CHEMISTRY (CHEM)

SPECIAL NOTE

Students must achieve a passing grade in the lab component of a chemistry course in order to be eligible to receive credit for the course.

All of the Chemistry courses listed on this page have a **3-hour per week lab** period except the following courses: Fundamental Chemistry (CHEM 1190), Chemicals (CHEM 1221), Green Chemistry (CHEM 2100), Environmental Chemistry I (CHEM 3473), Selected Research Topics in Chemistry (CHEM 4499) AND Research Thesis (CHEM 4500).

CHEM 1190 Fundamental Chemistry
3 credit hours
Prerequisite: Nova Scotia Grade 11 Chemistry or equivalent

The intent of this course is to develop fundamental conceptual understanding in chemistry, and associated problem-solving skills, essential for subsequent study in the subject.
Note: There is no lab component for this course; and students may not receive credit for CHEM 1190 following successful completion of CHEM 1210 or any higher-level CHEM courses. This course may not be taken concurrently with any other CHEM course.

CHEM 1210 General Chemistry I
3 credit hours
Prerequisite: Nova Scotia Grade 12 Chemistry and Nova Scotia Grade 12 Mathematics or equivalent

An introduction to general topics in chemistry including composition and properties of matter, reaction stoichiometry, chemical reactions, atomic structure, the periodic table, chemical bonding, molecular geometry and gases. The course is intended for students interested in the physical sciences, life sciences and for students in the engineering program.

CHEM 1211 General Chemistry II for Physical Sciences
3 credit hours
Prerequisite: CHEM 1210 and MATH 1210 (which may be taken concurrently)

A continuation of the introduction to general topics in chemistry including chemical equilibrium and applications to aqueous systems, physical equilibrium, thermodynamics, reaction kinetics, molecular structure, electrochemistry and organic chemistry. Emphasis is placed on applications to the physical sciences, including chemistry, geology and physics.
Note: This course is intended for students in the physical sciences. Credit is only given for one of CHEM 1211, 1212, or 1213.

CHEM 1212 General Chemistry II for Life Sciences
3 credit hours
Prerequisite: CHEM 1210; and three (3) credit hours in CSCI or MATH (except MATH 1202 and MATH 1203) (which can be taken concurrently)

A continuation of the introduction to general topics in chemistry including chemical equilibrium and applications to aqueous systems, physical equilibrium, thermodynamics, reaction kinetics, molecular structure, electrochemistry and organic chemistry. Emphasis is placed on applications to the life sciences, including biology.
Note: This course is intended for students in the life sciences. This course satisfies the requirement for the Chemistry Major or Honours only if MATH 1210/1211 is completed successfully. Credit is only given for one of CHEM 1211, 1212, or 1213.

CHEM 1213 General Chemistry II for Engineering
3 credit hours
Prerequisite: CHEM 1210; and MATH 1210 (which may be taken concurrently)

A continuation of the introduction to general topics in chemistry including chemical equilibrium and applications to aqueous systems, physical equilibrium, thermodynamics, reaction kinetics, molecular structure, electrochemistry and organic chemistry. Emphasis is placed on applications to the related field of engineering.
Note: This course is intended for students in the engineering program. Credit is only given for one of CHEM 1211, 1212, or 1213

CHEM 1221 Chemicals
3 credit hours
This course is an introduction to the chemistry of everyday life for non-science major students who have an interest in improving their scientific literacy and understanding of the world around them. Theory is presented on a need-to-know basis as real-world subjects ranging from the chemistry of global warming to designer drugs are encountered.

CHEM 1251 Food and You
3 credit hours
This course is an introduction to the basic chemistry of foods (proteins, fats, sugars) and their fates in the human body. Requirements for and effects of vitamins, micronutrients, and caffeine are also covered, as are chemical principals underlying food preservation, processed food, and grilling and baking. Subject matter does not require prior coursework in mathematics, chemistry, or other sciences.

CHEM 1800 – 1825 Special Topics in Chemistry
6 credit hours
Course content varies from year to year.

CHEM 1826 – 1849 Special Topics in Chemistry
3 credit hours
Course content varies from year to year.

CHEM 2100 Green Chemistry ENVS 2100
3 credit hours
Prerequisite: CHEM 1211 or CHEM 1212 or CHEM 1213

Green chemistry, or environmentally benign chemistry, is the design of chemical products and processes that reduce or eliminate the use and generation of hazardous substances. This course will examine the chemical principles and processes in the development of technology and in the effects that this technology has on the environment. The course will avoid traditional approaches that only consider the treatment of pollution after it was created, and will focus on alternative routes that limit the production of waste.

CHEM 2312 Physical Chemistry I
3 credit hours
Prerequisite: CHEM 1211, 1212 or 1213, MATH 1210 and MATH 1211 (which may be taken concurrently).

Students study the underlying physical principles that govern the properties and behaviour of chemical systems from a macroscopic viewpoint. Topics include thermodynamics laws, work, heat, enthalpy, entropy, Carnot cycle, free energy, phase equilibrium, phase diagrams of pure substances and simple mixtures, and chemical potentials.

CHEM 2313 Physical Chemistry II
3 credit hours
Prerequisite: CHEM 1211 or 1212 or 1213, and MATH 1211

In this second course in Physical Chemistry, the focus is on processes by which change occurs in chemical systems and the rates of these changes. The first part of the course examines molecular motion in gases and liquids and the mobility of ions in solution. In the second part, the focus is on the branch of Physical Chemistry called Kinetics. The rates and mechanisms of simple and complex chemical reactions will be examined, including polymerization and reactions at surfaces. Topics may include catalysis and kinetics of crystallization.

CHEM 2332 Introductory Analytical Chemistry: Wet Methods
3 credit hours
Prerequisite: CHEM 1211 or 1212 or 1213

An integrated lecture-laboratory course with emphasis on basic analytical methods. The practical application of analytical methods will be stressed by analyzing geological and environmental samples. Lecture topics will include treatment of data, theory of gravimetric and titrimetric analyses and chemical equilibria.

CHEM 2333 Introductory Analytical Chemistry: Electrochemistry and Spectroscopy
3 credit hours
Prerequisite: CHEM 2332

An integrated lecture-laboratory course with emphasis on basic analytical methods. The practical application of analytical methods will be stressed by analyzing geological and environmental samples. Lecture topics will include a thorough introduction to electrochemistry, spectroscopy, chromatography and extractions. Topics include redox titrations, potentiometry, voltammetry, and atomic and molecular spectroscopy. Aspects of quality assurance and quality control in the analytical laboratory setting will also be discussed.

CHEM 2344 Organic Chemistry I
3 credit hours
Prerequisite: CHEM 1211 or 1212 or 1213

An introduction to organic chemistry designed for all students in life science, physical science, general science, engineering or non-science. Topics covered include the structure, nomenclature, physical properties, synthesis, reactions and spectroscopic properties of all classes of hydrocarbons: alkanes, alkenes, alkynes, arenes, alicyclic compounds, polyenes, as well as the principle heterocyclic compounds. The course emphasizes the mechanistic approach to the reactivity of organic compounds and provides a thorough introduction to stereochemistry and nuclear magnetic resonance.

CHEM 2345 Organic Chemistry II
3 credit hours
Prerequisite: CHEM 2344

This course is for science students intending to go on to more advanced organic chemistry. Topics include: reaction mechanism as a means of understanding reactivity, introduction to synthesis design, the structure, nomenclature, physical properties, synthesis, and reactivity of monofunctional organic compounds: alkyl halides, alcohols, ethers, aldehydes, ketones, carboxylic acids and their derivatives, amines, and phenols.

CHEM 2346 Organic Chemistry for Life Sciences
3 credit hours
Prerequisite: CHEM 1211 or 1212 or 1213

A course for students in the life sciences. The course covers the chemistry of the principle functional groups in organic molecules with special emphasis on the relevance of organic functional group chemistry to molecules of biological importance. The functional group classes include: alcohols, thiols, phenols, ethers, epoxides, aldehydes, ketones, carboxylic acids, esters, amides, anhydrides, acid chlorides, nitriles, amines, amino acids, proteins, and carbohydrates. The course emphasizes the mechanistic approach to functional group reactivity and makes the connection to biochemistry at every opportunity. The stereochemical features of molecules of biological interest are emphasized.
Note: This course cannot be used to satisfy requirements for the Chemistry Major; Honours; or double Major or Honours. Students planning to go to some professional schools in Life Sciences are strongly advised to take CHEM 2344 and CHEM 2345.

CHEM 2800 – 2825 Special Topics in Chemistry
6 credit hours
Course content varies from year to year.

CHEM 2826 – 2849 Special Topics in Chemistry
3 credit hours
Course content varies from year to year.

CHEM 3322 Inorganic Chemistry I
3 credit hours
Prerequisite: Twelve (12) credit hours in CHEM at the 2000-level

Students examine the structure and bonding of the main group elements. Topics covered include electronic structure of atoms, bonding theories, ionic solids, and an introduction to point group symmetry and group theory, descriptive chemistry of the main group elements and their compounds.

CHEM 3398 Undergraduate Research I
3 credit hours
Prerequisite: Three of the following courses: CHEM 2313, CHEM 3424, CHEM 2345, or CHEM 2333. CHEM 3398 and CHEM 4500 may not be taken concurrently

A chemistry research course that does not require students to be registered in an honours program. Research may be experimental or theoretical and requires a written report and oral presentation at the end of the semester. Admission requires pre-selection of a faculty research supervisor. This course is a lab based course with a minimum of 6 hours per week in the laboratory.

CHEM 3399 Undergraduate Research II
3 credit hours
Prerequisite: CHEM 3398. Students may not be registered in CHEM 3398 and CHEM 4500 concurrently

A continuation of CHEM 3398, this course extends and further develops research skills without requiring a thesis. Research may be experimental or theoretical and requires a written report and oral presentation at the end of the semester. Admission requires pre-selection of a faculty research supervisor. This course is a lab based course with a minimum of 6 hours per week in the laboratory.

CHEM 3412 Introductory Computational Chemistry
3 credit hours
Prerequisite: CHEM 2313, CHEM 2345, and MATH 1211

Students use computers to model the energy of chemical structures to permit calculation of chemically significant properties. Computational methods include molecular mechanics, semiempirical, Hartree-Fock, density functional theory, and correlated methods. The use of these methods to determine optimal chemical geometries, spectra, and reaction mechanisms are discussed.

CHEM 3415 Polymers
3 credit hours
Prerequisite: CHEM 2312 and CHEM 2313

Students explore the physical chemistry of long#chain polymer molecules. Course material integrates and builds on foundation concepts in thermodynamics, kinetics, bonding and structure, as well as synthesis, and analytical methods. Topics include chain conformations; molecular weight averages, distributions and measurement; survey of different types of polymerization and polymerization kinetics; polymer solutions; phase behaviour; physical properties of glass and crystalline states; structure and morphology; survey of natural polymers, biopolymers and degradation; structure#property relationships and end-use applications.

CHEM 3424 Inorganic Chemistry II
3 credit hours
Prerequisite: CHEM 3322

This course examines the structure, bonding, and reactivity of transition metal complexes. Topics will include crystal field theory, ligand field theory, magnetism and electronic structure of coordination compounds; oxidation and reduction and substitution reactions of square planar and octahedral complexes. Ligands and an introduction to organometallic chemistry will also be covered.

CHEM 3432 Instrumental Analysis I: Separations
3 credit hours
Prerequisite: CHEM 2333

Students examine advanced aspects of instrumental analysis including (i) an introduction to chemical separations; (ii) separation techniques including high performance liquid chromatography and gas chromatography; iii) additional separations methods including capillary electrophoresis; and (iv) hyphenated techniques with organic mass spectrometry and additional topics at the discretion of the instructor.

CHEM 3443 Organic Reaction Mechanisms
3 credit hours
Prerequisite: CHEM 2345

A study of the more important mechanisms of reactions of organic molecules and the methods by which they are elucidated: applications of kinetic data, isotope effects, linear free energy relationships, orbital symmetry control and acid and base catalysis.

CHEM 3445 Organic Spectroscopy
3 credit hours
Prerequisite: CHEM 2345 or a minimum grade of B in CHEM 2346

Students build on the introduction to nuclear magnetic resonance (NMR) spectroscopy offered in CHEM 2344 and CHEM 2345 or in CHEM 2346. An in-depth study of 1H and 13C NMR spectroscopy is provided, assisting students in interpreting more complicated NMR spectra. Multi-nuclear and 2D NMR spectroscopic methods are covered. Students also apply infrared spectroscopy, mass spectrometry, and ultra-violet spectrophotometry to problems of organic and organometallic structural determination.

CHEM 3451 Introductory Biochemistry
3 credit hours
Prerequisite: CHEM 2345 or 2346

This course reviews and/or presents an introduction to the chemistry and biochemistry of macromolecules such as proteins, enzymes, simple and complex carbohydrates, lipids, nucleic acids, and coenzymes. A relationship between the molecular structure of a given macromolecule, its properties, and its function in the living system is explored. The laboratory work concentrates on the isolation, purification, and analysis of naturally occurring macromolecules and includes study of their properties, using micro chemical measurements.

CHEM 3473 Environmental Chemistry I ENVS 3473
3 credit hours
Prerequisite: Forty-eight (48) credit hours including one of CHEM 2332 or ENVS 2400 or GEOL 3454

Students examine sources, movements and ultimate destinations of chemicals in air, water and soil by using peer-reviewed literature. The course focuses on development of effective scientific communication skills. Topics include: reactions of the ozone layer; chemistry of ground-level air pollution; greenhouse effect and climate change; alternative energy sources; polycyclic organic compounds; and the chemistry of natural waters.

CHEM 3800 – 3825 Special Topics in Chemistry
6 credit hours
Course content varies from year to year.

CHEM 3826 – 3849 Special Topics in Chemistry
3 credit hours
Course content varies from year to year.

CHEM 4412 Quantum Chemistry
3 credit hours
Prerequisite: CHEM 2312 and 2313, MATH 2311

The basic principles of quantum physics are used to develop an understanding of atomic and molecular structure.

CHEM 4413 Physical Chemistry III
3 credit hours
Prerequisite: CHEM 2312, CHEM 2313 and MATH 2311

An introduction to statistical thermodynamics and the study of chemical reaction rates and mechanisms.

CHEM 4414 Symmetry and Chemical Applications of Group Theory
3 credit hours
Prerequisite: CHEM 3322 and three credit hours in MATH at the 2000-level or higher.

Students are introduced to symmetry and group theory for the experimental chemist. Applications of point groups and space groups in organic chemistry, inorganic chemistry, molecular spectroscopy, atomic and molecular structure and crystallography are discussed.

CHEM 4421 Organometallic Chemistry
3 credit hours
Prerequisite: CHEM 3424 or permission of the instructor

This course will deal with synthesis, structure, and reactivity or organotransition metal complexes. Topics will include transition metal-alkyls, -carbonyls, -alkenes, -alkynes and -bonded complexes, fundamental reactions and applications to organic synthesis and catalysis. Characterization of organometallic complexes using spectroscopic techniques (IR, Raman, NMR, and ESR) and X-ray crystallography will also be covered.

CHEM 4422 Advanced Topics in Inorganic Chemistry
3 credit hours
Prerequisite: CHEM 3424 or permission of the instructor

Current topics and applications of inorganic chemistry will be covered, and may include the following: cluster chemistry, chemistry of the lanthanides and actinides, inorganic and organometallic materials, bioinorganic chemistry and inorganic photochemistry.

CHEM 4433 Instrumental Analysis II: Materials Analysis
3 credit hours
Prerequisite: CHEM 2333

Students examine advanced aspects of instrumental analysis for materials chemistry including (i) X-ray spectrometry; (ii)optical microscopy; (iii) electron microscopy; and (iv) scanning probe microscopy. Students will also study analog circuits and devices as well as digital electronics and additional topics at the discretion of the Instructor.

CHEM 4444 Synthesis in Organic Chemistry
3 credit hours
Prerequisite: CHEM 2345

A study of the principles involved in the planning and execution of the synthesis of organic molecules. Laboratory experiments are designed so that students learn to identify their products by the use of spectroscopic and other techniques.

CHEM 4452 Biochemistry: Intermediary Metabolism
3 credit hours
Prerequisite: CHEM 3451

A course presenting principles of metabolism of biomolecules involved in energy production, formation of biosynthetic substrates and metabolism of nucleic acids. Both catabolic and anabolic processes as well as transport of biomolecules within cells and organs are considered.

CHEM 4453 Biochemistry: Secondary Metabolism II
3 credit hours
Prerequisite: CHEM 3451

A course presenting principles of metabolism of molecules commonly referred to as the secondary metabolites, i.e. involved neither in energy nor in biosynthetic substrates formation. Thus biosynthetic pathways leading to formation of major secondary metabolite (or natural products) classes, i.e. fatty acids derivatives, polyketides, isoprenoids including sterols, alkaloids, and shikimic acid pathway products such as phenols, lignans, and flavonoids, will be presented. Some major enzymes involved in formation of these biomolecules as well as the methods of pathway and structure elucidation will be presented along with biological activity, ecological and taxonomic significance of metabolites. The laboratory component will provide an opportunity to complete an individual research project, including literature search, experimental work, analysis of results, and writing a comprehensive report.

CHEM 4499 Selected Research Topics in Chemistry
3 credit hours
Prerequisite: Enrolment is permitted to declared Chemistry Majors or Honours students who have successfully completed twenty-four (24) credit hours in CHEM

A weekly seminar course that covers a broad range of research topics that are of current relevance, including ethics in science. Speakers include faculty from within and outside Saint Mary's University and students will normally be expected to present two seminars.
Note: There is no lab component for this course.

CHEM 4500 Research Thesis
6 credit hours
Prerequisite: Enrollment is permitted to declared Chemistry Honours students only

Students will carry out a research project under the direction of one of the Chemistry Department faculty members and will prepare a thesis on their work. The thesis is presented orally.
Note: There is no lab component for this course.

CHEM 4800 – 4825 Special Topics in Chemistry
6 credit hours
Course content varies from year to year.

CHEM 4826 – 4849 Special Topics in Chemistry
3 credit hours
Course content varies from year to year.

CHEM 4876 – 4899 Directed Study in Chemistry
3 credit hours
Prerequisite: Permission of instructor
These courses cover advanced topics in chemistry chosen according to the needs and interests of the students and instructor. These courses provide an opportunity to study a particular subject in detail and require some measure of independence and initiative from the student.