Spring 2024

THE UNIVERSITY OF TEXAS AT TYLER

CHEM 3354: Physical Chemistry II

An Introduction to Kinetics, Quantum Mechanics and Statistical Mechanics

Instructor: **Dr. Rachel Mason**
rmason@uttyler.edu
903/565-5641
RBS 3002

Office Hours: **MWF 10:30 –11:30 pm**
T 4:00-5:00 pm
R 1:30-2:30
Or by appointment

I practice an open door policy—any time my door is open you are welcome to stop in and I will help you as time allows. If I can't talk right then, we'll set an appointment for a different time.

Class Meetings: **RBS 2015**
TR 11:00am–12:20 pm
16 Jan—26 Apr 2023*

About this course:

It's a tough course. (See "Words From the Wise" on Page 9) Don't be afraid to come see me when you need help. I expect you to have questions and I expect you to come ask them.

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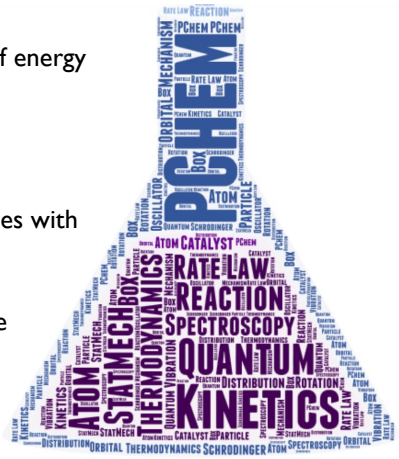
Course Description

Physical Chemistry is the quantitative and theoretical study of the properties and structure of matter. The aim of this course is to give the student an understanding of the principles, laws and theories of physical chemistry that will serve the needs of the chemistry, biochemistry, premedical and engineering student. Physical chemistry is typically grouped into four main topics:

- **Thermodynamics** – Dealing with the interconversion of various kinds of energy and the changes in physical properties involved.
- **Kinetics** – Dealing with the rates of chemical processes.
- **Quantum Mechanics** – Dealing with phenomena on the molecular level
- **Statistical Mechanics** – Connecting the properties of individual molecules with bulk properties.



This course, as the second of a two semester sequence, is concerned with the Middle two topics.

Learning Objectives

By the end of the course the students should be able to:

- Thoroughly understand and apply principles, laws and theories of introductory physical chemistry.
- Solve quantitative and qualitative problems.
- Use original thought and logic in solving complicated problems.
- Articulate the concepts learned.
- Learn and work independently.
- Work cooperatively with others.

Course Pre– and Co-requisites

Course Prerequisites are:

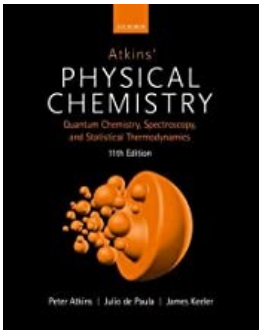
- Calculus I, & II
- University Physics I & II or College Physics I & II
- General Chemistry I & II
- Organic Chemistry I & II
- Analytical Chemistry
- Physical Chemistry I

Additionally:
Chem 3155: Physical Chemistry II Laboratory should be taken concurrently with this course. A student cannot use this lecture as part of the degree requirements without the corresponding laboratory course unless prior arrangements for a suitable substitution have been made.

Course Materials

Required Textbook:

- *Atkin's Physical Chemistry*, 11th edition by Atkins, de Paula & Keeler (ISBN: 9780198769866). Get the format that suits you best. You can just get Vol 2 of this book (ISBN: 9780198817901) if you also are not taking CHEM 3352.
- Students should also be aware of the Chem LibreText website (https://chem.libretexts.org/Bookshelves) which contains course-maps relating free OER text resources to published textbooks.



Other Materials:

- Scientific calculator capable of doing logarithms and exponentials.
- Additional materials will be posted on the course's Canvas page. Check it often.
- Students are encouraged to utilize outside resources.

Important Administrative Dates

Class will meet from 16 January 2023 to 26 April 2024.

Students should be aware of these dates:

January 15th (Mon) - MLK, Jr. Holiday—Classes will not meet.
January 29th (Mon) – Census date, last day to file for grade replacement or make a schedule change.
March 1st (Fri) – Last day to file for Spring 2024 graduation
Graduation checks must be completed prior to this date.
March 11th-15th (Mon-Fri) – Spring Break—The class will not meet.
March 25th (Mon) – Last day to withdraw from courses with a W.
(Note: Failure to officially drop the course will result in a grade of "F".
Students considering dropping should consult with the instructor prior to dropping)
April 2nd (Tues) – Registration for Fall 2024 enrollment opens
April 29th-May 3rd (Mon-Fri) – Final Exams
May 3rd-4th (Fri & Sat) - Spring 2024 Commencement Exercises

Tentative Topic Schedule

Please note this is a tentative schedule. It is subject to adjustment at my discretion and whim as needed to facilitate the course.

Students are strongly encouraged to read the material before coming to class and to review the text as needed after class. The accompanying schedule is my initial best guess. More specific readings will be announced in class.

Topic	Readings from	Timeframe:
Transport	Chapter 16	Week 1-2
Kinetics & Mechanisms	Chapters 17-18	Week 2-5
Quantum Theory	Chapters 7A-C	Week 6-7
Particle in a Box	Chapters 7D	Week 8
Rotation & Vibration	Chapters 7E-F	Week 9-10
Atomic Structure	Chapters 8	Week 11-12
Molecular Structure	Chapters 9	Week 13
Molecular Spectroscopy	Chapters 10 & 11	Week 15

Grade Calculation

Contributing Elements:

• 3 Regular Exams	57%	(score is the % grade on each exam)
• Final Exam	19%	(ACS Comprehensive Final)
• Homework	10%	(cumulative % for all assignments)
• In-Class Work & Quizzes	8%	(cumulative % for all assignments)
• Learning Journal	6%	(cumulative % for all assignments)

Grades will be based on a 90/80/70/60 scale, but may be adjusted on my evaluation of the class.

Homework

Learning PChem requires study, practice and drill.

Students benefit from completing all assigned homework sets, though not all problems will be graded. It is to your advantage to work all problems since homework problems and exam questions will be similar. The likelihood of success without doing the homework is minimal. Students are strongly encouraged to seek help from the instructor and classmates when completing the homework.

In-Class Work & Learning Reflections

Quizzes

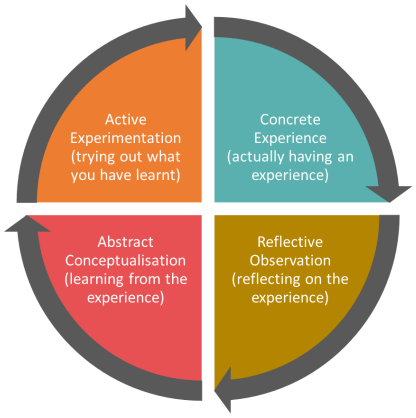
Both individual and group quizzes will be utilized. Quizzes will be generally be given toward the beginning of class and cover material from the previous session.

Other Assignments

A variety of other work may be assigned during or outside of class to facilitate instruction & learning.

Learning Reflection

Learning reflections are due at in Canvas by 11:59 pm on Friday of each week. Entries should: highlight the main points covered in class, describe what you learned, relate new concepts to earlier course material, and ask questions about course material or respond to specific prompts given.



Test Dates

Tentative Exam Schedule:

- Exam #1— 13 Feb 2024
- Exam #2—7 or 19 Mar 2024
- Exam #3—18 Apr 2024
- Final Exam—30 April 2024

Caveat:

While I never plan for the test dates to change, I do reserve the right to adjust the dates as needed. Any alterations will be announced in class and posted to Canvas.

We will determine the format of tests prior to each exam.

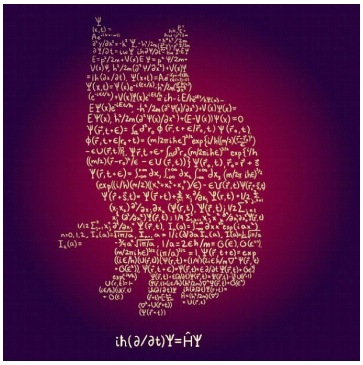
Exam Policies

Content:

- All exams are technically comprehensive as the course material builds on itself. However, exams will focus on material introduced since the previous exam.
- Exams will cover material discussed during class periods, assigned homework and other assigned materials, including material in assigned portions of the text or other readings, but not directly discussed during class periods. Any exceptions will be announced in class.

Missed Exams:

- As soon as a student is aware of a conflict, it should be discussed with the instructor well in advance of the exam. Except in extreme situations, no exam will be given after its scheduled date.
- **All students are required to take the final examination in order to receive a passing grade in the course.**



Additional Comments:

- Exams are loosely proctored and students are expected to conduct themselves with integrity and honesty.

Strategies for Success

Spend time studying.

PChem will be a time consuming course. Expect to spend several hours outside of class studying and working practice/homework problems as success is unlikely without working significant numbers of problems.

Come to class.

Attendance is extremely important and it is imperative to keep up with the course material as the semester progresses. Class participation and attendance will not be graded *per se*, but will be considered in the final grade.

Be prepared.

The course material is difficult and requires time to "sink in." It will be much more comprehensible if the text is read both before and after class. Keeping up with the material is necessary vital to succeed. This is simply not a class for which you can cram right before the test.

Take good notes.

Students should take notes and review them after each class. See me about points that seem unclear as soon as possible as each session builds on the previous material. It is NOT advisable to wait until just before an exam to seek help. My lecture notes are posted, but are not adequate substitution for your own notes.

Pool your knowledge.

Students are strongly encouraged to form cooperative learning groups in order to help and encourage each other. This allows students to share their knowledge and to take advantage of the talents of others surrounding them. Peer leaning is indispensable in this course.

Do not cheat.

Students are encouraged to do homework, study and prepare for exams with classmates. However, students are expected to work alone on exams. Cheating will not be tolerated. University regulations are explicit about academic dishonesty. These regulations are contained in *A Student Guide to Conduct and Discipline at UT Tyler,* which may be obtained in the Office of Student Affairs or accessed http://www.uttyler.edu/mainsite/conduct.html. During exams, an honor code will apply such that students will neither give help to nor accept help from others during the exams. Students are expected to abide by and to help enforce the code.

Handling Illness

In-Case of Illness

Students who are feeling ill or experiencing symptoms such as sneezing, coughing, digestive issues (e.g. nausea, diarrhea), or a higher than normal temperature are encouraged to stay home or at least social distance themselves from classmates. In these case sharing germs is NOT caring for your peers. You are likely to recover faster with rest and your instructor and peers will appreciate not catching your communicable disease.

Isolating & Quarantining Students:

Students who have been exposed to COVID-19 should follow University policies about quarantining (https://www.uttyler.edu/coronavirus/). Isolating and quarantining students should participate via Zoom as fully as possible given their individual health situation. Please let me know that you are isolating for whatever reason and I will make Zoom an option as is appropriate for the day's session.

Health Hygiene & Self Care

Students are reminded that the spread of most communicable diseases can be reduced by using good health hygiene practices such as covering coughs and sneezes, frequent hand washing, surface cleaning and staying home when ill. Students are further encouraged to maintain a healthy immune system through practicing good self-care. College is stressful enough without getting sick!

Additional Accommodation

Students needing additional accommodations may contact the Office of Student Accessibility and Resources at University Center 3150, or call (903) 566-7079 or email saroffice@uttyler.edu.

Course Format

This course will be taught face-to-face.

The course will be conducted in a face-to-face mode as much as is safely possible. At this time, it is anticipated that all class sessions will be held in-person. Students who need to miss class should communicate with me as soon as is practical to make arrangements. UT Tyler guidelines for COVID mitigation will be followed. Should the University mandate remote learning this class will shift to an online format. It is anticipated that will be Zoom sessions at the scheduled course time. Details will be provided on the course Canvas page in this event.

Recorded Sessions:

Class sessions will be recorded by the instructor for use by students enrolled in this course. They are reserved **ONLY** for the use of students enrolled in this course and are for educational purposed only. Course recordings should not be shared outside of the course without express written permission of the instructor. Recordings which contain information subject to the FERPA guidelines shall not be shared with individuals not enrolled in this course unless appropriate consent is obtained from all relevant parties. As a general rule class recordings will not be posted. However, they will be available for students missing class for a University approved event or illness.

Classroom Courtesy

Even though this is not a large class small disruptions add up quickly so please keep chatter to a minimum. The course has ample opportunity for discussion aand group work. Students are encouraged to actively participate at those times. I expect students to behave with respect and courtesy to both the instructor and fellow students. This includes:

- Choosing a back row or aisle seat if you arrive late or need to leave early.
- **Deactivating/silencing all cell phones, and other devices during class**.
- **Not texting, messaging or calling during class**. Please leave class if you absolutely must make a call.
- Using electronic devices responsibly. While you may use your tablet, laptop, iPad, *etc* to take notes, please don't work on homework, play games, chat, watch movies, or make TikToks (or do anything else that is not class!)
- Refraining from derogatory remarks and profanity in class.
- Not talking during class presentations or over top of another person during discussions. If you have questions, please ask them of me directly rather whispering to your neighbor. Chances are high that other students will share your questions and appreciate your voicing them.
- Participating appropriately in group work. Make every effort to stay on topic and respect time constraints. Treat group members with dignity and respect. Share the workload by neither shirking nor monopolizing.
- Keeping the environment friendly. Learning is a process which can be uncomfortable and frustrating. Please make every effort to keep expressions of chagrin, annoyance, aggravation, disgruntlement, dolefulness and exasperation appropriate for work. You are absolutely welcome to express such sentiments; just do so without vulgar language or personal attacks.

Academic Integrity

Honor and integrity will not allow me to lie, cheat, or steal, nor to accept that actions of those who do.

The value of any academic degree depends upon the integrity of the work done in earning the degree. Academic misconduct includes, but is not limited to cheating, plagiarism, collusion and/or falsification of records. Students are expected to assume full responsibility for the content and integrity of all academic work submitted as quizzes, homework, projects and examinations.

University policy obliges instructors to report cases of academic misconduct to the Dean of Students; it also obligates students to report observed instances of academic dishonesty to the instructor. As upper division students, I expect an extremely high level of responsibility and academic honesty from my PChem students.

Departmental policy states that cell phones, smart watches, and any similar electronic devices must be turned off and put in designated areas during exams. If these are observed out in a visually accessible place (*i.e.* between legs, on the floor, *etc.*), it will be assumed that they are being used to cheat**;** your exam will taken away, you will receive a zero score (0 points) for the exam, and you will be referred to the Office of Judicial Affairs.

Recently services such as Chegg, CourseHero, *etc* have become popular tools for college students. Please understand these services are businesses whose first concern is profit, not academic integrity. Such services do provide some legitimate value, but be careful how you use them. While ethically there is a huge difference between a learning tool and cheating, these services have blurred the practical line. None of these services should be ever be used in a exam situation. Using them on homeworks and projects should be cleared with the instructor PRIOR to doing so. **I never approve the posting of any of my course materials on these sites.**

University Policy Highlights

Students Rights and Responsibilities

To know and understand the policies that affect student rights and responsibilities as a student at UT Tyler, please follow this link: http://www.uttyler.edu/wellness/StudentRightsandResponsibilities.html

Campus Carry

We respect the right and privacy of students 21 and over who are duly licensed to carry concealed weapons in this class. License holders are expected to behave responsibly and keep a handgun secure and concealed. More information is available at http://www.uttyler.edu/about/campus-carry/index.php

UT Tyler a Tobacco-Free University

All forms of tobacco are not be permitted on the UT Tyler main campus, branch campuses, and any property owned by UT Tyler. This includes, but is not limited to: cigarettes, cigars, pipes, water pipes (hookah), bidis, kreteks, electronic cigarettes, smokeless tobacco, snuff, chewing tobacco, and all other tobacco products. This affects all members ofd the campus community and visitors. For more information, please visit www.uttyler.edu/tobacco-free.

Grade Replacement/Forgiveness

Paperwork for intent to receive grade forgiveness must be filed with the Registrar by the 12th day of class. Failure to do so will result in both the original and repeated grade being used to calculate overall grade point average. Undergraduates may receive grade forgiveness (grade replacement) for only three course repeats during an career at UT Tyler.

State-Mandated Course Drop Policy

Texas law prohibits a student who began college for the first time in Fall 2007 or thereafter from dropping more than six courses during their entire undergraduate career. This includes courses dropped at another 2- or 4-year Texas public college or university. This rule defines a dropped course as any course that is dropped after the 12th day of class. Exceptions to the 6-Drop rule may be found in the catalog. Petitions for exemptions must be submitted to the Registrar and must be include documentation of extenuating circumstance.

Disability Support Services

In accordance with federal law, a student requesting accommodation must provide documentation of his/her disability to the Disability Support Services counselor. If you have a disability, including a learning disability, for which you request an accommodation, please contact the Disability Support Services office in UC 282, or call (903) 566-7079.

Student Absence due to Religious Observance:

Students who anticipate being absent from class due to a religious observance are requested to inform the instructor of such absences by the second class meeting of the semester.

Student Absence for University-Sponsored Events and Activities:

If you intend to be absent for a university-sponsored event or activity, you or the event sponsor, must notify the instructor at least two weeks prior to the date of the planned absence. At that time, the instructor will set a date and time when make-up assignments will be completed.

Social Security and FERPA Statement:

It is the policy of The University of Texas at Tyler to protect the confidential nature of social security numbers. The University has changed its computer programming so that all students have an identification number. The electronic transmission of grades (e.g., via e-mail) risks violation of the Family Educational Rights and Privacy Act; grades will not be transmitted electronically.

Emergency Exits and Evacuation:

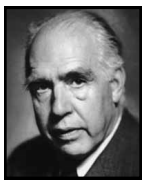
Everyone is required to exit the building when a fire alarm goes off. Follow the instructor's directions regarding the appropriate exit. If you require assistance during an evacuation, inform your instructor in the first week of class. Do not re-enter the building unless given permission by University Police, Fire Department, or Fire Prevention Services.

Student Resources

The following are resources available to UT Tyler students. Many of these offices provide additional programming throughout the academic year.

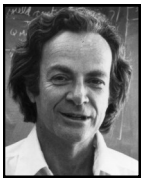
- **Enrollment Services Center** (ADM 230). Visit to add/change majors, add or drop classes or get financial aid help. (They are very busy during the first couple of weeks of the semester and around the "drop date" so please cut them some slack during those times.)
- **Student Counseling Center** (www.uttyler.edu/counseling). Available to help students deal with stress/anxiety, improve study skills, time management, *etc* (all confidential)
- **UT Tyler Student Health and Wellness** (www.uttyler.edu/wellness). Provides assistance with substance abuse, household violence, good eating habits, nutrition and exercise, *etc.*
- **Academic Success** (www.uttyler.edu/success). Manages Supplemental Instruction (SI), Student Learning Communities (SLC), and the tutoring center.
- **The Writing Center** (www.uttyler.edu/writingcenter). Ready to help writing skills and proofing.
- **Student Life** (www.uttyler.edu/admissions/studentlife). Coordinates Clubs, Greek system, recreational sports, service opportunities, *etc.*

Words from the Wise



"Anyone not shocked by quantum mechanics has not yet understood it."

Niels Bohr As quoted by Heisenberg, Werner. *Physics and Beyond.* New York: Harper and Row. (1971) p 206.



"I think I can safely say that nobody understands quantum mechanics."

Richard Feynman in Feynman, Richard. *Character of Physical Law. BBC.* London (1965) p. 129

"All matter originates and exists only by virtue of a force which brings the particles of an atom to vibration and holds this most minute solar system of the atom together."

Max Planck in *Das Wesen der Materie [The Nature of Matter],* speech at Florence, Italy (1944)

"But the atoms or elementary particles themselves are not as real; they form a world of potentialities or possibilities rather than one of things or facts."

Werner Heisenberg in Heisenberg, Werner. *Physics and Philosophy*. New York: Penguin Classics. (2000) 128.

Something unknown is doing we don't know what—that is what our theory amounts to.

Sir Stanley Eddington in The Nature of the Physical World (1928) 291.

"It is often stated that of all the theories proposed in this [20th]century, the silliest is quantum theory. In fact, some say that the only thing that quantum theory has going for it is that it is unquestionably correct."

Michio Kaku, in Kaku, Michio *Hyperspace* (1995), 263.