Fall 2018

BC411 – Physical Biochemistry

Instructors: Dr. Olve Peersen — Dr. Robert Cohen
Office: MRB 341 — MRB 273
Phone: 491-0433 — 492-4117
Email: Olve.Peersen@ColoState.edu — Bob.Cohen@ColoState.edu

Teaching Assistant: Ryan Czarny email: ryan.czarny@colostate.edu

Course Description
BC411 is delivered as a face-to-face course that covers fundamental concepts of physical chemistry and their application to understanding the behavior of biological systems. It is aimed at providing the student with an appreciation for the basic laws of thermodynamics, biochemical equilibria, reaction rates and kinetics in biological reactions, and molecular spectroscopy.

Learning Outcomes and Assessment
Students are expected to learn the applications of quantitative and experimental methods to study and understand biochemical processes. Students are expected to enter the course with a background in chemistry, physics, biology, mathematics (including calculus), and one full year of comprehensive biochemistry. Thus, students enrolled in BC411 will demonstrate the ability to understand the foundational principles from which fundamental biochemical processes are derived; understand how to interpret equations, formulas, and concepts that underlie these principles; and apply these equations, formulas, and concepts to conceptually understand various biochemical processes and solve problems based on experimental observations and quantitative data.

Class hours: BC411 Lectures: Mon–Wed–Fri 9:00–9:50 AM in Biology 136
BC411 Recitation **1:** Thu 9:00–9:50 AM in Clark A202
BC411 Recitation **2:** Thu 2:00–2:50 PM in Pathology 111

Office hours: Dr. Cohen: Friday, 2:00 – 2:50 PM in MRB 273
Dr. Peersen: Friday, 1:00 – 1:50 PM in MRB 341
Ryan Czarny: Tuesday, 2:30 – 4:30 PM in MRB 250

Pre/Co-requisites: Biochemistry (BC401, or BC351 with instructor approval)
CHEM113, MATH161 or MATH255.

Text: *The Molecules of Life* (2012) by Kuryan, Konforti & Wemmer; Garland Science
NOTE: E-book versions are available for purchase or rental from Amazon

Grading: The traditional grading (A, B, C…) system will be used. Grades in BC411 will be based on four exams (15% each), a two-hour comprehensive final (25%), and weekly problem sets (15%). Students are expected to devote 6 hours each week to complete the assigned homework. A portion of the homework grade will come from in-recitation presentations of answers to the problem sets.

CSU Student Honor Code: This course will adhere to the Academic Integrity Policy of the Colorado State University General Catalog {Page 7} and the Student Conduct Code.

BC411 Syllabus – Fall 2018

	Date	*Subject*	*Reading*	*Inst*
	Aug. 20	Introduction to Course & Thermodynamics	Syllabus – Ch 1	RC
	22	Systems, ideal gas equations	Ch 6A	RC
Wk1	23	*Recitation (Math concepts)*		
	24	Thermodynamic Laws	Ch 6.3, 7, & 8	RC
	Aug. 27	Free energy and solutions/Standard State	Ch 7 & 8	RC

	29	Intro macromolecular structure/Protein Folding	Ch 8 & 9	RC
Wk2	30	*Recitation*		
	31	Non-covalent interactions	Ch 10A & 10B	RC
Sep.	3	**Labor day – no class**		RC
	5	2° Structure; Ramachandran diagram	Ch 9.10 & 9.11	RC
Wk3	6	*Recitation*		
	7	Experimental Thermodynamics *End for Exam I*	Ch 10D	RC
Wk4	10	Introduction to spectroscopic methods	Supplemental	OP
	12	**Exam I**		OP
	13	Wave-Particle Duality, Biological Chromophores	Supplemental	
	14	Absorbance	Supplemental	OP
Sep.	17	UV/VIS Absorbance – protein quantitation methods	Supplemental	OP
	19	Circular Dichroism Spectroscopy	Supplemental	OP
Wk5	20	*Recitation*		
	21	Fluorescence Spectroscopy I	Supplemental	OP
Sep.	24	Fluorescence Spectroscopy II – Environmental effects	Supplemental	OP
	26	Fluorescence Spectroscopy III – Polarization	Supplemental	OP
Wk6	27	*Recitation*		
	28	Fluorescence Spectroscopy IV – FRET *End for Exam II*	Supplemental	OP
Oct.	1	Analytical Ultracentrifugation		OP
	3	**Exam II**		OP
Wk7	4	*Recitation*		
	5	Nuclear Magnetic Resonance of proteins		OP
Oct.	8	Multidimensional NMR		OP
	10	Protein structure by NMR		OP
Wk8	11	*Recitation*		
	12	Crystallography I: Crystals & Symmetry		OP
Oct.	15	Crystallography II: Diffraction		OP
	17	Crystallography III: The Phase Problem		OP
Wk9	18	*Recitation*		
	19	Crystallography IV: Density Maps *End for Exam III*		OP
Oct.	22	**Exam III**		**TA**
	24	Kinetics – General principles for rates, reaction orders	Ch 15A (15.1–.8)	OP
Wk10	25	*Recitation*		
	26	Kinetics – Half-lives, sequential reactions	Ch 15A (15.9–.10)	OP
Oct.	29	Reversibility, equilibrium, steady state	Ch 15B (15.11–18)	OP
Wk11	31	Rate constants, catalysis and activation energy	Ch 15C (15.22–.30)	OP
Nov.	1	*Recitation*		
	2	Enzyme catalysis – Michaelis-Menten Kinetics	Ch 16A (16.1–.8)	RC
Nov.	5	Complex enzymatic reactions and inhibition	Ch 16B (16.9–.17)	RC
	7	Inhibition, concentrations at equilibrium	Ch 16B (16.9–.17)	RC
Wk12	8	*Recitation*		
	9	Affinity & specificity *End for Exam IV*	Ch 13A (13.1–.9)	RC
Nov.	12	Protein-Protein Interactions	Ch 13B (13.10–.21)	RC
	14	Protein-Nucleic Acid Interactions	Ch 13C (13.22–33)	RC
Wk13	15	*Recitation*		
	16	**Exam IV**		RC

Nov 19-23	**Fall Break week – no classes**		
Nov. 26	Allostery and biological responses	Ch 14A (14.1–.9)	RC
28	Molecular Recognition – Drug binding	Ch 12B (12.12–.23)	RC
Wk14 29	*Recitation*		
30	Membranes: Composition and Structure	Ch 3B (3.13–.23)	RC
Dec. 3	Membrane Proteins	Ch 4D (4.31–.44)	RC
5	Mass Spectrometry	Supplemental	RC
Wk15 6	*Recitation*		
7	Protein Analysis by Mass Spectrometry	Supplemental	RC

Dec. 13 ***Thursday***	**Final Exam** **4:10 – 6:10 PM in Biology 136** Approximately half of the final exam will be on material since Exam IV and the other half will be comprehensive over the full semester		

Additional useful resources for the course (<u>not required</u>):

Principles of Physical Biochemistry, 2nd Ed., by van Holde, Johnson, and Ho (2006)

Principles and Problems in Physical Chemistry for Biochemists
by Price, Dwek, Ratcliffe & Wormald (2002)