SYLLABUS **CHEM 529-Applied Spectroscopy** **Fall 2015**

LECTURES: MWF 11:10 in Q 407.

INSTRUCTORS: Prof. Ursula Mazur, OFFICE: Fulmer VIF N116a; PHONE: 335-5822; Email: umazur@wsu.edu. Office Hours: by appointment

INSTRUCTORS: Prof. Alex Li, OFFICE: Fulmer 171; PHONE: 335-7196; Email: dequan@wsu.edu; Office Hours: by appointment

GRADING: There is one midterm exam covering week 1 through week 7 materials and one final exam covering week 8 through week 15 material. The Final Grade will be the average of the percentage earned in these two exams.

Grade Ranges (guaranteed minimum grade)	Combined percentage
A	100—92.8%
A-	92.7—85.7%
B+	85.6—78.6%
B	78.5—71.5%
B-	71.4—64.4%
C+	64.3—57.2%
C	57.1—50%
F	below 50%

CREDITS: 3

PREQUISSITES: None, but see recommendation below.

It is recommended that students have completed at least one semester of undergraduate Organic Chemistry, for example, CHEM 345 and one semester of Physical Chemistry CHEM 331 but preferably Quantum Chemistry CHEM332. Quantitative Instrumental Analysis CHEM 425 is not required, but highly desirable.

COURSE DESCRIPTION, OBJECTIVES, AND LEARNING GOALS: This graduate level course provides fundamental and practical aspects about molecular spectroscopy. This course will focus on the materials that will be instrumental to routine research activities for those who use nuclear magnetic resonance and optical spectroscopies. The focus will be using spectroscopy to solve experimental problems and provide interpretation of observed phenomena. Two major emphases will address subject matter in optical spectroscopy (UV-Visible, FT-IR, Raman, and Fluorescence) associated with the electronic/molecular processes, and nuclear magnetic resonance (NMR) associated with structures and dynamics. Theoretical aspects about molecular spectroscopies are not emphasized here because this course aims to apply spectroscopies in critical thinking to solve real-world problems. The following are only a few general outcomes after students have finished the course successfully:

Student Learning Outcomes At the end of this course, students should be able to:	Course Topics/Dates The following topic(s)/dates(s) will address this outcome:	Evaluation of Outcome: This outcome will be evaluated primarily by:
Use spectroscopic techniques to identify and quantify experimental samples	*UV-vis spectroscopy/Week 1 & 2*	*Homework 1 and Exam 1*
Interpret the basic processes associated with molecular phenomena.	*UV-vis spectroscopy and infrared spectroscopy /Week 2 & 3*	*Homework 2 and Exam 1*
Explain the strengths and weaknesses of individual techniques and their applications in organic and inorganic compounds.	UV-vis spectroscopy, infrared spectroscopy, Raman spectroscopy, and fluorescence spectroscopy / Week 1-11	*Homework 1-7 and Exam 1 and Exam 2*
Explain spectra and relate the observations to electronic, molecular and dynamic processes occurring in the samples.	UV-vis spectroscopy, infrared spectroscopy, Raman spectroscopy, fluorescence spectroscopy, and NMR/ Week 1-15	*Homework 1-10 and Exam 1 and Exam 2*
Apply UV-Visible, FT-IR, and Raman and the techniques within those spectroscopic methods to gas, liquid, and solid samples.	UV-vis spectroscopy, infrared spectroscopy, and Raman spectroscopy/ Week 1-7	*Homework 1-5 and Exam 1*
Use optical spectroscopy to study the structure and orientation of molecules adsorbed on surfaces.	Infrared spectroscopy, and Raman spectroscopy/ Week 3-7	*Homework 1-5 and Exam 1*
Use fluorescence energy transfer as yardstick to measure distance at nanometer scales.	Fluorescence spectroscopy/ Week 8-10	*Homework 6 and Exam 2*
Use fluorescence turn-on or turn-off as active chemical or biological sensing and detection mechanism.	Fluorescence spectroscopy/ Week 9-11	*Homework 7 and Exam 2*
Use NMR techniques to determine and confirm structures.	NMR spectroscopy/ Week 12 and 13	*Homework 8 and 9 and Exam 2*
Use NMR techniques to understand dynamic processes and molecular motions and molecular self-assemblies.	NMR spectroscopy/ Week 14 and 15	*Homework 10 and Exam 2*

TEXTBOOKS: No required textbooks, but the reference textbooks listed below are highly recommended. During the semester, lecture materials for the course will be organized from these textbooks and literature when necessary.

LECTURES: Lectures must be attended regularly and students are responsible for making up the missed materials if they missed the classes for reasons beyond their control. Exam questions are based primarily on lecture materials and homework. Students must read the reference textbooks or other reference materials before and after class in order to digest the materials better. The lectures will supplement, enhance (with literature works), and clarify the information from reference textbooks rather than simply reiterate it.

HOMEWORK: There will be 10 homework sets and they will be assigned associated with the materials presented in the recent week. Homework will be due one week from the date of assignment except specified otherwise. Late homework will not be accepted. We strongly encourage that you complete your homework because even though homework does not count as points earned, it will greatly help you solving the problems in the two exams.

EXAMS: There will be two exams: one midterm and one final. You will be responsible for bringing a calculator and a pencil to all exams. No notes or books are allowed. No make-up exams will be given. If you are unable to take a scheduled exam for reasons beyond your control, you should contact the instructor as soon as possible. These issues will be determined case-by-case by the instructor.

ACADEMIC INTEGRITY: Cheating or plagiarism in any form will not be tolerated. Cheating includes, but is not limited to: submitting non-original materials as the student's work or copying another student's work. Plagiarism is an act of using the language and thoughts of another author without authorization and the representation of that author's work as one's own, as by not crediting the original author. All incidences of cheating may be reported to the Office of Student Conduct. Cheating is defined in the Standards for Student Conduct WAC 504-26-010 (3). The standards of Conduct for Students can be found at http://conduct.wsu.edu.

ACCOMMODATIONS: **Students with Disabilities:** Reasonable accommodations are available for students with documented disability. If you have a disability and may need an accommodation to fully participate in the class, please visit the DRC (Washington Building Room 217). Please stop by or call 509-335-3417 to make an appointment with a disability specialist http://www.drc.wsu.edu.

SAFETY ON CAMPUS: WSU has developed resources for the safety of students, faculty, staff and visitors. These are the Campus Safety Plan at http://safetyplan.wsu.edu and the university emergency management at http://oem.wsu.edu/. You should also become familiar with the WSU ALERT site at http://alert.wsu.edu for information about emergencies affecting WSU. It is recommended that you go to the zzusis portal at http://zzusis.wsu.edu and **register your emergency contact information** for the Crisis Communication System (CCS).

Schedule **CHEM 529-Applied Spectroscopy** **Fall 2014**

Week	Topics	Instructor	Homework/Exam
8/25-8/29	UV-vis Spectroscopy	Mazur	HW1 assigned
9/1-9/5	UV-vis Spectroscopy, Labor Day Monday*	Mazur	HW2 assigned HW1 due
9/8-9/12	Infrared Spectroscopy	Mazur	HW2 due
9/15-9/19	Infrared Spectroscopy	Mazur	HW3 assigned
9/22-9/26	Infrared/Raman Spectroscopy	Mazur	HW4 assigned HW3 due
9/29-10/3	Raman Spectroscopy	Mazur	HW5 assigned HW4 due
10/6-10/10	Raman Spectroscopy	Mazur	HW5 due Mid-term Exam
10/13-10/17	Fluorescence Spectroscopy	Li	HW6 assigned
10/20-10/24	Fluorescence Spectroscopy	Li	HW6 due
10/27-10/31	Fluorescence Spectroscopy	Li	HW7 Assigned
11/3-11/7	Fluorescence Spectroscopy	Li	HW7 due
11/10-11/14	NMR, Veteran's Day Tuesday	Li	HW8 assigned
11/17-11/21	NMR	Li	HW8 due HW9 assigned
11/24-11/28	Thanksgiving Vacation		
12/1-12/5	NMR	Li	HW9 due and HW 10 assigned
12/8-12/12	NMR	Li	HW 10 due
12/15-12/19	Final Week		Final Exam

- No lecture on Labor Day (Monday).

Reference textbook for UV-Vis: UV-VIS Spectroscopy and Its Applications, Heinz-Helmut Perkampus, H.C. Grinter, T.L. Threlfall, Springer Lab, 2012.

Reference textbooks for IR and Raman: Infrared and Raman Spectra of Inorganic and Coordination Compounds, Applications in Coordination, Organometallic, and Bioinorganic Chemistry, 6th edition, Kazuo Nakamoto, Wiley, 2009; Infrared and Raman Spectroscopy; Principles and Spectral Interpretation, Peter Larkin, Elsevier, 2011.

Textbook for fluorescence: Principles of Fluorescence Spectroscopy, 3rd edition, Joseph R. Lakowicz, Springer, 2006

Textbook for NMR: Spin Dynamics: Basics of Nuclear Magnetic Resonance, 2nd edition, Malcolm H. Levitt, Wiley, 2008