UNIVERSITY OF THE PACIFIC
GRADUATE COURSE APPROVAL FORM

Please fill in all information. After all required signatures are obtained on page two, send to Research and Graduate Studies, Knoles Hall, 2nd Floor. Research and Graduate Studies will then forward to the Academic Affairs Committee, Office of the Provost, Anderson Hall, 2nd Floor.

Date: August 8, 2006
Contact Person: Dr. Silvio Rodriguez
Department: Chemistry
Phone: 946-2598

Please mark one:
ADDITION x
REVISION
DELETION

School or College: COP
Department: Chemistry
Course Number: PCSP 240
Title: Molecular Spectroscopy
Units: 4
Minimum Number of Students: 6
Prerequisites: Graduate standing or permission of the instructor.

If replacing a course, old course title and number:

Catalog Description:
The basic theory behind infrared, visible, ultraviolet, and magnetic resonance spectroscopy are studied. The course includes the quantum mechanics of light absorption, atomic absorption and emission spectroscopy, vibrational spectroscopy of diatomic and polyatomic molecules. Absorption and emission electronic spectroscopic and magnetic resonance spectroscopy. Prerequisite: Graduate standing or permission of the instructor.

Please attach a syllabus.

What are the reasons for the new course (e.g., student needs, major, etc.), program changes or deletion of the program?

This is a new elective course for all chemistry tracks of the PCSP program.

If approved, when will this be implemented?

Fall, 2007
What is the anticipated impact on resources (Faculty, funds, library materials, etc.)? None.

Describe any special facilities, furnishings, or technology needs. List software needs, if any. None.

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**APPROVAL PROCESS**

1. Action by department requesting addition/change:
   - Approved by: [Signature] Date: 10/10/06

2. Action by the Curriculum and/or Graduate Studies Committee of the School/College:
   - Approved by: [Signature] Date: 10/20/06

3. Action by the Dean of the School/College:
   - Approved by: [Signature] Date: 10/20/06

4. Action by the Dean of the Library:
   - Approved by: [Signature] Date: 10/20/06

5. Action by the Director of Educational Technology Services (if computer lab, software needed):
   - Approved by: N/A Date: 

6. Action by the Registrar:
   - Approved by: [Signature] Date: 11/13/06

7. Action by the Graduate Studies Committee (as appropriate):
   - Approved by: [Signature] Date: 1/16/06

8. Action by the Academic Affairs Committee:
   - Approved by: Date:

After approval by the Academic Affairs Committee, information regarding new, revised, or deleted courses is sent to the Registrar for listing in or modifying the catalog.

Form revised: 9/4/03
1.) JUSTIFICATION FOR THE COURSE:
   This course will provide the theoretical basis for the understanding of infrared, visible, ultraviolet, and magnetic resonance spectroscopy. The course will be oriented taking in consideration the background and professional interests of the students. Study cases will be selected accordingly.

2.) STAFFING NEEDS:
   Graduate Faculty

3.) ESTIMATED CLASS ENROLLMENT:
   Minimum of 4 classes.

4.) ANTICIPATED IMPACT ON CLASSROOM FACILITIES:
   A lecture/discussion room will be needed for this course.

5.) ANTICIPATED IMPACT ON ELECTRONIC TECHNOLOGY:
   Current ET facilities are adequate
COURSE SYLLABUS

Pharmaceutical and Chemical Sciences Graduate Program

Course Number: PCSP YYY
Course Title: Molecular Spectroscopy.

Department: PCSP
Instructor(s): Dr. Silvio Rodriguez

Number of Weeks: 13
Maximum Enrollment: 20
Unit Value: 4

Lecture Hours per Week: 4
Laboratory Hours per Week: 0
Discussion Hours per Week: Variable
Number of Labs per Semester: 0
Experiential Hours per Week: 0

Course Description:
A study of the theory and applications of infrared, visible, ultraviolet, and magnetic resonance spectroscopy.

Prerequisites:
Graduate standing or permission of instructor.

Teaching Methodology:
Lecture and discussions.

Evaluation Methodology:
The University Honor Code is an essential element in academic integrity. It is a violation of the Honor Code to give or receive information from another student during an examination, to use unauthorized sources during an examination, or to submit all or part of someone else’s work or ideas as one’s own. If a student violates the Honor Code, the faculty member may refer the matter to the Office of Student and Professional Affairs. If found guilty, the student may be penalized with failure of the assignment or failure of the course. The student may also be reprimanded or suspended from the University. A complete statement of the Honor Code may be found in the Student Handbook, “TIGER LORE”.

Attendance is expected at all class sessions.

Class assignments may be retained by the instructor to assess how the learning objectives of the course are met.

The instructor may be contacted during office hours or by email, phone, or via Blackboard.com.

Weighting of Assignments:

<table>
<thead>
<tr>
<th>Assignment Type</th>
<th>Weighting</th>
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<tbody>
<tr>
<td>Four Examinations</td>
<td>60%</td>
</tr>
<tr>
<td>Case Study Assignments</td>
<td>20%</td>
</tr>
<tr>
<td>Final Exam</td>
<td>20%</td>
</tr>
</tbody>
</table>

Assignment of Grades:

- $> 90\%$ - A
- $80\% - 90\%$ - B
- $70\% - 80\%$ - C
- $60\% - 70\%$ - D
- $< 60\%$ - F
## COURSE SYLLABUS

Pharmaceutical and Chemical Sciences Graduate Program

<table>
<thead>
<tr>
<th>GOALS</th>
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<tbody>
<tr>
<td>1. To outline the kind of qualitative and quantitative information to be obtained from infrared, visible, ultraviolet, and magnetic resonance spectroscopy.</td>
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<td>2. To describe the strengths and limitations of spectroscopy in the study of a molecular system.</td>
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<td>3. To apply quantitative relations to the solution of a wide range of assigned numerical problems.</td>
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<td>4. To be able to interpret spectra from the different techniques.</td>
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<td>5. To be able to critically review the current scientific literature on the use of spectroscopy to study a selected system of interest.</td>
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<tr>
<td>6. To prepare a case study which involves an extensive literature search and presentation to the class.</td>
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</table>
OBJECTIVES

This course will introduce the basic theory behind infrared, visible, ultraviolet, and magnetic resonance spectroscopy. Given that spectroscopy can be best described by quantum mechanics, we will review the necessary topics needed to fully understand a given spectrum. In each case a molecule or a group of molecules will be selected as a model and analyzed in detail. According to their personal interests, students will be assigned a case study molecule which they will present to the class after an exhaustive review of the current literature.
COURSE SYLLABUS
Pharmaceutical and Chemical Sciences Graduate Program

LECTURER: Dr. Silvio Rodriguez; office: Classroom Building 118; email: srodriguez@pacific.edu
Phone: (209) 946 2598 Fax: (209) 946 3213

TEXTBOOK: “Molecular Spectroscopy” by Jeanne L. McHale, notes, handouts and recent publications from the literature.

TENTATIVE SCHEDULE (13 weeks; 26 lectures, 120 minutes each)

1.- Quantum Mechanics of Light Absorption
   - Time-dependent Perturbation Theory
   - The Einstein coefficients
   - Selection rules

2.- Atomic Absorption and Emission Spectroscopy
   - Hydrogen Atom. Energy levels and Selection Rules
   - Many-electron atoms. The Clebsch-Gordan series
   - Spin-orbit coupling. Term symbols
   - Selection Rules for atomic absorption and emission
   - The Effect of external fields. The Zeeman effect. The Stark effect

3.- Vibrational Spectroscopy of Diatomic and Polyatomic molecules
   - Rotation-vibration spectra of diatomic molecules
   - Anharmonicities. Centrifugal distortions.
   - Vibrations of polyatomic molecules. Selection rules
   - Group theory and molecular vibrations
   - Symmetries of normal modes.
   - Symmetries of vibrational wavefunctions
   - Selection rules for infrared and Raman scattering

4.- Absorption and Emission Electronic Spectroscopy
   - Molecular orbitals and electronic configurations
   - Term symbols for diatomic molecules. Selection Rules
   - Vibrational Structure in the electronic spectra of diatomic molecules
   - Electronic states and selection rules for polyatomic molecules
   - Solvent effects in electronic spectroscopy
   - Quenching of fluorescence. Energy transfer

5.- Magnetic Resonance Spectroscopy
   - Magnetic susceptibility
   - Paramagnetic and diamagnetic current density
   - Nuclear properties and molecular structure
   - Nuclear magnetic resonance
   - Chemical shifts and shielding constants
   - Spin-spin coupling