CHEM 3354: Physical Chemistry II

An Introduction to Kinetics, Quantum Mechanics and Statistical Mechanics

Instructor: Dr. Rachel Mason
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RBS 3032

Office Hours: WF 2:30-3:30 pm
TR 9:00-10:00 am
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
14 Jan—4 May 2019

About this course:
It’s a tough course. 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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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 last three 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.
Required Textbook:

Optional Materials:

Other Materials:
- Additional materials will be posted on the course's Blackboard page.
- Students will need a scientific calculator.

Important Administrative Dates

Classes meet from 14 January 2019 to 26 April 2019.

Students should also be aware of these dates:
- January 28th (Mon) – Census date, last day to file for grade replacement or make a schedule change.
- March 1st (Thurs) – Last day to file for Spring 2019 graduation
- March 11th-16th (Mon-Fri) – Spring Break—The class will not meet.
- April 1st (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 29th (Mon) – Study day—no classes meet.
- April 30th-May 4th (Tues-Fri) – Final Exams

Tentative Topic Schedule

<table>
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<tr>
<th>Topic</th>
<th>Readings from</th>
<th>Timeframe:</th>
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<td>Molecular Kinetic Theory &amp; Transport</td>
<td>Chapters 33 &amp; 34</td>
<td>Week 1 – 2</td>
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<tr>
<td>Kinetics &amp; Mechanisms</td>
<td>Chapters 35 &amp; 36</td>
<td>Week 3-5</td>
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<td>Quantum Mechanics</td>
<td>Chapters 12-17</td>
<td>Week 5-9</td>
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<td>Vibration &amp; Rotation of Molecules</td>
<td>Chapters 18-19</td>
<td>Week 9-12</td>
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<td>Atomic Structure</td>
<td>Chapters 20 &amp; 24</td>
<td>Week 12 – 14</td>
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<td>Statistical Mechanics</td>
<td>Selections from Chapters 29-32</td>
<td>Week 14 – 15</td>
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Please note this is a tentative schedule.

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.
Contributing Elements:
- 3 Regular Exams 66% (score is the % grade on each exam)
- Final Exam 22% (ACS Comprehensive Final)
- Homework & In-Class Work 12% (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.

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.

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.

Responses
Responses will be assigned toward the end of class and will invite students to reflect on the material of the current session. May be in class or online.

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

Test Dates

Tentative Exam Schedule:
- Exam #1—7 Feb 2019 (during lab)
- Exam #2—7 Mar 2019 (during lab)
- Exam #3—18 Apr 2019 (during lab)
- Final Exam—30 April 2019 (TBA) ACS Comprehensive Exam

Caveat:
While I never plan for the test dates to change, I do reserve the right to adjust the dates as needed. In the extremely unlikely event of a change, any alterations will be announced in class and posted to Canvas.
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 a rule, make-up examinations will be given not be given. 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:
• Regular exams are generally ~4 hours in duration. Students are allowed snacks and restroom breaks. 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 nor accept help to/from others. Students are expected to abide by and to help enforce the code.
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 and 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 an outside seat if you arrive late or need to leave early.
- **Deactivating/silencing all cell phones, pagers, ipods, etc during class.**
- **Not texting or calling during class.** Please leave class if you absolutely must make a call.
- Using of electronic devices responsibly. While you may use your tablet, laptop, iPad, etc to take notes, please don’t work on homework or play games.
- 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.

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 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 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 area 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.

Tobacco Free Campus

The University of Texas at Tyler is a tobacco free campus.

No forms of tobacco are permitted on the UT Tyler main campus, branch campuses, and any property owned by UT Tyler. Forms of tobacco not permitted include cigarettes, cigars, pipes, water pipes (hookah), bidis, kreteks, electronic cigarettes, smokeless tobacco, snuff, chewing tobacco, and all other tobacco products. This policy applies to all members of the University community, including students, faculty, staff, University affiliates, contractors, and visitors. There are several cessation programs available to students looking to quit smoking, including counseling, quitlines, and group supports. For more information on cessation programs please visit www.uttyler.edu/tobacco-free.
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

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 your overall grade point average. Undergraduates may receive grade forgiveness (grade replacement) for only three course repeats during his/her 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.

Campus Carry Policy
At UT Tyler, we respect the right and privacy of students who are duly licensed to carry concealed weapons in this class. University policy requires licensed handgun carriers carry the handgun in a holster or other secure weapon case that completely covers the trigger and the trigger guard area. The holster must sufficiently retain the handgun in place so that it will not discharge in the event of sudden movement. License holders are expected to behave responsibly and keep any handgun secure and concealed. More information is available at http://www.uttyler.edu/about/campus-carry/index.php.
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](http://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](http://www.uttyler.edu/wellness)). Provides assistance with substance abuse, household violence, good eating habits, nutrition and exercise, etc.
- **Academic Success** ([www.uttyler.edu/success](http://www.uttyler.edu/success)). Manages Supplemental Instruction (SI), Student Learning Communities (SLC), and the tutoring center.
- **The Writing Center** ([www.uttyler.edu/writingcenter](http://www.uttyler.edu/writingcenter)). Ready to help writing skills and proofing.
- **Student Life** ([www.uttyler.edu/admissions/studentlife](http://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.”

“I think I can safely say that nobody understands quantum mechanics.”

“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 possibilities rather than one of things or facts.”

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.”