

Chemistry 305: Physical Biochemistry for the Biological Sciences (Fall 2020)

Department of Chemistry and Biochemistry, Loyola University Chicago

Instructor: Dr. Pengfei Li
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Lectures: Tuesday and Thursday 9:45-11:00 AM (CST), online
Discussions: Tuesday 1:15-2:05 PM or 3:00-3:50 PM (CST), online
Office Hours: Thursday 2:30-3:30 PM (CST) or by appointment, online

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

Course Prerequisites: CHEM 222 or 224, 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”, 5th 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.

Required Software: Zoom.

Course Overview: 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 and Online Class Specifics: 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. The lectures and discussions will be delivered through the “Zoom” tool on Sakai for each session independently and will be recorded in keeping with the statement shown below. The office hours will be accessed by the “Office Hours” tool on Sakai. 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.

Recording of Zoom Class Meetings: In this class software will be used to record live class discussions. As a student in this class, your participation in live class discussions will be recorded. These recordings will be made available only to students enrolled in the class, to assist those who cannot attend the live session or to serve as a resource for those who would like to review content that was presented. All recordings will become unavailable to students in the class when the course has concluded. *Students will be required to turn on their cameras at the start of class. Students who have a need to participate via audio only must reach out to me to request audio participation only without the video camera enabled.* The use of all video recordings will be in keeping with the University Privacy Statement shown below.

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.

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 componets:

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

Finally, the course grade will be determined based on the class score through two different scales: the fixed scale and the Gaussian scale, with the better grade will be your final grade.

Fixed scale	Gaussian scale ^a	Grade
score ≥ 82	score $\geq \mu + 1.4\sigma$	A
$77 \leq \text{score} < 82$	$\mu + 1.1\sigma \leq \text{score} < \mu + 1.4\sigma$	A-
$72 \leq \text{score} < 77$	$\mu + 0.8\sigma \leq \text{score} < \mu + 1.1\sigma$	B+
$67 \leq \text{score} < 72$	$\mu + 0.5\sigma \leq \text{score} < \mu + 0.8\sigma$	B
$62 \leq \text{score} < 67$	$\mu + 0.2\sigma \leq \text{score} < \mu + 0.5\sigma$	B-
$57 \leq \text{score} < 62$	$\mu - 0.2\sigma \leq \text{score} < \mu + 0.2\sigma$	C+
$52 \leq \text{score} < 57$	$\mu - 0.5\sigma \leq \text{score} < \mu - 0.2\sigma$	C
$47 \leq \text{score} < 52$	$\mu - 0.8\sigma \leq \text{score} < \mu - 0.5\sigma$	C-
$42 \leq \text{score} < 47$	$\mu - 1.1\sigma \leq \text{score} < \mu - 0.8\sigma$	D+
$37 \leq \text{score} < 42$	$\mu - 1.4\sigma \leq \text{score} < \mu - 1.1\sigma$	D
score < 37	score $< \mu - 1.4\sigma$	F

^a μ and σ are the average and standard deviation of the class scores of the entire class, respectively.

Midterm Grade: Your midterm grades will be obtained based on the first two midterm exams (80%, with each contributes 40%) and homework assignments (20%) according to the method described above – with the better grade of the fixed scale and Gaussian scale will be your midterm grade.

Homework: Homework assignments will be assigned online, with each assignment has several problems and each problem is worth certain points. To receive full credit, a student's homework has to be submitted online by the beginning of the next lecture. Each homework must present meaningful steps to solving assigned problems. If only the final result is correct but no meaningful steps presented, the problem solution

will receive zero points. Late homework assignments, or less than 1/2 completed problem solutions will receive zero points. Students may compare and discuss their homework solutions, but each solution has to be arrived at independently.

Exams: There will be three midterm exams and one final exam. All the exams will be online. 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 exam will be held on: **Monday, December 7, 2020 at 1:00 PM (CST)**. You will have exactly 2 hours to complete the final 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. Students who are physically outside United States may request to have their final exam rescheduled because of the time zone difference. If a student has either or both of the above two issues, this student should be directed to e-mail a petition to Adam Patricoski, Assistant Dean for Student Academic Affairs, CAS Dean's Office (apatricoski@luc.edu).

Ethical Considerations:

a. Academic integrity: All students in this course are expected to have read and to abide by the demanding standard of personal honesty, drafted by the College of Arts and Sciences, which can be viewed at:

<http://www.luc.edu/cas/advising/academicintegritystatement/>

A basic mission of a university is to search for and to communicate the truth as it is honestly perceived. A genuine learning community cannot exist unless this demanding standard is a fundamental tenet of the intellectual life of the community. Students of Loyola University Chicago are expected to know, to respect, and to practice this standard of personal honesty.

Academic dishonesty can take several forms, including, but not limited to cheating, plagiarism, copying another student's work, and submitting false documents.

Any instance of dishonesty (including those detailed on the website provided above or in this syllabus) will be reported to The Chair of The Department of Chemistry and Biochemistry who will decide what the next steps may be.

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 plagiarism 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.

Loyola University Absence Policy for Students in Co-Curricular Activities 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 (develop standard form on web) 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 as far in advance of the absence as possible. It is the responsibility of the student to make up any assignments. If the student misses an examination, the instructor is required to give the student the opportunity to take the examination at another time. (<https://www.luc.edu/athletheadvising/attendance.shtml>).

Student Accommodations: The Student Accessibility Center (formerly known as Services for Students with Disabilities), Sullivan Center (773-508-3700), www.luc.edu/sac, has the mission “to serve students with documented disabilities by creating and fostering an accessible learning environment,” including “support[ing] faculty, staff, and administrators on matters such as ADA and Section 504 compliance, as it relates to individuals with disabilities.” Please direct all questions concerning accommodations of disabilities to the Student Accessibility Center. Academic accommodations afforded to students require documentation and review. The Student Accessibility Center will issue accommodation letters for registered students to present to their instructors: accommodations are not active until students present these letters to their instructors. If students’ accommodations involve attendance or deadlines, instructors and students will jointly complete and execute an Agreement Form articulating their terms. See <https://www.luc.edu/sac/faculty/facilitatingaccommodations/> for guidance about implementing various kinds of accommodations in a way that is appropriate to your class. The Student Accessibility Center stands ready to work with you.

Accommodations for Religious Reasons: If you have observances of religious holidays that will cause you to miss class or otherwise effect your performance in the class you must alert the instructor ***within 10 calendar days of the first class meeting of the semester*** to request special accommodations, which will be handled on a case by case basis.

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). After the second attempt, the student must secure approval for a third attempt. Students must come to the Chemistry Department, fill out a permission to register form or print it from the Department of Chemistry and Biochemistry website: <http://www.luc.edu/chemistry/forms/> and personally meet and obtain a signature from either the Undergraduate Program Director, Assistant Chairperson, or Chairperson in Chemistry. A copy of this form is then taken to your Academic Advisor in Sullivan to secure final permission for the attempt.

The Loyola COVID-19 Website: <https://www.luc.edu/coronavirus/>

The Return to Campus Website: <https://www.luc.edu/returntocampus/>

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

- Student Complaint Procedure: <https://www.luc.edu/online/resources/student-grievances/>
- Technology Support, including Sakai, Zoom, and LOCUS: <https://www.luc.edu/online/resources/technology/>
- Academic Services, including the Center for Tutoring and Academic Excellence, and the Writing Center: <https://www.luc.edu/online/resources/academicservices/>
- Student Support Services, including the Student Accessibility Center, and the Wellness Center: <https://www.luc.edu/online/resources/student-support-services/>

Tentative Schedule*

Week	Dates	Lecture Topics
1	Tuesday Aug 25	Introduction of physical chemistry for the biological sciences; Syllabus
	Thursday Aug 27	Chapter 2: First law of thermodynamics, energy, heat capacity
2	Tuesday Sep 1	Chapter 2: State and path, enthalpy, bond energies
	Thursday Sep 3	Chapter 3: Second law of thermodynamics, entropy
3	Tuesday Sep 8	Chapter 3: Free energy, noncovalent interactions
	Thursday Sep 10	Chapter 4: Free energy and chemical equilibria
4	Tuesday Sep 15	Chapter 4: Chemical equilibria of different systems
	Thursday Sep 17	Chapter 4: Biochemical applications of thermodynamics
5	Tuesday Sep 22	Chapters 4 & 5: the isothermal titration calorimetry approach, Boltzmann distribution
	Thursday Sep 24	Midterm Exam 1
6	Tuesday Sep 29	Chapter 9: Rates of chemical reactions, rate laws, reaction orders
	Thursday Oct 1	Chapter 9: Reaction mechanisms, transition state theory
7	Tuesday Oct 6	Chapter 9: Very-fast reactions, single-molecule kinetics
	Thursday Oct 8	Chapter 10: Enzyme kinetics, Michaelis-Menten Kinetics
8	Tuesday Oct 13	Chapter 10: Competition and Inhibition
	Thursday Oct 15	Midterm Exam 2
9	Tuesday Oct 20	Chapter 11: Foundations of quantum mechanics
	Thursday Oct 22	Chapter 11: Particle-in-a-box, harmonic oscillator
10	Tuesday Oct 27	Chapters 11&12: electronic structures of atoms and H ₂ molecule, molecular orbitals
	Thursday Oct 29	Chapter 12: Intramolecular and intermolecular interactions, the Monte Carlo and molecular dynamics methods
11	Tuesday Nov 3	Applications of quantum mechanics and molecular dynamics to modeling biomolecules
	Thursday Nov 5	Midterm Exam 3
12	Tuesday Nov 10	Chapter 13: Electromagnetic spectrum, ultraviolet spectroscopy
	Thursday Nov 12	Chapter 13: Fluorescence and phosphorescence
13	Tuesday Nov 17	Chapter 13: Infrared and Raman spectroscopy
	Thursday Nov 19	Chapter 14: nuclear magnetic resonance (NMR), chemical shifts, spin-spin coupling
14	Tuesday Nov 24	<i>No Class; Thanksgiving break</i>
	Thursday Nov 26	
15	Tuesday Dec 1	Chapter 14: Relaxation mechanisms, multidimensional NMR spectroscopy
	Thursday Dec 3	Summary and Review
Final exam: Monday December 7, 1:00-3:00 PM (CST), Online		

*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.