Semiconductor Optoelectronic Devices

ECE 6535

Credit Hours:
3.00 - 3.00

Course Levels:
Graduate (5000-8000 level)

Course Components:
Lecture

Course Description:
This course will cover the basics and physics of semiconductor optoelectronic devices including light-emitting diodes, semiconductor lasers, photodetectors, and solar cells.

Prerequisites and Co-requisites:
Prereq: Grad standing in Engineering or Physics.

Course Goals / Objectives:
- Master the understanding of optical processes in semiconductors
- Master the principles of light emitters, semiconductor photodetectors and solar cells
- Capable of designing an optoelectronic device (e.g. LED, Laser, Detector, Solar Cell) which can meet specified performance parameters
Course Topics:

1. Compound Semiconductor Materials
   1.1 Optoelectronic materials
1. Compound Semiconductor Materials
   1.2 Epitaxial growth techniques
2. Recombination Processes and Heterostructures
   2.1 Absorption, spontaneous emission and stimulated emission
2. Recombination Processes and Heterostructures
   2.2 Franz-Keldysh and Stark effect
2. Recombination Processes and Heterostructures
   2.3 Kramer-Kronig Relation
2. Recombination Processes and Heterostructures
   2.4 Radiative, non-radiative recombination
2. Recombination Processes and Heterostructures
   2.5 Measurement of absorption and luminescence spectra
2. Recombination Processes and Heterostructures
   2.6 Schottky barriers, heterojunctions
3. Semiconductor Light Emitters (LEDs and Lasers)
   3.1 Structure and types of LEDs and their characteristics
3. Semiconductor Light Emitters (LEDs and Lasers)
   3.2 LEDs for solid state lighting
3. Semiconductor Light Emitters (LEDs and Lasers)
   3.3 UV LEDs
3. Semiconductor Light Emitters (LEDs and Lasers)
   3.4 Guided waves and optical modes
3. Semiconductor Light Emitters (LEDs and Lasers)
   3.5 Optical gain
3. Semiconductor Light Emitters (LEDs and Lasers)
   3.6 Confinement factor, laser structures
3. Semiconductor Light Emitters (LEDs and Lasers)
   3.7 Edge-emitting and VCSELs
3. Semiconductor Light Emitters (LEDs and Lasers)
   3.8 Design of laser cavity
3. Semiconductor Light Emitters (LEDs and Lasers)
   3.9 Threshold current, LI and IV characteristics
3. Semiconductor Light Emitters (LEDs and Lasers)
   3.10 Frequency response, relaxation oscillations and modulation bandwidth
4. Semiconductor Photodetectors
   4.1 Optical detection processes
4. Semiconductor Photodetectors
   4.2 Photoconductive and Photovoltaic detectors
4. Semiconductor Photodetectors
   4.3 Avalanche photodiodes
4. Semiconductor Photodetectors
   4.4 Noise in detectors
4. Semiconductor Photodetectors
   4.5 Figures of merit for detectors
4. Semiconductor Photodetectors
   4.6 Different types of detection schemes
5. Solar Cells
   5.1 Basic principles
5. Solar Cells
   5.2 Spectral response
5. Solar Cells
   5.3 Cascaded solar cells, Schottky barrier cells
5. Solar Cells
   5.4 Degradation

Designation:
Elective