

| Course Type | Course Code | Name of Course | L | T | P | Credit |
|-------------|-------------|------------------------|---|---|---|--------|
| DC | ECD416 | Optoelectronic Devices | 3 | 0 | 0 | 9 |

Course Objective

The objective of the course is to develop an understanding of the fundamentals of optoelectronics and principles of the operation of optoelectronic devices including LEDs, laser diodes, photodetectors, solar cells and optical modulators. The techniques for design and improvement of the device performance will also be analyzed.

Learning Outcomes

Upon successful completion of this course, students will:

- acquire fundamental understanding of the basic physics behind optoelectronic devices
- develop the understanding of operating principles and characteristics of optoelectronic devices
- acquire the techniques to improve the operation and device characteristics by employing their understanding of optoelectronic device physics
- be able to calculate the design parameters for the target device features

| Unit No. | Topics to be Covered | Lecture Hours | Learning Outcome |
|----------|--|---------------|---|
| 1 | Semiconductors: Energy bands and charge carriers, Semiconductor materials, Generation, Recombination, Injection, Junctions, Heterojunctions, Quantum confined structures | 6 | Acquire an understanding of the fundamental physical processes of semiconductor materials suitable for optoelectronic devices |
| 2 | Interactions of photons with charge carriers, Photon interaction in bulk semiconductors, Band to band transitions, Absorption Emission and Gain, Photon interactions in quantum confined structures | 6 | Develop an understanding about the light matter interaction in semiconductors |
| 3 | Light emitting diodes: Injection electroluminescence, LED characteristics, Materials and device structures | 6 | Understand the functioning LEDs |
| 4 | Semiconductor optical amplifiers and lasers: Gain and bandwidth, Pumping, Heterostructures, Quantum well structures, Laser diodes, Amplification, Feedback and oscillations, Power and efficiency, Spectral and spatial characteristics, Quantum confined lasers | 10 | Develop an in-depth understanding of the concepts and characteristics of lasers |
| 5 | Photodetectors: Photoconductors, Photodiodes, Avalanche photodiodes, Noise in photodetectors, Solar cells | 8 | Understand the fundamentals and characteristics of photodetectors and solar cells |
| 6 | Modulation of light: Acousto-optics, Interaction of light and sound, Bragg diffraction, Acousto-optic devices, Modulators, Switches, Filters, Isolators Electro-optics, Principles of electro-optics, Electro-optic modulators and switches, Directional couplers | 6 | Get a detailed understanding of optical modulators and their characteristics |

Textbook:

1. Semiconductor Optoelectronic Devices, Pallab Bhattacharya, Pearson Education (2017)

Reference Books:

1. Optoelectronics & Photonics: Principles & Practices, S. O. Kasap, Pearson (2013)
2. Fundamentals of Photonics, B.E.A. Saleh and M.C. Teich, Wiley India (2012)