAR APPLICATIONS 9

3G cellular systems, cellular architecture, UMTS architecture, WCDMA ROF systems, Micro diversity, Macro diversity, Traffic estimation, Spectral efficiency, power level, multiple user interference, ROF for Hiper LAN2, Micro cellular communication networks.

UNIT V FIBER OPTIC RADIO NETWORKS 9

Introduction to radio highway – types of radio highway, Photonic TDMA Highway – Natural sampling of photonic TDMA, Photonic CDMA – Conventional CDMA, DOSCDMA, Photonic chirp multiple access – architecture and performance, routing networks, chirp multiplexing transform.

TOTAL: 45 PERIODS

REFERENCES:

1. Hameed Al-Raweshidy, Shozo Komaki, "Radio Over fiber technologies for mobile communication networks" Artech House publications, London. 2002.
2. William S.C.Chang, "RF Photonic technology in optical fiber links" Cambridge University press. 2002.

OC7211 OPTICAL NETWORKING LABORATORY L T P C

0 0 4 2

LIST OF EXPERIMENTS

Sl. No.	Details of Experiment		Details of Equipment / Instrument Required for a batch of 25 Students	
	Name	Duration	Name	Quantity
1.	Comparison of WDM Routing and Wavelength Assignment Algorithms Using Simulation	4	Optical Simulation Tool	1
2.	Signal transmission and reception using WDM and spectral characterization	4	WDM Module, Optical Spectrum Analyzer	1
3.	Characterization and Comparison of Direct and External Modulation Schemes Using Simulation	4	Optical Simulation Tool	1
4.	Characterization of linear and non-linear behavior of SMF, DSF and NZDSF Using Simulation	4	Optical Simulation Tool	1
5.	Characterization and Comparison of Optical Multiplexing techniques Using Simulation	4	Optical Simulation Tool	1
6.	Characterization and Comparison of Optical Filters Using Simulation	4	Optical Simulation Tool	1
7.	Characterization of Fiber Bragg Grating Filter (Reflectivity, Insertion loss & Crosstalk)	4	WDM Module with circulator, FBG and photo-detectors , MSO	1
8.	Characterization of Add Drop Multiplexers	4	WDM Module with circulator, FBG and photo-detectors , MSO	1
9.	Characterization and Comparison of Optical Amplifiers Using Simulation	4	Optical Simulation Tool	1
10.	Characterization of Erbium Doped Fiber Amplifiers	4	WDM Module with circulator, WDM Coupler, EDFA with pump source, photo-detectors , MSO	1

TOTAL: 60 PERIODS

OC7301 OPTICAL SWITCHING ARCHITECTURES AND PROTOCOLS L T P C
3 0 0 3

UNIT I OPTICAL NETWORK ARCHITECTURES 9

Introduction to Optical Networks; Layered Architecture- Spectrum partitioning, Network Nodes, Network Access Stations, Overlay Processor, Logical network overlays.

UNIT II OPTICAL SWITCHING 9

Free-space optical switching – multistage optical interconnection networks- back plane optical interconnects, optical memory for switching – logic functionality – nonlinear fiber couplers, photonic switch architectures based on TDM, WDM, OCX, ATM.

UNIT III OPTICAL INTERNET NETWORKS 9

Optical Circuit switching- Optical Burst switching- Optical packet switching – Unbuffered Networks, Buffering Startegies- MPLS in WDM Networks -Types MPLS Nodes – Multi protocol lambda switching – MPLS and Optical TE similarities – IP, MPLS and Optical control planes –LSP routing.

UNIT IV NETWORK CONNECTIONS AND THE CONTROL PLANE 9

Connection Management and Control; Static and Wavelength Routed Networks; Linear Lightwave networks; Logically Routed Networks; Traffic Grooming; The Optical Control Plane- Architecture, Interfaces, Functions; Generalized Multiprotocol Label Switching – MPLS network and protocol stack, Link management, Routing and Signaling in GMPLS.

UNIT V ACCESS NETWORKS 9

Network architecture overview - today's access networks - future Access networks - optical access network architecture - application area – Passive optical networks- Broadcast Select PON – WRPON - Case study – SUCCESS HPON- Network topology – Media access control protocol – Scheduling algorithm- Ethernet based passive optical networks –QoS.

TOTAL : 45 PERIODS

REFERENCES:

1. Thomas E. Stern, Georgios Ellinas, Krishna Bala, "Multiwavelength Optical Networks – Architecture, Design and control ", Cambridge University Press, 2nd Edition, 2009.
2. Rajiv Ramaswami and Kumar N. Sivarajan, "Optical Networks : A Practical Perspective", Harcourt Asia Pte Ltd., Second Edition 2006.
3. C. Siva Ram Moorthy and Mohan Gurusamy, "WDM Optical Networks : Concept, Design and Algorithms", Prentice Hall of India, Ist Edition, 2002.
4. Uyless Black, " Optical Network: Third Generation Transport System",Pearson Education, Ist edition,2002.
5. Hussein T.Mouftah and Jaafar M.H.Elmirghani, " Photonic Switching Technology – Systems and Networks ",IEEE Press, New York -10016-5997,ISBN – 0-7803- 4707-2.
6. P.E. Green, Jr., "Fiber Optic Networks", Prentice Hall, NJ, 1993.
7. Biswanath Mukherjee, "Optical WDM Networks", Springer, 2006.
8. Bahaa E.A. Saleh, Malvin Carl Teich, "Fundamentals of Photonics" Wiley Interscience ; 1st edition, 2002.
9. http://www.wdm.stanford.edu/ snrc-access/

AP7103 ADVANCED MICROPROCESSOR AND MICROCONTROLLER L T P C
3 0 0 3

OBJECTIVES:

- To familiarize the fundamental concepts of microprocessor architecture.
- To gain knowledge about high performance CISC and RISC architectures.
- To study about 8 bit Microcontrollers viz. 68HC11 and PIC.

UNIT I OVERVIEW 9

Generic Architecture--Instruction Set – Data 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.

UNIT II HIGH PERFORMANCE CISC ARCHITECTURE – PENTIUM 9

CPU Architecture- Bus Operations – Pipelining – Brach predication – floating point unit-Operating Modes –Paging – Multitasking – Exception and Interrupts – Instruction set –addressing modes – Programming the Pentium processor.

UNIT III HIGH PERFORMANCE RISC ARCHITECTURE – ARM 9

Organization of CPU – Bus architecture –Memory management unit - ARM instruction set- Thumb Instruction set- addressing modes – Programming the ARM processor.

UNIT IV MOTOROLA 68HC11 MICROCONTROLLERS 9

Instruction set addressing modes – operating modes- Interrupt system- RTC-Serial Communication Interface – A/D Converter PWM and UART.

UNIT V PIC MICROCONTROLLER 9

CPU Architecture – Instruction set – interrupts- Timers- I2C Interfacing – UART- A/D Converter –PWM and introduction to C-Compilers.

TOTAL:45 PERIODS

REFERENCES:

1. Daniel Tabak , '' Advanced Microprocessors" McGraw Hill.Inc., 1995
2. James L. Antonakos , " The Pentium Microprocessor '' Pearson Education , 1997.
3. Steve Furber, '' ARM System –On –Chip architecture "Addision Wesley , 2000.
4. Gene .H.Miller ." Micro Computer Engineering ," Pearson Education , 2003.
5. John .B.Peatman , " Design with PIC Microcontroller , Prentice hall, 1997.
6. James L.Antonakos ," An Introduction to the Intel family of Microprocessors '' Pearson Education 1999.
7. Barry.B.Breg," The Intel Microprocessors Architecture , Programming and Interfacing " , PHI, 2002.
8. Valvano "Embedded Microcomputer Systems" Thomson Asia PVT LTD first reprint 2001.

OC7001 MEMS L T P C
3 0 0 3

UNIT I INTRODUCTION TO MEMS 9

Principles of Microsystems, Nano and Microscale systems, devices, and structures, Microstructures, Axial stress and strain, Shear stress and strain, Static bending of beams
and thin plates, Mechanical vibration, Stiction issue, Scaling laws in miniaturization & Materials ;MEMS Materials: Substrates and Wafers, Active substrate materials, Silicon, Silicon compounds, Silicon Piezoresistors, Gallium Arsenide, Quartz, Polymers, Packaging materials**.**

UNIT II ACTUATION MECHANISMS IN MEMS AND FABRICATION 9

Electrostatic Actuators: charge control, voltage control, spring suspended C, pull-in voltage, linearization methods, comb drive actuators, levitation, equivalent circuits, Piezoelectric, Thermal, Magnetic actuators, gap closers, rotary finger pull up, Electronics Interface, Feedback systems, Noise, circuit and system issues.MEMS Fabrication: Bulk micromachining, Surface micromachining, Thin-film depositions (LPCVD, Sputtering, Evaporation), LIGA, Electroplating, Wet and dry etching, Packaging: Microsystems packaging, Interfaces in microsystem packaging, Essential packaging technologies, 3D packaging, Assembly of Microsystems, Selection of packaging materials, Current and future trends for NEMS

UNIT III RF MEMS 9

Introduction to RF MEMS, general concepts in high frequency effects, RF MEMS Switches- Intro, basic design guidelines, RF switch design case studies, RF filters with MEMS- Tunable Capacitors and Inductors, RF MEMS resonators and their applications, Comparison of electrostatic and piezoelectric resonators, Case Study: Micromachined Antennas, Microstrip antenna, Micromachining for antennas fabrication, Reconfigurable antennas, Example of RF MEMS switches and applications, design approaches**.**

UNIT IV MOEMS 9

Digital Micro mirror Device, Grating Light Valve, Optical switches, optical filters, arrayed waveguide grating,, Electrostatic reflective light modulator, Torsion mirror (TI DMD) Micromachined optical structures ,Fiber-optic couplers, Refractive lenses, Diffractive lenses, Waveguide optical systems, MEMS deformable mirrors Case study: Grating Light
Valve

UNIT V MODELLING OF MEMS SYSTEMS 9

Circuit Modeling of MEMS: resonator equivalent circuits, thermal circuits, fluidic circuits, general filter topologies, insertion loss , shape factor, resonator and couplers, circuit modeling of coupled resonators, systematic micromechanical filter design procedure, Electro statically actuated micro-mirror, design of optical filters, case studies.

TOTAL: 45 PERIODS

REFERENCES:

1. Gregory T.A. Kovacs, Micromachined Transducers Sourecbook, The McGraw-Hill, Inc.1998
2. Stephen D. Senturia, Microsystem Design, Kluar Publishers, 2001
3. Nadim Maluf, An Introduction to Microelectromechanical Systems Engineering, Artech House, 2000.
4. Vijay Varadan, K. J. Vinoy, K.A. Jose, .RF MEMS and their applications,Wiley,2002.
5. N.P.Mahalik, MEMS, TataMcGraw hill, 2007.
6. Tai Ran Hsu ,MEMS and Microsystems Design and Manufacture, Tata McGraw hill, 2002

CU7001 REAL TIME EMBEDDED SYSTEMS L T P C
3 0 0 3

UNIT I INTRODUCTION TO EMBEDDED COMPUTING 9

Complex systems and microprocessors – Design example: Model train controller – Embedded system design process – Formalism for system design – Instruction sets Preliminaries – ARM Processor – CPU: Programming input and output – Supervisor mode, exception and traps – Coprocessor – Memory system mechanism – CPU performance – CPU power consumption.

UNIT II COMPUTING PLATFORM AND DESIGN ANALYSIS 9

CPU buses – Memory devices – I/O devices – Component interfacing – Design with microprocessors – Development and Debugging – Program design – Model of programs – Assembly and Linking – Basic compilation techniques – Analysis and optimization of execution time, power, energy, program size – Program validation and testing.

UNIT III PROCESS AND OPERATING SYSTEMS 9

Multiple tasks and multi processes – Processes – Context Switching – Operating Systems – Scheduling policies - Multiprocessor – Inter Process Communication mechanisms – Evaluating operating system performance – Power optimization strategies for processes.

UNIT IV HARDWARE ACCELERATES & NETWORKS 9

Accelerators – Accelerated system design – Distributed Embedded Architecture – Networks for Embedded Systems – Network based design – Internet enabled systems.

UNIT V CASE STUDY **9**

Hardware and software co-design - Data Compressor - Software Modem – Personal Digital Assistants – Set–Top–Box. – System-on-Silicon – FOSS Tools for embedded system development.

TOTAL: 45 PERIODS

REFERENCES:

1. Wayne Wolf, “Computers as Components - Principles of Embedded Computer System Design”, Morgan Kaufmann Publisher, 2006.
2. David E-Simon, “An Embedded Software Primer”, Pearson Education, 2007.
3. K.V.K.K.Prasad, “Embedded Real-Time Systems: Concepts, Design & Programming”, dreamtech press, 2005.
4. Tim Wilmshurst, “An Introduction to the Design of Small Scale Embedded Systems”, Pal grave Publisher, 2004.
5. Sriram V Iyer, Pankaj Gupta, “Embedded Real Time Systems Programming”, Tata Mc-Graw Hill, 2004.
6. Tammy Noergaard, “Embedded Systems Architecture”, Elsevier, 2006.

OC7002 MIXED SIGNAL VLSI **L T P C**
3 0 0 3

UNIT I MOS TRANSISTOR PRINCIPLES **9**

MOS Technology and VLSI, Process parameters and considerations for, MOS and CMOS, Electrical properties of CMOS circuits and Device modeling. CMOS Inverter Scaling CMOS circuits, Scaling principles and fundamental limits.

UNIT II OPERATIONAL AMPLIFIERS **9**

Concept of negative feedback, Effect of loading in feedback networks, operational amplifier performance parameters, One-stage Op Amps, Two-stage Op Amps, Input range limitations, Gain boosting, slew rate, power supply rejection, noise in Op Amps

UNIT III OSCILLATOR FUNDAMENTALS AND PHASE LOCK LOOPS **9**

General considerations, LC oscillators, monolithic inductors, monolithic varactors, Quadrature oscillators, distributed oscillators, voltage controlled oscillators, mathematical model of VCOs. Basic PLL topology, Charge-Pump PLLs, nonideal effects in PLLs, Delay locked loops, Frequency multiplication and synthesis, skew reduction, Jitter reduction.

UNIT IV DSP IN VLSI **9**

Introduction To DSP Systems -Typical DSP algorithms; Iteration Bound – data flow graph representations, loop bound and iteration bound, Longest path Matrix algorithm; Pipelining and parallel processing – Pipelining of FIR digital filters, parallel processing, pipelining and parallel processing for low power.

UNIT V TRANSCIEVER ARCHITECTURE AND ISSUES **9**

Receiver Architectures, Superheterodyne receiver, Image rejection receiver,-Hartley and Weaver, Zero IF receiver, Low IF receiver, Transmitter architecture, Superheterodyne transmitter, Direct up transmitter, Two-step-up transmitter, Transceiever architectures for modern wireless systems, Case study.

TOTAL: 45 PERIODS

REFERENCES:

1. Jan Rabaey, Anantha Chandrakasan, B Nikolic, " Digital Integrated Circuits: A Design Perspective". Second Edition, Feb 2003, Prentice Hall of India.
2. N.Weste, K. Eshraghian, " Principles of CMOS VLSI Design". Second Edition, 1993 Addision Wesley,
3. M J Smith, "Application Specific Integrated Circuits", Addisson Wesley, 1997
4. Anantha Chandrakasan, W.J, Bowhill and F.Fox, "Design of High Performance Microprocessor Circuits", John Wiley, 2000.
5. Emad N. Farag, Mohamed I. Elmasry, "Mixed signal VLSI Wireless design Circuits and systems", Kluwer Academic Publishers, 2002.
6. Wolfgang Eberle, "Wireless Transceiver Systems Design", Springer, 2008.
7. Keshab K.Parhi, " VLSI Digital Signal Processing systems, Design and implementation ", Wiley, Inter Science, 1999.
8. Michiel Steyaert , Arthur H. M. van Roermund, Herman Casier "Analog Circuit Design High - speed Clock and Data Recovery, High-performance Amplifiers Power Management " springer, 2008.
9. Behzad Razavi, " Design of Integrated circuits for Optical Communications", Mc Graw Hill, 2003
10. Behzad Razavi, "Design of Analog CMOS Integrated Circuits", Tata McGraw Hill 2001
11. Willey M.C. Sansen, "Analog design essentials", Springer, 2006.
12. Grebene,"Bipolar and MOS Analog Integrated circuit design", John Wiley & sons, Inc., 2003.
13. Phillip E.Allen, DouglasR.Holberg, "CMOS Analog Circuit Design", Second edition,Oxford University Press, 2002

NC7102 COMMUNICATION NETWORKS MODELLING AND SIMULATION L T P C
3 0 0 3

UNIT I INTRODUCTION TO MODELING AND SIMULATION 9

Introduction, Discrete-event Simulation, Modeling for Computer Simulation, Tools and Methods for Network Simulation, The Simulation Platform, Simulation Framework, Tools and Modeling Approaches for Simulating Hardware.

UNIT II MONTE CARLO SIMULATION 9

Fundamental concepts, Application to communication systems, Monte Carlo integration, Semianalytic techniques, Case study: Performance estimation of a wireless system.

UNIT III LOWER LAYER & LINK LAYER WIRELESS MODELING 9

Physical Layer Modeling, Description of the Main Components of the PHY Layer, Accurate Simulation of Physical Layers, Physical Layer Modeling for Network Simulations, Link Layer Modeling, Medium Access Control (MAC) Protocols, Logical Link Control, Forward Error Detection and Correction, Backward Error Detection and Correction, Queueing and Processing Delay.

UNIT IV CHANNEL MODELING & MOBILITY MODELING 9

Channel Modeling :The Physics of Radiation, The Nature of Electromagnetic Radiation, Classification of Propagation Models, Deterministic Approaches by Classical Field Theory, Deterministic Geometric Optical Approaches, Empirical Path Loss Approaches, Stochastic Shadowing Models, Stochastic Fading Models, MIMO Channel Models.

Mobility modeling :Categorization of Mobility Models, Mobility Models, Random Walk Model, Random Waypoint Model, Random Direction Model, Gauss-Markov Model, Manhattan Model, Column Model , Pursue Model, Nomadic Community Model, Selection of Appropriate Mobility Models.

UNIT V HIGHER LAYER MODELING & MODELING THE NETWORK TOPOLOGY **9**

Higher Layer Modeling :Modeling the Network Layer and Routing Protocols, Components of a Routing Protocol, Metrics, Virtual Routing on Overlays, Modeling Transport Layer Protocols, Modeling Application Traffic.

Modeling the Network Topology : Abstraction of Network Topologies by Graphs, Characterizing Graphs, Common Topology Models, Geometric Random Graphs – The Waxman Model, Hierarchical Topologies, Preferential Linking – The Barabási-Albert Model, Modeling the Internet.

TOTAL: 45 PERIODS

REFERENCES:

1. K.Wehrie. Gunes, J.Gross, “Modeling and Tools for Network simulation”, Springer, 2010.
2. Irene Karzela, “Modeling and Simulating Communications Networks”, Prentice Hall India, 1998,
3. William.H.Tranter, K. Sam Shanmugam, Theodore. S. Rappaport, Kurt L. Kosbar, “Principles of Communication Systems Simulation”, Pearson Education (Singapore) Pvt. Ltd, 2004.
4. M.C. Jeruchim, P.Balaban and K. Sam Shanmugam, “Simulation of Communication Systems: Modeling, Methodology and Techniques”, Plenum Press, New York, 2001.
5. Nejat; Bragg, Arnold, “Recent Advances in Modeling and Simulation Tools for Communication Networks and Services”, Springer, 2007

CU7003 DIGITAL COMMUNICATION RECEIVERS **L T P C**
3 0 0 3

UNIT I REVIEW OF DIGITAL COMMUNICATION TECHNIQUES **9**

Base band communication; signal space representation, linear and nonlinear modulation techniques, Error tracking and Spectral characteristics of digital modulation.

UNIT II OPTIMUM RECEIVERS FOR AWGN CHANNEL **9**

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 III RECEIVERS FOR FADING CHANNELS **9**

Characterization of fading multiple channels, statistical models, flat and frequency selective fading, diversity technique, Optimal receivers for data detection and synchronization parameter estimation, coded waveform for fading channel.

UNIT IV SYNCHRONIZATION TECHNIQUES **9**

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

UNIT V ADAPTIVE EQUALIZATION **9**

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

TOTAL : 45 PERIODS

REFERENCES:

1. Heinrich Meyer, Mare Moeneclacy, Stefan.A.Fechtel, " Digital communication receivers ", Vol I & Vol II, John Wiley, New York, 1997.
2. U.Mengali & A.N.D’Andrea, Synchronization Techniques for Digital Receivers, Kluwer, 1997.
3. John.G.Proakis, “Digital communication “4th Edition, McGraw-Hill, New York, 2001.

4. E.A.Lee and D.G. Messerschmitt, “Digital communication ", 2nd Edition, Allied Publishers, New Delhi, 1994.
5. Simon Marvin, “Digital communication over fading channel; An unified approach to performance Analysis ", John Wiley, New York, 2000.
6. H.Meyr & G.Ascheid, Synchronization in Digital Communications, John Wiley, 1990.
7. R. G. Gallager, Principles of Digital Communication, Cambridge University Press, 2008.

AP7301 ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY L T P C
3 0 0 3

OBJECTIVES:

- To understand the basics of EMI
- To study EMI Sources
- To understand EMI problems
- To understand Solution methods in PCB
- To understand Measurement technique for emission
- To understand Measurement technique for immunity

UNIT I EMI/EMC CONCEPTS 9

EMI-EMC definitions and Units of parameters; Sources and victim of EMI; Conducted and Radiated EMI Emission and Susceptibility; Transient EMI, ESD; Radiation Hazards.

UNIT II EMI COUPLING PRINCIPLES 9

Conducted, radiated and transient coupling; Common ground impedance coupling ; Common mode and ground loop coupling ; Differential mode coupling ; Near field cable to cable coupling, cross talk ; Field to cable coupling ; Power mains and Power supply coupling.

UNIT III EMI CONTROL TECHNIQUES 9

Shielding- Shielding Material-Shielding integrity at discontinuities, Filtering- Characteristics of Filters-Impedance and Lumped element filters-Telephone line filter, Power line filter design, Filter installation and Evaluation, Grounding- Measurement of Ground resistance-system grounding for EMI/EMC-Cable shielded grounding, Bonding, Isolation transformer, Transient suppressors, Cable routing, Signal control. EMI gaskets

UNIT IV EMC DESIGN OF PCBS 9

EMI Suppression Cables-Absorptive, ribbon cables-Devices-Transient protection hybrid circuits ,Component selection and mounting; PCB trace impedance; Routing; Cross talk control-Electromagnetic Pulse-Noise from relays and switches, Power distribution decoupling; Zoning; Grounding; VIAs connection; Terminations.

UNIT V EMI MEASUREMENTS AND STANDARDS 9

Open area test site; TEM cell; EMI test shielded chamber and shielded ferrite lined anechoic chamber; Tx /Rx Antennas, Sensors, Injectors / Couplers, and coupling factors; EMI Rx and spectrum analyzer; Civilian standards-CISPR, FCC, IEC, EN; Military standards-MIL461E/462. Frequency assignment - spectrum conversation. British VDE standards, Euro norms standards in japan - comparisons. EN Emission and Susceptibility standards and Specifications.

TOTAL: 45PERIODS

OUTCOMES:

Upon Completion of the course, the students will be able to

- To design a EMI free system
- To reduce system level crosstalk
- To design high speed Printed Circuit board with minimum interference
- To make our world free from unwanted electromagnetic environment

REFERENCES:

1. V.P.Kodali, "Engineering EMC Principles, Measurements and Technologies", IEEE Press, Newyork, 1996
2. Clayton R.Paul," Introduction to Electromagnetic Compatibility", John Wiley Publications, 2008
3. Henry W.Ott.,"Noise Reduction Techniques in Electronic Systems", A Wiley Inter Science Publications, John Wiley and Sons, New york, 1988.
4. Bemhard Keiser, "Principles of Electromagnetic Compatibility", 3rd Ed, Artech house, Norwood, 1986.
5. Don R.J.White Consultant Incorporate, "Handbook of EMI/EMC", Vol I-V, 1988.

CU7004 DETECTION AND ESTIMATION THEORY L T P C
3 0 0 3

OBJECTIVES:

- To enable the student to understand the basic principles of random signal processing , spectral estimation methods and their applications.
- To enable the student to understand the different signal detection and estimation methods used in communication system design and the implications of proper synchronization methods for proper functioning of the system.

UNIT I DISCRETE RANDOM SIGNAL PROCESSING 9

Discrete Random Processes- Ensemble Averages, Stationary processes, Bias and Estimation, Autocovariance, Autocorrelation, Parseval's theorem, Wiener-Khintchine relation, White noise, Power Spectral Density, Spectral factorization, Filtering Random Processes, Special types of Random Processes – ARMA, AR, MA – Yule-Walker equations.

UNIT II SPECTRAL ESTIMATION 9

Estimation of spectra from finite duration signals, Nonparametric methods – Periodogram, Modified periodogram, Bartlett, Welch and Blackman-Tukey methods, Parametric methods – ARMA, AR and MA model based spectral estimation, Solution using Levinson-Durbin algorithm.

UNIT III DETECTION AND ESTIMATION CRITERIA 9

Detection criteria : Bayes detection techniques, MAP, ML,– detection of M-ary signals, Neyman Peason, minimax decision criteria. Estimation: linear estimators, non-linear estimators, Bayes, MAP,ML, properties of estimators, phase and amplitude estimation.

UNIT IV SYNCHRONIZATION 9

Signal parameter estimation, carrier phase estimation, symbol timing estimator, joint estimation of carrier phase and symbol timing.

UNIT V RECEIVERS FOR AWGN AND FADING CHANNELS 9

Optimum receivers for AWGN channel -Correlation demodulator, matched filter, maximum likelihood sequence detector, envelope detectors for M-ary signals; Characterization of fading multipath channels, RAKE demodulator, Multiuser detection techniques.

TOTAL: 45 PERIODS

REFERENCES:

1. Monson H. Hayes, 'Statistical Digital Signal Processing and Modeling", John Wiley and Sons, Inc, Singapore, 2002
2. John J. Proakis, Dimitris G. Manolakis, : Digital Signal Processing', Pearson Education, 2002.
3. John G. Proakis., 'Digital Communication', 4 th edition, Mc Graw Hill Publication, 2001.
4. Bernard Sklar and Pabitra Kumar Roy, Digital Communications: Fundamentals & Applications, 2/E, Pearson Education India, 2009
5. John G. Proakis, Masoud Salehi, "Communication Systems Engineering", Prentice Hall, 1994.

OUTCOMES:

- The student would be able to demonstrate an understanding of the basic principles of random signal processing, spectral estimation methods and their applications.
- The student would be able to demonstrate an understanding of the different signal detection and estimation methods used in communication system design and the implications of proper synchronization methods for proper functioning of the system.
- The student would be in a position to apply his knowledge for designing a baseband system addressing the channel impairments.
- Heinrich Meyer, Mare Moeneclacy, Stefan.A.Fechtel, " Digital communication receivers ", Vol I & Vol II, John Wiley, New York, 1997.
- Sergio Verdu, "Multiuser Detection", Cambridge University Press, 1998.

CU7005 COGNITIVE RADIO L T P C
3 0 0 3

OBJECTIVES:

- To enable the student to understand the evolving paradigm of cognitive radio communication and the enabling technologies for its implementation.
- To enable the student to understand the essential functionalities and requirements in designing software defined radios and their usage for cognitive communication.
- To expose the student to the evolving next generation wireless networks and their associated challenges.

UNIT I INTRODUCTION TO SDR 9

Definitions and potential benefits, software radio architecture evolution – foundations, technology tradeoffs and architecture implications, Antenna for Cognitive Radio.

UNIT II SDR ARCHITECTURE 9

Essential functions of the software radio, architecture goals, quantifying degrees of programmability, top level component topology, computational properties of functional components, interface topologies among plug and play modules, architecture partitions.

UNITIII INTRODUCTION TO COGNITIVE RADIOS 9

Marking radio self-aware, the cognition cycle, organization of congnition tasks, structuring knowledge for cognition tasks, Enabling location and environment awareness in cognitive radios – concepts, architecture, design considerations.

UNIT IV COGNITIVE RADIO ARCHITECTURE 9

Primary Cognitive Radio functions, Behaviors, Components, A–Priori Knowledge taxonomy, observe – phase data structures, Radio procedure knowledge encapsulation, components of orient, plan, decide phases, act phase knowledge representation, design rules.

UNIT V NEXT GENERATION WIRELESS NETWORKS 9

The XG Network architecture, spectrum sensing, spectrum management, spectrum mobility, spectrum sharing, upper layer issues, cross – layer design.

TOTAL: 45 PERIODS

REFERENCES:

1. Alexander M. Wyglinski, Maziar Nekovee, And Y. Thomas Hou, " Cognitive Radio Communications And Networks - Principles And Practice", Elsevier Inc. , 2010.
2. "E. Biglieri, A.J. Goldsmith., L.J. Greenstein, N.B. Mandayam, H.V. Poor, Principles of Cognitive Radio", Cambridge University Press, 2013.
3. Kwang-Cheng Chen and Ramjee Prasad, " Cognitive Radio Networks" , John Wiley & Sons, Ltd, 2009.
4. Khattab, Ahmed, Perkins, Dmitri, Bayoumi, Magdy, "Cognitive Radio Networks - From Theory to Practice", Springer Series: Analog Circuits and Signal Processing, 2009.
5. J. Mitola, " Cognitive Radio: An Integrated Agent Architecture for software defined radio", Doctor of Technology thesis, Royal Inst. Technology, Sweden 2000.
6. Simon Haykin, "Cognitive Radio: Brain –empowered wireless communications", IEEE Journal on selected areas in communications, Feb 2005.
7. Ian F. Akyildiz, Won – Yeol Lee, Mehmet C. Vuran, Shantidev Mohanty, " NeXt generation/dynamic spectrum access / cognitive radio wireless networks: A Survey Elsevier Computer Networks, May 2006.

OUTCOMES:

1. The student would be able to appreciate the motivation and the necessity for cognitive radio communication strategies.
2. The student would be able to evolve new techniques and demonstrate their feasibility using mathematical validations and simulation tools.
3. The student would be able to demonstrate the impact of the evolved solutions in future wireless network design.

OC7003 DIGITAL SPEECH SIGNAL PROCESSING L T P C
3 0 0 3

UNIT I MECHANICS OF SPEECH 8

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

UNIT II TIME DOMAIN METHODS FOR SPEECH PROCESSING 8

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

UNIT III FREQUENCY DOMAIN METHOD FOR SPEECH PROCESSING 9

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

HOMOMORPHIC SPEECH ANALYSIS**:** Cepstral analysis of Speech – Formant and Pitch Estimation – Homomorphic Vocoders.

UNIT IV LINEAR PREDICTIVE ANALYSIS OF SPEECH 10

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 SIGNAL PROCESSING 10

Algorithms: Spectral Estimation, dynamic time warping, hidden Markov model – Music analysis – Pitch Detection – Feature analysis for recognition –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 PERIODS

REFERENCES:

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

NC7002 MULTIMEDIA COMPRESSION TECHNIQUES L T P C
3 0 0 3

OBJECTIVES:

To provide in-depth knowledge about

- Data Compression
- Text Compression and Audio Compression
- Image and Video Compression

OUTCOMES:

Students will be able to

- Explain Scalar quantization theory and Rate distribution Theory
- Understand different coding techniques
- Describe Contour based compression and Motion estimation techniques

UNIT I INTRODUCTION 9

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

UNIT II TEXT COMPRESSION 9

Compaction techniques – Huffmann coding – Adaptive Huffmann Coding – Arithmatic coding – Shannon-Fano coding – Dictionary techniques – LZW family algorithms.

UNIT III AUDIO COMPRESSION 9

Audio compression techniques - μ- Law and A- Law companding. Speech compression- waveform codecs-source codecs- hybrid codecs-Shorten compressor, Frequency domain and filtering – Basic sub-band coding – Application to speech coding – G.722 –Application to audio coding – MPEG audio, progressive encoding for audio – Silence compression, speech compression techniques – Formant and CELP Vocoders.

UNIT IV IMAGE COMPRESSION 9

Predictive techniques – DM, PCM, DPCM: Optimal Predictors and Optimal Quantization– Contour based compression – Transform Coding – JPEG Standard – Sub-band coding algorithms: Design of Filter banks – Wavelet based compression: Implementation using filters – EZW, SPIHT coders – JPEG 2000 standards – JBIG, JBIG2 Standards

UNIT V VIDEO COMPRESSION 9

Video compression techniques and standards – MPEG Video Coding I: MPEG – 1 and 2 MPEG Video Coding II: MPEG – 4 and 7 – Motion estimation and compensation techniques – H.261 Standard – DVI technology – PLV performance – DVI real time compression – Packet Video.

TOTAL: 45 PERIODS

REFERENCES:

1. Khalid Sayood : Introduction to Data Compression, Morgan Kauffman Harcourt India, 2nd Edition, 2000.
2. David Salomon : Data Compression – The Complete Reference, Springer Verlag New York Inc., 2nd Edition, 2001.
   - Yun Q.Shi, Huifang Sun : Image and Video Compression for Multimedia Engineering Fundamentals, Algorithms & Standards, CRC press, 2003.
3. Peter Symes : Digital Video Compression, McGraw Hill Pub., 2004.
4. Mark Nelson : Data compression, BPB Publishers, New Delhi, 1998.
5. Mark S.Drew, Ze-Nian Li : Fundamentals of Multimedia, PHI, 1st Edition, 2003.
6. Watkinson,J : Compression in Video and Audio, Focal press, London. 1995.
7. Jan Vozer : Video Compression for Multimedia, AP Profes, New York, 1995

DS7201 ADVANCED DIGITAL IMAGE PROCESSING L T P C
3 0 0 3

OBJECTIVES:

- To understand the image fundamentals and mathematical transforms necessary for image processing and to study the image enhancement techniques.
- To understand the image segmentation and representation techniques.
- To understand how image are analyzed to extract features of interest.
- To introduce the concepts of image registration and image fusion.
- To analyze the constraints in image processing when dealing with 3D data sets.

UNIT I FUNDAMENTALS OF DIGITAL IMAGE PROCESSING 9

Elements of visual perception, brightness, contrast, hue, saturation, mach band effect, 2D image transforms-DFT, DCT, KLT, and SVD. Image enhancement in spatial and frequency domain, Review of morphological image processing

UNIT II SEGMENTATION 9

Edge detection, Thresholding, Region growing, Fuzzy clustering, Watershed algorithm, Active contour methods, Texture feature based segmentation, Model based segmentation, Atlas based segmentation, Wavelet based Segmentation methods

UNIT III FEATURE EXTRACTION 9

First and second order edge detection operators, Phase congruency, Localized feature extraction-detecting image curvature, shape features Hough transform, shape skeletonization, Boundary descriptors, Moments, Texture descriptors- Autocorrelation, Co-occurrence features, Run length features, Fractal model based features, Gabor filter, wavelet features.

UNIT IV REGISTRATION AND IMAGE FUSION 9

Registration- Preprocessing, Feature selection-points, lines, regions and templates Feature correspondence-Point pattern matching, Line matching, region matching Template matching .Transformation functions-Similarity transformation and Affine Transformation. Resampling- Nearest Neighbour and Cubic Splines

Image Fusion-Overview of image fusion, pixel fusion, Multire solution based fusion discrete wavelet transform, Curvelet transform. Region based fusion.

UNIT V 3D IMAGE VISUALIZATION 9

Sources of 3D Data sets, Slicing the Data set, Arbitrary section planes, The use of color, Volumetric display, Stereo Viewing, Ray tracing, Reflection, Surfaces, Multiply connected surfaces, Image processing in 3D, Measurements on 3D images.

TOTAL: 45 PERIODS

OUTCOMES:

Upon Completion of the course, the students will be able to

- To understand image formation and the role human visual system plays in perception of gray and color image data.
- To apply image processing techniques in both the spatial and frequency (Fourier) domains.
- To design image analysis techniques in the form of image segmentation and to evaluate the methodologies for segmentation.
- To conduct independent study and analysis of feature extraction techniques.
- apply image processing algorithms in practical applications.

TEXT BOOKS:

1. John C.Russ, “The Image Processing Handbook”, CRC Press,2007.
2. Mark Nixon, Alberto Aguado, “Feature Extraction and Image Processing”, Academic Press, 2008.
3. Ardeshir Goshtasby, “ 2D and 3D Image registration for Medical, Remote Sensing and Industrial Applications”,John Wiley and Sons,2005.

REFERENCES:

1. Rafael C. Gonzalez, Richard E. Woods, , Digital Image Processing’, Pearson, Education, Inc., Second Edition, 2004.
2. Anil K. Jain, , Fundamentals of Digital Image Processing’, Pearson Education, Inc., 2002.
3. Rick S.Blum, Zheng Liu,“ Multisensor image fusion and its Applications“, Taylor & Francis, 2006.

CU7006 WAVELET TRANSFORMS AND APPLICATIONS L T P C
3 0 0 3

OBJECTIVES:

- To study the basics of signal representation and Fourier theory
- To understand Multi Resolution Analysis and Wavelet concepts
- To study the wavelet transform in both continuous and discrete domain
- To understand the design of wavelets using Lifting scheme
- To understand the applications of Wavelet transform

UNIT I FUNDAMENTALS 9

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- Fourier Theory: Fourier series expansion, Fourier transform, Short time Fourier transform, Time-frequency analysis.

UNIT II MULTI RESOLUTION ANALYSIS 9

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.

UNIT III CONTINUOUS WAVELET TRANSFORMS 9

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 9

Filter Bank and Sub Band Coding Principles – Wavelet Filters – Inverse DWT Computation by Filter Banks – Basic Properties of Filter Coefficients – Choice of Wavelet Function Coefficients – Derivations of Daubechies Wavelets – Mallat's Algorithm for DWT – Multi Band Wavelet Transforms Lifting Scheme- Wavelet Transform Using Polyphase Matrix Factorization – Geometrical Foundations of Lifting Scheme – Lifting Scheme in Z –Domain.

UNIT V APPLICATIONS 9

Wavelet methods for signal processing- Image Compression Techniques: EZW–SPHIT Coding – Image Denoising Techniques: Noise Estimation – Shrinkage Rules – Shrinkage Functions – Edge Detection and Object Isolation, Image Fusion, and Object Detection.

TOTAL: 45 PERIODS

OUTCOMES:

Upon Completion of the course, the students will be able to

- Use Fourier tools to analyse signals
- Gain knowledge about MRA and representation using wavelet bases
- Acquire knowledge about various wavelet transforms and design wavelet transform
- Apply wavelet transform for various signal & image processing applications

TEXT BOOKS:

1. Rao R M and A S Bopardikar, —Wavelet Transforms Introduction to theory and Applications, Pearson Education, Asia, 2000.
2. L.Prasad & S.S.Iyengar, Wavelet Analysis with Applications to Image Processing, CRC Press, 1997.

REFERENCES

1. J. C. Goswami and A. K. Chan, "Fundamentals of wavelets: Theory, Algorithms and Applications" WileyInterscience Publication,John Wiley & Sons Inc., 1999.
2. M. Vetterli, J. Kovacevic, "Wavelets and subband coding" Prentice Hall Inc, 1995.
3. Stephen G. Mallat, "A wavelet tour of signal processing" 2 nd Edition Academic Press, 2000.
4. Soman K P and Ramachandran K I, —Insight into Wavelets From Theory to practicell, Prentice Hall, 2004.

DS7101 DSP PROCESSOR ARCHITECTURE AND PROGRAMMING L T P C
3 0 0 3

OBJECTIVES:

The objective of this course is to provide in-depth knowledge on

- Digital Signal Processor basics
- Third generation DSP Architecture and programming skills
- Advanced DSP architectures and some applications.

OUTCOMES:

Students should be able to:

- Become Digital Signal Processor specialized engineer
- DSP based System Developer

UNIT I FUNDAMENTALS OF PROGRAMMABLE DSPs 9

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

UNIT II TMS320C5X PROCESSOR 9

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 TMS320C6X PROCESSOR 9

Architecture of the C6x Processor - Instruction Set - DSP Development System: Introduction – DSP Starter Kit Support Tools- Code Composer Studio - Support Files - Programming Examples to Test the DSK Tools – Application Programs for processing real time signals.

UNIT IV ADSP PROCESSORS 9

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 PROCESSORS 9

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 PERIODS

REFERENCES:

1. B.Venkataramani and M.Bhaskar, “Digital Signal Processors – Architecture, Programming and Applications” – Tata McGraw – Hill Publishing Company Limited. New Delhi, 2003.
2. Avtar Singh and S. Srinivasan, Digital Signal Processing – Implementations using DSP Microprocessors with Examples from TMS320C54xx, cengage Learning India Private Limited, Delhi 2012
3. User guides Texas Instrumentation, Analog Devices, Motorola.
4. Rulph Chassaing, Digital Signal Processing and Applications with the C6713 and C6416 DSK, A JOHN WILEY & SONS, INC., PUBLICATION, 2005

NC7001 NETWORK ROUTING ALGORITHMS L T P C
3 0 0 3

OBJECTIVES:

- To expose the students to the layered architecture for communication networks and the specific functionality of the network layer.
- To enable the student to understand the basic principles of routing and the manner this is implemented in conventional networks and the evolving routing algorithms based on Internetworking requirements, optical backbone and the wireless access part of the network.
- To enable the student to understand the different routing algorithms existing and their performance characteristics.

UNIT I INTRODUCTION 7

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 10

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 10

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 9

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 9

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 PERIODS

REFERENCES:

1. William Stallings, ' High speed networks and Internets Performance and Quality of Service', IInd Edition, Pearson Education Asia. Reprint India 2002
2. M. Steen Strub, 'Routing in Communication network, Prentice – Hall International, New york, 1995.
3. S. Keshav, 'An engineering approach to computer networking' Addison Wesley 1999.
4. William Stallings, 'High speed Networks TCP/IP and ATM Design Principles, Prentice- Hall, New York, 1995
5. C.E Perkins, 'Ad Hoc Networking', Addison – Wesley, 2001
6. 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.
7. A.T Campbell et al., "Comparison of IP Micromobility Protocols," IEEE Wireless Communications Feb. 2002, pp 72-82.
8. C.Siva Rama Murthy and Mohan Gurusamy, "WDM Optical Networks – Concepts, Design and Algorithms", Prentice Hall of India Pvt. Ltd, New Delhi –2002.

OUTCOMES:

1. Given the network and user requirements and the type of channel over which the network has to operate, the student would be in a position to apply his knowledge for identifying a suitable routing algorithm , implementing it and analyzing its performance.
2. The student would also be able to design a new algorithm or modify an existing algorithm to satisfy the evolving demands in the network and by the user applications.

NC7201 COMMUNICATION NETWORK SECURITY L T P C
3 0 0 3

UNIT I DATA ENCRYPTION STANDARD 9

Services – Mechanisms and Attacks – OSI security Architecture – Model for Network Security – Classical Encryption Techniques – Symmetric Cipher Model – Substitution Techniques – Transposition Techniques – Rotor Machines– Stenography – Block Ciphers and Data Encryption Standard – Simplified DES – Block Cipher Principles, Data Encryption Standard – Strength of DES – Differential and Linear Crypt Analysis, Block Cipher Design Principles – Block Cipher Modes of Operation.

UNIT II ADVANCED ENCRYPTION STANDARD 9

Advanced Encryption Standard – Evaluation Criteria for AES, AES Cipher– Contemporary Symmetric Ciphers – Triple DES, Blowfish, RC5 – Characteristics of Advanced Symmetric Block Ciphers – RC4 Stream Cipher – Confidentiality using Symmetric Encryption – Placement of Encryption Function – Traffic Confidentiality – Key Distribution and Random Number Generation.

UNIT III PUBLIC KEY ENCRYPTION AND HASH FUNCTIONS 9

Public Key Cryptography and RSA – Principles of Public Key Cryptosystems – RSA Algorithm – Key Management and other public key cryptosystems – 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 MACs; Hash Algorithms – MD5 Message Digest Algorithm, Secure Hash Algorithm RIPEMD 160, HMAC– Digital Signatures and Authentication Protocols – Digital Signature Standards .

UNIT IV NETWORK SECURITY PRACTICE 9

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 – Combining Security Associations – Web Security – Web Security Considerations – Secure Sockets Layer and Transport Layer Security – Secure Electronic Transaction .

UNIT V WIRELESS NETWORK SECURITY 9

Security Attack issues specific to Wireless systems: Worm hole, Tunneling, DoS. WEP for Wi-Fi network, Security for 4G networks: Secure Ad hoc Network, Secure Sensor Network.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. William Stallings, “Network Security Essentials”, 2nd edition, Prentice Hall of India New Delhi, 2004.
2. Charlie Kaufman, “Network Security Private Communication in Public World” 2nd edition, Prentice Hall of India New Delhi, 2004.

REFERENCES:

1. William Stallings, “Cryptography and Network Security”, 3rd edition, Prentice Hall of India, New Delhi, 2004.
2. R.K.Nichols and P.C. Lekkas ,” Wireless Security” Mc Graw Hill 2002

NC7202 WIRELESS ADHOC AND SENSOR NETWORKS L T P C
3 0 0 3

UNIT I ADHOC NETWORKS AND ROUTING PROTOCOLS 9

Ad hoc Wireless Networks – What is an Ad Hoc Network? Heterogeneity in Mobile Devices – Wireless Sensor Networks – Traffic Profiles – Types of Ad hoc Mobile Communications – Types of Mobile Host Movements – Challenges Facing Ad hoc Mobile Networks – Ad hoc wireless Internet .
Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks – Classifications of Routing Protocols – Table–Driven Routing Protocols – Destination Sequenced Distance Vector (DSDV) – Wireless Routing Protocol (WRP) – Cluster Switch Gateway Routing (CSGR) – Source–Initiated On–Demand Approaches – Ad hoc On–Demand Distance Vector Routing (AODV) – Dynamic Source Routing (DSR) –Temporally Ordered Routing Algorithm (TORA) – Signal Stability Routing (SSR) –Location–Aided Routing (LAR) – Power–Aware Routing (PAR) – Zone Routing Protocol (ZRP).

UNIT II MULTICAST ROUTING AND SECURITY 9

Issues in Designing a Multicast Routing Protocol – Operation of Multicast Routing Protocols – An Architecture Reference Model for Multicast Routing Protocols –Classifications of Multicast Routing Protocols – Tree–Based Multicast Routing Protocols– Mesh–Based Multicast Routing Protocols – Summary of Tree and Mesh based Protocols – Energy–Efficient Multicasting – Multicasting with Quality of Service Guarantees – Application – Dependent Multicast Routing –
Comparisons of Multicast Routing Protocols - Design Goals of a Transport Layer Protocol for Ad hoc Wireless Networks –Classification of Transport Layer Solutions – TCP over Ad hoc Wireless Networks- Security in Ad Hoc Wireless Networks – Network Security Requirements – Issues and Challenges in Security Provisioning – Network Security Attacks – Key Management – Secure Routing in Ad hoc Wireless Networks.

UNIT III QoS AND ENERGY MANAGEMENT 9

Issues and Challenges in Providing QoS in Ad hoc Wireless Networks – Classifications of QoS Solutions – MAC Layer Solutions – Network Layer Solutions – QoS Frameworks for Ad hoc Wireless Networks Energy Management in Ad hoc Wireless Networks – Introduction – Need for Energy Management in Ad hoc Wireless Networks – Classification of Energy Management Schemes – Battery Management Schemes – Transmission Power Management Schemes – System Power Management Schemes.

UNIT IV SENSOR NETWORKS – ARCHITECTUREAND MACPROTOCOLS 9

Single node architecture – Hardware components, energy consumption of sensor nodes, Network architecture – Sensor network scenarios, types of sources and sinks, single hop versus multi-hop networks, multiple sinks and sources, design principles, Development of wireless sensor networks. , physical layer and transceiver design consideration in wireless sensor networks, Energy usage profile, choice of modulation, Power Management - MAC protocols – fundamentals of wireless MAC protocols, low duty cycle protocols and wakeup concepts, contention-based protocols, Schedule-based protocols - SMAC, BMAC, Traffic-adaptive medium access protocol (TRAMA), Link Layer protocols – fundamentals task and requirements, error control, framing, link management.

UNIT V SENSOR NETWORKS – ROUTING PROTOCOLS AND OPERATING SYSTEMS 9

Gossiping and agent-based uni-cast forwarding, Energy-efficient unicast, Broadcast and multicast, geographic routing, mobile nodes, Data-centric routing – SPIN, Directed Diffusion, Energy aware routing, Gradient-based routing – COUGAR, ACQUIRE, Hierarchical Routing – LEACH, PEGASIS, Location Based Routing – GAF, GEAR, Data aggregation – Various aggregation techniques. Introduction to TinyOS – NesC, Interfaces, modules, configuration, Programming in TinyOS using NesC, Emulator TOSSIM.

TOTAL: 45 PERIODS

REFERENCES

1. C. Siva Ram Murthy and B. S. Manoj, "Ad Hoc Wireless Networks Architectures and Protocols", Prentice Hall, PTR, 2004.
2. C. K. Toh, "Ad Hoc Mobile Wireless Networks Protocols and Systems", Prentice Hall, PTR, 2001.
3. Charles E. Perkins, "Ad Hoc Networking", Addison Wesley, 2000.
4. Kazem Sohraby, Daniel Minoli and Taieb Znati, " Wireless Sensor Networks Technology-Protocols and Applications", John Wiley & Sons, 2007.
5. Feng Zhao, Leonidas Guibas, "Wireless Sensor Networks: an information processing approach", Else vier publication, 2004.
6. C.S.Raghavendra Krishna, M.Sivalingam and Tarib znati, "Wireless Sensor Networks", Springer publication, 2004.
7. Holger Karl , Andreas willig, "Protocol and Architecture for Wireless Sensor Networks", John wiley publication, Jan 2006.
8. K.Akkaya and M.Younis, " A Survey of routing protocols in wireless sensor networks", Elsevier Adhoc Network Journal, Vol.3, no.3,pp. 325-349, 2005.
9. Philip Levis, " TinyOS Programming", 2006 – www.tinyos.net.
10. I.F. Akyildiz, W. Su, Sankarasubramaniam, E. Cayirci, "Wireless sensor networks: a survey", computer networks, Elsevier, 2002, 394 - 422.
11. Jamal N. Al-karaki, Ahmed E. Kamal, "Routing Techniques in Wireless sensor networks: A survey", IEEE wireless communication, December 2004, 6 – 28.

NE7007 NETWORK MANAGEMENT L T P C
3 0 0 3

OBJECTIVES

The objective of this course is to

- To understand the need for interoperable network management
- To learn to the concepts and architecture behind standards based network management
- To understand the concepts and terminology associated with SNMP and TMN
- To understand network management as a typical distributed application
- To study the current trends in network management technologies

UNIT I FUNDAMENTALS OF COMPUTER NETWORK TECHNOLOGY 9

Network Topology, LAN, Network node components- Hubs, Bridges, Routers, Gateways, Switches, WAN, ISDN Transmission Technology, Communications protocols and standards. Network Management: Goals, Organization, and Functions, Network and System Management, Network Management System Platform, Current Status and future of Network

UNIT II OSI NETWORK MANAGEMENT 9

OSI Network management model-Organizational model-Information model, communication model. Abstract Syntax Notation - Encoding structure, Macros Functional model CMIP/CMIS

UNIT III INTERNET MANAGEMENT(SNMP) 9

SNMP(V1 and V2)-Organizational model-System Overview, The information model, communication model-Functional model, SNMP proxy server, Management information, protocol remote monitoring- , RMON SMI and MIB, RMON1,RMON2 - A Case Study of Internet Traffic Using RMON.

UNIT IV BROADBAND NETWORK MANAGEMENT 9

Broadband networks and services, ATM Technology-VP,VC, ATM Packet, Integrated service, ATMLAN emulation, Virtual Lan. ATM Network Management-ATM Network reference model, integrated local management Interface. ATM Management Information base, Role of SNMD and ILMI in ATM Management, M1, M2, M3, M4 Interface. ATM Digital Exchange Interface Management, TMN conceptual Model- TMN Architecture, TMN Management Service Architecture

UNIT V NETWORK MANAGEMENT APPLICATIONS 9

Configuration management, Fault management, performance management, Event Correlation Techniques security Management, Accounting management, Report Management, Policy Based Management Service Level Management- Network Management Tools, Network Statistics Measurement Systems – Web Based Management, XML Based Network Management - : Future Directions.

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of this course, the students will be able to

- Analyze the issues and challenges pertaining to management of emerging network technologies such as wired/wireless networks and high-speed internets.
- Apply network management standards to manage practical networks.
- Formulate possible approaches for managing OSI network model.
- Use on SNMP for managing the network
- Use RMON for monitoring the behavior of the network
- Explore the possibilities of improving the speed of the network and managing them
- Identify the various components of network and formulate the scheme for the managing them

REFERENCES:

1. Mani Subramanian, “Network Management Principles and practice ", Pearson Education, New Delhi, 2010.
2. STALLINGS, WILLIAM, “SNMP, SNMPv2, SNMPv3, and RMON 1 and 2,” Pearson Education, 2012
3. Salah Aiidarous, Thomas Plevayk, “Telecommunications Network Management Technologies and Implementations ", eastern Economy Edition IEEE press, New Delhi, 1998.
4. Lakshmi G. Raman, “Fundamentals of Telecommunication Network Management", Eastern Economy Edition IEEE Press, New Delhi, 1999.

CU7007 INTERNETWORKING MULTIMEDIA L T P C

3 0 0 3

UNIT I MULTIMEDIA NETWORKING 9

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 BROADBAND NETWORK TECHNOLOGY 9

Broadband Services – ATM and IP, IPV6, High Speed Switching – Resource Reservation, Buffer Management – Traffic Shaping – Caching – Scheduling and Policing, Throughput, Delay and Jitter Performance – Storage and Media Services – Voice and Video Over IP – MPEG–2 over ATM/IP – Indexing Synchronization of Requests – Recording and Remote Control .

UNIT III RELIABLE TRANSPORT PROTOCOL AND APPLICATIONS 9

Multicast over Shared Media Network – Multicast Routing and Addressing – Scaling Multicast and NBMA Networks – Reliable Transport Protocols – TCP Adaptation Algorithm – RTP, RTCP – MIME – Peer–to–Peer Computing – Shared Application – Video Conferencing, Centralized and Distributed Conference Control – Distributed Virtual Reality – Light Weight Session Philosophy .

UNIT IV MULTIMEDIA COMMUNICATION STANDARDS 9

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 9

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 PERIODS

REFERENCES:

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

OC7004 INTEGRATED OPTICS L T P C
3 0 0 3

UNIT I OPTICAL WAVE GUIDES 9

Coupled mode theory in guided wave systems, Theory of gratings in wave guide structure- Guided wave control – Fabrication of optical waveguides in glass, lithium niobate substrate.

UNIT II WAVEGUIDE COUPLERS 9

Coupling of beams to planar guides-prism, grating couplers. Theory of beam couplers and design. Waveguide couplers and mode converters, Filters.

UNIT III INTEGRATED OPTICAL DEVICES AND SYSTEMS 9

2D Dielectric Waveguides -3D Dielectric Waveguides - Losses in Optical Waveguides Waveguide Fabrication and Fiber-to-Waveguide Couplers - Introduction to Plasmonics - Coupled-Mode Theory - Slot-Waveguides and Directional Couplers - Microresonators and Integrated Gratings - Optical Modulators- Optical interconnects and switches

UNIT IV SEMICONDUCTOR INTEGRATED OPTIC DEVICES 9

Integrated semiconductors laser:- Gas heterostructure lasers, DFB lasers, modulators, Epitaxial detectors and electro absorption detectors, active switches, Optolectronic integrated circuits. Development trends.

UNIT V APPLICATIONS OF OPTICAL INTEGRATED CIRCUITS 9

Optical switches, A/D converters, RF spectrum analysers, convolvers and correlators. Integrated optic sensors. Optical inter connectors.

TOTAL: 45 PERIODS

REFERENCES:

1. Hiroshi Nishihara, Masamitsu Haruna, Toshiaki Suhara, Optical Integrated Circuits, McGraw-Hill, New York, 1992.
2. B.Saleh, Fundamental of Photonics, John Wiley, New York, 1991.
3. Tamir.T. (ed) Integrated optics, Vol. 7, Topics in applied Physics, Springer Verlag, New York, 1975.
4. Tamir.T. (ed) Guided wave Optoelectronics, Springer Verlag, Berlin, 1990.
5. .Buckman. AB, Guided Wave Photonics, Saunders College publishing, New York, 1992.
6. Photonic Switching, Technology & Sensors, Vol. 13, OSA publishing, 1987.
7. J. D. Joannopoulos, R. D. Meade, and J. N. Winn, Photonic Crystals: Molding the Flow of Light , Princeton University Press, 1995.

OC7005 HIGH SPEED PHOTONICS AND OPTO ELECTRONICS L T P C
3 0 0 3

UNIT I ELECTRONICS PROPERTIES OF SEMICONDUCTORS 9

Semiconductor materials, Band structure, Band structure modification by alloying, Heterostructure, Intrinsic carrier concentration, Defect levels, excess carriers, recombination process, charge injection and non radiative effects.

UNIT II HIGH SPEED PHENOMENA 9

Picosecond process in carrier transport theory, carrier-carrier interaction, exciton-exciton interaction in super lattices, exciton life time reduction, reduction of electrons – photon scattering rates, hot electron diffusion.

UNIT III HIGH SPEED OPTOELECTRONIC DEVICES 9

Mode locked lasers, Fast multiple quantum well absorbers, suppressing of timing and energy fluctuation in lasers, Parametric oscillation in lasers, Ultra fast detectors – metal semiconductor photo diodes, Photo conductors, Switches.

UNIT IV SHORT PULSE GENERATION 9

Gain switching in semiconductor lasers, Self-pulsation in semiconductor laser, bistable laser, Short pulse generation using fiber non-linearity, Application to long distance and high speed communication.

UNIT V APPLICATIONS

High speed optical signal processing, Pico-second electro optic sampling, logic gates, parallel processing, high speed photonic interconnects.

TOTAL: 45 PERIODS

REFERENCES:

1. M.L.Riaziat, “Introduction to high speed electronics and Opto electronics”, John Wiley, New York, 1995.
2. Sueta. T, Okoshi. T, “Fundamental of Ultra fast and Ultra parallel opto electronics”, John Wiley, New York, 1996.
3. Mourou.G.A., Bloom O.M and Lee.C.H., “Principle electronics and Opto Electronics”, Springer Vering, Berlin, 1995.

AP7005 **QUANTUM ELECTRONICS** **L T P C**
3 0 0 3

OBJECTIVES:
1. To know the concepts of EM fields and wave equations.
2. To study the types of lasers and its characteristics.
3. To know the various methods of scattering.
4. To learn the concept of Non-linear optics.

UNIT I BASIC THEOREMS AND POSTULATES OF QUANTUM MECHANICS 9
Introduction to Quantum Electronics- Résumé of electromagnetic theory-Waveguides-Planar-mirror waveguides-Modes in dielectric slab waveguides-Effective Index Method-Guided wave coupling and interference-Coupled Mode Theory-Directional coupler-Mode coupling in periodic waveguides-Mode interference-The Schrodinger wave equation, some solutions of time independent Schrodinger equation, Matrix formulation of quantum mechanics, Lattice vibration and their quantization, Electromagnetic fields and their quantization.

UNIT II LASER 9
Gaussian beam in a homogenous medium, Gaussian beam in a lens waveguide, Elliptic Gaussian beams, Optical resonators, Spontaneous and induced transitions, gain coefficient, homogenous and inhomogeneous broadening, Laser oscillations, Semiconductor laser, quantum well laser, modulation of optical radiation, Q switching and Mode locking of laser, Quantum wires and dots, Laser arrays, Concept of super modes, Phase amplitude in laser, Free electron lasers.

UNIT III NONLINEAR OPTICS 9
Introduction to nonlinear (NL) optics, 2nd order NL effects-The nonlinear optical susceptibility tensor, Second harmonic generation, parametric oscillations, parametric amplifiers, Applications--Nonlinear polarization -physical origin-Complex notation, conservation laws-Second Harmonic Generation, Birefringence and Quasi- Phase Matching-3rd order NL effects-Self-Phase Modulation, Optical soliton-Stimulated Raman Scattering-Electro-optic (EO) modulation of light-Linear EO effect, Phase retardation-Amplitude, and Phase modulation-Traveling wave modulator

UNIT IV STIMULATED RAMAN AND BRILLOUIN SCATTERING 9
Stimulated Raman scattering, Antisokes scattering, stimulated Brillouin scattering, self focusing of optical beams.

UNIT V NOISE 9
Noise in laser amplifier and oscillator, Laser spectra, Measurements

TOTAL:45 PERIODS

REFERENCES:

1. Amnon Yariv, “Quantum Electronics”, John Wiley 1989
2. Max Schubert, Bernd Wilhelmi, “Nonlinear optics and quantum electronics”, Wiley-Interscience 1986
3. D.Marcuse, “Principle of Quantum Electronics”, Cambridge 1980
4. David Klyshko, “Physical Foundations of Quantum Electronics” , World Scientific 2011
5. J.T. Verdeyen, “Laser Electronics”, Prentice-Hall 1995
6. Harisson Paul, “Quantum Wells, Wires and Dots”, Wiley 2011
7. G.P.Agarwal and N.K.Dutta, “Long Wavelength Semiconductor lasers”, Van Nostrand Reinhold 1986
8. A.Yariv, “Optical Electronics”, CBS College Publishing 1984

OC7006 **LASER COMMUNICATIONS** **L T P C**
3 0 0 3

UNIT I INTRODUCTION TO LASER COMMUNICATIONS 9
Atmospheric low loss windows, optical sources and detectors for these windows, Characteristics of source and detectors. Optical transmitting and receiving antennas.

UNIT II SYSTEM DESIGN 9
Link equation, Transmitter terminal, Antenna design, Antenna gain, Beam width, C/N, Optical detectors, Optical modulation formats, Deriving error statistics, Signal requirements for acquisition and tracking, Fundamentals of system design.

UNIT III SEMICONDUCTOR AND METAL LASER SOURCES FOR SATELLITE COMMUNICATIONS 9
Performance and Geometries, output wavelength control, Semiconductor laser lifetime, Direct and indirect modulation techniques and radiation effects.

UNIT IV OPTICAL RECEIVERS AND SYSTEM DESIGN 9
Direct detection, coherent detection and demodulation. Gimbals in transceiver design, Receiver options and optics; Lasers; antennas / Telescope, Internal optical systems, Transmitter analysis.

UNIT V LASER BEAM POINTING CONTROL 9
Acquisition and Tracking systems, System description, Acquisition methodology, racking and pointing control system, RF cross link system design, link equation.

TOTAL: 45 PERIODS

REFERENCES:
1. Morris Katzman, “Laser Satellite Communications”, Prentice Hall Inc, New York, 1991.
2. J. Franz and V.K.Jain, “Optical Communication Systems”, Narosa Publication, New Delhi, 1994.

AP7014 **OPTICAL COMPUTING** **L T P C**
3 0 0 3

OBJECTIVES:
- To know the basic pricinciples of optical computing.
- To study about various optical computing elements.
- To study and compare analog and digital optical computing.

UNIT I OPTICAL COMPUTING PRINCIPLES 9
Non Von-Neuman architecture, various forms of parallel processing, SLM, LEDs, Lasers and Photo detectors arrays, Holographic techniques, Optical storage devices.

UNIT II DIGITAL LOGIC 9
Symbolic substitution, Image computing, Cellular logic, Boolean logic, Cellular arrays, Cellular hyper cubes, conventional hyper cube, Binary stack coded arithmetic, Binary Row coded, Binary symbol, Coded arithmetic multilevel logic processing.

UNIT III OPTICAL COMPUTING ELEMENTS 9
ß switches, Machzender interferometeric logic elements for Boolean functions, Acousto optic; optical matrix multipliers, Non linear optical switches as memories.

UNIT IV ANALOG OPTICAL COMPUTING 9
Linear optic processing, Analog optical arithmatics. Recognition by analog optical system.

UNIT V DIGITAL OPTICAL COMPUTING 9

Devices, Shadow casting, Symbolic substitution, Optical matrix processing, Optical linear neural network. Nonlinear network.

TOTAL: 45 PERIODS

REFERENCES:

1. A.Karim Mohammed and A.S.Abdul Awwall, Optical computing-An introduction, John Wiley, New York, 1992.
2. Mc. Aulay Alastair.D, Optical Computer Architecture: The Application of optical concepts to next generation computers, John Wiley, New York, 1991.
3. Dror Feitelsen, Optical Computing, MIT press, Cambridge, 1988.

AP7007 FIBER OPTIC SENSORS L T P C

3 0 0 3

OBJECTIVES:

- To familiarize about fiber optic sensor technology.
- To study about Optical resonators.
- To acquire knowledge about magnetic sensors.
- To know about Chemical and Biosensors.
- To gain knowledge about smart structures.

UNIT I SENSOR TECHNOLOGY 9

The Emergence of Fiber Optic Sensor Technology-Optical Fibers-Light Sources-Optical Detectors-Optical Modulators- Intensity-Based and Interferometric Sensors-Fabry perot, Mach Zender, Michelson and Sagnac

UNIT II GRATING SENSORS 9

Multimode Grating and Polarisation Sensors-Sensors Based on Relative Movement of Opposed Gratings-Grating Period Modulation-Sensors Based on the Photoelastic Effect-Retardation Plates-Fiber Grating Sensors

UNIT III DISTRIBUTED AND MAGNETIC SENSORS 9

Fiber Optic Distributed and Magnetic Sensor-Distributed Sensing- Basic Principles of Sensor Multiplexing- Interferometric Sensor Multiplexing- Faraday effect sensors-Magneto strictive - Lorentz force sensors-Evanescent Field Absorption Sensors

UNIT IV CHEMICAL AND BIOSENSOR 9

Fiber Optic Chemical and Biosensor: Reagent Mediated sensor-Humidity sensor – pH sensor - Hydrogen sensor - CO_2 sensor – Ammonia sensor - Chloride sensor – Glucose sensor – Oxygen sensor - Surface Plasmonic Resonance based sensor

UNIT V APPLICATIONS 9

Industrial Applications of Fiber Optic Sensors : Temperature – Pressure - fluid level – flow – position - vibration - rotation measurements - Current -voltage measurement - Chemical analysis. Introduction to smart structures - Applications –skins.

TOTAL: 45 PERIODS

REFERENCES:

1. Eric Udd, William B. Spillman, Jr., “Fiber Optic Sensors: An Introduction for Engineers and Scientists”, John Wiley & Sons 2011
2. Bhagavānadāsa Gupta, Banshi Das Gupta, “Fiber Optic Sensors: Principles and Applications”, New India Publishing 2006
3. David A. Krohn, “Fiber optic sensors: fundamentals and applications”, ISA Publishing 2000
4. Francis T.S. Yu, Shizhuo Yin, Paul B. Ruffin, “Fiber Optic Sensors”, CRC Press Publisher 2010
5. B.Culshaw and J.Daykin, “Optic fiber Sensors Systems and Applications”, Artech House 1989
6. KTV Grattan & BT Meggit, “Optical fiber sensor technology & Applications”, Kluwer Academic 2000

OC7007 BROAD BAND ACCESS NETWORKS L T P C
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UNIT I BROAD BAND ACCESS TECHNOLOGIES 9

Evolution path of Typical access networks-Fiber to the Home building access networks-PON-WDM FTTH-FTTH Network topologies –Multiple access techniques for PON- Wireless Access Network - Fiber in the access Network-Basic Optical access network components –Radio over fiber –Free Space Optical communication .

UNIT II OPTICAL ACCESS NETWORKS 9

Band width allocation for Ethernet Passive optical networks EPON -Data link Layer Protocol-for PON- Multipoint Content Protocol MPCP.-QoS in EPON- QoS enabled Dynamic bandwidth allocation Algorithm-QoS protection and Admission control in EPON-Bandwidth management for Multichannel EPON-Separate and Combined Time and Wavelength Assignment.

UNIT III OPTICAL WIRELESS ACCESS NETWORKS 9

Radio Over Fiber networks – basic technologies -Networking concepts and Techniques-Wi Max networks – Point to Multipoint Wimax networks – Mobility in Wimax networks –Integrated architecture of EPON and WiMAx –Hybrid architecture –Multistage integration.

UNIT IV HYBRID WIRELESS-OPTICAL BROADBAND ACCESS NETWORKS (WOBAN) 9

WOBAN – Archietecture – Study on physical layer of optical backhaul and wireless front end-Connectivity and Routing – Delay aware routing algorithm –Capacity and Delay aware routing – GROW NET integrated routing -Fault tolerance and self healing techniques.

UNIT V BROAD BAND ACCESS NETWORKS –APPLICATIONS 9

Broad band drivers and network requirements –Network architecture – Scalable broad band access networks – Deployment – Next generation access and Backhaul –WDM-PON analysis and applications

TOTAL: 45 PERIODS

REFERENCES:

1. Abdallah Shami ,Martin Maier,Chadi Assi, “Broadband Access Networks Technologies and Deployments” Springer 2009
2. Adeel Ahmed,salman asadulla ’ Deploying IPv6 in Broadband Access Networks John Wiley sons, 2009
3. Chinlon Lin, Broadband Optical Access Networks and Fiber-to-the-Home: Systems Technologies and Deployment Strategies’John Wiley sons , ISBN-10: 0470094788
4. ISBN-13: 978-0470094785 | Edition: 1.

OC7008 OPTICAL DEVICES AND CIRCUITS L T P C
3 0 0 3

UNIT I ACTIVE OPTICAL DEVICES 9

Laser Diodes – types – Properties and Modulations-Amplifiers – Transimpedance amplifiers –TIA performance amplifiers –Open loop TIA, Differential TIA ,- AGC- Liquid crystal display,Novel liquid crystals,Thin film transistors,Electroluminescent display,Thin film deposition techniques,Plasma display panel,Plasma gas characteristics,Field emission display,Field emitter tip fabrication, Field emission characteristics

UNIT II PASSIVE OPTICAL DEVICES 9

Fiber to the premises components – PLC splitter – Fused splitter module 1XN,- 2 port fiber distribution terminal-Optical demodulators-DQPSK demodulators- QPSK mixer , Interleaver-Optical isolators- circulators-WDM devices- hybrid devices-Optical attenuators –Optical filters-Optical power monitors- single and multi
channels-Optical coatings and special materials.

UNIT III PASSIVE OPTICAL NETWORKS 9

Full service active network FSAN – ITU-secure passive optical network-WDM-PON- Upstream bandwidth allocation-.RFoG Radio Frequency over glass—APON –ATM based Passive optical network-Long Reach optical access networks –Optical distributions-Fiber to home services-OFDM-PON

UNIT IV PHOTONIC INTEGRATED CIRCUIT 9

PIC – PIC materials- Fabrication techniques - Photo ICs Applications - Schmitt trigger circuit photo IC-Light modulation PIC-Illuminance Sensor-PIC for optical switch-LASER beam sensor detection.

UNIT V INTEGRATED OPTICAL CIRCUITS AND COMPONENTS: DESIGN AND APPLICATIONS 9

Commercialization of lithium niobate modulators; requirements for integrated optics devices in communication systems; silica waveguide devices; erbium doped gas waveguide devices; erbium doped lithium niobate waveguide devices; inP-based photonic circuits and components; polymeric thermo-optic digital optical switches; hybrid integration of optical devices on silicon; integrated optics in sensors - advances toward miniaturization; nonlinear integrated optical devices; design and simulation tools for integrated optics.

TOTAL: 45 PERIODS

REFERENCES:

1. S. M. Sze, Physics of Semiconductor Devices, Wiley, 2007
2. A. Yariv,Optical Electronics, Saunders, 1991
3. B. G. Streetman and S. Banerjee,Solid State Electronic Devices Prentice Hall, 2000.
4. S. Matsumoto,Electronic Display Devices,, Wiley, 1990.
5. M. A. Karim,Electro Optical Displays , Dekker, 1992.
6. "Full Service Access Network". FSAN Group official web site. 2009. Archived from the original on October 12, 2009. Retrieved September 1, 2011. http://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-G.987.1-201001-I!!PDF-E&type=items
7. D. B. Payne and R. P. Davey, "The Future of Fiber Access Systems," BT Technology Journal , vol. 20, 2002, pp. 104–114..
8. D. P. Shea and J. E. Mitchell, "A 10 Gb/s 1024-Way Split 100-km Long Reach Optical Access Network," IEEE/OSA Journal of Lightwave Technology , vol. 25, no. 3, Mar.2007.
9. Rec. G.984, Gigabit-capable Passive Optical Networks (GPON), ITU-T, 2003. Novera's Got a New PON Spin from Light Reading, retrieved on 2009-09-02.