

**ANNA UNIVERSITY COIMBATORE**

**FACULTY OF  
ELECTRONICS & COMMUNICATION  
ENGINEERING**

**BOARD OF STUDIES -ECE**

**M.E. OPTICAL COMMUNICATION**

**CURRICULUM AND SYLLABI**

**I –IV SEMESTERS**

**REGULATIONS - 2007**

**ANNA UNIVERSITY COIMBATORE**  
**M.E. OPTICAL COMMUNICATION**  
**CURRICULUM 2007 - FULL TIME MODE**

**SEMESTER – I**

Code No.	Course Title	L	T	P	M
<b>Theory</b>					
	Applied Mathematics	3	1	0	100
	Fiber Optic Sensors and Devices	3	1	0	100
	Optical Fiber Communication	3	1	0	100
	Optical Fiber Technology and Applications	3	1	0	100
	Modern Digital Communication Techniques	3	0	0	100
	Elective I	3	0	0	100
<b>Practical</b>					
	Optical Communication Lab I	0	0	4	100
	<b>Total</b>	18	4	4	-

**SEMESTER – II**

Code No.	Course Title	L	T	P	M
<b>Theory</b>					
	Integrated Optics	3	1	0	100
	Optical Computing	3	1	0	100
	Optical Imaging Techniques	3	1	0	100
	Optical Signal Processing	3	1	0	100
	Elective II	3	0	0	100
	Elective III	3	0	0	100
<b>Practical</b>					
	Optical Communication Lab II	0	0	4	100
	<b>Total</b>	18	4	4	-

**SEMESTER – III**

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

**SEMESTER – IV**

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

**LIST OF ELECTIVES**  
**M.E. OPTICAL COMMUNICATION**

<b>Code No.</b>	<b>Course Title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>M</b>
	Non Linear Fiber Optics	3	0	0	100
	High Speed Photonics and Optoelectronics	3	0	0	100
	Photonics Switching	3	0	0	100
	Laser Satellite Communication	3	0	0	100
	Laser Holographic Techniques	3	0	0	100
	Laser and its Applications	3	0	0	100
	Soliton in Optical Communication	3	0	0	100
	Advanced Digital Signal Processing	3	1	0	100
	Digital Image Processing	3	0	0	100
	Internetworking Multimedia	3	0	0	100
	Electromagnetic Interference and Compatibility in System Design	3	0	0	100
	ISDN Architecture	3	0	0	100
	Network Management	3	0	0	100
	High Performance Communication Networks	3	0	0	100
	Optical Communication Networks	3	0	0	100
	Digital Communication Receivers	3	0	0	100
	Nano photonics	3	0	0	100
	Optical MEMS	3	0	0	100
	Optical Waveguide Technology	3	0	0	100
	Quantum Electronics	3	0	0	100
	Special Elective	3	0	0	100

**Unit-I:****LINEAR ALGEBRAIC EQUATION AND EIGEN VALUE PROBLEMS 9+3**

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

**Unit-II:****WAVE EQUATION****9+3**

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

**Unit-III:****SPECIAL FUNCTIONS****9+3**

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

**Unit-IV:****RANDOM VARIABLES****9+3**

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

**Unit-V:****QUEUEING THEORY****9+3**

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

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

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

**07MO02 FIBER OPTIC SENSORS AND DEVICES****3 1 0 100****UNIT I****9****OPTOELECTRONIC DEVICES**

Electrooptic modulators, Magneto optic devices, Acousto optic devices, Photo detectors, Thermal Detectors, Photon Devices, Photo conductors, Photo diodes, Detector Arrays, Optical switching and Logic Devices.

**UNIT II****9****FIBERS AND MODULATED SENSORS**

Principles of glass and plastic fibers for sensing application, Electro- optic modulation, Bulk and integrated optic types, All fiber modulators, Interferometric Sensors, Fabry perot, Mach Zender, Michelson and Sagnac interferometric sensors.

<b>UNIT III</b>	<b>9</b>
<b>MULTIMODE GRATING AND POLARISATION SENSORS</b>	
Introduction to sensors based on relative movements of opposite gratings, sensors based on grating period modulation, Photo elastic effects, retardation plates	
<b>UNIT IV</b>	<b>9</b>
<b>DISTRIBUTED AND MULTIPLEXED FIBER OPTIC SENSORS</b>	
Introduction, Distributed sensing, Principles of sensor multiplexing, Topology, Detection schemes, Interferometer sensor multiplexing, Faraday Effect sensors, Magneto strictive and Lorentz force sensors.	
<b>UNIT V</b>	<b>9</b>
<b>INDUSTRIAL APPLICATIONS AND SMART STRUCTURES</b>	
Temperature, Pressure, fluid level, flow position, vibration and rotation measurements, chemical analysis, Current and voltage measurement. Introduction to smart structures, Application of fiber optic smart structures and skins, Examples.	

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

**REFERENCES**

1. Eric Udd, Fiber Optic Sensors, John Wiley, Newyork, 1991.
2. Eric Udd, Fiber Optic Smart structures, John Wiley, Newyork, 1995.
3. B.P.Pal, Fiber Optics in Telecommunication and sensor, Wiley Eastern, New Delhi, 1995.
4. B.Chulshaw and J.Daykin, Optic fiber sensors Systems and Application, Vol. I & II , Artech House, Norwood, 1989.
5. F.Allard, Fiber Optics Hand Book, McGraw Hill, Newyork, 1990.
6. J.Wilson and J.Haukes, Opto Electronics- An Introduction, Prentice Hall of India Pvt. Ltd., New Delhi, 1995.
7. Bhattacharya, Semiconductor Opto Electronics devices, Printice Hall of India Pvt. Ltd., New Delhi, 1995..

**07MO03 OPTICAL FIBER COMMUNICATION** **3 1 0 100**

**UNIT I** **9**  
**OPTICAL FIBERS**

Geometrical description – wave propagation- Dispersion in single mode (SM) and multimode (MM) fibers – Limitations due to dispersion – Fiber Losses – Non liner optical effects.

**UNIT II** **9**  
**OPTICAL AMPLIFIERS**

Concepts- Semiconductor optical Amplifier – Raman and Brillouin amplifier – Fiber amplifiers – Erbium doped amplifiers – System applications

**UNIT III** **9**  
**DISPERSION MANAGEMENT**

Need- Precompensation schemes – Postcompensation techniques – Dispersion compensating fibers – Optical filters – Fiber Bragg gratings- Optical Phase Conjugation – Long Haul lightwave systems – High capacity systems.

**UNIT IV** **9**  
**MULTICHANNEL SYSTEMS**

WDM lightwave systems- WDM components – System performance issues – Time Division Multiplexing (TDM) - Sub carrier multiplexing – Code Division Multiplexing, DWDM.

**UNIT V** **9**

## COHERENT LIGHTWAVE SYSTEMS

Concepts – Modulation formats – Demodulation formats – Bit Error Rate (BER) – Sensitivity degradation – System performance.

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

### REFERENCES:

1. G.P. Agrawal, "Fiber optic communication systems", 3<sup>rd</sup> Ed, John Wiley & Sons, New York, 2002.
2. H. Franz & V.K.Jain, "Optical Communication Systems", Narosa Publications, New Delhi, 1995.
3. G. Keiser, "Optical fiber communication systems", McGraw-Hill, 3<sup>rd</sup> Edition, New York, 2000.
4. H. Franz & V.K. Jain, "Optical communication, Components and Systems, Narosa Publications, New Delhi, 2002.
5. Selvarajan, S. Kar and T. Srinivas, Optical fiber Communication – Principle and Systems, Tata McGraw-Hill, 2002.

## 07MO04 OPTICAL FIBER TECHNOLOGY AND APPLICATIONS

3 1 0 100

### UNIT I

9

#### PROPERTIES OF FIBER

Physical, Mechanical and Optical properties of fiber. Material selection, properties of materials.

### UNIT II

9

#### MANUFACTURING TECHNOLOGY

Fiber drawing, Multicomponent technology, Vapour deposition techniques: IVD, OVD and CVD, VAD, MOCVD processes. Performance comparison.

### UNIT III

9

#### FIBER PARAMETER MEASUREMENTS

Measurement of fiber parameters: NA, Modefield diameter, profile, attenuation, bandwidth, signal degradations in fiber, Dispersion, Birefringence and propagation constant of fiber modes. OTDR and OFDR.

### UNIT IV

9

#### FIBER CABLES DESIGN

Design conditions: Loss mechanism, mechanical design, standard fibers, design of strength member, sheaths, Fiber core construction, Ribbon cable, stranding cable, loose tube cable, V-groove cables, Submarine cables – armored and unarmored cables.

### UNIT V

9

#### FIBER OPTIC COUPLERS

Single mode and multimode couplers, Transmission and reflection type couplers, Active couplers,  $\Delta\beta$  couplers, switches, modulators.

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

### REFERENCES:

1. K.C.Kao, "Optical Fiber Technology and Applications, McGraw-Hill, New York, 1989.
2. Hiroshi Murata, "Handbook of Optical Fibers and Cables" Marcel Dekker Inc., New York, 1998.
3. Tamir.T, "Guided wave Optoelectronics" Springer Verlag, Berlin, 1992.
4. Gred Keiser, "Optical Communication" 3rd Edition McGraw-Hill, 2000.
5. John Gowar, "Optical Communication System", Prentice Hall, New Delhi, 1995.
6. Mahlke Gunther, and Goessing Peter, Fiber optic cables: Fundamentals, Cable Engineering, System planning, 3<sup>rd</sup> ed., John Wiley, 1997.

**UNIT I****9****POWER SPECTRUM AND COMMUNICATION OVER MEMORYLESS CHANNEL:**

PSD of a synchronous data pulse stream; M-ary Markov source; Convolutionally coded modulation; Continuous phase modulation – Scalar and vector communication over memoryless channel – Detection criteria.

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

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

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

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

**UNIT IV****9****BLOCK CODED DIGITAL COMMUNICATION:**

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

**UNIT V****9****CONVOLUTIONAL CODED DIGITAL COMMUNICATION:**

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

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

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

1. Simulation of Modulation and Coding in a AWGN Communication Channel using Simulation Packages.
2. Performance evaluation of Digital Data Transmission through Fiber Optic Link
3. Characterization of Glass /Plastic Optical Fibers.
4. P-I Characteristics of LED and LASER Diode.
5. DC Characteristics of PIN PD and APD.
6. System Bandwidth determination for Analog Fiber Link.
7. Optical Link Simulation using Simulation Packages.
8. Optical Device Modeling using SPICE

**07MO06 INTEGRATED OPTICS****3 1 0 100****UNIT I  
OPTICAL MODES****9**

Advantages of Integrated Optics, Substrate Materials for Optical Integrated Circuits, Optical Waveguide modes, Modes in a Planar Waveguide structure, Ray Optic approach to Optical Mode theory, theory of Optical Waveguides.

**UNIT II  
OPTICAL WAVEGUIDES****9**

Waveguide fabrication techniques, Polymer and Fiber Integrated Optics, Losses in Waveguides, Waveguide Input and Output Couplers, Coupling between waveguides.

**UNIT III  
OPTICAL INTEGRATED CIRCUIT****9**

Microfabrication techniques in optical integrated circuits, Pattern fabrication, passive waveguide devices- Functional devices.

**UNIT IV  
SEMICONDUCTOR INTEGRATED OPTIC DEVICES****9**

Basic principles of Light Emission in Semiconductors, Semiconductor Lasers, Heterostructure, Confined Lasers, DFB Lasers, Direct modulation of Semiconductor lasers, Quantum well Devices, Micro optic Electromechanical Devices.

**UNIT V  
APPLICATIONS OF OPTICAL INTEGRATED CIRCUITS****9**

Application of OI circuits, Optoelectronic IC, Optical switches, convolvers and correlators, Devices & systems for Telecommunications, Photonic and Microwave Wireless Systems.

**L + T = 45 + 15 = 60****REFERENCES**

1. Hiroshi Nishihara, Masamitsu Haruna, Toshiaki Suhara, Optical Integrated Circuits, McGraw –Hill, New York, 1992.
2. Robert .G. Hunsperger, Integrated Optics, Springer – Verlag, 5<sup>th</sup> Edition, New York 2002.

**07MO07 OPTICAL COMPUTING****3 1 0 100****UNIT I  
BASICS OF OPTICAL COMPUTING****9**

Sources, Basic elements of Optical System, Acousto-Optic System, Limitations, Detectors, Holographic techniques

**UNIT II  
OPTICAL IMAGING AND NUMERICAL PROCESSING****9**

Spectral analysis and filtering, Pattern Recognition, Picture Deblurring, Synthetic Aperture Radar Imaging , Transforms, Simple Arithmetic, Matrix Operations, Differentiation and Integration.

**UNIT III  
ANALOG OPTICAL COMPUTING****9**

Linear optic processing, Analog optical arithmetic, Recognition by analog optical system.

**UNIT IV** 9  
**DIGITAL LOGIC**

Logic elements and Operations, Combinational Logic, Sequential Logic.

**UNIT V** 9  
**DIGITAL OPTICAL COMPUTING**

Devices, Shadow casting, Symbolic substitution, Optical matrix processing

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

**REFERENCES**

- 1) Karim Mohammed and A.S. Abdul Awwall, Optical computing-An introduction, John Wiley, New York ,1992.
- 2) Dror Feitelsen. Optical Computing, MIT press, Cambridge, 1988

**07MO08 OPTICAL IMAGING TECHNIQUES** 3 1 0 100

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

Coherence and light source, optical image formation, Fraunhofer diffraction, Single slit, double slit circular aperture, double aperture gratings, 1D and 2D lens aperture, Interference.

**UNIT II** 9  
**FOURIER SERIES AND TRANSFORM**

Fourier series, Fourier coefficients, optical and crystal diffraction gratings, Fourier series formulation, Fourier transform and single slit diffraction, grating pattern, Fourier transform of light waves, correlation.

**UNIT III** 9  
**OPTICAL IMAGING AND PROCESSING**

Incoherent optical imaging, transfer function, coherent optical imaging, periodic and non periodic objects, optical transform, Holography, coherent and incoherent optical processing.

**UNIT IV** 9  
**IMAGE CONSTRUCTION TECHNIQUES**

X- ray computed tomography, reconstruction by simple back projection, iterative reconstruction, analysis methods, magnetic resonance imaging, Ultrasonic computed tomography.

**UNIT V** 9  
**APPLICATIONS**

Michelsons stellar interferometry, spectral interferometer, fringe visibility and spectral distribution, partial coherence and correlation, Fourier transform spectroscopy, Synthetic aperture radar, Intensity interferometer, Imaging by holographic techniques.

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

**REFERENCES**

- 1) E.G. Stewart, Fourier Optics an Introduction, 2<sup>nd</sup> Edition, Ellis Harwood limited, Chichester, 1987.
- 2) Dror.G. Feitelson, Optical Computing, MIT press, Cambridge, 1988.

**07MO09 OPTICAL SIGNAL PROCESSING** 3 1 0 100

**UNIT I** 9  
**BASIC SIGNAL PARAMETERS**

Characterisation, Sample function, geometrical optics, basic laws, refraction by prisms, lens formula, imaging condition, optical invariants, physical optics, Transforms: Fresnel, Fourier, Inverse Fourier and Extended Fourier.

**UNIT II** **9**  
**SPECTRAL ANALYSIS**

Spatial light modulation, spatial light modulators, detection process, system performance process, dynamic range, raster format, spectral analysis.

**UNIT III** **9**  
**SPATIAL FILTERING AND FILTERING SYSTEM**

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

**UNIT IV** **9**  
**ACOUSTO-OPTIC DEVICES AND POWER SPECTRUM ANALYSIS**

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** **9**  
**HOMODYNE AND HETERODYNE SPECTRUM ANALYSERS**

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

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

**REFERENCES:**

1. Vanderlugt, Optical Signal Processing, John Wiley & Sons, New York, 1992.
2. P.K. Das, Optical Signal Processing Fundamentals, Narosa Publishing New Delhi, 1991.
3. Bradley G. Boone “Signal Processing using optics”, Oxford University Press, 1998.

**07MO52 OPTICAL COMMUNICATION LAB II** **0 0 4 100**

- 1) Study of spatial light modulator
- 2) Response of optical filters
- 3) Characteristics of optical switches
- 4) Optical convolution
- 5) Optical matrix multiplication
- 6) Study of Machzender interferometer

**07MO11 NON LINEAR FIBER OPTICS** **3 0 0 100**

**UNIT I** **9**  
**GROUP VELOCITY DISPERSION**

Fiber characteristics, Fiber non-linearities, Basic propagation equation, Group velocity dispersion: Different propagation regimes, Dispersion-induced pulse broadening, Higher-order dispersion.

**UNIT II** **9**  
**NONLINEAR REFRACTION**

SPM induced spectral broadening, Effect of group velocity dispersion, Higher order nonlinear effects, XPM induced non-linear coupling and modulation instability, spectral and temporal effects.

**UNIT III** **9**  
**STIMULATED INELASTIC SCATTERING**

Stimulated Raman Scattering: Raman gain and threshold, Quasi-CW SRS, Ultrashort SRS.  
Stimulated Brillouin Scattering: Brillouin gain and threshold, Quasi-CW SBS, Dynamic aspects, Brillouin fiber lasers, SBS applications.

**UNIT IV** **9**  
**OPTICAL SOLITONS AND POLARIZATION EFFECTS**

Solitons: Modulation instability, Fiber solitons, other types of solitons, Perturbation of solitons, Nonlinear birefringence and phase shift, Evolution of polarization state, vector modulation instability, Birefringence and solitons.

**UNIT V** **9**  
**PARAMETRIC PROCESSES**

Origin and theory of Four-Wave Mixing, Phase-matching techniques, Parametric amplification, FWM applications.  
Pulse Compression: Physical mechanism, Grating-Fiber Compressors, soliton –effect compressors, other compression techniques.

**TOTAL : 45**

**REFERENCES**

- 1) G.P.Agrawal, Non-linear fiber optics, 3<sup>rd</sup> Edition, Academic press, 2001
- 2) G.P.Agrawal, Applications of nonlinear fiber optics, Academic press, 2001
- 3) E.G.Sauter, Nonlinear Optics, Wiley Interscience, 1996
- 4) D.L.Mills, Nonlinear Optics-Basic Concepts, Narosa publishing House, New Delhi, 1991.

**07MO12 HIGH SPEED PHOTONICS AND OPTO ELECTRONICS** **3 0 0 100**

**UNIT I** **9**  
**ELECTRONICS PROPERTIES OF SEMICONDUCTORS**

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** **9**  
**HIGH SPEED PHENOMENA**

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

**UNIT III** **9**  
**HIGH SPEED OPTOELECTRONIC DEVICES**

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 photodiodes, Photoconductors, Switches.

**UNIT IV** **9**  
**SELF PULSATION AND ULTRA SHORT PULSE GENERATORS**

Gas switching in semiconductor lasers, Self-pulsation in semiconductor laser, bistable laser, Short pulse generation using fiber non-linearity. Period doubling in modulated laser diodes. Optical chaos, Mode locking in laser diodes, Monolithic mode locked laser diodes.

**UNIT V  
APPLICATIONS**

9

Application to long distance and high speed communication, High speed optical signal processing, Picosecond electro optic sampling, logic gates, parallel processing and inter connectors.

**TOTAL : 45**

**REFERENCES**

- 1) M.L.Riazat, " 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 Verlag, Berlin, 1995.

**07MO13 PHOTONIC SWITCHING**

**3 0 0 100**

**UNIT I  
PHOTONIC DEVICES**

9

Light sources and laser diodes: semiconductor diode lasers, free-electron lasers, Mode-locking, Q-switching, pulse shaping – Photo detectors – Optical Amplifiers(SOAs) – Integrated Optical Modulators.

**UNIT II  
OPTICAL SWITCHES**

9

Basic 2X2 switch, layered switch designs, blocking, crosstalk, dilation. Optical cross connects. Add Drop Multiplexers-Routing switches: Kerr gates, four-wave mixing gates, directional couplers, Mach-Zehnder interferometer switches- Acoustic optics.

**UNIT III  
OPTICAL SWITCHING**

9

Free-space optical switching, optical memory for switching, photonic switch architectures based on TDM, WDM,OCX,ATM.

**UNIT IV  
SOLITON GATES**

9

Soliton - dragging logic gates; Time domain chirp switch architecture;- Soliton-trapping logic gates; Soliton ring network.

**UNIT V  
APPLICATIONS OF PHOTONIC SWITCHING**

9

High speed data transmission systems, Clock distribution, All optical fibre communication systems: Clock extraction & dispersion compensation, Power mixing & Frequency division switching, Space switches.

**TOTAL : 45**

**REFERENCES**

- 1) Bahaa E.A. Saleh, Malvin Carl Teich, "Fundamentals of Photonics" Wiley Interscience ; 1<sup>st</sup> edition, 2002.
- 2) Mohammed N.Islam, P.L. Knight, A.Miller, "Ultrafast Fiber Switching Devices and Systems" Cambridge University Press 1992.
- 3) H. Kawaguchi, "Bistabilities and Non-Linearities in Laser Diodes" , Artech house Inc,Norwood, 1994

**07MO14 LASER SATELLITE COMMUNICATION**

**3 0 0 100**

**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** **9**  
**SYSTEM DESIGN**

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** **9**  
**SEMICONDUCTOR AND METAL LASER SOURCES FOR SATELLITE COMMUNICATIONS**

Performance and Geometries, output wavelength control, Semiconductor laser lifetime, Direct and indirect modulation techniques and radiation effects.

**UNIT IV** **9**  
**OPTICAL RECEIVERS AND SYSTEM DESIGN**

Direct detection, coherent detection and demodulation. Gimbals in transceiver design, Receiver options and optics; Lasers; antennas / Telescope, Internal optical systems, Transmitter analysis.

**UNIT V** **9**  
**LASER BEAM POINTING CONTROL**

Acquisition and Tracking systems, System description, Acquisition methodology, racking and pointing control system, RF cross link system design, link equation.

**TOTAL : 45**

**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.

**07MO15 LASER HOLOGRAPHIC TECHNIQUES** **3 0 0 100**

**UNIT I** **9**  
**OPTICAL HOLOGRAPHY**

Light wave interference patterns, Diffraction, Hologram formation, wavefront construction, plane and volume hologram, formation geometries, In line and Off axis holograms.

**UNIT II** **9**  
**FOURIER TRANSFORM AND DIFFRACTION**

Linear space invariant systems, correspondences and transform relations, convolution operation, operational and functional correspondences. Plane waves, Diffraction from periodic objects relation to Fresnel and Kirchhoff integral. Optical systems with spherical lenses.

**UNIT III** **9**  
**LIGHT SOURCES AND PLANE HOLOGRAMS**

Light sources for hologram formation, fringe visibility in hologram recoding, illumination with expanded laser beams, division and attenuation of laser beams, stability in hologram formation, light sources for hologram reconstruction, simple holographic techniques. Analysis of plane holograms, Mediums and Geometries.

**UNIT IV** **9**  
**HOLOGRAM RECORDING MATERIALS**

Photosensitive materials, exposure sensitivity, resolution, erasability, noise in recording, wavefront reconstruction, ideal materials, exposure characteristics of real materials, Photographic emulsions, gelatin films, thermo plastics, photo chromatic and ferroelectric materials.

#### **UNIT V**

**9**

#### **PULSED LASER HOLOGRAPHY**

Pulsed laser holograms, recording materials, Non linear recording, Holographic interferometry, information storage, real image applications.

**TOTAL : 45**

#### **REFERENCES**

- 1) Graham Saxby, Practical Holography, Prentice Hall, London, 1988.
- 2) P.Hariharan, P.L.Knight & A.Miller, Optical Holography :Principles : Techniques and Applications, Cambridge University press, 2<sup>nd</sup> Edition,1996.

### **07MO16 LASER AND ITS APPLICATIONS**

**3 0 0 100**

#### **UNIT I**

**9**

#### **LASER THEORY**

Laser Theory and Principles, Wave Nature of Light – The Interaction of Light with Matter, Atomic Absorption, Energy Levels and Radiative Properties of Molecules, Liquids, Solids and Semiconductors, Radiative Transition and Emission Line Width, optical Resonators, Q Switching and Mode Locking Techniques, Rate Equation.

#### **UNIT II**

**9**

#### **TYPES OF LASERS**

He-Ne Lasers, Co<sub>2</sub> Laser, He-Cd Laser, Ruby Laser, Pulsed Laser, Nd-Yag Laser, Chemical and Dye Laser, Excimer Laser, Nitrogen- Lasers , Xenon – Helium Laser.

#### **UNIT III**

**9**

#### **SEMICONDUCTOR LASERS**

Semiconductor Laser Theory, Structure, Excitation, Gain Coefficient and Threshold Density, Passive, Active and Injection Locking Mode, HetroStructure, Large Optical Cavity and Quantum Well and Quantum Dot Lasers, External Cavity Lasers, Vertical Cavity Surface Emitting Lasers, Pumped Lasers.

#### **UNIT IV**

**9**

#### **LASER AMPLIFIERS**

Absorption and Gain, Laser Oscillation above Threshold, Amplification of Short and Long Duration Pulses, Pumping Requirements and Techniques. Fiber Non-Linearity, Optical Amplifiers, Rare Earth Doped Fiber Amplifiers, Fiber Lasers, Soliton Lasers, Raman Fiber Laser.

#### **UNIT V**

**9**

#### **APPLICATIONS**

Holography, Optical Communication, LIDAR, Remote Sensing, Bio Medical Applications. Industrial Applications: Metal Cutting and Welding Processes. Optical Metrology and Precision Measurements.

**TOTAL : 45**

#### **REFERENCES**

- 1) J.T.Verdeyan, Laser Electronics – Prentice Hall India, New Delhi, 1995.
- 2) Jeff Hecht, The Laser Guide Book, McGraw Hill Professional, 2<sup>nd</sup> Edition, 1999.
- 3) Anthony E.Siegman, Lasers, University Science Books, 1986.
- 4) William T.Silfvast, Laser fundamentals, Cambridge University Press, 2<sup>nd</sup> Edition, 2004.
- 5) H.Koebner, Ed, Industrial Applications of Lasers, John Wiley, New York, 1984.

6) Olbarshi. M.L, Laser Applications in Medicine and Biology, Plenum press, New York, 1989.

## **07MO17 SOLITONS IN OPTICAL COMMUNICATION**

**3 0 0 100**

### **UNIT I INTRODUCTION**

**9**

Solitons – an Introduction, Soliton based communication systems, fiber solitons, Non Linear Schrodinger equation and a solitary wave solution, temporal soliton dynamics, Parameters for Soliton transmission, Loss Managed Soliton, Dispersion Managed Soliton.

### **UNIT II DARK SOLITONS AND PERTURBATION METHODS**

**9**

Dark solitons, Kerr medium- Inverse scattering transforms, Non- kerr Media- Soliton solutions- Perturbation methods- Conservation Laws- Stability.

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

**9**

Reshaping schemes – Lie transformation – guiding centre soliton – Reshaping of solitons in Erbium doped fiber amplifiers and Raman amplifiers, Soliton transmission control : The Gordon Haus limit, Guiding Filter, Soliton control in frequency and time domains, Synchronization techniques.

### **UNIT IV INTERACTION BETWEEN SOLITONS**

**9**

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

### **UNIT V SOLITON TRANSMISSION AND APPLICATIONS**

**9**

Soliton based communication system design, High capacity Soliton systems, long distance soliton transmission, Soliton laser, Optical soliton switching, WDM Soliton systems, spatial soliton application.

**TOTAL : 45**

### **REFERENCES**

- 1) Akira Hazegawa and Yuji Kodama, Solitons in Optical Communication, Oxford University Press Inc, Oxford, 1995.
- 2) Y.S. Kivshar, Optical Solitons : From fibers to Photonic Crystals, Academic Press, 2003.
- 3) Iannone Engenio, Matera Francesco, Mecozzi Antonio & Settembre Marina , Non Linear Optical Communication Networks, John Wiley and Sons, New York, 1998.
- 4) Govind P. Agarwal, Non Linear fiber Optics, Academic Press, New York, 1995.

## **07MO18 ADVANCED DIGITAL SIGNAL PROCESSING**

**3 1 0 100**

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

### **UNIT I DISCRETE RANDOM SIGNAL PROCESSING**

**9**

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

### **UNIT II**

**9**

## **SPECTRUM ESTIMATION**

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

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

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

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

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

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

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

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

#### **REFERENCES:**

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

## **07MO19 DIGITAL IMAGE PROCESSING** **3 0 0 100**

### **UNIT I** **9** **DIGITAL IMAGE FUNDAMENTALS:**

Elements of digital image processing systems, Elements of visual perception, psycho visual model, brightness, contrast, hue, saturation, mach band effect, Color image fundamentals -RGB,HSI models, Image sampling, Quantization, dither, Two-dimensional mathematical preliminaries.

### **UNIT II** **9** **IMAGE TRANSFORMS:**

1D DFT, 2D transforms – DFT, DCT, Discrete Sine, Walsh, Hadamard, Slant, Haar, KLT, SVD, Wavelet Transform.

### **UNIT III** **9** **IMAGE ENHANCEMENT AND RESTORATION:**

Histogram modification and specification techniques, Noise distributions, Spatial averaging, Directional Smoothing, Median, Geometric mean, Harmonic mean, Conharmonic and Yp mean filters, Homomorphic filtering, Color image enhancement. Image Restoration – degradation model, Unconstrained and Constrained restoration, Inverse filtering – removal of blur caused by uniform linear motion, Wiener filtering, Geometric transformations – spatial transformations, Gray-Level interpolation,

#### **UNIT IV**

**9**

#### **IMAGE SEGMENTATION AND RECOGNITION:**

Edge detection. Image segmentation by region growing, region splitting and merging, edge linking.. Image Recognition – Patterns and pattern classes, Matching by minimum distance classifier, Matching by correlation, Back Propagation Neural Network, Neural Network applications in Image Processing.

#### **UNIT V**

**9**

#### **IMAGE COMPRESSION:**

Need for data compression, Huffman,. Run Length Encoding, Shift codes, Arithmetic coding, Vector Quantization, Block Truncation Coding. Transform Coding – DCT and Wavelet. JPEG ,MPEG. Standards, Concepts of Context based Compression.

**Total: 45**

#### **REFERENCES:**

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

### **07MO20 INTERNETWORKING MULTIMEDIA**

**3 0 0 100**

#### **UNIT I**

**9**

#### **MULTIMEDIA NETWORKING**

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

#### **UNIT II**

**9**

#### **BROADBAND NETWORK TECHNOLOGY**

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

#### **UNIT III**

**9**

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

Multicast over shared media network, multicast routing and addressing, scaling multicast and NBMA networks, Reliable transport protocols, TCP adaptation algorithm, RTP, RTCP. MIME, Peer- to-Peer

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

**UNIT IV** **9**  
**MULTIMEDIA COMMUNICATION STANDARDS**

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

**UNIT V** **9**  
**MULTIMEDIA COMMUNICATION ACROSS NETWORKS**

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

**TOTAL : 45**

**REFERENCES**

1. Jon Crowcroft, Mark Handley, Ian Wakeman, Internetworking Multimedia, Harcourt Asia Pvt. Ltd. Singapore, 1998.
  2. B.O. Szuprowicz, Multimedia Networking, McGraw Hill, Newyork. 1995
  3. Tay Vaughan, Multimedia making it to work, 4ed, Tata McGraw Hill , NewDelhi, 2000.
- K.R.Rao, Zoran S. Bojkovic and Dragorad A. Milovanovic, Multimedia Communication systems, PHI , 2003 ( Unit 4 and Unit 5).**

**07MO21 ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY IN SYSTEM DESIGN**

**3 0 0 100**

**UNIT I** **9**  
**EMI ENVIRONMENT**

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

**UNIT II** **9**  
**EMI COUPLING PRINCIPLES**

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

**UNIT III** **9**  
**EMI/EMC STANDARDS AND MEASUREMENTS**

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

**UNIT IV** **9**  
**EMI CONTROL TECHNIQUES**

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

**UNIT V** **9**  
**EMC DESIGN OF PCBs**

**REFERENCES**

1. Henry W.Ott, "Noise Reduction Techniques in Electronic Systems", John Wiley and Sons, NewYork. 1988.
2. C.R.Paul, "Introduction to Electromagnetic Compatibility" , John Wiley and Sons, Inc, 1992
3. V.P.Kodali, "Engineering EMC Principles, Measurements and Technologies", IEEE Press, 1996.
4. Bernhard Keiser, "Principles of Electromagnetic Compatibility", Artech house, 3rd Ed, 1986.

**07MO22 ISDN ARCHITECTURE**

**3 0 0 100**

**UNIT I  
ISDN**

**9**

ISDN - Conceptual View of ISDN - ISDN Standards-transmission structure - User - Network interface configuration - ISDN protocol architecture - ISDN Connection – Addressing - Internetworking.

**UNIT II  
ISDN LAYERS**

**9**

User network interface - Primary rate user - Network interface - U interface - LAPD-Terminal adaption - Channel DLC using I.465/V.120.

**UNIT III  
ISDN SERVICES**

**9**

Basic cell control - Supplementary services-service capabilities-Bearer services-teleservices - SS7 architecture-Simulation link level - Simulation network level.

**UNIT IV  
FRAME RELAY**

**9**

Frame mode protocol architecture - frame mode call control - LAPF-congestion in frame relay - approaches traffic rate management-congestion avoidance.

**UNIT V  
BISDN ARCHITECTURE**

**9**

BISDN Standard - Broadband services - B-ISDN Protocol - Reference model - BISDN physical layer - SONET/SDH - ATM protocol - Traffic management and congestion control in ATM networks.

**Total: 45**

**REFERENCES:**

1. William Stallings "ISDN and Broad band ISDN with frame relay and ATM" 4<sup>TH</sup> edition Pearson Education Asia ,2001.
2. Alberto Leon Garcia and Indra Widjaja, "Communication Networks – fundamentals Concepts and Key Architecture", TMH, 2001.
3. Sumit Kesara and Pankaj sethi, "ATM Networks – Concepts and Protocols", TMH, 2002.
4. Rajiv Ramasamy and Kumar N. Sivarajan, "Optical Networks – a Practical perspective, Morgan Kaufmann Publishers, 2<sup>nd</sup> Edition, 2002.

**07MO23\_NETWORK MANAGEMENT**

**3 0 0 100**

**UNIT I  
FUNDAMENTALS OF COMPUTER NETWORK TEHNOLOGY**

**9**

NetworkTopology, LAN,Network node components  
Hubs,Bridges,Routers,Gateways,Switches,WAN,ISDNTransmission Technology,Communications  
protocols and standards

**UNIT II** **9**  
**OSI NETWORK MANAGEMENT**

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

**UNIT III** **9**  
**INTERNET MANAGEMENT(SNMP)**

SNMP-Organizational model-System Overview,The information model,communication model-Functional model,SNMP proxy server,Management information ,protocol remote monitoring

**UNIT IV** **9**  
**BROADBAND NETWORK MANAGEMENT**

Broadband network s and services,ATM Technology-VP,VC,ATM Packet,Intergrated service,ATMLAN emulation,Virtual Lan.ATM Network Management-ATM Network reference model,Intergrated local management Interface.ATM Management Information base,Role of SNMD and ILMIin ATM Management,M1,M2,M3,M4 Interface.ATM Digital Exchange Interface Management

**UNIT V** **9**  
**NETWORK MANAGEMENT APPLICATIONS**

Configuration management, Fault management, performance management, Event Corelation Techniques security Management, Accounting management, Report Management, Policy Based Management Service Level Management

**TOTAL : 45**

**REFERENCES**

1. Mani Subramanian, " Network Management Principles and practice ", Addison Wesley New York, 2000.
2. Salah Aaidarous, Thomas Plevayk, " Telecommunications Network Management Technologies and Implementations ", eastern Economy Edition IEEE press, New Delhi, 1998.
3. Lakshmi G. Raman, " Fundamentals of Telecommunication Network Management ", Eastern Economy Edition IEEE Press, New Delhi, 1999.

**07MO24 HIGH PERFORMANCE COMMUNICATION NETWORKS** **3 0 0 100**

**UNIT I** **9**  
**PACKET SWITCHED NETWORKS**

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

**UNIT II** **9**  
**ISDN AND BROADBAND ISDN**

ISDN - overview, interfaces and functions, Layers and services - Signaling System 7 - Broadband ISDN architecture and Protocols.

**UNIT III** **9**  
**ATM AND FRAME RELAY**

ATM: Main features-addressing, signaling and routing, ATM header structure-adaptation layer, management and control, ATM switching and transmission.  
Frame Relay: Protocols and services, Congestion control, Internetworking with ATM, Internet and ATM, Frame relay via ATM.

**UNIT IV  
ADVANCED NETWORK ARCHITECTURE**

**9**

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

**UNIT V  
BLUE TOOTH TECHNOLOGY**

**9**

The Blue tooth module-Protocol stack Part I: Antennas, Radio interface, Base band, The Link controller, Audio, The Link Manager, The Host controller interface; The Blue tooth module-Protocol stack Part I: Logical link control and adaptation protocol, RFCOMM, Service discovery protocol, Wireless access protocol, Telephony control protocol.

**TOTAL : 45**

**REFERENCES**

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

**07MO25 OPTICAL COMMUNICATION NETWORKS**

**3 0 0 100**

**UNIT I  
OPTICAL NETWORKING COMPONENTS:**

**9**

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

**UNIT II  
SONET AND SDH NETWORKS:**

**9**

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

**UNIT III  
BROADCAST – AND- SELECT NETWORKS:**

**9**

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

**UNIT IV  
WAVELENGTH-ROUTING NETWORKS**

**9**

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

**UNIT V  
HIGH CAPACITY NETWORKS:**

**9**

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

**TOTAL : 45**

**REFERENCES**

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

**07MO26 DIGITAL COMMUNICATION RECEIVERS**

**3 0 0 100**

**UNIT I**

**9**

**REVIEW OF DIGITAL COMMUNICATION TECHNIQUES**

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

**UNIT II**

**9**

**OPTIMUM RECEIVERS FOR AWGN CHANNEL**

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

**UNIT III**

**9**

**RECEIVERS FOR FADING CHANNELS**

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

**UNIT IV**

**9**

**SYNCHRONIZATION TECHNIQUES**

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

**UNIT V**

**9**

**ADAPTIVE EQUALIZATION**

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

**TOTAL : 45**

**REFERENCES**

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

**07MO27 NANOPHOTONICS**

**3 0 0 100**

**UNIT I INTRODUCTION TO NANOPHOTONICS**

**9**

Foundation for nanophotonics : Photons and electrons, nanoscale optical interactions, nanoscale confinement of electronic interactions, Near field interaction and microscopy: near field optics, theoretical modeling of near field nanoscopic interactions, Near field microscopy, examples of near field studies, apertureless near field spectroscopy and microscopy, nanoscale enhancement of optical interactions, time and space resolved studies of nanoscale dynamics, available sources for near field microscope.

**UNIT II QUANTUM CONFINED MATERIALS** **9**

Inorganic semiconductors, manifestation of quantum confinement, dielectric confinement effect, superlattices, core shell quantum dots and quantum dot-quantum wells, organic quantum-confined structures,

**UNIT III PLASMONICS AND NANOCONTROL OF EXCITATION DYNAMICS** **9**

Plasmonics: Metallic nanoparticles and nanorods/metallic nanoshells, local field enhancement, aperture plasmonics, plasmonic wave guiding, applications of metallic nanostructures, radiativity decay engineering, nanocontrol of excitation dynamics: Nanostructures and excited states, rare earth doped nanostructures, up-converting nanopores, photon avalanche, quantum cutting, site isolating nanoparticles

**UNIT IV NANOMATERIALS AND NANOCOMPOSITES:** **9**

Growth methods of nanomaterials, characterization of nanomaterials, Photonic crystals: basic concepts, theoretical modeling of photonic crystal, features of photonic crystal, methods of fabrication, photonic crystal optical circuitry, nonlinear photonic crystals, photonic crystal fibers, photonic crystal and optical communications, photonic crystal sensors, Nanocomposites: Nanocomposites as photonic media, Nanocomposite waveguide, random lasers, local field enhancement, multiphase nanocomposites, Nanocomposites for optoelectronics, polymer dispersed liquid crystals (PDLC), Nanocomposite materials

**UNIT 5 BIOMATERIALS AND NANOPHOTONICS:** **9**

Bio-derived materials, bioinspired materials, biotemplates, bacteria as biosynthesizers, Nanophotonics for biotechnology and nanomedicines: Near field bioimaging, nanoparticles for optical diagnostics and targeted therapy, semiconductor quantum dots for bioimaging, up converting nanopores for bioimaging, biosensing, nanoclinics for optical diagnostics and targeted therapy, nanoclinic gene delivery, nanoclinic for photodynamic therapy,

Total 45

Reference

1. Paras N. Prasad, Nanophotonics, Wiley-Interscience, 2004
2. Paras N. Prasad, Introduction to Biophotonics, Wiley-Interscience, 2003.
3. [Stefan A. Maier](#), Plasmonics: Fundamentals and Applications, Springer; 1 edition (May 15, 2007)
4. [Thomas E., Ph.D. Twardowski](#), Introduction to Nanocomposite Materials: Properties, Processing, Characterization, Destech Publications (April 15, 2007)
5. [Buddy D. Ratner](#), [Allan S. Hoffman](#), [Frederick J. Schoen](#), [Jack E. Lemons](#), Biomaterials Science, Second Edition: An Introduction to Materials in Medicine, Academic Press; 2 edition (July 29, 2004)

**07MO28 OPTICAL MEMS** **3 0 0 100**

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

Micromechanical photonics, fabrication methods, miniaturized systems with microoptics and micromechanics, Integrated systems with LDs and micromechanics

**UNIT II SHORT EXTERNAL CAVITY LASER DIODE** **9**

Theoretical analysis, experimental analysis, applications design for related problems of an ESEC LD

**UNIT III OPTICAL TWEEZERS,** **9**

Theoretical analysis, experimental measurement and comparison, application of optical tweezers

**UNIT IV OPTICAL ROTOR** **9**

Introduction, theoretical analysis I and II, fabrication and evaluation, Mixer application of  $\mu$ -TAS

**UNIT V NEAR FIELD** **9**

Introduction, theoretical analysis, experimental analysis and future application

**Reference:**

1. H. Ukita ,Micromechanical Photonics (Microtechnology and MEMS) , Springer; 1 edition (June 2, 2006)

**07MO29 OPTICAL WAVEGUIDE TECHNOLOGIES****3 0 0 100****UNIT I****9**

Wave theory of optical waveguides, Planar optical waveguides: Slab waveguides, rectangular waveguides, radiation field from waveguides, MMI device

**UNIT II****9**

Optical fibers : Basic equation, wave theory of step index fibers, optical power carried by each mode, linearly polarized mode, fundamental  $HE_{11}$  mode, dispersion characteristics of step index fibers, wave theory graded index fibers, relation between dispersion and transmission capacity, birefringent optical fibers, dispersion control in single mode optical fibers, photonic crystal fibers

**UNIT III****9**

Coupled mode theory: derivation of coupled mode equations based on perturbation theory, codirectional couplers, contradirectional coupling in corrugated waveguides, derivation of coupling coefficients, optical waveguide devices using directional couplers, fiber Bragg gratings

**UNIT IV****9**

Non linear optical effects in optical fibers: Figure of merit for nonlinear effects, Optical Kerr effects, optical solitons, optical pulse compressions, light scattering in isotropic media, stimulated Raman scattering, simulated brillouin scattering, second harmonic generation, Erbium doped fiber amplifier, four wave mixing in optical fibers

**UNIT V****9**

Finite element methods : FEM analysis of slab waveguides, FEM analysis of optical fibers, FEM analysis of rectangular waveguides, Stress analysis of optical waveguides, semi vector FEM analysis high index contrast.

**Total: 45****References:**

1. Katsunari Okamoto, Fundamentals of Optical Waveguides, Second Edition, Academic Press; 2 edition (December 13, 2005)
2. Maria L. Calvo (Editor), Vasudevan Lakshminarayanan (Editor), Optical Waveguides: From Theory to Applied Technologies, CRC (January 19, 2007)
3. John A. Buck, Fundamentals of Optical Fibers, Wiley-Interscience; 2 Sub edition (April 27, 2004)

**07MO30 QUANTUM ELECTRONICS****3 0 0 100****UNIT I BASIC THEOREMS AND POSTULATES OF QUANTUM MECHANICS****9**

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**

The nonlinear optical susceptibility tensor, Second harmonic generation, parametric oscillations, parametric amplifiers, Applications.

### **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**

Introduction, noise in laser amplifier, spontaneous emission noise in laser oscillators, some mathematical background, laser equation, laser spectra, laser spectra measurement, the  $\alpha$  parameter, the measurement of

$(\Delta\nu)_{laser}$

**TOTAL : 45**

#### **REFERENCES :**

1. Schubert Max, Wilhelmi Bernd, Non liner Optics and Quantum Electronics, John Wiley, New York, 1998.
2. D.Marcuse, Principle of Quantum Electronics, Academic Press, New York, 1980.
3. J.T. Verdeyen, Laser Electronics, Prentice Hall of India, New Delhi, 1981.
4. A.Yariv, Optical Electronics, Holt Reinhart and Winston, Cambridge, 1983.
5. G.P.Agarwal and N.K.Dutta, Long Wavelength Semiconductor lasers, Von Nostrand Reinholt, New York, 1985.
6. Harisson Paul, Quantum Wells, Wires and Dots, John Wiley, New York, 2000.
7. A.Yariv, Quantum Electronics, 3<sup>rd</sup> ed, John Wiley, New York, 1989.