



Course Syllabus: Contemporary Topics in Bioscience - B 394

Division	Biological and Environmental Sciences & Engineering Division
Course Number	B 394
Course Title	Contemporary Topics in Bioscience
Academic Semester	Fall
Academic Year	2019/2020
Semester Start Date	08/25/2019
Semester End Date	12/10/2019
Class Schedule (Days & Time)	09:00 AM - 10:30 AM Sun Wed

Instructor(s)				
Name	Email	Phone	Office Location	Office Hours
Lukasz Jaremko	LUKASZ.JAREMKO@KAUST .EDU.SA	+966128082568	4337, 2, Ibn Al-Haytham (bldg. 2)	arranged upon request
Mariusz Jaremko	MARIUSZ.JAREMKO@KAUST .EDU.SA			arranged upon request

Teaching Assistant(s)	
Name	Email

Course Information	
Comprehensive Course Description	The course " <i>Advanced biomacromolecular NMR techniques</i> " will introduce students into the theoretical and practical aspects of state-of-the-art high-resolution multidimensional nuclear magnetic resonance (NMR) spectroscopy. The aim of the course is to provide advanced theoretical knowledge and practical experience, including the <i>hands on</i> experience with the NMR spectrometer.
Course Description from Program Guide	A course of current interest. Topics are not permanent and the content of the course will change to reflect recurring themes and topical interest. The content will be approved by the division.
Goals and Objectives	Students will govern the technical and practical knowledge to design, set up and run the advanced bioNMR experiments on their samples, integrate them with results coming from X-ray crystallography and cryoEM. Students will learn how to prepare the valuable biomaterial for their studies and make decisions of the labeling strategies and spectroscopic techniques selection that will yield answers for their research specific questions. Students will learn basics of pulse programming and setting up their own NMR experiments on the top-end NMR spectrometers
Required Knowledge	Advanced knowledge in Chemistry, Physics and substantial interest in biomacromolecules, proteins and nucleic acids. Solid bases with Linux environment. CoreLab trainings allowing to enter AIC NMR facility at KAUST.

Reference Texts	<p>Positions in BOLD are mandatory and constitute the integral core of the course.</p> <p>Structural Biology: Practical NMR Applications 2nd ed. 2013 Edition by Quincy Teng</p> <p>Nuclear Spin Relaxation in Liquids: Theory, Experiments, and Applications, Second Edition 2nd Edition by Jozef Kowalewski , Lena Maler</p> <p>A Primer of NMR Theory with Calculations in Mathematica 1st Edition by Alan J. Benesi</p> <p>NMR: THE TOOLKIT: How Pulse Sequences Work (Oxford Chemistry Primers) 2nd Edition by Peter Hore , Jonathan Jones , Stephen Wimperis</p> <p>Protein NMR Spectroscopy: Principles and Practice 2nd Edition by Arthur G. Palmer III, Wayne J. Fairbrother, John Cavanagh, Nicholas J. Skelton, Mark Rance</p> <p>Structure And Mechanism In Protein Science: A Guide To Enzyme Catalysis And Protein Folding (Series in Structural Biology) Reprint Edition by Alan R Fersht</p> <p>Textbook of Structural Biology (Series in Structural Biology) 2nd Edition Edition by Anders Liljas, Lars Liljas, Miriam-Rose Ash, Göran Lindblom, Poul Nissen, Morten Kjeldgaard Isotope Labeling of Biomolecules – Labeling Methods, Volume 565 (Methods in Enzymology) 1st Edition by Zvi Kelman (Editor)</p> <p>Isotope Labeling of Biomolecules – Applications, Volume 566 (Methods in Enzymology) 1st Edition by Zvi Kelman (Editor)</p> <p>Protein NMR Techniques (Methods in Molecular Biology) 3rd ed. 2012 Edition by Alexander Shekhtman (Editor), David S. Burz (Editor)</p> <p>NMR Spectroscopy: Basic Principles, Concepts and Applications in Chemistry 3rd Edition by Harald Günther</p> <p>Practical Nuclear Magnetic Resonance Relaxation for Chemists 1st Edition by Vladimir I. Bakhmutov</p> <p>NMR Spectroscopy in Inorganic Chemistry (Oxford Chemistry Primers) 1st Edition by Jonathan A. Iggo</p>
Method of evaluation	<p>50.00% - Presentation 50.00% - Final exam</p>
Nature of the assignments	<p>Final exam will include practical experimentation with the NMR spectrometer and biomacromolecular sample. Presentations of advanced NMR-related topics will be assigned to course participants on a weekly basis.</p>
Course Policies	<p>All lectures/trainings are mandatory to attend.</p>
Additional Information	

Tentative Course Schedule

(Time, topic/emphasis & resources)

Week	Lectures	Topic
1	Sun 08/25/2019 Wed 08/28/2019	Classical NMR - from Bloch equations to 1D spectrum, chemical structure and dynamics and... Part 1 Part 2
2	Sun 09/01/2019 Wed 09/04/2019	Quantum NMR - from Schrodinger equation to single and multiple coherences Part 1 Part 2
3	Sun 09/08/2019 Wed 09/11/2019	NMR spectrometer - what is inside and how does it work? Part 1 Part 2
4	Sun 09/15/2019 Wed 09/18/2019	Pulse programming and several useful 1D experiments, like how to suppress the water resonance and decouple spins? Part 1 Part 2
5	Sun 09/22/2019 Wed 09/25/2019	22 September 2019 - Holidays Pulse programming and several useful 1D experiments, like how to suppress the water resonance and decouple spins? Part 3
6	Sun 09/29/2019 Wed 10/02/2019	Pulse programming and several useful 1D experiments, like how to suppress the water resonance and decouple spins? Part 4 Part 5
7	Sun 10/06/2019 Wed 10/09/2019	Multidimensionality of NMR experiments, how to? What for? Practical and applications of 2D spectroscopy. COSY, TOCSY, NOESY, ROESY. Part 1 Part 2
8	Sun 10/13/2019 Wed 10/16/2019	Multidimensionality of NMR experiments, how to? What for? Practical and applications of 2D spectroscopy. COSY, TOCSY, NOESY, ROESY. Part 3 Part 4
9	Sun 10/20/2019 Wed 10/23/2019	Multidimensionality of NMR experiments, how to? What for? Practical and applications of 2D spectroscopy. COSY, TOCSY, NOESY, ROESY. Part 5 Heteronuclei, adding another dimension - triple resonance 3D and 4D experiments for sequence specific resonance assignment of proteins and J-coupling measurements and applications. Part 1
10	Sun 10/27/2019 Wed 10/30/2019	27 October 2019 Mid-semester break Heteronuclei, adding another dimension - triple resonance 3D and 4D experiments for sequence specific resonance assignment of proteins and J-coupling measurements and applications. Part 2
11	Sun 11/03/2019 Wed 11/06/2019	Heteronuclei, adding another dimension - triple resonance 3D and 4D experiments for sequence specific resonance assignment of proteins and J-coupling measurements and applications. Part 3 Part 4
12	Sun 11/10/2019 Wed 11/13/2019	Heteronuclei, adding another dimension - triple resonance 3D and 4D experiments for sequence specific resonance assignment of proteins and J-coupling measurements and applications. Part 5 Part 6
13	Sun 11/17/2019 Wed 11/20/2019	X-detection, ¹³ C, ¹⁵ N detected experiments. Part 1 Part 2
14	Sun 11/24/2019 Wed 11/27/2019	Practical exams Theoretical exams

15	Sun 12/01/2019 Wed 12/04/2019	Practical exams Theoretical exams
16	Sun 12/08/2019	Final Exam and evaluation

Note

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