CHEM 4B Course Outline as of Fall 1999

CATALOG INFORMATION

Dept and Nbr: CHEM 4B Title: GEN CHEM WITH QUANT
Full Title: General Chemistry with Quantitative Analysis
Last Reviewed: 2/24/2014

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. Chem 4A=C/B1 & B3; Chem 4B=-/B1 & B3

Prerequisites/Corequisites:
Course Completion of CHEM 4A

Recommended Preparation:

Limits on Enrollment:

Schedule of Classes Information:
Description: Second semester of a one year program of general chemical principals with quantitative & instrumental analysis. (Grade Only)
Prerequisites/Corequisites: Course Completion of CHEM 4A
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 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:
In the lecture upon completion of the course, the student should be able to:
1. name and create chemical structures of organic compounds
2. recognize the common organic functional groups
3. determine the products of simple organic reactions
4. explain the concepts of Markownikoff•s Rule
5. recognize elimination, substitution and addition reactions
6. be able to identify and work with Lewis acids and bases
7. describe optical and geometric isomerism
8. explain the parameters of simple collision theory
9. be able to create a differential rate law for a given reaction
10. be able to mathematically work with both the differential and integrated forms of the reaction rate law
11. explain the concepts of reaction order and molecularity
12. mathematically solve for the half life and specific rate constant of a given nuclide
13. create a reaction mechanism from a series of rate expressions
14. explain the collision process from a potential energy point of view
15. explain how reaction rates affect the formulation of an equililbruim constant
16. create the law of mass action for a given reaction

17. calculate the equilibrium constant value from the mass action expression.
18. explain the concept of the reaction quotient
19. explain the difference between Kp and Kc
20. solve equililbruim problems
21. explain the concepts associated with Le ChÔtelier•s Principle
22. explain the nature and behavior of a catalyst
23. describe different types of acids and bases
24. calculate reagent concentration in terms of molarity, molality, and normalities
25. relate reagent dissociation to the magnitude of the equililbruim constant
26. describe the difference between a solute and a solvent
27. explain the nature and behavior of an acid/base indicator
28. explain the concept of acid/base conjugate pairs
29. explain the concept of pH and be able to calculate its value
30. describe the behavior of polyprotic acids
31. describe and mathematically work with solutions which involve weak acids/bases, buffer solutions, and hydrolysis reactions and slightly soluble salts
32. explain the common-ion effect and the concept of buffer capacity
33. explain and construct titration curves involving acid-base systems
34. explain complex-ion formation
35. apply the 1st, 2nd and 3rd laws of thermodynamics
36. know the sign convention regarding state functions
37. Solve mathematical problems involving thermodynamic concepts and terms
38. predict reaction spontaneity as a function of free energy
39. describe the relationship between free energy and equilibrium
40. explain the concept of work
41. create electrochemical cells and determine their EMF values
42. balance redox reactions using the ion-electron method
43. calculate cell potential using the Nernst equation
44. be able to do calculations involving electrolytic cells
45. apply the relative reactivity of metallic elements
46. desribe the effects on cell potential by changes in electrolyte concentration
47. explain the behavior and operation of batteries
48. be able to determine the oxidation states of elements
49. apply the concept of half-life
50. write equations of common modes of radioactive decay
51. describe the disintegration series of a given nuclide
52. solve problems for 1st order radioactive decay processes
53. calculate the age of some specie using radioisotope dating
54. describe the processes of nuclear fission and fusion
55. explain the concept of binding energy
56. describe the basic concepts of transition metal chemistry
57. be able to name coordination compounds
58. be able do draw the isomeric forms of coordination compounds
59. Apply valence bond theory and molecular orbital theory
60. Apply ligand field and crystal field theories
61. be able to relate molecular shape to the chemical formula
62. explain the effects of ligand field strength to spectral displays of

color by given molecules
In the laboratory upon completion of the course, the student should be able to:
1. observe all of the fundamental safety procedures and properly dispose of waste chemicals
2. perform reagent and product analyses regarding experiments involving the concepts of kinetics, acid-base theory, electrochemical cells, chemical equilibrium and inorganic synthesis
3. perform gravimetric, titrimetric and spectroscopic quantitative analyses
4. perform both quantitative and qualitative potentiometric and complexiметric titrations
5. correctly prepare and use primary standards to determine unknown reagent concentrations
6. be able to operate advance instrumental analytical equipment such as IR, UV-VIS and atomic absorption spectrophotometers
7. collect and analyze scientific data using graphical and statistical methods
8. summarize lab results in both formal and informal report formats
9. use Macintosh personal computer (or equivalent) to perform word processing, spreadsheet computations, graphing and statistical calculations for lab reports

Topics and Scope:

1. Interchapter"A Midcourse Perspective on the Properties of the Elements
   a. Key atomic properties
   b. Characteristics of Chemical Bonding
   c. Metallic behavior
   d. Acid-base behavior or the metallic oxides
   e. Redox behavior of the elements
   f. Physical states and changes of state
2. Organic Compounds and the Atomic Properties of Carbon
   a. The special nature of carbon and characteristic of organic molecules
   b. The structures and classes of hydrocarbons
   c. Some important classes of organic reactions
   d. Properties and reactivity of common functional groups
   e. Giant organic molecules: The monomer-polymer theme
3. Kinetics
   a. A qualitative look at the factors that influence reaction rates
   b. Expressing the reaction rate
   c. The rate law and its components
   d. explaining the effects of concentration and temperature on reaction rate
   e. Reaction mechanisms
   f. Catalysis
4. Equilibrium
   a. The dynamic nature of the equilibrium state
   b. The mass"action expression and the equilibrium constant
   c. How to solve equilibrium problems

d. Reaction conditions and the equilibrium state: Le ChÔtelier•s Principle

5. Acid”Base Equilibria
   a. Acids and bases in water
   b. Autoionization of water and the pH scale
   c. Proton transfer and the BrÖnsted-Lowry acid”base definition
   d. Solving problems involving weak”acid equilibria
   e. Weak”bases and their relation to weak”acids
   f. Molecular properties and acid strength
   g. Acid”base properties of salt solutions
   h. The leveling effect
   i. The Lewis acid”base definition
6. Ionic Equilibria in Aqueous Systems
   a. Equilibria of acid”base buffer systems
   b. Acid”base titration curves
   c. Equilibria of slightly soluble ionic compounds
   d. Equilibria involving complex ions
   e. Applications of Ionic equilibria to chemical analysis
7. Thermodynamics
   a. The second law of thermodynamics
   b. Entropy, free energy and work
   c. Free energy, equilibrium, and reaction direction
8. Electrochemistry
   a. Half”reactions and electrochemical cells
   b. Voltaic cells
   c. Free energy and electrical work
   d. Electrochemical processes in batteries
   e. Corrosion”environmental electrochemistry
   f. Electrolytic cells
9. Nuclear Reactions and Their Applications
   a. radioactive decay and nuclear stability
   b. The kinetics of nuclear change
   c. Nuclear transmutation
   d. The effects of nuclear radiation of matter
   e. Applications of radioisotopes
   f. Fission and Fusion
10. The Transition Elements and Their Coordination Compounds
   a. An overview of transition element properties
   b. The inner transition elements
   c. Highlights of selected transition metals
   d. Coordination compounds
   e. Theoretical basis for the bonding and properties of complexes
11. Introduction to Organic Chemistry
   a. Alkanes, alkenes and alkynes
   b. Functional groups
   c. Nomenclature

LAB 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. Separation and quantitation of organic compounds by gas chromatography

6. Analysis of trace metals by atomic absorption spectrophotometry
7. Identification of organic compounds by Fourier-transform infrared spectroscopy
8. Potentiometric titration
9. Complexometric titration
10. Iodometric titration
11. Simultaneous spectrophotometric determination of a mixture
12. Precipitation titration of halide ions
13. Voltaic cells
14. Electrogravimetric analysis
15. Acid-base indicators
16. Chemical kinetics and rate laws
17. Solubility-product constant of an ionic compound
18. Nuclear decay rates
19. Spectrophotometric determination of copper or iron in an ore sample

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 ar e typed formal laboratory reports with required computer analysis of laboratory data.
4. Specific laboratory experiments many of 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, Exams	Problem solving 40 - 70%

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

Class performances, using specific machinery, equipment, and glassware	Skill Demonstrations 5 - 20%

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

Multiple choice, Completion, and Short Answer, Essay	Exams 15 - 25%

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

Attendance, timeliness of assignements, improvement 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