

**Chemistry 302: Physical Chemistry II (Spring 2024)**  
Department of Chemistry and Biochemistry, Loyola University Chicago

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Telephone: 773.508.3169  
Lectures: 001: Tuesday and Thursday 10:00 AM-11:15 AM, Flanner Hall-105  
Discussions: 002: Tuesday 1:00-1:50 PM, Flanner Hall-105  
Office Hours: Monday: 1 PM-2:30 PM, **or by appointment**

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

**Course Prerequisites:**

CHEM 222 or 224, PHYS 112 or 122, and MATH 162, 263A, or the 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:**

“Atkins' Physical Chemistry Volume 2: Quantum Chemistry, Spectroscopy, and Statistical Thermodynamics”, 11<sup>th</sup> edition, by Peter Atkins, Julio de Paula, and James Keeler, Oxford University Press, 2018, ISBN: 978-0-19-881790-1.

**Require Materials:**

A calculator capable of scientific notation.

**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 phenomena as well as solve chemical problems. We will cover fundamental knowledge about physical chemistry, mainly quantum mechanics and molecular spectroscopy, along with their applications in chemical systems. Specifically, a tentative schedule of lectures is shown at the end of this syllabus. Your attendance at lectures and discussions is expected. The correct answers to 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.

**Course Structure:**

There are two 75-minute lectures (Tuesday and Thursday) and one 50-minute discussion section (Tuesday) per week. The discussion section will be small group work. You will work in small groups on problems, to work with your classmates to learn the material. It is highly recommended that you read (and think about) appropriate content 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.

**Homework:**

You will have several homework assignments to complement the materials covered in the class. You will have 5 days to finish each homework assignment. The due date may be postponed for excused absences that last three or more days. Late homework turned in within 72 hours of the due time will receive 50% of the credits, while late homework turned in after 72 hours of the due time will receive zero points.

**Tests:**

- **Midterm Exam:** There will be three midterm exams in the classroom. The lowest score midterm will be dropped. They will be open notes and books, but no other resources will be allowed.
- **Final Exam:** The Final Exam is a take-home and tentatively scheduled for 04/30/2024. You will have 24 hours to complete the exam. Please work on the exam independently and do not discuss it with your classmates. You can use textbooks and class notes but don't take any help from online resources or experts.

If a student disagrees with her/his score for the final exam, she/he must request re-grading *within four days* from the day he/she received the graded final exam. If you for any reason require special accommodation during any of the exams, contact me WELL BEFORE the exam. The day of the exam is too late. If you miss deadlines or exams for valid reasons (emergencies related to family, medical, legal, or immigration issues) you must contact me by email as soon as possible to avoid failing the exam.

**Grade Components:**

You will be evaluated based on the following components:

- Homework assignments: 20%
- Midterms: 50%
- Final exam: 30%

The course grade will be determined through the following scale:

Fixed scale	Grade
score $\geq$ 92	A
$87 \leq$ score $<$ 92	A-
$82 \leq$ score $<$ 87	B+
$77 \leq$ score $<$ 82	B
$72 \leq$ score $<$ 77	B-
$67 \leq$ score $<$ 72	C+
$62 \leq$ score $<$ 67	C
$57 \leq$ score $<$ 62	C-
$52 \leq$ score $<$ 57	D+
$47 \leq$ score $<$ 52	D
score $<$ 47	F

**Tentative Schedule\***

Week	Dates	Lecture Topics	Reading
1	Tuesday, Jan 16	Syllabus, the Boltzmann distribution	Syllabus, Topic 13A
	Thursday, Jan 18	Origins of quantum mechanics	Topic 7A
2	Tuesday, Jan 23	Wavefunctions	Topic 7B
	Thursday, Jan 25	Operators and observables	Topic 7C
3	Tuesday, Jan 30	Translational motion	Topic 7D
	Thursday, Feb 1	Vibrational motion	Topic 7E
4	Tuesday, Feb 6	Rotational motion	Topic 7F
	Thursday, Feb 8	Hydrogenic atoms	Topic 8A
5	Tuesday, Feb 13	Many-electron atoms	Topic 8B
	Thursday, Feb 15	Atomic spectra	Topic 8C
6	Tuesday, Feb 20	Valence-bond theory and Molecular orbital theory	Topic 9A, 9B
	Thursday, Feb 22	<b>Midterm 1</b>	
7	Tuesday, Feb 27	Molecular orbital theory: diatomic molecules	Topics 9C & 9D
	Thursday, Feb 29	Molecular orbital theory: polyatomic molecules	Topic 9E
8	Tuesday, Mar 5	<i>No Classes; Spring Break</i>	
	Thursday, Mar 7		
9	Tuesday, Mar 12	Shape and symmetry	Topic 10A
	Thursday, Mar 14	Group theory	Topic 10B
10	Tuesday, Mar 19	Applications of symmetry	Topic 10C
	Thursday, Mar 21	<b>Midterm 2</b>	
11	Tuesday, Mar 26	General features of molecular spectroscopy Rotational spectroscopy	Topic 11A Topic 11B
	Thursday, Mar 28	Vibrational spectra of diatomic molecules	Topic 11C
12	Tuesday, Apr 2	Vibrational spectra of polyatomic molecules	Topic 11D
	Thursday, Apr 4	Symmetry analysis of vibrational spectra	Topic 11E
13	Tuesday, Apr 9	Electronic spectra	Topic 11F
	Thursday, Apr 11	Decay of excited states	Topic 11G
14	Tuesday, Apr 16	General principles of magnetic resonance	Topic 12A
	Thursday, Apr 18	<b>Midterm 3</b>	
15	Tuesday, Apr 23	Features of NMR spectra, Pulse techniques in NMR	Topic 12B, 12C
	Thursday, Apr 25	Electron paramagnetic resonance	Topic 12D
<b>Final exam: Tuesday, April 30 (Take home)</b>			

\*The instructor reserves the right to make changes to the schedule, any changes to the exam dates will be announced in class and on Sakai. Reading assignments are from the textbook unless noted otherwise.

**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 & Sciences, which can be viewed at:

<https://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, 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 contact 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. Academic misconduct includes but is not limited to the following:

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

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. 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 who will decide the next steps.

#### **Health, Safety, and Well-Being On-Campus:**

Please be familiar with and adhere to all policies and protocols posted on the Campus Info & Resources site: <https://www.luc.edu/healthsafetyandwellbeing/campusinforesources/>

#### **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/athletheadvising/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.

#### **Student Accommodations:**

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 equitable 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 at 773-508-3700 or [SAC@luc.edu](mailto:SAC@luc.edu).

**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.

**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/exams. 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. The instructor will handle the accommodations on a case-by-case basis.

**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 Spring 2024 semester, students are able to convert a class to “Pass/No-Pass” or “Audit” through Monday, January 29th. 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). 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 Official Academic Calendar:** [www.luc.edu/academics/schedules](http://www.luc.edu/academics/schedules)

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

**COVID-19 Info & Resources:** <https://www.luc.edu/healthsafetyandwellbeing/covid-19inforesources/>

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

