Course description

Introduction: This is a three-credit, upper-level undergrad/graduate course. This course will discuss the principles of various conventional and modern biophysical techniques and how these techniques may be applied to biological research to obtain unique and sometimes complementary information about biomacromolecules (*e.g.*, proteins, nucleic acids, lipids, etc). The organization of this course is divided into five modules: structural methods, spectroscopic methods, thermodynamics, hydrodynamics, and other techniques and applications. Most of the lectures will be given by expert faculty researchers from the greater Houston area (Rice, Baylor, UT, and UH). The goals are for the students to have a general impression of what these techniques are, how scientific literature on such topics can be properly interpreted, and how they can be useful for their own research projects. The pre-requisite is BIOS301 (Biochemistry) or equivalent. This is a core course for all students in the HAMBP and SCBMB graduate student training programs.

Course material: No course book. Relevant materials will be posted at the course website https://owlspace-ccm.rice.edu/portal.

Classroom: The class will meet in Keck 102.

Reference books: *Physical Biochemistry* by Holde, Johnson, and Ho
Biophysical Chemistry II and III by Cantor and Schimmel

Guest lectures:

Richard Brennan, rgbrenna@mdanderson.org
Biochemistry and Molecular Biology, MD Anderson

Susan Cates, mscates@rice.edu
Biochemistry and Cell Biology, Rice University

Margaret Cheung, mscheung@uh.edu
Physics, University of Houston

Wah Chiu, wah@bcm.tmc.edu
Biochemistry, Baylor College of Medicine

Michael Diehl, diehl@rice.edu
Bioengineering, Rice University

Kevin MacKenzie, mev@rice.edu
Biochemistry and Cell Biology, Rice University

Ed Nikonowicz, edn@rice.edu
Biochemistry and Cell Biology, Rice University

John Olson, olson@rice.edu
Biochemistry and Cell Biology, Rice University

Timothy Palzkill, timothyp@bcm.tmc.edu
Virology and Microbiology, Baylor College of Medicine

Steen Pedersen, pedersen@bcm.tmc.edu
Molecular Physiology and Biophysics, Baylor College of Medicine

Robert Raphael, rraphael@rice.edu
Bioengineering, Rice University

Yousif Shamoo, shamoo@rice.edu
Biochemistry and Cell Biology, Rice University

Joff Silberg, joff@rice.edu
Biochemistry and Cell Biology, Rice University

Ah-Lim Tsai, Ah-Lim.Tsai@uth.tmc.edu
Hematology, University of Texas Medical School in Houston

Ted Wensel, twensel@bcm.tmc.edu
Biochemistry, Baylor College of Medicine

Grading:

Four assignments	4 x 10%
Exam 1 (1st half of course)	20%
Exam 2 (2nd half of course)	20%
Final project	20%

There will be two close-book, in-class exams. In addition, there will be one final comprehensive project assignment in which you will be asked to write a five-page essay that discusses the application of biophysics techniques in studying a particular biological system. A list of possible systems will be provided. For your system of choice, you will be asked to review (1) how three biophysics techniques have been used in the past to provide unique information, and (2) how additional biophysics techniques may be used to further our understanding. More information about the final project assignment will be provided later in the semester.

Disability Support: Any student with a documented disability needing academic adjustments or accommodations is requested to speak with me during the first two weeks of class. All discussions will remain confidential. Additionally, students with disabilities will need to also contact Disability Support Services in the Ley Student Center.

Discussion topics

Structural methods	**6 lectures**	
NMR	2	Nikonowicz
X-ray	2	Shamoo
EM	2	Chiu
Spectroscopy	**4 lectures**	
Absorption, CD	1	MacKenzie/Pederson
Fluorescence	2	MacKenzie, Wensel
EPR	1	Tsai
Thermodynamics	**6 lectures**	
Thermodynamics and ligand binding	2	Olson
Complex equilibria and protein folding	2	Olson
Calorimetry	1	Brennan
Physics-based simulation and molecular dynamics	1	Cheung
Hydrodynamics	**3 lectures**	
Dynamic scattering and SAXS	1	Tao
Ultracentrifugation	1	Cates
Electrophoresis and chromatography	1	Tao
Other techniques and applications	**5 lectures**	
Single-molecule spectroscop	1	Diehl
Confocal microscopy	1	Raphael
Functional genomics	1	Palzkill
Laboratory evolution	1	Silberg
Mass spectrometry	1	Silberg