**ORIGINAL COURSE IMPLEMENTATION DATE:** September 2002
**REVISED COURSE IMPLEMENTATION DATE:** September 2016
**COURSE TO BE REVIEWED: (six years after UEC approval)** December 2021
**Course outline form version: 09/15/14**

# OFFICIAL UNDERGRADUATE COURSE OUTLINE FORM

**Note: The University reserves the right to amend course outlines as needed without notice.**

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| **Course Code and Number:** CHEM 114 | **Number of Credits:** 5 Course credit policy (105) |
| **Course Full Title:** Principles of Chemistry II<br>**Course Short Title (if title exceeds 30 characters):** | |
| **Faculty:** Faculty of Science | **Department (or program if no department):** Chemistry |

**Calendar Description:**

Topics include chemical thermodynamics and kinetics, aqueous equilibria, and the reactivity of organic molecules. Work performed in the laboratory complements lecture material. With CHEM 113, this course satisfies the requirements for honours, majors, or minors programs in science.

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| **Prerequisites (or NONE):** | CHEM 113. |
| **Corequisites (if applicable, or NONE):** | NONE |
| **Pre/corequisites (if applicable, or NONE):** | NONE |

**Equivalent Courses (cannot be taken for additional credit)**
Former course code/number: CHEM 112
Cross-listed with:
Equivalent course(s): CHEM 112
*Note: Equivalent course(s) should be included in the calendar description by way of a note that students with credit for the equivalent course(s) cannot take this course for further credit.*

**Transfer Credit**
Transfer credit already exists: ☒ Yes ☐ No
Transfer credit requested (OReg to submit to BCCAT):
☐ Yes ☐ No (if yes, fill in transfer credit form)
Resubmit revised outline for articulation: ☐ Yes ☐ No
To find out how this course transfers, see **bctransferguide.ca**.

**Total Hours: 102**
**Typical structure of instructional hours:**

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| Lecture hours | 45 |
| Seminars/tutorials/workshops | 12 |
| Laboratory hours | 45 |
| Field experience hours | |
| Experiential (practicum, internship, etc.) | |
| Online learning activities | |
| Other contact hours: Tutorial | - |
| **Total** | **102** |

**Special Topics**
Will the course be offered with different topics?
☐ Yes ☒ No
If yes, different lettered courses may be taken for credit:
☐ No ☐ Yes, repeat(s) ☐ Yes, no limit
*Note: The specific topic will be recorded when offered.*

**Maximum enrolment (for information only):** 36

**Expected frequency of course offerings (every semester, annually, every other year, etc.):** Winter and Summer

| | | |
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| **Department / Program Head or Director:** David Fenske | **Date approved:** | September 2015 |
| **Faculty Council approval** | **Date approved:** | September 2015 |
| **Campus-Wide Consultation (CWC)** | **Date of posting:** | November 20, 2015 |
| **Dean/Associate VP:** Lucy Lee | **Date approved:** | September 2015 |
| **Undergraduate Education Committee (UEC) approval** | **Date of meeting:** | December 18, 2015 |

**Learning Outcomes**

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

1. Define the basic terminology, conventions, and laws of thermodynamics.
2. Explain concepts of enthalpy, entropy, and free energy, and how they relate to spontaneity and equilibrium.
3. Apply thermodynamic principles to solve problems involving simple chemical and physical systems.
4. Describe the properties and theories of acids and bases, and solve quantitative problems related to acid/base equilibria.
5. Explain the basic terminology and concepts of chemical kinetics.
6. Derive rate laws and apply them quantitatively to solve problems in chemical kinetics.
7. Explain and predict the kinetics, mechanisms, and stereochemical outcomes of organic substitution reactions.
8. Exhibit safe handling and disposal of chemicals.
9. Write formal chemistry laboratory reports.
10. Use basic chemical equipment and techniques to measure or analyze acid dissociation constants, thermodynamic values, partition coefficients, kinetic rate constants, rate orders, equilibrium constants and solution concentrations.

**Prior Learning Assessment and Recognition (PLAR)**

☒ Yes ☐ No, PLAR cannot be awarded for this course because

**Typical Instructional Methods (guest lecturers, presentations, online instruction, field trips, etc.; may vary at department's discretion)**

Lectures, labs, group problem-solving sessions, computer-based problem solving.

**Grading system:** Letter Grades: ☒ Credit/No Credit: ☐ Labs to be scheduled independent of lecture hours: Yes ☒ No ☐

**NOTE: The following sections may vary by instructor. Please see course syllabus available from the instructor.**

**Typical Text(s) and Resource Materials (if more space is required, download Supplemental Texts and Resource Materials form)**

| | Author (surname, initials) | Title (article, book, journal, etc.) | Current ed. | Publisher | Year |
|---|---|---|---|---|---|
| **1.** | Petrucci R.H., et al. | General Chemistry: Principle and Modern Applications | ☒ | Pearson | 2010 |
| **2.** | | | ☐ | | |
| **3.** | Fritzke, G., Webb, J. | Chemistry 114 Lab Manual | ☒ | UFV | Current |
| **4.** | | Molecular Model Kit (available in the UFV Bookstore) | ☐ | | |

**Typical Evaluation Methods and Weighting**

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| Final exam: | 40% | Assignments: | 10% | Midterm exam: | 20% | Practicum: | % |
| Quizzes/tests: | **10**% | Lab work: | 20% | Field experience: | % | Shop work: | % |
| Assignments and tests: | | Other: | % | Other: | % | Total: | 100 |

**Typical Course Content and Topics**

1. **Principles of thermodynamics**. Thermodynamic terminology and definitions. Gas Laws. Heat, work, enthalpy and the First Law of Thermodynamics. Entropy and the Second law of Thermodynamics. Gibbs free energy and the relationship to spontaneity and equilibrium. Application of these principles to problems involving physical and chemical systems.
2. **Equilibria**. Thermodynamics of aqueous equilibria, Le Châtelier's principle, and relationship to kinetics. Solubility equilibria. Brønsted Lowry and Lewis theories of acids and bases. Weak and strong acids, monoprotic and polyprotic acids, buffers, and titrations.
3. **Chemical Kinetics.** Concepts of reaction order and molecularity, elementary reaction steps, reaction mechanisms, rate-limiting steps, transition states and reaction coordinate diagrams. Derivation of zeroth, first, and second order rate laws and their application to chemical reactions. The effect of temperature on reaction rates.
4. **Organic Chemistry.** Introduction to organic reactivity through the study of nucleophilic substitution reactions of alkyl halides. Properties, kinetics, and mechanisms of SN1 and SN2 reactions of alkyl halides. Effect on substitution reaction rates of the properties of the nucleophile, leaving group, solvent, and substrate structure. Stereochemical outcomes of substitution mechanisms.

LABORATORY CONTENT:

[Choice of experiments may vary by instructor. An example of experiments for this course might be:]

1. Determination of sodium, calcium and magnesium ions in a sample of seawater
2. Chemical Equilibrium: Reversible reactions and chemical equilibrium
3. Determination of an equilibrium constant
4. Potentiometric acid-base titrations and identification of a weak acid
5. Investigation of buffer systems
6. Thermodynamics: The entropy and enthalpy of solution for potassium hydrogen tartrate in water
7. Rates of Chemical Reactions: The iodination of acetone
8. Determination of the Universal Gas Constant
9. Preparation and analysis of benzoic acid
10. Extraction: The determination of a partition coefficient