Master Course Syllabus

For additional course information, including prerequisites, corequisites, and course fees, please refer to the Catalog: https://catalog.uvu.edu/

Semester: Spring
Year: 2025
Course Prefix: CHEM
Course and Section #: 1210-004
Course Title: Principles of Chemistry I
Credits: 4

Course Description

This course is the first semester of a full-year course primarily for students in the physical and biological sciences and engineering. This course covers fundamentals of chemistry including atoms, molecules, reactions, stoichiometry, chemical bonding, thermochemistry, and gas laws
This is a GE course fulfilling PP - Physical Science Dist. It is a required course for chemistry majors.

Course Attributes

This course has the following attributes:
☒ General Education Requirements
☐ Global/Intercultural Graduation Requirements
☐ Writing Enriched Graduation Requirements
☒ Discipline Core Requirements in Program
☐ Elective Core Requirements in Program
☐ Open Elective
Other: *Click here to enter text.*

Instructor Information

Instructor Name: Daniel Scott, Ph.D.

Student Learning Outcomes

Upon successful completion of this course, students will be able to:

- Use mathematical and chemical knowledge to solve stoichiometric and other types of chemistry problems.
- Use the periodic table to make predictions about the structure and properties of atoms, ions, and chemical reactions.
- Explain in basic terms the current quantum mechanical model of the atom.
- Differentiate types of chemical compounds on a molecular level.
- Apply basic thermodynamic principles to chemical reactions.

Course Materials and Texts

Chemistry, 2nd edition OpenStax.Links. This is a free, digital textbook.
A scientific calculator is also required for this course. Any scientific calculator that has logarithm, scientific notation, and exponent capability will be suitable.

Course Requirements

Course Assignments, Assessments, and Grading Policy
Homework (15% of total course grade)
Homework problems will be assigned through the W. W. Norton Smartwork5 Platform and with Scientist Spotlight assignments. Each assignment will have a link to it through Canvas. The problems are intended to guide you through practicing the chemistry concepts. The Scientist Spotlight assignments teach you about careers in chemistry.

Quizzes: ~18% of your grade Each week there will be one or two quizzes due a half an hour before class begins. The homework you do will help you prepare for these quizzes. The homework exercises come from the questions in the back of the chapters in the text. The quiz title tells you which practice problems you should become proficient at to do well on the quiz. The quizzes are timed and must be done by you. There will be approximately 25 quizzes worth 8 points each.

Midterm Exams: Each ~12% of your grade (for a total of ~48% of your grade) Four midterm exams will be given on the approximate dates noted on the course outline (see below). Each will be worth 125 points. All Exams are cumulative. All of the exams will be similar to standardized American Chemical Society exams where the class average is expected to be 50%, thus the gridding scale is corrected so that a 63% in the class results in a C (expecting points from attendance and homework). Because exams are cumulative, if you improve your score on a latter exam, your score on your previous exams will change when the final scores are tallied at the end of the course.

Final Exam: ~24% of your grade The final will be a comprehensive American Chemical Society exam worth 250 points at the end of the course. The final exam cannot be made up. It will occur in class on Wednesday Apr 28th 1pm-2:50pm.
Grading Policy: Grades are assigned based on the percentage of points you earn throughout the course.

A	=	87-100%
A-	=	84-87%
B+	=	82-84%
B	=	78-82%
B-	=	75-78%
C+	=	70-75%
C	=	63-70%
C-	=	57-63%
D+	=	52-57%
D	=	47-52%
D-	=	42-47%
F	=	<42%

Required or Recommended Reading Assignments
Chemistry 2e, 1.1 Chemistry in Context
Chemistry 2e, 1.2 Classification of Matter
Chemistry 2e, 1.3 Physical and Chemical Properties

Chemistry 2e, 1.5 Uncertainty, Accuracy, and Precision
Chemistry 2e, 1.4 Measurement
Chemistry 2e, 1.6 Mathematical Treatment of Measurement Results
Chemistry 2e, 2.1 Early Ideas in Atomic Theory
Chemistry 2e, 2.2 Evolution of Atomic Theory
Chemistry 2e, 2.3 Atomic Structure and Symbolism
Chemistry 2e, 2.5 The Periodic Table
Chemistry 2e, 2.4 Chemical Formulas
Chemistry 2e, 2.6 Molecular and Ionic Compounds

Chemistry 2e, 2.7 Chemical Nomenclature
Chemistry 2e, 3.1 Formula Mass and the Mole
Chemistry 2e, 3.2 Determining Empirical and Molecular Formulas
Chemistry 2e, 3.3 Molarity
Chemistry 2e, 3.4 Other Units for Solution Concentrations
Chemistry 2e, 4.1 Writing and Balancing Chemical Equations
Chemistry 2e, 11.1 The Dissolution Process
Chemistry 2e, 11.2 Electrolytes
Chemistry 2e, 4.2 Classifying Chemical Reactions
Chemistry 2e, 4.3 Reaction Stoichiometry
Chemistry 2e, 4.4 Reaction Yields
Chemistry 2e, 4.5 Chemical Analysis
Chemistry 2e, 5.1 Energy Basics
Chemistry 2e, 5.2 Calorimetry
Chemistry 2e, 5.3 Enthalpy
Chemistry 2e, 6.1 Electromagnetic Radiation
Chemistry 2e, 6.2 The Bohr Model
Chemistry 2e, 6.3 Development of Quantum Theory
Chemistry 2e, 6.4 Electronic Structure of Atoms
Chemistry 2e, 6.5 Periodic Variations in Element Properties
Chemistry 2e, 7.1 Ionic Bonding
Chemistry 2e, 7.2 Covalent Bonding
Chemistry 2e, 7.3 Lewis Symbols and Structures
Chemistry 2e, 7.4 Formal Charges and Resonance
Chemistry 2e, 7.5 Strengths of Ionic and Covalent Bonds
Chemistry 2e, 7.6 Molecular Structure and Polarity
Chemistry 2e, 8.1 Valence Bond Theory
Chemistry 2e, 8.2 Hybrid Atomic Orbitals
Chemistry 2e, 8.3 Multiple Bonds
Chemistry 2e, 8.4 Molecular Orbital Theory
Chemistry 2e, 9.1 Gas Pressure
Chemistry 2e, 9.2 Relating Pressure, Volume, Amount, and Temperature: The Ideal Gas Law
Chemistry 2e, 9.3 Stoichiometry of Gaseous Substances, Mixtures, and Reactions
Chemistry 2e, 9.4 Effusion and Diffusion of Gases
Chemistry 2e, 9.6 Non-Ideal Gas Behavior

General Description of the Subject Matter of Each Lecture or Discussion
Module 1 (Lessons 1-4). Upon successful completion of this lesson, students will be able to:

- Describe the scientific method.
- Classify matter and chemical/physical changes using the scientific method.
- Navigate complex dimensional analysis problems using metrics, international system of units (SI), and other units of measurement.
- Calculate density and use it in applications such as identification of unknowns.
- Apply concepts of accuracy and precision to determine significant digits.

Module 2 (Lessons 5-9). Upon successful completion of this lesson, students will be able to:

- Describe the tenets of Dalton's Atomic Theory, Law of Multiple Proportions, and Law of Definite Proportions to explain atoms and molecules.
- Visualize the iterations of atomic structure through experiments including Thompson's Cathode Ray Tube, Milliken's Oil Drop experiment, and Rutherford's gold foil experiment.
- Describe the subatomic particles and their properties and behavior, and use them to identify elements, isotopes, ions, mass number and atomic number.
- Predict reactivity and ions by using the periodic table.
- Calculate weighted average atomic mass.
- Describe ionic and covalent bonds, distinguishing between molecular and ionic compounds.
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- Describe the subatomic particles, their properties and behavior, and use them to identify elements, isotopes, ions, mass number and atomic number
- Predict reactivity and ions by using the periodic table
- Define the mole chemical unit and use it to convert between masses and number of atoms or molecules
- Calculate weighted average atomic mass, molar mass, and the number of atoms in a given mass of an element

Module 3 (Lessons 10-14). Upon successful completion of this lesson, students will be able to:

- Define the mole chemical unit and use it to convert between masses and number of atoms or molecules.
- Calculate formula mass and molar mass of compounds.
- Calculate percent composition and, using elemental analysis, determine empirical and molecular formulas from mass percent composition.
- Calculate molar concentrations and use the dilution formula.
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- Describe laboratory techniques for preparing solutions and dilutions.
- Calculate concentrations of solutions using percent composition.

Module 4 (Lessons 15-19): Upon successful completion of this lesson, students will be able to:

- Balance chemical equations
- Calculate theoretical yield, limiting and excess reagents, and percent yield using stoichiometry
- Solve solution stoichiometry problems using molar concentrations
- Identify the solubility of ionic compounds based on the classification of electrolytes and non-electrolytes
- Identify oxidation-reduction reactions using oxidation numbers
- Identify oxidizing and reducing agents in oxidation-reduction reactions
- Identify acids and bases using Brønstead-Lowry and Arrhenius definitions

- Calculate the endpoint of a titration using solution stoichiometry
- Predict products for common gas-forming reactions

Module 5 (Lessons 20-24): Upon successful completion of this lesson, students will be able to:

- Distinguish between potential and kinetic energy
- Summarize the 1st Law of Thermodynamics in terms of state functions and heat and work
- Evaluate the difference between the system and surroundings and the sign of heat and work
- Calculate internal energy under constant volume conditions as modeled by bomb calorimeters
- Calculate enthalpy under constant pressure conditions using coffee-cup calorimeters
- Use Hess' Law to calculate heat of a reaction as a combination of other reactions
- Use heat of formation reactions to calculate reaction enthalpy

Module 6 (Lessons 25-29): Upon successful completion of this lesson, students will be able to:

- Describe the properties of light, including diffraction and interference
- Calculate wavelength, frequency, and energy of light using dispersion relations
- Distinguish between the wave nature and particle nature of the electron, citing examples from the photoelectric effect and the double slit diffraction
- Use the de Broglie relation to relate wavelength of light to momentum of particles
- Interpret the Bohr model of the atom using concepts of atomic emission spectra and calculate the wavelength of light emitted from a Hydrogen atom using the Rydberg equation
- Describe shapes of molecular orbitals that arise from probability distribution of wave-functions
- Describe orbitals occupied by electrons using quantum numbers

Module 7 (Lessons 30-34): Upon successful completion of this lesson, students will be able to:

- Draw orbital diagrams and electron configurations using the aufbau principle and Hund's rule
- Use orbital diagrams to determine paramagnetic and diamagnetic properties of atoms
- Distinguish between valence electrons and core electrons, calculating effective nuclear charge and utilizing this concept to describe periodic trends in atomic radius, ionization energy, and electron affinity

Module 8 (Lessons 35-39): Upon successful completion of this lesson, students will be able to:

- Represent valence electrons as dots and predict ionic compound structure using Lewis Theory
- Predict structures for atoms, isomers, and resonance structures
- Use electronegativity to predict bond polarity
- Use formal charge to predict dominant resonance structures
- Identify and justify exceptions to the octet rule
- Use bond energies to calculate reaction enthalpy

Module 9 (Lessons 40-44): Upon successful completion of this lesson, students will be able to:

- Predict molecular and electron group geometry using valance shell electron pair repulsion (VSEPR)
- Predict bond angles using VSEPR
- Predict polarity of molecules using VSEPR
- Describe bonds in terms of orbital overlap, sigma, and pi bonds
- Predict hybridization using hybrid orbital bond theory
- Calculate bond order and predict para- and dia-magentism of molecules using molecular orbitals

Module 10 (Lessons 45-49): Upon successful completion of this lesson, students will be able to:

- Explain pressure and kinetic molecular theory of gases
- Use Boyle's Law, Charles' Law, Lussac's Law, Avogadro's Law, the combined gas law, and the ideal gas law
- Calculate densities of gases

- Explain the origin of the “absolute zero” concept in terms of an ideal gas thermometer
- Describe how pressure is measured using a manometer
- Convert commonly used units for pressure, volume, and temperature and compare conversions to defined Standard Temperature and Pressure (STP)
- Distinguish between effusion and diffusion of gases
- Calculate root-mean-square velocities of gases and relative rates of effusion and diffusion between various gases
- Explain deviations from ideality in gases based upon conditions that result in real gas behavior and the resulting changes in molar volume and pressure
- Describe the components of the Van der Waals equation for real gases

Required Course Syllabus Statements

Generative AI

Potential employers will expect graduates to know how to use tools like ChatGPT to generate content, code, and data. You should learn how to use artificial intelligence (AI) and in what instances AI can be helpful to you. Remember, AI programs are not a replacement for your human creativity, originality, and critical thinking. Writing, thinking, and researching are crafts you must develop over time to develop your own voice.

The use of generative AI tools (e.g., ChatGPT, Google Bard, etc.) is permitted for the following activities:

Brainstorming and refining your ideas.
Fine-tuning your research questions; don’t accept anything AI generates at face value without checking it critically.
Finding accurate information on your topic.
Drafting an outline to organize your thoughts.
Checking grammar and style.
The use of generative AI tools is not permitted in this course for the following activities:

Impersonating you in classroom contexts, such as by using the tool to compose discussion board prompts/responses assigned to you or content that you put into a Teams/Canvas chat.
Completing group work that your group has assigned to you unless it is mutually agreed upon that you may utilize the tool.
Writing entire sentences, paragraphs, or papers to complete class assignments.
You are responsible for the information you submit based on an AI query (for instance, that it does not violate intellectual property laws or contains misinformation or unethical content). Your use of AI tools must be appropriately documented and cited to stay within university policies on academic honesty.

Any student work submitted using AI tools should clearly indicate what work is the student’s work and what part is generated by the AI. In such cases, no more than 25% of the student work should be generated by AI. If any part of this is confusing or uncertain, please get in touch with the course instructor for a conversation before submitting your work. Additional university resources regarding the use of AI are available through the UVU Office of Teaching and Learning

Using Remote Testing Software

☐ This course does not use remote testing software.

☒ This course uses remote testing software. Remote test-takers may choose their remote testing locations. Please note, however, that the testing software used for this may conduct a brief scan of remote test-takers' immediate surroundings, may require use of a webcam while taking an exam, may require the microphone be on while taking an exam, or may require other practices to confirm academic honesty. Test-takers therefore shall have no expectation of privacy in their test-taking location during, or immediately preceding, remote testing. If a student strongly objects to using test-taking software, the student should contact the instructor at the beginning of the semester to determine whether alternative testing arrangements are feasible. Alternatives are not guaranteed.

Required University Syllabus Statements

Accommodations/Students with Disabilities
Students needing accommodations due to a permanent or temporary disability, pregnancy or pregnancy-related conditions may contact UVU Accessibility Services at accessibilityservices@uvu.edu or 801-863-8747.

Accessibility Services is located on the Orem Campus in BA 110.

Deaf/Hard of Hearing students requesting ASL interpreters or transcribers can contact Accessibility Services to set up accommodations. Deaf/Hard of Hearing services can be contacted at DHHservices@uvu.edu

DHH is located on the Orem Campus in BA 112.

Academic Integrity
At Utah Valley University, faculty and students operate in an atmosphere of mutual trust. Maintaining an atmosphere of academic integrity allows for free exchange of ideas and enables all members of the community to achieve their highest potential. Our goal is to foster an intellectual atmosphere that produces scholars of integrity and imaginative thought. In all academic work, the ideas and contributions of others must be appropriately acknowledged and UVU students are expected to produce their own original academic work.

Faculty and students share the responsibility of ensuring the honesty and fairness of the intellectual environment at UVU. Students have a responsibility to promote academic integrity at the university by not participating in or facilitating others' participation in any act of academic dishonesty. As members of the academic community, students must become familiar with their rights and responsibilities. In each course, they are responsible for knowing the requirements and restrictions regarding research and writing, assessments, collaborative work, the use of study aids, the appropriateness of assistance, and other issues. Likewise, instructors are responsible to clearly state expectations and model best practices.

Further information on what constitutes academic dishonesty is detailed in UVU Policy 541: *Student Code of Conduct*.

Equity and Title IX
Utah Valley University does not discriminate on the basis of race, color, religion, national origin, sex, sexual orientation, gender identity, gender expression, age (40 and over), disability, veteran status, pregnancy, childbirth, or pregnancy-related conditions, citizenship, genetic information, or other basis

protected by applicable law, including Title IX and 34 C.F.R. Part 106, in employment, treatment, admission, access to educational programs and activities, or other University benefits or services. Inquiries about nondiscrimination at UVU may be directed to the U.S. Department of Education's Office for Civil Rights or UVU's Title IX Coordinator at 801-863-7999 – TitleIX@uvu.edu – 800 W University Pkwy, Orem, 84058, Suite BA 203.

Religious Accommodation

UVU values and acknowledges the array of worldviews, faiths, and religions represented in our student body, and as such provides supportive accommodations for students. Religious belief or conscience broadly includes religious, non-religious, theistic, or non-theistic moral or ethical beliefs as well as participation in religious holidays, observances, or activities. Accommodations may include scheduling or due-date modifications or make-up assignments for missed class work.

To seek a religious accommodation, a student must provide written notice to the instructor and the Director of Accessibility Services at accessibilityservices@uvu.edu. If the accommodation relates to a scheduling conflict, the notice should include the date, time, and brief description of the difficulty posed by the conflict. Such requests should be made as soon as the student is aware of the prospective scheduling conflict.

While religious expression is welcome throughout campus, UVU also has a specially dedicated space for meditation, prayer, reflection, or other forms of religious expression.