CHEM 4A Course Outline as of Fall 2014

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:
First semester of an intensive one-year program covering physical inorganic and analytical chemistry. Includes the periodic table, stoichiometry, atomic theory and structure, bonding, thermochemistry, kinetic molecular theory of gases, and properties of mixtures. Laboratory includes quantitative and instrumental analysis. Recommended for chemistry, chemical engineering, preprofessional, and physical or life science majors.

Prerequisites/Corequisites:
Completion of CHEM 42 AND completion of MATH 154 or completion of MATH 155 or higher (V2). Students petitioning to enroll without CHEM 42 (or equivalent) should take the chemistry diagnostic test and submit a chemistry placement questionnaire to the Assessment Office in Student Services.

Recommended Preparation:
Completion of ENGL 1A.

Limits on Enrollment:

Schedule of Classes Information:
Description: First semester of an intensive one-year program covering physical inorganic and

analytical chemistry. Includes the periodic table, stoichiometry, atomic theory and structure, bonding, thermochemistry, kinetic molecular theory of gases, and properties of mixtures. Laboratory includes quantitative and instrumental analysis. Recommended for chemistry, chemical engineering, preprofessional, and physical or life science majors. (Grade Only)
Prerequisites/Corequisites: Completion of CHEM 42 AND completion of MATH 154 or completion of MATH 155 or higher (V2). Students petitioning to enroll without CHEM 42 (or equivalent) should take the chemistry diagnostic test and submit a chemistry placement questionnaire to the Assessment Office in Student Services.
Recommended: Completion of ENGL 1A.
Limits on Enrollment:
Transfer Credit: CSU;UC.
Repeatability: Two Repeats if Grade was D, F, NC, or NP

ARTICULATION, MAJOR, and CERTIFICATION INFORMATION:

			Effective:	Inactive:
AS Degree:	**Area**			
	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:
Major Applicable Course

COURSE CONTENT

Outcomes and Objectives:
1. Use dimensional analysis and stoichiometry to solve quantitative chemical problems.
2. Apply atomic theory in describing the physical and chemical properties of matter.
3. Summarize the quantum mechanical structure of the hydrogen atom in light of its emission spectrum, and apply it to many-electron systems.
4. Apply kinetic-molecular theory to the behavior of ideal and real gases.
5. Calculate energy changes in calorimetry and chemical reactions.
6. Relate an understanding of changes in entropy and free energy to the spontaneity of physical and chemical processes.
7. Describe the bonding and shapes of simple compounds and ions with a range of models.
8. Relate intermolecular forces to the physical properties of matter.

9. Calculate the effects of solute concentration on the physical properties of solutions.
10. Use appropriate techniques to obtain accurate and precise analytical measurements in the laboratory.
11. Use advanced instrumentation, such as UV-Visible and infrared (IR) spectroscopy, gas chromatography (GC) and atomic absorption (AA) in analysis of unknowns.
12. Analyze experimental error qualitatively and with statistical methods.
13. Graph (as appropriate), interpret, and communicate the results of laboratory experiments in writing.
14. Apply chemical principles to real world situations.

Topics and Scope:

I. Fundamentals
  A. Metric system and units
  B. Dimensional analysis and conversions
  C. Significant figures
  D. Atomic theory
  E. Nomenclature of binary ionic and covalent compounds
  F. Chemical composition
  G. Basic chemical reactions
II. Stoichiometry
  A. Moles and molar mass
  B. Mass calculations
  C. Limiting reactants and yields
  D. Molarity and solution stoichiometry
  E. Gas stoichiometry
  F. Energy calculations
III. Structure of the atom
  A. Light and the electromagnetic spectrum
  B. Wave and particle properties of light
  C. Emission spectra
  D. Bohr model of hydrogen
  E. Quantum mechanical model of the atom
  F. Quantum numbers
  G. Writing electron configurations
IV. Thermochemistry
  A. Calorimetry and the first law of thermodynamics
  B. Pressure-Volume (PV) work
  C. Energy vs. enthalpy
  D. Hess's law
  E. Reaction enthalpies
  G. Entropy and the second law of thermodynamics
  H. Spontaneity and Gibbs free energy
V. Periodic trends
  A. Atomic size
  B. Ionization energy
  C. Electronegativity
  D. Ionic radius
VI. Bonding and Molecular Structure
  A. Ionic bonding
  B. Born-Haber cycle
  C. Lewis structures

D. Valence Shell Electron Pair Repulsion (VSEPR) Theory
E. Covalent bond order, polarity, energy and length
F. Bond energies and reaction enthalpies
G. Hybridization of atomic orbitals
H. Valence Bond (VB) theory
I. Molecular Orbital (MO) theory

VII. Kinetic Molecular Theory of Gases
A. Molecular scale understanding of gas pressure and temperature
B. Heat capacity of gases
C. Development and applications of the ideal gas law
D. Dalton's law of partial pressures
E. Graham's law of effusion and diffusion
F. Approximating real gases with the van Der Waals equation

VIII. Intermolecular Forces (IMF)
A. Molecular polarity
B. Types of intermolecular forces
C. Physical properties and IMF
D. Phases and phase diagrams

IX. Liquids and Solids

X. Colligative Properties
A. Using molality and mole fraction to measure solution concentration
B. Vapor pressure lowering
C. Freezing point depression
D. Boiling point elevation
E. Osmosis

Laboratory material:
1. Lab safety and maintaining a lab notebook
2. Measurements
3. Gravimetric analysis
4. Determining a stoichiometric ratio
5. Synthesis and limiting reactants
6. Determining the formula of a compound
7. Gas laws
8. Calorimetry
9. Hydrogen emission spectrum
10. Determination of an unknown
11. Titration
    a. Acid-base
    b. Complexometric
    c. Redox
12. Instrumental analysis
    a. Ultraviolet-Visible spectroscopy
    b. Infrared (IR) spectroscopy
    c. Atomic absorption (AA)
    d. Gas chromatography (GC)
    e. Mass spectrometry (MS)
13. Techniques and skills
    a. Determining mass using a balance
    b. Use of a buret
    c. Using volumetric glassware to prepare solutions
    d. Using spreadsheet software to graph data and perform calculations

e. Writing laboratory reports

Assignment:

1. Specific reading and study assignments from the textbook (20-30 pages per week)
2. Completion of recommended homework problems (0-30 per week).
3. Lab experiments and reports (approximately 1 per week)
4. Exams (3-5 per semester), quizzes (0-4 per semester), final exam

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.

Lab reports	Writing 20 - 35%

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

Homework problems	Problem solving 0 - 20%

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

None	Skill Demonstrations 0 - 0%

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

Exams, quizzes, final exam	Exams 50 - 80%

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

None	Other Category 0 - 0%

Representative Textbooks and Materials:
Chemical Principles, 7th Ed., Zumdahl and DeCoste (Cengage, 2013).
Chemical Principles: The Quest for Insight, 6th Ed., Atkins and Jones (Freeman, 2012).
General Chemistry: Principles and Modern Applications, 10th Ed., Petrucci, Herring, Madura, Bissonnette (Pearson, 2010).
Chemistry: The Molecular Nature of Matter and Change, 6th Ed, Silberberg (McGraw-Hill, 2011).
Principles of Modern Chemistry, 7th Ed., Oxtoby, Gillis and Campion, (Cengage, 2011).

Lab Manuals
Instructor Prepared Materials
Laboratory Experiments for Chemistry: The Central Science, 12th Ed., Brown, Nelson, Kemp

and Stoltzfus (Pearson, 2011).
Quantitative Chemical Analysis, 8th Ed., Daniel Harris, (Freeman, 2010).
Fundamentals of Analytical Chemistry, 9th Ed., Skoog, West, Holler and Crouch (Cengage, 2013).