

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

E-mail: gutow@uwosh.edu Web: <https://cms.gutow.uwosh.edu/Gutow>

Office Hours: MW 11 – 12 (HS – 412), T 1:30 – 3:30 (HS – 1, the glass shop), F 10:15 – 11:15 (HS - 412) *or by appointment (online requires an 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 9:10 – 10:10 (HS – 208)

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.

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.

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. These will be graded as full credit for *honest effort* even if incorrect. Make sure to show work.

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. These will be graded as full credit for *honest effort* even if incorrect. Make sure to show work.

Problems: These problems will be a little more challenging and based on material discussed in previous class meetings. Partial credit will be given on problems. To receive full credit you must show your work and get the correct result.

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/482491>. A public class website with limited content (syllabus and some links) is at:

<https://cms.gutow.uwosh.edu/Gutow/classes/current-classes/biophysical-chemistry-chem-365>.

Dr. Gutow also maintains many resources that are generally useful to chemists on his website at: <https://cms.gutow.uwosh.edu/Gutow>.

COMPUTER AIDES TO HELP WITH P-CHEM PROBLEM SOLVING: In this class you are encouraged to use computer assistance for algebra, calculus and numerical computations. There are lots of options (e.g. [Maple™](#), [MathCAD™](#), [Mathematica™](#), [SageMath](#), and others), but the *Python* programming language plus a web interface called *Jupyter* has recently been widely adopted for scientific computing and mathematics, so we will focus our efforts on that in class.

The software is available on a server at: <https://math.gutow.uwosh.edu>. You will be provided with server log-in information during the first meeting of class. This software is open-source and could also be installed on your own computer. Dr. Gutow will provide instructions for installation, if requested.

ACCOMMODATIONS: It is the University's policy to provide reasonable accommodations to students who have documented disabilities that may affect their ability to participate in course activities or to meet course requirements. Students are expected to inform instructors of the need for accommodations as soon as possible by presenting an Accommodation Plan from either the [Accessibility Center](#), [Project Success](#), or both. Reasonable accommodations for students with disabilities is a shared instructor and student responsibility.

THERE ARE LOTS OF SUPPORT SERVICES ON CAMPUS: If you have an emergency, mental health issue, suffer harassment, have food insecurity, ..., see "Where to get help" module in the class Canvas site.

Tentative Lecture Schedule S22:

| Topic (text sections) | Lectures |
|-------------------------------------------------|-------------------------------|
| I. Thermodynamics (Energy & Entropy) | |
| Math tools/Review & The First Law (chapter 1) | 1/31, 2/2, 2/4, 2/7 |
| The Second Law (chapter 2) | 2/9, 2/11 |
| Phase Equilibria (chapter 3) | 2/14, 2/16, 2/18 |
| Wrap-up/Review | 2/21 |
| Exam 1 (Unit I) | Wednesday, February 23 |
| II. Equilibria and Electrochemistry | |
| Chemical Equilibria (chapter 4) | 2/25, 2/28, 3/2, 3/4, 3/7 |
| Ion and Electron Transport (chapter 5) | 3/7, 3/9, 3/11, 3/14 |
| Wrap-up/Review | 3/16 |
| Exam 2 (Unit II) | Friday, March 18 |
| SPRING BREAK | |
| III. Kinetics | |
| Reaction Rates (chapter 6) | 3/28, 3/30 |
| Rate Laws and Mechanisms (chapter 7) | 4/1, 4/4, 4/6 |
| Complex Mechanisms (chapter 8) | 4/6, 4/8, 4/11, 4/13 |
| Wrap-up/Review | 4/15 |
| Exam 3 (Unit III) | Monday, April 18 |
| IV. Quantum Mechanics and Structure | |
| Quantum Mechanics (chapter 9) | 4/20, 4/22, 4/25 |
| Bonding (chapter 10) | 4/27, 4/29, 5/2 |
| Macromolecules and Self-Assembly (chapter 11) | 5/4, 5/6, 5/19, 5/11 |
| Wrap-up/Review | 5/11 |
| Exam 4 (Unit IV) | Friday, May 13 |

General Information:

OFFICIAL BULLETIN COURSE DESCRIPTION: This course focuses on thermodynamics, kinetics, chemical equilibria and spectroscopy as they pertain to biological molecules, macromolecules and cells. 3 crs.

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/>.

RESPECTING THE DIVERSITY OF OUR COMMUNITY: Diversity drives innovation,

creativity, and progress. At the University of Wisconsin Oshkosh, the culture, identities, life experiences, unique abilities, and talents of every individual contribute to the foundation of our success. Creating and maintaining an inclusive and equitable environment is of paramount importance to us. This pursuit prepares all of us to be global citizens who will contribute to the betterment of the world. We are committed to a university culture that provides everyone with the opportunity to thrive. Therefore, all members of our community are expected to treat each other with respect and apply intellectually rigorous critical analysis to all their interactions with others (e.g. activities, discussions, arguments, etc...).