SYLLABUS CHEM 535-Applied Spectroscopy Fall 2016

LECTURES: MWF 11:10 am -12:00 noon in Fulmer 124.

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

CREDITS: 3

PREQUISSITES: Students must 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 CHEM 332. Quantitative Instrumental Analysis CHEM 425 is not required, but highly desirable.

COURSE DESCRIPTION and OBJECTIVES/OUTCOMES: This course covers both basic theory and practical aspects of modern photon and electron based spectroscopies. The techniques include FT-IR, Raman, UV-Visible, Fluorescence, and UV and X-ray photoelectron spectroscopies. Qualitative and quantitative applications of these methods in biochemistry, chemistry (organic and inorganic), radiochemistry, and materials science are discussed. The course includes demonstrations of the operation of selected spectrometers. The focus will be using spectroscopy to solve experimental problems and provide interpretation of observed phenomena.

GOALS: The overall goals of this course are to:

- Provide understanding of basic processes associated with molecular phenomena.
- Instruct about the application of different spectroscopic techniques to identify and quantify experimental samples.
- Explain the strength and weakness of individual techniques and their applications for studying biological, organic and inorganic compounds, and materials.
- Instruct how to interpret and explain spectra and relate the observations to electronic, molecular and dynamic processes occurring in the samples.

LEARNING OUTCOMES: After completing this course, the students should have learned the following:

- Application of UV-Visible, FT-IR, and Raman and the techniques within those spectroscopic methods to gas, liquid, and solid samples.
- Application of fluorescence as active chemical or biological sensing and detection mechanism.
- Application of Ultraviolet photoelectron spectroscopy (UPS) to the measurement of kinetic energy spectra of photoelectrons emitted by molecules in order to determine molecular orbital energies in the valence region.
- Application of X-ray photoelectron spectroscopy (XPS) to measure the elemental composition, empirical formula, chemical state, and electronic state of the elements in a compound.
- Application of Auger for probing chemical and compositional surface environments.
- Application Low-energy electron diffraction (LEED) for the determination of the surface structure of single-crystalline materials.

TEXTBOOKS: There are no required textbooks, but reference books listed below or similar are highly recommended. Notes and pertinent material will be provided on \\diamond3\instruction\Chem. More information on accessing Chem 535 folder will be provided in class.

LECTURES: Lectures must be attended regularly and students are responsible for making up the missed materials. Assignments will be based primarily on lecture material.

ASSIGNMENTS: Homework and in class presentations will be assigned by topics and graded. They will be due one week from the date of the assignment unless otherwise specified. Late homework will not be accepted. Since we are covering 8 spectroscopic techniques there will be 8 assignments given.

FINAL GRADE: No exams will be given. Final grade will be determined by performance on the eight homework and in class presentations.

OUTSIDE READING: You should be doing a couple hours a week of reading. You are all mature enough to find readings on your own that supplement parts of the lecture that are hard to understand.

ACADEMIC INTEGRITY: Cheating of any kind is unacceptable. This includes the inappropriate use of solution manuals for homework sets, as well as the usual forms of copying, etc. Cooperative learning is encouraged, but all work submitted for grading must be your own. All instances of cheating will be reported to Student Affairs and the Dean of Students. The assignment in question will receive no 3 credit. Students who violate WSU's Standards of Conduct for Students will receive an F as a final grade in this course, will not have the option to withdraw from the course and will be reported to the Office Student Standards and Accountability. Cheating is defined in the Standards for Student Conduct WAC 504-26-010 (3). It is strongly suggested that you read and understand these definitions. The standards of Conduct for Students can be found at http://conduct.wsu.edu.

CHANGE IN THE RULES FOR WITHDRAWALS: There are no longer uncontested withdrawals so students cannot drop classes on the last day of instruction unless they cancel their entire enrollment. Students still have a total of four withdrawals during their career. The regular withdrawal deadline has been extended from week 9 to week 13. A student can use any of their withdrawals up until the end of week 13.

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).

Tentative Schedule CHEM 535-Applied Spectroscopy Fall 2016

Week	Topics
Aug 22	Infrared Spectroscopy
Aug 29	Infrared Spectroscopy
Sep 5	Infrared/Raman Spectroscopy
Sep 12	Raman Spectroscopy
Sep 19	Raman Spectroscopy/UV-vis Spectroscopy
Sep 26	UV-vis Spectroscopy
Oct 3	UV-vis Spectroscopy
Oct 10	UV-vis Spectroscopy/Fluorescence Spectroscopy
Oct 17	Fluorescence Spectroscopy
Oct 24	Ultraviolet Photoelectron Spectroscopy
Oct 31	Ultraviolet Photoelectron Spectroscopy
Nov 7	X-ray Photoelectron Spectroscopy
Nov 14	X-ray Photoelectron Spectroscopy
Nov 21	Thanksgiving break
Nov 28	Auger
Dec 5	LEED
Dec 12	Final Week

REFERENCE BOOKS:

UV-VIS Spectroscopy and Its Applications. H.H.Perkampus, H.C. Grinter, and T.L. Threlfall. Springer Lab, 2012.

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. P. Larkin, Elsevier, 2011.

Raman, Infrared, and Near-Infrared Chemical Imaging. S. Sasic and Y. Ozaki. J. Wiley & Sons, 2010

Principles of Fluorescence Spectroscopy. 3rd ed. J.R. Lakowicz. Springer-Verlag, 2006.

Photoelectron Spectroscopy 3rd ed. S. Hüfner. Springer-Verlag, 2003.

Surface Science Analysis: The principal Techniques. J.C. Vickerman. J. Wiley & Sons. 1999.

Encyclopedia of Materials Characterization. C.R. Brundle, C.A. Evans, Jr., and S. Wilson. Butterworth-Heinemann, 1992.

An Introduction to Surface Analysis by XPS and AES. 2nd ed. J.F. Watts. J. Wiley & Sons. 2003.

Surface Microscopy with Low Energy Electrons. E. Bauer. Springer-Verlag, 2014.

Low-Energy Electron Diffraction: Experiment, Theory and Surface Structure Determination. M.A. VanHove, W. H. Weinberg, and C.M. Chan. Springer-Verlag, 1986.