Subject : Laser Applications

Units: 6

Weekly Hours : Theoretical : 2

Experimental: 2

week	Syllabus
1	Introduction
2-10	• Material & Laser Parameters • Material Parameters • Laser Parameters • Beam Transport • Beam Focusing • Controlling the beam after it is emitted out of the optical cavity • Beam Expander • Applications of Lasers with Beam Expanders • Types of Beam Delivery System • Optical Processes • Energy • Balance Approximation
11-20	• Industrial Applications • Laser Drilling • Laser Cutting • Laser Welding • Materials –Processing Applications • Surface Hardening • Re-melting (Glazing) • Alloying • Cladding • Annealing • Micromaching • Laser marking • Laser Scribing

21-30	• Metrological & Scientific Applications • Scatter Measurement • Optical Alignment • Applications of Lasers in Chemistry • Pollution Detection • Laser Doppler Velocimeter • Digital Optical Storage of Information • Laser Spectroscopy • Free Space Optical Communications • Optical computer. • Laser Depth Sounder. • Laser Printer. • Ring Laser Gyroscope • Interaction between Laser Radiation and Biological Tissue • The effects of the laser beam on the biological tissue • Military Applications • Laser Range-finder • Detecting the Laser signal • Classification of Laser Range Finders • Laser Tracking Systems • Laser Target Designator • Laser weapons ("Star War") • Laser blinding for man and sensitive equipment.

Subject : Advanced laser systems
Units: 6
Weekly Hours : Theoretical : 2
Experimental: 2

week	Syllabus
1	Introduction
2-10	• Operation of practical Lasers • The Laser: Background • The Active Medium. • Lasing thresholds • Types of energy levels in lasers. • Level Lifetime. • The Pump Source • The Optical Cavity. • Population Inversion in Lasing Mediums. • Operational Modes of Lasers. • Continuous mode of operation. • Pulsed mode of operation. • Output Parameters • Laser power and Laser energy. • Laser efficiency. • Operating Wavelengths. • Classification of Lasers
11-20	• Gas Lasers • Excitation of Gas Laser by Electrical Discharge. • Excitation of Laser by Optical Pumping . • Atomic Gas Lasers (Neutral Gas Lasers) • He-Ne Lasers. • The Copper Vapor Laser . • Ion Lasers • The Argon ion Laser • He-Cd Laser.

	• The Krypton Laser. • Molecular Gas Laser . • The Carbon Dioxide Laser . • The Carbon Monoxide Laser. • The Nitrogen Laser . • The Excimer Laser . • The Chemical Laser . • Far Infra- Red Laser (FIR)
21-30	• Solid State Insulator Laser • Structure of the Active Medium in Solid State Laser. • Pumping Methods • Optically Pumped Solid State Lasers • Arrangement of Pump and Laser rod • Diode Pumped solid state Lasers. • Fresnel Losses. • The Ruby Laser(Cr ^{3}t :AL2O3) • The Nd:YAG Lasers • The Nd : glass Laser • Alexandrite Laser(Cr3t:BeAL2O4) • Color or F Center Laser • Titanium Sapphire Laser • Semiconductor Lasers • Energy Bands in Semiconductors • Laser Action in A semiconductor Laser • Diode Lasers • The Difference between Diode Laser and LED • Dye Lasers • Special Lasers • Free Electron Laser(FEL) • X-Ray Laser • Fiber Laser • Gamma- Ray Laser • Mid- Infrared Advanced Chemical Laser (MIRACL).

Subject : Optical Communication systems

Units: 4

Weekly Hours : Theoretical : 2

Experimental: –

week	Syllabus
1	Introduction
2-10	• Optical Fiber : Structures and wave guiding Fundamentals • Nature of Light • Optical Fiber modes and configurations • Mode Theory for circular waveguides • Graded-Index Fiber structure • Signal Degradation in optical Fiber. • Fiber Material and Fabrication Methods • Attenuation • Signal Distortion in Optical Waveguide
11-20	• Optical Sources • Light Emitting Diodes (LED's) • Laser Diodes (LD • Power Launching and Coupling • Source –to- Fiber Power Launching • Fiber-to- FIBER Joints • Photodetectors. • PIN Photodiode.

	• ADD Photodiode
21-30	• Optical Receiver Operation • Fundamental Receiver Operation. • Digital Receiver Performance Calculation. • Analogue Receiver. • Transmission Link Analyses • Point -to- Point Links • Wavelength Division Multiplexing (WDM) • Line Coding

Subject : Digital Signal Process DSP

Units: 4

Weekly Hours : Theoretical : 2

Experimental: –

week	Syllabus
1	Introduction
2-10	• Continuous and discrete signals and systems • Convolution
11-20	• Fourier analysis continuous signals and system • Discrete Fourier transform (DFT), Fast Fourier transform (FFT).
21-30	• Fast Fourier transforms (FFT). • The Laplace transform and the z-transform, solution of difference equations. • Feedback system • Signal processing, filtering

Subject : Optoelectronics and Light modulation

Units: 6

Weekly Hours : Theoretical : 4

Experimental: −

week	Syllabus
1	Introduction
2-10	• Remote sensing elements • Energy source or illumination • Radiation and atmosphere • Interaction with target • Recording of energy by the sensor • Transmission , Reception ,and processing • Interpretation and Analysis • Application • The electromagnetic spectrums used in remote sensing • Ultraviolet or UV Spectrum • Visible spectrum • Infrared spectrum • Microwaves spectrum . • Interaction with Atmosphere • Scattering • Absorption • Remote sensing system • Passive remote sensing • Active remote sensing

11-20	• Platforms of recording energy by sensors • Ground-based sensors • Aerial platforms • Space- based sensors • Satellite characteristics • Resolution • Spatial resolution • Spectral resolution • Radiometric resolution • Temporal resolution • Multi spectral scanning • Scanning systems • IFOV • Across – track scanning • Along – track scanning • Thermal imaging • Weather satellites and sensors • GOES
21-30	• Retardation and Birefringence • Electro-Optic Effect And Pockls Cell And Optical Activity • Materials Kerr Modulation And Optical Frequency Kerr Effect • Scanning and Switching • Magneto- Optic Device And Faraday Effect • Acousto- Optic Effect • Raman-Nath Regime • Bragg Regime • Non Linear Optics • Harmonic Generation • Parametric Oscillation

Subject : Laser Design

Units: 4

Weekly Hours : Theoretical : 2

Experimental: −

week	Syllabus
1	Introduction
2-10	• Gas laser • Power supplies for continuous-wave gas lasers • Electrical Characteristics of Gas Discharges • Power Supplies for Helium-Neon Lasers Switching Elements • Carbon Dioxide Laser Power Supplies • Flash lamps For Pulsed Lasers and Flash lamp Power Supplies • Electrical Characteristics of Flash lamps • Triggering • Power Supplies for Flash lamps • Charging Power Supply • Control of Pulse Shape • Optical Characteristics • Mechanical Characteristics • Cooling for Flash lamps • Failure Mechanisms and Lifetime • Selection of Flash lamps • Maintenance and Care
11-20	• DIODE LASER POWER SUPPLIES • Description of Laser Diodes • Semiconductor Laser Materials

	• Structures of Laser Diodes • Laser Diode Damage and Lifetime • Mounting and Cooling of Laser Diodes • Power Supplies for Laser Diodes
21-30	• PULSED SOLID-STATE LASER • Pulsed Solid-State Laser Components • Laser Rod • Optical Pumping System • Optical Cavity • Cooling System • Output Characteristics Of Pulsed Solid-State Lasers • Active resonators • Resonators sensitivity • Mode selection technique • Resonators configuration used in the generation of TEM00mode output • Large radius mirror configuration • Resonators with internal beam focusing • Unstable resonator

Subject : Solid State
Units: 4
Weekly Hours : Theoretical : 2
Experimental: −

week	Syllabus
1	Introduction
2-10	• Photons • The photoelectric Effect • Compton Scattering • Energy Quantization in Atoms • The De Broglie Hypothesis • Electron Interference and Diffraction • Sate Functions • Operators • Corollary 1 • Corollary 2 • Commutation relation
11-20	• Uncertainty Principle • Eigen Value and Eigen Function • The Schrödinger Equation • Three-dimensional Time Dependent Schrödinger Eq. for free particle • Time Dependent Schrödinger Eq. for a particle in a field • Hamiltonian Operator • Physical Interpretation of Ψ and the probability current density • The General Solution of the One-dimensional Schrödinger Equation for a Free

	• Particle • Time Independents One-dimensional Schrödinger Equation • Particle in a One-Dimension Box • Partials in infinite well • The concept to of parity • Partials in finite well • Particles at Potential Step • Particles At A Barrier and The Quantum Mechanical Tunnelling Effect
21-30	• The harmonic oscillators • Dirac's notation • Heisenberg's equation of motion • The harmonic oscillator based on Heisenberg's formalism of quantum mechanics • Photons • Quantization of free electromagnetic wave • Black Body Radiation • Quantum theory of coherent optical states • The Hamiltonian of the hydrogen atom • Angular momentum of the hydrogen atom • Structure of the hydrogen atom • Electron spin and the theory of generalized