

Syllabus: CHEM 4501

Molecular Thermodynamics and Kinetics

Fall Semester, 2021, MWF 11:15 am – 12:05 pm

Location: Fraser Hall Room 101 (and synchronous delivery VIA ZOOM)

Course Web Site: <https://canvas.umn.edu/courses/267836>

University of Minnesota, Twin Cities Campus

The Course: This is a 3 credit course that meets for 42 class periods, 50 minutes each, during the 15 week semester. The main themes include the fundamental underpinnings of molecular thermodynamics and statistical mechanics. In addition to the origins and applications of the fundamentals of thermodynamics (the first, second, and third laws, and free energy at constant volume and constant pressure), this includes an introduction to partition functions and the statistical relationship between molecular and macroscopic observables. Once developed, statistical mechanics and thermodynamics are applied to systems that include ideal gases, more advanced equations of state, phase equilibria, solutions, and chemical equilibrium. The course ends with an introduction to chemical kinetics, including differential and integrated rate laws, that extends to reactions beyond first-order. This course will develop these skills and help prepare you to be an informed citizen and life-long learner. This course addresses the University of Minnesota student learning outcomes SLO1, “Can identify, define, and solve problems”, SLO2, “Locate and critically evaluate information” and SLO3, “Master a body of Knowledge and a mode of inquiry.”

Prerequisites: CHEM 1062/1066 or CHEM 1071H/1075H, MATH 2263 or concurrent registration is required (or allowed) in MATH 2263 or MATH 2374 or concurrent registration is required (or allowed) in MATH 2374, PHYS 1302 or PHYS 1402V or PHYS 1502V

Instructor: Professor David Blank; Office: 139A Smith Hall; email: blank@umn.edu
Office hours: Monday and Thursday 2:00-3:00 pm.

Teaching Assistants:

Hridya Premnathan, email: premn006@umn.edu

Office hours: Tuesdays 1:00-2:00 pm and Fridays 2:00-3:00 pm.

Jacob Schaffner, email: schaf653@umn.edu

Office hours: Wednesdays 1:00-2:00 pm

Textbook and Materials:

- *Physical Chemistry: A Molecular Approach* by Donald A. McQuarrie and John D. Simon. University Science Books, 1997. ISBN:0-935702-99-7.
- *Optional text: Problems and Solutions to Accompany Molecular Thermodynamics* by Heather Cox. University Science Books, 1997. ISBN: 0-935702-43-1.
- Access to an internet-capable laptop or desktop computer (with webcam and microphone) to access our exam system for midterms and the final exam.

Course web site: The course Canvas site can be accessed by going to your myu page at <https://www.myu.umn.edu/>. After you login, click on the MY CLASSES tab and then on the appropriate link for the course Canvas site (CHEM 4501). ***This site will be used for quizzes, exams, and the posting of important announcements, course related materials, and grades.***

Examinations: There will be three midterm exams and one final exam. See the schedule at the end of the syllabus for exam dates.

Exam format: All exams will be administered electronically through the course Canvas site using Proctorio electronic proctoring. You must have your student I.D. at each of the midterm exams and the final. I.D. checks will be made by the e-proctoring system. All midterm exams for this course will consist of about 20 questions, including multiple-choice, short answer, ranking, matching, and numerical. The exams will be proctored and graded by computer. Make sure you understand fully how to set up your computer and prepare for e-proctoring **in advance of the actual exams**. Details are provided in the course Canvas site.

Midterm exams will be open from 6:00 am until 11:59 pm on the dates indicated on the schedule at the end of this syllabus. There is no lecture scheduled on exam dates.

The final exam must be taken at the University scheduled time, and will be available on the electronic system December 22, from 6:00 am until 6:00 pm.

Missed exams: A student can be excused from one midterm exam for a true emergency, serious illness, or University sponsored activity. The student should contact the instructor as soon as circumstances allow and appropriate documentation must be provided. If the circumstances are deemed as appropriate for missing the exam, the unweighted average score of all other midterm exams and of the final exam in the course will be used in place of the missed exam. If circumstances lead to a student missing more than one midterm exam, the student should immediately schedule a meeting with the instructor to discuss any available options.

Quizzes: There will be a short graded quiz at the end of each chapter. All quizzes will be administered electronically through the course Canvas site using Proctorio electronic proctoring. The dates are indicated on the schedule at the end of this syllabus. Each end of chapter quizzes will be available from 6:00 am until 11:59 pm on the date indicate.

Problem Sets (Homework): *Working and understanding the problem sets is very important for doing well in this course.* Problem sets and complete solutions, will be provided and available on the course Canvas site. It is highly recommended that these problem sets are completed in concert with the material coverage schedule provided at the end of this syllabus (about one chapter and associated problem set per week). The problem sets will not be graded. However, the content in the problem sets is fair game for the end of chapter quizzes and exams.

Grading: The final course grade will be determined by the combined performance on the 10 end of chapter quizzes, the 3 midterm exams, and the final exam. Each of these will be weighted with the following percentages in the determination of the final grade:

Proctorio Test Exam	2%	(participation only, Canvas / Proctorio)
10 Quizzes	30%	(3% each, outside class, Canvas)
3 Exams	48%	(16% each, Canvas / Proctorio)
Final Exam	20%	(Canvas / Proctorio)

To calculate the final weighted percentage for the class (out of 100% possible):

$$\text{total \% earned} = (2\%) \frac{n_{e, \text{test exam}}}{n_{p, \text{test exam}}} + \sum_{\alpha=1}^{\alpha=10} (3\%) \frac{n_{e, \text{quiz } \alpha}}{n_{p, \text{quiz } \alpha}} + \sum_{\beta=1}^{\beta=3} (16\%) \frac{n_{e, \text{exam } \beta}}{n_{p, \text{exam } \beta}} + (20\%) \frac{n_{e, \text{final exam}}}{n_{p, \text{final exam}}}$$

$n_{e,x}$ = the number of points earned on assignment x

$n_{p,x}$ = the number of points possible on assignment x

Course grades will be assigned based on the following table:

total percentage	letter grade
92% and higher	A
87% and higher	A-
82% and higher	B+
77% and higher	B
72% and higher	B-
67% and higher	C+
62% and higher	C
57% and higher	C-
52% and higher	D
less than 52.0%	F

Overlapping & Back-to-Back Courses: Enrollment in overlapping or back-to-back courses that does not allow enough travel time to arrive at our class meetings on time is prohibited. For more information, please see:

<http://policy.umn.edu/Policies/Education/Education/OVERLAPPINGCLASSES.html>

Teaching & Learning: The materials provided in this course are intended only for the students officially enrolled in this section and are to be used to learn and practice the course material. Disseminating class notes, videos, exams, etc. beyond the classroom community or accepting compensation (in the form of cash or in trade, such as access to a study website) undermines instructor interests in their intellectual property while not substantially furthering instructor and student interests in effective learning. Such actions violate shared norms and standards of the academic community and are not allowed. For additional information, please see:

<http://policy.umn.edu/Policies/Education/Education/STUDENTRESP.html>

Student Conduct Code: As a student at the University you are expected to adhere to Board of Regents Policy: Student Conduct Code. To review the Student Conduct Code, please see:

http://regents.umn.edu/sites/default/files/policies/Student_Conduct_Code.pdf

Scholastic Dishonesty: The Board of Regents Student Conduct Code states that, "Scholastic dishonesty means plagiarizing; cheating on assignments or examinations; engaging in unauthorized collaboration on academic work; taking, acquiring, or using test materials without faculty permission; submitting false or incomplete records of academic achievement; acting alone or in cooperation with another to falsify records or to obtain dishonestly grades, honors, awards, or professional endorsement; altering, forging, or misusing a University academic record; or fabricating or falsifying data, research procedures, or data analysis." For additional information see the student conduct code at http://regents.umn.edu/sites/default/files/policies/Student_Conduct_Code.pdf. The Office for Student Conduct and Academic Integrity has compiled a useful list of Frequently Asked Questions pertaining to scholastic dishonesty: <http://www1.umn.edu/oscai/integrity/student/index.html>. The policy in this course is **zero tolerance**. The *minimum* action taken in a case of scholastic dishonesty in any portion of the work in this course will be a grade of F for the course.

Prof. Blank will make it absolutely clear when collaboration with other students is acceptable and even encouraged. Students are permitted and encouraged to work together on homework assignments, but students need to ensure they can work problems independently in preparation for the exams.

Students may not collaborate on exams or quizzes.

Incompletes: Students that have an excused absence from the final exam AND are passing the course based on all the work completed prior to the final exam may be eligible to receive a grade of "I" in the course. If these criteria are met, contact the instructor as soon as circumstances allow to discuss the possibility of an incomplete grade and the associated requirements for completion.

Student Mental Health and Stress Management: As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance or reduce a student's ability to participate in daily activities. University of Minnesota services are available to assist you with addressing these and other concerns you may be experiencing. You can learn more about the broad range of confidential mental health services available on campus at:

<http://www.mentalhealth.umn.edu/>

Sexual Harassment: The University policy on sexual harassment can be found at:

<http://regents.umn.edu/sites/default/files/policies/SexHarassment.pdf>

Equity, Diversity, and Equal Opportunity: The University policy on equity, diversity, and equal opportunity can be found at:

http://regents.umn.edu/sites/default/files/policies/Equity_Diversity_EO_AA.pdf

Disability Resource Center (DRC): Students with special needs should contact the DRC:

<https://diversity.umn.edu/disability/>

The staff at the DRC will work with the instructor to provide accommodations. If you have a disability, please contact DRC as soon as possible to ensure that your accommodations are in place.

Makeup Work for Legitimate Absences: The University policy on makeup work for legitimate absences can be found at:

<https://policy.umn.edu/education/makeupwork>

Academic Freedom: The University policy on academic freedom can be found at:

https://regents.umn.edu/sites/regents.umn.edu/files/policies/Academic_Freedom.pdf

COVID-19 Related Safety, Recommendations and Restrictions: Current university policy and recommendations related to COVID-19 can be found at:

<https://safe-campus.umn.edu/return-campus/university-planning-response>

Current requirements for face covering are outlined at:

<https://safe-campus.umn.edu/return-campus/face-coverings>

Schedule (2021)

Sept 8	Introduction	
Sept 10	Energy Units and Molecular Energy Levels	
Sept 13–17	Properties of Gases	Chapter 16
<i>Sept 20</i>	<i>quiz 1 (open 6:00 am – 11:59 pm, Canvas/Proctorio)</i>	
Sept 20–24	Boltzmann Factor and Partition Functions	Chapter 17
<i>Sept 27</i>	<i>quiz 2 (open 6:00 am – 11:59 pm, Canvas/Proctorio)</i>	
Sept 27 – Oct 1	Ideal Gas and Partition Functions	Chapter 18
<i>Oct 1</i>	<i>Proctorio test exam completion for credit</i>	
<i>Oct 4</i>	<i>quiz 3 (open 6:00 am – 11:59 pm, Canvas/Proctorio)</i>	
Oct 4	Catch-up and examples	
Oct 6	EXAM 1 (open 6:00 am – 11:59 pm, Canvas/Proctorio)	
Oct 8–14	The First Law	Chapter 19
<i>Oct 18</i>	<i>quiz 4 (open 6:00 am – 11:59 pm, Canvas/Proctorio)</i>	
Oct 18–22	The Second Law	Chapter 20
<i>Oct 25</i>	<i>quiz 5 (open 6:00 am – 11:59 pm, Canvas/Proctorio)</i>	
Oct 25–27	The Third Law	Chapter 21
<i>Oct 29</i>	<i>quiz 6 (open 6:00 am – 11:59 pm, Canvas/Proctorio)</i>	
Oct 29 – Nov 3	The Helmholtz and Gibbs Energies	Chapter 22
<i>Nov 5</i>	<i>quiz 7 (open 6:00 am – 11:59 pm, Canvas/Proctorio)</i>	
Nov 5	Catch-up and examples	
Nov 8	EXAM 2 (open 6:00 am – 11:59 pm, Canvas/Proctorio)	
Nov 10–15	Phase Equilibria	Chapter 23
<i>Nov 17</i>	<i>quiz 8 (open 6:00 am – 11:59 pm, Canvas/Proctorio)</i>	
Nov 17–24	Solutions	Chapter 24
<i>Nov 26</i>	<i>OFF FOR THANKSGIVING</i>	
<i>Nov 29</i>	<i>quiz 9 (open 6:00 am – 11:59 pm, Canvas/Proctorio)</i>	
Nov 29 – Dec 3	Chemical Equilibrium	Chapter 26
<i>Dec 6</i>	<i>quiz 10 (open 6:00 am – 11:59 pm pm, Canvas)</i>	
Dec 6	Catch-up and examples	
Dec 8	EXAM 3 (open 6:00 am – 11:59 pm, Canvas/Proctorio)	
Dec 10–13	Chemical Kinetics	Chapter 28
Dec 15	Last day, catch-up, examples, evaluations	
Dec 22	FINAL EXAM, Scheduled 1:30 PM – 3:30 PM Canvas/Proctorio (OPEN 6:00 am – 6:00 pm)	