



# CHM 3400

## “Physical Chemistry for the Biosciences”

Fall 2023 (Aug 23 – Dec 6)

### Instructor

Dr. Matthew Eddy  
matthew.eddy@ufl.edu  
Scott Family Hall (SFH) 302C, 352 294 1048 (office)

### Office Hours

Tue, 2:00 – 3:00 pm , Thurs 9:00 – 10 am & by appointment

### Communication

All electronic communication should be conducted through the course Canvas e-learning site.

I am generally available via email and will make every attempt to respond in 24 hours. If you wait to the last minute to contact me regarding questions for an assignment, I may not get back to you before the assignment due date.

### Teaching Assistant

Arka Ray, ray.arkaprab@chem.ufl.edu  
Office Hours: Tue, 9:30 – 10:30am, SFH 326

### Learning Assistants

Anton Roche, antonroche@ufl.edu  
Office Hours: Wed, 2:00 – 3:00pm, SFH 326 and via Zoom: <https://ufl.zoom.us/j/7743478383>

Robert Casper, casperr@ufl.edu  
Office Hours: Mon, 10:30am – 11:30am, SFH 326

Chris Spangler, cspangler1@ufl.edu  
Office Hours: Wed, 10:30 – 11:30am, SFH 326

### Lectures

M,W,F 9:35 – 10:25 am, LEI 207

FALL SEMESTER 2023							
S	M	T	W	T	F	S	
Aug.	20	21	22	23	24	25	26
	27	28	29	30	31		
Sept.						1	2
	3	4	5	6	7	8	9
	10	11	12	13	14	15	16
	17	18	19	20	21	22	23
	24	25	26	27	28	29	30
Oct.	1	2	3	4	5	6	7
	8	9	10	11	12	13	14
	15	16	17	18	19	20	21
	22	23	24	25	26	27	28
	29	30	31				
Nov.			1	2	3	4	
	5	6	7	8	9	10	11
	12	13	14	15	16	17	18
	19	20	21	22	23	24	25
	26	27	28	29	30		
Dec.						1	2
	3	4	5	6	7	8	9
	10	11	12	13	14	15	16
	17	18	19	20	21	22	23
	24	25	26	27	28	29	30
	31						

## Required Textbooks

There are no required textbooks for this course.

## Recommended Reading

The following textbooks are recommended:

“Physical Chemistry: Principles and Applications in Biological Sciences”, 5<sup>th</sup> Edition, Tinoco, Sauer, Wang, Puglisi, Harbison, and Rovnyak

The 4<sup>th</sup> edition of this text is also fine to use.

While this textbook is not required, it is strongly recommended that you follow it or a similar undergraduate physical chemistry textbook that includes the topics of thermodynamics and kinetics. I can also recommend the following as additional useful reference textbooks:

“Physical Chemistry for the Life Sciences”, 3<sup>rd</sup> edition, Atkins, Ratcliffe, Wormald, De Paula.

The 2<sup>nd</sup> edition is also fine.

“Physical Chemistry for the Biosciences,” by Raymond Chang.

“Physical Chemistry” by Atkins and de Paula, 7<sup>th</sup> edition or more recent

Physical copies of the above texts are on reserve in the UF Library West

## Course Description

Physical chemistry is concerned with the quantitative measurement and analysis of natural phenomena. When applied to the biosciences, it offers a structured approach to understanding the underlying factors guiding biological processes. This course provides a concise yet comprehensive exploration of physical chemistry principles, specifically tailored to the viewpoint of biochemical and biological systems. Encompassing a single semester, the curriculum aims to delve into various subjects such as thermodynamics, kinetics, molecular structure, bonding, and spectroscopy. The course uniquely emphasizes the integration of these concepts with insights drawn from the realm of biological systems.

## Course Objectives

- **Comprehend Fundamental Concepts:** Develop a strong foundation in the fundamental principles of physical chemistry, tailored to the context of biological systems.
- **Bridge Theory and Applications:** Bridge the gap between physical chemistry theories and their applications in the biosciences, fostering critical thinking skills to solve real-world biological problems.

- **Apply Thermodynamic Principles:** Apply thermodynamic concepts such as entropy, enthalpy and Gibbs free energy to analyze and predict the feasibility and spontaneity of biochemical reactions and processes
- **Analyze Enzyme Catalysis:** Explore the principles of enzyme catalysis, including the role of transition states, enzyme-substrate interactions, and factors influencing enzyme activity.
- **Integrate Quantum Mechanics:** Integrate basic quantum mechanical principles to explain the electronic structure of biomolecules and the role of molecular orbitals in biochemical reactions.
- **Apply Spectroscopic Techniques:** Gain an understanding in applying spectroscopic methods, such as UV-visible, infrared, and NMR spectroscopy, to analyze biomolecular structures and interactions
- **Explore Current Research:** Gain exposure to current research at the interface of physical chemistry and biological sciences, fostering an awareness of ongoing advancements and interdisciplinary opportunities.

## Course Grade Computation

Your letter grade will be derived from weighting the following components of your performance in the class:

- 35% Homework Assignments
- 40% Mid-term Exams (2 Exams, 20% Each)
- 20% Final Exam (Optional, see below)
- 5% In-Class Participation

Your course grade will be determined from your total course performance percentage as follows:

Grade Ranges			
>90%	A	69% - 72.9%	C+
86% - 89.9%	A-	64% - 68.9%	C
82% - 85.9%	B+	60% - 63.9%	C-
77% - 81.9%	B	56% - 59.9%	D+
73% - 76.9%	B-	50% - 55.9%	D+
		< 50%	E

All grades will be posted in the Canvas GradeBook, as available.

UF's Grading Policy: <http://www.registrar.ufl.edu/catalog/policies/regulationgrades.html>

## Exams

There will be two mid-term exams and one final exam. The dates of the exams are:

**Mid-Term Exam 1:** Monday October 2, 2023

**Mid-Term Exam 2:** Friday November 17, 2023

**Final Exam:** Wednesday, December 13, 2023

Conflicts with the exam dates must be resolved with the instructor no later than one week prior to the exam date.

The final exam is optional. If you choose to take the final exam, your grade will be calculated using the rubric listed above in this syllabus. If you choose to not take the final exam, your final grade will then be calculated by counting each mid-term score as 30% of your total score. Note that taking the final exam may or may not be beneficial to your final grade, depending on your mid-term exam performance.

## Homework

There will be weekly homework assigned that is designed to build on lecture material and aid in the development of your understanding of the course material. There will be 12 homework assignments in total. If you submit all 12 homework assignments, your homework score will be calculated by scoring your 10 best homework assignments grades. Submission of a late assignment will receive a 25% deduction per day that the assignment is late (e.g, submitting two days late results in a 50% deduction on your homework grade), unless you have communicated with the instructor in advance and received approval for submitting an assignment late.

## In-class Participation

Lecture attendance is essential for your success in the class. This class will not take a roll call to assess who is attending. However, most classes will include 1-2 problems that I will ask small groups of students to solve and present their work. Being available to participate and present on your work will count toward 5% of your final grade. If you are not present and do not participate in group discussions, you will not receive full participation credit.

## Cell Phone & Laptop Policy

Please put all cell phones and other digital devices on "silent mode" during all class periods and avoid use during class. **During exams, cell phones must be placed on the table in front of you, face down, for the duration of the test period.**

## COVID Policy

In response to COVID-19, the following recommendations are in place to maintain your learning environment, to enhance the safety of our in-classroom interactions, and to further the health and safety of ourselves, our neighbors, and our loved ones.

- If you are not vaccinated, get vaccinated. Vaccines are readily available and have been demonstrated to be safe and effective against the COVID-19 virus. Visit [one.ufl.edu](https://one.ufl.edu) for screening / testing and vaccination opportunities.
- If you are sick, stay home. Please call your primary care provider if you are ill and need immediate care or the UF Student Health Care Center at 352-392-1161 to be evaluated.
- Course materials will be provided to you with an excused absence, and you will be given a reasonable amount of time to make up work.

## Students Requiring Accommodations

Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, [www.dso.ufl.edu/drc/](http://www.dso.ufl.edu/drc/)) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

Students with disabilities have an equal right to use and benefit from resources at the George A. Smathers Libraries, including (but not limited to) Course Reserve materials. To ensure this right, students with disabilities:

- Have the responsibility to identify themselves as needing appropriate, reasonable accommodations for their disabilities
- Have the responsibility for making their needs known in a timely manner
- Have the same obligation as any library user to comply with library policies and procedures

The George A. Smathers Libraries Course Reserves Unit will work with patrons needing assistance or accommodations to access course reserve materials.

## Course Evaluations

Students are expected to provide feedback on the quality of instruction in this course by completing online evaluations at <https://evaluations.ufl.edu>. Evaluations are typically open during the last two or three weeks of the semester, but students will be given specific times when they are open. Summary results of these assessments are available to students at <https://evaluations.ufl.edu/results/>

## Materials and Supplies Fees

There are no additional fees for this course.

## University Honor Policy

This class will operate under the policies of the student honor code, which can be found at: <http://www.registrar.ufl.edu/catalog/policies/students.html>. The students and instructor are honor-bound to comply with the Honors Pledge: *We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honesty and integrity.*

**More specific to this course is the expectation that any submitted written assignments are in your own language. This means that submission of verbatim or nearly-verbatim text taken from other sources and repurposed for your own assignments without proper acknowledgement of the original citation will be considered a violation of the honor code and treated as such.**

## Zoom Presence Policy

This class may contain hybrid lectures, i.e. lectures that are simultaneously given in-person and broadcast online via Zoom. Our class lectures may be audio and visually recorded for students in the class to refer back and for enrolled students who are unable to attend live. Students who participate with their camera engaged or utilize a profile image are agreeing to have their video or image recorded. If you are unwilling to consent to have your profile or video image recorded, be sure to keep your camera off and do not use a profile image. Likewise, students who un-mute during class and participate orally are agreeing to have their voices recorded. If you are not willing to consent to have your voice recorded during class, you will need to keep your mute button activated and communicate exclusively using the "chat" feature, which allows students to type questions and comments live. The chat will not be recorded or shared. As in all courses, unauthorized recording and unauthorized sharing of recorded materials is prohibited.

## Counseling and Wellness Center

Contact information for the Counseling and Wellness Center:

<http://www.counseling.ufl.edu/cwc/Default.aspx>, 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

## Policy on In-class Recording

Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A "class lecture" is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and

delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To “publish” means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student

## Preliminary Lecture Schedule

Date	Day	Topic	Textbook	HW Out	HW Due
8/23	W	Course Introduction			
8/25	F	Math Review, 0 <sup>th</sup> Law of Thermo	Ch. 2	1	
8/28	M	Definitions, Work & Heat, 1 <sup>st</sup> Law	Ch. 2		
8/30	W	State & Path Variables	Ch. 2		
9/1	F	Enthalpy	Ch. 2	2	1
9/4	M	UF Holiday			
9/6	W	Ideal Gases	Ch. 2		
9/8	F	Chemical Reactions	Ch. 2	3	2
9/11	M	Entropy & 2 <sup>nd</sup> Law	Ch. 3		
9/13	W	Entropy & 2 <sup>nd</sup> Law	Ch. 3		
9/15	F	Molecular Interpretation of Entropy	Ch. 3	4	3
9/18	M	3 <sup>rd</sup> Law, Gibbs Energy	Ch. 4		
9/20	W	Free Energy & Chemical Eq.	Ch. 4		
9/22	F	Non-Ideal Systems		5	4
9/25	M	Chemical Equilibria			
9/27	W	Thermo Review			
9/29	F	Mid-Term Exam 1 Review			5
10/2	M	Mid-Term Exam 1			
10/4	W	Biochemical Applications of Thermo		6	
10/6	F	UF Holiday			
10/9	M	Introduction to Kinetics	Ch. 9		
10/11	W	0 <sup>th</sup> and 1 <sup>st</sup> order reactions	Ch. 9		
10/13	F	2 <sup>nd</sup> order reactions	Ch. 9	7	6
10/16	M	Reaction Mechanisms	Ch. 9		
10/18	W	Reaction Dynamics, Transition State	Ch. 9		
10/20	F	Arrhenius Equation	Ch. 9	8	7
10/23	M	Enzyme Kinetics	Ch. 10		
10/25	W	Michaelis-Menten Kinetics	Ch. 10		
10/27	F	Competition & Inhibition	Ch. 10	9	8
10/30	M	Ligand Binding & Allostereism			
11/1	W	Origins of Quantum Mechanics	Ch. 11		
11/3	F	Wave Functions	Ch. 11	10	9
11/6	M	Particle-In-a-Box	Ch. 11		
11/8	W	Harmonic Oscillator & Rigid Rotor	Ch. 11		
11/10	F	UF Holiday			
11/13	M	Kinetics Review		11	10
11/15	W	Mid-Term Exam 2 Review			
11/17	F	Mid-Term Exam 2			
11/20	M	Techniques: Optical Spectroscopy 1	Ch. 13		
11/22	W	UF Holiday			
11/24	F	UF Holiday			
11/27	M	Techniques: Optical Spectroscopy 2	Ch. 13		
11/29	W	Techniques: NMR, EPR	Ch. 14	12	11
12/1	F	Techniques: MRI	Ch. 14		
12/4	M	Techniques: X-ray, Cryo-EM	Ch. 15		
12/6	W	Final Exam Review			12
12/13	W	Final Exam			