

# ENGINEERING CHEMISTRY (ENCH)

## **ENCH 211 Main Group Chemistry Units: 4.75**

An introduction to chemistry of main group inorganic and organic compounds with the use of fundamental quantum mechanics, molecular orbital diagrams and Lewis structures to describe the structure and bonding. The stereochemistry and chirality of organic compounds, solid-state inorganic chemistry, and descriptive chemistry of compounds of the main group elements will be covered. The laboratory will introduce skills in inorganic and organic synthesis.

**Requirements:** APSC 131 and APSC 132

**Offering Faculty:** Faculty of Arts and Science

## **ENCH 212 Princip Of Chem Reactivity Units: 4.00**

An introduction to the kinetics and mechanisms of reactions in gaseous and condensed phases, including acid-base and nucleophilic substitution reactions at carbon and other main group centers. Other topics will include molecular dynamics and reactions in solution. The laboratory illustrates measurement techniques and develops laboratory skills

**Requirements:** APSC 111, 112, 131, 132, 172

**Offering Faculty:** Faculty of Arts and Science

## **ENCH 213 Intro To Chemical Analysis Units: 4.75**

Introduction to analytical chemical methods and science. Topics include statistical analysis of data, titrations and equilibrium theory, spectrophotometry and instrumental elemental analysis.

**Requirements:** APSC 131 and APSC 132

**Offering Faculty:** Faculty of Arts and Science

## **ENCH 222 Meth Struct Determination Units: 3.75**

A survey of practical spectroscopic and spectrometric methods for the determination of the structures of organic and inorganic compounds. Methods will include nuclear magnetic resonance, electronic, infrared/Raman spectroscopy, and mass spectrometry. Tutorials will involve solving compound structures using spectroscopic data, and include an introduction to computational methods in spectroscopy.

**Requirements:** (APSC 131 and APSC 132) or CHEM 112

**Offering Faculty:** Faculty of Arts and Science

## **ENCH 245 Applied Organic Chemistry I Units: 4.75**

A survey of organic functional group reactivity from a mechanistic perspective, including substitution, addition, elimination, rearrangement and redox reactions; extensive use of examples from industrial process chemistry. The laboratory provides experience in organic synthesis, including the preparation, purification and characterization of organic compounds.

**Requirements:** ENCH 211 OR CHEM 211 AND ENCH

**Offering Faculty:** Faculty of Arts and Science

## **ENCH 311 Mechanistic Organic Chem Units: 3.50**

Fundamental mechanistic concepts of organic reactions, structure-activity relationships, solvent effects and catalysis. Mechanistic aspects of substitution, addition, elimination and pericyclic reactions. Fall Term.

**Requirements:** ENCH 245 or CHEM 245

**Offering Faculty:** Faculty of Arts and Science

## **ENCH 312 Transition Metal Chem Units: 3.50**

Introduction to the chemistry, bonding and structures of coordination compounds of the transition metals; transition metals in the solid state and in biological systems; industrial and environmental aspects of transition metal chemistry.

**Requirements:** ENCH 211 OR CHEM 211

**Offering Faculty:** Faculty of Arts and Science

## **ENCH 313 Quantum Mechanics Units: 3.50**

Elementary principles and applications of wave mechanics with special reference to molecular orbitals and chemical bonding.

**Offering Faculty:** Faculty of Arts and Science

## **ENCH 321 Instrumental Chemical Analysis Units: 3.50**

Overview of instrumental methods of chemical analysis. Topics include gas and liquid chromatography, mass spectrometric detection, new separation methods, electrochemical analysis, inductively coupled plasma-based elemental analysis.

**Requirements:** ENCH 213 OR CHEM 213

**Offering Faculty:** Faculty of Arts and Science

## **ENCH 322 Chem Bond: Comp & Spectro. Units: 3.50**

The application of quantum mechanics to the structures and internal motions of molecules. The foundations of electronic, vibrational, rotational and NMR spectroscopy will be discussed together with their applications. Winter Term.

**Requirements:** PREREQ: ENCH 313 and registered in BSCE or BASC.

**Offering Faculty:** Faculty of Arts and Science

## **ENCH 323 Biological Chemistry Units: 3.00**

Introduction to the chemical basis of biological systems and biomolecules, protein structure and synthesis, enzyme catalysis, nucleic acids (DNA, RNA), carbohydrates, membranes, cell signalling, biosynthetic and metabolic pathways.

**Requirements:** PREREQUISITES: CHEE 342 or CHEE 324. Must be registered in BASC.

**Offering Faculty:** Faculty of Arts and Science

**ENCH 326 Environmental & Green Chemistry Units: 3.00**

The first part examines chemical contaminants in the atmosphere, water, soils and sediments, including sources, behaviour, transport, and distribution among these environments. The second part introduces Green Chemistry, examining industrial sources of contaminants and the modification of industrial processes in order to minimize environmental impact.

**Requirements:** ENCH 211 OR CHEM 211 AND ENCH

**Offering Faculty:** Faculty of Arts and Science

**ENCH 347 Applied Surface & Colloid Chem Units: 3.00**

The course covers four major topics. 1. The thermodynamic properties of interfaces (surface energy, wetting, surface area and porosity, capillary effects, work of adhesion/cohesion). 2. Models of adsorption/desorption phenomena. 3. The dynamics of phase transitions (meta-stability, nucleation, spinoidal decomposition). 4. The stability and characterization of colloidal systems. Student appreciation for the importance of these phenomena is cultivated using examples drawn from industrial processes/products including inks, paints, foods, polymer blends, and nanocomposites.

**Requirements:** CHEM240 OR CHEE210 OR CHEM241 OR CHEM244 OR CHEM221 OR CHEM244 OR METL241 OR CHEM221

**Offering Faculty:** Faculty of Arts and Science

**ENCH 397 Experimental Chemistry Units: 7.00**

Laboratory course introducing modern experimental methods in chemistry, including synthesis, analytical instrumentation and computational methods. The integration of several methods will be emphasized in the synthesis and characterization of molecules.

**Requirements:** Prerequisite At least 6 units at the 200-level ENCH/CHEM or permission of the dept. Corequisite At least 3 units at the 300-level ENCH/CHEM or permission of the dept.

**Offering Faculty:** Fac of Engineering Appl Sci

**ENCH 398 Experimental Chemistry I Units: 3.50**

Laboratory course. In consultation with the course coordinator, and subject to availability, students may select experiments as are relevant to their degree program including synthesis, analytical instrumentation and computational methods. The integration of several methods will be emphasized in the design and characterisation of molecules.

**Requirements:** PREREQUISITE(S): (ENCH 211 or ENCH 212), ENCH 222, ENCH 245 COREQUISITE(S): At least 3 units at the 300-level in ENCH/CHEM or permission of the Department.

**Offering Faculty:** Faculty of Arts and Science

**ENCH 399 Experimental Chemistry II Units: 3.50**

Laboratory course. In consultation with the course coordinator, and subject to availability, students may select experiments as are relevant to their degree program including synthesis, analytical instrumentation and computational methods. The integration of several methods will be emphasized in the design and characterization of molecules.

**Requirements:** PREREQUISITE(S): (ENCH 211 or ENCH 212), ENCH 222, ENCH 245 COREQUISITE(S): At least 3 units at the 300-level in ENCH/CHEM

**Offering Faculty:** Faculty of Arts and Science

**ENCH 411 Adv. Analytical Chem Units: 3.00**

A discussion of recent advances in analytical chemistry and its applications to the environmental, materials and biomedical fields. At least four topics will be covered from sample preparation, separation methods, multidimensional chromatography, elemental spectroscopy, mass spectroscopy, and surface analysis methods. Additional topics will be selected from the current literature.

**Requirements:** ENCH 213

**Offering Faculty:** Faculty of Arts and Science

**ENCH 412 Statistical Mechanics Units: 3.00**

The fundamentals of statistical mechanics with applications to thermodynamic properties of gases, liquids and solids and to chemical equilibrium in dilute gases.

**Requirements:** Prerequisite: ENCH 313 and registered in BSCE or BASC

**Offering Faculty:** Faculty of Arts and Science

**ENCH 413 Computational Chemistry Units: 3.00**

The application of quantum mechanics to chemical structures, energetics, internal motions of molecules, and chemical reactions. An introduction to the use of modern electronic structure software in chemistry

**Requirements:** Prereq: ENCH 313 (CHEM 313) and registered in BASC

**Offering Faculty:** Faculty of Arts and Science

**ENCH 414 Catalysis Units: 3.00**

An advanced treatment of the concepts and applications of catalysis, including the kinetics of catalysis and topics selected from the areas of homogeneous, heterogeneous, and biocatalysis

**Requirements:** ENCH 245 and ENCH 312 (CHEM312) and registered in BSCE or BASC

**Offering Faculty:** Faculty of Arts and Science

**ENCH 415 Electrochemistry and Electrocatalysis Units: 3.00**

The course covers concepts of equilibrium electrochemistry and examines the structure of the electrode/solution interface. It discusses the basics of electron transfer and derives electrochemical kinetics equations. It shows examples of several electrochemical reactions and overviews experimental methods used to study electrochemical phenomena.

**Requirements:** CHEE 210

**Offering Faculty:** Faculty of Arts and Science

**ENCH 417 Research Project Units: 9.00**

In this course, projects will be assigned requiring design and synthesis in the solution of problems in engineering chemistry, using principles and concepts discussed in previous courses. Originality and innovation are encouraged. Students are required to significantly contribute to the design of original experiments, and independently analyze, interpret and communicate the results, both orally and in writing.

**Requirements:** Prerequisite: ENCH 397 or ENCH 398 or ENCH 399. Must be registered in a BASC program.

**Course Equivalencies:** ENCH 417; ENCH 417B

**Offering Faculty:** Faculty of Arts and Science

**ENCH 421 Adv. Meth. Physical Chem. Units: 3.00**

Modern spectroscopic methods for the structural and electronic characterisation of molecules will be discussed, including: NMR, X-ray and synchrotron-based spectroscopies, laser spectroscopy, surface spectroscopic methods and scanning probe methods.

**Requirements:** PREREQ: ENCH 313 or CHEM 313 and registered in BSCE or BASC

**Offering Faculty:** Faculty of Arts and Science

**ENCH 422 Synthetic Organic Chem Units: 3.50**

Modern synthetic methods in organic chemistry. Principles of strategy in planning organic syntheses based on simple classifications of reagents and reactions, and on the control of stereochemistry.

**Requirements:** PREREQ: CHEE 324 and registered in a BASC Academic Program.

**Offering Faculty:** Faculty of Arts and Science

**ENCH 423 Topics In Inorg/Organomet Chem Units: 3.00**

An examination of aspects of modern inorganic and organometallic chemistry. Topics will include metal-ligand bonding in organometallic complexes, applications of organometallics in organic synthesis, metal-metal bonding in dinuclear and polynuclear metal complexes, and may include reaction mechanisms of transition metal complexes, bioinorganic chemistry, and symmetry.

**Requirements:** Prerequisite CHEM 312.

**Offering Faculty:** Faculty of Arts and Science

**ENCH 424 Polymer Chemistry Units: 3.00**

Specific properties of polymers (glass transition, crystallinity, polydispersity, etc) and their dependence on macromolecular structure and isomerism. Polymer synthesis overview: step and chain polymerization (free-radical, ionic and insertion

**Requirements:** CHEM 223 or ENCH 245

**Course Equivalencies:** CHEM424, CHEM450

**Offering Faculty:** Faculty of Arts and Science

**ENCH 425 Self Assembly & Materials Units: 3.00**

Four topics covering a range of self-assembled molecular systems will be discussed: monolayers and bilayers, block co-polymers, nanoparticles, and liquid crystals. Material properties, synthetic methods and application of these systems in current and emerging technologies, including nanotechnologies, will be covered.

**Requirements:** CHEE 210 and ENCH 245, or CHEM 221 and CHEM 223 Must also be registered in BSCE or BASC

**Offering Faculty:** Faculty of Arts and Science