ILLINOIS VALLEY COMMUNITY COLLEGE

COURSE OUTLINE

DIVISION: Natural Sciences Business

COURSE: General Chemistry I (Chm 1006)

Date: revised 9/26/13 for Fall, 2013

Credit Hours: 5.0

Prerequisite(s): Chm 1004 or one year of high school chemistry, 1.5 units of high school algebra.

Delivery Method:		
	☒ **Lecture**	**3 Contact Hours (1 contact = 1 credit hour)**
	☒ **Seminar**	**1 Contact Hours (1 contact = 1 credit hour)**
	☒ **Lab**	**2 Contact Hours (2 contact = 1 credit hour)**
	☐ **Clinical**	**0 Contact Hours (3 contact = 1 credit hour)**
	☐ **Online**	
	☐ **Blended**	

Offered: ☒ **Fall** ☒ **Spring** ☐ **Summer**

IAI Equivalent –***Only for Transfer Courses***-go to *http://www.itransfer.org*: P1902

CATALOG DESCRIPTION:

This course covers the general principles of chemistry including atomic theory, bonding and molecular geometry, stoichiometry, the states of matter, thermodynamics, atomic structure, and solution chemistry. Laboratory emphasizes quantitative work. The course is recommended for students with a year of high school chemistry and at least one and one-half units of algebra.

Course Description:

Topics include the periodic table of the elements, atomic structure, basic concepts of quantum theory, chemical bonding, stoichiometry, thermochemistry, the properties and chemistry of gases, liquids and solids, aqueous solution chemistry, acid and bases, physical equilibrium processes. Laboratory and Seminar are required.

GENERAL EDUCATION GOALS ADDRESSED

[See the last page of this form for more information.]

Upon completion of the course, the student will be able:

[Choose those goals that apply to this course.]

☒ To apply analytical and problem solving skills to personal, social and professional issues and situations.
☐ To communicate orally and in writing, socially and interpersonally.
☐ To develop an awareness of the contributions made to civilization by the diverse cultures of the world.
☒ To understand and use contemporary technology effectively and to understand its impact on the individual and society.
☒ To work and study effectively both individually and in collaboration with others.
☒ To understand what it means to act ethically and responsibly as an individual in one's career and as a member of society.
☐ To develop and maintain a healthy lifestyle physically, mentally, and spiritually.
☐ To appreciate the ongoing values of learning, self-improvement, and career planning.

EXPECTED LEARNING OUTCOMES AND RELATED COMPETENCIES:

Outcome 1 - Students will be able to perform mathematical calculations to utilize, interpret and present chemical data appropriate to college chemistry.

Competency 1.1 - Students will be able to use the metric system, convert English to metric and vice versa.

Competency 1.2 - Students will be able to use scientific notation in expressing numbers and in calculations

Competency 1.3 – Students will be able to report measurements and result of calculations to the proper number of significant digits.

Competency 1.4 - Students will be able to distinguish between precision and accuracy, express precision of results and determine % error.

Competency 1.5 - Students will be able to graph data and interpret graphs.

Competency 1.6 - Students will be able to use the factor-label method of problem solving.

Outcome 2 - Students will be able to demonstrate an understanding of the general concepts and vocabulary of chemistry.

Competency 2.1 - Students will be able to distinguish between a scientific hypothesis, a scientific theory, and a scientific law.

Competency 2.2 - Students will be able to use the general outline of the classification of matter and the terminology involved to characterize a sample of matter that is described to you.

Competency 2.3 - Students will be able to correctly use the terminology: atom, molecule, symbol, isotope, allotrope, formula, equation, compound, element, and physical, chemical, and nuclear change.

Competency 2.4 - Students will be able to balance chemical equations.

Competency 2.5 - Students will be able to perform calculations involving density and specific gravity.

Competency 2.6 - Students will be able to define molar mass, atomic mass, mass number, Avogadro's number, and mole.

Competency 2.7 - Students will be able to convert between mass, moles and number of atoms or molecules.

Competency 2.8 - Students will be able to calculate the empirical formula and molecular formula given the per cent composition and the molar mass.

Competency 2.9 - Students will be able to perform calculations involving chemical equations.

Competency 2.10 -Students will be able to describe the historical development of the model of the nuclear atom.

Competency 2.11 -Students will be able to name binary compounds and compounds with common polyatomic ions (the list given must be memorized) and write their formulas given the names.

Outcome 3 - Students will be able to demonstrate an understanding of the concepts of thermochemistry.

Competency 3.1 **-** Students will be able to define work, energy, heat, temperature, units of energy, types of energy, enthalpy, endothermic, exothermic, state function and know the sign conventions.

Competency 3.2 -Students will be able to calculate the enthalpy of a reaction given either heats of formation or bond energies.

Competency 3.3 -Students will be able to calculate heat capacity and specific heat as well as use those values in calorimetry calculations.

Competency 3.4 -Students will be able to calculate the heat of a reaction using Hess's law.

Outcome 4 - Students will be able to demonstrate an understanding of atomic theory and periodicity.

Competency 4.1 - Students will be able to describe the difference between the Bohr model and the modern model (quantum mechanical model) of the atom.

Competency 4.2 - Students will be able to write the ground-state electron configuration for any element or ion.

Competency 4.3 - Students will be able to calculate wavelength, frequency, and energy given one of these parameters and relate these terms to atomic spectra.

Competency 4.4 - Students will be able to sketch s, p, and d orbitals.

Competency 4.5 - Students will be able to name and explain the relationship of each of the four quantum numbers to the properties of electrons in orbitals.

Competency 4.6 - Students will be able to utilize Hund's rule and draw orbital diagrams.

Competency 4.7 - Students will be able to use the periodic table to predict and explain trends in atomic radius, ionic radius, ionization energy, electron affinity, metallic character, and electronegativity.

Competency 4.8 - Students will be able to use the terms isoelectronic, Heisenberg's uncertainty principle, and Pauli's exclusion principle.

Outcome 5 - Students will be able to demonstrate an understanding of chemical bonding.

Competency 5.1 - Students will be able to predict the type of bonding that takes place between two elements based on electronegativity difference and/or on the relative positions of the elements in the periodic table.

Competency 5.2 - Students will be able to explain what is meant by ionic bonds, polar covalent bonds, and nonpolar covalent bonds.

Competency 5.3 - Students will be able to predict the geometry, the bond angles, and the polarity of molecules or polyatomic ions using VSEPR.

Competency 5.4- Students will be able to predict the hybridization of atomic orbitals to account for the molecules geometry.

Competency 5.5 -Students will be able to account for the structure of a molecule in terms of hybrid orbitals and $\sigma-$ and $\pi-$ bonds.

Competency 5.5 –Students will be introduced to molecular orbital theory and be expected to draw the molecular orbital energy level diagram for simple diatomic systems to predict if the molecule is stable.

Outcome 6 - Students will be able to demonstrate an understanding of the states of matter.

Competency 6.1 - Students will be able to state the postulates of the Kinetic Molecular Theory of gases and use it to explain the behavior of ideal gases and the relationship of kinetic energy to temperature.

Competency 6.2 - Students will be able to explain how real gases differ from ideal gases.

Competency 6.3 - Students will be able to state Dalton's law, Graham's law, Charles' law, Boyle's law, Avogadro's law, and Gay-Luussac's law.

Competency 6.4 - Students will be able to use the ideal gas law to calculate molar volume, density, mass, pressure, temperature and volume.

Competency 6.5 - Students will be able to calculate the mass, moles or volume of gases in a chemical reaction at nonstandard conditions.

Competency 6.6 - Students will be able to use Graham's law to account for relative rates of effusion.

Competency 6.7 - Students will be able to explain how the enthalpy of vaporization and the boiling point of a compound are related to the strength of its intermolecular forces.

Competency 6.8 - Students will be able to explain how dispersion forces arise and how they vary with the polarizability of an atom and the size and shape of a molecule.

Competency 6.9 - Students will be able to describe hydrogen bonds and explain why they are stronger than other kinds of intermolecular forces.

Competency 6.10 -Students will be able to distinguish between intermolecular forces and intramolecular forces as related to molecules, atoms, or ions.

Competency 6.11 -Students will be able to distinguish metals, ionic solids, network solids, and molecular solids by their structures and by their properties.

Competency 6.12 -Students will be able to sketch, label and interpret a phase diagram.

Competency 6.13 -Students will be able to distinguish between: face-centered and body-centered cubic structures, crystalline and amorphous solids.

Competency 6.14 -Students will be able to interpret the cooling curve for a substance.

Outcome 7 - Students will be able to safely and correctly perform laboratory techniques and procedures.

Competency 7.1 - Students will be able to use proper techniques when measuring volumes and masses, absorption with a spectrophotometer or the atomic absorption etc.

Competency 7.2 - Students will be able to use proper recording and reporting techniques for data such as always recording information directly into the laboratory notebook.

Competency 7.3 - Students will be able to draw and interpret graphs from lab data.

Competency 7.4 - Students will be able to draw conclusions from experimental evidence.

Competency 7.5 - Students will be able to develop safe work habits in the laboratory.

COURSE TOPICS AND CONTENT REQUIREMENTS:

Lecture Schedule (50 min ea)	Topics Covered
Day 1	Course Syllabus
Day 2	1. Matter and Measurement • Classifications of Matter • Properties of Matter • Types of Changes • Scientific Method
Day 3	• Units of Measurement • Dimensional Analysis
Day 4	• Uncertainty in Measurement • Significant Figures
Day 5	2. Atoms, Molecules, Ions, Compounds • The Atomic Theory of Matter • Law of Conservation of Mass • Law of Constant Composition
Day 6	• The Discovery of Atomic Structure • The Modern View of Atomic Structure
Day 7	• Atomic Weights • The Periodic Table
Day 8	• Nomenclature • Molecules and Molecular Compounds • Naming Inorganic Compounds
Day 9	• Formulas o Ions and Ionic Compounds o Molecular Compounds
Day 10	3. Stoichiometry

	• Chemical Equations • Formula Weights
Day 11	Exam 1
Day 12	• Avogadro's Number and the Mole
Day 13	• Empirical Formulas
Day 14	• Stoichiometry
Day 15	• Limiting Reactants
Day 16	4. Reaction Types and Solution Stoichiometry • Aqueous Solutions • Precipitation Reactions
Day 17	• Acids, Bases, and Neutralization Reactions
Day 18	• Concentrations of Solutions
Day 19	• Solution Stoichiometry and Chemical Analysis
Day 20	5. Thermochemistry • Nature of Energy • The First Law of Thermodynamics
Day 21	• Enthalpy • Enthalpies of Reaction
Day 22	• Calorimetry • Hess's Law
Day 23	• Enthalpies of Formation
Day 24	Exam 2
Day 25	6. Electronic Structure of the Atom • The Wave Nature of Light • Quantized Energy and Photons • Line Spectra and the Bohr Mode
Day 26	• The Wave Behavior of Matter • Quantum Mechanics and Atomic Orbitals • Representations of Orbitals
Day 27	• Many-Electron Atoms • Electron Configurations
Day 28	7. Periodic Properties of the Elements • Development of the Periodic Table • Effective Nuclear Charge • Sizes of Atoms and Ions
Day 29	• Ionization Energy • Electron Affinities • Electronegativity
Day 30	8. Chemical Bonding • Lewis Symbols and the Octet Rule • Ionic Bonding and Covalent Bonding • Bond Polarity
Day 31	• Drawing Lewis Structures • Resonance Structures • Exceptions to the Octet Rule
Day 32	9. Molecular Geometry and Bond Theories

	• Molecular Shapes • The VSEPR Model
Day 33	• Molecular Shape and Molecular Polarity • Hybrid Orbitals • Multiple Bonds
Day 34	• Molecular Orbitals
Day 35	Exam 3
Day 36	10. Gases • Characteristics of Gases and Pressure • The Gas Laws • The Ideal-Gas Equation • Gas Mixtures and Partial Pressures
Day 37	• The Kinetic-Molecular Theory of Gases • Molecular Effusion and Diffusion • Real Gases: Deviations from Ideal Behavior
Day 38	11. Liquids, Intermolecular Forces, Colligative Properties • Intermolecular Forces
Day 39	• Select Properties of Liquids
Day 40	• Phase Diagrams • The Solution Process •
Day 41	• Saturated Solutions and Solubility • Factors Affecting Solubility
Day 42	• Solution Concentration Calculations
Day 43	• Colligative Properties
Day 44	Exam 4

INSTRUCTIONAL METHODS:

A. Lecture
B. Lecture demonstrations
C. Youtube videos (animations of chemical processes, chemical demonstrations)
D. Laboratory experiments
E. Laboratory reports
F. Online Homework and Quizzing system
G. Examinations
H. Peer tutoring

INSTRUCTIONAL MATERIALS:

A. Textbook: Chemistry: The Central Science, 12 ed. Brown, Lemay, Bursten
B. Laboratory manual: In house
C. Online Ebook, homework and quizzing.
D. Worksheets

STUDENT REQUIREMENTS AND METHODS OF EVALUATION:

A. Regular attendance in lecture, seminar and laboratory
B. Reading assignments
C. Quizzes
D. Online homework assignments
E. Examinations
F. Participation in classroom discussions
G. Performance of laboratory experiments

Final course grade is determined as a weighted average:
Exams (4) are 70% of the final points, 20% Laboratory (12), 10% homework and quizzes.

Grading Scale	
Percent	Grade
90-100	A
80-89	B
70-79	C
60-69	D
< 60%	F

Laboratory Requirements

Students are expected to complete all laboratory assignments. Missing one experiment will result in the final course grade being lowered by one full grade letter. Missing two experiments will result in an "F" for the final course grade. Students are expected to attend seminars during which the laboratory procedure will be discussed. Students will then complete the laboratory assignment following the prelab discussion.

OTHER REFERENCES

A. Chemistry and Chemical Reactivity, Kotz 2005
B. Handbook of Laboratory Safety, Steere
C. Handbook of Chemistry and Physics
D. Chemistry, Chang 2009
E. www.acs.org
F. Journal of Chemical Education
G. Chemical and Engineering News

Course Competency/Assessment Methods Matrix

Course Prefix, Number and Name	Assessment Options																																
For each competency/outcome place an "X" below the method of assessment to be used.	**Assessment of Student Learning**	Article Review	Case Studies	Group Projects	Lab Work	Oral Presentations	Pre-Post Tests	Quizzes	Written Exams	Artifact Self Reflection of Growth	Capstone Projects	Comprehensive Written Exit Exam	Course Embedded Questions	Multi-Media Projects	Observation	Writing Samples	Portfolio Evaluation	Real World Projects	Reflective Journals	Applied Application (skills) Test	Oral Exit Interviews	Accreditation Reviews/Reports	Advisory Council Feedback	Employer Surveys	Graduate Surveys	Internship/Practicum /Site Supervisor Evaluation	Licensing Exam	In Class Feedback	Simulation	Interview	Written Report	Assignment
Assessment Measures – Are direct or indirect as indicated. List competencies/outcomes below.	**Direct/ Indirect**	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	I	I	I	I	D	D							
Outcome 1 - Students will be able to perform mathematical calculations to utilize, interpret and present chemical data appropriate to college chemistry.					X			X	X																		X					
Outcome 2 - Students will be able to demonstrate an understanding of the general concepts and vocabulary of chemistry.					X			X	X																		X					
Outcome 3 - Students will be able to demonstrate an understanding of the concepts of thermochemistry.					X			X	X																		X					
Outcome 4 - Students will be able to demonstrate an understanding of atomic theory and periodicity.					X			X	X																		X					
Outcome 5 - Students will be able to demonstrate an understanding of chemical bonding.					X			X	X																		X					
Outcome 6 - Students will be able to demonstrate an understanding of the states of matter.					X			X	X																		X					

Outcome 7- Students will be able to safely and correctly perform laboratory techniques and procedures.					X																						X					