Course: Quantum Electronics I, ESE 515
Professor: Vera Gorfinkel, Ph.D.

Course Description
Physics of lasers; Topics include introduction to laser concepts; Interaction of radiation with atoms and ions; Energy levels, Radiative and non-radiative transitions in molecules and semiconductors; Ray and wave propagation through optical media; Continuous wave operation; Solid state and semiconductor lasers.

Grading principles: Class attendance (30%), Midterm test (30%), Final (40%).

Student Responsibilities
Each student is expected to:
- Complete assigned readings and homework.
- Participate in classroom activities,
- Successfully complete midterm and final exams.

AGENDA
1. Introduction to laser concepts
2. Interaction of radiation with atoms and ions
   2.1. Absorption, stimulated and spontaneous emission
   2.2. Einstein formula for spontaneous emission
   2.3. Spectral line broadening
3. Energy levels, radiative and non-radiative transitions in molecules and semiconductors:
   3.1. Molecules
   3.2. Bulk semiconductors
   3.3. Quantum wells
4. Ray and wave propagation through optical media
   4.1. Geometric optics
   4.2. Wave reflection and transmission in dielectric media
   4.3. Fabry-Perot interferometer
5. Pumping Processes
   5.1. Optical pumping
   5.2. Electrical pumping
6. Continuous wave operation
   6.7. Rate equations
   6.8. Threshold conditions
7. Solid state and semiconductor lasers
Student Learning Objectives

After taking this course, students should be able to:

- Apply knowledge of mathematics, science, and engineering for understanding fundamentals of solid state theory which form a basis for operation of semiconductor devices;
- Understand physical processes which underlay spectral properties of light-matter interaction;
- Prepare and defend research project;
- Apply theoretical concepts and basic formulas to solving specific problems;
- Continually develop life skills for:
  - Identifying, formulating, and solving engineering problems in optimum way by making reasonable assumptions
  - Conducting research, reading and understanding books and journal publications in the field of semiconductor devices