QUANTUM ELECTRONICS
Physics 427

Typical Textbook: *Lasers,* Peter W. Milonni and Joseph H. Eberly
Supplements:
Quantum Electronics, Third Edition, Amnon Yariv
Nonlinear Optics, Robert Boyd

Course Outcomes:

Upon completion of the course, students should:

1. Know how to apply quantum mechanics to the semiclassical theory of the interaction of atoms with electromagnetic radiation including dispersion relations and response functions.
    a. Appreciate the concepts associated with the interaction of electromagnetic energy with a near resonant two-level atom.
    b. Apply the time-dependent Schödinger equation to these problems.
    c. Understand how semiclassical radiation theory describes rate equations and laser action
2. Understand properties of lasers such as
    a. Threshold, gain, power, and frequency response
    b. Continuous-wave lasers, Q-switching, and mode-locking
    c. Laser cavities
    d. Coherence
3. Master concepts in nonlinear optics such as
    a. The nonlinear optical susceptibility
    b. Second and third order nonlinear optics
4. Further develop skill in problem solving, independent research and communication

Course Requirements and Grading: Weekly homework 20%, three exams 60%, topic paper 20%. Homework assignments will normally be due every Friday. Course information including homework assignments, homework solutions, exam solutions, etc. can be obtained using Blackboard
Reading assignments below:

Course Outline

Week	*Reading*	*Subject*
1	1,2	Intro to Laser Operation, Classical Dispersion Theory
2	2,3	Classical Theory of Absorption
3	6	Time-Dependent Schrödinger Equation
4	7	Emission, Absorption, and Rate Equations
5	8	Semiclassical Radiation Theory

6	10	Laser Gain and Threshold
7	11	Laser Power and Frequency
8	12	Laser Modes
9	14	Laser Resonators
10	15	Coherence of Laser Light
11	17	Introduction to Nonlinear Optics
12	17	Second Order Nonlinear Optics
13	18	Third Order Nonlinear Optics
14	18	Third Order Nonlinear Optics