CREDIT COURSE OUTLINE

I. COVER PAGE

(1) CHEM 1B	(2) GENERAL CHEMISTRY AND QUALITATIVE ANALYSIS	(3) 5
Number	Title	Units

(4)	Lecture / Lab Hours:			
	Total Course Hours			
		Total Lec hours:		3.00
		Total Lab hours:		6.00
		Total Contact hours:		162.00
	Lec will generate _0_ hour(s) outside work.			
	Lab will generate _0_ hour(s) outside work.			
(5)	Grading Basis:	Grading Scale Only		
		Pass/No Pass option		X
		Pass/No Pass only		
(6)	Advisories: Eligibility for English 126 Eligibility for English 125			
(7)	Pre-requisites(requires C grade or better): CHEM 1A MATH 103			
	Corequisites:			

(8)Classification:			
		Degree applicable:	X
		Non-degree applicable:	
		Basic skills:	
(9)RC	Fulfills AS/AA degree requirement: (area)		
	General education category:		
		Area A Natural Sciences	
	Major:	BIOLOGICAL SCIENCE	
	Certificate of:		
	Certificate in:		
(10)CSU		Baccalaureate:	X
(11)Repeatable: (A course may be repeated three times)			0

(12) Catalog Description:
Acid-base theory; chemical kinetics, equilibrium (acid-base, hydrolysis, and solubility); chemical thermodynamics, electrochemistry; selected topics in nuclear chemistry, coordination chemistry, and/or chemistry of selected groups; inorganic qualitative and quantitative analysis.

II. COURSE OUTCOMES:

(Specify the learning skills the student demonstrates through completing the course and link critical thinking skills to specific course content and objectives.)

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

I. Understand chemical kinetics and mechanisms;
II. Understand and be able to solve chemical equilibrium questions including but not limited to acid/base and pH concepts;
III. Understand and be able to solve problems on thermodynamic concepts;
IV. Understand and be able to solve problems on electrochemical concepts;
V. Understand the fundamental concepts of nuclear chemistry;
VI. Demonstrate general chemistry skills in the laboratory including qualitative analysis.

III. COURSE OBJECTIVES:

(Specify major objectives in terms of the observable knowledge and/or skills to be attained.)

In the process of completing this course, students will:

I. learn chemical kinetic mathematical operations to determine order and rates of a reaction and understand the effects of temperature;
II. learn to apply Le Chatelier's Principle to systems displaced from equilibrium, mathematically solve for the equilibrium constant and understand limitations involving the equilibrium constant;
III. demonstrate the ability to classify acids and bases then determine equilibrium constant and pH of acids, bases, and buffers;
IV. learn to solve problems involving the common-ion effect in acid-base and solubility equilibria;
V. evaluate neutralization reactions and titration curves;
VI. recognize fractional precipitations and equilibria involving complex ions;
VII. recognize the concept of qualitative cation analysis and be able to perform related laboratory experiments;
VIII. learn to solve simple problems involving chemical thermodynamic problems (work, heat, internal energy, enthalpy, entropy, and free energy);

IX. examine the Second Law of Thermodynamics and apply to the spontaneity of a reaction and the complexity of natural systems;
X. discuss concepts of an electrochemical cell and mathematically solve for a standard cell potential, change in standard free energy, and equilibrium constants;
XI. recognize physical and chemical properties of element groups (e.g. alkali metals; alkaline earth metals, transition elements, group 13 metals, group 14 metals, nonmetals including halogens, and noble gases);
XII. learn to describe, name, and understand bonding of complex ions and coordination compounds;
XIII. discuss general concepts of nuclear chemistry (e.g. stability, decay, fission, fusion, radioactivity, and nuclear reactions);
XIV. learn to perform laboratory procedures and techniques used in semimicro qualitative and quantitative analysis of simple inorganic ions, and the apparatus and measurements used in simple calorimetry and electrochemistry experiments;
XV. learn skills in the laboratory in the use of the analytical balance, titration, spectroscopy, pH meter, correct use of glassware, melting point apparatus, use safety precautions and general laboratory procedures.

IV. COURSE OUTLINE:

Lecture Content:

A. Lecture
1. Chemical Kinetics
a. Rates of a chemical reaction
b. Zero, first, and second order reactions
c. Reaction mechanisms

2. Principles of Chemical Equilibrium
a. Dynamic equilibrium
b. Equilibrium constant expression
c. Predicting the direction of net change Le Châtelier's Principle

3. Acid-Base equilibria, hydrolysis
a. Arrhenius, Lewis, and Brønsted-Lowry Theory
b. Strong and weak acids
c. Strong and weak bases
d. Molecular structure and Acid-Base Behavior
e. Buffer solution
f. Acid-base indicators
g. Common-ion effect
h. Neutralization reactions
i. Titration curves
j. Solutions of salts and polyprotic acids

4. Solubility and Complex-Ion Equilibria
a. Solubility product constant Ksp
b. Common-ion effect in solubility equilibria
c. Criteria for precipitation and its completeness
d. Fractional precipitation
e. Solubility and pH
f. Equilibria involving complex ions
e. Qualitative cation analysis

5. Thermodynamics, with application to equilibria
a. Spontaneity
b. Evaluating entropy and entropy changes
c. The Second Law of Thermodynamics
d. Standard Free Energy Change and Equilibrium
e. Gibbs free energy and Keq as a function of temperature
f. Coupled reactions

6. Electrochemistry
a. Electrode potentials and their measurements
b. Ecell, Gibbs free energy, and Keq
c. Ecell as a function of concentration
d. Batteries
e. Industrial electrolysis Processes

7. Chemistry of Select Groups
a. Main-Group elements I and II
b. The Transition elements

8. Coordination Compounds
a. Ligands
b. Nomenclature
c. Isomerism
d. Magnetic Properties of Coordination Compounds and Crystal Field Theory
e. Acid base reactions with complex ions

9. Nuclear Chemistry
a. Radioactivity
b. Isotopes

c. Artificially induced radioactivity
d. Rate of radioactive decay
e. Nuclear reactions
f. Nuclear stability, nuclear fission, and nuclear fusion

Lab Content:

1. LeChatelier's Principle in Iron Thiocyanate Equilibrium
2. A Kinetic Study of an Iodine Clock Reaction
3. Determination of an Equilibrium Constant
4. Determining pH of weak acids, weak bases, and their salts
5. Determination of the Ionization Constant of a Weak Acid
6. Investigation of a Buffer System
7. Determination of a Solubility Product Constant
8. Precipitating and quantifying a product using the Solvay process
9. Spectrohotometric Analysis of Commercial Aspirin
10. Chromatography: Separation of Amino Acids
11. Qualitative Analysis Scheme: Groups I, II, III, IV, V
12. (Optional) Melting Point Characteristics

V. APPROPRIATE READINGS

Reading assignments may include but are not limited to the following:

I. Sample Text Title:

1. Recommended - Tro, Nivaldo *Chemistry A Molecular Approach,* ed. 2 nd Pearson Prentice Hall, Upper Saddle River, New Jersey, 2011, ISBN: 0-321-65178-2
2. Recommended - Petrucci, Ralph H. *General Chemistry Principles and Modern Applications,* ed. 8th Prentice Hall, Upper Saddle River, New Jersey, 2002,
3. Recommended - Chang, Raymond *Chemistry,* ed. 8th McGraw Hill, Boston, Illinois, 2005,
4. Recommended - Dekker/Kimball *General Chemistry Quantitative and Qualitative Laboratory Experiments for Science Majors Book B,* Stipes Publishing, Champaign, Illinois , 2003,
5. Recommended - Weiss, Gerald S. *Experiments in General Chemistry: Principles and Modern Applications,* ed. 8th Prentice Hall, Upper Saddle River, New Jersey, 2002,

II. Other Readings

___ Global or international materials or concepts are appropriately included in this course
___ Multicultural materials and concepts are appropriately included in this course

If either line is checked, write a paragraph indicating specifically how global/international and/or multicultural materials and concepts relate to content outline and/or readings.

VI. METHODS TO MEASURE STUDENT ACHIEVEMENT AND DETERMINE GRADES:

Students in this course will be graded in at least one of the following four categories. Please check those appropriate. A degree applicable course must have a minimum of one response in category A, B, or C.

A. Writing Check either 1 or 2 below			
X	***1. Substantial writing assignments are required. Check the appropriate boxes below and provide a written description in the space provided.***		
	2. Substantial writing assignments are NOT required. If this box is checked leave this section blank. For degree applicable courses you must complete category B and/or C.		
X	a) essay exam(s)	X	d) written homework
	b) term or other paper(s)		e) reading reports
X	c) laboratory report(s)		f) other (specify)

Required assignments may include but are not limited to the following:

1. Exams may include questions where the student would need to explain a concept or theory.
2. There are 15 to 18 laboratories performed and all require a written laboratory report.
3. All homework is written, some questions require students write definitions or explanations of concepts.

B. Problem Solving Computational or non-computational problem-solving demonstrations, including:			
X	a) exam(s)	X	d) laboratory reports
X	b) quizzes		e) field work
X	c) homework problems		f) other (specify):

Required assignments may include but are not limited to the following:
1. Exams, quizzes, and homework problems are composed of problem solving questions.

2. After each experiment is performed the students are required to write a lab report. The lab report includes a purpose, reactions, reaction mechanisms, data, results, and a conclusion.

C. Skill demonstrations, including:			
	a) class performance(s)		c) performance exams(s)
	b) field work	X	d) other (specify)

Required assignments may include but are not limited to the following:
The students will be required to perform an experiment (laboratory practical) without the assistance of others. Instead they can only refer to a laboratory notebook they have been keeping notes in throughout the semester.

D. Objective examinations including:			
X	a) multiple choice	X	d) completion
X	b) true/false		e) other (specify):
X	c) matching items		

COURSE GRADE DETERMINATION:
Description/Explanation: Based on the categories checked in A-D, it is the recommendation of the department that the instructor's grading methods fall within the following departmental guidelines; however, the final method of grading is still at the discretion of the individual instructor. The instructor's syllabus must reflect the criteria by which the student's grade has been determined. (A minimum of five (5) grades must be recorded on the final roster.)

If several methods to measure student achievement are used, indicate here the approximate weight or percentage each has in determining student final grades.
Item Percentage Exams (3) 30 Quizzes (5) 20 Final 25 Laboratory 15 Homework 8 Participation 2 Total 100

VII. EDUCATIONAL MATERIALS

For degree applicable courses, the adopted texts, as listed in the college bookstore, or instructor-prepared materials have been certified to contain college-level materials.

Validation Language Level (check where applicable):	College-Level Criteria Met YES	NO
Textbook	X	
Reference materials		X
Instructor-prepared materials	X	
Audio-visual materials	X	

Indicate Method of evaluation:

Used readability formulae (grade level 10 or higher)	
Text is used in a college-level course	X
Used grading provided by publisher	
Other: (please explain; relate to Skills Levels)	

Computation Level (Eligible for MATH 101 level or higher where applicable)	X	
Content		
Breadth of ideas covered clearly meets college-level learning objectives of this course	X	
Presentation of content and/or exercises/projects:		
Requires a variety of problem-solving strategies including inductive and deductive reasoning.	X	
Requires independent thought and study	X	
Applies transferring knowledge and skills appropriately and efficiently to new situations or problems.	X	

List of Reading/Educational Materials
Recommended - Tro, Nivaldo *Chemistry A Molecular Approach,* ed. 2 nd Pearson Prentice Hall, Upper Saddle River, New Jersey, 2011, ISBN: 0-321-65178-2
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Recommended - Weiss, Gerald S. *Experiments in General Chemistry: Principles and Modern Applications,* ed. 8th Prentice Hall, Upper Saddle River, New Jersey, 2002,

Comments:

_____ This course requires special or additional library materials (list attached).
__X__ This course requires special facilities:
Laboratory where students can perform chemistry experiments

Attached Files:

BASIC SKILLS ADVISORIES PAGE The skills listed are those needed for eligibility for English 125, 126, and Math 101. These skills are listed as the outcomes from English 252, 262, and Math 250. In the right hand column, list at least three major basic skills needed at the beginning of the target course and check off the corresponding basic skills listed at the left.

(eligibility for English 126) (as outcomes for English 262) __X__ Using phonetic, structural, contextual, and dictionary skills to attack and understand words. _____ Applying word analysis skills to reading in context. _____ Using adequate basic functional vocabulary skills. _____ Using textbook study skills and outlining skills. _____ Using a full range of literal comprehension skills and basic analytical skills such as predicting, inferring, concluding, and evaluating.	1. Students are required to read a college-level textbook with sophisticated vocabulary. 2. Students are required to read lab manuals outline procedure. 3. Students are required to read lab manuals and understand safety procedures. 4. Analytical skills are required for good comprehension of dense readings.
(eligibility for English 125) (as outcomes for English 252) __X__ Writing complete English sentences and avoiding errors most of the time. _____ Using the conventions of English writing: capitalization, punctuation, spelling, etc. _____ Using verbs correctly in present, past, future, and present perfect tenses, and using the correct forms of common irregular verbs. _____ Expanding and developing basic sentence structure with appropriate modification. _____ Combining sentences using coordination, subordination, and phrases. _____ Expressing the writer's ideas in short personal papers utilizing the writing process in their development.	1. Written answers are part of the homework assignments. 2. Lab reports are required which necessitates ability to write well organized and coherent purpose, procedure, results, and conclusion. 3. Exams require explanations for chemical equilibria and writing calculations coherently.

Check the appropriate spaces.
_____ Eligibility for Math 101 is advisory for the target course.
__X__ Eligibility for English 126 is advisory for the target course.
__X__ Eligibility for English 125 is advisory for the target course.
If the reviewers determine that an advisory or advisories in Basic Skills are all that are necessary for success in the target course, stop here, provide the required signatures, and forward this form to the department chair, the appropriate associate dean, and the curriculum committee.

CONTENT REVIEW

MATH 103 INTERMEDIATE ALGEBRA

create a linear equation given a slope and a point or two points; graph linear equations and inequalities and use function notation to find the value of expressions.	
add, subtract, multiply, and divide radical expressions and use exponent properties and conjugate properties to simplify and solve radical expressions.	
complete the square of a quadratic equation and use the quadratic formula to solve any quadratic equation; graph quadratic equations using translations.	

CHEM 1A GENERAL CHEMISTRY

REQUISITES

Subject Prerequisite -- CHEM 1A GENERAL CHEMISTRY

• identify the names and symbols of the representative elements; • identify the first ten transition elements and selected others as they are introduced; • name inorganic compounds and the rules for these names; • predict ionic and covalent bonding between species; • convert from the English to the metric system in weights, volume, and linear measurements; • calculate molecular weights, formula weights, gas volumes, temperature, pressure concentration of solutions, molarity, empirical and molecular formulas, and percentage composition; • solve oxidation reduction equations, assign oxidation numbers, and use both molecular and net ion forms of the equation; • apply the Arrhenius definition of acid and base; • solve limiting reagent problems involving molecular and ionic compounds as pure substances and as solutions; • describe covalently bonded structures using Lewis theory, valence bond theory (including hybrid orbitals), and molecular orbital theory of diatomic molecules; • describe colligative properties of solutions of ionic and non-ionic substances and solve their numerical problems; • solve thermochemical problems, including using Hess's Law and calorimetry; • demonstrate skills in laboratory in the use of the analytical balance, thermometer calibration and usage, barometer reading, glass working, filtration, titration, simple synthesis, spectroscopy, the care of one's equipment, and the recognition that if an experiment is not correct, there must have been a mistake and how to find this mistake.	• learn chemical kinetic mathematical operations to determine order and rates of a reaction and understand the effects of temperature; • learn to apply Le Chatelier's Principle to systems displaced from equilibrium, mathematically solve for the equilibrium constant and understand limitations involving the equilibrium constant; • demonstrate the ability to classify acids and bases then determine equilibrium constant and pH of acids, bases, and buffers; • learn to solve problems involving the common-ion effect in acid-base and solubility equilibria; • evaluate neutralization reactions and titration curves; • recognize fractional precipitations and equilibria involving complex ions; • recognize the concept of qualitative cation analysis and be able to perform related laboratory experiments; • learn to solve simple problems involving chemical thermodynamic problems (work, heat, internal energy, enthalpy, entropy, and free energy); • examine the Second Law of Thermodynamics and apply to the spontaneity of a reaction and the complexity of natural systems; • discuss concepts of an electrochemical cell and mathematically solve for a standard cell potential, change in standard free energy, and equilibrium constants; • recognize physical and chemical properties of element groups (e.g. alkali metals; alkaline earth metals, transition elements, group 13 metals, group 14 metals, nonmetals including halogens, and noble gases); • learn to describe, name, and understand bonding of complex ions and coordination compounds; • discuss general concepts of nuclear chemistry (e.g. stability, decay, fission, fusion, radioactivity, and nuclear reactions); • learn to perform laboratory procedures and techniques used in semimicro qualitative and quantitative analysis of simple inorganic ions, and the apparatus and measurements used in simple calorimetry and electrochemistry experiments; • learn skills in the laboratory in the use of the analytical balance, titration, spectroscopy, pH meter, correct use of glassware, melting point apparatus, use safety precautions and general laboratory procedures.

Subject Prerequisite -- MATH 103 INTERMEDIATE ALGEBRA

• create a linear equation given a slope and a point or two points; graph linear equations and inequalities and use function notation to find the value of expressions. • add, subtract, multiply, and divide radical expressions and use exponent properties and conjugate properties to simplify and solve radical expressions. • complete the square of a quadratic equation and use the quadratic formula to solve any quadratic equation; graph	• learn chemical kinetic mathematical operations to determine order and rates of a reaction and understand the effects of temperature; • learn to apply Le Chatelier's Principle to systems displaced from equilibrium, mathematically solve for the equilibrium constant and understand limitations involving the equilibrium constant; • demonstrate the ability to classify acids and bases then

quadratic equations using translations. • solve exponential and logarithmic equations by using equivalent expressions; use exponential and logarithmic properties to convert between common logarithms, natural logarithms and other bases.	determine equilibrium constant and pH of acids, bases, and buffers; • learn to solve problems involving the common-ion effect in acid-base and solubility equilibria; • evaluate neutralization reactions and titration curves; • recognize fractional precipitations and equilibria involving complex ions; • learn to solve simple problems involving chemical thermodynamic problems (work, heat, internal energy, enthalpy, entropy, and free energy); • examine the Second Law of Thermodynamics and apply to the spontaneity of a reaction and the complexity of natural systems; • discuss concepts of an electrochemical cell and mathematically solve for a standard cell potential, change in standard free energy, and equilibrium constants; • discuss general concepts of nuclear chemistry (e.g. stability, decay, fission, fusion, radioactivity, and nuclear reactions); • learn skills in the laboratory in the use of the analytical balance, titration, spectroscopy, pH meter, correct use of glassware, melting point apparatus, use safety precautions and general laboratory procedures.

ESTABLISHING PREREQUISITES OR COREQUISITES

Every prerequisite or corequisite requires content review plus justification of at least one of the seven kinds below. Prerequisite courses in communication and math outside of their disciplines require justification through statistical evidence. Kinds of justification that may establish a prerequisite are listed below.

Check one of the following that apply. Documentation may be attached.

1. _____ The prerequisite/corequisite is required by law or government regulations.
   Explain or cite regulation numbers:
2. _____ The health or safety of the students in this course requires the prerequisite.
   Justification: Indicate how this is so.
3. _____ The safety or equipment operation skills learned in the prerequisite course are required for the successful or safe completion of this course.
   Justification: Indicate how this is so.
4. _____ The prerequisite is required in order for the course to be accepted for transfer to the UC or CSU systems.
   Justification: Indicate how this is so.
5. _____ Significant statistical evidence indicates that the absence of the prerequisite course is related to unsatisfactory performance in the target course.
   Justification: Cite the statistical evidence from the research.
6. __X__ The prerequisite course is part of a sequence of courses within or across a discipline.
   Chem 1B is the second course in the Chem 1A - Chem 1B sequence
7. _____ Three CSU/UC campuses require an equivalent prerequisite or corequisite for a course equivalent to the target course: