

Chemistry (CHEM)

Department of Chemistry
Faculty of Science

CHEM 0100 [1.0 credit] (formerly 65.010)

Introductory Chemistry

Introduction to fundamental laws and principles of chemistry and the techniques needed to solve numerical problems. Laboratory component introduces common lab methods and techniques, and reinforces some of the lecture material. Precludes additional credit for OAC Chemistry. Prerequisite: Ontario Grade 11 Chemistry or equivalent. Lectures three hours a week, tutorial one hour a week.

CHEM 1000 [1.0 credit] (formerly 65.100)

General Chemistry

Solution equilibria, acid and base chemistry; electronic structure of atoms; energy states and spectra; descriptive chemistry and periodic properties of elements; structure of covalent and ionic substances; energy relationships and theories in bonding, equilibria, and rates of reactions. Experimental techniques in analysis and synthesis. Precludes additional credit for CHEM 1101. Prerequisites: OAC in Calculus and Chemistry, or equivalent. This course is intended for students in all programs who plan to take further chemistry courses. Lectures three hours a week, laboratory and tutorial three hours a week.

CHEM 1003 [0.5 credit] (formerly 65.103)

The Chemistry of Food, Health and Drugs

Aspects of chemistry relating to food, food additives, drugs (both illicit and beneficial) and their relation to metabolism and health. Topics may include: proteins, carbohydrates, fats, vitamins and cofactors, enzymes, steroids, electrolyte and pH balance, trace elements. Available only as a free option for Science students. Prerequisite: a course in Chemistry (e.g. Ontario Grade 11). Lectures three hours a week.

CHEM 1101 [0.5 credit] (formerly 65.111)

Chemistry for Engineering Students

Topics include stoichiometry, atomic and molecular structure, thermodynamics and chemical equilibrium, acid-base chemistry, carbon dioxide in water, alkalinity, precipitation, electrochemistry, kinetics and basic organic chemistry. Laboratory component emphasizes techniques and methods of basic experimental chemistry. Precludes additional credit for CHEM 1000. Prerequisites: OAC in Calculus and Chemistry, or equivalent. Lectures three hours a week, laboratory three hours a week.

CHEM 2101 [0.5 credit] (formerly 65.211)

Physical Chemistry I

Principles of thermodynamics. Development of thermodynamic functions, enthalpy, entropy and free energy and their applications to biochemical and chemical processes. Brief introduction to Excel. Precludes additional credit for CHEM 2100. Students presenting both CHEM 2101 and CHEM 2207 or CHEM 2203 will not be able to receive additional credit for CHEM 2800. Students in the B.Sc. program with CHEM 2203 will only be able to use CHEM 2800 in the free elective category. Prerequisites: CHEM 1000; MATH 1007 and MATH 1107; OAC Physics or PHYS 1007 and PHYS 1008. Lectures three hours a week, problems one hour a week, laboratory three hours a week.

CHEM 2102 [0.5 credit] (formerly 65.212)

Physical Chemistry II

Further development of thermodynamic equations and their applications to phase equilibria, chemical equilibria, electrochemistry, transport properties and kinetics. Precludes additional credit for CHEM 2100. Prerequisite: CHEM 2101.

Lectures three hours a week, problems one hour a week, laboratory three hours a week.

CHEM 2203 [0.5 credit] (formerly 65.223)

Organic Chemistry I

Structure, organization, and scope of organic chemistry including molecular structures of well-known and important organic chemicals, types of chemical reactions, and spectroscopic methods used in identification. Training in the handling and purification of organic compounds, organic chemical reactions, and the use of infrared spectroscopy. Precludes additional credit for CHEM 2200 and CHEM 2207. Students presenting both CHEM 2203 and CHEM 2101 will not be able to receive additional credit for CHEM 2800. Students in the B.Sc. program with CHEM 2203 will only be able to use CHEM 2800 in the free elective category, except for students in the Environmental Science Program, who may include CHEM 2203 in the Approved Science Course category while maintaining CHEM 2800 as a mandatory course requirement. Prerequisite: CHEM 1000. Lectures three hours a week, laboratory three hours a week.

CHEM 2204 [0.5 credit] (formerly 65.224)

Organic Chemistry II

Further discussion of chemical bonding in organic compounds, nomenclature, stereochemistry, and a systematic coverage of the chemical reactions of organic functional groups. Laboratory experience in organic chemical reactions, use of infrared spectroscopy and other techniques to determine the structure of unknown organic compounds. Precludes additional credit for CHEM 2208 or CHEM 2206. Prerequisite: CHEM 2200 or CHEM 2203. Lectures three hours a week, laboratory three hours a week.

CHEM 2206 [0.5 credit] (formerly 65.226)

Organic Chemistry IV

Further discussion of the chemical bonding in organic compounds, nomenclature, stereochemistry, and a systematic coverage of the chemical reactions of the organic functional groups. The laboratory consists of computational experiments and calculations on organic structures and reactions. Precludes additional credit for CHEM 2200, CHEM 2204, or CHEM 2208. Prerequisite: CHEM 2203 or CHEM 2207. Lectures three hours a week, laboratory three hours a week.

CHEM 2207 [0.5 credit] (formerly 65.227)

Introduction to Organic Chemistry I

Structure, organization, and scope of organic chemistry, including molecular structures of well-known and important organic chemicals, types of chemical reactions, and spectroscopic methods used in identification. Precludes additional credit for CHEM 2200 and CHEM 2203. Students presenting both CHEM 2207 and CHEM 2101 will not be able to receive additional credit for CHEM 2800. Students in the B.Sc. program with CHEM 2207 will only be able to use CHEM 2800 in the free elective category, except for students in the Environmental Science Program, who may include CHEM 2207 in the Approved Science Course category while maintaining CHEM 2800 as a mandatory course requirement. Prerequisites: CHEM 1000. Lectures three hours a week.

CHEM 2208 [0.5 credit] (formerly 65.228)

Introduction to Organic Chemistry II

Further discussion of the chemical bonding in organic compounds, nomenclature, stereochemistry, and a systematic coverage of chemical reactions of the organic functional groups. Precludes additional credit for CHEM 2200, CHEM 2204 or CHEM 2206. Prerequisite: CHEM 2207 or CHEM 2203. Lectures three hours a week.

CHEM 2302 [0.5 credit] (formerly 65.232)

Analytical Chemistry

Analytical measurement process. Sampling and sample

preparation techniques. Instrumental methods of analysis including absorption spectrophotometry (UV-visible, IR), molecular fluorimetry, atomic spectrometry, inductively coupled plasma atomic emission and ion chromatography. Experimental methodologies for various organic, inorganic, geological and industrial analyses.

Precludes additional credit for CHEM 2300.

Prerequisites: CHEM 1000 or CHEM 1101, MATH 1007 and MATH 1107.

Lectures three hours a week, laboratory three hours a week.

CHEM 2303 [0.5 credit] (formerly 65.233)

Analytical Chemistry

Analytes in biological and environmental matrices are separated by solvent or solid phase extraction, before they are determined by chromatographic, mass spectrometric and electrochemical methods. Topics of social and economic interests will be covered, including drugs, food, lipids, proteins, pesticides, dioxins, and PCBs.

Precludes additional credit for CHEM 2300 and CHEM 2301.

Prerequisites: CHEM 1000 or CHEM 1101, MATH 1007 and MATH 1107.

Lectures three hours a week, laboratory three hours a week.

CHEM 2800 [0.5 credit] (formerly 65.280)

Foundations for Environmental Chemistry

A basis of chemistry needed to understand the environment: composition of the atmosphere and natural waters; equilibrium; surface properties; kinetics and spectroscopy; physical and chemical properties of chemicals in the environment. This is a limited enrolment course; therefore top priority will be given to students registered in the Environmental Science program. Students in the B.Sc. program with CHEM 2203 or CHEM 2207 will only be able to use CHEM 2800 in the free elective category, except for students in the Environmental Science program, who may include CHEM 2203 or CHEM 2207 in the Approved Science Course category while maintaining CHEM 2800 as a mandatory course requirement.

Prerequisites: CHEM 1000, or CHEM 1101; and MATH 1007 or equivalent.

Lectures three hours a week, laboratory three hours a week.

CHEM 2909 [0.5 credit] (formerly 65.299)

Co-operative Work Term Report 1

These work terms provide practical experience for students enrolled in the Co-operative option. To receive credit, students must receive satisfactory evaluations from their work term employer and in their written and oral reports. Graded Sat or Uns.

Prerequisites: Registration in the Chemistry Co-operative option and permission of the Department.

CHEM 3101 [0.5 credit] (formerly 65.311)

Quantum Chemistry

Classical equations of motion, harmonic oscillator, diatomic and polyatomic molecules, molecular mechanics, quantum mechanics, Schrödinger equation and wave functions, vibrational spectra, hydrogen atom, quantum numbers, electronic spectra, bonding in small molecules.

Prerequisites: CHEM 2101, MATH 2007 and MATH 2008.

Lectures and problems three hours a week.

CHEM 3102 [0.5 credit] (formerly 65.312)

Methods of Computational Chemistry

Molecular orbital theory of organic and inorganic chemistry. Applications of computational chemistry to chemical bonding, aromaticity, molecular spectra. Semi-empirical and ab initio electronic structure theory. Comparison of theoretical methods used to obtain molecular properties. Introduction to statistical thermodynamics.

Prerequisite: CHEM 3101.

Lectures and problems three hours a week.

CHEM 3105 [0.5 credit] (formerly 65.315)

Experimental Physical Chemistry

A laboratory-based course designed to acquaint students with advanced concepts in physical chemistry and the use of more advanced physico-chemical techniques in other areas of chemistry. Students are responsible for literature surveys,

acquisition of theoretical background, design of experimental procedures and mathematical analysis of data.

Prerequisites: CHEM 2102, CHEM 3101 (may be taken concurrently), and at least one of CHEM 2203, CHEM 2302, CHEM 2303.

Note: Withdrawal from CHEM 3101 will require deregistration from CHEM 3105.

Laboratory and seminars four hours a week.

CHEM 3106 [0.5 credit] (formerly 65.316)

Computational Chemistry Methods Laboratory

Use of PC Spartan. Molecular mechanics models. Geometry optimization, vibration frequencies, IR spectra, animation of normal modes. Ab initio and semi-empirical models. Selection of an appropriate model; comparison of results. Reaction thermochemistry. Molecular structure. Transition states and activation energies. Display of graphical surfaces.

Prerequisite: CHEM 3102 (may be taken concurrently).

Laboratory four hours a week.

CHEM 3201 [0.5 credit] (formerly 65.321)

Advanced Organic Chemistry I

Instrumental methods for determining organic structures. Selected organic reactions with emphasis on mechanisms and reactive intermediates.

Prerequisite: CHEM 2204 or CHEM 2206 or CHEM 2208.

Lectures three hours a week.

CHEM 3202 [0.5 credit] (formerly 65.322)

Advanced Organic Chemistry II

Continued mechanistic survey of additional organic reactions with emphasis on synthetic usefulness and stereochemistry. Interspersed with selected topics such as instrumental methods, photochemistry, literature of organic chemistry, natural and synthetic polymers, heterocycles, terpenes and alkaloids.

Prerequisite: CHEM 3201 or equivalent.

Lectures three hours a week.

CHEM 3205 [0.5 credit] (formerly 65.325)

Experimental Organic Chemistry

A laboratory-based course including advanced concepts and techniques in organic synthesis, structure determination, and the rates and mechanisms of reactions. Students are responsible for literature surveys, acquisition of theoretical background, and design of experimental procedures.

Prerequisite: CHEM 2204 or CHEM 2206, CHEM 3201 or BIOC 3100 (may be taken concurrently).

Note: Withdrawal from CHEM 3201 will require deregistration from CHEM 3205.

Laboratory four hours a week.

CHEM 3305 [0.5 credit] (formerly 65.335)

Advanced Analytical Chemistry Laboratory

Advanced instrumentally based techniques of analysis. Emphasis on identification and quantitation of low-level contaminants in environmental matrices using chromatographic and spectroscopic methods, including sampling, cleanup, measurement and reporting of results.

Prerequisites: CHEM 2302 and CHEM 2303.

Laboratory four hours a week.

CHEM 3503 [0.5 credit] (formerly 65.353)

Inorganic Chemistry I

Concepts of atomic theory, elemental properties and the periodic system, resonance, introduction to molecular orbital theory, main group chemistry, transition metal complexes, metalloproteins and solid state materials.

Prerequisite: CHEM 1000.

Lectures three hours a week.

CHEM 3504 [0.5 credit] (formerly 65.354)

Inorganic Chemistry II

Symmetry and the application of group theory to spectroscopy and bonding, ligand field theory, solid state and molecular magnetic properties, organometallic chemistry, and electron transfer reactions.

Prerequisite: CHEM 3503.

Lectures three hours a week.

CHEM 3505 [0.5 credit] (formerly 65.355)

Experimental Inorganic and Analytical Chemistry

A laboratory-based course including advanced concepts and techniques in inorganic synthesis, structure determination and analytical chemistry. Students are responsible for literature surveys, acquisition of theoretical background, design of experimental procedures and mathematical analysis of data.

Prerequisites: CHEM 2101, CHEM 2302, CHEM 2303, CHEM 3503 and CHEM 3504 (may be taken concurrently).

Note: withdrawal from or a final grade of F in CHEM 3503 will require deregistration from CHEM 3505.

Laboratory four hours a week.

CHEM 3506 [0.5 credit]

Bioinorganic Chemistry

Chemical and physical factors that define the elements of life. The periodic system is used to describe roles played by the main and transition metal groups of elements in determining shapes and functions of the molecules found in biochemistry.

Prerequisite: BIOL 2200 or BIOC 2200 or BIOC 3100 (taken concurrently); or permission of the Institute.

Lectures three hours a week.

CHEM 3700 [0.5 credit] (formerly 65.370)

Industrial Applications of Chemistry

Uses of chemistry in a number of industries: fertilizers, electrochemical, metallurgical, petrochemical, pulp and paper, plastics, pharmaceutical. Interaction of chemistry with economic, political, engineering, environmental, health, legal considerations. Guest lecturers.

Prerequisite: CHEM 2101 and one of CHEM 2207 or CHEM 2203.

CHEM 3800 [0.5 credit] (formerly 65.380)

The Chemistry of Environmental Pollutants

Inorganic and organic environmental pollutants: their toxicology, production, use pattern and known effects on the environment. Aspects of risk and regulation. Chemistry involved in water and sewage treatment.

Prerequisite: CHEM 2207 or CHEM 2203 or CHEM 2800.

Lectures three hours a week.

CHEM 3909 [0.5 credit] (formerly 65.399)

Co-operative Work Term Report 2

These work terms provide practical experience for students enrolled in the Co-operative option. To receive credit, students must receive satisfactory evaluations from their work term employer and in their written and oral reports. Graded Sat or Uns.

Prerequisites: registration in the Chemistry Co-operative option and permission of the Department.

CHEM 4100 [0.5 credit] (formerly 65.410)

Advanced Topics in Physical Chemistry I

Principles of Group Theory as applied to Chemistry. Point groups, character tables, symmetry orbitals, molecular orbitals, aromaticity, allowed and forbidden reactions, sandwich complexes. Selection rules in spectroscopy, molecular vibrations.

Prerequisites: CHEM 3102 or PHYS 3602.

Lectures three hours a week.

CHEM 4102 [0.5 credit] (formerly 65.412)

Advanced Topics in Physical Chemistry II

Statistical thermodynamics, energy states, equilibrium, partition functions for diatomic molecules. Chemical kinetics: rate laws, solution of differential equations, transition state theory, bimolecular reactions in gases and in solution, chain reactions, catalysis, atmospheric chemical reactions and photochemistry.

Prerequisite: CHEM 3102.

Lectures and seminars three hours a week.

CHEM 4202 [0.5 credit] (formerly 65.422)

Advanced Topics in Organic Chemistry I

Topics include 2-dimensional ^1H and ^{13}C NMR spectroscopy and structure determination of complex organic molecules. Also offered at the graduate level, with additional

requirements, as CHEM 5407, for which additional credit is precluded.

Prerequisite: CHEM 3201.

Lectures and seminars three hours a week.

CHEM 4203 [0.5 credit] (formerly 65.423)

Advanced Topics in Organic Chemistry II

Synthetic organic chemistry. The application of reactions to the synthesis of organic molecules. Emphasis on design of sequences, new reagents, and stereoselectivity.

Prerequisites: CHEM 3201 and CHEM 3202.

Lectures and seminars three hours a week.

CHEM 4204 [0.5 credit] (formerly 65.424)

Organic Polymer Chemistry

Introduction to basic principles of polymer chemistry, industrial and synthetic polymers, different types of polymerization and polymer characterization. Study of commodity plastics, engineering thermoplastics, and specialty polymers, with emphasis on their synthesis. Also offered at the graduate level, with additional or different requirements, as CHEM 5406, for which additional credit is precluded.

Prerequisites: CHEM 3201 or equivalent.

Lectures three hours a week.

CHEM 4301 [0.5 credit] (formerly 65.431)

Advanced Topics in Analytical Chemistry I

Trace and ultratrace analytical chemistry. Sampling and sample preservation. The problems of the blank. Trace and ultratrace analysis. Sampling and sample preparation. Atomic absorption, fluorescence and emission spectroscopy.

Prerequisites: CHEM 2101; CHEM 2302 or CHEM 2303.

Given in alternate years with CHEM 4302.

CHEM 4302 [0.5 credit] (formerly 65.432)

Advanced Topics in Analytical Chemistry II

Solutions and separations in analytical chemistry. Stability of aqueous solutions of standards and samples. Complex formation, multi-step and competing equilibria and their application to the design of selective methods of separation and determination. Electroanalytical techniques. Electroanalytical chemistry of aqueous solutions. Phase equilibria and solvent extraction.

Prerequisites: CHEM 2101; CHEM 2302, or CHEM 2303.

Given in alternate years with CHEM 4301.

Lectures and seminars three hours a week.

CHEM 4406 [0.5 credit] (formerly 65.446)

Pharmaceutical Drug Design

Important elements of rational drug design. Ligand-receptor interactions, structure-activity relationships, molecular modeling of pharmacophores, structure and mechanism-based approaches to drug design. Enzyme inhibition in chemotherapy and design of anti-viral drugs.

Prerequisite: CHEM 2101, CHEM 2203 or CHEM 2207 and BIOC 3100.

Lectures and laboratory five hours a week.

CHEM 4407 [0.5 credit]

Polymer Modeling

Polymer architectures; Flexible and rigid rod polymers; Rotational isomeric states (RIS); Molecular mechanics, Ramachandran Map, Helix parameters; Internal and External Parameters; Regular and random coil structures; Molecular Dynamics; Calculation of end-to-end distance, NMR chemical shifts; conformational entropy and properties.

Prerequisite: MATH 1107 and CHEM 2204 or permission of the department.

Lectures three hours per week.

CHEM 4502 [0.5 credit] (formerly 65.452)

Radiochemistry

A study of nuclear stability and decay; chemical studies of nuclear phenomena. Applications of radioactivity.

Prerequisites: CHEM 2102, CHEM 2302 and CHEM 2303; or permission of the Department.

Lectures and seminars three hours a week.

CHEM 4503 [0.5 credit] (formerly 65.453)

Advanced Topics in Inorganic Chemistry I

Static and dynamic structures of inorganic coordination compounds. Group-theoretical description of vibrational and

electronic excited states. Ligand-field, parameters, bond covalence, prediction of inorganic reaction paths. Precludes additional credit for CHEM 4500. Prerequisite: CHEM 3504 or equivalent. Lectures three hours a week.

CHEM 4504 [0.5 credit] (formerly 65.454)

Advanced Topics in Inorganic Chemistry II

Reactivity of inorganic coordination compounds. Thermodynamic and kinetic factors affecting reactivity. Industrial and biochemical processes catalyzed by metal coordination compounds. Experimental methodologies, data analysis and rate law evaluation used to obtain reaction mechanisms leading to improved methods of catalysis. Prerequisite: CHEM 3504 or equivalent. Lectures three hours a week.

CHEM 4700 [0.5 credit] (formerly 65.470)

Special Topics in Chemistry

A topic of current interest in any branch of chemistry. Only one special topics course may be presented for credit. Prerequisite: permission of the Department.

CHEM 4800 [0.5 credit] (formerly 65.480)

Atmospheric Chemistry

Properties of natural atmospheric constituents; biogeochemical cycles involving gases; chemical reactions in the atmosphere; anthropogenic atmospheric pollutants (e.g., chlorofluorocarbons, sulphur and nitrogen oxides, photochemical smog sources and effects on the biosphere. Relation between the structure of molecules and their spectral and reactive properties.

Prerequisite: CHEM 2101 or CHEM 2800.

Lectures three hours a week.

CHEM 4908 [1.0 credit] (formerly 65.498)

Research Project and Seminar

Senior students in Honours Chemistry carry out a research project under the direction of one of the members of the Department. A written report and an oral presentation of the work are required before a grade can be assigned.

Prerequisites: any two of CHEM 3105, CHEM 3106, CHEM 3205, CHEM 3305 and CHEM 3505.

Laboratory and associated work equivalent to at least eight hours a week for two terms.

CHEM 4909 [0.5 credit] (formerly 65.499)

Co-operative Work Term Report 3

These work terms provide practical experience for students enrolled in the Co-operative option. To receive credit, students must receive satisfactory evaluations from their work term employer and in their written and oral reports. Graded Sat or Uns.

Prerequisites: registration in the Chemistry Co-operative option and permission of the Department.

Child Studies (CHST)

Child Studies Committee

Institute of Interdisciplinary Studies

Faculty of Arts and Social Sciences

CHST 2501 [0.5 credit] (formerly 04.251*)

Issues in Child Studies

An interdisciplinary approach to Child Studies. Introduction to perspectives and methods of study employed by various disciplines, including psychology and sociology. Issues related to research ethics will be introduced.

Prerequisite: PSYC 1001 and PSYC 1002 or PSYC 1000 and permission of the Institute.

Lecture and discussion groups, three hours a week.