

Course 16: Optoelectronics

Course code: MSCPH551

Credit: 3

BLOCK 1 Elemental and Optical properties Semiconductors

Unit –1: **Semiconductors:** Introduction to semiconductors, Doping, Alloy Semiconductors, Electron-hole pair formation and recombination, Energy bands in solids

Unit –2: **Optical Processes in Semiconductors:** Absorption in semiconductors – indirect intrinsic transitions, exciton absorption, donor acceptor and impurity band absorption, effect of electric field on absorption, Radiation in Semiconductors- Relation between absorption and emission spectra, near band gap radioactive transitions

BLOCK 2 Optoelectronic Devices I

Unit –3: **Optoelectronic detectors:** Photoconductors, junction Photodiodes, PIN Photodiodes, heterojunction diodes, avalanche Photodiodes, Phototransistors, modulated barrier Photodiode, metal- semiconductor -metal photodiode.

Unit –4: **Photovoltaic devices:** Solar energy spectrum, device principles, I-V characteristics, equivalent circuit, temperature effects, materials, devices and efficiencies

Unit –5: **Light emitting diode:** Electroluminescent process, choice of LED materials, device configuration and efficiency, light output from LED, LED structure, heterojunction LED, Surface emitting LED, device performance characteristics, frequency response and modulation bandwidth.

BLOCK 3 Optoelectronic Devices II

Unit –6: **Laser diode:** Junction laser operating principles, threshold current, heterojunction lasers, distributed feedback lasers, cleaved coupled cavity laser, quantum well lasers, modulation of lasers- rate equations, steady state solution, transient phenomena and frequency response, relaxation oscillations and oscillating output, high frequency modulation of laser diodes.

Unit –7: **Optical fiber:** Introduction, Structure of optical fiber, Propagation of light through a numerical aperture, Pulse broadening, advantages and disadvantages of fiber optics.

Reference Books:

1. S.M. Sze, *Semiconductor Devices - Physics and Technology*, Wiley, New York.
2. J. Singh, *Semiconductor Optoelectronics: Physics and Technology*, McGraw Hill.
3. P. Bhattacharya, *Semiconductor Optoelectronic Devices*, Pearson Education,
4. J. Singh, *Optoelectronics: An Introduction to Materials and Devices*, Tata McGraw Hill.
5. Donald A. Neamen, *Semiconductor physics and devices*, McGraw-Hill, 3rd Edition.