BIOP 506 (PHY 506)
SPRING 2008

Molecular Physiology: From Molecular Machines to Biological Information Processing

(4 credits)

The class will meet Tuesdays & Thursdays at 1-3 in the large conference room, 4th floor, Jordan Hall

Course Director: Lukas K. Tamm, Jordan Hall Room 4075
Phone: 982-3578, lkt2e@virginia.edu

Prerequisites: Biochemistry 503, Chemistry 743, or equivalent

Course Objective: This course will introduce students to various aspects of molecular and cellular physiology and biophysics, including structural biology, quantitative studies of molecular interactions, biomolecular spectroscopy, proteomics, membrane biophysics, electron microscopy of large complexes, and advanced optical microscopy to study cellular processes and the inner workings of molecular machines such as contractile systems, ion conduction, cellular signal transduction, and synaptic transmission. The various techniques will be explained with specific examples from cellular and molecular physiology.

Grading: There will be two mid-term and a final exam, each counting ~33%.

SYLLABUS

Th 01/17	***Focus Lecture: From Genes to Proteins*** Course Objectives. Intro to biological materials, transcriptional & translational molecular machines	Tamm Derewenda

Foundations of Structural Biology

Tu 01/22	Protein Crystallography: Principles of x-ray Diffraction	Derewenda
Th 01/24	Protein Crystallography: Solving Macromolecular Crystal Structures	Derewenda
Tu 01/29	NMR Spectroscopy: Principles of NMR	Columbus
Th 01/31	NMR Spectroscopy: Multidimensional NMR and Structure Determination	Columbus
Tu 02/05	Dynamics of Macromolecules	Liang

Macromolecular Spectroscopy

Th 02/07	EPR Spectroscopy: Principles and Applications to Membranes and Membrane Proteins	Tamm
Tu 02/12	CD and FTIR Spectroscopy: Secondary Structures and Conformational Changes	Tamm
Th 02/14	Fluorescence Spectroscopy: Probing Environments, Dynamics and Distances	Tamm
Tu 02/19	***Midterm Exam***	
Th 02/21	***Focus Lecture: Contractile Systems and Biological Force Generation*** (includes also intro to folding and self-assembly)	Egelman

Macromolecular Assemblies

Tu 02/26	Basic Concepts of Electron Microscopy	Egelman
Th 02/28	Large Macromolecular Complexes	Egelman

Spring Break

Complex Biological Systems

Tu 03/11	Mass Spectrometry: Introduction and Theory	Sherman
Th 03/13	Mass Spectrometry: Protein Analysis	Sherman
Tu 03/18	Systems Biology	Sherman

Thermodynamics of Biological Systems

Th 03/20	Review of Foundations of Thermodynamics	Derewenda
Tu 03/25	Protein Folding in vitro and in vivo	Derewenda
Th 03/27	Equilibrium Phenomena and Macromolecular Interactions	Derewenda
Tu 04/01	***Midterm Exam***	
Th 04/03	***Focus Lecture: Molecular Machines in Membranes*** Intro to membrane dynamics, ion channels, transporters, and motors in membranes	Nakamoto

Bioelectricity

Tu 04/08	Protein and Membrane Electrostatics	Cafiso
Th 04/10	Electrochemical Equilibria	Cafiso

Tu 04/15	Ion Channels	Nakamoto
Th 04/17	Patch Clamp Recording	Nakamoto
Tu 04/22	Current Propagation and Synaptic Transmission in Neurons	Nakamoto

Optical Approaches to Molecular and Cellular Physiology

Th 04/24	Basic and Confocal Fluorescence Microscopy	Tamm/Kiessling
Tu 04/29	Two Photon and Laser Trap Microscopy	Tamm/Kiessling
Th 05/01	Single Molecule Fluorescence Microscopy	Tamm/Kiessling

Tu 05/06 ***Final Exam***