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Chemistry (CHEM) 2211 General Chemistry (5 Units) CSU:UC  
[formerly Chemistry 1A]

Prerequisite: Successful completion of Chemistry 1510 and Mathematics 1060 with grades of "C" or better; high school chemistry and intermediate algebra or trigonometry with grades of "C" or better as part of the qualification by assessment process.

Advisory: Eligibility for English 1500 strongly recommended.

Prerequisite knowledge/skills: Before entering the course the student should be able to:

1. understand, explain, and demonstrate the logical problem solving methods of chemistry,
2. understand pertinent examples, analogies, and special topics used to introduce and illustrate basic chemical concepts,
3. analyze the fundamentals of chemistry to obtain an enhanced understanding of the physical world,
4. identify the way science solves problems and apply the use of the scientific method,
5. understand the basic concepts of chemistry with sufficient proficiency to allow for the study of more advanced chemistry concepts,
6. identify numbers as belonging to specified sets, and graph discrete and continuous sets of real numbers,
7. perform the basic arithmetic operations with positive and negative real numbers, plus raising to powers,
8. know and apply the rules of exponents and the order of operations in algebraic calculations,
9. know and apply the properties of addition and multiplication for real numbers and identify their use in practice,
10. solve linear equations and inequalities in one variable, and analyze and solve applications leading to such equations or inequalities,
11. solve and graph the solutions of compound inequalities or absolute value inequalities in one variable,
12. perform addition, subtraction, multiplication and division of polynomials,
13. factor simple polynomials, with special emphasis on trinomials quadratic in form, and solve related polynomial equations,
14. add, subtract, multiply and divide rational algebraic expressions, and reduce to lowest terms,
15. solve equations involving rational algebraic expressions, and analyze and solve word problems leading to such equations,
16. simplify radical expressions involving numbers and/or variables,
17. use fractional exponents,
18. perform addition, subtraction, multiplication and division of expression involving radicals and complex numbers and simplify the results, including rationalization of denominators,
19. solve equations that involve radicals,
20. solve quadratic equations in one variable, and equations quadratic in form, by factoring, completing the square, and the quadratic formula,
21. analyze and solve application problems requiring the use of quadratic equations,

22. solve and graph quadratic inequalities in one variable,
23. graph points in the rectangular coordinate system, and straight lines from ordered pairs obtained from its equation,
24. determine the slope of the line between any specified pair of points,
25. know the slope forms of the equation of a straight line, and be able to determine the equation of a particular straight line from specified input information,
26. solve and graph linear inequalities in two variables,
27. solve linear systems of equations in two or three variables algebraically, and solve those in two dimensions graphically,
28. analyze and solve application problems requiring the use of linear systems of equations in two or three variables,
29. evaluate determinants and use them to solve linear systems of equations,
30. determine whether or not a specified relation is a function,
31. for a function, compute the value of the function given the value of the independent variable, and be able to construct the inverse of simple functions in numeric or algebraic terms,
32. identify the quadratic equation representing a specific conic section, and be able to draw the graph of a conic section by analyzing its equation, or to write the equation of a specified conic section,
33. solve nonlinear systems of equation involving the intersection of two conic sections or a conic section and a straight line,
34. compute and graph specified exponential and logarithmic functions,
35. know the properties of logarithms (product, quotient, power and change of base rules) and be able to use them in practical numerical computations using a table of common logarithms or a calculator, and
36. solve simple exponential and logarithmic equations.

Total Hours: 48 hours lecture; 96 hours lab (144 hours total)

Catalog Description: This is the first semester of a one-year course sequence in chemistry intended for majors in the natural sciences (chemistry, biochemistry, biology, physics, pre-medicine), mathematics and engineering. C-ID: CHEM 110 & CHEM 120S

Type of Class/Course: Degree Credit

Lecture Text: Kotz, John C., P. M. Treichel and J. Townsend. *Chemistry and Chemical Reactivity*. 11th ed. Cengage. 2023.

Laboratory Manual: Slowinski, Emil, et al. *Chemical Principles in the Laboratory* 13th ed. Cengage Learning, 2024.

Course Objectives:

By the end of the course, a successful student will be able to

1. Solve computational problems related to general chemistry,
2. Describe the nature of matter and apply the principles of atomic theory,
3. Describe and interpret the periodic trends of elements and electron configuration,
4. Apply nomenclature rules, and determine the chemical formula of a compound,
5. Qualitatively and quantitatively describe processes involved in chemical reactions and stoichiometry,
6. Describe and analyze the behavior of solutions and gases,
7. Determine the type of bonding, molecular structure and polarity of a compound, and
8. Utilize molecular geometry and bond polarity to explain or predict properties of substances

## Course Level Student Learning Outcomes

### Local General Education Learning Outcomes

1. Develop an understanding of the relationship between science and other human behaviors.
2. Demonstrate the scientific method.

### Course Scope and Content: Lecture

Unit I	Measurement <ol style="list-style-type: none"><li>A. SI Units</li><li>B. Precision and accuracy</li><li>C. Dimensional analysis</li><li>D. Statistical analysis</li><li>E. Significant figures</li></ol>
Unit II	Atomic Structure <ol style="list-style-type: none"><li>A. Subatomic particles</li><li>B. Isotopes</li><li>C. The periodic table</li></ol>
Unit III	Nomenclature and Formula Writing <ol style="list-style-type: none"><li>A. Ionic compounds</li><li>B. Covalent compounds</li><li>C. Acids and bases</li></ol>
Unit IV	Stoichiometry <ol style="list-style-type: none"><li>A. Mass and moles</li><li>B. Empirical formulas</li><li>C. Chemical equations</li><li>D. Limiting reactant</li><li>E. Theoretical yield</li></ol>
Unit V	Solutions <ol style="list-style-type: none"><li>A. Solubility Guidelines</li><li>B. Molarity and preparing solutions</li><li>C. Acids, bases and pH</li><li>D. Net ionic equations</li></ol>
Unit VI	Enthalpy <ol style="list-style-type: none"><li>A. Heats of reactions</li><li>B. Hess's law</li><li>C. Calorimetry</li></ol>
Unit VII	Quantum Theory <ol style="list-style-type: none"><li>A. Quantization of energy</li><li>B. Quantum mechanical view of the atom</li></ol>

- C. Quantum numbers
- D. Electron configurations

- Unit VIII      Molecular Structure and Bonding
- A. Bond types and polarity
  - B. Lewis structures and VSEPR
  - C. Valence bond theory
  - D. Molecular orbital theory

- Unit IX        States of Matter and Gas Laws
- A. Kinetic molecular theory of gases
  - B. Gas laws
  - C. Ideal gases
  - D. Real gases

Course Scope and Content: Laboratory

The laboratory component of this course provides hands-on practical experience with general chemistry. Laboratory exercises are designed to familiarize students with common equipment and instrumentation as they qualitatively and quantitatively explore and expand on principles presented in lecture.

- Unit I          Measurement
- A. SI Units
  - B. Dimensional analysis
  - C. Statistical analysis
  - D. Density
- Unit II        Nomenclature and Formula Writing
- A. Determination of chemical formulas
  - B. Nomenclature
  - C. Metals and their compounds
  - D. Nonmetals and their compounds
- Unit III       Stoichiometry
- A. Mass and moles
  - B. Empirical formulas
  - C. Limiting reactant
  - D. Theoretical yield
- Unit IV       Enthalpy
- A. Heats of reactions
  - B. Calorimetry
- Unit V        Quantum Theory
- A. Quantization of energy
  - B. Atomic spectrum of hydrogen
- Unit VI       Separations
- A. Paper chromatography
  - B. Gas chromatography

- Unit VII            Quantitative analysis
- A. Gravimetric analysis
  - B. Molarity and preparing solutions
  - C. Volumetric analysis
  - D. Spectrophotometric analysis
  - E. Data analysis

Learning Activities Required Outside of Class:

The students in this class will spend a minimum of 6 hours per week outside of the regular class time doing the following:

- 1. Studying text, chapter handouts and learning objectives.
- 2. Answering questions.
- 3. Skill practice.
- 4. Completing required reading.
- 5. Problem solving activity or exercise.
- 6. Written work.

Methods of Instruction:

- 1. Assign reading topics in the text book and in the reference books present in our library.
- 2. Class lectures will be used to clarify and extend the theoretical and factual concepts present in the text.
- 3. Multimedia presentations, relative to some unit of study will be shown to supplement lecture materials.
- 4. Problem sets and questions from the text will be assigned.
- 5. Selected experiments will be assigned in the laboratory for individual student learning.
- 6. Demonstration experiments and lecture demonstrations will be used in the classroom and laboratory.
- 7.

Methods of Evaluation:

- 1. Substantial writing assignments including:
  - a. Essay Exams.
  - b. Laboratory reports.
  - c. Research reports.
- 2. Computational or non-computational problem-solving demonstrations including:
  - a. Exams.
  - b. Homework problems.
  - c. Quizzes.
  - d. Laboratory reports.
- 3. Other examinations, including:
  - a. Multiple choice.
  - b. Matching items.
  - c. True/false items.
  - d. Completion

Laboratory Category: Extensive Laboratory



Pre delivery criteria: All of the following criteria are met by this lab.

1. Curriculum development for each lab.
2. Published schedule of individual laboratory activities.
3. Published laboratory activity objectives.
4. Published methods of evaluation.
5. Supervision of equipment maintenance, laboratory setup, and acquisition of lab materials and supplies.

During laboratory activity of the laboratory: All of the following criteria are met by this lab.

1. Instructor is physically present in lab when students are performing lab activities.
2. Instructor is responsible for active facilitation of laboratory learning.
3. Instructor is responsible for active delivery of curriculum.
4. Instructor is required for safety and mentoring of lab activities.
5. Instructor is responsible for presentation of significant evaluation.

Post laboratory activity of the laboratory: All the following criteria are met by this lab.

1. Instructor is responsible for personal evaluation of significant student outcomes (lab exercises, exams, practicals, notebooks, portfolios, etc.) that become a component of the student grade that covers the majority of lab exercises performed during the course.
2. Instructor is responsible for supervision of laboratory clean-up of equipment and materials.

Supplemental Data:

TOP Code:	190500 Chemistry
SAM Priority Code:	E: Non-Occupational
Funding Agency:	Y: Not Applicable
Program Status:	I: Program Applicable
Noncredit Category:	Y: Not Applicable
Special Class Status:	N: Course is not a special class
Basic Skills Status:	N: Not Applicable
Prior to College Level:	Y: Not Applicable

Cooperative Work Experience:	N: Course is not a part of a cooperative education program
Eligible for Credit by Exam:	No
Eligible for Pass/No Pass:	Yes