PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

I. To prepare students to excel in research or to succeed in Laser & Electro-optical engineering profession through global, rigorous post graduate education.

II. To provide students with a solid foundation in Mathematics, Physics of Lasers and optical devices, and Electro-optical engineering fundamentals required to apply the principles for optical engineering design.

III. To train students with good scientific and engineering knowledge so as to comprehend, analyze, design, and create novel products and solutions for the optical engineering domain.

IV. To inculcate students in professional and ethical attitude, effective communication skills, teamwork skills, multidisciplinary approach, and an ability to apply laser and electro-optical engineering aspects.

V. To provide student with an academic environment aware of excellence, leadership, written ethical codes and guidelines, and the life-long learning needed for a successful professional career.

PROGRAMME OUTCOMES (POs):

On successful completion of the programme,

1. Students will demonstrate knowledge of mathematics, electromagnetics, laser theory, principles and applications, optical materials and opto-electronics.


3. Students will demonstrate an ability to identify, formulate and solve optics and laser related problems.

4. Students will demonstrate an ability to design and conduct optics and laser experiments, analyze and interpret data.

5. Students will demonstrate an ability to design a system, component or process as per needs and specifications.

6. Students will demonstrate an ability to visualize and work on laboratory and multidisciplinary tasks.

7. Students will demonstrate skills to use modern engineering tools, software and equipment to analyze problems.

8. Students will demonstrate knowledge of professional and ethical responsibilities.

9. Students will be able to communicate effectively in both verbal and written form.

10. Students will show the understanding of impact of laser and electro-optical engineering aspects for practical applications. Further, they will develop confidence for self education and ability for life-long learning.
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# ANNA UNIVERSITY, CHENNAI
# UNIVERSITY DEPARTMENTS
# M.TECH. LASER AND ELECTRO OPTICAL ENGINEERING
# REGULATIONS – 2015
# CHOICE BASED CREDIT SYSTEM
# CURRICULA AND SYLLABI

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<td>Holography and Speckle</td>
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<td>Materials Processing by Lasers</td>
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# Employability Enhancement Courses (EEC)

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OBJECTIVE:
- To educate the students the importance of electromagnetic radiation

UNIT I  PROPAGATION OF ELECTROMAGNETIC WAVES  9

UNIT II  REFLECTION AND REFRACTION OF ELECTROMAGNETIC WAVES  9

UNIT III  WAVE PROPAGATION IN ANISOTROPIC MEDIA  9

UNIT IV  ELECTROMAGNETIC ANALYSIS- SIMPLE OPTICAL WAVEGUIDE  9

UNIT V  ANALYSIS OF OPTICAL WAVEGUIDES  9

TOTAL: 60 PERIODS

OUTCOME:
- The students will understand how Maxwell’s electromagnetic wave equations are derived from the basic laws of Physics. Also they will learn to apply electromagnetic wave equations in different media and to analyze the interaction.

REFERENCES:
OBJECTIVE:
Educating the students about fabrication and configuration of different lasers

UNIT I  GAS LASERS

UNIT II  SOLID STATE, SEMICONDUCTOR AND LIQUID LASERS

UNIT III  ULTRA SHORT PULSE GENERATION AND MEASUREMENT
Nano second pulse generation- Pico,nano,femto and atto second pulse generation - Q-switching: methods - Cavity damping - Mode locking – Configurations – Methods of detection and measurement of ultrashort pulses.

UNIT IV  METROLOGICAL APPLICATIONS
CW and Pulsed laser beam characteristics and its measurements- Beam focusing effects-spot size-Power and Energy density Measurements-Distance measurement - Interferometric techniques – Calibration Methods -LIDARS - Theory and different experimental arrangements - Pollution monitoring by remote sensing - Applications - Laser gyroscope.

UNIT V  MATERIAL PROCESSING

OUTCOME:
• The students will explain the engineering principles and working of different types of lasers and their applications.

REFERENCES:
OBJECTIVE:
Educating the students to understand about various materials available for fabricating optical devices

UNIT I  OPTICAL PROCESSES

UNIT II  LASER CRYSTALS

UNIT III  OPTICS OF ANISOTROPIC CRYSTALS

UNIT IV  SEMICONDUCTORS

UNIT V  OPTICS OF THIN FILMS

TOTAL: 45 PERIODS

OUTCOME:
- The students will explain the principles of optical properties of materials and device applications.

REFERENCES:
OBJECTIVE:
Educating the students the basics of semiconductor optoelectronics

UNIT I REVIEW OF SEMICONDUCTOR DEVICE PHYSICS
9
Energy bands in solids, the E-k diagram, Density of states, Occupation probability, Fermi level and quasi Fermi levels, p-n junctions, Schottky junction and Ohmic contacts. Semiconductor optoelectronic materials, Bandgap modification, Heterostructures and Quantum Wells.

UNIT II SEMICONDUCTOR PHOTON SOURCES
9
Rates of emission and absorption, Condition for amplification by stimulated emission, the laser amplifier. Electroluminescence. The LED: Device structure, materials and characteristics. The Semiconductor Laser: Basic structure, theory and device characteristics; direct current modulation. Quantum-well lasers; DFB-, DBR- and vertical-cavity surface-emitting lasers (VCSEL); Laser diode arrays. Semiconductor optical amplifiers (SOA), SOA characteristics and their applications.

UNIT III SEMICONDUCTOR PHOTODETECTORS AND SOLAR CELLS
9

UNIT IV OPTOELECTRONIC MODULATION AND SWITCHING DEVICES
9

UNIT V OPTOELECTRONIC INTEGRATED CIRCUITS
9

TOTAL: 45 PERIODS

OUTCOME:
- The students will explain about the principles of semiconductors, optical processes in semiconductors and working of optoelectronic devices.

REFERENCES:
OBJECTIVE:
Teaching the students about the principles of optics and lasers

UNIT I  APPLIED OPTICS

UNIT II  RADIATION IN A CAVITY

UNIT III  INTRODUCTION TO LASERS

UNIT IV  CAVITY OPTICS AND LASER MODES

UNIT V  Q-SWITCHING, MODE LOCKING AND COHERENCE OF LASERS

TOTAL: 45 PERIODS

OUTCOME:
• The students will discuss the basic theory of optics, lasers, importance of optical resonators and different methods of laser beam control.

REFERENCES:
OBJECTIVE:
To prepare the students to apply mathematics in real Physics problems

UNIT I  VECTORS AND TENSORS  12
Gauss divergence theorem – Stokes’s theorem – Green’s theorem – applications to
electromagnetic field – definition of tensors – algebra of Cartesian tensors – outer product
contraction and quotient theorems – Kronecker & Levi-Civita tensors – example – applications in
physics – crystal optics.

UNIT II  PROBABILITY AND RANDOM VARIABLES  12
Introduction -sets -probability and relative frequency -random variables -cumulative distribution
functions and probability density functions -ensemble average and moments - binomial, poisson,
uniform, Gaussian and sinusoidal distributions -functional transformations of random variables -
multivariate statistics -central limit theorem (statement and applications) - power spectral density --
dc and rms values for ergodic random processes.

UNIT III  FOURIER TRANSFORMATIONS AND APPLICATIONS  12
Fourier series -Fourier transform and spectra -Parseval's theorem -Dirac delta function – unit step
function -two dimensional signals -Fresnel & Fraunhofer diffraction -examples FT by lens– point
source -single slit, double slit-circular aperture -cosine grating - coherent optical filtering -
holographic filters - discrete Fourier transform.

UNIT IV  SPECIAL FUNCTIONS  12
Beta and Gamma functions -Legendre, Bessel, Hermite and Lagurre polynomials - generating
functions -recurrence relations, orthogonal relations, associated polynomials and their properties -
confluent hyper geometric functions and their properties.

UNIT V  DYNAMICAL SYSTEMS  12
Linear and nonlinear oscillators – autonomous and non-autonomous systems – classification of
equilibrium points – bifurcations and chaos – chaos in a model laser system – linear and nonlinear
dispersive waves – Nonlinear Schrodinger equation in optical fibers - solitary wave solutions and
basic solitons, Nonlinear Schrodinger equation: envelope soliton, Hiroto's method, IST method.
Numerical analysis: Euler method and 4th order Runge-Kutta method for solving differential
equations –finite difference and finite element analysis methods for solving partial differential
equations.

OUTCOME:
The students will explain the basic mathematical methods including dynamical systems theory for
applying them in real Physics problems.

REFERENCES:
4. K. F. Riley, M.P. Hobson and S.J. Bence. Mathematical methods for physics and
(2013 ).
OBJECTIVE:
To carry out different diffraction and interference based experiments using optical devices and lasers.

Any ten experiments

1. Measurement of Brewster angle and the refractive index of a transparent material.
2. Studies on lenses
4. Kerr Effect Study
5. Measurement of Spatial and Temporal Coherence
6. Fraunhofer Diffraction Experiments
7. Fourier Filtering Experiments
8. Effect of Polarization on Interference
9. Acoustical Modulator
10. Gas laser design
11. Transversely Pumped Dye Lasers
12. Longitudinally Pumped Dye Lasers
13. Holographic Recording and Reconstruction
14. Speckle Photography
15. Construction of an optical phototransistor switch
17. Study of white, high-intensity red and IR light on a phototransistor and a photovoltaic cell.
18. Construction of optical transmitter and receiver circuits.
19. Fiber Communication Installation Procedure
20. Setting up of Fiber Optic Analog Link
21. Setting up of Fiber Optic Digital Link
22. Measurement of Losses in Optical Fiber
23. Measurement of Numerical Aperture
24. Time Division Multiplexing of Signals

TOTAL: 60 PERIODS

OUTCOME:
The students will demonstrate the principles of diffraction, interference and fiber optics.

OBJECTIVE:
Educating the students to understand about electro-optics and its applications

UNIT I  CRYSTAL OPTICS
Point group and space group – matrix representation of symmetry operations – the effect of crystal symmetry in crystal properties – Neumann’s principle – tensors – first-order electro-optical tensor - piezo-optical and elasto-optical tensors – dielectric description of a crystal - double refraction – polarization devices – crystal structures of LiNbO₃, KDP and BaTiO₃.
UNIT II  PROPAGATION OF ELECTROMAGNETIC WAVES  9

UNIT III  GROWTH OF ELECTRO-OPTIC AND ACOUSTO-OPTIC MATERIALS  9

UNIT IV  ELECTRO AND ACOUSTO OPTICS  9

UNIT V  OPTICAL MODULATORS  9

TOTAL: 45 PERIODS

OUTCOME:
The students will explain the principles of electro-optics, modulators, switches and their uses.

REFERENCES:
UNIT II CHARACTERISTICS AND FABRICATION OF OPTICAL FIBERS
Dispersion - Fiber attenuation, absorption loss & scattering loss measurement - Optical Time Domain Reflectometer (OTDR) and its uses - Interferometric method to measure fiber refractive index profile. Fiber materials - Fiber fabrication- fiber optic cables design - fiber connectors - fiber splices - Lensing schemes for coupling improvements.

UNIT III OPTICAL FIBER COMMUNICATION AND NETWORKS

UNIT IV INTENSITY AND POLARIZATION SENSORS
Intensity sensor: Transmissive concept - Reflective concept - Microbending concept - Transmission and Reflection with other optic effect - Interferometers - Mach Zehnder - Michelson - Fabry-Perot and Sagnac – Phase sensor: Phase detection - Polarization maintaining fibers. Displacement and temperature sensors: reflective and Microbending Technology - Applications of displacement and temperature sensors.

UNIT V INTERFEROMETRIC SENSORS

OUTCOME:
The students will acquire knowledge in fundamentals of fiber optics, communication equipments, construction and working of optical communication networks including sensor applications.

REFERENCES:
OBJECTIVE:
To teach the students the fundamentals and applications of integrated optics

UNIT I  OPTICAL AMPLIFIERS

UNIT II  OPTICAL WAVEGUIDES AND INTEGRATED CIRCUITS

UNIT III  ACTIVE OPTICAL INTEGRATED CIRCUITS AND APPLICATIONS

UNIT IV  PHOTONIC MATERIALS GROWTH & FABRICATION

UNIT V  PHOTONIC DEVICES

OUTCOME:
- The students will gain information in a way that they can understand the principle of optical amplifiers, waveguides and construction and working of integrated circuits.

REFERENCES:
OBJECTIVE:
To make the students understand the theory of nonlinear optics

UNIT I ORIGIN OF OPTICAL NONLINEARITIES 9
Effects due to quadratic and cubic polarization – Response functions – Susceptibility tensors – Linear, second order and $n^{th}$ order susceptibilities – Wave propagation in isotropic and crystalline media – The index ellipsoid.

UNIT II SECOND HARMONIC GENERATION (SHG) AND PARAMETRIC OSCILLATION 9

UNIT III THIRD ORDER NONLINEARITIES 9
Intensity dependent refractive index – Nonlinearities due to molecular orientation – Self-focusing of light and other self-action effects - Optical phase conjugation – Optical bistability and switching - Pulse propagation and temporal solitons.

UNIT IV ELECTRO-OPTIC AND PHOTOREFRACTIVE EFFECTS 9

UNIT V STIMULATED SCATTERING PROCESSES 9

TOTAL: 45 PERIODS

OUTCOME:
The students will explain the principles of nonlinear optics and origin of optical nonlinearities. They will also analyze various types of nonlinearities in optics.

REFERENCES:
OBJECTIVE:
To educate the students to carry out experiments on optical computing, holography, nonlinear optics and optical modulators.

ANY TEN EXPERIMENTS

1. Planar Dye laser
2. Distributed Feedback Dye Laser
3. Tuning of Dye Laser using Grating
4. Tuning of Dye Laser using DFDL Arrangement
5. Measurement of Ultrashort Pulses
7. Holographic Interferometry - Double Exposure in NDT
8. Holographic Interferometry - Time Average - Vibration Analysis
9. Real Time Holography
10. Contour Holography
11. Digital holography: Matlab simulations
12. Basic operations of computation by light
13. Speckle Interferometry - Out of Plane Displacement
14. Speckle Shear Interferometry
15. Laser Doppler Interferometry (LDV)
16. Stimulated Raman Scattering
17. Stimulated Brillouin Scattering
18. Phase Conjugation
19. Fiber Communication Installation Procedure
20. Setting up of Fiber Optic Analog Link
21. Setting up of Fiber Optic Digital Link
22. Nonlinear optics: Optical Z-scan
23. Nonlinear optics: Eclipse type Z-scan
24. Nonlinear optics: Optical limiting
25. Bistable optical devices
26. Laser Speckle Optometer
27. Laser Effects on Human Cell
28. Tumour Diagnosis using Lasers
29. CCD based experiments

OUTCOME:
The students will demonstrate the experimental techniques in the concepts of optical computing, holography, nonlinear optics and optical modulators.

TOTAL: 60 PERIODS
OBJECTIVE:
To study about the generation of digital holograms and its applications

UNIT I   COMPUTER GENERATED HOLOGRAMS

UNIT II   DIGITAL HOLOGRAPHIC MICROSCOPY

UNIT III   OPTICAL RECONSTRUCTION

UNIT IV   INTERFEROMETRY AND SPECKLE METROLOGY

UNIT V   THREE DIMENSIONAL DISPLAYS
Computer generated holograms for white light reconstruction – wide-angle computer generated holograms for 3D display – optical scanning holography – 3D display projection system – 3D display and information processing based on integral imaging – autostereoscopic, partial pixel, spatially multiplexed and 3D display technologies.

TOTAL: 45 PERIODS

OUTCOME:
Outline the concept of mathematics, computer programming, physics, technology and applications of digital holography. Course will cover the basic concepts of digital hologram generation, holographic interferometry, microscopy and three-dimensional display techniques.

REFERENCES:
OBJECTIVE:
To educate the students the importance optical devices

UNIT I NEW APPROACHES IN NANOPHOTONICS 9
Near-Field Optics-Aperture near-field optics - Apertureless near-field optics -Near-field scanning optical microscopy (NSOM or SNOM): - SNOM based detection of plasmonic energy transport- SNOM based visualization of waveguide structures- SNOM in nanolithography- SNOM based optical data storage and recovery.

UNIT II QUANTUM-CONFINED MATERIALS 9

UNIT III PLASMONICS 9

UNIT IV PHOTONIC CRYSTALS 9

UNIT V PHOTONIC DEVICES 9
Laser Diodes - Quantum well lasers - Quantum cascade lasers - Cascade surface-emitting photonic crystal laser - Quantum dot lasers - Quantum wire lasers - LEDs - White LEDs based on quantum dots - LEDs based on nanotubes - LEDs based on nanowires - LEDs based on nanorods: - Quantum well infrared photodetectors - Single electron transistors and quantum computing - White LEDs – quantum well and wires

TOTAL: 45 PERIODS

OUTCOME:
- The students will explain the physics and technology of various optical devices and fabrication of different optical devices.

REFERENCES:

[Signature]
DIRECTOR
Centre For Academic Courses
Anna University, Chennai-600 025
OBJECTIVE:
To make the students to understand the concepts of Fourier optics and their applications in optical information processing.

UNIT I   SIGNALS AND SYSTEMS  9

UNIT II   DIFFRACTION THEORY  9

UNIT III  COHERENT OPTICAL SYSTEMS  9

UNIT IV   WAVEFRONT MODULATION  9

UNIT V   OPTICAL INFORMATION PROCESSING  9

TOTAL: 45 PERIODS

OUTCOME:
- The students will learn discuss Fourier transform, diffraction theory and the principles of analog optical information processing.

REFERENCES:
OBJECTIVE:
To introduce the principles of holography and speckle

UNIT I  OPTICAL HOLOGRAPHY  9
General theoretical Analysis - Types of Holograms - Requirements to record and reconstruct holograms - Experimental techniques - Recording materials - Silver halide - Dichromated Gelatin - Ferroelectric Crystals - Inorganic Photochromatic Materials - Thermo plastic Materials - Photoreists

UNIT II  HOLOGRAMS FOR DISPLAY  9

UNIT III  HOLOGRAPHIC INTERFEROMETRY  9
Theoretical Analysis of Double Exposure - Real-Time and Time-averaged Interferometric Techniques - Contour holography - Sandwich Holography - Double Pulsed Holography - Acoustical and Microwave Holography

UNIT IV  APPLICATIONS OF HOLOGRAPHY IN ENGINEERING AND MEDICINE  9
Measurement of displacement, deformation, strain, stress and bending movements for opaque and transparent objects - Holographic NDT - Holography in Biology and Medicine – holographic data storage.

UNIT V  SPECKLE PHOTOGRAPHY AND INTERFEROMETRY  9
In-plane and out-of-plane translations – Pointwise and whole field analysis - Time averaged Speckle Photography - Speckle Interferometry - Speckle Shear Interferometry - displacements and strain measurements - Electronic speckle pattern Interferometry (ESPI)

OUTCOME:
The students will demonstrate about how experimentally holograms and specklegrams could be recorded and reconstructed. Further they will learn about the concept of holographic interferometry and its applications.

REFERENCES:
OBJECTIVE:
To educate the students about the basic principles of laser spectroscopy

UNIT I BASIC PRINCIPLES

UNIT II DOPPLER – LIMITED TECHNIQUES

UNIT III TIME-RESOLVED SPECTROSCOPY

UNIT IV HIGH RESOLUTION SPECTROSCOPY
Spectroscopy on collimated atomic beams: Detection through fluorescence - detection by photoionization - detection by the recoil effect - detection by magnetic deflection. Saturation spectroscopy and related techniques - Doppler-free two-photon absorption - spectroscopy of trapped ions and atoms.

UNIT V APPLICATIONS OF LASER-SPECTROSCOPY

OUTCOME:
The students will gain knowledge about the fundamentals of spectroscopy, different types of spectroscopy and applications of laser spectroscopy.

REFERENCES:
OBJECTIVE:
To educate the students understand the consequences for the electronic and optical properties of materials when carriers are confined in two, one and zero dimensional systems

UNIT I  LENGTH SCALES AND LOW DIMENSIONALITY  
Electronic transport in 1,2 and 3 dimensions- Quantum confinement, energy – subbands, quantum wells, quantum wires, quantum dots. Effective mass, Drude conduction and mean free path in 3D-ballistic conduction, phase coherence lengthand quantized conductance in 1D- Epitaxial growth of semiconductors: Molecular beam epitaxy -Gas epitaxy from metal-organics–Nanolithography - Self-organization of quantum dots and quantum wires.

UNIT II  ELECTRICAL PROPERTIES  
Density of energy states in low-dimensional electronic systems - Statistics of charge carriers in low-dimensional systems - Evolution from the discrete to the continuous spectra in quantization direction for low-dimensional systems for different dimensions Quasi-low dimensional systems - 2D and 3D shielding Electrons in quantum semiconductor structures: an introduction;-Electrons in quantum semiconductor structures: more advanced systems and methods

UNIT III  OPTICAL PROPERTIES  

UNIT IV  LASER OSCILLATIONS AND OPTICAL RESONATORS  
Threshold condition, Steady state and transient operation – Rate equations; Relaxation oscillation, Spectral and spatial hole burning, Frequency pulling and Lamb dip. Properties of laser beams. Gaussian beams and their properties, Optical resonators, General modes and resonances, Mode selection, Mode volume, Resonators for high power and high energy laser.

UNIT V  SEMICONDUCTOR LASERS  
(Condition for gain, gain spectrum, threshold current, double heterostructures, quantum well laser, quantum dot laser) - Light modulation using semiconductor quantum structures. (Excitons, Quantum Confined Stark Effect)- . High electron mobility transistor (HEMT). (Mobility, modulation doping) - Quantum Hall effect (Resistance standard)- High speed heterostructure devices-Multiple-Micro-Cavity (MMC) lasers, Deeply Etched Distributed Bragg Reflector (DBR) lasers, Coupled Cavity (CC) lasers, Distributed Reflective (DR) lasers, and Membrane lasers.

TOTAL: 45 PERIODS

OUTCOME:
• The students will explain the physics and technology of various nano based lasers, preparation and fabrication of low dimension based lasers, Low-Dimensional Semiconductor Structures and quantum heterostructures.

REFERENCES:
OBJECTIVE:
To educate the students about the applications of lasers in materials processing.

UNIT I  INDUSTRIAL LASER SYSTEMS  9

UNIT II  THERMAL PROCESSES IN INTERACTION ZONE  9
Depth of penetration with respect to laser energy density - Reflectivity of Metals with respect to wavelength - Rate of heating and cooling - Maximum temperature rise and depth of hardened layer - Different gases used during laser materials processing - Operational parameters in laser materials processing - Key hole effect – heat affected zone.

UNIT III  SURFACE TREATMENT  9

UNIT IV  LASER WELDING, DRILLING AND CUTTING  9

UNIT V  PRE-PROCESSING AND PROCESSING PARAMETERS  9

TOTAL: 45 PERIODS

OUTCOME:
The students will gain knowledge about industrial laser systems and interaction of laser radiation with matter.

REFERENCES:
OBJECTIVE:
To guide the students in different applications of lasers in the medical field

UNIT I  FUNDAMENTALS OF LASER-TISSUE INTERACTION
Laser Characteristics as applied to medicine and biology - Laser tissue interaction – Photophysical process - Photo biological process - Absorption by biological systems - Different types of interaction - Thermal photochemical (one photon and multiphoton) - Electromechanical - Photoablative processes

UNIT II  PHOTOBIOLOGY AND MEDICAL LASERS
Study of biological functions - Microradiation of cells - optical properties of tissues (normal and diseased state) - Experimental methods to determine the reflectance, absorption, transmittance and emission properties of tissues - Laser systems in medicine and biology - Nd:YAG, Ar ion, CO₂, Excimer, N₂, Gold Vapour laser - Beam delivery and measuring systems

UNIT III  THERMAL APPLICATIONS
Surgical applications of lasers - Sterilization - hermostasis - Cancer Liver stomach gynecological surgeries - Performance evaluation - Lasers in Opthalmology - Dermatology and Dentistry – Cosmetic Surgery.

UNIT IV  NON THERMAL APPLICATIONS

UNIT V  SAFETY REGULATIONS
Protection standards for lasers - Safety regulation - Specific precautions- Medical surveillance.

OUTCOME:
• The students will discuss about laser tissue interaction, photobiology and thermal and non-thermal applications of lasers.

REFERENCES:
OBJECTIVE:
- To make the students to understand the concepts of nanophotonics

UNIT I PHOTONIC PROPERTIES OF NANOMATERIALS  

UNIT II PHYSICS OF PHOTONIC CRYSTALS  

UNIT III NEAR-FIELD INTERACTION AND MICROSCOPY  

UNIT IV PLASMONICS  
Introduction: Plasmonics - merging photonics and electronics at nanoscale dimensions - single photon transistor using surface Plasmon - nanowire surface plasmons-interaction with matter, single emitter as saturable mirror, photon correlation, and integrated systems. All optical modulation by plasmonic excitation of quantum dots,—plasmonic wave guiding – applications of metallic nanostructures.

UNIT V NANOPHOTONICS FOR BIOTECHNOLOGY AND NANOMEDICINE  

TOTAL: 45 PERIODS

OUTCOME:
The students will explain the effects of interaction of photons with matter and their ensuing applications

REFERENCES:
OBJECTIVE:
To make the students understand the fundamentals of nonlinear fiber optics with a special emphasis on optical communication

UNIT I  FIBER NONLINEARITIES  9

UNIT II  GROUP VELOCITY DISPERSION AND PHASE MODULATION  9

UNIT III  OPTICAL SOLITONS AND DISPERSION MANAGEMENT  9
Soliton Characteristics - Soliton Stability - Dark Solitons – Other kinds of Solitons - Effect of Birefringence in Solitons - Solitons based Fiber Optic Communication System (Qualitative treatment) – Demerits - Dispersion Managed Solitons (DMS).

UNIT IV  SOLITON LASERS  9

UNIT V  APPLICATIONS OF SOLITONS  9

TOTAL: 45 PERIODS

OUTCOME:
• The students gain knowledge about nonlinear fiber optics and fundamentals of soliton dynamics.

REFERENCES:
OBJECTIVE:
- To introduce the concept of optical computing and the signal processing

UNIT I  FOURIER OPTICS AND IMAGE PROCESSING  9

UNIT II  OPTICAL COMPUTING WITH SPATIAL LIGHT MODULATOR (SLM)  9

UNIT III  OPTICAL SWITCHING DEVICES  9

UNIT IV  OPTICAL INTERCONNECTIONS  9

UNIT V  OPTICAL NEURAL NETWORKS  9

TOTAL: 45 PERIODS

OUTCOME:
- The students will explain about optical computing and application of Fourier optics in image processing.

REFERENCES:
OBJECTIVE:
To study about the principles of optical displays and optics based data storage devices

UNIT I VISUAL SYSTEM, COLOUR VISION AND COLORIMETRY  9

UNIT II 2D DISPLAY TECHNOLOGY  9

UNIT III BINOCULAR VISION AND 3D DISPLAY TECHNOLOGY  9

UNIT IV DIGITAL VIDEO DISPLAY  9

UNIT V OPTICAL DATA STORAGE SYSTEMS  9

TOTAL: 45 PERIODS

OUTCOME:
Discuss the concept of physics, technology and applications of optical displays and optical information storage devices.

REFERENCES:
OBJECTIVE:
- To make the students to understand the fundamentals of optical switching and networks.

UNIT I OPTICAL SYSTEM COMPONENTS AND NETWORK DESIGN 9

UNIT II OPTICAL NETWORK ARCHITECTURES 9

UNIT III WAVELENGTH ROUTING NETWORKS 9

UNIT IV PACKET SWITCHING AND ACCESS NETWORKS 9
Photonic Packet Switching – OTDM, Multiplexing and Demultiplexing, Synchronisation, Header Processing, Buffering, Burst Switching, Testbeds; Access Networks.

UNIT V NETWORK MANAGEMENT AND SURVIVABILITY 9
Control and Management – Network management functions – optical layer services and interfacing – layers within the optical layer – multivendor interoperability - Configuration management, Optical safety, Service interface; network Survivability- Protection in SONET / SDH and IP Networks, Optical layer Protection, Interworking between layers.

TOTAL: 45 PERIODS

OUTCOME:
- The students will discuss about different types of optical components and their uses in designing optical switches and networks.

REFERENCES:
OBJECTIVE:
To study about the science of light and its interaction with matter which requires quantum mechanics to describe it.

UNIT I  PHOTON STATISTICS
9

UNIT II  PHOTON ANTIBUNCHING (PA)
9

UNIT III  COHERENT STATES AND SQUEEZED LIGHT
9

UNIT IV  ATOM-PHOTON INTERACTIONS
9

UNIT V  QUANTUM INFORMATION PROCESSING
9

TOTAL: 45 PERIODS

OUTCOME:
Explain the concept of physical principles involved in the light interaction of matter through quantum mechanics. The technology and application of quantum optics in information processing and cryptography will be covered.

REFERENCES:
OBJECTIVE:
To educate the students the importance of radiation sources and detectors

UNIT I SOURCES OF RADIATION

UNIT II SPECTROSCOPY AND OPTICAL DEVICES

UNIT III DETECTOR CHARACTERISTICS

UNIT IV CONVENTIONAL DETECTORS
Photomultipliers, microchannel analyzer, photoresistors, photodiodes, nonselective detectors - Thermal and photoemissive detectors - Photoconductive and photovoltaic detectors, performance limits. Photographic, thermoplastic materials - Sensitivity, time and frequency response - eye and vision, photographic film - Camera tubes.

UNIT V MODERN DETECTORS

OUTCOME:
The students will explain physics of radiation from different sources in different signals of electromagnetic spectrum. Further, they will understand the principle involved in fabrication of different radiation detectors.

REFERENCES:
OBJECTIVE:
To teach the students understand the basic principles of remote sensing by lasers

UNIT I       ECOSYSTEM
Atmosphere - Hydrosphere - Biosphere Main feature contents - Dynamical Variation - their influence on human life - Changes in ecosystem by natural and anthropogenic causes

UNIT II       SOURCES AND DETECTORS FOR REMOTE SENSING
CO₂, N₂, Dye, Ar-ion, Excimer Lasers - Optical Telescopes - Light collection filtering receivers - diodes and PMT - Sensitivity Limit.

UNIT III       PRINCIPLES AND DESIGN OF SYSTEMS

UNIT IV       ATMOSPHERIC POLLUTION AND SURVEILLANCE
Pollution Source Monitoring - Detection limit - Source Detector Characteristics - Detection of OH ion SO₂, CO₂, CO, NO, N₂O, methane, ethylene in industrial environment, green House gases detection - Ozone Depletion Study.

UNIT V       HYDROSPHERIC LIDAR APPLICATION
LIF by UV Laser - Laser Fluorosensor - Oil Slick, Chlorophyll - Laser Phytoplankton mapping - Study on Shoals - Coral reefs.

TOTAL: 45 PERIODS

OUTCOME:
The students will explain the basics of remote sensing.

REFERENCES:

OBJECTIVE:
To study about the physics and technological applications of ultrashort laser pulses.

UNIT I       ULTRAFAST PULSE GENERATION
UNIT II    ULTRASHORT PULSE MEASUREMENT
Introduction – electric field autocorrelation – intensity auto correlation – electric field-cross correlation and spectral interferometry – chirped pulses and measurement in the time-frequency domain – frequency-resolved optical gating – characterization of noise and jitter.

UNIT III    DISPERSION AND DISPERSION COMPENSATION

UNIT IV    ULTRAFAST NONLINEAR OPTICS

UNIT V    ULTRAFAST SPECTROSCOPY

OUTCOME:
Explain the concept of physics, technology and applications of ultrashort laser pulses. Course will cover the basic concepts of ultrafast laser pulse generation, mode-locking, higher-order effects and spectroscopy.

REFERENCES: