CHEMISTRY (CHM)

The following courses are offered by the Faculty of Science.

CHM 1100 Chemistry and the Human Environment (3 units)
Chemical principles useful for environmental studies and everyday life. The chemistry of water, air, food, human health and raw materials. This course cannot be combined for credit by Science and Engineering students.
Course Component: Lecture
This course cannot be combined for credit by Science and Engineering students.

CHM 1301 Foundations of Chemistry (3 units)
A course intended primarily for students who have not completed Ontario 4U Chemistry (SCH4U) or its equivalent. Includes an additional lecture of 1.5 hour per week and a 3 hour lab in alternate weeks. Atoms, orbitals, chemical bonding and molecular geometry; stoichiometry, chemical equations and quantitative relations; solutions and redox reactions; gas laws; thermochemistry, thermodynamics and kinetics; principles of equilibrium and ionic equilibria; acids and bases, pH, solubility, and buffer solutions.
Course Component: Discussion Group, Laboratory, Lecture
The courses CHM 1301 and CHM 1311 cannot be combined for units. Must register to CHM 1301 if Ontario 4U Chemistry (SCH4U, or its equivalent) not completed.

CHM 1311 Principles of Chemistry (3 units)
Atoms, orbitals, chemical bonding and molecular geometry; stoichiometry, chemical equations and quantitative relations; solutions and redox reactions; gas laws; thermochemistry, thermodynamics and kinetics; principles of equilibrium and ionic equilibria; acids and bases, pH, solubility, and buffer solutions. Includes a 3 hour lab in alternate weeks.
Course Component: Discussion Group, Laboratory, Lecture
Prerequisite: Ontario 4U Chemistry (SCH4U) or its equivalent. The courses CHM 1311 and CHM 1301 cannot be combined for units. Must register to CHM 1301 if Ontario 4U Chemistry (or its equivalent) not completed.

CHM 1321 Organic Chemistry I (3 units)
Classification, identification and structural representation of organic compounds. Theories of chemical bonding and molecular structure. Conformational analysis of alkanes and basic principles of organic stereochemistry. Mechanistic patterns and principles of organic reactions: acid-base and addition reactions, reactions of pi electrophiles, pi nucleophiles, aromatic pi nucleophiles. Principles of organic synthesis and retrosynthesis. Resonance, delocalization, and aromaticity. Includes a 3 hour lab in alternate weeks.
Course Component: Discussion Group, Laboratory, Lecture
Prerequisite: Ontario 4U Chemistry (SCH4U) or its equivalent.

CHM 1701 Fondements de la chimie (3 crédits)
Cours à l'intention des étudiants qui n'ont pas pris le cours d'Ontario 4U Chimie (SCH4U) ou l'équivalent. Comprend une période additionnelle hebdomadaire de 1.5 heures et un laboratoire de 3 heures alternant chaque semaine. Atomes, orbitales, liaisons chimiques et géométrie moléculaire ; stœchiométrie, équations chimiques et relations quantitatives ; solutions et réactions d'oxydoréduction ; lois des gaz ; thermochimie, thermodynamique et cinétique ; principes d'équilibre et équilibres ioniques ; acides et bases, pH, solubilité et solutions tampons.
Volet : Laboratoire, Cours magistral, Tutoriel
Les cours CHM 1701 et CHM 1711 ne peuvent être combinés pour l'obtention de crédits. Doit s'inscrire à ce cours (CHM 1701) si cours d'Ontario 4U Chimie (SCH4U, ou l'équivalent) non complété.

CHM 1711 Principes de chimie (3 crédits)
Atomes, orbitales, liaisons chimiques et géométrie moléculaire ; stœchiométrie, équations chimiques et relations quantitatives ; solutions et réactions d'oxydoréduction ; lois des gaz ; thermochimie, thermodynamique et cinétique ; principes d'équilibre et équilibres ioniques ; acides et bases, pH, solubilité et solutions tampons. Comprend un laboratoire de 3 heures alternant chaque semaine.
Volet : Laboratoire, Cours magistral
Préalable : Le cours d'Ontario 4U Chimie (SCH4U) ou l'équivalent. Les cours CHM 1701 et CHM 1711 ne peuvent être combinés pour l'obtention de crédits. Doit s'inscrire à CHM 1701 si cours Ontario 4U Chimie (ou l'équivalent) non complété.

CHM 1721 Chimie organique I (3 crédits)
Classification, identification et représentation structurale des composés organiques. Théories de la liaison chimique et de la structure moléculaire. Analyse conformationnelle des alcanes et principes de base de la stéréochimie organique. Motifs mécanistiques et les principes des réactions organiques : réactions acido-basiques et d'addition, réactions des électrophiles-pi, nucléophiles-pi, et nucléophiles-pi aromatiques. Principes de la synthèse organique et de la rétrosynthèse. La résonance, délocalisation, et l'aromaticité. Comprend un laboratoire de 3 heures alternant chaque semaine.
Volet : Groupe de discussion, Laboratoire, Cours magistral
Préalable : Ontario 4U Chimie (SCH4U) ou l'équivalent.

CHM 2120 Organic Chemistry II (3 units)
This course builds on the fundamental concepts introduced in its prerequisite, emphasizing the relationship between structural information and the reactivity of organic molecules, reaction mechanisms, multi-step synthesis and stereochemistry. Topics include reactions of sigma electrophiles (E1, SN1, E2, SN2) including oxidation reactions; reactions of pi electrophiles bearing leaving groups (e.g., esters, acetals), pi nucleophiles (enols, enolates) with a range of electrophiles. The course also introduces spectroscopic techniques for the structural identification of organic molecules.
Course Component: Discussion Group, Lecture
Prerequisite: CHM 1321.

CHM 2123 Laboratory of Organic Chemistry II (3 units)
Laboratory work associated with CHM 2120. Previously CHM 2126.
Course Component: Laboratory
CHM 2120 is corequisite to CHM 2123.

CHM 2128 Synthesis and Characterization of Advanced Materials (3 units)
An introduction to the fundamentals of advanced materials with special focus on synthesis and characterization of liquid crystals, semiconductors, superconductors, mesoporous materials, light emitting materials, thin films and colloids.
Course Component: Lecture
Prerequisites: CHM 1311, CHM 2120.

CHM 2131 Chemical Thermodynamics of Gases and Solutions (3 units)
The first law of thermodynamics, relationships between work, heat, internal energy, and enthalpy. Thermochemistry. Heat capacity. The second and third laws of thermodynamics. Entropy. Free energy. Chemical equilibrium and chemical potential. Phase equilibrium and phase diagrams. Ideal and real solutions. Raoult's law and Henry's law. Colligative properties. Thermodynamics of solutions and electrolytes in solution. Debye-Hückel theory, ion migration and conductivity. Electrochemistry, electrochemical cells, and the Nernst equation. This course cannot be combined for credit with CHM 2132.
Course Component: Discussion Group, Laboratory, Lecture
Prerequisites: (CHM 1301 or CHM 1311), (MAT 1322 or MAT 1332), (PHY 1121 or PHY 1321 or PHY 1122 or PHY 1331). The courses CHM 2131, CHM 2132 cannot be combined for units.

CHM 2132 Physical Chemistry for the Life Sciences (3 units)
A course intended primarily for Biology and Biochemistry students. Laws of chemical thermodynamics and their application in bioenergetics. Properties of solutions. Electrochemistry and electrochemical phenomena in biological systems. Chemical spectroscopy and its application in the quantification of biological substances. Chemical kinetics and enzyme kinetics.
Course Component: Discussion Group, Lecture
Prerequisites: (CHM 1301 or CHM 1311), (MAT 1322 or MAT 1332), (PHY 1121 or PHY 1321 or PHY 1331). The courses CHM 2131, CHM 2132 cannot be combined for units.

CHM 2311 Introduction to Structure and Bonding (3 units)
Applications of quantum theory: atomic structure, bonding in molecules, molecular orbital theory, metallic bond, molecular symmetry. Structure and energetics of solids.
Course Component: Discussion Group, Lecture
Prerequisites: (MAT 1320 or MAT 1321 or MAT 1327 or MAT 1330), (CHM 1301 or CHM 1311).

CHM 2313 Environmental Chemistry (3 units)
Chemical aspects of environmental processes in the atmosphere, hydrosphere, and lithosphere. Topics to be covered include: the origins, fates, and reactivity of compounds in natural and polluted environments; environmental analysis and remediation. Environmental implications of energy utilization; climate change; air pollution, acid precipitation, greenhouse effect, stratospheric and ground level ozone, and corrosion. Treatment of water sources; utilization of insecticides and herbicides.
Course Component: Laboratory, Lecture
Prerequisites: (CHM 1311 or CHM 1301), CHM 1321, CHM 2353.

CHM 2330 Physical Chemistry: Introduction to the Molecular Properties of Matter (3 units)
Introduction to the molecular interpretation of physico-chemical phenomena. Introduction to quantum mechanics, statistical mechanics andspectroscopy (vibrational, rotational, nmr). Kinetic theory of gases. Chemical kinetics (order of a reaction, Arrhenius equation, reaction mechanism). Surface chemistry, adsorption isotherms, structure of adsorbed layers, colloids, viscosity, diffusion, and sedimentation. Previously CHM 2130 and CHM 2136.
Course Component: Discussion Group, Laboratory, Lecture
Prerequisites: (CHM 1301 or CHM 1311), (MAT 1322 or MAT 1332), (PHY 1121 or PHY 1321 or PHY 1122 or PHY 1331).

CHM 2353 Descriptive Inorganic Chemistry (3 units)
A review of simple concepts in bonding and acid-base theory. A survey of the chemistry of the elements, trends and their relation to the periodic system. Includes a 3 hour lab in alternate weeks.
Course Component: Discussion Group, Laboratory, Lecture
Prerequisite: CHM 1301 or CHM 1311 or CHM 1321.

CHM 2354 Analytical Chemistry (3 units)
An introduction to fundamental principles of analytical chemistry, including analytical data, theory of acid-base and redox titrations, and separation schemes. Buffer solutions and precipitation equilibria. (Formerly CHM 2154 and CHM 2118)
Course Component: Discussion Group, Laboratory, Lecture
Prerequisite: CHM 1301 or CHM 1311.

CHM 2520 Chimie organique II (3 crédits)
Ce cours s'appuie sur les concepts fondamentaux introduits dans son cours préalable, en mettant l'accent sur la relation entre l'information structurelle et la réactivité des molécules organiques, les mécanismes des réactions, la synthèse en plusieurs étapes et la stéréochimie. Les sujets abordés comprennent les réactions des électrophiles-sigma (E1, SN1, E2, SN2), les réactions d'oxydation, les électrophiles-pi ayant des groupes partants (ex. les esters, les acétals), les nucléophiles-pi (ex. les énols, les énolates) avec divers électrophiles. Le cours introduit également des techniques spectroscopiques pour l'identification structurelle des molécules organiques.
Volet : Groupe de discussion, Cours magistral
Préalable : CHM 1721.

CHM 2523 Laboratoire de chimie organique II (3 crédits)
Travaux pratiques accompagnant CHM 2520. Antérieurement CHM 2526.
Volet : Laboratoire
Le cours CHM 2520 est concomitant à CHM 2523.

CHM 2528 Synthèse et caractérisation de matériaux de pointe (3 crédits)
Une introduction aux fondements de matériaux de pointe avec un accent particulier sur la synthèse et la caractérisation de cristaux liquides, les semi-conducteurs, les supraconducteurs, les matériaux mésoporeux, les matériaux luminescents, les films minces et les colloïdes.
Volet : Cours magistral
Préalables : CHM 1711, CHM 2520.

CHM 2531 Thermodynamique chimique des gaz et des solutions (3 crédits)
Première loi de la thermodynamique: relation entre le travail, la chaleur, l'énergie interne et l'enthalpie. Thermochimie. Chaleur spécifique. Deuxième et troisième lois de la thermodynamique. Entropie. Énergie libre. Potentiel chimique et équilibre chimique. Changement de phase et diagramme de phase. Solutions idéales et réelles. Loi de Raoult et loi de Henry. Propriétés colligatives. Thermodynamique des solutions et des électrolytes. Théorie de Debye-Hückel, migration des ions, et conductivité. Électrochimie, cellules électrochimiques et équations de Nernst.
Volet : Laboratoire, Cours magistral
Préalables : (CHM 1701 ou CHM 1711), (MAT 1722 ou MAT 1732), (PHY 1521 ou PHY 1721 ou PHY 1522 ou PHY 1731). Les cours CHM 2531, CHM 2532 ne peuvent être combinés pour l'obtention de crédits.

CHM 2532 Chimie physique pour les sciences de la vie (3 crédits)
Cours destiné aux étudiants de biologie et de biochimie. Lois de la thermodynamique chimique et applications bioénergétiques. Propriétés des solutions. Électrochimie et phénomènes électrochimiques dans les systèmes biologiques. La spectroscopie chimique et son application à la quantification des substances biologiques. Cinétique chimique et cinétique enzymatique.
Volet : Groupe de discussion, Cours magistral
Préalables : (CHM 1701 ou CHM 1711), (MAT 1722 ou MAT 1732), (PHY 1521 ou PHY 1721 ou PHY 1731). Les cours CHM 2531, CHM 2532 ne peuvent être combinés pour l'obtention de crédits.

CHM 2711 Introduction à la structure et aux liaisons (3 crédits)
Applications de la théorie quantique: structure électronique de l'atome, liaisons chimiques, symétrie moléculaire, théorie des orbitales moléculaires, liaison métallique. Aspects énergétiques et structuraux de solides.
Volet : Cours magistral
Préalables : (MAT 1720 ou MAT 1721 ou MAT 1727 ou MAT 1730), (CHM 1701 ou CHM 1711).

CHM 2713 Chimie de l'environnement (3 crédits)
Aspects chimiques des procédés environnementaux dans l'atmosphère, l'hydrosphère et la lithosphère. Les sujets couverts comprendront : les origines, les destins et la réactivité des composés dans les milieux naturels et pollués, l'analyse environnementale et l'assainissement. Les implications environnementales de l'utilisation de l'énergie, les changements climatiques, la pollution de l'air, les pluies acides, l'effet de serre, l'ozone stratosphérique et troposphérique et la corrosion. Traitement des sources d'eau, utilisation des insecticides et des herbicides.
Volet : Laboratoire, Cours magistral
Préalables : (CHM 1711 ou CHM 1701), CHM 1721, CHM 2753.

CHM 2730 Chimie physique : introduction aux propriétés moléculaires de la matière (3 crédits)
Introduction à l'interprétation des phénomènes physico-chimiques. Introduction à la mécanique quantique, à la mécanique statistique et à la spectroscopie (rotationelle, vibrationnellle, RMN). Théorie cinétique des gaz. Cinétique chimique (ordre d'une réaction, équation d'arrhénius, mécanisme réactionnel). Chimie des surfaces, isotherme d'adsorbées, colloïdes, viscosité, diffusion et sédimentation. Antérieurement CHM 2530 et CHM 2536.
Volet : Groupe de discussion, Laboratoire, Cours magistral
Préalables : (CHM 1701 ou CHM 1711), (MAT 1722 ou MAT 1732), (PHY 1521 ou PHY 1721 ou PHY 1522 ou PHY 1731).

CHM 2753 Chimie minérale des éléments (3 crédits)
Revue des concepts simples des liaisons et des théories acido-basiques. Vue d'ensemble de la chimie des éléments, leurs tendances, et leur relation au système périodique. Comprend un laboratoire de 3 heures alternant chaque semaine.
Volet : Laboratoire, Cours magistral
Préalable : CHM 1701 ou CHM 1711 ou CHM 1721.

CHM 2754 Chimie analytique (3 crédits)
Introduction aux principes fondamentaux de la chimie analytique, y compris la théorie des erreurs, la théorie des titrages acido- basiques et oxydoréducteurs, ainsi que les méthodes de séparation. Solutions tampons et précipitation à l'équilibre. Antérieurement CHM 2554 et CHM 2518.
Volet : Groupe de discussion, Cours magistral, Laboratoire
Préalable : CHM 1701 ou CHM 1711.

CHM 3120 Intermediate Organic Chemistry (3 units)
Synthesis, stereochemistry, reaction intermediates and mechanisms of organic chemistry with illustrations from natural and therapeutic products. Heterocyclic chemistry.
Course Component: Discussion Group, Lecture
Prerequisite: CHM 2120.

CHM 3122 Applications of Spectroscopy in Chemistry (3 units)
Introduction to infrared, visible and ultraviolet spectroscopy, multinuclear magnetic resonance (with emphasis on 1H and 13C), Fourier-transform. NMR, mass spectrometry.
Course Component: Lecture, Discussion Group
Prerequisite: CHM 2120.

CHM 3126 Laboratory of Organic Chemistry (3 units)
Laboratory work accompanying CHM 3120.
Course Component: Laboratory
Prerequisite: CHM 2123. CHM 3120, CHM 3122 are prerequisite or corequisite to CHM 3126. CHM 3126 and CHM 3127 cannot be combined for units.

CHM 3127 Laboratory of Organic Chemistry – Research Option (3 units)
This alternative course is intended for students interested in completing a research project in a participating synthetic organic chemistry research lab rather than the traditional laboratory course.
Course Component: Research
Prerequisite: CHM 2123. CHM 3120, CHM 3122 are prerequisite or corequisite to CHM 3127. CHM 3126 and CHM 3127 cannot be combined for units.

CHM 31271 Laboratory of Organic Chemistry – Research Option (Part 1 of 2)
This alternative course is intended for students interested in completing a research project in a participating synthetic organic chemistry research lab rather than the traditional laboratory course. (Part 1 of 2)
Course Component: Research
Prerequisite: CHM 2123. CHM 3120, CHM 3122 are prerequisite or corequisite to CHM 3127. CHM 3126 and CHM 3127 cannot be combined for units.

CHM 31272 Laboratory of Organic Chemistry – Research Option (Part 2 of 2) (3 units)
This alternative course is intended for students interested in completing a research project in a participating synthetic organic chemistry research lab rather than the traditional laboratory course. (Part 2 of 2)
Course Component: Research
Prerequisite: CHM 31271. CHM 3120, CHM 3122 are prerequisite or corequisite to CHM 3127. CHM 3126 and CHM 3127 cannot be combined for units.

CHM 3128 Catalysis and Sustainable Chemical Manufacturing (3 units)
An introduction to the fundamentals of sustainable chemical manufacturing, with a special focus on solvent use, impacts, and alternatives; catalytic synthesis, supported catalysis, and renewable feedstocks.
Course Component: Lecture
Prerequisites: CHM2120, CHM2123, CHM3350.

CHM 3140 Quantum Chemistry and Molecular Modelling (3 units)
This course builds upon basic quantum mechanics introduced in earlier courses with the goal of introducing students to modern quantum chemical methods for investigating molecular properties, reaction thermodynamics and reaction mechanisms. Quantum mechanical methods and theory for studying many electron systems such as molecules will be introduced, including Hartree-Fock theory, semi-empirical methods, and density functional theory. Practical, working knowledge of quantum chemical calculations and molecular modeling that are typically reported in the current chemical literature will be provided through hands-on exercises using commercial software packages.
Course Component: Lecture
Prerequisite: CHM 2330.

CHM 3350 Transition Metal Chemistry (3 units)
Coordination complexes, ligand field theory, magnetic and spectroscopic properties, stereochemistry, optical and stereoisomerism, reactions of complexes: substitution, electron transfer, isomerization, photochemistry. Previously CHM 3150 and CHM 3156.
Course Component: Laboratory, Lecture
Prerequisites: CHM 2120, (CHM 2311 or CHM 2353), (CHM 2131 or CHM 2132). The courses CHM 3350, BPS 3350 cannot be combined for units.

CHM 3373 Molecular Spectroscopy and Statistical Mechanics (3 units)
Analysis and calculation of atomic, rotational, vibrational and electronic spectra of simple molecules. Boltzmann distribution and partition functions. Microscopic interpretation and calculation of thermodynamic properties (entropy, enthalpy, free energy, heat capacity,rate constant and transition state) from molecular and atomic spectroscopic data. (Formerly CHM3371 and CHM3336)
Course Component: Laboratory, Lecture
Prerequisite: CHM 3140.

CHM 3520 Chimie organique intermédiaire (3 crédits)
Synthèse, stéréochimie, intermédiaires réactionnels et mécanismes en chimie organique. Illustrations par des produits naturels et thérapeutiques. Chimie des hétérocycles.
Volet : Groupe de discussion, Cours magistral
Préalable : CHM 2520.

CHM 3522 Applications de la spectroscopie en chimie (3 crédits)
Introduction aux spectroscopies infrarouge, visible et ultraviolette, résonance magnétique multinoyaux (notamment 1H et 13C), transformées de Fourrier. Spectrométrie de masse.
Volet : Groupe de discussion, Cours magistral
Préalable : CHM 2520.

CHM 3526 Laboratoire de chimie organique (3 crédits)
Travaux pratiques accompagnant CHM 3520.
Volet : Laboratoire
Préalable : CHM 2523. Les cours CHM 3520, CHM 3522 sont préalables ou concomitants à CHM 3526. CHM 3526 et CHM 3527 ne peuvent être combinés pour l'obtention de crédits.

CHM 3527 Laboratoire de chimie organique – Volet recherche (3 crédits)
Ce cours alternatif est destiné aux étudiants qui souhaitent réaliser un projet de recherche dans un laboratoire de recherche en chimie organique synthétique plutôt que de suivre le cours de laboratoire traditionnel.
Volet : Recherche
Préalable : CHM 2523. CHM 3520, CHM 3522 sont préalables ou concomitants à CHM 3527. CHM 3526 et CHM 3527 ne peuvent être combinés pour l'obtention de crédits.

CHM 35271 Laboratoire de chimie organique – Volet recherche (Partie 1 de 2)
Ce cours alternatif est destiné aux étudiants qui souhaitent réaliser un projet de recherche dans un laboratoire de recherche en chimie organique synthétique plutôt que de suivre le cours de laboratoire traditionnel. (Partie 1 de 2)
Volet : Recherche
Préalable : CHM 2523. CHM 3520, CHM 3522 sont préalables ou concomitants à CHM 3527. CHM 3526 et CHM 3527 ne peuvent être combinés pour l'obtention de crédits.

CHM 35272 Laboratoire de chimie organique – Volet recherche (Partie 2 de 2) (3 crédits)
Ce cours alternatif est destiné aux étudiants qui souhaitent réaliser un projet de recherche dans un laboratoire de recherche en chimie organique synthétique plutôt que de suivre le cours de laboratoire traditionnel. (Partie 2 de 2)
Volet : Recherche
Préalable : CHM 2523. CHM 3520, CHM 3522 sont préalables ou concomitants à CHM 3527. CHM 3526 et CHM 3527 ne peuvent être combinés pour l'obtention de crédits.

CHM 3528 Catalyse et production chimique durable (3 crédits)
Une introduction aux principes fondamentaux de la production chimique durable dans le cadre du développement durable, et plus particulièrement sur l'utilisation des solvants, les impacts et les alternatives, la synthèse catalytique, la catalyse sur support solide et les matières premières renouvelables.
Volet : Groupe de discussion, Cours magistral
Préalable: CHM2520, CHM2523, CHM3750.

CHM 3540 La chimie quantique et modélisation moléculaire (3 crédits)
Ce cours repose sur la mécanique quantique de base mise en place dans les cours précédents dans le but d'initier les étudiants aux méthodes modernes de chimie quantique afin d'étudier les propriétés moléculaires, la thermodynamique des réactions et les mécanismes réactionnels. Des méthodes de mécanique quantique et la théorie pour étudier les systèmes à plusieurs électrons tels que les molécules seront présentées, notamment la théorie de Hartree-Fock, les méthodes semi-empiriques et la théorie de la fonctionnelle de la densité. Une connaissance pratique des calculs de chimie quantique et de modélisation moléculaire qui sont généralement rapportés dans la littérature chimique actuelle sera assurée par des exercices pratiques en utilisant des logiciels commerciaux.
Volet : Cours magistral
Préalable : CHM 2730.

CHM 3750 Chimie des métaux de transition (3 crédits)
Complexes de coordination, théorie du champ de ligandes, propriétés magnétiques et spectroscopiques, stéréochimie, isoméries optique et géométrique, réactions des complexes: substitutions, transferts d'électrons, isomérisation, photochimie. (Antérieurement CHM 3550 et CHM 3556)
Volet : Laboratoire, Cours magistral
Préalables : CHM 2520, (CHM 2711 ou CHM 2753), (CHM 2531 ou CHM 2532). Les cours CHM 3750, BPS 3750 ne peuvent être combinés pour l'obtention de crédits.

CHM 3773 Spectroscopie moléculaire et mécanique statistique (3 crédits)
Analyse et calcul des spectres atomiques, rotationnels, vibrationnels et électroniques des molécules simples. Répartition de Boltzmann et fonctions de partition. Interprétation microscopique et calcul des propriétés thermodynamiques (entropie, enthalpie, énergie libre, chaleur spécifique, constante de vitesse et état de transition) à partir des données spectroscopiques des atomes et des molécules. Antérieurement CHM 3771 et CHM 3736.
Volet : Laboratoire, Cours magistral
Préalable : CHM 3140.

CHM 4010 Travail de recherche / Research Project (9 crédits / 9 units)
Travail de recherche dirigé dans le laboratoire d'un professeur. Les étudiants doivent faire une demande auprès du département en avril de leur avant-dernière année d'études. Ce cours est réservé aux étudiants de dernière année au spécialisé en chimie ou au spécialisé avec majeure en chimie qui ne sont pas inscrits au programme coopératif. / Based on supervised research in a professor's laboratory. Students must apply to the Department in April of their penultimate year of study. The course is intended only for those students, not in the Co-operative program, seeking an Honours in Chemistry or an Honours with Major in Chemistry.
Volet / Course Component: Recherche / Research
Préalable : L'étudiant ou l'étudiante doit avoir conservé une MPC minimale de 6.0 et avoir la permission du Département. Antérieurement CHM 4006 et CHM 4910. / Prerequisite: The student must have a minimum CGPA of 6.0 and the permission of the Department. Previously CHM 4006 and CHM 4910.

CHM 40101 Travail de recherche (Partie 1 de 2) / Research Project (Part 1 of 2)
Travail de recherche dirigé dans le laboratoire d'un professeur. Les étudiants doivent faire une demande auprès du département en avril de leur avant-dernière année d'études. Ce cours est réservé aux étudiants de dernière année au spécialisé en chimie ou au spécialisé avec majeure en chimie qui ne sont pas inscrits au programme coopératif. / Based on supervised research in a professor's laboratory. Students must apply to the Department in April of their penultimate year of study. The course is intended only for those students, not in the Co-operative program, seeking an Honours in Chemistry or an Honours with Major in Chemistry. (Part 1 of 2)
Volet / Course Component: Recherche / Research
Préalable : L'étudiant ou l'étudiante doit avoir conservé une MPC minimale de 6.0 et avoir la permission du Département. Antérieurement CHM 4006 et CHM 4910. / Prerequisite: The student must have a minimum CGPA of 6.0 and the permission of the Department. Previously CHM 4006 and CHM 4910.

CHM 40102 Travail de recherche (Partie 2 de 2) / Research Project (Part 2 of 2) (9 crédits / 9 units)
Travail de recherche dirigé dans le laboratoire d'un professeur. Les étudiants doivent faire une demande auprès du département en avril de leur avant-dernière année d'études. Ce cours est réservé aux étudiants de dernière année au spécialisé en chimie ou au spécialisé avec majeure en chimie qui ne sont pas inscrits au programme coopératif. (Partie 2 de 2) / Based on supervised research in a professor's laboratory. Students must apply to the Department in April of their penultimate year of study. The course is intended only for those students, not in the Co-operative program, seeking an Honours in Chemistry or an Honours with Major in Chemistry. (Part 2 of 2)
Volet / Course Component: Recherche / Research
Préalable: CHM 40101. Antérieurement CHM 4006 et CHM 4910. Permission du Département est requise. / Prerequisite: CHM 40101. Previously CHM 4006 and CHM 4910. Permission of the Department is required.

CHM 4016 Travail de recherche / Research Project (6 crédits / 6 units)
Travail de recherche dirigé dans le laboratoire d'un professeur.
Les étudiants et étudiantes doivent faire une demande auprès du Département en avril de leur avant-dernière année d'études. / Based on supervised research in a professor's laboratory. Students must apply to the Department in April of their penultimate year of study.
Volet / Course Component: Recherche / Research
Ce cours est réservé aux étudiants et étudiantes de dernière année du B.Sc. spécialisé en chimie, inscrits dans le programme Coop. / The course is intended only for those students seeking a B.Sc. with Honours in Chemistry, within the Co-op program.

CHM 4118 Advanced Materials Laboratory (3 units)
Laboratory experiments associated with CHM4318. Synthesis and characterization of various advanced materials (including semiconductors, nanoparticles, luminescent materials, liquid crystals, etc) and their application in the fabrication of modern devices.
Course Component: Laboratory
Prerequisite: CHM 2120, CHM 2123, CHM 2128, CHM 2131, CHM 2353.
Corequisite: CHM 4318.

CHM 4120 Advanced Organic Chemistry (3 units)
Stereoselective synthesis. Radical Chemistry. Carbenes and carbenoids. Organosilicon, -boron, -phosphorus and -sulfur species in synthesis.
Course Component: Lecture
Prerequisite: CHM 3120.

CHM 4123 Medicinal Chemistry (3 units)
Drug design, discovery and optimization, including the relationship between structure and activity and modes of action, as well as an overview of the drug development process in the pharmaceutical industry.
Course Component: Lecture
Prerequisite: CHM 2120. The courses CHM 4123, BPS 4125 cannot be combined for units.

CHM 4129 Chemistry of Sustainable Energy (3 units)
Chemical fundamentals, cost-benefits, and impacts of enabling science for emerging battery, hydrogen storage, fuel cell, solar and nuclear energy technologies. Analysis of opportunities and limitations on the exploitation and deployment of fossil fuel resources, including clean coal and oil sands. Focus areas include electrochemistry, photochemistry, catalysis, and interfacial phenomena.
Course Component: Lecture
Prerequisites: CHM 3350 plus 6 units at the CHM 3000 level or higher.

CHM 4139 Enzyme Chemistry and Biocatalysis (3 units)
An introduction to chemical processes and catalysis as performed by enzymes, with emphasis on applications in medicinal chemistry and in the development of environmentally sustainable technologies. Topics include enzyme structure, general mechanisms of biocatalysis, enzyme kinetics, enzyme mechanism elucidation, biocatalytic processes in industry and biocatalyst engineering.
Course Component: Lecture
Prerequisites: CHM 2120, CHM 2123, (CHM 2131 or CHM 2132).

CHM 4155 Polymer and Applied Chemistry (3 units)
A general introduction to polymer chemistry and survey of organic compounds of economic importance. Preparative procedures, polymerization methods and sources of raw materials will be discussed. Applications of polymer and preparative chemistry leading to plastics, drugs, agrochemicals, etc will be described. Previously CHM 3125.
Course Component: Discussion Group, Lecture
Prerequisites: CHM 1311, CHM 2120.

CHM 4182 Molecular Dynamics in Chemistry (3 units)
Introduction to the models used by chemists to investigate reaction dynamics and kinetics in the gas phase, in solution, on surfaces, and in photochemistry. The properties of potential energy surfaces and their influence on reaction dynamics. Conventional transition state theory, variational transition sate theory, and the methods of modelling diffusion in solution and on surfaces. Unimolecular reactions and RRKM theory. Lasers and their operation. Reaction kinetics of excited states.
Course Component: Lecture
CHM 3373 is corequisite to CHM 4182.

CHM 4311 Selected Topics in Inorganic Chemistry (3 units)
Thermochemical aspects of inorganic chemistry, inorganic rings, chains, clusters and polymers, chemistry of the less common elements, nuclear chemistry, non-aqueous solvents.
Course Component: Lecture
Prerequisite: CHM 3350 or BPS 3350.

CHM 4317 Organometallic Chemistry (3 units)
Organometallic compounds of elements in the principal groups and transition groups. Synthesis and structure determination.
Course Component: Lecture
Prerequisites: CHM 3120, (CHM 3350 or BPS 3350).

CHM 4318 Nanostructured Materials (3 units)
Synthesis and investigation of functional nanoscale materials (1 to 100 nm) with emphasis on size dependant chemistry and physics. Structure property relationship in clusters, nanoparticles, semiconductors, nanoporous materials. Potential applications in catalysis.
Course Component: Lecture
Prerequisites: CHM 2120, CHM 2123, CHM 2131, CHM 2353.

CHM 4319 Bio-Inorganic Chemistry (3 units)
Bio-redox agents and mechanisms, electron transport enzymes, nitrogen fixation, toxicology, oxygen transport and transfer, inorganic medicinal chemistry.
Course Component: Lecture
Prerequisite: CHM 3350.

CHM 4325 Advanced Organic Synthesis and Reaction Mechanisms (3 units)
Retrosynthetic analysis as an approach to the synthesis of complex molecules. Modern synthetic methods. Concepts of atoms, steps and redox economy. Reaction mechanisms and the stability and reactivity to key organic reaction intermediates. Free energy relationships. Conservation of orbital symmetry and pericyclic reactions.
Course Component: Lecture
CHM 3120 is corequisite to CHM 4325.

CHM 4328 Special Topics in Organic Chemistry (3 units)
A discussion of recent progress in selected areas of organic chemistry.
Course Component: Lecture
Prerequisite: CHM 3120.

CHM 4340 Introduction to Molecular Simulation and Statistical Mechanics (3 units)
This course provides a practical introduction to molecular simulation techniques that are widely used in modern chemical research, specifically, classical molecular dynamics and Monte Carlo simulation methods. The necessary statistical mechanics required to understand and properly interpret the simulations are also introduced.
Course Component: Lecture
Prerequisite: CHM 2330 or equivalent.

CHM 4354 Principles of Instrumental Analysis (3 units)
Introduction to the analytical processes and instrumentation that are used in modern analytical chemistry. Topics covered include: the analytical method (what is it and what it encompasses); review of analytical protocols; data analysis and presentation, signal, noise, sensitivity and detection limits; calibration; separations (solid phase extraction, molecularly imprinted polymers, immunoaffinity separations, supercriticial fluid separations); chromatography (gas chromatography, liquid chromatography and others); mass spectrometry; atomic speciation methods such as atomic absorption (AA), atomic emission (AE) and inductively coupled plasma (ICP) spectroscopies. Laboratory component involves experiments with these techniques.
Course Component: Laboratory, Lecture
Prerequisite: CHM 2354.

CHM 4380 Advanced Characterization Methods in Material Science and Catalysis (3 units)
A discussion of physico-chemical techniques from the practical and theoretical point of view. Topics covered will be chosen from the following: high- and ultra-high vacuum techniques, optical spectroscopy, mass spectroscopy, chromatography, X-ray, and electron diffraction, electron microscopy, laser chemistry, Fourier transform techniques, electron spectroscopies, magnetic resonance, general instrumental methods.
Course Component: Lecture
Prerequisites: CHM 2354, CHM 2330, (CHM 2131 or CHM 2132), CHM 3373

CHM 4381 Photochemistry and Photobiology (3 units)
Primary photophysical and photochemical processes. Fluorescence and Phosphorescence. The structure and reactivity of electronically excited molecules. Energy and electron transfer processes. Applications of fluorescent molecules as sensors. Uses of photochemistry in imaging, synthesis and photoprotection. Sunlight as a source of sustainable energy.
Course Component: Lecture
Prerequisites: CHM 2120, (CHM 2311 or CHM 2353), (CHM 2131 or CHM 2132).

CHM 4390 Special Topics in Physical Chemistry (3 units)
A discussion of recent progress in selected areas of physical chemistry.
Course Component: Lecture
CHM 3373 is prerequisite or corequisite to CHM 4390.

CHM 4391 Selected Topics in Physical Chemistry (3 units)
Selected advanced topics.
Course Component: Lecture
CHM 3140 is prerequisite or corequisite to CHM 4391.

CHM 4518 Laboratoire des matériaux de pointe (3 crédits)
Travaux pratiques accompagnant CHM4318. La synthèse et la caractérisation de plusieurs matériaux de pointe (comme les nanoparticules, les matériaux luminescents, les cristaux liquides, etc.) et leurs rôles dans la fabrication des appareils modernes
Volet : Laboratoire
Préalables: CHM 2520, CHM 2523, CHM 2528, CHM 2531, CHM 2753.
Concomitant: CHM 4318.

CHM 4520 Chimie organique avancée (3 crédits)
Synthèse stéréosélective. Chimie radicalaire. Carbènes et carbénoïdes. Utilisation des organosilanes, des dérivés organoborés, -phosphorés et -soufrés en synthèse.
Volet : Cours magistral
Préalable: CHM 3520.

CHM 4523 Chimie médicinale (3 crédits)
Conception, découverte et optimisation des médicaments incluant la relation entre la structure et l'activité et les modes d'action ainsi qu'un survol du processus de développement des médicaments dans l'industrie pharmaceutique.
Volet : Cours magistral
Préalable : CHM 2520. Les cours CHM 4523, BPS 4525 ne peuvent être combinés pour l'obtention de crédits.

CHM 4528 Thèmes choisis en chimie organique (3 crédits)
Une étude des progrès récents dans un domaine choisi de la chimie organique.
Volet : Cours magistral
Préalable : CHM 3520.

CHM 4555 La chimie appliquée et la chimie des polymères (3 crédits)
Une introduction générale à la chimie des polymères et un survol des composés organiques d'importance économique. On discutera les procédures de préparation, les méthodes de polymérisation et les sources de matériaux primaires. On discutera également les applications des polymères et les processus industriels qui nous fournissent les plastiques, les médicaments, les produits chimiques agricoles, etc.
Volet : Cours magistral
Préalables : CHM 1711, CHM 2520.

CHM 4590 Thèmes choisis en chimie physique (3 crédits)
Une discussion des progrès récents dans un domaine choisi de la chimie physique.
Volet : Cours magistral
CHM 3773 is prerequisite or corequisite to CHM 4590.

CHM 4711 Thèmes choisis en chimie inorganique (3 crédits)
Une discussion des progrès récents dans un domaine choisi de la chimie inorganique.
Volet : Cours magistral
Préalable : CHM 3750.

CHM 4754 Principes d'analyse instrumentale (3 crédits)
Introduction aux procédures d'analyse et à l'instrumentation utilisée en chimie analytique moderne. Les sujets inclus sont : la méthode analytique (définition et description); revue des protocoles analytiques; analyse et présentation des données, signal, bruit de fond, sensibilité et limites de détection; étalonnage; séparation (extraction en phase solide, polymères à empreintes moléculaires, chromatographie d'immunoaffinité, séparation par fluide supercritique); chromatographie (chromatographie en phase gazeuse, chromatographie en phase liquide et autres); spectrométrie de masse; méthodes de spéciation atomiques telles que la spectroscopie d'absorption atomique, d'émission atomique et de plasma à couplage inductif. La composante de laboratoire consiste en des expériences utilisant ces techniques.
Volet : Laboratoire, Cours magistral
Préalable : CHM 2754.

CHM 4900 Études dirigées en chimie / Directed Studies in Chemistry (3 crédits / 3 units)
Revue de la littérature dans le but de bien cerner un domaine établi ou d'explorer un domaine prometteur de la chimie. La revue est dirigée par un professeur. Les résultats de l'étude seront présentées à un séminaire. Ce cours est destiné uniquement aux étudiants préparant un B.Sc. spécialisé en chimie. / Based on a supervised literature search for the purpose of reviewing an established area of chemistry or exploring a promising new area of chemistry. A seminar reporting the results of the study will be presented. This course is intended only for those seeking an Honours B.Sc. in Chemistry.
Volet / Course Component: Recherche / Research
Préalable : L'étudiant ou l'étudiante doit avoir conservé une MPC minimale de 4.5 et avoir la permission du Département. / Prerequisite: The student must have a minimum CGPA of 4.5 and the permission ofthe Department.

CHM 5105 Radiochemistry (3 units)
A study of nuclear stability and decay; chemical studies of nuclear phenomena. Application of radioactivity.
Course Component: Lecture
Permission of the Department is required.

CHM 5108 Surface Chemistry and Nanostructures (3 units)
Surface structure, thermodynamics and kinetics, specifically regarding adsorption/desorption and high vacuum models. Nanoscale structures and their formation, reactivity and characterization. Thin films, carbon nanotubes, self-assembled monolayers and supramolecular aggregates. This course is equivalent to CHEM 5108 at Carleton University
Course Component: Lecture

CHM 5109 Advanced Applications in Mass Spectrometry (3 units)
Detailed breakdown of the physical, electrical and chemical operation of mass spectrometers. Applications in MS ranging from the analysis of small molecules to large biological macromolecules. Descriptions of the use of mass spectrometry in industry as well as commercial opportunities in the field. This course is equivalent to CHEM 5109 at Carleton University.
Course Component: Lecture

CHM 5206 Physical Methods of Nanotechnology (3 units)
An overview of methods used in nanotechnology. Principles of scanning probe techniques ranging from surface physics to biology. State of the art methods to create nanostructures for future applications in areas such as nanolithography, nanoelectronics, nano-optics, data storage and bio-analytical nanosystems. This course is equivalent to CHEM 5206 at Carleton University.
Course Component: Lecture

CHM 5207 Macromolecular Nanotechnology (1.5 unit)
Fundamentals of synthetic macromolecules related to nanoscale phenomena. Challenges and opportunities associated with polymers on the nanoscale. Topics include molecular recognition, self-assembled nanostructures, functional nanomaterials, amphiphilic architectures, nanocomposites, and nanomachines. Applications to sensing, drug delivery, and polymer based devices. This course is equivalent to CHEM 5207 at Carleton University.
Course Component: Lecture

CHM 5208 Bio Macromolecular Nanotechnology (1.5 unit)
Fundamentals of biological macromolecules related to nanoscale phenomena. Challenges and opportunities associated with natural polymers on the nanoscale. Topics include molecular recognition, self-assembled nanostructures, scaffolds and templates, functional nanomaterials, amphiphilic architectures, nanocomposites, and nanomachines. Applications to sensing, biomaterials, drug delivery, and devices. This course is equivalent to CHEM 5208 at Carleton University.
Course Component: Lecture

CHM 5606 Environmental Chemistry and Toxicology (1.5 crédit)
Overview of environmental chemistry and toxicology principles including chemical sources, fate, and effects in the environment. Examining organic reactions occurring in abiotic environments and biological systems, and study aspects of toxicant disposition and biotransformation. Emphasis on contemporary problems in human health and the environment. This course is equivalent to CHEM 5606 at Carleton University
Volet : Cours magistral

CHM 8104 Scientific Data Processing and Evaluation (3 units)
Optimization of scientific measurements, calibration, uni-variate and multi-variate analysis of scientific data, 'intelligent' spreadsheets for scientific data processing and presentation, noise reduction using spreadsheets, correction for signal drifts; examples from chemistry, spectroscopy and other scientific disciplines. This course is equivalent to CHEM 5904 at Carleton University.
Course Component: Lecture

CHM 8126 Bioorganic Chemistry (3 units)
Overview of recent developments in the mechanistic understanding of selected enzyme-catalyzed reactions. Topics include Cytochrome P450, methane monooxygenase, biotin and lipoic acid biosynthesis, methyl transfer, Vitamin B12, lipoxygenase, prostaglandin synthase; etc. Emphasis will be placed on biotransformations which are relatively poorly understood from a mechanistic point of view. This course is equivalent to CHEM 5303 at Carleton University.
Course Component: Lecture

CHM 8134 Spectroscopy for Organic Chemists (3 units)
Analysis of proton NMR spectra. Fourier transform 13C NMR, strategies for structure elucidation, relaxation times, two-dimensional NMR. Aspects of mass spectrometry. This course is equivalent to CHEM 5407 at Carleton University.
Course Component: Lecture

CHM 8150 Special Topics in Molecular Spectroscopy (3 units)
Topics of current interest in molecular spectroscopy. In past years, the following areas have been covered: electronic spectra of diatomic and triatomic molecules and their interpretation using molecular orbital diagrams; Raman and resonance Raman spectroscopy; symmetry aspects of vibrational and electronic levels of ions and molecules in solids in the presence of weak and strong resonant laser radiation. This course is equivalent to CHEM 5009 at Carleton University.
Course Component: Lecture

CHM 8158 Directed Special Studies (3 units)
Under unusual circumstances and with the recommendation of the research supervisor, it is possible to engage in a directed study on a topic of particular value to the student. This may also be used for unit if there are insufficient course offerings in a particular field of chemistry. This course is equivalent to CHEM 5900 at Carleton University.
Course Component: Lecture

CHM 8164 Organic Polymer Chemistry (3 units)
Basic principles of industrial and synthetic polymers. Polymerization and polymer characterization. Selected topics to cover some important polymers with emphasis on the synthesis, commodity plastics, engineering thermoplastics and specialty polymers. Students should have a basic knowledge of organic reaction mechanisms and stereochemistry. This course is equivalent to CHEM 5406 at Carleton University.
Course Component: Lecture
Prerequisites: CHM 3120, CHM 4120, CHM 4125, equivalent. or A basic knowledge of organic reaction mechanisms and stereochemistry.

CHM 8165 Advanced Protein Engineering (3 units)
Overview of recent developments in the conception and design of proteins with novel structures and functions. Topics include rational and computational design, ancestral protein reconstruction, and directed evolution of proteins.
Course Component: Lecture

CHM 8173 Introduction to Molecular Simulation and Statistical Mechanics (Part A) (1.5 unit)
A practical introduction to modern molecular simulation techniques widely used as tools in chemical research. Classical molecular dynamics and Monte Carlo simulations methods are discussed. The necessary statistical mechanics required to understand and properly interpret the molecular simulations and link the results to measured bulk properties are introduced. An introduction to modern scientific computing environments and the Linux operating system is also provided. This course is equivalent to CHEM 5114 at Carleton University.
Course Component: Lecture

CHM 8174 Stereoselective Synthesis (1.5 unit)
Fundamentals of stereoselective synthesis and catalysis, including conformational analysis, substrate and catalyst control. Includes the use of allylic, chiral auxiliaries, directed reactions and chiral catalysts. This course is equivalent to CHM 5113 at Carleton University.
Course Component: Lecture

CHM 8175 Introduction to Molecular Simulation and Statistical Mechanics (Part B) (1.5 unit)
A practical introduction to modern molecular simulation techniques widely used as tools in chemical research. Classical molecular dynamics and Monte Carlo simulations methods are discussed. The necessary statistical mechanics required to understand and properly interpret the molecular simulations and link the results to measured bulk properties are introduced. An introduction to modern scientific computing environments and the Linux operating system is also provided. This course is equivalent to CHEM 5115 at Carleton University.
Course Component: Lecture

CHM 8176 Chemistry Education and Chemistry Education Research (1.5 unit)
Overview of key areas of chemistry education, including theories of learning, aligning intended outcomes with course activities and assessment, and troublesome areas of learning and teaching in chemistry. Key educational research areas are addressed, including types evidence, research methods, and central publications. This course is equivalent to CHEM 5110 at Carleton University
Course Component: Lecture

CHM 8180 Directed Special Studies (1.5 unit)
Under unusual circumstances and with the recommendation of the research supervisor, it is possible to engage in a directing study on a topic of particular value to the student. This may also be used for unit if there are insufficient course offerings in a particular field of chemistry. This course is equivalent to CHEM 5900 at Carleton University.
Course Component: Lecture

CHM 8181 Chemical Physics of Electron-Molecule Collisions (3 units)
Basic classical scattering theory and quantum mechanical scattering theory. Experimental aspects, such as electron optics, electron gun fundamentals, energy analyzers and electron detectors. Applications to the understanding of the chemistry of materials. This course is equivalent to CHEM 5101 at Carleton University.
Course Component: Lecture

CHM 8256 Seminar I (1 unit)
A seminar course in which students are required to present a seminar on a topic not related to their research project. In addition, students are required to attend the seminar of their fellow classmates and actively participate in the discussion following the seminar. This course is equivalent to CHEM 5801 at Carleton University.
Course Component: Seminar

CHM 8257 Seminar II (1 unit)
A seminar course in which students are required to present a seminar on their Ph.D research project. In addition, students are required to attend the seminars of the fellow classmates and departmental seminars, and actively participate in the discussion. This course is equivalent to CHEM 5802 at Carleton University.
Course Component: Seminar

CHM 8301 Analytical Mass Spectrometry (1.5 unit)
The principles of ion sources and mass spectrometers will be described, together with their applications to problems in chemistry and biochemistry. Introduction to the chemistry gaseous ions. Ion optics. Special emphasis on interpreting mass spectra. This course is equivalent to CHEM 5001 at Carleton University.
Course Component: Lecture

CHM 8302 Advanced Topics in Inorganic Chemistry (1.5 unit)
Topics of current interest in inorganic chemistry. Variable content from year to year. This course is equivalent to CHEM 5902 at Carleton University.
Course Component: Lecture

CHM 8303 Descriptive Organometallic Chemistry (1.5 unit)
Review of basic concepts of M-C bonds and of the preparation and reactivity of transition and non-transition metal organometallic species. Brief discussion of the most important catalytic processes (e.g. Ziegler-Natta, Fisher-Tropsch, catalytic hydrogenation and hydroformilation). This course is equivalent to CHEM 5204 at Carleton University.
Course Component: Lecture

CHM 8304 Advanced Topics in Organic Chemistry (1.5 unit)
Topics of current interest in organic chemistry. Variable content from year to year. This course is equivalent to CHEM 5901 at Carleton University.
Course Component: Lecture

CHM 8308 Multinuclear Magnetic Resonance Spectroscopy (1.5 unit)
Principles of Nuclear Magnetic Resonance (NMR). Study of NMR parameters: chemical shift, spin-spin coupling, electric quadrupole coupling, spin-spin and spin-lattice relaxation rates. NMR and the periodic table. Dynamic NMR. Applications in chemistry and biochemistry. Fourier Transform technique. Pulse sequences. Basic principles and applications of two-dimensional NMR. This course is equivalent to CHEM 5002 at Carleton University.
Course Component: Lecture

CHM 8309 Advanced Topics in Physical (1.5 unit)
Topics of current interest in physical/theoretical chemistry. Variable content from year to year. This course is equivalent to CHEM 5903 at Carleton University.
Course Component: Lecture

CHM 8310 Introduction to Photochemistry (1.5 unit)
Basic principles of photochemistry including selection rules, energy transfer processes and the properties of excited state reactions. Lasers and their applications to measurements of the dynamics of elementary reactions. This course is equivalent to CHEM 5007 at Carleton University.
Course Component: Lecture

CHM 8311 Advanced and Applied Photochemistry (1.5 unit)
Photochemical reactions of small molecules and their relationship to atmospheric chemistry. Production and detection of reactive species. Photolysis. Multiphoton absorption. This course is equivalent to CHEM 5008 at Carleton University.
Course Component: Lecture
Prerequisite: CHM 8310

CHM 8314 Surface Chemistry Aspects of Electrochemical Science (1.5 unit)
Introduction to electrode processes and electrolysis. Potential differences at interfaces. Characterization of the electrical double layer. Dipole orientation effects, charge-transfer in adsorbed layers, electrochemical origins of surface science concepts. Theory of electron transfer, electrode kinetics, electrocatalysis. This course is equivalent to CHEM 5504 at Carleton University.
Course Component: Lecture

CHM 8315 Electrochemical Surface Science (1.5 unit)
Introduction to advanced in-situ techniques in electrochemistry: Scanning probe microscopy, Raman, infrared and laser spectroscopy. This course is equivalent to CHEM 5505 at Carleton University.
Course Component: Lecture
Prerequisites: CHM 8314, CHM 8714

CHM 8316 Surface Chemistry (1.5 unit)
Adsorption phenomena and isotherms, surface areas of solids. Modern techniques in surface chemistry and surface science such as electron diffraction, Auger electron spectroscopy, photoelectron spectroscopy, electron energy loss spectroscopy, infrared and Raman spectroscopy. Current new techniques. This course is equivalent to CHEM 5506 at Carleton University.
Course Component: Lecture

CHM 8319 Total Syntheses (1.5 unit)
Discussion on philosophy and strategy development for complex syntheses, along with modern reagents and reactions that have shortened classical routes and lead to more efficient and atom economy. This course is equivalent to CHEM 5403 at Carleton University.
Course Component: Lecture

CHM 8320 Pericyclic and Stereoelectronic Effects (1.5 unit)
Pericyclic reactions, facial selectivity, stereoelectronic effects in carbohydrates and related acetal cleavage. Applications to complex synthetic problems. This course is equivalent to CHEM 5405 at Carleton University.
Course Component: Lecture

CHM 8321 Solid State Chemistry (1.5 unit)
Thermodynamic and kinetic aspects of solid state synthesis. Characterization of solids. Chemical and physical properties of solids that may include aspects of intercalation reactions, ionic conductors, glasses, electronic, magnetic optical and physical/mechanical properties. This course is equivalent to CHEM 5201 at Carleton University.
Course Component: Lecture

CHM 8322 Topics in Coordination Chemistry (1.5 unit)
Brief introduction to basic concepts in coordination chemistry. Topics to include the following: carbon dioxide fixation, dinitrogen fixation, activation, olefin metathesis, nature of the M-M bond. This course is equivalent to CHEM 5203 at Carleton University.
Course Component: Lecture

CHM 8323 Quantum Mechanical Methods - Theory (1.5 unit)
Examination of the theory behind quantum mechanical methods (HF, MP2, CI, DFT). Semi-empirical. This course is equivalent to CHEM 5600 at Carleton University.
Course Component: Lecture

CHM 8324 Quantum Mechanical Methods - Applications (1.5 unit)
Practical applications of methods taught in CHM 8323 such as thermochemistry, reaction pathway moeling, structure predictions. This course is equivalent to CHEM 5601 at Carleton University.
Course Component: Lecture
Prerequisite: CHM 8323 or CHM 8723

CHM 8325 Solid State Nmr Spectroscopy (1.5 unit)
Brief introduction to solid state NMR spectroscopy. Topics include dipolar coupling interactions, chemical shielding anisotropy, the quadrupolar interaction and averaging techniques such as magic angle spinning. This course is equivalent to CHEM 5003 at Carleton University.
Course Component: Lecture

CHM 8326 Nmr Spectroscopy (1.5 unit)
Advanced NMR techniques for both proton and carbon spectra, various decoupling and related experiments. Interpretation of NOSY, COSY and related data. This course is equivalent to CHEM 5004 at Carleton University.
Course Component: Lecture

CHM 8327 Physical Organic Chemistry (1.5 unit)
Transition state theory, experimental kinetics and thermodynamics, isotope effects, Linear Free Energy Relationships (LFERs), catalysis and Reaction Profile Kinetic Analysis (RPKA). This course is equivalent to CHEM 5005 at Carleton University
Course Component: Lecture

CHM 8328 Applications of Organometallic Chemistry to Synthesis (1.5 unit)
Study of organometallic methods, many of which have become catalytic and involve metals such as Cu, Pd, Pt, Mo, Cr, Ru. Various applications to be discussed including Stille coupling, Heck reaction, ring closing metathesis. This course is equivalent to CHEM 5401 at Carleton University.
Course Component: Lecture

CHM 8329 Medicinal Chemistry (1.5 unit)
Preparation of drugs, their mode of action, their use in treating of disease. Evolution of medicine due to chemistry. Discussion of metabolic pathways and their modification to control and/or circumvent disease. This course is equivalent to CHEM 5402 at Carleton University.
Course Component: Lecture

CHM 8330 Heterocyclic Chemistry (1.5 unit)
Properties of heterocycles. Synthesis and reactivity of heterocyclic systems, with examples relevant to the synthesis of pharmaceuticals and natural products. Includes metal-catalysed reactions. This course is equivalent to CHEM 5120 at Carleton University.
Course Component: Lecture

CHM 8331 Physical Chemistry of Biological Macromolecules (1.5 unit)
Focus on how the application of physical techniques, normally applied to small molecules, can be used to study macromolecular structure and function of DNA and proteins. Examples of applications to include: kinetics, electrochemistry, equilibria phemonmena (thermodynamics). This course is equivalent to CHEM 5300 at Carleton University.
Course Component: Lecture

CHM 8332 Electrochemical Phenomena in Biological Systems (1.5 unit)
Description of theory accounting for the generation of membrane potentials. Application to the generation of nerve impulses. This course is equivalent to CHEM 5301 at Carleton University.
Course Component: Lecture

CHM 8333 Surface Phenomena in Biological Systems (1.5 unit)
Description of theory of surface tension phenomena in aqueous systems. Discussion of effects of cell and macromolecular structures in biological systems. This course is equivalent to CHEM 5302 at Carleton University.
Course Component: Lecture

CHM 8334 Novel Organic and Inorganic Molecules and Radicals (1.5 unit)
Topics to include neutralization-reionization techniques as well as flash pyrolysis and matrix isolation studies. This course is equivalent to CHEM 5009 at Carleton University.
Course Component: Lecture

CHM 8336 Non-Equilibrium Kinetics (1.5 unit)
Gas phase chemical kinetics of elementary and complex reaction mechanisms, as seen from a microscopic viewpoint. Unimolecular and bimolecular reactions under conditions of non-Boltzmann energy distributions. Consequences for combustion and atmospheric chemistry, as well as for fundamental kinetics. This course is equivalent to CHEM 5604 at Carleton University.
Course Component: Lecture

CHM 8337 Non-Linear Chemical Kinetics (1.5 unit)
Principles of non-linear dynamics as applied to very complex chemical reaction mechanisms containing feed-back processes. Monotonic, oscillatory, and chaotic dependence of concentrations on time. Gas phase and liquid phase reactions. This course is equivalent to CHEM 5605 at Carleton University.
Course Component: Lecture

CHM 8338 Unimolecular Reaction Dynamics: Experiment and Theory (1.5 unit)
Presentation of the theoretical models that have been developed for the understanding of unimolecular reactions, focussing on statistical theories such as RRKM theory. Experimental techniques for exploring the kinetics and mechanism of unimolecular reactions, including mass spectrometry, coincidence spectroscopy and ZEKE spectroscopy. This course is equivalent to CHEM 5100 at Carleton University.
Course Component: Lecture

CHM 8339 Heterogeneous Catalysis (1.5 unit)
Principles of catalytic reactions and topics in modern applications of catalysis. Bonding of substrates on surfaces; cluster-surface analogy; ensemble requirements; mechanisms of catalysis on metal and metal oxide surfaces. This course is equivalent to CHEM 5105 at Carleton University.
Course Component: Lecture

CHM 8340 Organotransition Metal Catalysis: E-H Bond Activation (1.5 unit)
Focus on the catalytic activation of E-H bonds by soluble organometallic complexes. Examples to include hydrogenation, hydrosilation and hydroboration catalysis, hydroamination and hydrophosphination. This course is equivalent to CHEM 5106 at Carleton University.
Course Component: Lecture

CHM 8341 Transition-Metal Catalyzed Polymerization (1.5 unit)
Recent developments in polymerization catalysis via transition metal complexes, including insertion, metathesis, and atom-transfer polymerization. Brief overview of relevant concepts in polymer chemistry (e.g. molecular weight, polydispersity, living polymerization, the glass transition). This course is equivalent to CHEM 5107 at Carleton University.
Course Component: Lecture

CHM 8343 Chemistry of the Main Group Elements (1.5 unit)
Fundamental and applied aspects of main group element chemistry. Topics may include non-metal chemistry, main group organometallic chemistry, application of main group element compounds to 3 uses of main group element compounds in synthesis. This course is equivalent to CHEM 5202 at Carleton University.
Course Component: Lecture

CHM 8344 Computational Approaches in Medicinal Chemistry (1.5 unit)
Theory and application of methods used in the pharmaceutical industry including molecular mechanics. This course is equivalent to CHEM 5602 at Carleton University.
Course Component: Lecture

CHM 8345 Molecular Energy Transfer (1.5 unit)
Principles of energy transfer during non-reactive molecular collisions as deduced from experiment and theory, mostly in the gas phase. Translational, rotational, vibrational and electronic energies are discussed. This course is equivalent to CHEM 5603 at Carleton University.
Course Component: Lecture

CHM 8346 Supercritical Fluids (1.5 unit)
Fundamental and practical aspects of the uses of supercritical fluids in the chemistry laboratory. Thermodynamic treatment of high pressure multicomponent phase equilibria, transport properties, solubilities, supercritical fluid extraction and chromatography for analytical purposes, reactions in supercritical fluids, equipment considerations, new developments. This course is equivalent to CHEM 5102 at Carleton University.
Course Component: Lecture

CHM 8348 Analytical Instrumentation (1.5 unit)
Principles of modern electronics, devices and instruments. Measurement of photonic and electrochemical signals. Conditioning of signals for feedback control and microcomputer interfacing. Computational data analysis techniques such as simplex optimization. Applications in chemical analysis include amperometric detector for capillary electrophoresis, and surface plasmon resonance immunosensor. This course is equivalent to CHEM 5500 at Carleton University.
Course Component: Lecture

CHM 8349 Free Radicals in Chemistry and Biology (1.5 unit)
Oxidative stress induced by free radicals plays a significant role in most fatal and chronic diseases. The chemistry of bio-radicals will be described and related to pathobiological processes such as lipid peroxdiation and atherosclerosis, protein nitration and cross linking, and DNA scission. This course is equivalent to CHEM 5304 at Carleton University.
Course Component: Lecture

CHM 8352 Analytical Approach to Chemical Problems (1.5 unit)
Case study of analytical approach to various chemical problems in agricultural, biochemical, environmental, food processing, industrial, pharmaceutical and material sciences. Analytical methods include capillary electrophoresis, chemiluminescence, Fourier transform infrared spectroscopy, inductively coupled plasma emission spectroscopy, mass spectrometry, biochemical sensors, and fiber optics for remote sensing. This course is equivalent to CHEM 5501 at Carleton University.
Course Component: Lecture

CHM 8353 Trace and Ultratrace Analytical Chemistry (3 units)
Criteria for evaluation and selection of analytical techniques and methods. Electroanalytical techniques. Simultaneous and sequential multielement determination. Atomic absorption, atomic emission and atomic fluorescence spectrometry, using optical spectrometric and mass-spectrometric determination. Applications of these techniques at trace and ultratrace levels in complex matrices. This course is equivalent to CHEM 5502 at Carleton University.
Course Component: Lecture

CHM 8355 Trace Elemental Analysis Using Inductively Coupled Plasma Emission (Icp-Es) and Mass Spectrometry (I (1.5 unit)
ICP-ES/MS techniques are among the most powerful tools presently available for elemental analysis for a wide range of interests such as environmental, geological and biological applications. The fundamentals, state of the art instrumentation, applications, existing challenges, and new research and developments will be covered.
Course Component: Lecture

CHM 8358 Advanced Topics in Biomolecular Sciences (1.5 unit)
Topics of current interest in biomolecular sciences and biological chemistry. Variable content from year to year. The course is equivalent to CHEM 5111 at Carleton University.
Course Component: Lecture

CHM 8359 Advanced Topics in Materials Chemistry (1.5 unit)
Topics of current interest in Materials Chemistry. Variable content from year to year. This course is equivalent to CHEM 5112 at Carleton University.
Course Component: Lecture

CHM 8360 Characterization Methods and Applications of Advanced Materials. (1.5 unit)
Detailed discussion of physico-chemical techniques from the practical and theoretical point of view. Topics covered will be chosen from the following: thermal analysis technics, optical spectroscopy, electrochemistry, X-ray and electron diffraction, electron microscopy, electron spectroscopies, magnetic resonance, and general instrumental methods. Applications related to materials science may include: field affect transistors, photovoltaics, light emitting devices, batteries, fuel cells, smart windows, and liquid crystalline displays. This course is equivalent to CHEM 5116 at Carleton University.
Course Component: Lecture

CHM 8361 Chemical Biology Part A (1.5 unit)
Overview of the field of Chemical Biology focussed on modern aspects of molecular science with applications to understanding biological mechanisms. Concepts such as biorthogonal chemistry, chemical genetics, expanded genetic codes ans expanded genetic alphabets will be discussed in the context of how new chemical tools are developed and applied to understand and engineer living systems. Chemical probes for genomics, proteomics, metabolomics and vivo understanding of biology will be introduced with specific examples described. Genetically encoded probes will also be discussed. This course is equivalent to CHEM 5117 at Carleton University.
Course Component: Lecture

CHM 8362 Molecular Magnetism I (1.5 unit)
Metal containing paramagnetic molecules are omnipresent in chemistry and biochemistry. The presence of unpaired electron in a system has a drastic effect on physical properties of a molecule. Provides an introduction to the principles (Molecular Magnetism I) and advanced characterization of paramagnetic molecules (Molecular Magnetism II). Emphasis will be made on structure property relationship. This course will contain variable content from year to year by discussing recent progress on molecular magnetism. This course is equivalent to CHEM 5119 at Carleton University.
Course Component: Lecture

CHM 8363 Chemical Biology Part B (1.5 unit)
Overview of field of Chemical Biology focussed on modern aspects of molecular science with applications to understanding biological mechanisms. Concepts such as biorthogonal chemistry, chemical genetics, expanded genetic codes ans expanded genetic alphabets will be discussed in the context of how new chemical tools are developed and applied to understand and engineer living systems. Chemical probes for genomics, proteomics, metabolomics and vivo understanding of biology will be introduced with specific examples described. Genetically encoded probes will also be discussed. This course is equivalent to CHEM 5118 at Carleton University.
Course Component: Lecture

CHM 8364 Molecular Magnetism II (1.5 unit)
Metal containing paramagnetic molecules are omnipresent in chemistry and biochemistry. The presence of unpaired electron in a system has a drastic effect on physical properties of a molecule. Provides an introduction to the principles (Molecular Magnetism I) and advanced characterization of paramagnetic molecules (Molecular Magnetism II). Emphasis will be made on structure property relationship. This course will contain variable content from year to year by discussing recent progress on molecular magnetism. This course is equivalent to CHEM 5121 at Carleton University.
Course Component: Lecture

CHM 8365 Communication in Chemistry (1.5 unit)
This course will involve a variety of activities over the semester, including an oral presentation. The three major modes of scientific communication will be covered: written, verbal, and visual communication. Students will be educated in best practices via lectures and assignments, and regular attendance at Departmental seminars. Graded work will include: a) writing a cover letter and CV, and abstract for a conference presentation. b) communicating research orally to scientific and non-scientific audiences, c) producing a scientific poster. Plagiarism will also be discussed. The course is focused on students producing the above deliverables, peer review of their work, and enhancing student capacity to engage and communicate beyond a specialist academic audience.
Course Component: Lecture

CHM 8714 Électrochimie interfaciale (1.5 crédit)
Introduction aux processus électrochimiques. Double couche électrique. Transfert de charge. Théorie du transfert d'électrons, cinétique électrochimie et électrocatalyse.
Volet : Cours magistral

CHM 8722 Sujets choisis de la chimie de coordination (1.5 crédit)
Introduction des concepts fondamentaux de la chimie de coordination. Discussions des sujets suivants : fixation du dioxyde de carbone et de l'azote, activation, méthathèse d'oléfines, liaison métal-métal.
Volet : Cours magistral

CHM 8723 Méthodes de la mécanique quantique - théorie (1.5 crédit)
Description de la théorie sur laquelle sont basées les méthodes de chimie quantique (HF, MPS, CI, DFT).
Volet : Cours magistral

CHM 8958 Projet de recherche / Research Proposal
Préparation d'un projet de recherche, sans rapport avec le sujet de thèse, à soutenir oralement devant un comité d'examen. L'étudiant doit démontrer sa capacité à défendre et justifier le mérite scientifique, la méthodologie, l'importance et la nouveauté du projet. Il doit réussir ce cours dans l'année qui suit la réussite de l'examen général. Les étudiants dont les résultats ne seraient pas satisfaisants peuvent se réinscrire une fois et doivent alors réussir en une session. / Preparation of a research project, unrelated to the thesis topic, to be defended orally before an examining committee. Student required to demonstrate the ability to defend and justify the scientific merit, methodology, importance, and novelty of the project. Must be completed within one year of passing the comprehensive examination. Students who fail this activity may re-register for it once and must then successfully complete it within one session.
Volet / Course Component: Recherche / Research

CHM 9998 Examen général de doctorat / Ph.D. Comprehensive
Volet / Course Component: Recherche / Research