Chemical Thermodynamics and Kinetics
Course Syllabus – Fall 2020

Courses: **CHEM 4110**, **CHEM 4110 HON**, and **CHEM 6110**
Instructor: Samer Gozem
E-mail: sgozem@gsu.edu

TA: Astrid Tarleton
E-mail: atarleton@student.gsu.edu

Instruction Mode: Fully online. Lectures are asynchronous and will be uploaded to iCollege.

Live problem-solving sessions: We will have live problem-solving sessions biweekly on Wednesdays, 9:30-10:20 am, via Webex. Those sessions will be recorded and uploaded to iCollege as well. We may adjust days, times, and frequency of those sessions during the semester as needed.

Office Hours: I am available to meet online via Webex, Wednesdays from 10:30 am – 12:30 pm (right after the problem-solving session). Please e-mail in advance if you would like to meet at a different time.

Course Prerequisites: This course relies on chemistry, physics and math concepts from Chem 1212K; Math 2212; Phys 2211K, and Phys 2212K.

Textbook: "**Physical Chemistry**" by Peter Atkins, Julio de Paula, and James Keeler, 11th Edition, Oxford University Press, 2017, ISBN 9780198769866. A few notes and tips:

- The textbook is available from a number of resources online, both as a rental and to buy. You might be able to grab a cheaper copy if you buy early, before semester starts.
- An older edition is fine.
- The full Atkins book has ~900 pages and has a black and blue cover. However, the publishers also have released the same book in three volumes. Most of the material in this course is from volume 1. Please be sure to get either the full textbook or volume 1 (both have black/blue covers, other editions use different colors).
- If you plan to take Chem 4120 next spring, I will likely be using the same Atkins book. In that case, it's better to invest in the full book and/or rent for longer.

Student Resources: Resources accompanying the Atkins textbook, including additional information and the student solutions manual, are available at https://oup-arc.com/access/pchem11e-student-resources#tag_a-deeper-look.

Course Description: "Chemical Thermodynamics and Kinetics" is a 3-credit semester course that covers the principles of thermodynamics, transport and kinetics. These topics serve as the basis for interpreting and interrelating the properties of matter. Focuses 1-6 and 17 from the textbook will be covered in this course.

This course is divided into 7 modules, each module typically lasting around 2 weeks.

Course Objectives: The overall objective is to understand the behavior of matter and transformation between different forms of energy as they relate to expansion and compression of gases, phase transitions, and chemical reactions.

Specific Learning Outcomes are listed for each module towards the end of syllabus.

Homework and Practice Problems: For each module, you will be assigned both required homework as well as additional practice problems to help you apply and assess your knowledge of each of the topics covered in the course. For each module, you will need to type in your answers for required homework in iCollege by the given deadline. Practice problems are for you to get more practice at problem-solving independently. Note that some questions on the exams will be very similar in format to homework questions. Mastering homework will go a long way towards better performance on exams.

Discussion Forums: For each module, there will be two discussion forums set up:

- One forum is for questions and answers. Questions about lectures, homework, and additional practice problems can be discussed here. All students can either post questions or reply to questions. However, please do not give direct answers to homework questions.
- The second forum is for resources. Feel free to post any relevant reading material, videos, websites, or notes you found useful.

These forums will be open throughout the whole course, except during exam times.

Exams: Each module will end with one exam. These exams will be made available Wednesdays at noon and will remain available until Friday at 5 pm local Atlanta time. Once you start the exam, however, you have to complete it in one sitting within a set time limit. Exams are open book. You can use book, notes, calculators, and the internet. Please note, however, that exams will be time-limited and once you answer a question you may not return to it. You can attempt the exam a second time (after Friday), to get back up to half of the points you missed in the first attempt by fixing your answers.

Each exam will primarily test your knowledge of the corresponding module. However, approximately ~10-20% of questions on each exam will come from previous modules.

There will be no other midterm or final exam.

Grading:

The grade breakdown for this course is as follows, per module:

Module	%
1	5
2	15
3	15
4	20
5	15
6	15
7	15

For **Chem 4110 students**: The typical grading scheme for each module (except module 1) is **50% for the exam, 40% for homework, and 10% for participation in discussion forums**. The lowest exam grade out of the six exams will be dropped.

For **Chem 4110 HON and 6110 students**: The typical grading scheme for each module (except module 1) is **40% for the exam, 40% for homework, 10% for an extra problem, and 10% for participation in discussion forums.**

The following plus/minus grading system will be used for everyone:

Grade	%
A+	98+
A	90-98
A-	87-90
B+	83-87
B	80-83
B-	77-80
C	73-77
C	70-73
C-	67-70
D	60-67
F	< 60

Last day to withdraw is **Tuesday, October 13th, 2020**
The University requires faculty, on a date set by the Provost after the mid-point of the course,
1. to give a WF to all those students who are on their rolls but no longer taking the class, and
2. to report the last day the student attended or turned in an assignment.

Student Integrity Policy: All exams must represent the student's individual, unaided efforts. Receiving unauthorized outside information or offering unauthorized information to another student during an examination is cheating. Any suspected offenses may be referred to the Department of Chemistry and the College of Arts and Sciences for appropriate action. Please refer to GSU's policy on academic dishonesty for more information: https://deanofstudents.gsu.edu/files/2019/07/Academic-Honesty-Policy.pdf

Americans with Disabilities Act: The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. Students who wish to request accommodation for a disability may do so via the Access and Accommodations Center (AACE) at https://access.gsu.edu/. Students may only be accommodated upon issuance of a signed Accommodation Plan by the AACE Center (see: https://access.gsu.edu/testing-services/) and are responsible for providing a copy of that plan to instructors of all classes in which accommodations are sought.

Family Educational Rights and Privacy Act: In keeping with USG and university policy, this course website will make every effort to maintain the privacy and accuracy of your personal information. Specifically, unless otherwise noted, it will not actively share personal information gathered from the site with anyone except university employees whose responsibilities require access to said records. However, some information collected from the site may be subject to the Georgia Open Records Act. This means that while we do not actively share information, in some cases we may be compelled by law to release information gathered from the site. Also, the site will be managed in compliance with the Family Educational Rights and Privacy Act (FERPA), which prohibits the release of education records without student permission. For more details on FERPA, go here.

Course Evaluation: Your constructive assessment of this course plays an indispensable role in shaping education at Georgia State. Upon completing the course, please take time to fill out the online course evaluation.

Modules and course schedule:
The course syllabus provides a general plan for the course; please note that deviations may be necessary.

Homework (HW) is due at midnight on the due date (always on Tuesdays). Exams are due at 5 pm (always Fridays) Some modules may be posted before start date, please feel free to start earlier than the scheduled "start date" for each module.

If you miss the deadline for homework or exam for reasons outside of your control (i.e., emergencies) please contact me as soon as possible. There will be no make-up exams, but extensions may be possible under certain circumstances.

Module	Chapters in book	Start date	HW Due date	Exam due date	% of final grade
1	Topic 1A	08/24	N/A	08/28	5
2	Topics 1B+1C	08/31	09/08	09/11	15
3	Focus 2	09/14	09/22	09/25	15
4	Foci 3+4	09/28	10/13	10/16	20
5	Focus 5	10/19	10/27	10/30	15
6	Focus 6	11/2	11/10	11/13	15
7	Focus 17	11/16	12/01	12/04	15

The following pages will list specific learning outcomes, tasks, and grading scheme for each module.

Module 1 (M1): Introduction to physical chemistry and the ideal gas laws.

Start date: Monday, August 24th, 2020.
End date: Monday, August 31st, 2020.
Homework due: N/A.
Exam due: Friday, August 28th (entrance quiz, you get full marks for just completing it)

Outcomes:
- Identify different subfields of physical chemistry and their relationship.
- Define some basic but important terms that will be used repeatedly in this course.
- Review the ideal gas laws.

Tasks:
1. View all M1 lectures by end date.
2. Read Topic 1A in the textbook.
3. Complete the introductory quiz by Friday, August 28th.
4. Post a comment, question, answer, resource, or just introduce yourself in a M1 discussion forum.

M1 Grading:

40% for viewing all M1 videos.
40% for completing the introductory quiz (you will NOT be graded for the quiz, you get the full 40% grade just for completing the quiz, even if you "fail" it. Consider it a survey).
20% for M1 discussion forum post.

Module 2 (M2): Introduction to kinetic theory and the Maxwell Boltzmann distribution.

Start date: Monday, August 31st, 2020.
Homework due: Tuesday, September 8th, 2020
Exam due: Friday, September 11th, 2020

Outcomes:
- Gain a molecular-level perspective of temperature, pressure, and volume.
- Derive the ideal gas law from a molecular model.

Tasks:
1. View M2 lectures.
2. Read Topics 1B and 1C in the textbook.
3. Post at least one question, answer, comment, or resource in the M2 discussion forum.
4. Complete the M2 homework and submit by due date.
5. Complete the M2 exam and submit by due date.

Grading:

Module	Chem 4110 (%)	Chem 4110HON/6110 (%)
Forum post	10	10
Homework	40	40
Exam	50	40
Extra problem	0 (not required)	10

Module 3 (M3): The first law of thermodynamics + thermochemistry.

Start date: Monday, September 14th, 2020.
Homework due: Tuesday, September 22nd, 2020
Exam due: Friday, September 25th, 2020

Outcomes:
- Define internal energy and enthalpy and how they relate to state properties.
- Define the first law of thermodynamics.
- Differentiate between state and path functions and how to relate them.
- Apply concepts and laws of thermodynamics to physical and chemical processes.

Tasks:
1. View M3 lectures.
2. Read Topics 2A-2E in the textbook.
3. Post at least one question, answer, comment, or resource in the M3 discussion forum.
4. Complete the M3 homework and submit by due date.
5. Complete the M3 exam and submit by due date.

Grading:

Module	Chem 4110 (%)	Chem 4110HON/6110 (%)
Forum post	10	10
Homework	40	40
Exam	50	40
Extra problem	0 (not required)	10

Module 4 (M4): Entropy, the second and third laws of thermodynamics, and phase transitions.

Note: this is a three-week module.

Start date: Monday, September 28th, 2020.
Homework due: Tuesday, October 13th, 2020
Exam due: Friday, October 16th, 2020

Outcomes:
- Define entropy and how it relates to other state functions of a system.
- Explain the second and third laws of thermodynamics.
- Define free energies and how they relate to other state functions of the system.
- Combine the first and second laws of thermodynamics through the Maxwell relations.
- Define the phase rule and interpret phase diagrams.
- Determine the factors that affect the positions and shapes of phase diagrams.

Tasks:
1. View M4 lectures.
2. Read Topics 3A-3E and 4A-4B in the textbook.
3. Post at least one question, answer, comment, or resource in the M4 discussion forum.
4. Complete the M4 homework and submit by due date.
5. Complete the M4 exam and submit by due date.

Grading:

Module	Chem 4110 (%)	Chem 4110HON/6110 (%)
Forum post	10	10
Homework	40	40
Exam	50	40
Extra problem	0 (not required)	10

Module 5 (M5): Simple Mixtures.

Start date: Monday, October 19th, 2020.
Homework due: Tuesday, October 27th, 2020
Exam due: Friday, October 30th, 2020

Outcomes:
- Apply concepts and laws of thermodynamics to describe mixtures.
- Define colligative properties and relate them to state functions.
- Interpret liquid mixture phase diagrams and apply them to understand distillation.
- Differentiate between real and ideal behavior of liquids.
- Define activity and account for deviations from ideality using activity.

Tasks:
1. View M5 lectures.
2. Read Topics 5A-5C and 5F in the textbook.
3. Post at least one question, answer, comment, or resource in the M5 discussion forum.
4. Complete the M5 homework and submit by due date.
5. Complete the M5 exam and submit by due date.

Grading:

Module	Chem 4110 (%)	Chem 4110HON/6110 (%)
Forum post	10	10
Homework	40	40
Exam	50	40
Extra problem	0 (not required)	10

Module 6 (M6): Chemical Equilibria.

Start date: Monday, November 2nd, 2020.
Homework due: Tuesday, November 10th, 2020
Exam due: Friday, November 13th, 2020

Outcomes:
- Apply concepts from thermodynamics to describe chemical equilibria and how they respond to external factors.
- Define different equilibrium constants and how they relate to each other and to state functions.
- Apply concepts from thermodynamics to describe electrochemical cells and to define cell potentials.
- Relate cell potentials to other state functions and external factors.

Tasks:
1. View M6 lectures.
2. Read Topics 6A-6D in the textbook.
3. Post at least one question, answer, comment, or resource in the M6 discussion forum.
4. Complete the M6 homework and submit by due date.
5. Complete the M6 exam and submit by due date.

Grading:

Module	Chem 4110 (%)	Chem 4110HON/6110 (%)
Forum post	10	10
Homework	40	40
Exam	50	40
Extra problem	0 (not required)	10

Module 7 (M7): Kinetics: Chemical reaction rates.

Start date: Monday, November 16th, 2020.
Homework due: Tuesday, December 1st, 2020
Exam due: Friday, December 4th, 2020

Outcomes:

- Define reaction rates and rate constants and their relation to concentrations.
- Derive integrated rate laws for different reaction mechanisms.
- Understand rates of chemical reactions near equilibrium.
- Relate rates of chemical reactions to temperature.
- Determine expressions for rates of chemical reactions for different reaction mechanisms, with examples.

Tasks:

1. View M7 lectures.
2. Read Topics 17A-17F in the textbook.
3. Post at least one question, answer, comment, or resource in the M7 discussion forum.
4. Complete the M7 homework and submit by due date.
5. Complete the M7 exam and submit by due date.

Grading:

Module	Chem 4110 (%)	Chem 4110HON/6110 (%)
Forum post	10	10
Homework	40	40
Exam	50	40
Extra problem	0 (not required)	10