UNIVERSITY OF THE FRASER VALLEY

OFFICIAL COURSE OUTLINE (page 1)

COURSE IMPLEMENTATION DATE: September 2003
COURSE REVISED IMPLEMENTATION DATE: September 2013
COURSE TO BE REVIEWED: January 2015
(six years after UEC approval) *(month, year)*

OFFICIAL COURSE OUTLINE INFORMATION

Students are advised to keep course outlines in personal files for future use.
Shaded headings are subject to change at the discretion of the department – see course syllabus available from instructor

CHEM 110	Chemistry	4
COURSE NAME/NUMBER	FACULTY/DEPARTMENT	UFV CREDITS

Introductory Chemistry
COURSE DESCRIPTIVE TITLE

CALENDAR DESCRIPTION:

This course covers the principles of chemical kinetics and thermodynamics, redox processes, electrochemistry, and chemistry of solutions, including solubility and acid-base equilibria. It can be used as a prerequisite for CHEM 113 by students without Chemistry 12.

PREREQUISITES: Chemistry 11 or CHEM 083, and one of the following: Foundations of Mathematics 11, Pre-calculus 11, Principles of Mathematics 11, or MATH 085.
COREQUISITES:
PRE or COREQUISITES:

SYNONYMOUS COURSE(S):
(a) Replaces:
(b) Cross-listed with:
(c) Cannot take: for further credit.

SERVICE COURSE TO: *(department/program)*

TOTAL HOURS PER TERM: **84**

STRUCTURE OF HOURS:

Lectures:	**45**	Hrs
Seminar:		Hrs
Laboratory:	39	Hrs
Field experience:		Hrs
Student directed learning:		Hrs
Other (specify):		Hrs

TRAINING DAY-BASED INSTRUCTION:
Length of course:
Hours per day:

OTHER:
Maximum enrolment: **36**
Expected frequency of course offerings: every semester
(every semester, annually, every other year, etc.)

WILL TRANSFER CREDIT BE REQUESTED? (lower-level courses only)	☒ Yes	☐ No
WILL TRANSFER CREDIT BE REQUESTED? (upper-level requested by department)	☐ Yes	☐ No
TRANSFER CREDIT EXISTS IN BCCAT TRANSFER GUIDE:	☒ Yes	☐ No

Course designer(s): **Noham Weinberg**

Department Head:	**David Fenske**	Date approved:	**April 13, 2012**
Supporting area consultation ((Pre-UEC)		Date of meeting:	**April 27, 2012**
Curriculum Committee chair:	**David Fenske**	Date approved:	**May 18, 2012**
Dean/Associate VP:	**Ora Steyn**	Date approved:	**June 1, 2012**
Undergraduate Education Committee (UEC) approval		Date of meeting:	**June 22, 2012**

LEARNING OUTCOMES:

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

1. Describe the properties of solutions.
2. Apply the concepts of chemical equilibrium to problems involving solutions and gases.
3. Use Bronsted-Lowry theory to describe the properties of acids and bases.
    3.1 Discuss clearly the difference between strong and weak acids and bases.
    3.2 Explain the purpose of the pH scale and use it to classify weak acids and bases.
4. Use concepts of chemical kinetics to describe the rate law of a reaction.
    4.1 Discuss critically the difference between a first-order and second-order rate chemical reaction.
    4.2 Explain the effect of temperature on the rate of a chemical reaction.
    4.3 Draw an energy profile for a multistep reaction and identify the rate-limiting step.
5. Explain how energy, enthalpy, and entropy are related.
    5.1 Predict whether a reaction is spontaneous or non-spontaneous based on its free energy change.
6. Describe a galvanic cell and the half-reactions that are occurring.
7. Discuss critically the meaning of the standard reduction potential.
8. Use electrochemical concepts to describe batteries, corrosion, and electrolysis.
9. Perform basic laboratory operations.
10. Demonstrate the practice of laboratory safety.

METHODS: *(Guest lecturers, presentations, online instruction, field trips, etc.)*

Lectures, labs, group problem-solving sessions.

METHODS OF OBTAINING PRIOR LEARNING ASSESSMENT RECOGNITION (PLAR):

☐ Examination(s) ☐ Portfolio assessment ☐ Interview(s)

☒ Other (specify): Theoretical and laboratory exams

☐ PLAR cannot be awarded for this course for the following reason(s):

TEXTBOOKS, REFERENCES, MATERIALS: *[Textbook selection varies by instructor. Examples for this course might be:]*

Ebbing et al., Essentials of General Chemistry (latest edition)

UFV Lab manual for CHEM 110

SUPPLIES/MATERIALS

STUDENT EVALUATION: *[An example of student evaluation for this course might be:]*

Labs	20%
Assignments and tests including:	80%
Final exam	40-50%
Midterm exam(s)	20-30%
Assignments	0-10%

COURSE CONTENT: *[Course content varies by instructor. An example of course content might be:]*

Solutions
Concentration. Dilution. Electrolytes and Nonelectrolytes.
Arrhenius theory of electrolytic dissociation. Ionic equations. Solution stoichiometry.

Gases
Units of pressure. Ideal gas equation. Dalton's Law of partial pressures. Basic principles of Kinetic Molecular Theory of Gases.

Chemical kinetics
Rate of reaction. Rate laws. Rate constant. First- and second-order reactions. Principles of collision theory. Temperature dependence of the rate constant. Activation energy. Arrhenius equation. Multistep processes. Energy profiles for multistep processes. Intermediates. Rate-limiting step.
Catalysis. Energy profiles for catalyzed and uncatalyzed reactions.

Course content continued:

Chemical equilibria
Reversible reactions. Chemical equilibrium. Equilibrium constant. Reaction quotient. Calculation of equilibrium concentrations.
Factors that affect chemical equilibrium. Le Châtelier's Principle.

Solubility
Molecular view of solution process. Enthalpy and entropy of dissolution. Solubility equilibrium. Solubility.
Effect of temperature on solubility of solids and gases. Effect of pressure on solubility of gases.
Solubility product. Solubility calculations. Common ion effect.

Acids and Bases
Brønsted-Lowry theory. Conjugate acid-base pairs. Acid-base properties of water. The ion product of water. pH, pOH, and pK_w. Strong and weak acids and bases. Ionization constants K_a and K_b. Relationship between K_a and K_b. Acid-base titration. Acid-base properties of salts. Hydrolysis (qualitatively).

Thermodynamics
Energy changes in chemical reactions. Exothermic and endothermic reactions.
Hess' Law. Thermochemical calculations.
Energy and enthalpy. Enthalpy changes in chemical reaction. Standard enthalpy of formation and reaction.
Concept of Entropy. Gibbs free energy. Spontaneous and nonspontaneous processes.

Redox reactions and electrochemistry
Oxidation number. Oxidation. Reduction. Half-reactions. Balancing redox reactions (half-reaction method; acidic and basic solutions). Galvanic cells. Standard reduction potential. Spontaneity of redox processes.
Batteries. Corrosion. Electrolysis (aqueous solutions, molten salts, active and inactive electrodes). Quantitative aspects of electrolysis.

Laboratory experiments will illustrate theoretical material and may include the following experiments:
Experiment 1: Preparation of Solutions
Experiment 2: Spectrophotometric Study of an Unknown Copper Compound
Experiment 3: Thermochemistry: Heats of Reaction
Experiment 4: Chemical Equilibrium: Equilibrium Investigations and Le Châtelier's Principle
Experiment 5: Equilibrium: The Determination OF Ksp Values for Calcium iodate
Experiment 6: Acids, Bases and Buffered Systems
Experiment 7: Potentiometric Titrations: Analysis of a Wine-Vinegar Sample and of Ammonia Solution
Experiment 8: Oxidation-Reduction Titrations - Determination of the Empirical Formula of a Hydrate $Cu(NO_3)_2 \cdot X\ H_2O$
Experiment 9: Activity Series, Electrochemical and Electrolytic Cells
Experiment 10: Factors Affecting Reaction Rate