Meets (4 cr) *Lecture:* MWF 10:20–11:20 (HS–457). *Lab:* M 1:50–5:10 or T 10:20–1:40 (HS–428).

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Office Hours: MWF 8:30 –9:30, T 2:15–3, Th 10:50–11:50 *or by appointment.*

Required Texts and Supplies

Readings will be from the LibreText Physical Chemistry Library (links provide with specific assignments), plus additional instructor provided material as necessary.

Gutow, *Chem 370 Lab Manual Spring 2025.*

Bound duplicating lab notebook; calculator; safety goggles.

Course Description: This semester both students needing Chem 370 (Physical Chemistry I) and Chem 365 (Biophysical Chemistry) are taking this course. As such the topics contained in both courses will be covered. Topics for Chem 370 will be covered in less depth than normal. The missing depth will return in Chem 371 (Physical Chemistry II) in place of the material covered this semester that is usually covered in Chem 371.

Chem 370 (from bulletin): Fundamental principles of physical chemistry. Lecture topics include ideal and real gases, kinetic theory, thermodynamics, equilibria, properties of solutions, surface and colloid chemistry. Laboratory includes experiments that are designed to illustrate the lecture material. Prerequisites: Mathematics 273 (may be taken concurrently), Chemistry 235, and Physics 192 (may be taken concurrently), and declared chemistry major or consent of instructor.

Chem 365 (from bulletin): This course focuses on thermodynamics, kinetics, chemical equilibria and spectroscopy as they pertain to biological molecules, macromolecules and cells. Prerequisite: Chemistry 303, Math 171 and either Physics 172 or 192.

Course Overview: Chemists often use mathematical models to describe natural phenomena. In this class you will learn to use the mathematical tools of thermodynamics, kinetics and quantum mechanics to model molecules and macromolecules, chemical equilibria, chemical energetics and chemical reactions.

After taking this course you should be able to:

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

The anticipated schedule of topics is provided in the last section of this syllabus.

Reading Assignments and Homework *will have parts due at the beginning of most class meetings*. 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 the class tutor, but copying answers will not provide sufficient practice for exams. You need to study the material so that ultimately you can answer the questions independently. If you get stuck, ask the professor for help!

Reading assignments will come primarily from the LibreText website. Other sources will be used as necessary.

Homework will be *due for most class meetings* 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 text 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: 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 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 material 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.

Lab will concentrate on making measurements related to the topics covered in the class and analyzing the data using the quantitative models discussed during the semester. Laboratory will provide opportunities to assess your chemical knowledge and document your ability to:

- read and follow experimental protocols;
- properly set up and safely manipulate laboratory equipment;
- plan and execute experiments, including the use of the chemical literature;
- maintain accurate records of experimental work;
- perform error propagation and assess reliability of results;

- prepare effective written scientific reports;
- use mathematical representations of physical phenomena;
- use and understand modern instrumentation;
- use computers for chemical applications;
- retrieve specific information from the chemical literature;
- work cooperatively in problem solving situations.

The experiments this semester will cover: thermodynamic measurements (calorimetry and electrochemistry); equilibria (chemical and solubility); chemical kinetics; and quantum calculations. See the last section for a more detailed schedule.

The detailed laboratory schedule and grading specifications are included in the lab manual. In addition to in lab performance you will be evaluated on (see the lab manual for details):

- *Laboratory Notebooks*: These will include pre-lab, during the experiment and analysis notes.
- *Lab Reports*: You will be preparing formal reports, a posters, a news article, and an oral report. You will have a chance to rewrite some of these to improve your grade.
- *Peer Reviews*: You will get credit for reviewing some of your peers' work in a timely manner so that your input can be used by your peers to rewrite their work.
- *SciFinder Searches*: You will do a number of literature searches to find articles related to the experiments you do.
- *Final Lab Quiz*: This will focus on your understanding of concepts from lab, and some simple data analysis including error propagation.

Grading:

Homework & group exercises:	25%
Exams:	50%
Lab:	25%

Course Attendance Policy: Students are expected to attend every scheduled class meeting. If you miss a lecture you should get class notes from a classmate or the professor. You are responsible for informing your instructor of absences and making arrangements to make up any missed work.

Additional Resources:

Web: Class content and useful links will be in the course CANVAS site: https://uwosh.instructure.com/courses/749543. A public class website with limited content (syllabus and some links is at: https://cms.gutow.uwosh.edu/Gutow/classes/current-classes/physical-chemistry-1-chem-370.

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 learn to use that. The software is available on a server at:

https://math.gutow.uwosh.edu. You will be provided with server log-in information during class. This software is open-source and can also be installed on your own computer. Dr. Gutow will provide instructions for installation.

University Policies:

It is the policy and practice of UW Oshkosh to create an inclusive learning environment. If there are aspects of the instruction or design of this course that result in barriers to your inclusion, please notify me as soon as possible. For more information about **accommodations**, visit the Dean of Students Office's Accessibility Center (https://www.uwosh.edu/cadr/).

The University of Wisconsin Oshkosh is built upon a strong foundation of integrity, respect, and trust. All members of the university community have a responsibility to be honest and the right to expect honesty from others. Any form of academic misconduct is unacceptable to our community and will not be tolerated. See the Dean of Students Office's Academic Misconduct site for more information (https://www.uwosh.edu/deanofstudents/student-conduct/academic-misconduct/).

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/.

Approximate Course Schedule
Tentative Lecture Schedule S25:

Topic	**Lectures**
I. Thermodynamics (Energy & Entropy)	
The First Law	2/3, 2/5, 2/7
The Second Law	2/10, 2/12, 2/14
Phase Equilibria	2/14, 2/17, 2/19, 2/21
Wrap-up/Review	2/21
Exam 1 (Unit I)	Monday, February 24
II. Equilibria and Electrochemistry	
Chemical Equilibria	2/26, 2/28, 3/3, 3/5, 3/7
Ion, Electron Transport, Electrochemistry	3/7, 3/10, 3/12, 3/14
Wrap-up/Review	3/17
Exam 2 (Unit II)	Wednesday, March 19
Current Battery Technology	3/21
SPRING BREAK	
III. Kinetics	
Reaction Rates	3/21, 4/2
Rate Laws and Mechanisms	4/4, 4/7, 4/9
Complex Mechanisms	4/9, 4/11, 4/14, 4/16
Wrap-up/Review	4/18
Exam 3 (Unit III)	Monday, April 21
IV. Quantum Mechanics and Structure	
Quantum Mechanics	4/23, 4/25, 4/28
Bonding	4/30, 5/2, 5/5
Intermolecular Forces and Macromolecules	5/7, 5/9, 5/12, 5/14
Wrap-up/Review	5/14
Exam 4 (Unit IV)	Friday, May 16

Tentative Lab Schedule S25:

Week of	**In Class**	**Complete before Class (**how turned in)
2/3	Safety and introduction to tools and lab requirements.	☐ Review lab safety guidelines. ☐ Review lab expectations and evaluation
2/10	Thermo 1 – solution calorimetry or temperature dependence of batteries.	☐ Completed introductory exercies (online) ☐ Pre-lab Thermo 1 (turn in duplicate pages).
2/17	Analyze thermo 1.	☐ Intro to plotting and fitting in Jupyter (online). ☐ SciFinder Search Thermo 1(online).
2/24	Thermo 2 – solution calorimetry or temperature dependence of batteries.	☐ Formal Report on Thermo 1 (online). ☐ Pre-lab Thermo 2 (duplicate pages).
3/3	Analyze thermo 2.	☐ Review of peer's Thermo 1 (online). ☐ SciFinder Search Thermo 2 (online).
3/10	Ionic Strength and pK_a of Bromocresol Green.	☐ Formal Report on Thermo 2 (online). ☐ Pre-lab Ionic Strength (duplicate pages).
3/17	Analyze Ionic Strength.	☐ Review of peer's Thermo 2 (online). ☐ SciFinder Search Ionic Strength (online). ☐ Rewrite of Thermo 1 (online).
3/31	Solubility Equilibrium using a Gel.	☐ Formal Report on Ionic Strength (online). ☐ Pre-lab Solubility (duplicate pages).
4/7	Solubility Equilibrium Analysis.	☐ SciFinder Search Solubility Equilibrium (online). ☐ Rewrite of Thermo 2 (online).
4/14	Solution Kinetics	☐ News Article on Solubility Equilibrium (online). ☐ Pre-lab Kinetics (duplicate pages).
4/21	Kinetics Analysis.	☐ SciFinder Search Kinetics (online).
4/28	Quantum Computations. Poster Review.	☐ Poster on Solution Kinetics (online). ☐ Pre-lab Quantum (duplicate pages).
5/5	Quantum Computations.	☐ Check on computations. Restart if necessary. ☐ SciFinder Search Quantum (online).
5/12	Lab cleanup. Lab quiz. Oral Report on Quantum Computations.	☐ Prepare for lab quiz. ☐ Oral Report Slides (online).