**Subject : Laser Applications**

 **Units: 6**

**Weekly Hours : Theoretical : 2**

 **Experimental: 2**

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| **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 |

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| 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**

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| **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. |

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|  |  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 ³t :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: −**

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| **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. |

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|  |  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: −**

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| **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: −**

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| **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 |

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| 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: −**

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| **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 |

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|  |  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: −**

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| **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 aFree |

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|  |  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 quantummechanics 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 |