

**Chemistry 305: Physical Biochemistry for the Biological Sciences (Fall 2024)**  
Department of Chemistry and Biochemistry, Loyola University Chicago

**Instructor:** Dr. Pengfei Li  
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**Email:** [pli4@luc.edu](mailto:pli4@luc.edu) (Please use CHEM305 in the email subject)  
**Telephone:** 773-508-3785  
**Lectures:** 001: Tuesday and Thursday 8:30-9:45 AM, Flanner Hall Room 105  
**Discussions:** 002: Tuesday 10:00-10:50 AM, Flanner Hall Room 7  
**Office Hours:** Tuesday 11:00 AM-12:00 PM, 2:00-3:00 PM and Thursday 10:00-11:00 AM, Flanner Hall Room 314B, **or by appointment**  
**Online Homework:** Mastering Chemistry course ID is LI18342

*Please see the Sakai site for up-to-date information and posts.*

**Course Prerequisites:** CHEM 240 and 260 or CHEM 222 or CHEM 224, and PHYS 112, and MATH 132 or equivalent. If you have not completed these course prerequisites, you may be administratively dropped from the class. Please discuss this with the instructor immediately!

**Required Textbook:** “Physical Chemistry: Principles and Applications in Biological Sciences”, 5<sup>th</sup> edition, by Tinoco, Sauer, Wang, Puglisi, Harbison, and Rovnyak, Pearson Education Inc. 2014, ISBN-10: 0-13-605606-7; ISBN-13: 978-0-13-605606-5.

**Require Materials:**

- (1) Mastering Chemistry online learning system for Tinoco 5<sup>th</sup> edition.
- (2) A calculator capable of scientific notation.

**Course Overview**

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Physical chemistry is a chemistry discipline that uses physical principles to understand chemical phenomena. This class aims to enable the students to understand the fundamental principles of physical chemistry and apply them to interpret chemical and biochemical phenomena as well as solve chemical and biochemical problems. We will cover fundamental knowledge about physical chemistry, such as thermodynamics, kinetics, and quantum mechanics, along with their applications in chemical and biochemical systems. Specifically, the class will mainly cover selective contents in chapters 2-5, 9-14 of the textbook, with a tentative schedule of lectures accompanying with this syllabus. Your attendance at lectures and discussions is expected. The correct answers of the exam problems may require knowledge of all the information presented in the lectures, discussions, and textbook, along with the prerequisite knowledge in general chemistry, physics, and mathematics.

**Class Preparation:** In order to understand the material presented during lectures and discussions, it is important to come to the class with good background knowledge. This can be achieved by reading (and thinking about) material in the textbook, reviewing appropriate material from calculus, physics, and general chemistry classes, and solving end-of-chapter problems. Work together with your classmates; if you don't understand something, someone else may. You will also find that explaining a solution to your classmate will improve your understanding and long-term retention of the material. I cannot overstate how much more useful the classes will be if you come into the room well prepared, and even better, with questions for me and your fellow classmates. The three keys to success in physical chemistry are reading the text, solving as many problems as possible, and asking questions! Ask me questions about the material in class and office hours and ask your classmates questions. It is recommended that students devote to the preparation for this class a minimum of one hour every day.

**Course Structure:** There are two 75-minute lectures (Tuesday and Thursday) and a single 50-minute discussion section (Tuesday) per week. The discussion section will be small group work. You will work in

small groups (3-4 people) on problems, with the goal of working with your classmates to learn the material. Again, it is highly recommended that you read (and think about) appropriate contents in the textbook before the lecture covering such content, and ask relevant questions during the lectures, discussions, and office hours. Materials from the course, including the exam problems, cannot be shared outside the course without the instructor's written permission.

**Copyright/Intellectual Property reminder** Course materials provided by your instructors at Loyola, including my materials, may not be shared outside any course without the instructor's written permission. Content posted without permission will be in violation of Copyright/Intellectual Property laws. Class meetings may not be recorded without the instructor's written permission.

**Privacy Statement** Assuring privacy among faculty and students engaged in online and face-to-face instructional activities helps promote open and robust conversations and mitigates concerns that comments made within the context of the class will be shared beyond the classroom. As such, recordings of instructional activities occurring in online or face-to-face classes may be used solely for internal class purposes by the faculty member and students registered for the course, and only during the period in which the course is offered. Students will be informed of such recordings by a statement in the syllabus for the course in which they will be recorded. Instructors who wish to make subsequent use of recordings that include student activity may do so only with informed written consent of the students involved or if all student activity is removed from the recording. Recordings including student activity that have been initiated by the instructor may be retained by the instructor only for individual use.

## Exams, Homework, and Grading

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**Exams:** There will be three midterm exams and one final exam. If a student disagrees with her/his score for the exam, she/he must request re-grading *within one week* from the day he/she received the graded exam. Each midterm exam will last 75 mins. The University sets the schedule for all final exams. The final will be held on: **Saturday, December 14, 2024 at 9:00 AM (CST)**. You will have exactly 2 hours to complete the exam. Additional time will not be granted, even if you start late. There will be no make-up final exams given under any circumstance, and the exam will not be given early, either. Instructors may not reschedule final exams for a class for another day and/or time during the final exam period. There can be no divergence from the posted schedule of dates for final exams. Individual students who have four (4) final examinations scheduled for the same date may request to have one of those exams rescheduled. If a student reports having four final examinations scheduled for the same date, students should be directed to e-mail a petition to Adam Patricoski, Assistant Dean for Student Academic Affairs, CAS Dean's Office ([apatricoski@luc.edu](mailto:apatricoski@luc.edu)).

**Homework:** Homework assignments will be assigned online through the *Mastering Chemistry* learning system. Students need to buy the access code and register at: <https://www.pearson.com/en-us/higher-education/products-services/mastering/chemistry.html> before accessing the homework for the first time. During the registration, select your textbook, school, and the course ID (LI18342). Students will have one week time to finish each homework assignment. Due date may be postponed for excused absences that last five or more days. Late homework assignments will receive zero points.

**Grade Components:** There will be homework assignments, three midterm exams, and the final exam. Each midterm exam is worth the same number of points, **with the lowest score will be dropped**. *There will be no make-up homework or exams*. In the end, the class score is calculated based on the following components:

Homework assignments:	20%
Midterm exams:	40%
Final exam:	40%

Finally, the class score will be rounded to the nearest integer, and then the course grade will be determined based on the class score through the following scale:

Fixed scale	Grade
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score $\geq$ 82	A
77 $\leq$ score $<$ 82	A-
72 $\leq$ score $<$ 77	B+
67 $\leq$ score $<$ 72	B
62 $\leq$ score $<$ 67	B-
57 $\leq$ score $<$ 62	C+
52 $\leq$ score $<$ 57	C
47 $\leq$ score $<$ 52	C-
37 $\leq$ score $<$ 47	D
score $<$ 37	F

**Midterm Grade:** Your midterm grades will be obtained based on midterm exam(s) (80%) and the homework (20%) according to the method described above.

**Pass/Fail Conversion Deadlines and Audit Policy** A student may request to convert a course into or out of the “Pass/No-Pass” or “Audit” status only within the first two weeks of the semester. For the Fall 2024 semester, students are able to convert a class to “Pass/No-Pass” or “Audit” through Monday, September 9th. Students must submit a request for Pass/No-Pass or Audit to their Academic Advisor.

**Course Repeat Rule** Effective with the Fall 2017 semester, students are allowed only THREE attempts to pass Chemistry courses with a C- or better grade. The three attempts include withdrawals (W). The Department advises that it is preferable to complete a course with a grade of C or C-, and to demonstrate growth in future coursework, than to withdraw from a course. After the second attempt, the student must secure Department approval for a third attempt. Students must fill out the [Permission to Register Form](#), and arrange a meeting with the Undergraduate Program Director, Assistant Chairperson, or Chairperson in Chemistry. If approved, a signed copy of this form is then sent to the student's Advising office to secure final permission for the attempt.

### **Ethical Considerations:**

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a. **Academic integrity:** Academic integrity is the pursuit of scholarly activity in an open, honest, and responsible manner. Academic integrity is a guiding principle for all academic activity at Loyola University Chicago, and all members of the University community are expected to act in accordance with this principle. Please open and read the foldout for the third item, “Academic Integrity” in the [Undergraduate Academic Standards and Regulations](#).

Academic dishonesty can take several forms, including, but not limited to cheating, plagiarism, copying another student’s work, submitting false documents, and deliberately disrupting the performance of other class members. Standards apply to both individual and group assignments.

**Regarding the use of Artificial Intelligence:** our Provost has expressed to “Let us all make sure we are learning and sharing best practices and not allowing AI to do the learning for us.” In this course, any work you submit for credit must represent your own ideas and understanding of the assigned material. If you are uncertain about any case where your use of AI may be in conflict with University or course standards, please see me to discuss your concerns.

An instance of academic misconduct (including those detailed on the website provided above or in this syllabus) will be reported to the Department Chair and the academic Dean’s office.

b. **Exams:** Students will not collaborate on any exams. Only those materials and devices permitted by the instructor may be used to assist in examinations. Students will not represent the work of others as their own. Any student caught cheating during an exam will be reported to the Dean’s office and will receive zero points for the given exam. The Chair of the Department of Chemistry and Biochemistry will also be notified and will decide what the next steps may be. Please be honest with your work.

c. **Teamwork:** I strongly encourage you (the class) to work together to solve assigned and unassigned problems. In order to learn and excel in Physical Chemistry, you should work through problems. The

assigned problems are a minimum. Work together with your classmates, if you do not understand something, someone else may. You will also find that explaining a solution to your classmate will cement the information in your mind, and make you a better student. When working as a group, if each member contributes to the discussion, and you each hand in very similar work, that is perfectly acceptable given the nature of the assignments. On the other hand, if someone simply copies an assignment from someone else, that is plagiarism, and will be treated as such. Any students caught plagiarizing for an assignment will receive zero points on the given assignment. The Chair of the Department of Chemistry and Biochemistry will be notified and will decide what the next steps may be.

## **Student Accommodations**

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**Student Support: Requests for Accommodation:** Loyola University Chicago provides reasonable accommodations for students with disabilities. Any student requesting accommodations related to a disability or other condition is required to register with the Student Accessibility Center (SAC). Professors will receive an accommodation notification from SAC, preferably within the first two weeks of class. Students are encouraged to meet with their professor individually in order to discuss their accommodations. All information will remain confidential. Please note that in this class, software may be used to audio record class lectures in order to provide equal access to students with disabilities. Students approved for this accommodation use recordings for their personal study only and recordings may not be shared with other people or used in any way against the faculty member, other lecturers, or students whose classroom comments are recorded as part of the class activity. Recordings are deleted at the end of the semester. For more information about registering with SAC or questions about accommodations, please contact [SAC](mailto:SAC@luc.edu) at 773-508-3700 or [SAC@luc.edu](mailto:SAC@luc.edu). *If you use the Testing Center, please schedule all of the tests for this class at the beginning of the semester. If a scheduled test date changes, you will still be accommodated if you had scheduled your test in advance. If you have any questions or concerns regarding the implementation of your accommodations in this course, please contact the SAC for assistance.*

**Universal Absence Accommodation Policy:** The purpose of a universal absence accommodation policy is to account for emergency circumstances (e.g., serious illness, caring for a family member, car accident) that require you to be absent from class, while maintaining fairness in grading for students who attend and complete all in-class graded assignments. We believe that class attendance and participation are essential for your success in this class, and that your health is important to us and our shared community. Please use good judgement and stay home if necessary/prudent for your circumstances. You should inform the instructor and provide documentation for such an absence as soon as feasible. The instructor will handle the accommodations on a case-by-case basis.

**Loyola University Absence Policy for Students in Co-Curricular Activities (including ROTC):** Students missing classes while representing Loyola University Chicago in an official capacity (e.g., intercollegiate athletics, debate team, model government organization) shall be allowed by the faculty member of record to make up any assignments and to receive notes or other written information distributed in the missed classes. Students should discuss with faculty the potential consequences of missing lectures and the ways in which they can be remedied. Students must provide their instructors with proper documentation i.e., "[Athletic Competition & Travel Letter](#)" describing the reason for and date of the absence. This documentation must be signed by an appropriate faculty or staff member and it must be provided to the professor in the first week of a semester. It is the responsibility of the student to make up any assignments. If the student misses an examination, the instructor is required to allow the student to take the examination at another time. (<https://www.luc.edu/athleteadvising/attendance.shtml>) Students who will miss class for an academic competition or conference must provide proper documentation to their instructor as early in the semester as possible. Advance notice must be sent to the instructor through Loyola email.

**Accommodations for Religious Observances** If you have observances of religious holidays that will cause you to miss class or otherwise affect your academic work in the course you must alert the instructor ***no later than Friday of Week 2 in the semester*** to request accommodations. Advance notice must be sent to the instructor through Loyola email by this deadline.

**Health, Safety, and Well-Being On-Campus** Please be familiar with and adhere to all guidelines posted on the *Wellness Center* website (<https://www.luc.edu/wellness/>). This site relays updates and protocols related to COVID-19 and other matters.

**The Loyola Official Academic Calendar:** [www.luc.edu/academics/schedules](http://www.luc.edu/academics/schedules)

**The CURA website:** <https://www.luc.edu/cura/>

**Student Services at Loyola Online:** <https://www.luc.edu/online/resources/index.html>

**Tentative Schedule\***

Week	Dates	Lecture Topics
1	Tuesday Aug 27	Introduction of physical chemistry for the biological sciences; Syllabus
	Thursday Aug 29	Chapter 2: First law of thermodynamics, energy, heat capacity
2	Tuesday Sep 3	Chapter 2: State and path, enthalpy
	Thursday Sep 5	Chapter 3: Second law of thermodynamics, entropy
3	Tuesday Sep 10	Chapter 3: Free energy, noncovalent interactions
	Thursday Sep 12	Chapter 4: Free energy and chemical equilibria
4	Tuesday Sep 17	Chapter 4: Chemical equilibria of different systems
	Thursday Sep 19	Chapter 4: Biochemical applications of thermodynamics
5	Tuesday Sep 24	Chapters 4 & 5: Isothermal titration calorimetry, Boltzmann distribution
	Thursday Sep 26	<b>Midterm Exam 1</b>
6	Tuesday Oct 1	Chapter 9: Rates of chemical reactions, rate law, reaction orders
	Thursday Oct 3	Chapter 9: Reaction mechanisms
7	Tuesday Oct 8	<i>No Class; Mid-Semester break</i>
	Thursday Oct 10	Chapter 9: Temperature dependence of chemical rates, single-molecule kinetics
8	Tuesday Oct 15	Chapter 10: Enzyme kinetics, Michaelis-Menten Kinetics
	Thursday Oct 17	Chapter 10: Competition and Inhibition
9	Tuesday Oct 22	Chapter 11: Foundations of quantum mechanics
	Thursday Oct 24	<b>Midterm Exam 2</b>
10	Tuesday Oct 29	Chapter 11: Quantum mechanics calculations, Particle-in-a-box
	Thursday Oct 31	Chapters 11: Harmonic oscillator, Rigid rotor
11	Tuesday Nov 5	Chapters 11: Electronic structures of atoms
	Thursday Nov 7	Chapter 12: Molecular orbitals
12	Tuesday Nov 12	Chapter 13: Electromagnetic spectrum, ultraviolet spectroscopy
	Thursday Nov 14	<b>Midterm Exam 3</b>
13	Tuesday Nov 19	Chapter 13: Fluorescence and phosphorescence
	Thursday Nov 21	<i>No Class; Thanksgiving break</i>
14	Tuesday Nov 26	Chapter 13: Infrared and Raman spectroscopy
	Thursday Nov 28	Chapter 14: Nuclear magnetic resonance (NMR)
15	Tuesday Dec 3	Chapter 14: Chemical shifts, spin-spin coupling
	Thursday Dec 5	Summary and Review
<b>Final exam: Saturday December 14, 9:00-11:00 AM (CST)</b>		

\*The instructor reserves the right to make changes to the schedule, except the date and time of the final exam. Any changes to other exam dates will be announced in class and on Sakai.