PPH316: OPTOELECTRONICS

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Course Objectives: The course aims at imparting knowledge about modulation of light, LEDs, Lasers, and Photodetectors important for fiber-optic communication

Introduction: Energy bands in solids, Electrical conductivity, Semiconductors, carrier concentrations, Work function, Excess carrier in semiconductors, Junctions, Heterojunctions, Metal-semiconductor junctions.

Modulation of Light: Birefringence, Optical activity, Electro-optic effect, Materials exhibiting electro-optic effect, Kerr modulators, Magneto-optic devices – Faraday effect; Acousto-optic effect – Raman-Nath and Bragg effects, Nonlinear optics.

Display Devices: Introduction, Luminescence – Photoluminescence, Cathodoluminescence, Electroluminescence; Injection luminescence and light emitting diode – Radiative recombination processes: Interband transitions, Impurity center recombination, Exciton recombination; LED materials, LED construction, Plasma displays, Liquid crystal displays, Numeric displays.

Lasers: introduction, Threshold conditions, Laser losses; Lineshape function, Doppler broadening, Collision broadening, Natural broadening, Population inversion and pumping threshold conditions, Laser modes, Doped insulator lasers, Semiconductor lasers, Mode locking, Q-switching, Laser applications, Holography and its applications.

Photodetectors: Introduction, Thermal detectors – Thermoelectric detectors, Bolometer, Pneumatic devices, Pyroelectric detectors; Photon devices – Photoemissive devices, photodiodes, Photomultipliers, Photon cutting techniques, Image intensifiers, Photoconductive detectors, Junction arrays, Detector performance parameters.

Laboratory Assignments:

1. To determine the numerical aperture of a given multimode fiber
2. To determine the mode field diameter of the fundamental mode in a single-mode fiber
3. To measure the near-field intensity profile of a multimode fiber and hence its refractive index
4. To measure the power loss at a splice between the multimode fibers, and study the variation of splice loss with transverse, longitudinal and angular offsets
5. To study a simple intensity modulated fiber-optic pressure sensor based on microbending loss in a multimode fiber
6. To set up a Mach-Zehnder interferometer with single-mode fiber