Course Description: An integrated treatment of modern spectroscopy and photophysics. Topics to include atomic spectroscopy, microwave, infrared and UV-visible spectroscopy of diatomic and polyatomic molecules, lasers, creation and detection of excited states, fluorescence, phosphorescence, radiationless processes and photochemical transformations.

Prerequisites: [CHE 547](#) or [CHE 440G/CHE 442G](#) or permission of instructor.
Syllabus

Professor: Dennis J. Clouthier
Office: CP-235
Class Meetings: TR, 11:00-12:15 PM, Room CP-208
Office Hours: T 1:30-3:00 PM, R 9:30-11:00 AM CP-235

Course Content

I. SPECTROSCOPY

A. Introduction
   1. The electromagnetic spectrum
   2. Absorption of light
   3. Emission of light
   4. Width and shape of spectroscopic lines
   5. Mathematical methods
      i. Matrices and vectors, Dirac notation
      ii. Matrix mechanics
      iii. Comparison of matrix and perturbation methods

B. Atomic Spectroscopy
   1. Observed line spectra
   2. The vector model
   3. Selection rules and energy level diagrams
   4. Zeeman and Stark effects
   5. Hyperfine structure

C. Molecular Spectroscopy
   1. The Born-Oppenheimer approximation
   2. Microwave spectroscopy and molecular rotation
      !Diatomc Molecules
      !Polyatomc Molecules
   3. IR and Raman spectroscopy and molecular vibration
      !Diatomc Molecules
      !Polyatomc Molecules
   4. UV-visible spectroscopy and molecular electronic energy levels
      !Diatomc Molecules
      !Polyatomc Molecules

II. LASERS

A. Fundamental Principles
B. Types of Lasers
1. Continuous Lasers
   - Gas Lasers
   - Ion Lasers
   - Chemical Lasers
2. Pulsed Lasers
   - Solid State Lasers
   - Nitrogen and Excimer Lasers
3. Dye Lasers
C. Nonlinear Optics
D. Laser Power Measurements

III. PHOTOPHYSICS

A. Production of excited states

B. Deactivation of excited states

1. Radiative processes
   ! Fluorescence
   ! Phosphorescence
   - Kinetics
   - Quantum Yields and Lifetimes

2. Radiationless processes
   ! Theory
   i. The Statistical Limit
   ii. The Resonance limit
   iii. The Intermediate Case

I have developed a comprehensive set of notes for this class, taken from a wide variety of reference books and my own research experience in this field. Portions of these notes will be given to you at the beginning of each class. You will be responsible for studying them diligently before the next class, and coming to class prepared to ask questions and discuss the notes. The remainder of the class time will be taken up with students doing problems at the blackboard in small groups. For examination purposes, you will be responsible for all the material in the notes and in the classroom and homework problems.
Grading

There will be three examinations which will be comprehensive in nature.

1. A written in-class exam on or about Mar. 1.

2. A written 2 hour exam in the evening on or about April 4.

3. A written 2 hour final exam Tuesday, May 1 at 10:30 AM in CP 208.

There will be approximately 13 sets of problems which will be distributed weekly, usually on Tuesday and must be handed in during the lecture, one week from the day of distribution. These problems will be graded and returned to you. My solutions to the problems will be put on reserve in the library immediately after you receive your graded problems. In order to obtain high marks on the problems it is essential that you show all the details of your calculations and reasoning in a clear, legible and understandable fashion. The right answer without the details will not be acceptable. Failure to submit all the problem sets, on time, will result in the loss of one letter grade.

Problem Sets ..............................................15%
First Mid-Term Exam........................................20%
Second Mid-Term Exam ......................................30%
Final Exam ............................................... 35%

The cut points for letter grades in this course will be:

A  100 - 90%
B  89.9 - 80%
C  79.9 - 70%
E        <70%

These represent guaranteed minima, meaning that if you score within the quoted range, you are assured that you will receive at least that letter grade. The instructor reserves the right to lower the minimum grade cut points to account for variations in the difficulty of examinations.

Important Dates: Last day to drop any course without a grade appearing on record - Feb. 07, 2007.

Last day to drop with a W on record - March 9, 2007.

Plagiarism: “When students submit work that they represent as their own, but which in any way borrows ideas, organization or
wording from another source without appropriate acknowledgment, the students are guilty of plagiarism."[1] Appropriate acknowledgment means enclosing all writing that is taken from other sources in quotation marks and giving a complete reference, as shown in the previous sentence. My advice is that you simply do not use material from any source other than your own inspiration. For this course, this specifically means that copying off of old homework solutions or the homework of others will be treated as plagiarism. Plagiarism is an academic offense.

The minimum penalty for academic offenses such as plagiarism or cheating in this course will be a grade of "E".

[1] Students Rights and Responsibilities handbook, University of Kentucky, Section 6.3.1, pg 84.