JINAN UNIVERSITY

Summer 2025

0703C100
General Chemistry I

Instructor: TBA

Time: Monday through Thursday (June 30, 2025-August 1, 2025)

Office Hours: 2 hours (according to the teaching schedule)

Contact Hours: 45(50 minutes each)

Credits: 3

E-mail: TBA

Course Description

General Chemistry I is designed as an introduction to the most fundamental laws, theories, and principles of general chemistry. It is appropriate for students that have not had an advanced chemistry course in high school, and for those majoring in the environmental, earth, and social sciences, as well as disciplines such as architecture, business, and the humanities. The goal of this course is to provide students with a firm foundation on the basic concepts and principles of chemistry, by working through example cases and practice problems.

Required Textbook(s)

Chemistry, The Molecular Nature of Matter and Change, 7th edition (2014), by Martin S. Silberberg. Publisher: McGraw-Hill, ISBN 978-0021442546.

Prerequisites

No prerequisites

Course Hours

The course has 20 sessions in total. Each class session is 120 minutes in length. The course meets from Monday to Thursday.

Course Structure

The course content is divided into 10 modules:

Module I (Keys to the Study of Chemistry) discusses central ideas in chemistry, including: matter and energy; the process of science and the origins of chemistry; units of measurement for mass, length, volume, density, and temperature; applications of chemical problem-solving to unit conversions; uncertainty in measurements and the distinction between accuracy and precision.

Module II (The Components of Matter) examines the properties and composition of matter on the microscopic and atomic scales, including: the differences between elements, compounds, and mixtures, and between atoms, ions, isotopes, and molecules; the evolution of the atomic theory and the nuclear atom model; the atomic arrangement in the periodic table; introduction to chemical bonding, and the formation of ionic compounds and covalent substances; naming compounds and formulas, and calculating their masses on the atomic scale.

Module III (Stoichiometry of Formulas and Equations) relate the mass of a substance to the number of chemical entities comprising it (atoms, ions, molecules, or formula units) and apply this relationship to formulas and equations. We start by defining the mole, and using it to convert between mass and number of entities, and to derive a chemical formula from mass analysis. We explore how formulas relate to molecular structures, and learn how to write and balance chemical equations. We calculate the amounts of reactants and products in a reaction, and determine limiting reactants and reaction yields.

Module IV (Major Classes of Chemical Reactions) examines the underlying nature of three classes of reactions, and the complex part that water plays in aqueous chemistry. We start by exploring the molecular structure of water and its role as a solvent, then discuss molarity as a way to express the concentration of an ionic or covalent compound in a solution. We write equations for aqueous ionic reactions, describe precipitation reactions and their stoichiometry, explore acid-base reactions as proton-transfer processes, examine oxidation-reduction reactions in the formation of ionic and covalent substances, and explore the nature of equilibrium.

Module V (Gases and the Kinetic-Molecular Theory) explores the physical behavior of gases and the theory that explains this behavior. We begin by comparing the behavior of solids, liquids, and gases, the discuss methods for measuring gas pressure. We consider laws that describe the behavior of a gas and its volume changes, and rearrange the ideal gas law to determine the density and molar mass of an unknown gas, the partial pressure of a gas in a mixture, and the amounts of reactants and products in a chemical change. We relate gas laws to the kinetic-molecular theory, and apply key ideas about gas behavior to Earth's atmosphere.

Module VI (Thermochemistry) investigates how heat, or thermal energy, flows when matter changes, how to measure the quantity of heat for a given change, and how to determine the direction and magnitude of heat flow for any reaction. We begin by exploring energy transformation and flow between systems, then we discuss the units of energy and identify the heat of a reaction as a change in enthalpy. We describe how a calorimeter measures heat and how the quantity of heat in a reaction is proportional to the amounts of substances. We define standard conditions in order to compare enthalpies of reactions and see how to obtain the change in enthalpy for any reaction, and discuss some current and future energy sources.

Module VII (Quantum Theory and Atomic Structure) discusses quantum mechanics, the theory that explains the fundamental nature of energy and matter and accounts for atomic structure. We begin by considering the classical distinction between the wave properties of energy and the particle properties of matter, then examine some observations that led to a quantized, or particulate, model of light. We see that light emitted by excited atoms suggests an atom with distinct energy levels, and we apply spectra to chemical analysis. We investigate how wave-particle duality and the uncertainty principle led to the current model of the H atom.

Module VIII (Electron Configuration and Chemical Periodicity) explores recurring patterns of electron distributions in atoms to see how they account for the recurring behavior of the elements. We begin by describing a new quantum number and a restriction on the number of electrons in an orbital. We then explore electrostatic effects that lead to splitting of atomic energy levels into sublevels, and recognize how this filling order correlates with the order of elements in the periodic table. We then examine the reasons for periodic trends in three atomic properties, and see how these trends account for chemical reactivity with regard to metallic and redox behavior, oxide acidity, ion formation, and magnetic behavior.

Module IX (Models of Chemical Bonding) examines how atomic properties give rise to three models of chemical bonding (ionic, covalent, and metallic) and how each model explains the behavior of substances. We see how metals and nonmetals combine via three types of bonding and learn how to depict atoms and ions with Lewis symbols. We look at how a bond forms and discuss the relations among bond order, energy, and length. We explore the relationship between bond energy and the enthalpy change of a reaction, with a focus on fuels and foods. We examine periodic trends in electronegativity and learn its role in the range of bonding, and we consider a simple bonding model that explains the properties of metals.

Module X (The Shapes of Molecules) explores the three-dimensional shapes of molecules and examines some effects of these molecular shapes on physical and biochemical behavior. We learn how to apply the octet rule to convert a molecular formula into a flat structural formula that shows atom attachments and electron-pair locations. We see how electron delocalization limits our ability to depict a molecule with a single structural formula and requires us to apply the concept of resonance. We introduce bond angle and apply a theory that converts two-dimensional formulas into three-dimensional shapes. We describe five basic classes of shapes that many molecules adopt and consider how multiple bonds and lone pairs affect them and how to combine smaller molecular portions into the shapes of more complex molecules. We discuss the relation among bond polarity, shape, and molecular polarity and the effect of polarity on behavior.

Course Schedule

Please note that the schedule is meant to give an overview of the major concepts in this course. Changes may occur in this calendar as needed to aid in the student`s development.

Week 1

Lecture 1 － Keys to the Study of Chemistry

Lecture 2 － Matter and Energy

Lecture 3 － Atoms and Isotopes

Lecture 4 － Periodic Table

Week 2

Lecture 5 － Formulas and Equations

Lecture 6 – Balance of Equations

Lecture 7 – Major Chemical Reactions I

Lecture 8 – Major Chemical Reactions II

Week 3

Lecture 9 – Gas Laws and Gas Properties

Lecture 10 – The Kinetic-Molecular Theory

Lecture 11 – Atmospheres

Mid-Term Exam

Week 4

Lecture 12 – Thermochemistry

Lecture 13 – Calorimetry

Lecture 14 – Quantum Theory

Lecture 15 – Atomic Structures

Week 5

Lecture 16 – Chemical Bonding

Lecture 17 – The Shapes of Molecules

Lecture 18 – Chemistry in Research and Industry

Lecture 19 – Chemistry of Nature Recap

Cumulative Final Exam

Grading Policy

Your final grade is based on the following components:

Quizzes/Homework	30%
Midterm Exam	30%
Final Exam	30%

Participation	10%
Total	100%

Quizzes/Homework

Multiple self-assessment quizzes and homework assignments will be offered for students to practice their concept understanding and to prepare for the lectures. These quizzes and homework assignments will be distributed in class on weekly basis. Late homework will NOT be accepted, except in the case of a documented medical reason (documentation is required).

Attendance Participation

Attendance at lectures and recitations. Continued absences will detract from your final grade. If you have missed/will be missing a class or recitation session for an acceptable reason, such as illness or religious observance, please let me know in person with a written document. Ideally, you should let me know of your absence prior to missing the class. In addition, missing a class for an acceptable reason will not excuse you from completing the class exercises and the out of class assignments so, if you miss a class, it is your responsibility to obtain notes from a classmate and contact the instructor in order to complete all the assignments by their original or extended deadlines.

Grading Scale

The instructor will use the grading system as applied by JNU:

Definition	**Letter Grade**	**Score**
Excellent	A	90~100
Good	B	80~89
Satisfactory	C	70~79
Poor	D	60~69
Failed	E	Below 60

Attendance

Attendance is mandatory in the class. It would be recorded each class and forms part of students' participation record. Students should inform the instructor at the earliest opportunity if they need to ask for a leave. All absences may have negative effect on students' final grades. Any students with more than three unexcused absences will automatically fail the course.

Academic Integrity

As members of the Jinan University academic community, students are expected to be honest in all of their academic coursework and activities. Academic dishonesty, includes (but is not limited to) cheating on assignments or examinations; plagiarizing, i.e., misrepresenting as one's own work any work done by another; submitting the same paper, or a substantially similar paper, to meet the requirements of more than one course without the approval and consent of the instructors concerned; or sabotaging other students' work within these general definitions. Instructors, however, determine what constitutes academic misconduct in the courses they teach. Students found guilty of academic misconduct in any portion of the academic work face penalties that range from the lowering of their course grade to awarding a grade of E for the entire course.