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

Course Syllabus: Biomolecule Structure and Function - B 214

Division	Biological and Environmental Sciences & Engineering Division
Course Number	B 214
Course Title	Biomolecule Structure and Function
Academic Semester	Fall
Academic Year	2019/2020
Semester Start Date	08/25/2019
Semester End Date	12/10/2019
Class Schedule (Days & Time)	02:30 PM - 04:00 PM | Sun Wed

Instructor(s)

Name	Email	Phone	Office Location	Office Hours
Stefan Theodor Arold	Stefan.Arold@KAUST.EDU.SA	+966128082557	4275, 2, Ibn Al-Haytham (bldg. 2)	I will be available directly after each of my classes without appointment. I will be available outside of classes upon appointment only (please contact me at stefan.arold@kaust.edu.sa to fix time and date).
Lukasz Jaremko	LUKASZ.JAREMKO@KAUST.EDU.SA	+966128082568	4337, 2, Ibn Al-Haytham (bldg. 2)	I will be available directly after each of my classes without appointment.
Mariusz Jaremko	MARIUSZ.JAREMKO@KAUST.EDU.SA			I will be available directly after each of my classes without appointment.

Teaching Assistant(s)

Name	Email

Course Information

Comprehensive Course Description	This course will start with an overview of the structural features of proteins and some other biological macromolecules, and discuss how these features have evolved to support specific functions. The course will then proceed to introduce the major methods used to determine 3D structures of proteins and other biomolecules, in particular X-ray crystallography, Nuclear Magnetic Resonance, cryo-Electron Microscopy, Small Angle X-ray Scattering and computational methods (Bioinformatics, 3D Homology Modelling). We will discuss the strengths and weaknesses of each method and to instruct students on how these methods are best used and combined. Finaly the course will discuss specific aspects of structure-function relationships, including drug design.

Course Description from Program Guide	This course will start with an overview of the structural features of proteins and some other biological macromolecules, and discuss how these features have evolved to support specific functions. The course will then proceed to introduce the major methods used to determine 3D structures of proteins and other biomolecules, in particular X-ray crystallography, Nuclear Magnetic Resonance, cryo-Electron Microscopy, Small Angle X-ray Scattering and computational methods (Bioinformatics, 3D Homology Modelling). We will discuss the strengths and weaknesses of each method and to instruct students on how these methods are best used and combined.
Goals and Objectives	This course is destined to provide biologists with the most important tools in biophysics, in particular concerning structural biology, advanced direct imaging methods. Thus, the course aims at allowing biology students to understand advanced imaging methods well enough to critically evaluate research in these areas, plan own experiments, and fully profit from available resources (for example the PDB, BMRB). For students with a physics, engineering or biophysics background, the course also provides an understanding of the physical basis for current state-of-the-art biophysical structural biology methods. Generally, for students in the field of bioscience, this course should provide a solid basis for their own experimental research, especially through its emphasis of hands-on practical tutorials.
Required Knowledge	Degree in biological, chemical sciences or engineering or consent of instructor. Solid understanding of chemistry and physics at the undergraduate level is required.
Reference Texts	Authors: John Cavanagh John Cavanagh Nicholas Skelton Wayne Fairbrother Mark Rance Arthur Palmer, III Wayne Fairbrother Arthur Palmer, III Nicholas Skelton Mark Rance Hardcover ISBN: 9780121644918 eBook ISBN: 9780080471037 Imprint: Academic Press Published Date: 20th November 2006 Page Count: 912 Principles of Physical Biochemistry 2nd Edition by van Holde, Kensal E, Curtis Johnson, Pui Shing Ho ISBN-13: 978-0130464279 ISBN-10: 0130464279 752 pages Online resources and scientific cliterature as discussed in the classes, and as required by student's background knowledge
Method of evaluation	**10.00**% - Others - Please specify **30.00**% - Final exam **30.00**% - Exam 2 **30.00**% - Exam 1
Nature of the assignments	Evaluation is based on exams (mid-term & final), but can also include assignments and/or oral participation (as discussed with instructors).
Course Policies	In accordance with the University policy and professional standards, the highest levels of academic integrity are expected in this class. The code of student conduct is strictly enforced. Academic dishonesty will result in reductions in grades and/or expulsions from this class and/or the University.
Additional Information	Being able to bring a personal laptop with the appropriate structural visualisation software is a plus, however not a necessity, because two students can share one computer (the recommended program is pymol; which can be obtained for students free of charge from KAUST; and can be downloaded as free educational-only-use version from https://pymol.org/edu/).

Tentative Course Schedule *(Time, topic/emphasis & resources)*		
Week	**Lectures**	**Topic**
1	Sun 08/25/2019 Wed 08/28/2019	Introduction To Macromolecular Structure & High-resolution Techniques: Principles And Use Of Macromolecular Structure Determination For Solving Biological Questions (SA, LJj, MJ) X-ray Crystallography L: History & Crystallization (SA)
2	Sun 09/01/2019 Wed 09/04/2019	X-ray Crystallography Ii: A Walk Through Reciprocal Space (SA) X-ray Crystallography Iii: Structure Determination (SA)
3	Sun 09/08/2019 Wed 09/11/2019	X-ray Crystallography Practical: Crystallization (SA) X-ray Crystallography Practical: Structural Analysis Through X-Ray Diffraction (SA)
4	Sun 09/15/2019 Wed 09/18/2019	3d Bioimormatlcs: Investigating 3d Structure And Function Using Available Data (SA) 3d Bioimormatlcs: Hands-on Case Studies (SA)
5	Sun 09/22/2019 Wed 09/25/2019	Holidays Cryo-em: The Resolution Revolution I
6	Sun 09/29/2019 Wed 10/02/2019	Cryo-em: The Resolution Revolution Ii Saxs & Other Low-resolution Methods (SA)
7	Sun 10/06/2019 Wed 10/09/2019	1st Midterm Exam (SA) Nuclear Magnetic Resonance meets macromolecules (LJ And MJ)
8	Sun 10/13/2019 Wed 10/16/2019	Nuclear Magnetic Resonance meets macromolecules... NMR– Spin Dynamics & Theoretical Bases…
9	Sun 10/20/2019 Wed 10/23/2019	Bio-material Preparation – Stable Isotope Labeling Strategies 1d, 2d, 3d, ... Nd Spectra And Pulse Programming?!
10	Sun 10/27/2019 Wed 10/30/2019	The Multidimensionality Of TheNmrReality Resonance Assignment I & Ii – Homo- And Heteronuclear Strategy
11	Sun 11/03/2019 Wed 11/06/2019	Assignment – All Complete Story Told Once Again. Spin Relaxation – The Macromolecular Motions Chemical Exchange And NMR
12	Sun 11/10/2019 Wed 11/13/2019	Midterm Exam. Understanding And Monitoring The Macromolecular Interactions – From Mm To Nm Affinity And Beyond (LJ And MJ)
13	Sun 11/17/2019 Wed 11/20/2019	Intrinsically Disordered Proteins (IDPs), Membrane Proteins - Do We Really Need A 3d Structure To Function And Why Membranes?
14	Sun 11/24/2019 Wed 11/27/2019	Few Words On Protein Deposits, Amyloids And Aggregates (LJ And MJ) No Existing Experiment To See What We Want? Molecular Dynamics Simulations (LJ And MJ)
15	Sun 12/01/2019 Wed 12/04/2019	Drug Design Or Discovery? How To Find More Potent Drugs - Medice Cura Te Ipsum (LJ And MJ)
16	Sun 12/08/2019	Final EXAM.

Note

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