KERALA TECHNOLOGICAL UNIVERSITY

ERNAKULAM – I CLUSTER

DRAFT

SCHEME AND SYLLABI

FOR

M. Tech. DEGREE PROGRAMME

IN

OPTOELECTRONICS AND COMMUNICATION SYSTEMS

(2015 ADMISSION ONWARDS)

SCHEME AND SYLLABI FOR M. Tech. DEGREE PROGRAMME IN OPTOELECTRONICS AND COMMUNICATION SYSTEMS

SEMESTER-1

Exam Slot	Course No:	Name	L- T – P	Internal Marks	End Semester Exam		Credits
					Marks	Duration (hrs)	
A	06EC 6013	Digital & Optical signal processing	4-0-0	40	60	3	4
B	06EC 6023	Fiber Optics I	4-0-0	40	60	3	4
C	06EC 6033	Optoelectronics	4-0-0	40	60	3	4
D	06EC 6043	Laser Technology	3-0-0	40	60	3	3
E	06EC 6x53	Elective I	3-0-0	40	60	3	3
F	06EC 6063	Research methodology	0-2-0	100	0	0	2
G	06EC 6073	Seminar I	0-0-2	100	0	0	2
H	06EC 6083	Signal Processing Lab	0-0-3	100	0	0	1

Credits:23

Elective I	
06EC 6153	Microwave Photonics
06EC 6253	Communication Networks
06EC 6353	DSP algorithms and processors

SEMESTER-II

Exam Slot	Course No:	Name	L- T – P	Internal Marks	End Semester Exam		Credits
					Marks	Duration (hrs)	
A	06EC 6014	Biophotonics	4-0-0	40	60	3	4
B	06EC 6024	Optical Communication Technology	3-0-0	40	60	3	3
C	06EC 6034	Industrial Photonics	3-0-0	40	60	3	3
D	06EC 6x44	Elective II	3-0-0	40	60	3	3
E	06EC 6x54	Elective III	3-0-0	40	60	3	3
F	06EC 6064	Mini Project	0-0-4	100	0	0	2
G	06EC 6074	Optoelectronics and Fiber Optics Lab	0-0-3	100	0	0	1

Credits:19

Elective II		Elective III	
06EC 6144	Integrated Optics	06EC 6154	Modern Optics
06EC 6244	Wavelets : Theory and Applications	06EC 6254	Laser Applications
06EC 6344	Digital Communication Techniques	06EC 6354	Laser spectroscopy

SEMESTER-III

Exam Slot	Course No:	Name	L- T – P	Internal Marks	End Semester Exam		Credits
					Marks	Duration (hrs)	
A	06EC 7x13	Elective IV	3-0-0	40	60	3	3
B	06EC 7x23	Elective V	3-0-0	40	60	3	3
C	06EC 7033	Seminar II	0-0-2	100	0	0	2
D	06EC 7043	Project (Phase 1)	0-0-12	50	0	0	6

Credits: 14

Elective-IV		Elective-V	
06EC 7113	Biomedical Signal Processing	06EC 7123	Optical sensor Technology
06EC 7213	Advanced optical communication	06EC 7223	Radio over Fiber communication
06EC 7313	Non linear optics	06EC 7323	Optical Instrumentation

SEMESTER-IV

Exam Slot	Course No:	Name	L- T – P	Internal Marks	End Semester Exam		Credits
					Marks	Duration (hrs)	
A	06EC 7014	Project (Phase 2)	0-0-21	70	30	0	12

Credits: 12

Total Credits for all semesters: 68

SEMESTER-I

Course No: 06EC 6013 Course Title: Digital and Optical Signal Processing Credits: 4-0-0: 4

Year :2015

Pre-requisites: Basic knowledge of signals & systems

Course Objectives:

To give the Student:-

- A review of the DSP concepts, along with an understanding of the filter design & Z transforms.
- An introduction to the different transforms used in optical signal processing & understanding of the fourier transforming property of lens.
- An insight to spatial modulators along with their different types & optical numerical processing.
- An introduction to optical neural networks & their implementation

Syllabus

Fundamental concepts and overview of discrete time systems; z transform & digital Filter design; Transforms used in optical signal processing ; fourier transforming property of lens; spatial light modulators & their different types, Optical numerical processing, Optical neural networks & their implementation.

Course Outcome:

On successful completion of this course, the student will demonstrate an ability to understand the fundamental concepts of discrete time systems; design digital filters, understand the fourier transforming property of a lens, working of spatial light modulators & implementation of numerical processing using optics and the working of optical neural networks & their implementation.

Text Books:

1) Digital Signal Processing: Principles, Algorithms, and Applications Proakis & Minoloakis (Pearson Education, 4th Ed 2007)

2) Signal Processing using Optics B G Boone (Oxford University Press)

3) Anthony Vanderlugt, Optical signal processing: Wiley-Interscience , 2005.

References:

1) Theory and Applications of Digital Signal Processing – Rabiner & Gold (PHI, 2005)

2) Optical Computing D G Feitelson (MIT Press, 1988)

3) Digital Signal Processing A computer based Approach – Sanjit K Mitra, (TMH, 2nd Ed)

COURSE PLAN

COURSE NO: 06EC 6013 COURSE TITLE: Digital & Optical signal processing **(L-T-P :4-0-0) CREDITS:4**		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE : 1 Discrete time signals: properties of discrete time system, Z transform, inverse Z transform, discrete FT and its properties, FFT,decimation in time and frequency, Two dimensional Ztransforms, digital filters, IIR and FIR filters, design of IIR and FIR filters, Window function	14	25
MODULE : 2 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	16	25
FIRST INTERNAL TEST		
MODULE : 3 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.	13	25
MODULE : 4 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.	13	25
SECOND INTERNAL TEST		

Course No 06EC 6023 Course Title: Fiber Optics Credits: 4-0-0:4 Year :2015

Pre-requisites: Nil

Course Objectives:

To give the Student:-

1. A deep understanding of the fundamental and salient features behind fibre optics technology, which is the key to design/development for highly accurate and sensitive application requirements. ;
2. An introduction to experimental methods.

Syllabus

Introduction and importance of Fiber Optics Technology, Ray analysis of optical fiber, Fiber numerical aperture, Electromagnetic (modal) analysis of Planar Waveguide, Step-index multimode fibers, Hybrid and linearly polarized modes, Single mode fiber, Power confinement and mode cutoff, Mode field diameter, Graded-index fiber, Optimum profile.

Loss mechanism in optical fiber. Pulse propagation, Dispersion in single-mode fibers, Dispersion compensation mechanism, Fiber birefringence and polarization mode dispersion, Fiber bandwidth.

Power launching methods and losses-Power coupling calculations- Lensing schemes for coupling Improvement.

Optical fiber measurements : Attenuation, dispersion, refractive index profile measurement, OTDR- field measurement, eye pattern technique.

Course Outcome:

Students who successfully complete this course will have demonstrated an ability to understand the fundamental concepts of Fibre Optics; Apply the basic Maxwell's equations to determine the modes; Determine the attenuation losses and dispersion parameter in optical fibres; Find the power coupling efficiency from source to different types of fibres; Apply the different techniques to measure the fibre parameters.

Text Books:

1. Fiber Optics – Ghattak & Thyagarajan, (Cambridge University Press)

2. Optical Fiber Communications - J M Senior (Pearson, 2nd Ed, 2006)

References:

1. Fiber Optic Communication - D C Agarwal (S. Chand)

2. Optical Fiber Communication Systems - J Gowar (PHI, 2nd Ed)

3. Fiber Optics Communication – Joseph C Palais (PHI, 5th Ed)

COURSE PLAN

COURSE NO: 06EC 6 023 **COURSE TITLE: Fibre Optics** **(L-T-P : 3-1-0)** **CREDITS:4**		
Module/Topics	**Contact hours**	**Sem.Exam Marks;%**
Introduction and importance of Fiber Optics Technology.Ray analysis of optical fiber: Propagation mechanism of rays in an optical fiber, Meridional rays, Skew rays, Fiber numerical aperture, dispersion.Electromagnetic (modal) analysis of Planar Waveguide: Wave equation and boundary conditions, Characteristics equation, TE, TH and Hybrid modes of Planar waveguide Step Index Multimode Fibres, Weakly guiding approximation, linearly polarized modes, Single mode fiber, V parameter, Power confinement and mode cutoff, Mode field diameter. Graded-index fiber: Modal analysis of graded index fiber, Optimum profile.	2 3 4 3 4	25
Loss mechanism in optical fiber: Absorption loss, scattering loss – Linear and Non linear, bending loss, splice loss. Power launching methods and losses-Power coupling calculations from source to fibre Lensing schemes for coupling Improvement.	4 3	25
FIRST INTERNAL TEST		
Pulse propagation and Dispersion in singlemode/Multi mode fibers: Pulse propagation in non-dispersive and dispersive medium, Pulse broadening and chirping, Group and phase velocity, Intermodal and intramodal dispersion, Group velocity (material and waveguide) dispersion, Higher order dispersion, Fiber bandwidth. Dispersion compensation mechanism: Dispersiontailored and dispersion compensating fibers, Fiber Birefringence and polarization mode dispersion, Fiber bandwidth.	8 5	25
Optical fiber measurements **:** Attenuation measurement, dispersion measurement, refractive index profile measurement OTDR- field measurement – Trace – Attenuation measurement Eye pattern technique.	4 2	25
SECOND INTERNAL TEST		

Course No: 06EC 6033 Course Title: OPTO ELECTRONICS Credits: 4-0-0: 4 Year :2015

Pre-requisites: Nil

Course Objectives:

To give the Student:-

A deep understanding of the fundamentals of optoelectronics including Optical emission from semiconductors ,quantum efficiency, heterojunction, quantum well,Opto Electronic modulators. Be familiar with recent trends in optoelectronics.

Syllabus

Nature of light, light sources, Electronic properties of semi conductors, injection efficiency, , internal quantum efficiency,heterojunction, double heterojunction, quantum well and super lattices.

Opto Electronic Modulators,Opto electronic devices,Optical emission from semiconductors- Hetero junction lasers. Semiconductor Injection Lasers, Injection laser structures,Display devices,Optoelectronic detectors, Design of detector arrays, CCD, Solar cells.

Course Outcome:

Students who successfully complete this course will have demonstrated an ability to understand the fundamental concepts of Optoelectronics;Ability to design single-mode junction lasers at different wavelengths to meets specs;Ability to incorporate heterostructures and quantum wells to improve device performance;Ability to design junction & avalanche photodiodes to meet specs

Text Books:

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. Solid State Electronic Devices - Ben G Streetman ,Sanjaykumar Banerjee, PHI, 6th Ed, 2006)
3. Optical fibre communication systems - J Gowar (Prentice Hall, 2nd 1995).
4. Semiconductor Optoelectronic Devices - Pallab Bhattacharya (Prentice Hall; 2nd Ed, 2001)
5. Fundamentals of Photonics- B E A Saleh and M C Teich, (John Wiley, 2007)

COURSE PLAN

COURSE NO: 06EC 6033 COURSE TITLE: OPTO ELECTRONICS (L-T-P : 4-0-0) CREDITS:4		
Module/Topics		
Module/Topics	**Contact hours**	**Sem.Exam Marks;%**
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, 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.	2 8 4	25
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	8 4	25
FIRST INTERNAL TEST		
Opto electronic devices: Injection luminescence and LED , LED structures,LED-Materials, Power and efficiency, hetereostructure LED. Laser: Basic concepts, Optical emission from semiconductors- Hetero junction lasers. Semiconductor Injection Lasers, Injection laser structures- gain guided lasers, index guided lasers, Distributed Feedback Lasers. **Display devices:** Photoluminescence, cathodo luminescence, Electroluminescence, CRT, Plasma panel display, LCD displays- liquid crystals, properties, Numeric displays	10 5	25
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.	8 4	25
SECOND INTERNAL TEST		

Course No: 06EC6043 Course Title: Laser Technology Credits: 3-0-0: 3 Year :2015

Pre-requisites: Nil

Course Objectives:

To give the Student:-

- The fundamental concepts of Laser ;
- The theoretical knowledge of producing various laser types;
- And the general description and applications of different laser systems;

Syllabus

Laser - introduction, properties. Necessary and sufficient condition for laser action, Principle of laser amplifiers, pumping threshold requirements, Laser cavity modes Q switching, mode locking, Laser systems - General description, laser structure, excitation mechanism and applications of different lasers

Course Outcome:

Students who successfully complete this course will understand the fundamental concepts of laser, the conditions for producing laser, the methods for producing Q switching and mode locking and the general description and applications of different laser systems.

Text Books: Laser Fundamentals - Willaim T Selfvast (Cambridge University press, 1996)

References:

Lasers-theory and application - Ghatak & Thyagarajan (Mcmillan,India,2003)

1. Laser Electronics - J T Vardeyan (Prentice Hall India, 1995)
2. Principles of Laser - Svelto, (Plenum Press New York 1998)
3. Solid State Laser Engineering - Koechonar (Springer Verlag,5th Ed,1999)

COURSE PLAN

COURSE NO: 06EC 6043 COURSE TITLE: Laser Technology (L-T-P : 3-0-0) CREDITS:3		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE : 1 Laser-introduction, properties. Laser spectrum and wavelengths, Radiative transitions and emission line widths, radiative decay of excited states of atoms, nonradiative decay of exicted state, emission broadening, homogeneous and inhomogeneous broadening, radiation and thermal equilibrium,Principle of detailed balance. Einstein A and B coefficients, gain coefficient and stimulated emission cross section for homogeneous and inhomogeneous broadening.	12	25
MODULE : 2 Necessary and sufficient condition for laser action, growth of gain medium with homogeneous & inhomogeneous broadening, threshold requirements for a laser with and without cavity, laser oscillation above threshold, Principle of laser amplifiers, rate equation for three and four level system, pumping threshold requirements, pumping parameters associated with optical and particle pumping.	10	25
FIRST INTERNAL TEST		
MODULE : 3 Laser cavity modes: Fabry perot cavity modes, longitudinal and transverse modes, mode characteristics, stability of laser resonator, stability diagram, unstable resonators, Q switching - general theory, active and passive Q switching techniques, mode locking- general theory, active and passive mode locking	10	25
MODULE : 4 Laser systems - General description, laser structure, excitation mechanism and applications of following lasers. He-Ne, Argon ion, CO2, excimer, nitrogen, X-ray, dye, Nd: Yag, Nd: Glass, Alexanderite and Ti: Sapphire, diode pumped solid state laser	10	25
SECONDT INTERNAL TEST		

Course No: 06 6153 Course Title: Microwave Photonics Credits: 3-0-0: 3 Year :2015

Pre-requisites: Nil

Course Objectives:

Course Objectives:

To give the Student:-

•An introduction to the linear & nonlinear analysis of RF and microwave circuits.

•An understanding of how to characterize Microwave photonic and microwave fiber optic link components

• An understanding of optical switching of Microwave circuits; Tetrahertz lasers & fast Photodetectors.

Syllabus:

Linear & nonlinear analysis of RF and microwave circuits; lines, waveguides). Analysis, design and simulation of passive and active circuits: Fast lasers sources , High speed photodetection, High speed optical modulators , Optical amplifiers; Characterization of microwave photonics components; Microwave Fiber optic Link Analysis; Optical switching of microwave circuits; Terahertz Generation and Detection; photomixing in a fast photodetector, sensing techniques; imaging techniques and applications

Course Outcome:

Students who successfully complete this course will have demonstrated an ability to understand the linear & nonlinear analysis of RF & microwave circuits; characterize active & passive microwave components; understand the optical switching of microwave circuits ; working of tetrahertz lasers and fast photodetectors; different sensing & imaging techniques.

References:

1) Stavros Iezekiel, “Microwave Photonics – Devices and Applications”, Wiley 2009.
2) Rainee Simons, “Optical Control of Microwave Devices”, Artech House 1990.
3) Coplanar waveguides, circuit, components and systems- E J Simons, Wiley(2001)
4) Integrated optics,circuits-EJ Murphy., Marcel Dekker Inc(1999)

COURSE PLAN

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COURSE NO: 06EC 6153 COURSE TITLE: Microwave photonics (L-T-P : 3-0-0) CREDITS:3		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE : 1 Linear and nonlinear analysis of RF and Microwave circuits Guided structures (transmission lines, waveguides). Analysis, design and simulation of passive circuits (couplers, hybrids, filters) and active circuits (mixers, modulators, amplifiers). Photonics: Fast lasers sources (Basics, Modulation, Noise), High speed photodetection (Basics, Noise, PIN, Traveling wave and Uni-traveling carrier photodiodes, phototransistor), High speed optical modulators (Mach-Zehnder, Electroabsorption, Microdisk, Polymer, Crystalline and Semiconductor based), Optical amplifiers (Basics)	12	15
MODULE : 2 Characterization of microwave photonics components -S parameter like approach to characterize mixed optical/electrical components , Microwave Fiber optic Link Analysis and design of fiber optic link for wideband (microwave rate) data transmission , Photonic microwave signal generation and processing, Photonic assisted wireless networks and systems, RF sub-carrier links	10	15
FIRST INTERNAL TEST		
MODULE : 3 Optical switching of microwave circuits- Advantages and applications of optical switching of microwave components, Optical control of microwave oscillators: Switching, modulation, tuning, injection locking	10	15
MODULE : 4 Terahertz Generation and Detection: Electronic methods (frequency multiplication, Vacuum Tubes), THz lasers, Cascade lasers, Optical down conversion, Photo mixing in a fast photo detector, sensing techniques and applications, imaging techniques and applications	10	15
SECOND INTERNAL TEST		

Course No: 06EC 6253 Course Title: Communication Networks Credits: 3-0-0: 3 Year :2015

Pre-requisites: Computer networks

Course Objectives:

To give the Student:-

- A deep insight to networks
- An idea about working of internet
- Basics of queuing theory
- An idea about Optical networking and various optical networks

Syllabus

Internet architecture, working of Internet, Switching and Bridging in internet, Queuing theory fundamentals, queuing models in network, various types optical networks.

Course Outcome:

Students who successfully complete this course will have through knowledge about internet architecture, working of internet queuing problems in internet and an idea about optical networking

Text Books:

1.Computer networks: A system approach Peterson L.L. & Davie B.S, Morgan Kaufman

2.Data NetworksBertsekas and R. Gallager, PHI, 2000.

3. Introduction to Optical fiber communication Suematsu and Iga , John Wiley, 1982

4. Computer Networks, A topdown approach featuring the InternetJames. F. Kurose and Keith. W.Ross, Addison Wesley, 2001

References :

1. Communication Networking: An analytical approach Anurag Kumar, D.Manjunath and

Joy Kuri , Morgan Kaufman publishers, 20042. Data and Computer Communications" by William Stallings ,

Above 7th edition , 2004

3.Computer Networks" Principles,Technologies and Protocols for Network Design, by

NATALA OLIFER and VICTOR OLIFER , 2010

4 .http://www.ietf.org/rfc.html relevant RFC document could be used to get more detailed

information about any of the concepts prescribed in the syllabus

COURSE PLAN

COURSE NO: 06EC 6253 COURSE TITLE: Communication networks (L-T-P : 3-0-0) CREDITS:3		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE : 1 Internet Architecture: Architectural concepts in ISO's OSI layered model, layering in the internet. Network Performance : Bandwidth and Latency , Delay Bandwidth Product , RTT, jitter, packing delay queuing delay etc.High-Speed Networks ,Application Performance Needs, Framing in internet : bit oriented, Byte oriented and clock based framing Error detection in internet : CRC, Internet check sum algorithm, stop and wait and sliding window TCP and UDP ..	10	15
MODULE : 2 Internet Working : switching and Bridging : Datagrams, Virtual circuit, ATM Basic Internet working and Routing, Resource allocation : Issues in Resource allocation, queuing in disciplines, Congestion avoidance mechanisms Broadband services and QOS issues: Quality of Service issues in networks, Integrated Service architecture, Differentiated Services Protocols for QOS	12	15
FIRST INTERNAL TEST		
MODULE : 3 Introduction to Queuing theory:Markov chain Discrete time and continuous time Markov chainsPoisson process, queuing models for data gram networks, Little's theorem M/M/1 queuing systemsM/ M/m/m queuing models M/ G/1 queue, Mean value analysis	12	15
MODULE : 4 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	8	15
SECOND INTERNAL TEST		

Course No:06EC 6353 Course Title: DSP Algorithms and Processors Credits: 3-0-0: 3 Year: 2015

Pre-requisites: Nil

Course Objectives:

To give the student:-

- An introduction to various advanced architectures of DSP processors
- Practice in the programming of DSP processors

Syllabus

Fundamentals of DSP architecture; various architectures of processors; DSP benchmarks, Pipeline implementation; Instruction level parallelism; review of memory hierarchy; TMS320C6x DSP processor: architectural details; addressing modes; instruction set; peripherals; SHARC processor: architectural details, peripherals

Course outcome:

Upon completion of this course student will be able to Understand various advanced architectures of DSP processors and DSP benchmarks; Learn the role of pipelining and parallelism in DSP processors; Understand the architectural details of TMS320C6x processor and SHARC processor; Apply the instructions of TMS320C6x processor in assembly and C programming.

Text Books:

1. Steven W Smith, Digital Signal Processing: A Practical guide for Engineers and scientists, Newness (Elsevier), 2003.
2. Rulf Chassaing, Digital Signal Processing and applications with the C6713 and C6416 DSK, Wiley-Interscience, 2005.

References:

3. Sen M Kuo, Bob H Lee, Real time Digital Signal Processing, , John Wiley and Sons, 2001.

4. Nasser Kehtarnawaz, Real Time Signal Processing Based on TMS320C6000, Elsevier,2004.

5. JL Hennesy, D.A. Patterson, Computer Architecture A Quantitative Approach; 3rd Edition, Elsevier India.

COURSE PLAN

COURSE NO: 06EC 6353 COURSE TITLE: DSP ALGORITHMS AND PROCESSORS (L-T-P : 3-0-0) **CREDITS: 3**		
MODULES	**Contact Hours**	**Sem. Exam Marks; %**
MODULE : 1 **Introduction**: Need for special DSP processors, Von Neumann versus Harvard Architecture, Architectures of superscalar and VLIW fixed and floating point processors, review of Pipelined RISC, architecture and Instruction Set Design. Performance and Benchmarks- SPEC CPU 2000, EEMBC DSP benchmarks. Basic Pipeline: Implementation Details- Pipline Hazards.	**6** **4**	**25**
MODULE : 2 **Instruction Level Parallelism (ILP)**: Concepts, dynamic Scheduling - reducing data hazards. Tomasulo algorithm, Dynamic Hardware Prediction- reducing Branch Hazards, Multiple Issue- hardware-based Speculation, limitations of ILP. Review of memory hierarchy – Cache design, cache Performance Issues, improving Techniques.	**7** **3**	**25**
FIRST INTERNAL TEST		
MODULE : 3 **TMS 320 C 6x:** Architecture, Functional Units, Fetch and Execute Packets, Pipelining, Registers. Linear and Circular Addressing Modes, Indirect Addressing, Circular Addressing,TMS320C6x Instruction Set, Types of Instructions, Assembler Directives, Linear Assembly, ASM Statement within C, C-Callable Assembly Function. Timers, Interrupts, Multichannel Buffered Serial Ports, Direct Memory Access, Memory Considerations, Fixed- and Floating-Point Formats, Code Improvement, Constraints.	**4** **6** **4**	**25**
MODULE : 4 **Sharc Digital Signal Processor**: – Architecture, IOP Registers, peripherals, synchronous Serial Port, interrupts, internal/external/multiprocessor memory space, multiprocessing, host Interface, link Ports. Review of TMS 320 C 6x and Sharc digital signal processors based on DSP bench marks.	**8**	**25**
SECOND INTERNAL TEST		

Course No:06EC 6083 Course Title: Signal Processing Lab Credits: 3-0-0: 3 Year: 2015

Experiments include

Familiarization Of MATLAB, Generation of Simple Signals, Sampling Rate Alteration, Linear And Circular Convolution, Correlations And Energy Spectral Density, FIR Filters, IIR Filters, Toeplitz And Circulant Matrices, Hilbert Transform

SEMESTER II

Course No: 06EC 6014 Course Title Biophotonics Credits:4-0-0: 4 Year :2015

Pre-requisites: Nil

Course Objectives:

To give the Student:-

- An introduction to photonic processes in biopolymers & the different types of microscopy involved in biophotonics.
- An insight into the working of biosensors & flow cytometer for studies involving blood cells.
- An introduction to Laser activated therapy & tissue engineering using light.
- An idea about the optical trapping of cells using laser tweezers & the applications of various biomaterials in biophotonics.

Syllabus

Light interaction with cells & tissues; different types of microscopy used in biophotonics; nonlinear imaging; optical biosensors; flow cytometry; laser activated therapy- photodynamic therapy; Tissue engineering using light; Optical tweezers; cell trapping using guassian & nonguassian beams; photonics & biomaterials..

Course Outcome:

Students who successfully complete this course will have demonstrated an ability to understand the fundamental concepts of various photonics based processes occurring in the human body, Light induced therapy, different types of microscopy, various bioimaging processes, and optical tweezers.

Text Books:

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)

COURSE PLAN

COURSE NO: 06EC 6014 COURSE TITLE: Biophotonics (L-T-P : 4-0-0) CREDITS:4		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE : 1 Photobiology: Interaction of light with cells and tissues, photo-processes in Biopolymer- human eye and vision, Photo-excitation: free space propagation, optical fiber delivery system, articulated arm delivery, hollow tube wave-guides. Optical coherence tomography, , fluorescence resonance energy transfer (FRET) imaging, nonlinear optical 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	12	25
MODULE : 2 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	12	25
FIRST INTERNAL TEST		
MODULE : 3 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	11	25
MODULE : 4 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	11	25
SECOND INTERNAL TEST		

Course No: 06 EC 6024 Course Title: Optical Communication Technology Credits: 3-0-0: 3
Year : 2015

Pre-requisites: Nil

Course Objectives:

To give the Student:-

- A deep understanding of the optical fibre communication Link including sources, detectors, receiver amplifiers and optical fibres;
- An introduction to experimental techniques of Fiber fabrication and characterization, Splices, Connectors and fiber cable;
- A thorough knowledge on Fiber Amplifiers;
- Link Design aspects and coherent detection.

Syllabus :

Optical communication system -guided and Unguided, Fiber fabrication and characterization, Splices, Connectors Couplers and fiber cable. Loss mechanism in optical fiber. Pulse propagation, Dispersion in single-mode fibers, Sources for communication: LED and Laser Diode – modulation circuits: analog & digital, Switches : Opto mechanical & Photonic switches.

Detectors for communication: PIN diode & APD, Noise Sources in detectors, Receiver configurations, Preamplifiers : Low impedance, High impedance and Trans impedance amplifiers.

Fiber amplifiers: Semiconductor Laser Amplifier, Erbium doped fiber amplifier, **Nonlinear effects in optical fiber:** Solitons.

System design considerations: multiplexing, OTDM, WDM. Link Power Budget Analysis, Rise Time Budget Analysis. Line coding, Coherent systems.

Course Outcome:

- Students who successfully complete this course will have demonstrated an ability to understand the fundamental components of Optical Fibre Communication Link;
- E**xperimental techniques of** Fiber fabrication and characterization, Splices, Connectors and fiber cable.
- Loss mechanism in optical fiber. Signal distortion; Design of preamplifiers; WDM concepts, Link design analysis, Non linear effects: Soliton propagation
- Student will understand the two types of Coherent detection.

Text Books:

1. Optical Fiber Communication - G Keiser (4th Ed, TMH)
2. Optical Fiber Communications - J M Senior (Pearson, 3rd Ed.)

References:

1. Fiber Optic Communication – Joseph C Palais, (PHI, 5th Ed, 2004)

2. Optical Fiber Communication Systems - J Gowar (Prentice Hall India, 2nd Ed)

3. Fiber Optic Communication Systems - D C Agarwal (S Chand).

4. An Introduction to Fiber Optic Systems – John Powers(McGraw Hill - Irwin,)

5. Fiber Optic Communication Systems : Govind P Agrawal

COURSE PLAN

COURSE NO: 06EC 6024 COURSE TITLE: Optical communication Technology (L-T-P :3-0-0) CREDITS:3		
Module/Topics	**Contact hours**	**Sem.Exam Marks;%**
Introduction to Guided optical communication system: Comparison between unguided and Guided optical communication, Elements of an Optical Fiber Transmission System. **Experimental techniques in fiber optics:** Fiber fabrication (OVD, VAD, CVD, MCVD, PMCVD etc) and characterization, Splices, Connectors and fiber cable**Signal degradation- Attenuation & Dispersion**	3 7 3	25
Sources for communication: LED and Laser Diode – modulation circuits: analog & digital –challenges in the design. **Switches :** Opto mechanical & Photonic switches. **Detectors for communication:** PIN diode & APD, Noise Sources in detectors: Principal Noises - thermal noise, dark current noise, quantum noise. **Receiver configurations:** Receiver noises- Equivalent circuit. Preamplifiers : Low impedance, High impedance and Trans impedance amplifiers.	2 4 4	25
FIRST INTERNAL TEST		
Fiber amplifiers : Types, Semiconductor Laser Amplifier, Erbium doped fiber amplifier- Gain flattening, Raman Fiber Amplifier, **Nonlinear effects in optical fiber:** Solitons.	6 4	25
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.	4 4 2 4	25
SECOND INTERNAL TEST		

Course No: 06EC 6034 Course Title: Industrial Photonics, (L-T-P :3-0-0) Credits: 3, Year :2015

Pre-requisites: Nil

Course Objectives:

This course will introduce students to a range of photonic components; students will gain an understanding of the fundamentals of how these devices operate and an appreciation of where these components find applications in telecommunications and sensing system

Syllabus

Photonics Technology: Passive components,Active components, Modulation and demodulation: direct detection, coherent detection,Optical layer in network, node design, Networking design and operation, Routing wavelength assignment,Optical Networks,upgrading the transmission capacity, Multiplexing and demultiplexing, Control and Management**,**Network management function, Optical protection, attacks on fiber networks, Intrusion detection and prevention techniques. Network test equipments.

Course Outcome:

Students who successfully complete this course will have demonstrated an ability to understand the Industrial applications of Optical components,Ability to design optical networks from the physical layer to the network layer,Maintenance and repair of industrial equipment, instruments

Text Books:

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)

COURSE PLAN

COURSE NO: 06EC 6034 COURSE TITLE: Industrial Photonics (L-T-P : 3-0-0) CREDITS:3		
Module/Topics	**Contact hours**	**Sem.Exam Marks;%**
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	8 6	25
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	6 4	25
FIRST INTERNAL TEST		
Optical Networks: Network architecture, HFC, FTTC, Optical Access Network Architecture, **Upgrading the transmission capacity**, SDM, TDM, WDM, OTDM, Multiplexing and demultiplexing, Synchronization, broadcast OTDM Network, OTDM testbeds, **Application areas**- interexchange, undersea, local exchange networks.	2 4 2	25
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.	4 6	25
SECOND INTERNAL TEST		

Course No: 06EC 6144 Course Title: Integrated Optics Credits: 3-0-0: 3 Year :2015

Pre-requisites: Nil

Course Objectives:

To give the Student:-

- A thorough knowledge about integrated optics;
- A clear picture about the materials used and the fabrication techniques
- The problems faced in the fabrication process
- different applications.

Syllabus

Advantages of Integrated optics, substrate materials for OIC, fabrication techniques Electro optic and acousto optic modulators, Quantum well modulators, Quantum well detectors, SEED, Applications of Integrated optics, Devices and systems for Telecommunications, Optomicrowave applications.

Course Outcome:

Students who successfully complete this course will have thorough knowledge about integrated optics, materials used, its fabrication techniques and various applications.

Text Books:

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. Handbook of optics Vol II Micheal Bau Ed (Mc Graw Hill, 1995)

3. Guided wave opto electronics (ch 6) T Tamir (Editor Springer Verlag 1990)

COURSE PLAN

COURSE NO: 06EC 6144 COURSE TITLE: Integrated optics (L-T-P : 3-0-0) CREDITS:3		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE : 1 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. Waveguide fabrication techniques electro optic waveguides Losses in optical waveguides measurements of waveguide losses, waveguide input/ output couplers, coupling between waveguides..	12	25
MODULE : 2 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.	10	25
FIRST INTERNAL TEST		
MODULE : 3 Quantum well modulators, Quantum well detectors, SEED, Applications of Integrated optics RF spectrum analyser, ADC	10	25
MODULE : 4 IO optical disk Readhead OIC temperature and voltage sensor, optoelectronic IC transmitter and receiver, Devices and systems for Telecommunications, Optomicrowave applications.	10	25
SECOND INTERNAL TEST		

Course No: 06EC 6244 Course Title: Wavelet Transforms: Theory and applications

Credits: 3-0-0: 3 Year :2015

Pre-requisites : Knowledge in signals and systems

Course Objectives:

- To enable the students to understand the concept of time frequency representation of signals .
- To understand the mathematical concept of different wavelet systems and their use in signal analysis and processing..
- To familiarize with the application of wavelet transform in signal processing

Syllabus

Continuous time frequency representation of signals, windowed Fourier transform, Uncertainty Principle and time frequency tiling, Wavelets, specifications, Continuous wavelet transform, Haar scaling and wavelet functions and function spaces, discrete wavelet transform , signal decomposition and signal reconstruction using orthogonal wavelet system and its filter bank implementation, signal decomposition and signal reconstruction using biorthogonal wavelet system and its filter bank implementation , Applications of wavelelet transform.

Course Outcome:

Students will be able to understand the concepts of time frequency analysis of signals , mathematical concept of different wavelet systems and their application in signal analysis and processing.

References

1. Insight into wavelets: From theory to Practice- K P Soman and K I Ramachandran, Prentice Hall of India
2. Wavelet Transforms: Introduction to theory and applications- R M Rao and A S Bopardikar, Pearson
3. Wavelets and filter banks- G Strang and T Q Nguyen, Wellesley Cambridge Press, 1998.
4. Fundamentals of Wavelets: Thory, Algorithms and Applications- J C Goswamy and A K Chan, Wiley-Interscience publications, John Wiley and sons, 1999
5. Wavelets and Multiwavelets- F Keinert, SIAM, Chapman and Hall/CRC, 2004
6. Ten Lectures on Wavelets- Ingrid Daubechies, SIAM, 1990
7. Wavelet Analysis- The scalable structure of Information- H L Resnikoff, R. O. Wells,Jr., Springer, 2004.

COURSE PLAN

COURSE NO: 06EC 6244 COURSE TITLE: Wavelet Transforms: Theory and applications (L-T-P : 3-0-0) CREDITS:3		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE : 1 **Continuous and Discrete Wavelet Transform:** Continuous time frequency representation of signals,The Windowed Fourier Transform , Uncertainty Principle and time frequency tiling, Wavelets, specifications, admissibility conditions, Continuous wavelet transform, Haar scaling functions and function spaces, nested spaces, Haar wavelet function, orthogonality, normalization of bases , refinement relations.	12	15
MODULE : 2 **Orthogonal wavelet Transform:** Refinement relation for orthogonal wavelet system, restriction on filter coefficients, Discrete wavelet transform and relation to filter banks, signal decomposition ,signal reconstruction, Filter bank implementation, perfect matching filters, computation of coefficients.	10	15
FIRST INTERNAL TEST		
MODULE : 3 **Biorthogonal Wavelet transform:** Biorthogonality in vector space, biorthogonal wavelet systems. Biorthogonal analysis and synthesis, Filter bank implementation,	10	15
MODULE : 4 **Applications:** Image Compression: wavelet transform of an image ,quantization , entropy encoding, EZW Coding, SPIHT, Denoising using wavelet shrinkage, shrinkage functions, shrinkage rules.	10	15
SECOND INTERNAL TEST		

Course No: 06EC 6344 Course Title: Digital Communication Techniques Credits: 3-0-0: 3

Year :2015

Pre-requisites: Nil

Course Objectives:

To give the Student:-

- An introduction to random signals and random processes;
- An idea about different coding systems;
- An exposure to information theory and coding.

Syllabus:

Random variables and random process; Signal space analysis; Detection of signals in noise; Waveform Coding Techniques; Digital Modulation techniques; Base band data transmission; Information theory & Coding; Error control codes

Course Outcome:

Students who successfully complete this course will have demonstrated an ability to understand the fundamental concepts of digital communication systems; Code a signal using waveform coding; Explain different digital modulation techniques; Find error control codes

Text Books:

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

References:

1. Modern Digital and analog Communication Systems, B.P.Lathi, (Oxford UniversityPress, 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)
6. Probalility and Random Process ,Papaulis and SU Pillai TMH

COURSE PLAN

Course No: 06EC 6344 Course Title: Digital Communication Techniques (L-T-P:3-0-0) Credits: 3		
Modules	**Contact hours**	**Sem. Exam Marks %**
Module 1. Random variables and random process:, Random variables, 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	**10**	**25**
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 Waveform Coding Techniques: Sampling theorem ,PCM, Channel noise & error probability, Quantization Noise & Signal to noise ratio, robust quantization, DPCM, Delta Modulation, ADPCM.	**10**	**25**
First Internal test		
Module 3. Digital Modulation techniques: Digital modulation formats, Coherent binary modulation techniques PSK, FSK, QPSK, MSK. Noncoherent 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, , Intersymbol interference, Eye pattern	**11**	**25**
Module 4 Information theory & Coding: Information theory :Information ,entropy, Information Rate,Channelcapacity, Mutual information ,Channel coding theorem, Capacity of Gaussian channel, S/NBandwidthtradeoff, Information capacity theorem, Error control codes: discrete memory less channels, Linear block codes, cyclic codes , convolution codes	**11**	**25**
Second Internal test		

Course No: 06EC 6154 Course Title: Modern Optics Credits: 3-0-0: 3 Year :2015

Pre-requisites: Nil

Course Objectives:

To give the Student:-

- A basic understanding of Electromagnetic Theory and Maxwell's equations
- A detailed theoretical analysis of the optical phenomena like Polarization, Interference, Diffraction etc
- A clear picture of propagation of Optical beam through different media

Syllabus

Electromagnetic Theory, Maxwell's equations, Polarization, Stoke's Parameters, Jones Vectors and matrices, Interference, different Interferometers, interference filters, Propagation of Optical beams, ray vector and ray matrices, Coherence: Spatial and temporal coherence, Diffraction: Fresnel and Fraunhoffer diffraction

Course Outcome:

Students who successfully complete this course will have a methodical knowledge about Electromagnetic Theory and Maxwell's equations, will acquire a detailed theoretical analysis of many optical phenomena and a clear picture of propagation of Optical beam through different media

Text Books:

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. 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)

COURSE PLAN

COURSE NO: 06EC 6154 COURSE TITLE: Modern Optics (L-T-P : 3-0-0) CREDITS:3		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE : 1 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.	12	15
MODULE : 2 Interference, Michelson's Interferometer, Mach-Zender Interferometer, Free Spectral Range and Finesse of Fabry-Perot Interferometer, Multi-layer interference coatings and interference filters.	10	15
FIRST INTERNAL TEST		
MODULE : 3 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.	10	15
MODULE : 4 Coherence: Spatial and temporal coherence, Fourier Transform spectroscopy, auto correlation function and coherence, intensity interferometry. Diffraction: Fresnel and Fraunhoffer diffraction, circular and rectangular apertures	10	15
SECEND INTERNAL TEST		

Course No: 06EC 6254 Course Title: Laser Applications Credits: 3-0-0: 3 Year :2015

Pre-requisites: Basic Knowledge of Lasers

Course Objectives:

To give the Student:-

- A basic understanding of Holography and Speckle Interferometry
- A detailed theoretical analysis of the Laser Doppler Velocity and its applications
- Familiarization in various industrial and chemical application of laser

Syllabus

SYLLABUS

Holography and Speckle Interferometry; Laser Doppler Velocimetry; Industrial applications,

Lasers in chemistry.

Course Outcome:

Students who successfully complete this course will have a detailed understanding of Holography and its applications, Speckle interferometry, will acquire a detailed theoretical analysis of LDV and will get a knowledge about various applications of laser

TEXT:

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

REFERENCE

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 Lasers in Medicine – H K Kobener, John Wiley 1980)

6 Laser Spectroscopy- Demtroder (Springer, 2nd Ed)

7 Fundamentals of Photonics- B E A Saleh and M C Teich, Wiley Interscience, 1991

COURSE PLAN

COURSE NO: 06EC 6254 COURSE TITLE: Laser Applications (L-T-P : 3-1-0) CREDITS:4		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE : 1 **Holography and Speckle interferometry:** Theory of hologram, recording and reconstruction , recording media, types of holograms, application of holography - particle-size analysis, holographic diffraction gratings, holographic scanners, holographic filter, holographic memories Electronic Speckle Pattern Interferometry - theory and applications	12	15
MODULE : 2 **Laser Doppler Velocimetry:** Principle of operation, performance parameters- scale factor relative error, accuracy of the Doppler frequency, size of the sensing region, Alignment and positioning errors, direction discrimination, particle seeding, Time domain & frequency domain processing of the Doppler signal	10	15
FIRST INTERNAL TEST		
MODULE : 3 **Industrial applications:** Absorption of laser radiation by metals, semiconductors and insulators, laser drilling, welding , cutting and surface treatment – hardening, glazing, laser alloying and cladding, applications in Integrated Circuit fabrication	10	15
MODULE : 4 **Lasers in chemistry:** laser initiated chemical reactions, Laser altered reactions, Laser monitoring of chemical dynamics , schemes of laser isotope separation **Lasers in other fields:** optical data storage, opical data processing, laser graphics, consumer products	10	15
SECEND INTERNAL TEST		

Course No: **06EC 6354** **Course Title: Laser spectroscopy** **Credits: 3-0-0-3** **Year :2015**

Pre-requisites: Nil

Course Objectives:

To give the Student:-

- An Idea about the principle of Laser Raman spectroscopy & its applications
- An understanding of the principle underlying Fluorescence spectroscopy & the various dyes associated with that.
- A foundation in the basics of high resolution spectroscopy, two photon absorption spectroscopy,etc
- An introduction to Photoacoustic spectroscopy & its applications

Syllabus:

Spectroscopy technique; Comparison between Spectrometers and interferometers; Laser Raman Techniques; General applications of Laser Raman Spectroscopy; Fluorescence spectroscopy;Rare earth- ions- Absorption and fluorescence spectra; colour centres Fluorescence of Dyes structure and properties of organic laser Dyes- Quantum efficiency; High Resolution spectroscopy; Two photon absorption spectroscopy; Correlation spectroscopy of scattered light, photon assisted collisional energy transfer; Photoacoustic Spectroscopy- PA effect in gases, liquids, and solids- Design of PA spectrometer; Application of PAS —Evaluation of optical and thermal parameters-Thermal diffusivity-Depth profiling.

Course Outcome:

Students who successfully complete this course will have an idea about the different types of spectroscopy like Laser Raman spectroscopy, Fluorescence spectroscopy, two photon saturation absorption spectroscopy, Photoacoustic spectroscopy etc and the different processes involved in them & their applications in various areas of photonics.

Text Books:

1.Laser Spectroscopy : W Demtroder , Springer Verlag 3 rd ed, 2003

2. Laser spectroscopy and its Applications- Leon J Radzemski, Marcel Deklar Pub.IncNY

(1987)

References

1.Photoacoustic spectroscopy — Rosencwaig, Wiley,(1981)

2.Thermo optic spectroscopy- J Sell, Academic press, (1992)

3.Lumincence in Solids —D R Vij ,Plenum Press NY, (1998)

4.Lasers and Nonlinear optics — B B Laud, New Age International 2 nd Edition, (2003)

5.Dye lasers —F P Schafer, Springer Verlag 2 nd Revised Ed (1977) (2006)

6.Laser Photoionization Spectroscopy _ Vladin S Letokhov, Accademic Press Inc (1987)

COURSE PLAN

Course No: 06EC 6354 Course Title: Laser Spectroscopy (L-T-P:3-0-0) Credits: 3		
	Contact hours	**Sem. Exam Marks %**
Module I Spectroscopy technique, Conventional spectroscope recording in UV-Vis-NIR region using dispersing spectrographs, Comparison between Spectrometers and interferometers. Laser Raman Techniques- Hyper Raman effect, SRS,CARS, PARS,Experimental schemes General applications of Laser Raman Spectroscopy.	10	25%
Module II Fluorescence spectroscopy;Rare earth- ions- Absorption and fluorescence spectra.- Energy levels of rare earth ions in fluoride and suiphide crystals. Phosphoresence, colour centres Fluorescence of Dyes structure and properties of organic laser Dyes- Quantum efficiency.	10	25%
FIRST INTERNAL EXAM		
. Module III High Resolution spectroscopy-Doppler free spectroscopy, Two photon absorption spectroscopy,Saturation absorption spectroscopy. Laser photoionization spectroscopyphotoionization of excited atoms-Rydberg atomic states .Correlation spectroscopy of scattered light, photon assisted collisional energy transfer, single molecule detection, spectroscopic characterization of BE condensates.	10	25%
Module IV Photoacoustic Spectroscopy- PA effect in gases, liquids, and solids- Design of PA spectrometerApplication of PAS —Evaluation of optical and thermal parameters-Thermal diffusivity- Depth profiling..	12	25%
SECOND INTERNAL EXAM	42	

Course No 06EC 6074 Course Title Optoelectronics and Fiber Optics Lab (L-T-P: 0-0-3) Credits::1 Year :2015

Experiments include

Characteristics of Optocoupler, Characteristics of Photo transistor, Characteristics of LDR, LED Modulator, Faraday Effect, Light Sensor Alarm Circuit, V-I Characteristics of Laser Source, P-I Characteristics of Laser Source, Analog Signal Transmission Using Laser Source, Digital Signal Transmission Using Laser Source, Study of OTDR, Study of Fiber Optics Wavelength Division Demultiplexing, Insertion Loss measurement, Time Delay in Single Mode Fiber Optic Cable,Study of EDFA

SEMESTER-III

Course No: 06EC 7113 Course Title: Biomedical Signal Processing Credits: 3-0-0: 3 Year :2015

Pre-requisites: Nil

Course Objectives:

To give the Student:-

- An introduction to biomedical signals;
- An idea to model biomedical signals;
- An exposure to various applications.

Syllabus:

Introduction to biomedical signals; Tasks in biomedical signal processing; Concurrent, coupled and correlated processes; Modeling of Biomedical signals; Detection of biomedical signals in noise; Classification of biomedical signals; Cardio vascular applications; ECG parameters & their estimation; ECG Signal Processing; Neurological Applications; Modeling EEG; EEG applications; Analysis of EEG channels

Course Outcome:

Students who successfully complete this course will have demonstrated an ability to understand the fundamental concepts of biomedical signal processing; Choosing a class of signal model; Selecting a specific form of the model; Process the signal.

References:

1. Rangayyan, “Biomedical Signal Analysis”, Wiley 2002.
2. D.C.Reddy, “Biomedical Signal Processing: Principles and techniques” , Tata McGraw Hill, New Delhi, 2005
3. Willis J Tompkins, Biomedical Digital Signal Processing, Prentice Hall, 1993
4. Bruce, “Biomedical Signal Processing & Signal Modeling,” Wiley, 2001
5. Sörnmo, “Bioelectrical Signal Processing in Cardiac & Neurological Applications”, Elsevier
6. Semmlow, “Biosignal and Biomedical Image Processing”, Marcel Dekker, 2004
7. Enderle, “Introduction to Biomedical Engineering,” 2/e, Elsevier, 2005

COURSE PLAN

Course No: 06EC 7113 Course Title: Biomedical Signal Processing (L-T-P:3-0-0) Credits: 3		
Modules	**Contact hours**	**Sem. Exam Marks %**
Module 1. Introduction to Biomedical Signals - Examples of Biomedical signals - ECG, EEG, EMG etc- Tasks in Biomedical Signal Processing - Computer Aided Diagnosis. Origin of bio potentials - Review of linear systems - Fourier Transform and Time Frequency Analysis (Wavelet) of biomedical signals- Processing of Random & Stochastic signals – spectral estimation - Properties and effects of noise in biomedical instruments - Filtering in biomedical instruments .	**10**	**25**
Module 2. Concurrent, coupled and correlated processes - illustration with case studies – Adaptive and optimal filtering - Modeling of Biomedical signals - Detection of biomedical signals in noise - removal of artifacts of one signal embedded in another -Maternal-Fetal ECG – Muscle contraction interference. Event detection - case studies with ECG & EEG – Independent component Analysis - Cocktail party problem applied to EEG signals - Classification of biomedical signals.	**10**	**25**
First Internal test		
Module 3. Cardio vascular applications : Basic ECG - Electrical Activity of the heart- ECG data acquisition - ECG parameters & their estimation - Use of multiscale analysis for ECG parameters estimation - Noise & Artifacts- ECG Signal Processing: Baseline Wandering, Power line interference, Muscle noise filtering - QRS detection - Arrhythmia analysis – Data Compression: Lossless &Lossy- Heart Rate Variability - Time Domain measures – Heart Rhythm representation - Spectral analysis of heart rate variability - interaction with other physiological signals.	**11**	**25**
Module 4. Neurological Applications : The electroencephalogram - EEG rhythms & waveform - categorization of EEG activity - recording techniques - EEG applications- Epilepsy, sleep disorders, brain computer interface. Modeling EEG- linear, stochastic models - Non linearmodeling of EEG - artifacts in EEG & their characteristics and processing - Model based spectral analysis - EEG segmentation - Joint Time-Frequency analysis – correlation analysis of EEG channels - coherence analysis of EEG channels.	**11**	**25**
Second Internal test		

Course No: 06EC 7213 Course Title: Advanced optical communication Credits: 3-0-0: 3
Year :2015

Pre-requisites: Nil

Course Objectives:

To give the Student:-

- An idea about the advanced techniques used in optical communication
- Familiarization of OTDM technology
- A clear understanding of the concept of OTDM Technology
- An exposure to various applications of solitons
- The concepts behind FTH and PON technology

Syllabus

Review of optical components, optical amplifier types, issues in optical amplifier, introduction to OIC and its applications,DWDM Technology, optical solitons and applications, Optical pulse compression
FTH and PON technology, near space communication open air optical communication Inter satellite link hops (ISI) Introduction to all optical networks (AON). Military, civil consumer and industrial applications

Course Outcome:

Students who successfully complete this course will have demonstrated an ability to understand the fundamental concepts of advanced optical communication, optical amplifiers, optical solitons and applications and the concepts behind behind FTH and PON technology

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

COURSE PLAN

Course No: 06EC 7213 Course Title: Advanced optical communication (L-T-P:3-0-0) Credits: 3		
	Contact hours	**Sem. Exam Marks %**
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	**10**	**25**
Module II: WDM technology Introduction WDM optical networking evolution enabling technologies for WDM	**10**	**25**
First Internal test		
Module III: 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	**11**	**25**
Module IV 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	**11**	**25**
Second Internal test		

Course No: 06EC 7313 Course Title: Non linear optics Credits: 3-0-0: 3 Year :2015

Pre-requisites: Nil

Course Objectives: To give the student:

- An understanding of optical wave propagation in material media
- An idea about the effects of nonlinearity - coupling of waves, qualitative description of intensity dependent refraction and absorption
- An insight into the physical origin of the nonlinear optical coefficients, optical second harmonic generation, Parametric generation of light etc.
- An understanding of self phase modulation, four wave mixing and third order nonlinearities

Syllabus:

Interaction of light with matter, optical wave propagation in material media, effects of nonlinearity; Nonlinear optical susceptibility tensor, the physical origins of the nonlinear optical coefficients, electromagnetic formulation of nonlinear interactions, optical second harmonic generation; Generation of second harmonic and sum and difference frequency, phase matching; Four wave frequency mixing; Third order optical nonlinearities, Stimulated Raman Scattering, anti-stokes Raman scattering, stimulated Brilliouin scattering, self focusing of optical beams, Nonlinear optical materials,growth and characterization of nonlinear optical materials.

Course Outcome:

The student will be able to understand the concepts of nonlinearity & their effects along with their applications in four wave mixing and generation of second harmonic . The student gets to learn about the various processes involving third order optical nonlinearities and also the preparation of nonlinear optical materials & their applications in the photonics field.

Text Books:

1. Ammon Yariv, Quantum Electronics 3rd Edn, John Wiley, New York, 1989

2. Govind P. Agrawal, Nonlinear Fiber Optics, 3rd Edn, Academic Press, New Delhi, 2001.

3. Introduction to Photorefractive Nonlinear Optics, Pochi Yeh, John Wiley & Sons, New York,

1993

References:

1. R.W.Boyd, “Nonlinear Optics”, third edition, Academic, (2008).

2. N. Bloembergen, “Nonlinear Optics”, 4th edition, World Scientific (1996).

3. G. P.Agarwal, “Nonlinear Fiber Optics”, 4th edition, Academic (2007).

4. R. L. Sutherland, “Handbook of Nonlinear Optics”, 2nd edition, Marcel Dekker (2003).

5. Y. R.Shen, “Principles of Nonlinear Optics”, Wiley (1984).

COURSE PLAN

Course No: 06EC 7313 Course Title: Non linear optics (L-T-P:3-0-0) Credits: 3		
Modules	**Contact hours**	**Sem. Exam Marks %**
Module I: Interaction of light with matter, optical wave propagation in material media, effects of nonlinearity - coupling of waves, qualitative description of intensity dependent refraction and absorption, revision of main ideas in linear optics especially anisotropic media and dispersion effects on propagation of a wave packet.	**10**	**25**
MODULE II: Steady state response functions and susceptibility tensors and their quantum mechanical expressions, symmetry, Harmonic generation, Nonlinear optical susceptibility tensor, on the physical origins of the nonlinear optical coefficients, electromagnetic formulation of nonlinear interactions, optical second harmonic generation, experimental set up, Parametric generation of light, Basic equations of parametric amplification, parametric oscillation, frequency tuning, experimental arrangement, frequency up and down conversion	**10**	**25**
First Internal test		
MODULE III: Generation of second harmonic and sum and difference frequency, phase matching, Maker fringes, quasi-phase matching and periodically poled crystals Intensity dependent refraction and absorption, self-focusing, beam coupling and phase conjugation by photorefractive effect, self induced transparency, self phase modulation. Four wave frequency mixing processes including degenerate four wave mixing and optical phase conjugation, optical Kerr Effect and its applications in ultra-short pulse generation and characterization, nonlinear spectroscopy methods and their applications	**11**	**25**
MODULE IV: Third order optical nonlinearities, Stimulated Raman Scattering, anti-stokes Raman scattering, stimulated Brilliouin scattering self focusing of optical beams, Nonlinear optical materials,growth and characterization of nonlinear optical materials, optical bi-stability, absorptive and dispersive, simple model, optical bistable devices..	**11**	**25**
Second Internal test		

Course No: 06EC 7123 Course Title: Optical Sensor Technology Credits: 3-0-0: 3 Year :2015

Pre-requisites: Knowledge about the fundamentals of fibre optics.

Course Objectives:

- To enable the students to understand the fundamentals of optical sensing and its applications in various fields.
- To gather knowledge about different kinds of optical sensors , its features, construction and applications.

Syllabus

Fundamentals of optical sensing, simple optic sensors like optic levers, triangulation methods, projected fringe technique etc., LIDAR and its applications, Interferometry for precision measurements: classifications and applications. Optical fibre sensors: features, classifications and applications, FBG based sensors, EWFOS, OTDR and applications. Principle and applications of interferometric FOS.

Course Outcome:

The student will be able to understand the concepts of optical sensing and identify various sensor applications of optical fibre. Students will be equipped to take up optical sensor related topics as part of their project works during higher semester of the course.

REFERENCE:

1. Fundamentals of Fibre Optics in Telecommunications and Sensor Systems – Edited by B.P. Pal (New age international 1992)
2. Optics – Ajoy Ghatak, (TMH, 2008)
3. Lasers - Theory and Applications – Ghatak & Thyagarajan, (Macmillan India Limited,2003)
4. Optical Measurement Techniques and Applications - P K Rastogi ,Artech House,1997)

COURSE PLAN

Course No: 06EC 7123 Course Title: Optical Sensor Technology (L-T-P:3-0-0) Credits: 3		
	Contact hours	**Sem. Exam Marks %**
Single and double optic levers, method of triangulation, projected fringe technique. Interferometry for precision measurements, two-beam interferometry, Michelson interferometer, fringe displacement and fringe counting, heterodyne interferometer. Eelectron speckle pattern interferometry, photoelastic measurements, lidar for atmospheric remote sensing, lidar equation	4 6 4	25%
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	5 6 3	25%
FIRST INTERNAL EXAM		
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	4 6 4	25%
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.	6 5 3	25%
SECOND INTERNAL EXAM	56	

Course No: 06EC 7223 Course Title: Radio over Fiber communication Credits: 3-0-0-3
Year :2015

Pre-requisites: Nil

Course Objectives:

To give the Student:-

- A foundation in the basics of Radio Over Fiber communication;
- Practice in the modelling of Radio Over Fiber System and noise processes;
- An introduction of DSP modelling of Nonlinear distortions and its reduction in Radio Over Communication link;
- An introduction to performance analysis of various equalizers and filters

Syllabus

Fundamental concepts of Radio Over Fiber Communication; Basic Fi-Wi System Architecture ; Major Issues; Power Link Budget ; The Fundamental Noise Processes in ROF Links; DSP Modeling of the ROF Link Nonlinearity ; Various attempts to reduce non linear distortions; Modeling of ROF Link ; Asymmetric Compensation ; Performance Evaluation of Polynomial Filter s and linear filters; Brief History of Cellular Communication Systems

Course Outcome:

Students who successfully complete this course will have demonstrated an ability to understand the fundamental concepts of Radio over Fiber Communication; Model the Nonlinear distortions in ROF link ; Reduce the Nonlinear distortions using different equalizers and filters ; Analyze the performance of equalizers,polynomial filters and linear filters.

References

1. Xavier N. Fernando, Radio Over Fiber For Wireless Communications From Fundamentals To Advanced Topics, John Wiley and Sons Ltd-2014
2 H. Al Raweshidi, S. Komaki, Radio over Fiber Technologies for Mobile Networks, Norwood: Artech House, 2002.

COURSE PLAN

Course No: 06EC 7223 Course Title: Radio over Fiber communication (L-T-P:3-0-0) Credits: 3		
	Contact hours	**Sem. Exam Marks %**
MODULE : 1 The ROF System- ROF for Millimeter Wave Bands- Value-Added Use for Existing Fiber-Advancements in Microwave Photonics -Transparent System Enhancement-Basic Fi-Wi System Architecture-Major Issues-Fiber-Feeder Approaches- Important Fi-Wi Link Elements- Baseband-RFModulation Techniques- The Wireless Channel- Power Link Budget and Cumulating SNR	12	25%
MODULE : 2 The Fundamental Noise Processes in ROF Links- The Signal-to-Noise Ratio- Noise Floor Incrementin SCM ROF Systems- Subcarrier-Multiplexed ROF Downlink- The ROF Downlink Channel-Subcarrier-Multiplexed ROF Uplink-The ROF Uplink Channel- Signals to Distortion, Interference,and Noise Ratios- Externally Modulated ROF Links-Reflective Semiconductor Optical Amplifier-Optimization of the MZI Bias Voltage	10	25%
FIRST INTERNAL EXAM		
MODULE : 3 DSP Modeling of the ROF Link Nonlinearity- Various Attempts to Reduce NLD- Basics of DSP forNonlinear Systems- Baseband Representation of a Passband Complex Nonlinear System Nonlinear Modeling of Fi-Wi Link-Adaptive Modeling of the ROF Link- Asymmetric Compensation-TheWiener and Hammerstein System Model for Fi-Wi Links Fi-Wi Channel Estimation- Equalization of the Wireless Channel- Optimization of Polynomial Filter Parameters- Optimization of Linear Filter Parameters	10	25%
MODULE : 4 Performance Evaluation of the Hammerstein- Type DFE- Evaluation of the Polynomial Filter-Evaluation of Linear Filters- Multiuser Fi-Wi Uplink Model- Correlation Relationships- ROFChannel Estimation- Case Study - Fi-Wi Uplink Equalization- Brief History of CellularCommunication Systems- Wireless Access Schemes- Peak-to-Average Power Ratio ReductionTechniques- OFDM ROF System Improvement	10	25%
SECOND INTERNAL EXAM	42	

Course No: 06EC 7323 Course Title: Optical Instrumentation Credits: 3-0-0-3
Year :2015

Pre-requisites: Nil
Course Objectives:

To give the Student:-

- An idea about Optical materials ;
- Basics of optical design;
- A foundation in the basics of Optomedical instruments, optical coherence tomography, Infrared Instrumentation;
- An introduction to Photometry ;
- A deep understanding of the fundamental and salient features behind LASER Gyroscope

Syllabus

Optical materials, Optical components, polarizing components, Basics of optical design,

Telescopes and microscopes

Space optics, Adaptive optics, Optomedical instruments, optical coherence tomography, Infrared instrumentation

Photometry, polarizing instruments, Ellipsometry

Laser gyroscope : Basic gyro configurations. Ring Laser Gyros (RLG), Fiber Optics Gyros (FOG), the resonant FOG MEMS gyro, Piezoelectric gyro

Course Outcome:

Students who successfully complete this course will have an idea about Optical materials, the students will learn the basics of optical design and the basics of Optomedical instruments, optical coherence tomography and Infrared instrumentation the students will have a deep understanding of the fundamental and salient features behind LASER Gyroscopes

Text Books:

1 Fowles G.R., Introduction to Modern Optics, 2nd Edition, Holt, Rienhart and Winston, 1975.
2. Bruce H & Walkar, Optical Engineering Fundamentals, PHI, 2003
3. R. Khandpur, “Biomedical instrumentation- technology and applications”, McGraw Hill, 2005
4 Silvano Donati Electro-Optical Instrumentation, Pearson Education, Inc., 2004.

References

1. Daniel Malacara & Zacaria Malacara, Handbook of Optical Design, Marcel Dekker, 2004
2. Albert T Helfrack & William D Cooper, Modern Electronic Instrumentation and
3. Measurement Techniques PHI, 1990

COURSE PLAN

Course No: 06EC 7323 Course Title: Optical Instrumentation (L-T-P:3-0-0) Credits: 3		
	Contact hours	**Sem. Exam Marks %**
Module 1 Critical angle, linear and angular magnifications, cardinal points, optical aberrations-corrections. Optical materials, Optical components, polarizing components. Basics of optical design, Ray tracing, Fabrication and testing of optical components. Image intensifiers and Night vision devices. Telescopes and microscopes- reflecting and refracting telescopes, eyepieces, microscope-objectives, binocular, stereoscopic, phase contrast, polarizing and atomic force microscopes – Airy's disc, resolving power of a telescope and microscope and brightness	10	25%
Module 2 Stops and Photographic systems-theory of stops – aperture stop – entrance and exit pupils, telecentric stop and applications, requirements for photographic objectives – Eye as an optical instrument, defects of eye and correction methods, Space optics, Adaptive optics, Large space structures. Optomedical instruments, optical coherence tomography, Infrared instrumentation; IR telescopes; Morie self imaging and speckle metrology	10	25%
FIRST INTERNAL EXAM		
Module 3 Photometry, projection Systems and Refractometers -different sources for optical experiments –lasers – basic laws of photometry, Abbe and Kohler Illuminations – episcope – epi-dioscope, slide and overhead projectors – computer based projection systems – polarizing instruments. Ellipsometry and applications in material research.	10	25%
Module 4 LASER GYROSCOPES : Sagnac effect, Basic gyro configurations. Ring Laser Gyros (RLG): Dithered RLG, Ring Zeeman laser gyro, performance of RLG. Fiber Optics Gyros (FOG): Open loop FOG, Requirements on FOG components, technology to implement FOG, Closed loop FOG, the resonant FOG MEMS gyro, Piezoelectric gyro. Biomedical application :Laser instruments for surgery	12	25%
SECOND INTERNAL EXAM	42	

Course No: **06EC 7033** **Course Title: Seminar** **Credits: 0-0-2:2** **Year :2015**

Students have to register for the seminar and select a topic in consultation with any faculty member offering courses for the programme. A detailed write-up on the topic of the seminar is to be prepared in the prescribed format given by the Department. The seminar shall be of 30 minutes duration and a committee with the Head of the department as the chairman and two faculty members from the department as members shall evaluate the seminar based on the coverage of the topic, presentation and ability to answer the questions put forward by the committee.

Course No: 06EC 7043 Course Title: Project (Phase 1) Credits: 0-0-12:6 Year :2015

Normally students are expected to do the project within the college. However they are permitted to do the project in an industry or in a government research institute under a qualified supervisor from that organization. (However, this is only possible in the fourth semester and during the entire third semester students should be present at the college). Progress of the project work is to be evaluated at the end of the third semester. For this a committee headed by the head of the department with two other faculty members in the area of the project, of which one shall be the project supervisor.

Course No: 06EC 7014 Course Title: Project (Phase 2) Credits: 0-0-21:12 Year :2015

Final evaluation of the project will be taken up only on completion of the project in the fourth semester. This shall be done by a committee constituted for the purpose by the principal of the college. The concerned head of the department shall be the chairman of this committee. It shall have two senior faculty members from the same department, project supervisor and the external supervisor, if any, of the student and an external expert either from an academic/R&D organization or from Industry as members. Final project grading shall take into account the progress evaluation done in the third semester and the project evaluation in the fourth semester. If the quantum of work done by the candidate is found to be unsatisfactory, the committee may extend the duration of the project up to one more semester, giving reasons for this in writing to the student. Normally further extension will not be granted and there shall be no provision to register again for the project. While students are expected to do their projects in their colleges, provision is available for them to do it outside the college either in an industry or in an institute of repute. This is only possible in the fourth semester and the topic of investigation should be in line with the project part planned in the 3rd semester. Student should apply for this through the project supervisor indicating the reason for this well in advance, preferably at the beginning of the 3rd semester. The application for this shall include the following:-

Topic of the Project:

Project work plan in the 3rd Semester:

Reason for doing the project outside:

Institution/Organization where the project is to be done:

External Supervisor –

Name:

Designation:

Qualifications:

Experience:

Letter of consent of the External Supervisor as well as from the organization

This application is to be vetted by a departmental committee constituted for the same by the Principal and based on the recommendation of the committee the student is permitted to do the project outside the college. The same committee should ensure the progress of the work periodically and keep a record of this. Project work is to be evaluated both in the third and the fourth semesters. Based on these evaluations the grade is finalized in the fourth semester.