ECE 520.482
Introduction to Lasers.

This course is intended to give a broad description of lasers and the systems based on them. The course starts with reviewing of the physical principles of lasers followed by the development of the laser theory. Laser dynamics is studied extensively and methods of generating and amplification of short optical pulses are reviewed. ***The course makes emphasis on semiconductor lasers and amplifiers and their applications in communication systems.***

Credits: 3
Textbooks:
Main:
J. T. Verdeyen
Laser Electronics , Prentice Hall
Recommended:
A. Yariv,
Optcal Electronics in Modern Communications, Oxford

Course objectives:

The objective of this course is to familiarize the students with the operational principles and applications of lasers. This includes understanding the underlying physical principles, design and fabrication methods, performance characterization, and major limitations of the laser devices and systems. The course involves a project on a specific type of laser or application.

Tentative Course Syllabus and Schedule

WEEK 1
Introduction. Specifics of Laser Radiation; Maxwell Equations. (*Book:Chapter 1*)
WEEK 2
Review of the light interaction with matter. Harmonic oscillator model. Susceptibility. Absorption and Dispersion. ***HW 1***
WEEK 3
Basics of Quantum Mechanics. Semiclassical theory of susceptibility. Einstein Coefficients. Emission cross-section. Broadening and Saturation *(Book: Chapter 7)*.
WEEK 4
Population inversion. Gain. Rate equations. Laser amplification. *(Book: Chapter 7)* ***HW 2***
HW 2
WEEK 5
Fabry-Perot resonator. Q and Finesse. Longitudinal modes *(Book: Chapter 6)*.
WEEK 6
Ray tracing *(Book:Chapter 2)* Gaussian beams (*Book:Chapter 3*). Transverse modes. Stable and unstable resonators. (*Book:Chapter 5*) ***HW 3***
WEEK 7
Laser rate equations. CW lasing. Threshold and Efficiency. (*Book:Chapters 8,9*)
WEEK 8

Laser Dynamics. Q-switching. Laser linewidth. (*Book:Chapter 9*)

MIDTERM (Take Home)

WEEK 9
Mode-locking. Ultrafast optics. (*Book:Chapter 9*)***HW 4***
WEEK 10
Rare Earth Lasers and Amplifiers. Lasers based on transitional Metals. CO_2 lasers. He-Ne Lasers. Eximer Lasers (*Book:Chapter 10*)
WEEK 11
Light interaction with semiconductors. (*Book:Chapter 11*)***HW5***
WEEK 12
Semiconductor Laser. (*Book:Chapter 11*)
WEEK 13
Advanced Semiconductor Lasers. DFB, DBR, QW, QD. (*Book:Chapter 11*) ***HW6***
WEEK 14
Lasers and Amplifiers in Optical Communciation Systems.
WEEK 15
Student seminars
WEEK 16

FINAL (Take home)