CHEM 4A Course Outline as of Fall 1999

CATALOG INFORMATION

Dept and Nbr: CHEM 4A Title: GEN CHEM WITH QUANT
Full Title: General Chemistry with Quantitative Analysis
Last Reviewed: 10/14/2013

Units		Course Hours per Week		Nbr of Weeks	Course Hours Total	
Maximum	5.00	Lecture Scheduled	3.00	17.5	Lecture Scheduled	52.50
Minimum	5.00	Lab Scheduled	6.00	17.5	Lab Scheduled	105.00
		Contact DHR	0		Contact DHR	0
		Contact Total	9.00		Contact Total	157.50
		Non-contact DHR	0		Non-contact DHR	0

Total Out of Class Hours: 105.00 Total Student Learning Hours: 262.50

Title 5 Category:	AA Degree Applicable
Grading:	Grade Only
Repeatability:	00 - Two Repeats if Grade was D, F, NC, or NP
Also Listed As:	
Formerly:	

Catalog Description:
Intensive one-year program based upon the concepts of physical inorganic and analytical chemistry; laboratory includes quantitative and instrumental analysis. Subject matter of Chemistry 5 (Quantitative Analysis) is included in this sequence. Required for chemistry, chemical engineering, preprofessional and most physical and life science majors. C/B1 & B3

Prerequisites/Corequisites:
Completion of Chem 51 (formerly Chem 110) or placement on the Chemistry Diagnostic Test and completion of Math 155 or high school intermediate algebra.

Recommended Preparation:

Limits on Enrollment:

Schedule of Classes Information:
Description: First semester of a one year program of general chemistry with quantitative and instrumental analysis. (Grade Only)
Prerequisites/Corequisites: Completion of Chem 51 (formerly Chem 110) or placement on the Chemistry Diagnostic Test and completion of Math 155 or high school intermediate algebra.

Recommended:
Limits on Enrollment:
Transfer Credit: CSU;UC.
Repeatability: Two Repeats if Grade was D, F, NC, or NP

ARTICULATION, MAJOR, and CERTIFICATION INFORMATION:

AS Degree:	**Area**		Effective:	Inactive:
	C	Natural Sciences	Fall 1981	Fall 2018
CSU GE:	**Transfer Area**		Effective:	Inactive:
	B1	Physical Science	Fall 1981	Fall 2018
	B3	Laboratory Activity		
IGETC:	**Transfer Area**		Effective:	Inactive:
	5A	Physical Sciences	Fall 1981	Fall 2018
	5C	Fulfills Lab Requirement		

CSU Transfer:	Transferable	Effective:	Fall 1981	Inactive:	Fall 2018
UC Transfer:	Transferable	Effective:	Fall 1981	Inactive:	Fall 2018

CID:

CID Descriptor:CHEM 110	General Chemistry for Science Majors I, with Lab
SRJC Equivalent Course(s):	CHEM1A OR CHEM4A OR CHEM3A AND CHEM3AL
CID Descriptor:CHEM 120S	General Chemistry for Science Majors Sequence A
SRJC Equivalent Course(s):	CHEM1A AND CHEM1B OR CHEM4A AND CHEM4B OR CHEM3A AND CHEM3AL AND CHEM3B

Certificate/Major Applicable:
Not Certificate/Major Applicable

COURSE CONTENT

Outcomes and Objectives:
Upon completion of the course, the student should be able to:
In the lecture upon completion of the course, the student should be able to:
1. Solve problems involving the concepts listed under Course Content
2. Solve problems using SI units and dimensional analysis
3. Write concise explanations describing various chemical phenomena studied.
4. Write and interpret balanced chemical equations.
5. Describe and identify various types of colloids.
6. Write balanced chemical equations for oxidation-reduction reactions.
7. Write balanced chemical equations for precipitation reactions.
8. Describe different models of atomic structure.
9. Use standard chemical notation and nomenclature.
10. Predict the outcomes of combination, decomposition, single-displacement, metathesis and combustion reactions.
11. Calculate the mass percentages of the elements from the formula of a compound.
12. Determine the empirical formula of a compound from elemental

composition data.
13. Derive the molecular formula of a compound from the empirical formula.
14. Predict the amounts of reactants and products involved in a chemical reaction.
15. Solve limiting-reagent problems.
16. Calculate theoretical and actual percentage yields.
17. Perform calculations involving mass percentage, molarity, normality, molality and mole fraction units.
18. Solve solution stoichiometry problems.
19. Derive predictions of total pressure, partial pressures, volume, temperature, moles or mass utilizing the ideal gas laws.
20. Relate properties of gases to the kinetic-molecular theory.
21. Predict deviations from ideal behavior in real gases.
22. Calculate molecular weights of gases from Graham's law.
23. Apply the First Law of thermodynamics.
24. Describe colligative properties of solutions.
25. Write and interpret thermochemical equations.
26. Use Hess's Law to calculate enthalpies of reaction from standard heats of formation.
27. Calculate wavelength, frequency, speed and energy of electromagnetic radiation.
28. Describe the energy level diagram and spectral series for atomic hydrogen.
29. Calculate wavelength and momentum using the deBroglie relationship.
30. Use the Heisenberg principle to predict uncertainty in position or momentum.
31. Describe the significance of the four quantum numbers.
32. Use the Aufbau Principle to derive the ground-state electronic configurations of the elements.
33. Apply Hund's rule and predict the number of unpaired electrons in an atom.
34. Distinguish between diamagnetic and paramagnetic behavior.
35. Describe the relationship between electronic configuration and atomic radius, ionization energy, electron affinity and electronegativity.
36. Define ionic bonding, and apply the Born-Haber cycle to predict the stability of ionic crystalline solids.
37. Define covalent bonding utilizing Lewis dot structures.
38. Predict the existence of polar bonds and dipole moments in molecules.
39. Describe the delocalized bonding and resonance structures.
40. Explain the factors that affect solubility.
41. Calculate formal charges, bond orders, oxidation numbers and coordination numbers.
42. Calculate enthalpies of reaction using bond dissociation energies.
43. Apply the valence-shell electron-pair repulsion model to predict molecular geometries.

In the laboratory upon completion of the course, the student should be able to:

1. Observe all of the fundamental safety procedures.
2. Properly dispose of waste chemicals.
3. Manipulate standard laboratory apparatus.
4. Perform gravimetric and titrimetric analyses.
5. Collect and analyze scientific data using graphical and statistical

methods.
6. Summarize lab results in both formal and informal report formats.
7. Use a Macintosh personal computer (or equivalent) to perform word processing, spreadsheet computations, graphing and statistical calculations for lab reports.

Topics and Scope:

1. Keys to the Study of Chemistry
   a. Fundamental definitions
   b. Chemical arts and origins of modern chemistry
   c. The scientific approach
   d. Chemical problem solving
   e. Measurement in Scientific Study
   f. Significant Figures
2. The Components of Matter
   a. Elements, Compounds and Mixtures
   b. The atomic view of matter
   c. The nuclear atom model
   d. The atomic theory today
   e. Elements and the periodic chart
   f. Introduction to bonding
   g. Compounds - formulas, names, and masses
   h. Mixtures
3. Stoichiometry
   a. The mole
   b. Determining the formula of an unknown compound
   c. Writing and balancing chemical equations
   d. Calculating the amounts of reactant and product
   e. Fundamentals of solution stoichiometry
4. The Major Classes of Chemical Reactions
   a. Types of chemical reactions
   b. The role of water as a solvent
   c. Some important aqueous ionic reactions
   d. Redox reactions
   e. Reversible reactions, equilibrium
5. Gases and Kinetic-Molecular Theory
   a. The physical states of matter
   b. Measuring the pressure of a gas
   c. The gas laws and their experimental foundations
   d. Further applications of the ideal gas law
   e. The ideal gas law and reaction stoichiometry
   f. The kinetic-molecular theory
   g. Real gases: deviations from ideal behavior
6. Thermochemistry
   a. Forms of Energy and their inter conversion
   b. Enthalpy
   c. Calorimetry
   d. Stoichiometry of thermochemical equations
   e. Hess's law of heat summation
   f. Standard heats of reactions
7. Quantum Theory and Atomic Structure

a. The nature of light
b. Atomic spectra and the Bohr model of the atom
c. The wave-particle duality of matter and energy
d. The quantum-mechanical model of the atom

8. Electron Configuration and Chemical Periodicity
a. Characteristics of many-electron atoms
b. The quantum-mechanical atom and the periodic table
c. Trends in some key periodic atomic properties
d. The connection between atomic structure and chemical reactivity

9. Models of Chemical Bonding
a. Atomic properties and chemical bonds
b. The ionic bonding model
c. The covalent bonding model
d. Between the extremes: electronegativity and bond polarity
e. Depicting molecules and ions with Lewis structures
f. Using Lewis structures and bond energies to calculate heats of reaction
g. An introduction to metallic bonding

10. Molecular Shape and Theories of Covalent Bonding
a. VSEPR theory
b. Molecular shape and molecular polarity
c. Valence bond theory and orbital hybridization
d. Molecular orbital theory and electron delocalization

11. Intermolecular Forces
a. Physical states and phase changes
b. Types of intermolecular forces
c. Properties of the liquid state
d. Properties of the solid state
e. Quantitative aspects of changes in state
f. The uniqueness of water

12. The Properties of Mixtures
a. Types of solutions: intermolecular forces and the prediction of solubility
b. Energy changes in the solution process
c. Solubility as an equilibrium process
d. Quantitative ways of expressing concentration
e. Colligative properties of solutions
f. The structure and properties of colloids

Laboratory Material:

1. Laboratory safety, techniques and maintaining data notebooks
2. Writing formal and informal laboratory reports
3. Word processing, spreadsheets, graphing and curve-fitting software
4. Computer interfacing experiments
5. Calibration of volumetric glassware
6. Basic laboratory skills: weighing, pipetting, filtration, melting points
7. Graphical determination of density
8. Empirical formula of a compound
9. Gravimetric analysis of iron, sulfate or chloride
10. Observing & classifying types of chemical reactions
11. Calorimetry
12. Molar mass of a volatile compound by vapor density

13. Boyle•s and Charles• laws
14. Atomic spectroscopy
15. Acid-base titrations
16. Limiting reactants
17. Synthesis and analysis of an inorganic compound
18. Molecular geometry: VSEPR theory
19. Molar mass by freezing point depression

Assignment:

Assignments:
1. Specific reading and study assignments from the lecture textbook (averaging 25-30 pages per week).
2. Completion of recommended end-of-chapter problems (averaging 15-20 per week).
3. Writing an average of one laboratory report per week, some of which are typed formal lab reports with a required computer analysis of laboratory data.
4. Specific laboratory experiments which are solely quantitative analysis based.

Methods of Evaluation/Basis of Grade:

Writing: Assessment tools that demonstrate writing skills and/or require students to select, organize and explain ideas in writing.

Written homework, Lab reports, Essay exams	Writing 10 - 30%

Problem Solving: Assessment tools, other than exams, that demonstrate competence in computational or non-computational problem solving skills.

Homework problems, Lab reports, Quizzes, Exams	Problem solving 40 - 70%

Skill Demonstrations: All skill-based and physical demonstrations used for assessment purposes including skill performance exams.

Class performances, IN USE OF SPECIFIC ANALYTICAL MACHINERY AND EQUIP.	Skill Demonstrations 5 - 20%

Exams: All forms of formal testing, other than skill performance exams.

Multiple choice, Completion, SHORT ANSWER, ESSAY	Exams 15 - 25%

Other: Includes any assessment tools that do not logically fit into the above categories.

ATTENDANCE, ASSIGNMENTS TURNED IN ON TIME, IMPROVEMENT DEMONSTRATED ON FINAL EXAM	Other Category 0 - 5%

Representative Textbooks and Materials:
LECTURE MATERIALS:
CHEMISTRY: PRINCIPLES & PRACTICE by Daniel Reger, Scott Goode and Edward Mercer; Saunders College Publishing, 1997.
PRINCIPLES OF MODERN CHEMISTRY by David Oxtoby, H. P. Gillis & Norman Nachtrieb, Saunders College Publishing, 1999.
CHEMICAL PRINCIPLES by Steven Zumdahl, Houghlin Mifflin Publishing, 1998.
LABORATORY MANUALS:
CHEMISTRY IN THE LABORATORY by J. A. Beran, John Wiley Publishing, 1995.
EXPERIMENTS IN GENERAL CHEMISTRY by Frank Milio, Nordulf Debye & Clyde Metz, Saunders College Publishing, 1991.
QUANTITATIVE CHEMICAL ANALYSIS by Daniel Harris, W. H. Freeman Publishing, 1999.
FUNDAMENTALS OF ANALYTICAL CHEMISTRY by Douglas Skoog, Donald West & James
Holler, Saunders College Publishing, 1996.
SPECIAL STUDENT MATERIALS:
Safety goggles
Laboratory apron
Scientific calculator
Laboratory data notebook