ChemS 212- Course Syllabus

Name of Course: Spectroscopy Analysis
Prerequisites: Organic Chemistry and Inorganic Chemistry

Course objectives: This course will give an introduction to modern spectroscopic techniques including time-resolved laser methods. It is target towards master and PhD students in chemistry, materials science, electrical engineering, and bioscience. Theory and application to chemical research problems on will be discussed, including mass spectrometry, ultraviolet and visible spectroscopy, infrared spectroscopy, Raman, fluorescence, nuclear magnetic resonance spectroscopy, time-resolved spectra including lifetime measurements, etc. Emphasis will be placed on training the students to interpret spectra and to design experiments to address questions related to selectivity, reactivity, kinetics, etc. One NMR laboratories session will allow the students to be familiar with standard operations to acquire 1D and 2D spectra. It also provides detailed information about many photo-physical processes and every possible deactivation pathways of the excited systems including organic, inorganic and nanoscales materials.

General Schedule: There are 11 intensive lectures with 1 week of lab experience, two midterm examines, and one final presentation on term-project of identification of an unknown compound.

Lectures	Topic
1	Mass Spectrometry-I: Introduction of theory, ionization methods, molecule fragmentation.
2	Mass Spectrometry-II: Case studies
3	NMR Spectroscopy-I: Introduction of theory, ^{1}H and ^{13}C NMR, Spin-Spin Coupling
4	NMR Spectroscopy-II: Case studies on 1D NMR
5	NMR Spectroscopy-III: 2D NMR techniques, pulse sequences
6	NMR Spectroscopy-IV: Case studies on 2D NMR
7	Ultraviolet and Visible Spectroscopy: electronic transitions, radiative processes, energy diagram, internal conversion, conical intersection, Frank Condon principle, Kasha's rule, structure determination and solvent effect, and Fluorescence spectroscopy, Stokes Shift, fluorescence experiments, quenching, lifetime and quantum yield, fluorescence anisotropy.
8	Infrared Spectroscopy: Steady-state and time-resolved Infrared spectroscopy: from overview to potenial applications
9	Raman Spectroscopy: Standard Raman Spectroscopy vs Resonance-enhanced Raman Spectroscopy
10	Photoelectron spectroscopy: x-ray and Auger photoelectron spectroscopy, electron energy loss spectroscopy.
11	Application of steady-state and time-resolved laser spectroscopy in chemistry, materials science, physics and biology.

Assessment:

1.	Problem sets	20%
2.	Class participation	20%
3.	Midterms	40%
4.	Final Project Presentation	20%

*There will be two sets of tutorial questions given. Students are expected to submit written answers; the first set is due in class on March 3rd, 2016 and the second set on Apr. 28th.