THE OHIO STATE UNIVERSITY
COLLEGE OF ENGINEERING

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