DATE OF LAST REVIEW: 02/2013
CIP CODE: 24.0101
SEMESTER: Departmental Syllabus
COURSE TITLE: College Chemistry I and Lab
COURSE NUMBER: CHEM-0111
CREDIT HOURS: 5
INSTRUCTOR: Departmental Syllabus
OFFICE LOCATION: Departmental Syllabus
OFFICE HOURS: Departmental Syllabus
TELEPHONE: Departmental Syllabus
EMAIL: Departmental Syllabus

KCKCC-issued email accounts are the official means for electronically communicating with our students.

PREREQUISITE: College Algebra, MATH-0105, or an ACCUPLACER score of 100 or better.

REQUIRED TEXT AND MATERIALS: Please check with the KCKCC bookstore, http://www.kckccbookstore.com for the required text for your particular class.

COURSE DESCRIPTION: Primarily for biological or physical science majors, College Chemistry I and Lab provides an introduction to the fundamental concepts of chemistry. The laboratory supports the concepts through practical application and develops scientific techniques.

METHOD OF INSTRUCTION: A variety of instructional methods may be used depending on content area. These include but are not limited to: lecture, multimedia, cooperative/collaborative learning, labs and demonstrations, projects and presentations, speeches, debates, and panels, conferencing, performances, and learning experiences outside the classroom. Methodology will be selected to best meet student needs.

CORE OUTCOMES MISSION STATEMENT: The Core Outcomes Project is an academic initiative of the Kansas Board of Regents that brings together faculty for the purpose of developing core outcomes and competencies for general education courses from the state’s universities, community colleges, and technical colleges. Common core outcomes and competencies contribute to the state’s system of higher education by creating a seamless pathway for students by improving articulation and transfer between state institutions, facilitating communication within disciplines among the state’s faculty, and communicating to the state’s secondary schools the expectations of college-level curriculum that could result in improvements in college preparedness of students.
CORE OUTCOMES SYLLABI: The learning outcomes and competencies detailed in this syllabus meet or exceed the learning outcomes and competencies specified by the Kansas Core Outcomes Project for this course, as sanctioned by the Kansas Board of Regents.

COURSE OUTLINE:
The course outline that follows is subject to change as course development may dictate. The interest of the different instructors and class members may change from semester to semester, but the following topics may be used as the core to develop the subject materials.

I. Explain the processes involved in the scientific method, and be able to apply it to investigate natural phenomena and solve problems.

II. Explain the design and significance of experiments that led to the adoption of modern atomic theory.

III. Recognize and interpret isotopic notation; understanding the relationship between average atomic masses and isotopic masses (example: calculating the average mass of an element given isotopic masses and natural abundance).

IV. Relate atomic mass to composition in terms of subatomic particles.

V. Descriptive chemistry of ionic and covalent compounds.
   A. Learn the names and symbols (or formulas) for often-used elements, simple and polyatomic ions, Arrhenius acids and bases, and simple ionic and covalent compounds.
   B. Describe and identify Arrhenius, Bronsted-Lowery, and Lewis acids and bases.
   C. Identify conjugate acids and bases.
   D. Determine the valence electron configuration of the s and p block elements and the 3d metals.
   E. Determine oxidation states and assign oxidation numbers of atoms in simple ions, and the central atoms of polyatomic ions and covalent compounds.
   F. Use the valence electron configuration to predict common oxidation numbers of group 1, 2, 13, 16, and 17 elements.
   G. Define periodic trends in electronegativity, ionization energy and electron affinity, and relate them to the electron configuration of the element.

VI. Solutions.
   A. Describe general properties of solutions.
   B. Understand the forces that affect the aqueous solubility of materials.
   C. Calculate the molar concentration of a solute.
   D. Describe procedures for preparing a solution of known molarity.

VII. Chemical reactions and stoichiometry.
   A. Classify chemical reactions and predict whether simple chemical reactions will proceed.
   B. Employ stoichiometric reasoning in evaluating reactions of gases, liquids and solids.
   C. Perform calculations that employ relationships involving masses, formula units, and the mole relationships.
   D. Determine empirical and molecular formula from appropriate data.
   E. Demonstrate the ability to balance chemical equations.
   F. Discuss solubility rules
   G. Write net ionic equations based on solubility rules.
   H. Balance simple acid base reactions
   I. Define oxidation and reduction.
   J. Balance simple redox reactions and determine the identity of the oxidizing and reduction agents.
K. Determine limiting reagents from stoichiometric data; calculate the maximum product yield, and leftover reagent.
L. Calculate theoretical yield from stoichiometric data.

VIII. Properties of solids, liquids, and gases
A. Describe the origins and relative magnitudes of intermolecular forces.
B. Relate phase behavior to nature of intermolecular forces.
C. Compare general properties of solids, liquids and gases; including density, compressibility, heat capacity, and randomness intermolecular forces.
D. Describe phase transitions and phase diagrams (e.g. triple point and critical point).
E. Understand general properties of gases.
   a. Describe properties and temperatures of gases to kinetic molecular theory.
   b. Understand and employ ideal gas laws.
F. Understand general properties of liquids.
G. Understand general properties of solids.
   a. Compare and contrast properties of ionic, molecular and metallic solids.

IX. Describe, define, and perform calculations involving the following basic concepts of thermodynamics:
A. Heat capacity.
B. Calorimetry.
C. Heat/Work/Energy.
D. Enthalpy/Standard states.
E. Hess’s Law.
F. Heat of formation.
G. Phase changes/Energy.
H. Use of other thermodynamic cycles in the determination of thermodynamic quantities, such as the lattice energy of an ionic solid.

X. Conceptually and quantitatively relate spectroscopic observation of atoms to quantum mechanical theories.
A. Describe the historical development of and distinction between classical and wave mechanics.
B. Describe the radial and angular dependence of solutions to the Schroedinger equation for hydrogen-like atoms (s, p, d orbitals).
C. Describe the behavior of photons and electrons during electronic transitions between principle quantum levels and calculate the wavelength and frequency of light involved in these transitions.
D. Using the Aufbau principle, write the electron configuration of many electron atoms and monatomic ions.
E. Relate quantum mechanical theory to the organization of the periodic table and the periodic properties of elements.

XI. Molecular Bonding and Structure.
A. Describe the characteristics of ionic and covalent bonding.
B. Draw Lewis dot structures for atoms, simple ionic and molecular compounds.
C. Predict the shape of simple molecules and ions using VSEPR theory.
D. Explain how electronegativity differences relate to bond polarity.
E. Identify polar and non-polar molecules.
F. Understand valence bond descriptions of molecular structure and bonding.
G. Understand hybridization, including \( sp^3 \), \( sp^2 \) and \( sp \) hybridization.
H. Predict hybridization from VSEPR structures.
I. Determine bond orders and relate them to relative bond strength.
J. Describe the MO theory description of bonding and antibonding orbitals.
K. Relate MO theory to concepts such as the structural, energetic, spectroscopic, and magnetic properties of molecules.
LABORATORY PORTION OF THE CHEMISTRY I COURSE

Upon successful completion of this course the student will be able to:

I. Work in the laboratory in accordance with good laboratory practices
   A. Dress in an appropriate manner as to promote safety in the laboratory, wearing appropriate laboratory attire and goggles when anyone is working with chemicals in the laboratory.
   B. Follow written directions accurately.
   C. Work safely and effectively, using equipment and chemical carefully and correctly.
   D. Demonstrate use of required techniques.
   E. Dispose of waste products in a proper manner.
   F. Know how to find and understand MSDS’s for the chemicals used in a particular laboratory.

II. Gather and record qualitative and quantitative data accurately
   A. Acquire data using balances and volumetric glassware.
   B. Make and record visual observations.
   C. Use computers, when appropriate, as data acquisition tools.
   D. List or describe experimental assumptions made and any deviations from the written experimental procedures.

III. Handle and evaluate data in logical, productive, and meaningful ways
   A. Create notebooks and laboratory reports that are clear, understandable, and accurately represent the data collected.
   B. Display computer data in a spreadsheet or graphically, as appropriate.
   C. Correlate observations with chemical or physical processes.
   D. Carry out suitable calculations with quantitative data, recognizing when data and calculations are within a reasonable range.
   E. Use observations of experimental data to present relevant conclusions pertaining to the experimental procedure.

IV. Correlate laboratory work with principle topics in Chemistry I lecture.

EXPECTED LEARNER OUTCOMES:

Upon successful completion of college Chemistry I students will be able to:

A. The learner will be able develop an understanding of the application of mathematics to chemical measurements.
B. The learner will be able explain the modern atomic theory and its relation to our understanding of the periodic table.
C. The learner will be able to develop and understanding of ionic and covalent bonding and the effects on chemical and physical properties.
D. The learner will be able develop an understanding descriptive chemistry.
E. The learner will be able develop an understanding of reaction stoichiometry making relationships to a balanced equation.
F. The learner will be able develop an understanding of the states of matter and their interconversions.
G. The learner will be able to work in the laboratory in accordance with good laboratory practices.
COURSE COMPETENCIES:

The learner will be able develop an understanding of the application of mathematics to chemical measurements.

1. The student will be able to describe general properties of solutions and the procedures for preparing a solution of known molarity.
2. The student will be able to understand the forces that affect the aqueous solubility of materials, calculate the molar concentration of a solute.
3. The student will be able to handle and evaluate data in logical, productive, and meaningful ways.
4. The student will be able to create notebooks and laboratory reports that are clear, understandable, and accurately represent the data collected and display computer data in a spreadsheet or graphically, as appropriate.
5. The student will be able to carry out suitable calculations with quantitative data, recognizing when data and calculations are within a reasonable range.

The learner will be able explain the modern atomic theory and its relation to our understanding of the periodic table.

6. The student will be able to explain the design and significance of experiments that led to the adoption of modern atomic theory.
7. The student will be able to relate atomic mass to composition in terms of subatomic particles. Recognize and interpret isotopic notation; understanding the relationship between average atomic masses and isotopic masses (example: calculating the average mass of an element given isotopic masses and natural abundance).
8. The student will be able to learn the names and symbols (or formulas) for often-used elements, simple and polyatomic ions, Arrhenius acids and bases, and simple ionic and covalent compounds.
9. The student will be able to determine the valence electron configuration of the s and p block elements and the 3d metals.
10. The student will be able to determine oxidation states and assign oxidation numbers of atoms in simple ions, and the central atoms of polyatomic ions and covalent compounds.
11. The student will be able to use the valence electron configuration to predict common oxidation numbers of group 1, 2, 13, 16, and 17 elements.
12. The student will be able to define periodic trends in electronegativity, ionization energy and electron affinity, and relate them to the electron configuration of the element.
13. The student will be able to conceptually and quantitatively relate spectroscopic observation of atoms to quantum mechanical theories.
14. The student will be able to describe the historical development of and distinction between classical and wave mechanics.
15. The student will be able to describe the radial and angular dependence of solutions to the Schroedinger equation for hydrogen-like atoms (s, p, d orbitals) and describe the behavior of photons and electrons during electronic transitions between principle quantum levels and calculate the wavelength and frequency of light involved in these transitions.
16. The student will be able to use the Aufbau principle, write the electron configuration of many electron atoms and monatomic ions.
17. The student will be able to relate quantum mechanical theory to the organization of the periodic table and the periodic properties of elements.

The learner will be able to develop and understanding of ionic and covalent bonding and the effects on chemical and physical properties.

18. The student will be able to describe the characteristics of ionic and covalent bonding.
19. The student will be able to draw Lewis dot structures for atoms, simple ionic and molecular compounds and predict the shape of simple molecules and ions using VSEPR theory.
20. The student will be able to explain how electronegativity differences relate to bond polarity and identify polar and non-polar molecules.

21. The student will be able to understand valence bond descriptions of molecular structure and bonding.

22. The student will be able to understand hybridization, including $sp^3$, $sp^2$, and $sp$ hybridization and predict hybridization from VSEPR structures.

23. The student will be able to determine bond orders and relate them to relative bond strength describe the MO theory description of bonding and antibonding orbitals.

_The learner will be able develop an understanding descriptive chemistry._

24. The student will be able to describe and identify Arrhenius, Bronsted-Lowery, and Lewis acids and bases.

25. The student will be able to identify conjugate acids and bases.

26. The student will be able to classify chemical reactions and predict whether simple chemical reactions will proceed.

27. The student will be able to discuss solubility rules and write net ionic equations based on solubility rules.

28. The student will be able to define oxidation and reduction, balance simple redox reactions and determine the identity of the oxidizing and reduction agents.

_The learner will be able develop an understanding of reaction stoichiometry making relationships to a balanced equation._

29. The student will be able to employ stoichiometric reasoning in evaluating reactions of gases, liquids and solids and perform calculations that employ relationships involving masses, formula units, and the mole relationships.

30. The student will be able to determine empirical and molecular formula from appropriate data.

31. The student will be able to demonstrate the ability to balance chemical equations.

32. The student will be able to determine limiting reagents from stoichiometric data; calculate the maximum product yield, and leftover reagent and calculate theoretical yield from stoichiometric data.

_The learner will be able develop an understanding of the states of matter and their interconversions._

33. The student will be able to understand the properties of solids, liquids, and gases and relate these properties to phase transitions and phase diagrams (e.g. triple point and critical point).

34. The student will be able to describe the origins and relative magnitudes of intermolecular forces and relate phase behavior to nature of intermolecular forces.

35. The student will be able to describe properties and temperatures of gasses to kinetic molecular theory and employ ideal gas laws.

36. The student will be able to compare and contrast properties of ionic, molecular and metallic solids.

37. The student will be able to describe, define, and perform calculations involving the following basic concepts of thermodynamics: Heat capacity, Calorimetry, Heat/Work/Energy, Enthalpy/Standard states, Hess’s Law, Heat of formation, Phase changes/Energy.

_The learner will be able work in the laboratory in accordance with good laboratory practices._

38. The student will be able to dress in an appropriate manner as to promote safety in the laboratory, wearing appropriate laboratory attire and goggles when anyone is working with chemicals in the laboratory.

39. The student will be able to follow written directions accurately.

40. The student will be able to work safely and effectively, using equipment and chemical carefully and correctly.

41. The student will be able to know how to find and understand MSDS’s for the chemicals used in a particular laboratory

42. The student will be able to gather and record qualitative and quantitative data accurately including: using balances and volumetric glassware; recording visual observations; use computers, when appropriate, as data acquisition tools.

43. The student will be able to list or describe experimental assumptions made and any deviations from the written experimental procedures.
44. The student will be able to use observations of experimental data to present relevant conclusions pertaining to the experimental procedure.
45. The student will be able to correlate observations with chemical or physical processes.
46. The student will be able to carry out suitable calculations with quantitative data, recognizing when data and calculations are within a reasonable range.
47. The student will be able to use observations of experimental data to present relevant conclusions pertaining to the experimental procedure.
48. The student will be able to correlate laboratory work with principle topics in Chemistry I lecture.

ASSESSMENT OF LEARNER OUTCOMES:
Student assessment is evaluated by means of classroom participation, exams, quizzes, homework, laboratory reports, and a comprehensive final.

SPECIAL NOTES:
A. The student is expected to attend class regularly.
B. If the student is not present when an exam or quiz is given, the quiz or exam can only be made up at the discretion of the instructor.
C. The student may be dropped from the class for non attendance.
D. The student is expected to complete all assigned laboratory experiments.

SPECIAL NOTES:
This syllabus is subject to change at the discretion of the instructor. Material included is intended to provide an outline of the course and rules that the instructor will adhere to in evaluating the student’s progress. However, this syllabus is not intended to be a legal contract. Questions regarding the syllabus are welcome any time.

Kansas City Kansas Community College is committed to an appreciation of diversity with respect for the differences among the diverse groups comprising our students, faculty, and staff that is free of bigotry and discrimination.
Kansas City Kansas Community College is committed to providing a multicultural education and environment that reflects and respects diversity and that seeks to increase understanding.

Kansas City Kansas Community College offers equal educational opportunity to all students as well as serving as an equal opportunity employer for all personnel. Various laws, including Title IX of the Educational Amendments of 1972, require the college’s policy on non-discrimination be administered without regard to race, color, age, sex, religion, national origin, physical handicap, or veteran status and that such policy be made known.

Kansas City Kansas Community College complies with the Americans with Disabilities Act. If you need accommodations due to a documented disability, please contact the Director of the Academic Resource Center, in Rm. 3354 or call at: 288-7670.