COURSE STRUCTURE FOR M.TECH IN ELECTRONICS
WITH SPECIALIZATION IN
OPTOELECTRONICS AND COMMUNICATION SYSTEMS

First semester

Course Code	Name of Course	Int. Marks	Ext. Marks	Total Marks	Credits	Hrs/ week		
						L	T	P
OEC3101	Digital & Optical signal processing	50	50	100	3	3	1	
OEC3102	Fiber Optics	50	50	100	3	3	1	
OEC3103	Optoelectronics	50	50	100	3	3	1	
OEC3103A	Seminar	100	0	100	1			3
Electives								
	Elective-1	50	50	100	3	4		
	Elective-2	50	50	100	3	4		
Laboratory								
OEC3108L	Optoelectronics Lab	100	0	100	1			6
OEC3109L	Signal Processing Lab	100	0	100	1			6
Total Credits					18			

Second Semester

Course Code	Name of Course	Int. Marks	Ext. Marks	Total Marks	Credits	Hrs/ week		
						L	T	P
OEC3201	Biophotonics	50	50	100	3	4		
OEC3202	Optical Communication Technology	50	50	100	3	3	1	
OEC3203	Optical sensor technology	50	50	100	3	4		
Electives								
	Elective-3	50	50	100	3	4		
	Elective-4	50	50	100	3	4		
Laboratory								
OEC3208L	Fiber optics Lab	100	0	100	1			3
OEC3209L	Optical Communication Lab	100	0	100	1			3
OEC3210	Seminar	100	0	100	1			3
Total Credits					18			

Third Semester

Course code	Name of course	Internal Marks	Ext. Marks	Total Marks	Credits
OEC 3301	Project Progress Evaluation	100	200	300	18

Fourth Semester

Course code	Name of course	Internal marks	Ext. marks	Total Marks	Credits
OEC 3401	Project Dissertation Evaluation	100	200	300	18

LIST OF ELECTIVES

First Semester

Electives					
OEC3104	Laser Technology	50	50	100	3
OEC3105	Digital Communication Techniques	50	50	100	3
OEC3106	Modern Optics	50	50	100	3
OEC3107	Communication Networks	50	50	100	3

Second semester

Electives					
OEC3204	Laser based Instrumentation	50	50	100	3
OEC3205	Integrated Optics	50	50	100	3
OEC3206	Industrial photonics	50	50	100	3
OEC3207	Advanced optical communication	50	50	100	3

OEC3101 DIGITAL & OPTICAL SIGNAL PROCESSING

Module I

Discrete time signals: properties of discrete time system, difference equation representation, sampling and digitization Z transform, inverse Z transform, discrete FT and its properties, FFT, decimation in time and frequency

Module II

Two dimensional Z-transforms, digital filters, IIR and FIR filters, design of IIR and FIR filters, Window function

Module III

Fresnel transform, Hilbert, Radon and Mellin transforms, two dimensional Fourier transform, convolution and correlation, effect of lens on wavefront, FT property of lens, OTF, time and space integrating architecture, spectrum analysis, Vanderlugt filter

Module IV

Image spatial filtering, SLMs AO, MO, EO and LC based SLMs, optical numerical processing, simple arithmetic, evaluation of polynomials, optical implementation of matrix vector multiplication, differentiation, integration, partial differential equations

Module V

Optical neural network, characterization of ANN, supervised and unsupervised learning, neuron as nonlinear element, associative memory and vector matrix multiplication, double and multilayer NN, Hopfield net, optical implementation of neural networks.

TEXT:

1. Digital Signal Processing – Alan V Oppenheim & Ronald W Schafer, (Pearson Education)
2. Signal Processing using Optics - B G Boone (Oxford University Press)
3. Optical Signal Processing- Fundamentals – Das (Springer – Verlag, 1991)

REFERENCE:

1. Digital Signal Processing- A computer based Approach – Sanjit K Mitra, (TMH, 2nd Ed)
2. Theory and Applications of Digital Signal Processing – Rabiner & Gold (PHI, 2005)
3. Optical Computing - D G Feitelson (MIT Press, 1988)
4. Digital Signal Processing: Principles, Algorithms, and Applications- Proakis, (Pearson Education, 4th Ed 2007)

OEC3102 FIBRE OPTICS

Module I

Optical waveguide, Basic Optical Laws - ray theory of transmission, acceptance angle, numerical aperture, EM theory of optical propagation, modes in planar waveguides, phase and group velocity, phase shift, evanescent field, Cylindrical fibers, step index fibers, graded index fibers, modes, mode coupling, single mode fibers, cut off wavelengths, spot size.

Module II

Transmission characteristics of optical fiber, attenuation, absorption losses, intrinsic absorption, linear scattering losses, nonlinear losses, optimum wavelength for fiber optical communication, fiber bend losses, power launching methods and losses.

Module III

Dispersion effects in optical fibers, material and wave guide dispersions, inter modal dispersion, modal noise, overall fiber dispersion in multi mode fibers and single mode fibers, modal birefringence, polarization maintaining fibers.

Module IV

Optical fiber measurements, attenuation, OTDR, loss measurements, dispersion band width, refractive index profile, optical sources and their characteristics, mono mode fiber characteristics, testing of optical fiber systems, eye pattern technique.

Module V

Integrated optics: Fabrication of channel waveguides, electro optic waveguides, i/p o/p couplers, EO and MO modulators. Applications of integrated optics, Grating lenses, optical components, spectrum analyzers, ADC.

TEXT :

1. Fiber Optics – Ghattak & Thyagarajan, (Cambridge University Press, 1989)
2. Optical Fiber Communications - J M Senior (Pearson, 2nd Ed,2006)

REFERENCE:

1. Fiber Optic Communication - D C Agarwal (S. Chand)
2. Optical Fiber Communication Systems - J Gowar (PHI, 2nd Ed, 1996)
3. Fiber Optics Communication – Joseph C Palais (PHI, 5th Ed, 2004)
4. Fundamentals of Fiber Optics in Telecommunication ¬B P Pal (Wiley Eastern, 1992)
5. Integrated Optics - R G Husperger (Springer Verlag, 1991)
6. Fundamentals of Fibre Optics - B P Pal (New Age International)
7. Elements of Opto Electronics and Fiber Optics – Chin-Lin Chen, (Irwin Professional Publishing , 1995)
8. Optical Integrated Circuits - Hiroshi Nishihara (Mc Graw Hill)

OEC 3103 OPTO ELECTRONICS

Module I

Nature of light, light sources- black body radiation, Units of light Electronic properties of semi conductors: effect of temperature on band gap, density of carriers in intrinsic and extrinsic semiconductors, consequence of heavy doping, conduction processes in semiconductors, electron-hole pair formation and recombination, PN junction, carrier recombination and diffusion, injection efficiency, heterojunction, internal quantum efficiency, double heterojunction, quantum well and super lattices.

Module II

Opto Electronic Modulators: Basic principles, Polarization, birefringence. Electrooptic Modulators- electro optic effect, EO materials. Kerr modulators, scanning and switching, Magneto Optic Modulators-Faraday effect, Accusto Optic Modulators

Module III

Opto electronic devices: LED-Materials, Power and efficiency, double hereostructure LED, LED structures, performance characteristics. Laser: Basic concepts, Optical emission from semiconductors- Hetro junction lasers. Semiconductor Injection Lasers – Stripe Geometry, Laser modes, Injection laser structures- gain guided lasers, index guided lasers, Distributed Feedback Lasers.

Module IV

Display devices: Photoluminescence, cathodo luminescence, CRT, Electroluminescence, Injection luminescence and LED- drive circuitry, Plasma panel display, LCD displays- liquid crystals, properties, Numeric displays.

Module V

Optoelectronic detectors: thermal detectors, Photon devices- Photo emissive detectors, Photo conductive detectors, Photomultipliers (PMT), Image intensifiers, Photo diodes- PIN & APD, photo transistors, Design of detector arrays, CCD, Solar cells.

TEXT:

1. Opto electronics - An introduction - J Wilson and J F B Hawkes. (PHI, 1989)
2. Optical fiber communication - J M Senior (Pearson, 2nd Ed)
3. Fiber Optics and Optoelectronics – R P Khare, (Oxford University Press, 4th Ed)

REFERENCES:

1. Optical Electronics – Ghattak & Thyagarajan, (Cambridge University Press,1984)
2. Essentials of OptoElectronics – A Rogers, CRC Press, 1st ed,1997
3. Solid State Electronic Devices - Ben G Streetman (PHI,Sanjaykumar Banerjee,phi, 6th Ed, 2006)
4. Optical fibre communication systems - J Gowar (Prentice Hall, 2nd 1995).
5. Semiconductor Optoelectronic Devices - Pallab Bhattacharya (Prentice Hall; 2nd Ed, 2001)
6. Semiconductor Optoelectronics – Physics and Technology- Jasprit Singh(McGraw Hill, 1995)
7. Fundamentals of Photonics- B E A Saleh and M C Teich, (John Wiley, 2007)
8. Optoelectronics & Photonics : Principles and Practices – Safa Kasap O, (PHI, 2001)

OEC3104 LASER TECHNOLOGY

Module I

Radiative transitions and emission line widths, radiative decay of excited states of atoms, spontaneous emission, and collisional depopulation in atomic and molecular gases, emission broadening, homogeneous and inhomogeneous broadening, radiation and thermal equilibrium, Planck's law for cavity radiation. Absorption and stimulated emission. Einstein A and B coefficients, Conditions for producing laser action, absorption and gain of a homogeneously broadened radiative transition, gain coefficient and stimulated emission cross section for homogeneous and inhomogeneous broadening.

Module II

Necessary and sufficient condition for laser action (Population inversion and saturation intensity), growth of gain medium with homogeneous & inhomogeneous broadening, threshold requirements for a laser with and without cavity, laser oscillation above threshold and saturation of laser gain, Principle of laser amplifiers, Requirement to obtain population inversion, rate equation for three and four level system, pumping threshold requirements, pumping parameters associated with optical and particle pumping.

Module III

Laser cavity modes: Fabry perot cavity modes, longitudinal and transverse modes, mode characteristics, spectral and spatial hole burning, stability of laser resonator, stability diagram, optimization of output coupling, unstable resonators, ring cavity.

Module IV

Q switching - general theory, active and passive Q switching techniques, mode locking- general theory, active and passive mode locking, mode locking by pulse shortening, tunable cavities, properties of laser beam, experimental techniques to characterize laser beam.

Module V

Laser systems - General description, laser structure, excitation mechanism and applications of following lasers. He-Ne, Argon ion, CO2, excimer, nitrogen, X-ray, Free electron, dye, Nd: Yag, Nd: Glass, Alexanderite and Ti: Sapphire lasers, diode pumped solid state laser, OPO laser.

TEXT:

1. Laser Fundamentals - Willaim T Selfvast (Cambridge University press, 1996)
2. Lasers-theory and application - Ghatak & Thyagarajan (Mcmillan,India,2003)
3.

REFERENCES:

1. Laser Electronics - J T Vardeyan (Prentice Hall India, 1995)
2. Optical electronics - Amnon Yariv(Oxford University Press 4th Ed, 1986)
3. Principles of Laser - Svelto, (Plenum Press New York 1998)
4. Solid State Laser Engineering - Koechonar (Springer Verlag,5th Ed,1999)
5. Laser Physics - Tarasov (MIR Pub Moscow 1983)
6. Quantum Electronics - Amnon Yariv (John Wiley, 3rd Ed)

OEC3105 Digital Communication

Module 1

Random variables and random process: Review of Probablity theory, Random variables, conditional Probablity , Discrete and continuous random variables, cumulative distribution function ,Probability Density function, Conditional PDF, expected value and variance of random variables, Joint Random variables

Random process: stationary Process and Wide sense stationary Process, Mean, Correlation and Covariance functions, Ergodic Process, transmission of Random Process through LTI filter, Power Spectral Density, Gaussian Process, Rayleigh and Rician distributions

Module 2

Signal space analysis: Geometric Representation of signals, Gram Schmit Orthogonalization Procedure, Conversion of continuous AWGN channel into a vector channel, Likelihood detection, coherent Detection of signals in noise, Probability of Error, Minimum energy signals, Bit vs symbol error Probabilities, Union bound on the Probability of error

Module 3

Sampling Process: Quantization ,Sampling theorem, Interpolation Formula, Quadrature sampling of band pass signals, Reconstruction of a message process from its samples, signal distortion in sampling, practical aspects. PAM, PPM, PWM (Generation & Reconstruction-block level treatment only), Multiplexing- TDM, FDM.

Waveform Coding Techniques: PCM, Channel noise & error probability, Quantization Noise & Signal to noise ratio, robust quantization, DPCM, Delta Modulation, ADPCM, Linear Prediction

Module 4

Digital Modulation techniques: Digital modulation formats, Coherent binary modulation techniques- PSK, FSK, QPSK, MSK. Non-coherent binary modulation techniques-DPSK. Comparison of binary & quaternary modulation techniques. M-ary Mod techniques- PSK, QAM, FSK(Block level treatment only)

Base band data transmission: Discrete PAM signals, Power spectra of discrete PAM signals, , Matched filter,Intersymbol interference, Nyquist's criterion for distortion less base band binary transmission, Eye pattern, Optimum linear receiver Adaptive equalization.

Module 5

Information theory & Coding: Information theory :Information ,entropy, Information Rate, Channel capacity, Mutual information ,Channel coding theorem, Capacity of Gaussian channel, S/N-Bandwidth tradeoff, Information capacity theorem, Information capacity of colored noise channels, Error control codes: discrete memory less channels, Linear block codes, cyclic codes ,

convolution codes

TEXT :

2. Digital Communication Simon Haykin, (John Wiley& Sons, 2005)
3. Communication Systems ,Simon Haykin, (John Wiley& Sons , 2004)
4. Principles of Communication Systems, Taub & Schilling, (TMH, 1991)

REFERENCES:

1 Modern Digital and analog Communication Systems, B.P.Lathi, (Oxford University Press, 3rd Ed., 2005)

2. Digital Communications Fundamentals and applications ,Bernard Sklar, (Pearson 2006)
3. Analog and Digital Communications, Hwei Hsu, Schaum's Outline, (McGraw Hill, 2003)
4. Elements of Information theory, Cover and Thomas (Wiley, 2nd Ed., July 2006)

5. Error correction coding mathematical Methods and algorithms, T K Moon (Wiley,2005)

OEC3106 MODERN OPTICS

Module I

Electromagnetic Theory, Maxwell's equations, energy density and momentum of electromagnetic field. Polarization, Stoke's Parameters, Jones Vectors and matrices. Electromagnetic waves in conducting medium, Polarization by birefringence, Total internal reflection, evanescent waves.

Module II

Interference, Michelson's Interferometer, Mach-Zender Interferometer, Free Spectral Range and Finesse of Fabry-Perot Interferometer, Multi-layer interference coatings and interference filters.

Module III

Propagation of Optical beams, ray vector and ray matrices, lens wave guides, rays in lens-like media, gaussian beam, ABCD law, guassian beam focussing, anisotropic media.

Module 1V

Coherence: Spatial and temporal coherance, Fourier Transform spectroscopy, speckle phenomena, auto correlation function and coherence, intensity interferometry, Photon Statistics.
Holography: Theory of Holography,Recording and construction, applications in NDT

Module V

Diffraction: Fresnel and Fraunhoffer diffraction, circular and rectangular apertures, Cornu's spiral, Fresnel zones, spatial filters and apodisation.

TEXT:

1. Optics - E Hecht (Addison Wesley; 4 edition)

REFERENCE:

1. Quantum Electronics - Amnon Yariv (John Wiley, 3rd Ed)
2. Modern optics - R D Guenther (John Wiley 1990)
3. Wave optics and its Applications - R S Sirohi (Orient Longman 1993)
4. Principles of optics - Born and Wolf (Cambridge University Press 6th ed)
5. Optics and Lasers - M Young (Springer Verlag 2nd Ed.)
6. Introduction to Modern Optics – Grant R Fowles (Dover Publications, 2nd ed, 1989)

OEC3107 COMMUNICATION NETWORKS

Module I

Internet Architecture: Architectural concepts in ISO's OSI layered model, layering in the internet. TCP/ICP protocol stack. Transport layer- TCP and UDP . Network layer- IP, routing, internetworking, data link layer- ARQ shemes, LANs

Module II

Broadband services and QOS issues: Quality of Service issues in networks- Integrated service architecture- Queuing Disciplines- Weighted Fair queuing- random Early Detection- Differentiated Services- Protocols for QOS support- Resource reservation – RSVP- Multi protocol label Switching- real Time transport protocol

Module III

Introduction to Queuing theory: Markov chain- Discrete time and continuous time Markov chains- Poisson process- queuing models for data gram networks- Little's theorem- M/M/1 queuing systems- M/ M/m/m queuing models- M/G/1 queue- Mean value analysis

Module IV

Statistical Multiplexing in Communication Networks: Multiplexing: Network performance and source characterization, Stream sessions in packet networks- deterministic analysis, stochastic analysis, circuit multiplexed networks, elastic transfers in packet networks

Module V

Optical fiber network: Data buses, LAN systems, network configurations, FDDI network, SONET and SDH network, ISDN and BISDN , high speed networks, industrial network, public network applications

TEXT:

1. Communication Networking: An analytical approach- Anurag Kumar, D.Manjunath and Joy Kuri , Morgan Kaufman publishers, 2004

REFERENCES:

1. Computer Networks, A top-down approach featuring the Internet- James. F. Kurose and keith. W. Ross, Addison Wesley, 2001
2. Data Networks- Bertsekas and R. Gallager, PHI, 2000.
3. An Engineering approach to computer networking - S. Keshav (Addison Wesley 1st Ed, 1997)
4. Computer networks: A system approach- Peterson L.L. & Davie B.S, Morgan Kaufman Publishers , 2007, Elsvier

5.I Introduction to Optical fiber communication- Suematsu and Iga , John Wiley, 1982

OEC3201 BIOPHOTONICS

Module I

Photobiology: Interaction of light with cells and tissues, photo-processes in Biopolymers, human eye and vision, photosynthesis. Photo-excitation: free space propagation, optical fiber delivery system, articulated arm delivery, hollow tube wave-guides. Optical coherence tomography, spectral and time-resolved imaging, fluorescence resonance energy transfer (FRET) imaging, nonlinear optical imaging

Module II

Bio-imaging:Ttransmission microscopy, Kohler illumination, microscopy based on phase contrast, dark-field and differential interference contract microscopy, fluorescence, confocal and multi-photon microscopy. Applications of bio-imaging: Bio-imaging probes and fluorophores, imaging of microbes, cellular imaging and tissue imaging

Module III

Optical biosensors: Fluorescence and energy transfer sensing, molecular beacons and optical geometries of bio-sensing, biosensors based on fibre optics, planar waveguides, evanescent waves, interferometric and surface plasmon resonance. Flow cytometry:Basics, fluorochromes for flow cytometry, DNA analysis

Module IV

Laser activated therapy: Photodynamic therapy, photo-sensitizers for photodynamic therapy, applications of photodynamic therapy, two photon photodynamic therapy. Tissue engineering using light: Contouring and restructuring of tissues using laser, laser tissue regeneration, femto-second laser surgery

Module V

Laser tweezers and laser scissors, design of laser tweezers and laser scissors, optical trapping using non Gaussian optical beam, manipulation of single DNA molecules, molecular motors, lasers for genomics and proteomics, semiconductor quantum dots for bio imaging, metallic nano-particles and nano-rods for bio-sensing. Photonics and biomaterials: Bacteria as bio-synthesizers for photonic polymers

TEXT:

1. Introduction to Bio-Photonics - V N Prasad (Wiley-Interscience April 2003)
2. Biomedical Photonics: A Handbook - Tu Vo Dinh (CRC Presss, Boca Raton, FL 2003)

REFERENCES:

1. A Handbook of Optical Biomedical Diagnostics, SPIE press monograph vol pm107
2. Biomedical Optics- Principles and Imaging – Lihong V and Hsin-IWU, Wiley Interscience 1st ed, 2007)
3. Optical Coherence Tomography- Principles and Applications - Mark E. Brezinski, (Academic Press 1st ed,2006)
4. Biophysics – An Introduction – Rodney Cotterill , (John Wiley Student edition)

EC3202 OPTICAL COMMUNICATION TECHNOLOGY

Module I

Introduction to Guided optical communication system : Review of Unguided optical communication system, Guided optical communication, Elements of an Optical Fiber Transmission System. Optical Fibers - Types, Materials, Fabrication techniques. Signal degradation- Attenuation, Signal Distortion.

Module II

Sources for communication: Review of LED – modulation circuits: analog & digital. Laser Diode – Structure, modulation-analog & digital circuits. Opto mechanical switches, Photonic & digital switches.

Module III

Detectors for communication: Noise in PIN diode, Noise Sources, Principal Noises - thermal noise, dark current noise, quantum noise, receiver noise, noise in APD receiver.

Receiver configurations: Receiver noises- preamplifiers, Low impedance, High impedance, Trans impedance amplifiers.

Module IV

System design considerations: multiplexing, OTDM, WDM. Digital systems: regenerative repeaters, Point-to-point Links- Link Power Budget Analysis, Rise Time Budget Analysis. Line coding: NRZ codes, RZ codes, block codes. Analog Systems: Sub carrier multiplexing. Coherent systems- homodyne and heterodyne detection.

Module V

Optical Fiber Cables, Fiber Connectors, Joints, Splicers, Couplers, , Fiber amplifiers : Types, Semiconductor Laser Amplifier, Erbium doped fiber amplifier, Raman Fiber Amplifier, Brillowin fiber Amplifier, Solitons.

TEXT:

1. Optical Fiber Communication - G Keiser (4th Ed, TMH)
2. Optical Fiber Communications - J M Senior (Pearson, 2nd 2006)

REFERENCES:

1 Introduction to Optical Fibre Communication - Suematsu and Iga, (John Wiley ,1982)
2 Fiber Optic Communication – Joseph C Palais, (PHI, 5th Ed, 2004)
3 Optical Communication -Components and Systems – J H Franz, V K Jain (Narosa Publishing House 2005)
4 Optical Fiber Communication Systems - J Gowar (Prentice Hall India, 2nd Ed 1995)
5 Fiber Optic Communication Systems - D C Agarwal (S Chand).
6 An Introduction to Fiber Optic Systems – John Powers(McGraw Hill - Irwin,1996)
7 Fiber optic Communications Technology – Djafar K Mynbaev & Lowell L Scheiner, (Pearson Education, 2001)

OEC3203 OPTICAL SENSOR TECHNOLOGY

Module I

Light beam as a sensing tool, simple optical sensors, single and double optic levers, measurements of small displacements, radius of curvature-lamp and scale arrangement, angle of rotation, speed of rotation, stroboscope, method of triangulation, projected fringe technique, lidar for atmospheric remote sensing, lidar equation

Module II

Interferometry for precision measurements, two-beam interferometry, Michelson interferometer, fringe displacement and fringe counting, heterodyne interferometer, super heterodyne interferometry, electron speckle pattern interferometry photoelastic measurements, Moiré technique

Module III

Optical fibre sensors: general features, types of OFS, intrinsic and extrinsic sensors, intensity sensors, shutter based multimode OFS, simple fibre based sensors for displacement, temperature and pressure measurements- reflective FOS and applications, Fibre Bragg grating based sensors

Module IV

Light transmission in microbend fibres, microbend OFS, measurements with microbend sensors, evanescent wave phenomenon, evanescent wave FOS, chemical sensors using EWFOS, distributed sensing with FOS, OTDR and applications, FO smart sensing

Module V

Interferometric FOS: basic principles, interferometric configurations, Mach-Zender, Michelson and Fabri-Perot configurations- components and construction of interferometric FOS, applications of interferometric FOS, Sagnac interferometer, fibre gyro, OTDR and applications.

TEXT:

1. Fundamentals of Fibre Optics in Telecommunications and Sensor Systems – Edited by B.P. Pal (New age international 1992)

REFERENCE:

1. Optics - Ajoy Ghatak, (TMH, 2008)
2. Lasers - Theory and Applications – Ghatak & Thyagarajan, (Macmillan India Limited, 2003)
3. Optical Measurement Techniques and Applications - P K Rastogi ,Artech House,1997)

OEC3204 LASER BASED INSTRUMENTATION

Module I

Holography and Speckle interferometry: Theory of hologram, recording and reconstruction , recording media, types of holograms, application of holography to character recognition and NDT, theory and applications of speckle interferometry

Module II

Lasers in chemistry: Schemes of laser isotope separation, laser induced chemical reactions, infrared photo chemistry, ultra fast processes, laser induced fusion

Module III

Laser Doppler Velocimetry: Principle of operation, velocimeter as an interferometer, performance parameters- scale factor relative error, accuracy of the Doppler frequency, size of the sensing region, Alignment and positioning errors, direction discrimination, particle seeding, Electronic processing of the Doppler signal (Time domain & frequency domain)

Module IV

Industrial applications: Absorption of laser radiation by metals, semiconductors and insulators, laser drilling, welding , cutting and surface cleaning, optical fiber splicing, laser deposition of thin films.

Module V

Lasers in medicine: Photodynamic therapy, Laser angioplasty, Lasers in surgery, Laser tissue welding, Low-power Laser therapy, Surface- Enhanced Raman scattering(SERS) for biomedical diagnostics.

TEXT:

1. Electro-Optical Instrumentation- Sensing and Measuring with Lasers ,Silvano Donati, (Pearson)

REFERENCES:

1. Optical Interferometry - P Hariharan (Academic Press; 2nd Ed)
2. Industrial Applications of Laser – John F Ready (Academic Press, 2nd Ed1997)
3. Laser Physical Optics and Light Measurements - D Malacara (Academic Press, 1988)
4. Laser processing and analysis of materials- W W Duley (Springer, 1st Ed, 1983)
5. Biomedical Photonics Handbook- Tuan Vo-Dinh (Editor-in-chief CRC Press 1st Ed 2003)
6. Lasers in Medicine – H K Kobener, John Wiley 1980)
7. Laser Spectroscopy- Demtroder (Springer, 2nd Ed)
8. Fundamentals of Photonics- B E A Saleh and M C Teich, Wiley Interscience, 1991
9. Laser Handbook Vol II and III – Arecchi (Ed) and M L Stitch (North Holland 1972, 1985)

OEC3205 INTEGRATED OPTICS

Module I:

Advantages of Integrated optics- comparison of optical integrated circuits (OIC) with electronic integrated circuits- substrate materials for OIC- Modes in planar waveguide structure- channel waveguides, strip loaded wave guides.

Module II:

Waveguide fabrication techniques- electro optic waveguides- Losses in optical waveguides- measurements of waveguide losses, waveguide input/ output couplers, coupling between waveguides.

Module III:

Electro optic and acousto optic modulators- Direct modulation of semiconductor lasers- Integrated optical detectors- Depletion layer photodiodes, APD, PIN and MSM photodiodes- modification of spectral response of detectors.

Module IV:

Quantum well modulators, Quantum well detectors, SEED, Applications of Integrated optics- RF spectrum analyser,ADC

Module V:

IO optical disk Readhead OIC temperature and voltage sensor, optoelectronic IC transmitter and receiver, Devices and systems for Telecommunications, Opto-microwave applications.

TEXT:

1. Integrated optics- Theory and Technology- R.G Hunsperger (Springer Verlag, 4thEd,1995)

REFERENCES

1. Electro optic Handbook -(Ch 26, 27 R Way nant, M. Ediger) (Mc Graw Hill, 1993)
2. Elements of opto electronics and Fiber optics- (ch 7) Chin-Lin Chen (Irwin, 1966)
3. Handbook of optics Vol II- Micheal Bau Ed (Mc Graw Hill, 1995)
4. Guided wave opto electronics- (ch 6) T Tamir (Editor Springer Verlag 1990)

OEC3206 INDUSTRIAL PHOTONICS

Module I

Photonics Technology: Passive components- couplers, isolators, circulators, terminators, attenuators, multiplexers and filters. Fused fiber components based on Biconical taper Technology, Star and Tree couplers. Fiber delay lines, Clip-on couplers, Fiber gratings. Mode conditioning Patchcords, Optical switches, WDMs, arrayed waveguide gratings, lensed fibres, thermally expanded core fibers, polarization maintaining components. Active components: Media converters, Mode converters, Transponders, Optical Nodes, Regenerators, Modulators, Optical Cross Connects, EDFA, Raman amplifiers

Module II

Modulation and demodulation: Signals formats, direction detection, receivers, coherent detection, test beds- Lamdanets, STARNET, Rainbow, wavelength routing network.Optical layer in network, node design, Networking design and operation, Routing wavelength assignment. Wavelength routing test beds AON, NTTR, ONTC, MONET.

Module III

Optical Networks: Network architecture, HFC, FTTC, Optical Access Network Architecture, deployment considerations- upgrading the transmission capacity, SDM, TDM, WDM, OTDM, Multiplexing and demultiplexing, Synchronization, broadcast OTDM Network, OTDM testbeds, Application areas- interexchange, undersea, local exchange networks.

Module IV

Control and Management: Network management function, configuration, performance and fault managements, channel health monitoring, dark and active fibre monitoring, Optical protection- effect of PDL and PMD on high speed optical networks, attacks on fiber networks, Intrusion detection and prevention techniques. Network test equipments- OTDR measurements.

Module V

Reliability Concepts: Concepts on product reliability, Reliability of optical components, Thermal stability, factors affecting the reliability of fused fiber components, reliability tests and test setups, High power optical requirements, Effect of dirt on fiber endfaces, Reliability and Test standards in fiber optics.

Packaging and Cabling concepts : Basics of optical alignments, alignment stations, algorithms, epoxy bonding, epoxy dispensing systems, soldering, laser welding, glass soldering,

packaging of fused fiber devices, micro optic based components, laser diode packaging. Integrated Optic components.

Texts:

1. Optical Networks-A practical application-R. Ramaswami and K.N Sivarajan marcourt Asia (2000)
2. Optoelectronic Packaging - Nagesh R. Bassavanhally

References:

1. Photonics Switching Technology- H T Mouftah, J M H Elmirghani, IEEE Press (1999)
2. Deploying Optical Networking components- Gil Held, McGraw Hill (2001)
3. Optical Interconnection- C Tocci, H J Caulfield, Artech House (1999)
4. Optical Fiber Communication- (G Keiser TMH,4th Ed)
5. Reliability of passive optical components: Telcordia G R- 1209

OEC3207 ADVANCED OPTICAL COMMUNICATION

Module I:

Introduction to optical components- optical amplifier -types- issues in optical amplifiers- photonic switching- cross connect- wavelength conversion- multiplexer- demultiplexer- filters- tunable filters- introduction to OIC and its applications.

Module II:

First generation optical networks SONET/SDH- multiplexing, elements of a SONET/SDH infrastructure- SONET/SDH physical layer. Computer interconnects- ESCON, Fiber channel, HIPPI. Metropolitan area networks- FDDI, ATM. Layered architecture- SONET/SDH layers- second generation optical network layers.

Module III:

WDM technology Introduction- WDM optical networking evolution- enabling technologies for WDM optical networks- WDM optical network architecture- DWDM- issues in WRN

Module IV:

OTDM Technology- important issues in OTDM- optical solitons- applications of solitons. Optical pulse compression- fiber grating compressor- soliton effect compressor

Module V:

FTH and PON technology- proposed architectures and issues of Fiber to home (FTH)- passive optical networks (PON)- near space communication- open air optical communication- Inter satellite link hops (ISI)- Introduction to all optical networks (AON). Military, civil consumer and industrial applications

References:

1. Optical networks- A practical perspective- Rajiv Ramaswami and kumar N Sivarajan, (Morgan Kaufmann, 2nd 2001)
2. Integrated optics- Theory and technology- R.G. Hunsperger (Springer series in Optical Sciences", 5th edition 2002)
3. Optical Fiber Communications- G G Keiser (TMH, 4th Ed)
4. Optical Communication Systems- John Gowar,(PHI,2nd Ed 1996)
5. Optical Fiber Communications Principles and practice- John M. Senior PHI, 1992