CHEM 142: **PRINCIPLES OF MODERN CHEMISTRY II - online** Spring 2023

UA Catalog name: **GENERAL CHEMISTRY LECTURE II: QUANTITATIVE**

Credits: 3 credit hours (lecture only)

Course description: CHEM 142 is the second part of a two-semester lecture series introducing students to the central principles of modern chemistry using a quantitative approach. It mainly focuses on the principles of thermodynamics, chemical equilibrium, and chemical kinetics. No special mathematical background is needed, beyond the stated prerequisite requirements. The course aims to develop a deep understanding of general chemistry, rooted in a formal approach to the discipline, and is intended for students who wish to apply this knowledge to real problems they will encounter in their future careers. The class is presented online in an asynchronous format, emphasizing practical problem solving. The flexibility inherent in this student-focused and student-centered approaches allows for individual choice of optimal study plans involving any combination of self-paced learning for each student, depending on their individual circumstances, learning styles, and needs. The course is designed for all science and engineering majors, pre-medical and pre-pharmacy students, and is appropriate for any beginning student.

Instructor Professor Tori Hidalgo tlockett@arizona.edu

Class time Sections 101, 201, 401: Completely online (asynchronous)

Class Format and Attendance Policy This is a completely asynchronous online class. All lectures are available on D2L. All exams will be online.

Office Hours with Via zoom; by request (please email me). The office hours are there to help you the concepts – you are urged NOT to use the time purely for homework assistance. To discuss individual matters, one-on-one meetings can be scheduled.

Note: the instructor is not able to assist with CHEM 144 (lab), which is a separate course – please see your lab TA.

Teaching Assistants The TA is responsible for assistance with class activities and helping students with homework and exam preparation during tutor hours. The TA tutor hours will be held via Zoom. The hours will be posted on D2L.

Prerequisites Chem 141 or 151. Appropriate math placement level OR Proctored/Prep for College Algebra 88+ OR Proctored/Prep for Calculus 65+ OR MATH 109C, 110, 112, 113, 120, 120R, 124, 125, 129, 223. *These requirements are identical to those for CHEM 151/151*.

Text Brown, LeMay, Bursten, *Chemistry: The Central Science*, 14th ed. (*required*). The textbook is a useful reference and study guide, but is only a tool. Lectures will not be strictly based on the textbook and the presentation of the material in lecture will deviate from the book's outline.

D2L All course materials, such as the syllabus, schedule, lecture slides, etc., will be posted on D2L (http://d2l.arizona.edu). It is critical that you check D2L regularly for information.

Video Lectures covering all material have been pre-recorded and are available on the

Lectures course D2L site for viewing at times of your choosing. **The Course Schedule PDF document posted on D2L under Content/Start Here provides a suggested schedule, but you may of course adapt this to fit your own learning style as long as you complete the required work for each exam.**

At the end of each video, you will be asked to check a box and press a button, purportedly to submit your "grade" for watching the video to D2L. Do check that box, but please know that no credit will be awarded for watching the videos. We are simply keeping track of when students watch the videos. Graded points in this class will be based only on HW assignments and exams (see the Grading Policy section of this Syllabus).

Lecture Slides All lecture slides are posted on D2L.

Course Objective The objective of CHEM 142 is to introduce the students to the fundamental principles and quantitative applications of modern chemistry.

Relationship to Other Courses CHEM 142 is the second-semester lecture component of the two-semester general chemistry lecture-lab sequence CHEM 141-144. The complete sequence consists of 4 separate courses:

CHEM 141: General Chemistry Lecture I: Quantitative (3 units)
CHEM 142: General Chemistry Lecture II: Quantitative (3 units)
CHEM 143: General Chemistry Quantitative Laboratory I (1 unit)
CHEM 144: General Chemistry Quantitative Laboratory II (1 unit)

The independent lecture-lab architecture allows for flexibility in plans of study.

Expected Learning Outcomes and Course Outline:

After successfully completing CHEM 142, students will:
(Chapter numbers refer to Edition 14 of the textbook.)
Chapter 5 (Thermochemistry)

1. Predict the energy of making and breaking chemical bonds.
2. Calculate changes in internal energy.
3. Calculate enthalpy changes and understand how enthalpy relates to heat.
4. Predict the amount of heat evolved or absorbed from given amounts of reactants or for the formation of given amounts of products.
5. Use both enthalpies of formation and bond enthalpies to calculate overall enthalpy changes for chemical reactions.

Chapter 13 (Properties of Solutions)

1. Predict how enthalpy and entropy changes will determine solubility.
2. Describe the different effects of temperature on the solubility of solids in liquids and gases in liquids.
3. Compute molarity, molality, mole fraction, and percent composition of a solution
4. Calculate how dissolving a solute will affect the freezing point, boiling point, and vapor pressure over a solution.

Chapter 15 (Chemical Equilibrium)

1. Describe an equilibrium constant in terms of reaction rates.

2. Express the equilibrium constant in terms of ratios of concentrations or pressures.
3. Predict the relative concentrations of reactants or products given the equilibrium constant.
4. Understand how the reaction quotient Q is related to the equilibrium constant, and predict the direction of reaction given both values.
5. Predict equilibrium concentrations using ICE tables and the definition of the equilibrium constant.
6. Predict how physical changes or the addition of a reactant or product will shift equilibrium.

Chapter 16 (Acid-Base Equilibrium)

1. Identify all types of acids and bases, and their respective conjugate bases and conjugate acids.
2. Predict the strength of the conjugate member of a pair.
3. Predict the acidity of a solution from the strength of an acid or base.
4. Calculate pH of an acid or base solution from starting concentrations and K_a or K_b

Chapter 17 (Aqueous Equilibria)

1. Predict how addition of a common ion will shift equilibrium and change concentrations.
2. Predict the pH of a buffer and how addition of a strong acid or base will change the pH
3. Predict an equivalence point in a titration.
4. Calculate the molar solubility from K_{sp} and visa versa.
5. Calculate at what concentration precipitates will form.

Chapter 19 (Classical Thermodynamics)

1. Predict whether a process is spontaneous or at equilibrium.
2. Define entropy and the second law of thermodynamics.
3. Define the Gibbs Free Energy and using changes in entropy and enthalpy predict the change in Gibbs Free Energy.
4. Explain how temperature shifts an equilibrium from the expression for $\triangle G$.
5. Predict $\triangle G$ at any value of concentrations from standard values.
6. Predict the equilibrium constant from $\triangle G^o$

Chapter 20 (Electrochemistry)

1. Be able to identify the species oxidized and reduced in a redox reaction.
2. Be able to identify the anode and cathode of an electrochemical cell.
3. Calculate standard cell potential from half reaction tables and identify the direction of a spontaneous electrochemical reaction.
4. From cell potential calculate Gibbs Free Energy or equilibrium constant.

Chapter 14 (Chemical Kinetics)

1. Determine a rate law from initial rate data as a function of concentration.
2. Relate differential rates to the rate of loss of reactants or gain of products from the stoichiometry of reaction.
3. Apply the integrated rate laws to find the order of a chemical reaction.
4. For a first order reaction, be able to convert between the half-life and rate constant.
5. From rate laws predict a plausible chemical mechanism.

Chapter 21 (Nuclear Chemistry)

1. Identifying specific nuclear transformations via balanced nuclear equations.

2. Understanding nuclear decay processes.
3. Using decay half-lives to date objects and rock.
4. Calculate the energy released in a nuclear reaction from the mass defect.
5. Understand the differences between fission and fusion, and how a nuclear power plant works.

See the Schedule document on D2L for specific dates of various chapters.

These outcomes apply to students of all majors and are also part of the integrated learning outcomes of the undergraduate programs in Chemistry and Biochemistry, described at http://assessment.arizona.edu/sci/chembio.

Inclusive Access

Course materials (including all homework assignments and your electronic text) are being delivered digitally via D2L through the Inclusive Access program.

Inclusive Access materials can be reached from the CHEM 142 D2L site through the VitalSource app on D2L is entitled: HOMEWORK and TEXTBOOK (VitalSource App). The link to this app is found under Content/Vital Source Inclusive Access (HW and eText).

VERY IMPORTANT: Please follow the instructions provided under the VitalSource app link on D2L under Content/eText & Homework. Hint for following the instructions: BrightSpace and D2L are for all intents and purposes the same thing.

Please access the material through D2L on the first day of classes to make sure there are no issues in the delivery. Do not sign up for any trials—if you are enrolled in the class, you should have access to the materials throw the VitalSource App mentioned above.

You automatically have FREE access to the course materials through Jant. 24, 2023.

Notification to students mandated by the University: You **must** take action (even if you have not accessed the materials) to opt-out if you do not wish to pay for the materials, and choose to source the content independently. **The deadline to opt out is 9:00 pm MST, Jan. 24, 2023.** If you do not opt-out and choose to retain your access, the cost of the digital course materials will appear on your Bursars account.

Instructor's note: If you opt out of Inclusive Access, you will not be able to complete any of the homework assignments and will receive zeros for all of them. This will severely impact your learning and grade for the course. DO NOT OPT OUT WITHOUT TALKING TO THE INSTRUCTOR FIRST!!!

Please refer to the Inclusive Access FAQs at https://shop.arizona.edu/textbooks/Inclusive.asp for additional information.

IMPORTANT: The course instructor is not able to provide technical support for the online homework system hosted by the publisher (Pearson's Mastering Chemistry). In case of any technical/computer issues related to the homework assignments, please contact Support at Pearson.com: https://support.pearson.com/getsupport/s/

After submitting an assistance request, please make sure to capture your Pearson Tech Support Case Number ID for your reference.

Homework This course uses the online homework system *Mastering Chemistry* hosted by the textbook publisher (Pearson). See Inclusive Access instructions.

There will be 11 homework assignments (HW1-11). Their main objective is to guide you in the study of the material and help prepare for the exams. The HW due dates are indicated in the Course Schedule PDF document posted on D2L under Content/ Start Here. All assignments must be finished 11:55 PM (AZ time) on their due dates.

Exams There will be three midterm exams, each 1 hour in duration, and a final exam, 2 hours in duration. The exams will be administered via the Quizzes section of the D2L site. Exams can be taken at any time within the timec period from 6 AM to 11:59 PM on the day of the exam (**Arizona time**.) **Once you start the exam, you will have one hour (for midterms) or two hours (for the final) to complete it**.

The dates of the exams and the topics covered are in the Course Schedule PDF document posted on D2L under Content/Start Here.

Midterm Exam 1:	Friday, Feb. 3
Midterm Exam 2:	Monday, March 20
Midterm Exam 3:	Friday, April 21
Final Exam:	Friday, May 5

Please note the dates of the exams, because **there will be no makeups**. All exams will be un-proctored and open book.

Topics and format of the exams: The first midterm exam will cover the material of HW 1-3. The second exam will be based on HW 4-6, the third – HW 7-10. The final exam will be cumulative. All exams will be open book but must be solved by each student individually. Any discussion or interaction with others (either in person or by electronic means) while taking an exam will be viewed as an academic integrity violation.

Missed and Make-up Exams You can take each exam anytime during the 12-hour window when the exam is open. The exams can be taken from anywhere on planet Earth, all you need is a computer with internet access. For this reason, except for extraordinary documented emergencies, **THERE WILL BE NO MAKE-UP EXAMS**. Missed exams will be graded as zeros.

Calculators Scientific (non-graphing, non-programmable) calculators with standard exponential, trigonometric, power/root, log, etc. functions are recommended for this class.

Grading Course letter grades will be based solely on the total number of points earned. The weights of the graded assignments in the course grade calculation will be as follows:

Homework assignments 1-11:	20% combined
Three midterm exams:	50% combined
Final exam:	30%

The above are the only sources of points that can be earned in the class. No extra credit will be awarded for any additional work. No requests for extra-credit assignments to improve grades will be considered, because granting such requests would be in violation of this syllabus and unfair to other students.

The letter grades will be based on the total percentage of points earned during the semester ("Total") and assigned according to the following grading scheme:

1. A: 90.00 σ; Total
2. B: 80.00 σ; Total σ; 89.99
3. C: 68.00 σ; Total σ; 79.99
4. D: 55.00 σ; Total σ; 67.99
5. E: Total σ; 54.99

"THE CURVE": If the class average for any exam (including all students who have attempted the exam) is below 73%, all individual non-zero scores for this exam will be automatically increased by the amount of the deficit, bringing the average to 73%. This adjustment may result in some students earning more than 100% for that exam. For example, if the class average for Exam X is 70%, 3 percentage points will be added to all exam scores. If two students received 65% and 98% for the exam (prior to the adjustment), their recorded scores will be 68% and 101%, respectively.

No adjustments will be made if the class average for an exam is 73% or higher. No adjustment will be made for homework assignments, grades are invariably above this cutoff.

The above adjustments are intended to ensure a fair and balanced final grade distribution, regardless of the difficulty of the exams. Given the historic average of about 88% for all homework assignments, the minimum exam average of 73% assures a total class average of at least 76% for the semester.

Except for the adjustments described above, no extra points or percentages will be added to any of the exam or assignment scores or to the total number of points earned in the class.

SPECIAL NOTE ABOUT REQUESTS TO "DISCUSS" GRADES: The grades will be based solely on your quantitative performance in the class and are not up for subjective negotiation. No other factors in addition to those described above may be considered (including, but not limited to, the need to get a certain grade to maintain a scholarship or get into a certain professional school). Since the grades are determined by objective mathematical factors only, the instructor will not respond to requests for higher grades or to requests for meetings to discuss or negotiate grades, except if a grading error has been made. The instructor is available to review the subject matter, learning strategies, and the grading policy.

SPECIAL NOTE ABOUT POSTED LETTER GRADES: It is always disappointing to find yourself just below the cutoff for the grade you really wanted or needed. The University requires that specific grades be assigned in accordance with the grading policy and the grade cutoffs have to be drawn somewhere. Unfortunately, no matter where they are drawn, no matter how much thought goes into determining the levels, *someone* will always be at the top of any grade range – and there is nothing that can be done about it. Bumping someone from the top of a lower grade range to the next grade level will result in someone else turning up at the top of the lower range. Please do believe that faculty have every desire to accommodate reasonable request from their students – after all, we work for your success – but requests for higher grades without any basis in the syllabus only create undue stress for everyone. This class will adhere strictly to the following policy:

ONCE POSTED, THE LETTER GRADES ARE FINAL AND NOT SUBJECT TO DISCUSSION OR NEGOTIATION

Except for extremely rare cases of grade miscalculation, the instructor reserves the right not to respond to communications about posted grades.

University policy regarding grades and grading systems is available at http://catalog.arizona.edu/policy/grades-and-grading-system

Requests for incomplete (I) or withdrawal (W) must be made in accordance with University policies, which are available at http://catalog.arizona.edu/policy/grades-and-grading-system#incomplete and http://catalog.arizona.edu/policy/grades-and-grading-system#Withdrawal respectively. A grade of "Incomplete" can only be obtained when all but a minor portion of the course work has been satisfactorily completed and a valid argument can be made as to why an Incomplete should be awarded. For example, missing the final exam due to a documented emergency (assuming satisfactory performance for the duration of the semester) will likely result in an Incomplete. To the contrary, realizing at any point during the semester that you are in danger of a failing grade is not a valid reason for granting an Incomplete.

Syllabus Content

Students are responsible for knowing the content of this document.
The instructor reserves the right not to respond to emails with questions explicitly addressed in the Syllabus. For example, any and all emails inquiring about the "curve" for the class will not be answered, because this question is explicitly addressed in the above grading policy. Similarly, the instructor will not respond to requests for additional points or opportunities to raise your grade, or other similar requests to discuss or negotiate grades (except if a grading error has been made), as such requests violate the grading policy stated in this Syllabus.

Code of Academic Integrity

Students are encouraged to share intellectual views and discuss freely the principles and applications of course materials. However, graded work/exercises must be the product of independent effort unless otherwise instructed. Students are expected to adhere to the UA Code of Academic Integrity as described in the UA General Catalog. See: http://deanofstudents.arizona.edu/policies-and-codes/code-academic-integrity

Selling class notes and/or other course materials to other students or to a third party for resale is not permitted without the instructor's express written consent. Violations to this and other course rules are subject to the Code of Academic Integrity and may result in course sanctions. Additionally, students who use D2L or UA e-mail to sell or buy these copyrighted materials are subject to Code of Conduct Violations for misuse of student e-mail addresses. This conduct may also constitute copyright infringement.

UA Nondiscrimination and Anti-Harassment Policy

The University is committed to creating and maintaining an environment free of discrimination; see http://policy.arizona.edu/human-resources/nondiscrimination-and-anti-harassment-policy

Additional Resources for Students

UA Academic policies and procedures are available at http://catalog.arizona.edu/policies

Student Assistance and Advocacy information is available at
http://deanofstudents.arizona.edu/student-assistance/students/student-assistance

Confidentiality of Student Records

http://www.registrar.arizona.edu/personal-information/family-educational-rights-and-privacy-act-1974-ferpa?topic=ferpa

Subject to Change Statement

Information contained in the course syllabus, other than the grade and absence policy, may be subject to change with advance notice, as deemed appropriate by the instructor.