جامعة الملك عبدالله
للعلوم والتقنية
King Abdullah University of
Science and Technology

Course Syllabus: Advanced Topics in Chemistry - ChemS 390

Division	Physical Science and Engineering Division
Course Number	ChemS 390
Course Title	Advanced Topics in Chemistry
Academic Semester	Spring
Academic Year	2018/2019
Semester Start Date	01/27/2019
Semester End Date	05/23/2019
Class Schedule (Days & Time)	04:00 PM - 05:30 PM | Sun Thu

Instructor(s)

Name	Email	Phone	Office Location	Office Hours
Yu Han	yu.han@kaust.edu.sa	+966128082407	4221, 4, Al-Jazri (bldg. 4)	By appointment.
Kuo-Wei Huang	kuowei.huang@kaust.edu.sa	+966128080328	4232, 3, Ibn Sina (bldg. 3)	By appointment.
Omar Farghaly Mohammed Abdelsaboor	Omar.Abdelsaboor@KAUST.EDU.SA	+966128084491		By appointment.

Teaching Assistant(s)

Name	Email

Course Information

Comprehensive Course Description	**Course objectives:** This course will give an overall to modern spectroscopic techniques including microscopy for MS and PhD students in chemistry, materials science, electrical engineering, and bioscience. Theory and application on chemical research problems 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. ***Five weeks of laboratory sessions are designed*** to introduce hand-on equipment building experiences so the students will learn how to design and build a Raman spectrometer, and design logics to read and interpret the results. Detailed information will be obtained about many photo-physical processes and every possible deactivation pathways of the excited systems including organic, inorganic and nanoscales materials. General Schedule: There are 10 weeks intensive lectures with 5 week of lab experiences, two midterm exams, and one final presentation on the Raman project.
Course Description from Program Guide	The advanced topics class will focus on current research topics that have a direct influence on various applications including catalysis, solar energy in addition to emerging synthetic and analytical techniques for producing new generations of materials.
Goals and Objectives	This course will give an overall to modern spectroscopic techniques including microscopy for MS and PhD students in chemistry, materials science, electrical engineering, and bioscience. Theory and application on chemical research problems 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.

Required Knowledge	Knowledge of fundamentals of chemistry and spectroscopy.
Reference Texts	No textbook and Class materials and handouts will be provided by each instructor.
Method of evaluation	**50.00**% - Group Project(s) **50.00**% - Midterm exam
Nature of the assignments	There are 10 weeks intensive lectures with 5 week of lab experiences, two midterm exams, and one final presentation on the Raman project.
Course Policies	The highest levels of academic integrity are expected in this class. The code of student conduct will be strictly enforced. Proper attribution is expected when using any information from the scientific literature, textbooks, resources on the web. Lack of proper attribution or verbatim copying of content will result in an automatic *zero grade* for an *entire assignment*. There is no make-up for missed presentation dates, unless the instructor has been notified in advance of a valid reason for student's absence. A grade of 0 is automatically assigned for any missed presentation.
Additional Information	

Tentative Course Schedule

(Time, topic/emphasis & resources)

Week	Lectures	Topic
1	Sun 01/27/2019	Mass Spectrometry: Introduction of theory, ionization methods, molecule fragmentation.
1	Thu 01/31/2019	Mass Spectrometry: Introduction of theory, ionization methods, molecule fragmentation.
2	Sun 02/03/2019	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.
2	Thu 02/07/2019	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.
3	Sun 02/10/2019	Infrared Spectroscopy: Steady-state and time-resolved Infrared spectroscopy: from overview to potential applications
3	Thu 02/14/2019	Infrared Spectroscopy: Steady-state and time-resolved Infrared spectroscopy: from overview to potential applications
4	Sun 02/17/2019	Raman Spectroscopy: Standard Raman Spectroscopy vs Resonance-enhanced Raman Spectroscopy
4	Thu 02/21/2019	Raman Spectroscopy: Standard Raman Spectroscopy vs Resonance-enhanced Raman Spectroscopy
5	Sun 02/24/2019	1st Midterm
5	Thu 02/28/2019	Lab: Building Raman Spectrometer
6	Sun 03/03/2019	Photoelectron spectroscopy: x-ray and Auger photoelectron spectroscopy, electron energy loss spectroscopy.
6	Thu 03/07/2019	Photoelectron spectroscopy: x-ray and Auger photoelectron spectroscopy, electron energy loss spectroscopy.
7	Sun 03/10/2019	SEM, TEM and STEM
7	Thu 03/14/2019	SEM, TEM and STEM
8	Sun 03/17/2019	Electron tomography and electron crystallography
8	Thu 03/21/2019	Electron tomography and electron crystallography
9	Sun 03/24/2019	Spring Break
9	Thu 03/28/2019	Lab: Building Raman Spectrometer
10	Sun 03/31/2019	Lab: Building Raman Spectrometer
10	Thu 04/04/2019	Lab: Building Raman Spectrometer
11	Sun 04/07/2019	Lab: Building Raman Spectrometer
11	Thu 04/11/2019	NMR Spectroscopy I: Introduction of theory, 1H and 13C NMR, Spin-Spin Coupling
12	Sun 04/14/2019	NMR Spectroscopy I: Introduction of theory, 1H and 13C NMR, Spin-Spin Coupling
12	Thu 04/18/2019	NMR Spectroscopy II: 2D NMR techniques, pulse sequences
13	Sun 04/21/2019	NMR Spectroscopy II: 2D NMR techniques, pulse sequences
13	Thu 04/25/2019	2nd midterm
14	Sun 04/28/2019	EELS and EDX
14	Thu 05/02/2019	Lab: Building Raman Spectrometer
15	Sun 05/05/2019	Lab: Building Raman Spectrometer
15	Thu 05/09/2019	Lab: Building Raman Spectrometer
16	Sun 05/12/2019	Lab: Building Raman Spectrometer
16	Thu 05/16/2019	Presentation
17	Sun 05/19/2019	Final Exam Week
17	Thu 05/23/2019	Final Exam Week

Note

The instructor reserves the right to make changes to this syllabus as necessary.