ECE 463/626: Optoelectronics

Instructor: Prof. H. Grebel, Rm 302, MIC; x3538 grebel@njit.edu; Office hours: M: 1500-1800

Course Description: The course addresses electronic and optical devices on the micron and nano-scales. Nano-scale optoelectronic devices (optical devices controlled by electronics and electronic devices controlled by optics) find themselves in the forefront of communication and sensing systems. Traditional approaches need to be revisited when dealing with high-speed, ultra-sensitive small-scale elements. The course will cover topics such as traditional and non-traditional materials (semiconductors, dielectrics etc., and carbon nanotubes, graphene etc.,), structures (optical waveguides and electronic channels), detection methods as applied to optical and bio-optical systems, sources (lasers and LEDs) and manipulation of light and electrons.

Text: P. Bhattacharya, "Semiconductor Optoelectronic Devices", 2nd Ed, Prentice Hall. Reference: J. Singh, "Semiconductor Optoelectronics", McGraw Hill, 1995 ISBN-10: 0134956567 | ISBN-13: 978-0134956565

Grading policy: UG: MT: 40%; Final: 40%; HW and class participation: 20% G: MT: 40%; Final: 40%; Research paper: 15%; HW: 5%

Honor code: The NJIT honor code will be upheld and that any violations will be brought to the immediate attention of the Dean of Students.

Week	Topic	Chapter
1	Introduction: the importance of the refractive index; basics of E&M; refraction and Snell's law;	
2	Semiconductor materials; crystal structure; symmetry; band structure; doping	1
3	Semiconductor materials; electronic structure; carriers; optical characteristics	2-3
4	Junctions; electronic and optical properties; Light emitting diodes (LED)	4-5
5	Junctions: semiconductor lasers	6
6	Photodetectors: operation and noise considerations	8
7	Solar cells and other light induced devices	9-10
8	Midterm	
9	Dielectrics and wave propagation: linear devices; waveguides	notes
10	Dielectrics and wave propagation: electrooptics	notes
11	Light modulation with electro-optic devices	notes
12	Integrated optical circuits	12-13
13	New materials: carbon nano tubes, graphene	notes
14	Other elements: displays	notes

Course Learning Outcomes:

Students should be able to understand and comprehend the followings:

1. concepts of basic solids states concepts (e.g., semiconductors)
2. concepts of linear optical elements
3. concepts of nonlinear elements such as, electrooptic modulators
4. concepts of solids states materials and basics of Light Emitting Diodes (LEDs) and lasers

Relevant Student Outcomes:

(a) Ability to identify, formulate and solve engineering problems related to electrooptics (CLO 1, 2, 3)
(b) Ability to analyze and solve problems at hand (CLO 1, 2, 3)
(c) Ability to communicate effectively (CLO 4)
(d) Ability to understand the underlined constraints upon design of systems, components, or processes related to optoelectronics, such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability (CLO 1, 2, 3)
(e) Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice; (CLO 1, 2, 3)