ECE 441Optical Electronics- Fall 2025

Elective course for Computer Engineering, Elective for Electrical Engineering, Required for Lasers and Optics
Course credits: 3

Catalog Description: The course covers the fundamental aspects of lasers and light emitting diodes, optical resonators, optical waveguides, and detectors. It shows how these components can be used to design optoelectronic systems.
Prerequisites: ECE 341, ECE 342, Electromagnetics (for undergraduates only)

Textbooks : Class notes provided by the instructor. Recommended reading:
J. Verdeyen "Laser Electronics" Prentice Hall;
B. Saleh and M.Teich "Fundamentals of Photonics", Wiley Interscience,
William Silfvast, Cambridge University Press
A. Siegman "Lasers" University Science Books;

Course Objectives: To become familiar with fundamental concepts and devices that are the building blocks of optoelectronic systems, including lasers, detectors, and optical fibers.

Topics covered:

- Review of geometric optics, optical matrixes
- Optical resonators
- Stability of optical resonators
- Transverse and longitudinal modes
- Light-matter interaction. Einstein A and B coefficients
- Optical gain, population inversion
- Three and four laser level systems
- Lasers: examples of gas lasers(He-Ne, Argon lasers)
- Solid lasers: (Nd YAG, Ruby laser, Ti:Sapphire laser)
- Review of p-n junction.
- Semiconductor lasers: principles and characteristics; single mode semiconductor lasers; vertical cavity surface emitting lasers.
- Light emitting diodes

- Optical detectors: signal to noise considerations
- PIN photodiodes
- Photoelectric effect and photomultipliers
- Charge couple device detectors
- Principles of optical waveguides
- Optical fiber characteristics; fiber losses, multi mode dispersion, chromatic dispersion
- Fiber amplifiers
- Principles of optics communications and design of an optical data link.
- Concepts of non-linear optics (if time allows)

Course Evaluation methods:

1. Midterm exam: **30%.** (To take place near the end of September)
2. Final Project (design of a high bit rate optical data link using commercially available components; paper and in-class oral presentation): **30%;**
3. Final: **40%**