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: MW 1:50–2:50, T 12–1, Th 12:30–1:30, F 9:45–10:45 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 or 110.

Class times: *Lectures*: MWF 12:40-1:40 (HS 456)

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 prepare for exams and to really understand the material.

Reading Assignments will come primarily from the textbook. Other sources will be used as necessary.

Homework will be *due for each class* and consist of three sections of one or more questions each. The first two sections will focus on material we will be discussing during the class meeting for which the assignment is completed.

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.

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.

Problems: These problems will be a little more challenging and based on material discussed in the previous 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:	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.

Additional Resources:

WEB RESOURCES: This syllabus, copies of homework assignments, answer keys and useful links will be available at the course D2L website. Dr. Gutow also maintains many resources that are generally useful to chemists on his website at: http://www.uwosh.edu/facstaff/gutow.

CLASS DISCUSSION LIST: A private Google group has been set up for this class. Registering for the class adds you to the group. This e-mail discussion group will be used by the instructor to distribute notices and copies of assignments. You should use this group to ask questions of fellow students. The instructor monitors the list and will try to address any unanswered questions after 24 hours. If you want to access the group on the web the direct link is: https://groups.google.com/d/forum/uwo_chem365f15.

SYMBOLIC MATH PACKAGES: These can help you do algebra and calculus. The open source SageMath package is available on the Dr. Gutow's SageMath server (https://141.233.196.149/sage/) or can be downloaded from the SageMath website (http://www.sagemath.org) and installed on your personal computer. Information on user accounts on Dr. Gutow's SageMath Server will be provided in class. Alternatively, you can try a somewhat different version hosted in the cloud at https://cloud.sagemath.com/. MAPLE™ is also available on the computers in the open access labs in Halsey.

TEXTS: The following books are on reserve in in the Halsey Resource Center (HS-289). 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, spectroscopic and thermodynamic concepts we will discuss.

Assessment of Learning: As part of the department's assessment of its majors program, evidence will be added to your portfolios to demonstrate your ability to do a number of things.

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.

Lecture and Exam Schedule:

Topic (text sections)	Lectures
I. Thermodynamics (Energy & Entropy)	
The First Law (chapter 1)	9/9, 9/11, 9/14
The Second Law (chapter 2)	9/16, 9/18
Phase Equilibria (chapter 3)	9/21, 9/23, 9/25
Wrap-up/Review	9/28
Exam 1 (Unit I)	**Wednesday, September 30**
II. Equilibria and Electrochemistry	
Chemical Equilibria (chapter 4)	10/2, 10/5,10/7, 10/9
Ion and Electron Transport (chapter 5)	10/12, 10/14, 10/16, 10/19
Wrap-up/Review	10/21
Exam 2 (Unit II)	**Friday, October 23**
III. Kinetics	
Reaction Rates (chapter 6)	10/26, 10/28
Rate Laws and Mechanisms (chapter 7)	10/30, 11/2, 11/4
Complex Mechanisms (chapter 8)	11/6, 11/9, 11/11
Wrap-up/Review	11/13
Exam 3 (Unit III)	**Monday, November 16**
IV. Quantum Mechanics and Structure	
Quantum Mechanics (chapter 9)	11/18, 11/20, 11/23
Thanksgiving Break	
Bonding (chapter 10)	11/30, 12/2, 12/4
Macromolecules and Self-Assembly (chapter 11)	12/7, 12/9, 12/11, 12/14
Wrap-up/Review	12/16
Exam 4 (Unit IV)	**Friday, December 18**