Course Overview: Chemists and biochemists often use of mathematical models to describe natural phenomena. An understanding of these models is fundamental to doing and understanding biochemistry. We will concentrate on how thermodynamics, kinetics and quantum mechanics can be used to understand biochemistry.

Instructor: Dr. Gutow Office: HS-412 Phone: 424 – 1324

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Office Hours: MTWF 9 – 10, Th 8:30 – 9:30 *or by appointment.*

Required Text: Atkins & de Paula, *Physical Chemistry for the Life Sciences*, 2nd Edition

Required Equipment: scientific calculator.

Prerequisites: Math 171, Chem 303 (may be concurrent), Physics 108/172 or 110/192.

Class times: *Lectures*: MWF 8 – 9 (HS 457)

Reading Assignments and Homework will cover a week or two and *will have parts due at the beginning of each class meeting*. Assignments will not be accepted late, but some of your lowest scores will be dropped.

You are encouraged to discuss the homework with your classmates and instructor. The important thing is to understand the problems and exercises. Doing all the homework is the best way to understand the material and prepare for exams.

> **Reading Assignments** will come primarily from the textbook. Other sources will be used as necessary.
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> **Homework** will be *due for each class* and consist of up to three sections. The first two sections will focus on material we will be discussing during the class meeting for which the assignment is completed.
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> > **Critical Thinking Exercises/Discussion Questions:** The questions are designed to help you learn how to use the textbook and other reference sources to prepare for class. For example, you might be asked to find definitions, compare two models and explain when it is appropriate to use each or work through some 'what if' calculations.
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> > **Practice Exercises**: These will come primarily from the exercises section at the end of the chapter. The goal is to help you figure out what you need to ask about in class.
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> > **Problems:** These problems will be a little more challenging and based on material discussed in previous class meetings.

In Class Exercises will typically be worksheets/group exercises. You will receive 100% credit for putting in honest effort on the exercise during class.

Exams: There will be four one hour in class exams (see last page for course schedule), worth 200 points each (plus 20 points of extra credit distributed throughout the exam). The material requires that exams be cumulative, but primary emphasis will be on the chapters covered since the previous exam. The goal of this course is not to memorize formulas, but to learn how to use models to make predictions. You will be provided with an equation sheet for each exam consisting of the fundamental equations of each model. Additionally, you will be allowed to bring a 3" x 5" card of ***handwritten*** notes to the exam.

Grading:

Homework and in Class Exercises:	43%
Exams:	57%
Total:	100%

Grade Cutoffs: A/A- > 88%, B+/B/B- > 78%, C+/C/C- > 68%, D+/D > 60%, F ≤ 60%. The cutoffs will not be adjusted upwards, but the instructor reserves the right to lower them.

Assessment of Learning: Your grade in this course will be based on demonstrating your ability to do a number of things on exams and homework. The list below provides a general overview. Assigned homework and the checklists at the end of each chapter in the textbook provide more specificity:

1. describe the structure and composition of matter;
2. apply theoretical and mechanistic principles to the study of chemical systems employing both qualitative and quantitative approaches;
3. use theories of microscopic properties to explain macroscopic behavior;
4. explain the role of energy in determining the structure and reactivity of molecules;
5. use mathematical representations of physical phenomena;
6. extract information from resources such as books, the web and databases.

Additional Resources:

WEB RESOURCES: This syllabus, assignments, answer keys and useful links will be available in the course CANVAS site: https://uwosh.instructure.com/courses/287020. A public class website with limited content (syllabus and some links) is at: https://www.uwosh.edu/facstaff/gutow/biophysical_chemistry. Dr. Gutow also maintains many resources that are generally useful to chemists on his website at: http://www.uwosh.edu/facstaff/gutow.

SYMBOLIC MATH PACKAGES: These can help you do algebra and calculus. The open source SageMath package is available on the P-Chem lab computers or can be downloaded from the SageMath web site and installed on your personal computer. Alternatively, you can try a somewhat different version hosted in the cloud at https://cocalc.com. You will be introduced to SageMath during the first few meetings of the class. MAPLE™ is also available on the computers in the open access labs in Halsey.

TEXTS: The following books are on reserve at Polk Library. You may find it useful to see difficult concepts described a number of ways. Homework assignments will suggest sections of these texts to look at for additional help.

- Barrante, *Applied Mathematics for Physical Chemistry* QD455.3.M3 B37. A good review of chemical applications of graphing and calculus.
- Warren, *The Physical Basis of Chemistry*, QD475.P47. This book has nice simplified, but accurate, descriptions of many of the quantum, and spectroscopic concepts we will discuss.

Tentative Lecture Schedule S20:

Topic (text sections)	Lectures
I. Thermodynamics (Energy & Entropy)	
Math tools/Review & The First Law (chapter 1)	2/3, 2/5, 2/7, 2/10
The Second Law (chapter 2)	2/12, 2/14
Phase Equilibria (chapter 3)	2/17, 2/19, 2/21
Wrap-up/Review	2/24
Exam 1 (Unit I)	**Wednesday, February 26**
II. Equilibria and Electrochemistry	
Chemical Equilibria (chapter 4)	2/28, 3/2, 3/4, 3/6, 3/9
Ion and Electron Transport (chapter 5)	3/9, 3/11, 3/13, 3/16
Wrap-up/Review	3/18
Exam 2 (Unit II)	**Friday, March 20**
SPRING BREAK	
III. Kinetics	
Reaction Rates (chapter 6)	3/30, 3/31
Rate Laws and Mechanisms (chapter 7)	4/1, 4/3, 4/6
Complex Mechanisms (chapter 8)	4/8, 4/10, 4/13
Wrap-up/Review	4/15
Exam 3 (Unit III)	**Friday, April 17**
IV. Quantum Mechanics and Structure	
Quantum Mechanics (chapter 9)	4/20, 4/24, 4/27
Bonding (chapter 10)	4/29, 5/1, 5/4
Macromolecules and Self-Assembly (chapter 11)	5/6, 5/8, 5/11, 5/13
Wrap-up/Review	5/13
Exam 4 (Unit IV)	**Friday, May 15**

General Information

ACADEMIC MISCONDUCT: Representing the work of another as your own is considered academic misconduct. Any assignment (exams) which you are required to do individually should contain only your own work. Using ideas and writing from the work of others without proper attribution is considered plagiarism and could result in expulsion. See the Dean of Students office website for more information.

ABSENCES: You are responsible for informing your instructor of absences and making arrangements to make up any missed work. If an emergency (medical or exceptional personal circumstances) will cause you to miss more than three (3) days of class or prevents you from contacting individual instructors you should request an out-of-class letter from the Dean of Students office, which will go to all your instructors and provide you with one initial contact point.

STUDENTS RIGHT TO KNOW ACT OF 1990: Students are advised to see the following URL for disclosures about essential consumer protection items required by the Students Right to Know Act of 1990: https://uwosh.edu/financialaid/consumer-information/.

COURSE CATALOG/BULLETIN ENTRY: **Chemistry 365** (3 crs.) **Biophysical Chemistry**. This course focuses on Thermodynamics, kinetics, chemical equilibria and spectroscopy as they pertain to biological molecules, macromolecules and cells.