BLINN COLLEGE

MASTER COURSE SYLLABUS

CHEMISTRY 1411

CIP # 40.0501.5203

CIP Area: Physical Sciences

FALL, 2005

Prepared by:

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Bryan Campus / Date

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Chem 1411 General Chemistry I

This course is in the core curriculum.

Purpose Statement

The purpose of the natural sciences component in the core curriculum is to enable the student to understand the basic concepts in the natural sciences and to apply that understanding to the analysis of current issues in society. In particular, mastering general chemistry requires a thorough understanding of fundamental concepts of how the microscopic structure of matter determines the qualitative and quantitative properties of the world around them. Mastering general chemistry will enable the student to use these fundamentals to analyze, classify, and predict events based on chemical and physical properties.

Course Description

1. CHEM 1411 consists of the study of fundamental laws, theories and concepts of chemistry including quantitative relationships involving mass and energy, the structure and properties of matter and the chemical and physical changes it undergoes as well as the study of solutions. The laboratory component involves the application of the basic techniques and methods of chemical experimentation. Prerequisites: Two years of high school algebra with grades of "C" or better or concurrent enrollment in MATH 1314. Three class hours and three laboratory hours per week. Credit: Four semester hours.

1. The major areas which will be covered in lecture are:
    a. The Foundations of Chemistry
    b. Chemical Formulas and Composition Stoichiometry
    c. Chemical Equations and Reaction Stoichiometry
    d. Some Types of Chemical Reactions
    e. The Structure of Atoms
    f. Chemical Periodicity
    g. Chemical Bonding
    h. Molecular Structure and Covalent Bonding Theories
    i. Molecular Orbitals in Chemical Bonding
    j. Reactions in Aqueous Solutions I : Acids, Bases, and Salts
    k. Reactions in Aqueous Solution II : Calculations
    l. Gases and the Kinetic-Molecular Theory
    m. Liquids and Solids
    n. Solutions

    The major areas which will be covered in lab are:
    a. Safety
    b. Determination of intensive and extensive properties :density; measuring mass and volume.
    c. Gravimetric analysis of compounds, handling solids, use of Bunsen burner
    d. Determination of formula weight of a pure substance, transfer of materials, filtration
    e. Solubility of selected compounds and minerals, precipitation as a separation technique
    f. Comparison of relative reactivity of selected metals
    g. Synthesis of a compound, sequential reactions, % yield
    h. Construction of selected simple molecular models, Lewis dot structures
    i. Reactions in solutions:acid/base and redox titrations, use of indicators
2. Three lecture hours and three laboratory hours per week.

3. Chem 1411 earns four credit hours.
4. Prerequisite: Two years of high school algebra with grades of "C" or better or concurrent enrollment in MATH 1314.
5. This is a Core Course in the 42-hour Core of Blinn College; more can be found at www.blinn.edu/corecurriculum/. As such, students will develop proficiency in the appropriate Intellectual Competencies, Exemplary Educational Objectives, and Perspectives, as follows:
    a. Intellectual Competencies
        i. **Reading:** The ability to analyze and interpret a variety of printed materials, books, documents and articles – above the 12th grade level.
        ii. **Writing:** The ability to produce clear, correct and coherent prose adapted to purpose, occasion and audience – above the 12th grade level.
        iii. **Listening:** The ability to analyze and interpret various forms of spoken communication, possess sufficient literacy skills of writing, reading – above 12th grade level.
        iv. **Critical Thinking:** The ability to think and analyze at a critical level.
        v. **Computer Literacy:** The ability to understand our technological society, use computer-based technology in communications, solving problems, acquiring information.
    b. Exemplary Educational Objectives
        i. To understand and apply method and appropriate technology to the study of natural sciences.
        ii. To recognize scientific and quantitative methods and the differences between these approaches and other methods of inquiry and to communicate findings, analyses, and interpretation both orally and in writing.
        iii. To identify and recognize the differences among competing scientific theories.
        iv. To demonstrate knowledge of the major issues and problems facing modern science, including issues that touch upon ethics, values, and public policies.
        v. To demonstrate knowledge of the interdependence of science and technology and their influence on, and contribution to, modern culture.
    c. Perspectives
        i. To recognize the importance of maintaining health and wellness.
        ii. To develop a capacity to use knowledge of how science and technology affect their lives.
        iii. To use logical reasoning in problem solving.
        iv. To integrate knowledge and understand the interrelationships of the scholarly disciplines.

Course Objectives and Student Learning Outcomes

Upon completion of the course, the student will have an overall average of ≥60% of the combined lecture and laboratory components of the course. This includes at least 3 to 4 major exams and chapter/weekly quizzes given at the discretion of the Instructor. In the laboratory the student will successfully complete the experiments with the accompanying reports. The student will demonstrate in the laboratory an understanding of the experiment through analysis of the data and being able to use this data to solve problems and predict the outcome of similar reactions and/or experiments.

These learning outcomes will include the student showing competence in the course objectives listed below. The course objectives are:

From Lecture:

A. Foundation Topics
   1. Apply the methods and understand the meaning of chemistry.
   2. Make use of scientific notation and determine the number of significant figures in a calculated answer.
   3. Demonstrate a knowledge of chemical symbols and formulas and balance chemical equations.
   4. Name and identify inorganic compounds including making a distinction between these two types:
      a. Ionic compounds
      b. Molecular compounds

B. Periodic Properties of the Elements
   1. Periodic trends in the physical properties of the elements.
   2. Periodic trends in the chemical properties of the elements.

C. The Mole Concept:
   1. Calculate the number of particles in a given number of moles of a substance.
   2. Determine the mass corresponding to a given number of moles of a substance.

D. The Structure of the Atom
   1. Distinguish the differences between the Bohr atom and the model derived from quantum mechanics.
   2. Describe the electron configurations of atoms.
   3. Correlate the physical and chemical properties of an atom and its electron configuration with its position in the periodic table.

E. Chemical Reactions and Stoichiometry
   1. Determine the theoretical yield from the masses of the reactants.
   2. Apply the concept of a limiting reactant.
   3. Calculate a percentage yield.

F. Heat Flows and Bond Energies
   1. Calculate and compare specific heats of substances.
   2. Calculate an approximate heat of reaction from the bond energies of the reactants and products.
   3. Correlate bond energy with bond order and bond length for cases involving the same two atoms.

G. Chemical Bonding
   1. Describe differences in ionic and covalent bonding and predict when each is likely to occur.
   2. Draw accurate Lewis structures for compounds.
   3. Correlate bond order with physical properties of structures.
   4. Predict when resonance occurs according to the Valence Bond Theory and describe its effects.
   5. Use differences in electronegativities to predict the degree and direction of polarity in a bond.
   6. Describe the formation of a coordinate covalent bond.
   7. Apply Molecular Orbital Theory to explain the uniqueness of the bonding in an oxygen molecule.

H. The Structure of Molecular Compounds
1. Predict the shape of a molecule by applying the principles of hte Valence Shell Electron Pair Repulsion (VSEPR) Theory.
2. Use the shape of the molecule as predicted by the Valence Shell Electron Pair Repulsion Theory to determine whether a molecule is polar or not.
3. Correlate the type of hybrid orbitals described in the Valence Bond Theory with the geometries of molecules deduced from the VSEPR Theory.
4. Describe the molecular structures of some common nonmetals.

I. Relationship of Chemical Reactions and the Periodic Table.
1. Balance reactions involving metals as reducing agents.
2. Use an activity series to predict which metal ion will be reduced by another metal.
3. Predict which halogen will oxidize another.
4. Describe trends in acid strength for binary acids or for oxoacids in a family or period.
5. Distinguish between Bronsted acids and bases and Lewis acids and bases.
6. Describe the formation of a complex ion from a central metal ion and its ligands.

J. The States of Matter--Gases
1. Characterize a gas according to its properties with reference to the Kinetic Molecular Theory.
2. Solve problems involving the expansion or contraction of an ideal gas.
3. Calculate the molecular weight of a volatile liquid that has been vaporized.
4. Solve problems involving reactions in which one or more gases is involved.
5. Describe how real gases differ from ideal gases.

K. The States of Matter--Liquids and Solids
1. Compare the properties of gases, liquids and solids.
2. Identify various intermolecular forces of attraction and correlate these with physical properties of various substances.
3. Use LeChatelier's Principle to explain physical equilibria such as ice melting.
4. Distinguish between the simple cubic, face-centered cubic and body-centered cubic unit cells.
5. Describe and distinguish between the basic types of crystals (molecular, ionic, covalent and metallic) and their properties.
6. Interpret a phase diagram for a pure substance.

L. Colloids and Colligative Properties
1. Differentiate colloids from suspensions and solutions.
2. Define mole fraction and use it in calculations.
3. Calculate the boiling point elevation and freezing point depression for a solution involving a nonvolatile solute.
4. Define osmosis and calculate osmotic pressure.

From Lab:

A. Safety Orientation
   1. Describe the actions to be taken in case a chemical comes in contact with skin, eyes or clothing.
   2. Understand what to do in case of electrical shock or a fire hazard in the laboratory.
   3. Practice safely disposing of dangerous chemicals.
   4. Locate and use the Material Safety Data Sheet (MSDS) files.

B. Laboratory Techniques
   1. Use a Bunsen burner in a safe and effective manner.
   2. Measure masses to 0.001 or 0.0001 gram, volumes to 0.1 or 0.2 mL, length to 0.1 mm. and temperature to 0. 20 Celsius.
   3. Measure densities of liquids and solids.
   4. Perform chemical reactions and interpret the results.
   5. Practice naming inorganic compounds including salts,, molecular compounds and acids.
   6. Determine the empirical formula of a compound by converting an element to one of its compounds.
   7. Identify a volatile liquid by determining its molar mass or observe the demonstration of this.
   8. Determine the molecular formula for a hydrate by converting such a compound to its anhydrous form.
   9. Determine the specific heat of a solid or observe a classroom demonstration of it.
   10. Perform the synthesis of a compound.
   11. Apply the VSEPR Theory to determine the geometry of molecules.
   12. Observe a demonstration on the properties of acids and bases.

Course Requirements

1. The student should do each of the following:
   a. Read the assigned chapters in the textbook and laboratory manual.
   b. Attend all lectures and laboratory classes.
   c. Take notes in class.
   d. Participate in class discussions.
   e. Complete assigned outside reading material and homework.
   f. View audiovisual materials on selected topics.
   g. Use the computer software in the lab and/or classroom as it is assigned.
   h. Complete the exams on the assigned dates; the exams may include essay questions.

2. For laboratory the student should:
   a. Read and comprehend each experiment assigned in the laboratory manual and complete the prelab assignment before going into the lab.
   b. Successfully complete each experiment.
   c. Learn to use and/or analyze data from instruments or equipment needed to complete the experiments. (e.g. balance,pH meters,volumetric glassware)
   d. Complete the laboratory reports, including post lab calculations and discussion questions.

3. The Instructor should consider assigning a library assignment on topics relating to the course. The assignment should require both written and oral reports by the student. This may or may not be used for additional credit.

Grading System

The following areas will be clearly outlined by the Instructor in the Course Information Sheet given to the students in the first week of the semester:

1. Major Exams: Three or four major exams covering the lecture material, evenly distributed throughout the semester.
2. Laboratory: May be included on major exams or the instructor may give quizzes covering lab material or a laboratory final exam. Represents 25% of the total grade for the class.
3. Minor Exams/Quizzes/Homework: Given at the discretion of the instructor.
4. Additional Reports or projects: Given at the discretion of the instructor.
5. Final Exam: Comprehensive exam covering the entire course; required of all instructors.

Outcomes Inventory

Chemistry 1411 will be evaluated through the following methods:

1. A pre and post test instrument is used to determine the extent of improvement the class has gained during the semester.

2. Each Intellectual Competency listed above will be evaluated to measure its attainment:
    a. To measure reading:
        1. Exam or quiz over assigned textbook readings AND/OR
        2. Lab assignment or exam or quiz over lab book readings AND/OR
        3. Written assignment or exam over assigned journal articles.
    b. To measure writing:
        1. Written assignment or term paper AND/OR
        2. Essay question on exam.
    c. To measure listening:
        1. Exam or quiz over lecture material AND/OR
        2. Quiz over video viewed.
    d. To measure critical thinking:
        1. Lab assignment or exam or quiz involving problem solving.
    e. To measure computer literacy:
        1. Quiz over Internet/CD-Rom/DVD activities.

3. Grades of students completing the course will be compared with those who complete Chemistry 1412 in the following semester.

Calendar

The instructor will ensure that the course content is covered in a manner that fulfills the course objectives. The instructor will also provide Course Information Sheets to the students and the administration during the first week of the semester. Important details including tentative examination dates and due dates for assignments are provided.

Possible timeline

Week	Lecture Topic
1	Course orientation, The Foundations of Chemistry
2	Chemical Formulas and Composition Stoichiometry
3	Composition Stoichiometry , Chemical Equations and Reaction Stoichiometry
4	Chemical Equations and Reaction Stoichiometry
5	Some Types of Chemical Reactions
6	The Structure of Atoms
7	Chemical Periodicity
8	Chemical Bonding, Molecular Structure
9	Covalent Bonding Theories, Molecular Orbitals in Chemical Bonding
10	Reactions in Aqueous Solutions I : Acids, Bases, and Salts
11	Reactions in Aqueous Solution II : Calculations
12	Gases and the Kinetic-Molecular Theory
13	Liquids and Solids
14	Solutions
15	Closure, Final Exam Preparation

Week	Laboratory Topic
1	Laboratory Safety, Orientation and Pretest
2	Extensive and intensive properties, measurements for mass and volume, density
3	Gravimetric determination, decomposition reaction
4	Determination of the formula weight of a compound, redox displacement reaction
5	Comparative reactivity of selected metals
6	Synthesis of a compound, sequential reactions, separation techniques
7	Molecular models
8.	More models,
9-10.	Acid base titrations
11.	Redox titrations
12.	Use of gas laws to measure moles of a gas product
13.	Determination of molecular weight by freezing point depression
14.	Closure

Required Materials

TEXT: General Chemistry , Whiten , Davis, and Peck, Saunders, 6th Ed. , 2000
LAB MANUAL: Standard and Microscale Experimants in General Chemistry , Bishop, Bishop and Whitten , 4th Edition, 2000
Scientific Calculator. Calculators with extended memories must be cleared prior to tests or may not be used.

Optional Materials:

Lecture Outline , Whitten and Hedges, Saunders , 6th Ed. , 2000 (recommended, a real time saver)
Student Solutions Manual, Tang and Kenney-Kennicut , Saunders, 6th Ed. , 1996
Study Guide, Davis, Saunders , 6th ed. , 2000

Addendum for Internet Courses

Course Requirements

1. The student should do each of the following:
    a. Have access to a computer with a reliable internet connection
    b. Effectively use the computer software and tools for the online classroom including navigating the web using an Internet browser such as Netscape or Internet Explorer.
    c. Download and upload files from the Internet and attach and save files associated with e-mail.
    d. Read the assigned chapters in the textbook and laboratory manual.
    e. Take notes on the assigned reading materials.
    f. Complete assigned reading material and homework.
    g. Complete and submit quizzes online.
    h. Complete major exams on the assigned dates at an Instructor approved proctored testing facility; exams may include essay questions and problems requiring that the formulas used for the calculations be shown.
    i. View audiovisual materials on selected topics
    j. Participate in online class discussions.
    k. Participate in optional online tutorial sessions.

2. For laboratory the student should:
    a. Read and comprehend exercises assigned from the laboratory manual or from files available in the online classroom.
    b. Successfully complete the prelaboratory questions for each laboratory experiment and submit using the online software by the assigned date.
    c. View audiovisual materials on selected topics.
    d. Be aware of the potential hazards associated with each laboratory.
    e. Know the online location and proper use of MSDS sheets associated with chemicals used in each experiment.
    f. View the online discussion of the proper techniques for use of laboratory equipment.
    g. View the online discussion of the theory and techniques involved in measurements, titration, filtration, and use of safety equipment.
    h. View audiovisual materials on the selected experiments.
    i. Understand the theory behind each experiment and learn the formulas needed for the require calculations.
    j. Attend scheduled Saturday labs.
    k. Learn the proper use of general laboratory equipment, including balances, pipets, burets, and Bunsen burners.

Materials Required

Lecture Materials:
General Chemistry, 6th Edition, Whitten, Davis and Peck, Harcourt, 2000 (required); *Study Guide and Solutions Manual*, 6th Edition, Whitten, Davis, and Peck, 2000 (not required)

Laboratory Materials:
Standard and Microscale Experiments in General Chemistry, 4th Edition, Bishop, Bishop, and Whitten, Harcourt, 2000 (required); safety goggles (required); a scientific calculator (required); and a laboratory apron (not required).