**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 a  Free |

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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 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 |