CHEM 361

Physical Biochemistry

Professor: Joseph T. Jarrett
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Lectures
Tues & Thurs
12:00 – 1:15 pm
Bilger 341c

Office Hours
Mon
12 – 1 pm
(or email for an appt)

Textbook: **The Physical Chemistry of the Life Sciences**
Authors: Peter Atkins and Julio de Paula
Publisher: W.H. Freeman, New York, 2011.
ISBN: 1-4292-3114-9
UH Bookstore: $155 new, $118 used
Amazon.com: $100 + shipping
e-textbook is available from CourseSmart.com: $80

Lectures:
- The class will be divided into 4 blocks with 6-8 lectures per block.
- Most lectures will be based on the textbook. However, there are not enough lectures to cover everything, so you may have to learn some points from the textbook on your own.
- Where time permits, we'll try to cover techniques and instruments that take advantage of or measure specific physical properties.

Homework:
- Reading assignments will be given prior to each lecture.
- You are responsible for everything in the reading, even if it is not covered in lecture.
- On weeks with no exam, there will be a homework problem set, usually chosen from problems in the textbook. You will get credit for a reasonable attempt at each problem, even if some details are wrong. Time-permitting, we will go over the correct answers in class.

Grading:
- **Homework worth 20%** total. You may work together on the homework assignments. Please be certain that everyone in your group understands the problem and answer, and everyone should separately turn in the assignment.
- **Two midterm exams each worth 25%** of the final grade.
- **Final exam worth 30 %** of the final grade.

Equation sheet: For each exam you will be allowed to bring one letter sized page with hand-written equations and physical constants. Most physical constants will also be provided on the exam. The equation sheet and any scrap paper must be stapled to the exam and turned in for inspection.

Calculator: You must have a calculator capable of natural logarithms and exponentials. Programmable calculators are OK. Cell phones and any device with transmit or receive functions are not permitted.

Make up exam policy: Students who miss an exam for a valid illness or university obligation will be given a make-up exam within one week, provided they are able to furnish written proof or the absence has been arranged ahead of time. After one week, if you have not contacted me and arranged a make-up, you will receive zero credit for that exam.

Student Learning Outcomes:

- This course will focus on the basic principles of physical chemistry applied to biological systems and emphasize the interdisciplinary nature of physical biochemistry.
- Students will learn about the relevance of theoretical concepts for experimental analysis and gain a basic understanding of how thermodynamics, kinetics, and spectroscopy can be applied in biosciences.
- Students will gain awareness of current physical and biochemical issues and applications.
- Students will learn about literature search processes, selection of relevant articles, and use of scientific databases in order to gain knowledge of new advances in physical biochemistry.
- Students will learn about benefits of collaboration by working on problem sets in groups.

Lec #	Date	Topic	Reading
	1	**Thermodynamics**	
1	08/27	Introduction.	Fundamentals (pp 1-17)
2	08/29	The first law: conservation of energy; heat capacity	Ch. 1 (pp 23 – 38)
3	09/03	Enthalpy, energy, and heat: what's the difference?	Ch. 1 (pp 38 – 57)
4	09/05	Reaction enthalpies; Hess' Law; using enthalpies of formation for prediction	Ch. 1 (pp 58 – 64)
5	09/10	The second law: entropy	Ch. 2 (pp 70 – 83)
6	09/12	Gibbs Free energy	Ch. 2 (pp 84 – 90)
7	09/17	Phase equilibria; phase transitions in large biopolymers	Ch. 3 (pp 94 – 109)
8	09/19	Thermodynamics of solutions; colligative properties	Ch. 3 (pp 110 – 127)
9	09/24	Chemical equilibrium: thermodynamic considerations	Ch. 4 (pp 135 – 150)
10	09/26	Coupled reactions; acid-base equilibria	Ch. 4 (pp 151 – 173)
11	10/01	Thermodynamics of ion transport and membrane potentials	Ch. 5 (pp 181 – 188)
12	10/03	Thermodynamics of redox reactions and biological electron transport	Ch. 5 (pp 188 – 207)
13	10/08	Bioenergetics, respiration, and photosynthesis Exam Review	Ch. 5 (207 – 211) & handout
	10/10	**EXAM 1**	**Ch. 1 – 5**
	2	**Kinetics**	
14	10/15	Reaction rates, rate constants, and integrated rate laws	Ch. 6 (pp 219 – 234)
15	10/17	The Arrhenius equation	Ch. 6 (pp 235 – 238)
16	10/22	Reaction mechanisms	Ch. 7 (pp 243 – 258)
17	10/24	Reaction dynamics: collision theory and transition state theory	Ch. 7 (pp 259 – 266)
18	10/29	Enzyme kinetics	Ch. 8 (pp 273 - 284)

19	10/31	Electron transfer; Marcus theory	Ch. 8 (pp 296 - 302)
	3	**Biomolecular Structure**	
20	11/05	Principles of quantum theory	Ch. 9 (pp 313 – 336)
21	11/07	Hydrogen atoms; many electron atoms	Ch. 9 (pp 337 – 356)
22	11/12	Valence bond theory; molecular orbital theory	Ch. 10 (pp 365 - 385)
23	11/14	Polyatomic molecules; metal complexes; computational chemistry	Ch. 10 (pp 386 - 401)
	11/19	**EXAM 2**	**Ch. 6 - 10**
24	11/21	Macromolecules: determining size, shape, and three-dimensional structure	Ch. 11 (pp 407 - 423)
25	11/26	Forces that control structure; levels and types of structure	Ch. 11 (pp 424 – 455)
26	12/03	Spectroscopy: general features; vibrational spectroscopy	Ch. 12 (pp 463 – 484)
28	12/05	Electronic spectroscopy: UV-vis abs, fluorescence, phosphorescence	Ch. 12 (pp 485 – 505)
29	12/10	Magnetic resonance; NMR	Ch. 13 (pp 514 – 527)
30	12/12	Pulse techniques in NMR	Ch. 13 (pp 528 – 536)

	12/17	**Cumulative Final Exam.**	**12:00 pm – 2:00 pm**