BCH 3125: Protein Structure and Function: Winter, 2015

Protein structure with an emphasis on modern physical methods used for its study. Advanced enzyme kinetics. Mechanisms of enzyme action. Regulation of enzyme activity. Introduction to protein folding and engineering.

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Lecture Outline:

Week	Lecture[i]	Date	Topic
1	1	Jan. 13[1]	The molecular basis of disease
	2	15[1]	The building blocks
2	3	20[1]	From primary to quaternary structure
	4	22[2]	Protein Visualization Tools
3	5	27[1]	Non-covalent interactions and protein folding
	6	29[1]	Role of water in protein-structure and interactions **(Q1[ii])**
4	7	Feb. 03[2]	X-ray crystallography: Protein Crystallization
	8	05[2]	X-ray crystallography: Bragg's law
5	9	10[2]	X-ray crystallography: Model building
	10	12[1]	Cryo-Electron and Atomic Force Miscroscopy[iii]
		17,19	*STUDY BREAK*
6	11	24[2]	Isothermal titration calorimetry and spectroscopic techniques
	12	26[2]	NMR spectroscopy: The fundamentals
7	13	March 03[1]	NMR spectroscopy: Multidimensional
	14	05[1]	Midterm I
8	15	10[1]	NMR spectroscopy: Protein 3D structure
	16	12[1]	Protein-ligand interactions - cooperative vs noncooperative binding
9	17	17[1]	Hemoglobin and oxygen transport
	18	19[1,iv]	Michaelis Menton kinetics and enzyme mechanisms
10	19	24[1]	Chemical approaches to serine protease function[v]
	20	26[1]	Structural approaches to serine protease function
11	21	31[1]	Protein engineering: catalysis and ligand binding
	22	April 02[1]	Tyrosyl-t-RNA Synthetase : energetics of hydrogen bonding
12	23	07[1]	Tyrosyl-t-RNA Synthetase: specificity and catalysis
	24	09	Midterm II

[i]Lectures: Tuesday 10:00-11:30, Thursday 8:30-10:00 in LMX122; DGD Friday 11:30-1:00 in FSS2005
[ii]Q1: Amino acid quiz
[iii]Choice of protein for assignment due. Late penalty of 1 point (1/15) per day
[iv]March 20 drop date for course
[v]Protein Assignment due. Late penalty of 1 point (1/15) per day

Synopsis of Course:

Life itself exists because of the complex macromolecular structures - proteins, DNA, RNA, membranes, etc. – that are found within and that ultimately define cells. To understand life, we must characterize these complex structures at the atomic level and elucidate how these structures interact with one another leading to cellular function. Understanding macromolecular structure and function is essential to understanding the molecular basis of human disease, and thus has important medical/pharmaceutical implications.

The main goal of this course is to learn about the mechanisms of protein function. To do so, we will first review the basic structural features of proteins discussed in second year. We will then learn about both the methods that are used to solve protein structures and the software used to visualize protein structures. For the remainder of the course, we will discuss select proteins. We will learn about the approaches that were used to elucidate their mechanisms of action. In the course of these studies, we learn the basic principles that govern the activities of all proteins - principles that can be applied to all biological macromolecules. We will also learn the framework that must be used to understand the mechanisms of protein function.

Marking Scheme: The course evaluation will be in the form of a quiz, two midterms, an assignment, and a final exam

Quiz (January 17, 2013): The quiz is on the 20 naturally occurring amino acids. You must know the chemical structure, the three letter and one letter code, and the relative polarity of each amino acid. You must also know the pKa of each ionizable side chain.

Assignment: You will be given one assignment to complete over the course of the term. Details regarding the assignment will be posted on Virtual Campus and discussed in class.

Midterm and Final Exam: There will be two midterms, which are not cumulative. The first midterm will cover lectures 1 to 11, not including lecture 4. The second midterm will cover lectures 12 to 23 (not including the midterm in lecture 14). The final exam will cover the entire course. The marking scheme is firm is as follows:

Quiz	5%
Assignment	15%
Each midterm	20% (x2=40%)
Final Exam	40%
	100%

The *only* exception is for those who have a better mark on the final than on the combination of the two midterm marks. If the final is worth more, then it will be worth 80% of the mark.

Text Books:

There is no textbook required for this course. We take bits and pieces from different sources. Any basic biochemistry text book will provide a basis for the material covered in the course. Additional information has been placed on reserve in the library.
Delving into the techniques used for the structural characterization of proteins is a daunting task for any biochemistry student. One usually learns something from each reference that is consulted. Reading several presentations on a topic may be required to fully understand some of the material covered in the course. Useful texts are:

1) “Biochemistry” Voet & Voet 3rd edition
2) "Proteins, Structure and Molecular Properties" by Thomas Creighton
3) "Physical Chemistry, Principles and Applications in Biological Sciences" by Tinoco, Sauer, Wang
4) “Physical Biochemistry” by van Holde, Johnson, and Ho
5) “Crystallography Made Crystal Clear” Gale Rhodes

Tutorials:
Friday 11:30-1:00 in FSS2005

Markers:
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