



Chemistry 4/6/8570 Biophysical Chemistry Fall 2021
The University of Toledo
College of Natural Sciences and Mathematics
Department of Chemistry & Biochemistry
Chem 4570-001 (CRN 46673), 6570 (CRN 46674), 8570 (CRN 46675)

Instructor: Prof. Tim Mueser
Email: timothy.mueser@utoledo.edu
Office Hours: T, Th 10:00 am – 11:30 am
Office Location: WO 4211
Office Phone: 419-530-1510

Term: Fall 2021
Class Location: On-line, potentially BOL 2059
Class Day/Time: M & W 2:00 pm - 3:50 pm
Credit Hours: 4

SPECIAL COURSE EXPECTATIONS DURING COVID-19

ATTENDANCE

The University of Toledo has a missed class policy. It is important that students and instructors discuss attendance requirements for the course. Students must perform a daily health assessment, based on based on [CDC guidelines](#), before coming to campus each day, which included taking their temperature. Students who are symptomatic/sick should not come to class and should contact the Main Campus Health Center at 419-530-3451. *Medical and Physician Assistant Students should contact Jyothi Sri Pappula, MD via email at: Jyothi.pappula@utoledo.edu; All other clinical students should contact Dean Linda Lewandowski, College of Nursing, via email at Linda.Lewandowski@UToledo.Edu or by phone at 419-383-5835..* Absences due to COVID-19 quarantine or isolation requirements are considered excused absences. Students should notify their instructors and these absences may not require written notice.

FACE COVERINGS

All students must wear face coverings while on campus, except while eating, alone in an enclosed space, or outdoors practicing social distancing. NO students will be permitted in class without a face covering. If you have a medical reason that prevents you from wearing a face covering due to a health condition deemed high-risk for COVID-19 by the Centers for Disease Control and Prevention (CDC), you should submit a request for an accommodation through the Student Disability Services Office (SDS) by completing the [online application](#). Students will need to provide documentation that verifies their health condition or disability and supports the need for accommodations. If a student is already affiliated with SDS and would like to request additional accommodations due to the impact of COVID-19, should contact their accessibility specialist to discuss their specific needs.

SOCIAL DISTANCING

Students should practice social distancing inside and outside the classroom please follow signage and pay attention to the seating arrangements. Do not remove stickers or tape from seats and/or tables, this is there to provide guidance on the appropriate classroom capacity based on the recommended 6 feet of social distancing between individuals. Please be conscious of your personal space and respectful of others. Also be cognizant of how you enter and exit the room; always try to maintain at least 6 feet of distance between yourself and others.

DESKS AND WORK SPACES

Students will need to sanitize their desks and/or work space before class with the University provided sanitizing spray and paper towels their desks.

SPECIAL NOTES

It's important to note that based on the unpredictability of the COVID-19 virus things can change at any time so please



be patience and understanding as we move through the semester. I also ask that you keep me informed of concerns you may have about class, completing course work/assignments timely and/or health concerns related to COVID.

COURSE/CATALOG DESCRIPTION

Principles and applications of physical chemistry as applied to biological macromolecules (i.e., proteins and nucleic acids in solution), including thermodynamics, kinetics and spectroscopy of macromolecular interactions.

COURSE OVERVIEW

This course will introduce measurement and analysis of physical phenomena as they pertain to biological macromolecules including structure and energetics. Discussions of physical phenomena will be used to introduce techniques in physical biochemistry, the equations derived to describe the phenomena, and the analysis and interpretation of data.

STUDENT LEARNING OUTCOMES

Upon successful completion of this course, students will be able to:

- Understand strong and weak interactions as they pertain to the energetics of folding of biopolymers and the equations involved in molecular mechanics.
- Apply the laws of thermodynamics to the folding of three-dimensional structures of biological macromolecules.
- Have knowledge of isothermal titration and differential scanning calorimetry in the study of proteins and nucleic acids.
- Display an appreciation for the phenomena of diffusion and sedimentation as applied in the techniques of electrophoresis and analytical ultracentrifugation.
- Know the physical parameters and equations associated with macromolecules in solution including chemical potentials and equilibria.
- Have insight into the analysis of ligand binding and kinetics including Surface Plasmon Resonance.
- Show proficiency in the analysis of light, x-ray, and neutron scattering and diffraction techniques.
- Appreciate the fundamentals of light interaction with biological macromolecules including absorption, linear and circular dichroism, and Raman spectroscopy.
- Display an expertise in the analysis of fluorescence, fluorescence polarization and lifetimes, and resonance energy transfer associated with chromophores.

TEACHING STRATEGIES

The lectures will include PowerPoint slides that will be annotated with additional material during class. The PowerPoint slides and additional reading material will be provided on Blackboard prior to class. A lecture schedule is provided and readings from the required textbook will be assigned for each lecture. Students are expected to complete the readings prior to lecture. Attendance in lecture and reading the text are both important for successful mastery of the material. Students are responsible for all material in both the readings and the lectures. Students can get additional help by visiting scheduled office hours, posting messages in the discussion board on Blackboard, or contacting the instructor by e-mail.

PREREQUISITES AND COREQUISITES

The prerequisites for CHEM 4570 are passing grades in Chemistry 3520 (Biochemistry II) and Physics 2080 (General Physics II) or approval from the instructor. Students not satisfying the prerequisite will be dropped from the course.



REQUIRED TEXTBOOK

Kensal van Holde, Curtis Johnson, Pui Shing Ho, Principles of Physical Biochemistry, 2006, Prentice Hall, Pearson Higher Ed ISBN #0-13-046427-9

TECHNOLOGY REQUIREMENTS

Access to a computer capable of running the programs associated with the projects will be provided if necessary.

UNIVERSITY POLICIES

Policy Statement on Non-Discrimination on the basis of Disability (ADA)

The University is an equal opportunity educational institution. Please read [The University's Policy Statement on Nondiscrimination on the Basis of Disability Americans with Disability Act Compliance.](#))

Institutional Classroom Attendance Policy

<https://www.utoledo.edu/offices/provost/mandatory-attendance-tracking.html>

Please be aware that the university has implemented an attendance policy, which requires faculty to verify student participation in every class a student is registered at the start of each new semester/course. For this course, if you have not attended/participated in class (completed any course activities or assignments) within the first 14 days, I am required by federal law to report you as not attended. Unfortunately, not attending/participating in class impacts your eligibility to receive financial aid, so it is VERY important that you attend class and complete course work in these first two weeks. Please contact me as soon as possible to discuss options and/or possible accommodations if you have any difficulty completing assignments within the first two weeks.

Policy Statement on Non-Discrimination on the Basis of Disability (ADA)* The University is an equal opportunity educational institution. Please read [The University's Policy Statement on Nondiscrimination on the Basis of Disability Americans with Disability Act Compliance.](#) Students can find this policy along with other university policies listed by audience on the [University Policy webpage](#) <http://www.utoledo.edu/policies/audience.html/#students> .

ACADEMIC ACCOMMODATIONS

The University of Toledo is committed to providing equal access to education for all students. If you have a documented disability or you believe you have a disability and would like information regarding academic accommodations/adjustments in this course please contact the [Student Disability Services Office.](#)

ACADEMIC POLICIES

Undergraduate Policies: <http://www.utoledo.edu/policies/academic/undergraduate/>

Graduate Policies: <http://www.utoledo.edu/policies/academic/graduate/>

- The University of Toledo policy on academic honesty will be strictly enforced. Any student caught cheating in any way on an exam or facilitating the cheating of others on an exam will receive a grade of 0 for that exam and will be required to take any remaining exams in the Field House Testing Center. A second violation will result in an automatic F in the course and referral to the Dean's Office.
- The course may be dropped no later than **13 September 2021**, and you may withdraw from the course (with a grade of W) no later than **05 November 2021**.



- See the appropriate sections under **Course Expectations** below for more details about policies regarding homework assignments and exams.

COURSE EXPECTATIONS

- Students are responsible for all material covered in lecture, the assigned textbook readings, and homework assignments.
- Students with challenges that require special assistance should contact the Student Disability Services Office and follow up with me by e-mail to arrange the accommodations specified by the electronic memo.
- Students should access the course site on Blackboard regularly. Lecture slides will be posted on Blackboard as a note-taking and study guide. Additional material will be added to slides during lecture, so it may be helpful to print out the slides and take notes directly on them.
- I am available outside of class to answer questions during posted office hours, and other at other times by appointment (please contact me via e-mail to arrange a meeting). When e-mailing, please be sure to include your full name (especially if you are not using your Rocket e-mail account).

- **Homework**

Reading assignments are posted for each. Completing the assigned readings before class will help you understand the material. Some material covered in lecture is not in the book (or will be presented differently in lecture than the book presents it), and some material in the readings for which you will be responsible will not be discussed in lecture.

- **Exams**

- There will be three in-class exams held in class on **Monday 04 Oct 2021, Wednesday 03 Nov 2021, and Monday 08 Dec 2021**. Each exam will be worth 100 points.
- An excused absence from an exam will be granted **only** for **documented** circumstances meeting the criteria of the UT Missed Class Policy (personal emergencies, including, but not limited to, illness of the student or of a dependent of the student or death in the family; religious observances that prevent the student from attending class; participation in University-sponsored activities, approved by the appropriate University authority, such as intercollegiate athletic competitions, activities approved by academic units, including artistic performances, R.O.T.C. functions, academic field trips, and special events connected with coursework; government-required activities, such as military assignments, jury duty, or court appearances) Appropriate documentation must be provided before an excuse will be considered. See http://www.utoledo.edu/facsenate/missed_class_policy.html.
 - If you have a conflict for an approved student activity or other obligation that meets the criteria of the missed class policy, inform me as soon as you are aware of the conflict with documentation and arrangements will be made for you to take the exam *early*. It is your responsibility to contact me to make these arrangements as soon as you are aware of the conflict.
 - For other legal absences that arise without prior notice (such as medical emergencies), acceptable documentation will be required if an excused absence is requested. If you are granted an excused absence from a single mid-term exam **because of an unanticipated documented and qualified legal absence, *the missed exam will count as a dropped exam and the two other exams will count towards your course grade.*** If you miss two exams for documented and qualified legal absences, one will count as your dropped exam and the second missed exam will require a make-up examination.
 - Missing an exam for **any reason other than a qualified legal absence** according to the UT Missed Class policy (including but not limited to lack of preparation, travel,



transportation difficulties, oversleeping, job conflicts, etc.) will **result in a grade of 0 for the missed exam with no opportunity to make it up.** Plan accordingly.

- Exam questions will general based on material from the lectures, assigned readings, and homework and will be graded on completeness and conciseness of the answers.
- One notecard will be provided for your preparation and use during the exam. You can write equations only, no writing is allowed.
- **Projects (Graduate Students Only)**
 - Students enrolled in 6570 will be given three projects throughout the course of the semester. Students enrolled in 8570 will be given five projects throughout the course of the semester. Short, concise reports on the project will be required to receive credit. All reports will be due during finals weeks.

Grading:

Three in-class exams (100 points each)	300 points
Homework	100 points
Projects (Graduate Only - Maintain Test and Homework Grades)	90/150 points
Total	400 points

Final course grades will be assigned based on the following cutoffs for percentage of total possible points:

	A \geq 93%	92% > A- \geq 90%	
89% > B+ \geq 87%	86% > B \geq 82%	81% > B- \geq 79%	
78% > C+ \geq 76%	75% > C \geq 71%	70% > C- \geq 68%	
67% > D+ \geq 65%	64% > D \geq 60%	60% > D- \geq 58%	57% > F

Midterm grades (for advisory purposes and to officially track course participation) will be assigned in Mid-October (after Exam 2) and will be based on your percentage of total possible points earned on Exams 1 and 2 and the problem sets and clickers accumulated up to that point converted to letter grades using the above scale.

COURSE SCHEDULE

#		Topic	Chapter	Section	Pages
1	30 Aug	Introduction to Physical Biochemistry	1	1.1 - 1.5	1 - 52
2	01 Sept	First and Second Laws of Thermodynamics	2	2.1 - 2.3	73 - 91
	06 Sept	<i>Labor Day</i>			
3	08 Sept	ITC/DSC and Molecular Mechanics	2	2.4 - 2.5	91 - 103
4	13 Sept	Experimental Thermochemistry - Calorimetry	3	3.2	109 - 124
5	15 Sept	Diffusion and Sedimentation Coefficient	5	5.2 - 5.3	214 - 234
6	20 Sept	Sedimentation and Analytical Centrifugation	5	5.3	234 - 248
7	22 Sept	Ligand Binding and Kinetics - Hemoglobin	14	14.3	615 - 643
8	27 Sept	Ligand Binding and Kinetics – Stopped Flow	14	14.3	615 - 643
9	29 Sept	Surface Plasmon Resonance - Dignam	14	14.3	615 - 643
	04 Oct	Exam #1 (Lectures 2 – 9)			
10	06 Oct	Principles of Light and X-ray Scattering	7	7.1 – 7.3	351 - 370
11	11 Oct	X-Ray Diffraction	6	6.2 – 6.5	279 - 325
12	13 Oct	Neutron Diffraction and Scattering	7	7.4	370 - 376
13	18 Oct	Electronic Absorption and Spectroscopy	9	9.1	421 - 449
14	20 Oct	Vibrational Absorption and Raman Spectroscopy	9	9.2 - 9.3	449 - 463
15	25 Oct	Linear and Circular Dichroism	10	10.1 - 10.2	466 - 476
16	27 Oct	Emission Spectroscopy and Fluorescence	11	11.1 - 11.9	501 - 524
17	01 Nov	Single Molecule Methods - Dignam	16	16.1 - 16.5	693 - 707
	03 Nov	Exam #2 (Lectures 10 – 17)			
18	08 Nov	Light and Electronic Transitions - Nuclear	8	8.1 - 8.2	381 - 392
19	10 Nov	Interactions in Macromolecules	3	3.3	124 - 145
20	15 Nov	Structural Transitions in Macromolecules	4	4.2 - 4.3	175 - 198
21	17 Nov	Structure of Nucleic Acids	1	1.6	52 - 68
		Nucleic Acid Binding	14	14.4	648 - 654
22	22 Nov	Electrophoresis	5	5.4	248 - 269
	24 Nov	<i>Thanksgiving Break</i>			
23	29 Nov	Solution Thermodynamics	13	13.1	580 - 589
24	01 Dec	Chemical Potential and Equilibria	13	13.2	590 - 599
25	06 Dec	Thermodynamics of Equilibria	14	14.1 - 14.3	605 - 615
	08 Dec	Exam #3 2:45 pm - 4:45 pm (Lectures 18 – 25)			
	Finals	Exam #3 Due			