2019-2020 Graduate Calendar

The information published in this Graduate Calendar outlines the rules, regulations, curricula, programs and fees for the 2019-2020 academic year, including the Summer Semester 2019, Fall Semester 2019 and the Winter Semester 2020.

For your convenience the Graduate Calendar is available in PDF format.

If you wish to link to the Graduate Calendar please refer to the Linking Guidelines.

The University is a full member of:

• Universities of Canada

Contact Information:

University of Guelph
Guelph, Ontario, Canada
N1G 2W1
519-824-4120

Revision Information:

<table>
<thead>
<tr>
<th>Date</th>
<th>Description</th>
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<tbody>
<tr>
<td>May 1, 2019</td>
<td>Initial Publication</td>
</tr>
<tr>
<td>June 28, 2019</td>
<td>Revision 1</td>
</tr>
</tbody>
</table>
Disclaimer
The Office of Graduate and Postdoctoral Studies has attempted to ensure the accuracy of this on-line Graduate Calendar. However, the publication of information in this document does not bind the university to the provision of courses, programs, schedules of studies, fees, or facilities as listed herein.

Limitations
The University of Guelph reserves the right to change without notice any information contained in this calendar, including any rule or regulation pertaining to the standards for admission to, the requirements for the continuation of study in, and the requirements for the granting of degrees or diplomas in any or all of its programs.

The university will not be liable for any interruption in, or cancellation of, any academic activities as set forth in this calendar and related information where such interruption is caused by fire, strike, lock-out, inability to procure materials or trades, restrictive laws or governmental regulations, actions taken by the faculty, staff or students of the university or by others, civil unrest or disobedience, Public Health Emergencies, or any other cause of any kind beyond the reasonable control of the university.

The University of Guelph reaffirms section 1 of the Ontario Human Rights Code, 1981, which prohibits discrimination on the grounds of race, ancestry, place of origin, colour, ethnic origin, citizenship, creed, sex, sexual orientation, handicap, age, marital status or family status.

The university encourages applications from women, aboriginal peoples, visible minorities, persons with disabilities, and members of other under-represented groups.
Introduction

Collection, Use and Disclosure of Personal Information

Personal information is collected under the authority of the University of Guelph Act (1964), and in accordance with Ontario's Freedom of Information and Protection of Privacy Act (FIPPA) http://www.e-laws.gov.on.ca/DBLaws/Statutes/English/90f31_e.htm. This information is used by University officials in order to carry out their authorized academic and administrative responsibilities and also to establish a relationship for alumni and development purposes. Certain personal information is disclosed to external agencies, including the Ontario Universities Application Centre, the Ministry of Advanced Education and Skills Development, and Statistics Canada, for statistical and planning purposes, and is disclosed to other individuals or organizations in accordance with the Office of Registrarial Services Departmental Policy on the Release of Student Information. For details on the use and disclosure of this information call the Office of Registrarial Services at the University at (519) 824-4120 or see https://www.uoguelph.ca/registrar/.

Statistics Canada - Notification of Disclosure

For further information, please see Statistics Canada's web site at http://www.statcan.gc.ca and Section XIV Statistics Canada.

Address for University Communication

Depending on the nature and timing of the communication, the University may use one of these addresses to communicate with students. Students are, therefore, responsible for checking all of the following on a regular basis:

Email Address

The University issued email address is considered an official means of communication with the student and will be used for correspondence from the University. Students are responsible for monitoring their University-issued email account regularly.

Home Address

Students are responsible for maintaining a current mailing address with the University. Address changes can be made, in writing, through Registrarial Services.

Name Changes

The University of Guelph is committed to the integrity of its student records, therefore, each student is required to provide either on application for admission or on personal data forms required for registration, their complete, legal name. Any requests to change a name, by means of alteration, deletion, substitution or addition, must be accompanied by appropriate supporting documentation.

Student Confidentiality and Release of Student Information Policy Excerpt

The University undertakes to protect the privacy of each student and the confidentiality of their record. To this end the University shall refuse to disclose personal information to any person other than the individual to whom the information relates where disclosure would constitute an unjustified invasion of the personal privacy of that person or of any other individual. All members of the University community must respect the confidential nature of the student information which they acquire in the course of their work.

Complete policy at https://www.uoguelph.ca/secretariat/office-services/university-secretariat/university-policies.
Learning Outcomes

Graduate Degree Learning Outcomes

On May 27, 2013, the University of Guelph Senate approved the following five University-wide Learning Outcomes as the basis from which to guide the development of graduate degree programs, specializations and courses:

1. Critical and Creative Thinking
2. Literacy
3. Global Understanding
4. Communication
5. Professional and Ethical Behaviour

These learning outcomes are also intended to serve as a framework through which our educational expectations are clear to students and the broader public; and to inform the process of outcomes assessment through the quality assurance process (regular reviews) of programs and departments.

An on-line guide to the learning outcomes, links to the associated skills, and detailed rubrics designed to support the development and assessment of additional program and discipline-specific outcomes, are available for reference on the Learning Outcomes website.

Critical and Creative Thinking

Critical and creative thinking is a concept in which one applies logical principles, after much inquiry and analysis, to solve problems with a high degree of innovation, divergent thinking and risk taking. Those mastering this outcome show evidence of integrating knowledge and applying this knowledge across disciplinary boundaries. Depth and breadth of understanding of disciplines is essential to this outcome. At the graduate level, originality in the application of knowledge (master’s) and undertaking of research (doctoral) is expected.

In addition, Critical and Creative Thinking includes, but is not limited to, the following outcomes: Independent Inquiry and Analysis; Problem Solving; Creativity; and Depth and Breadth of Understanding.

Literacy

Literacy is the ability to extract information from a variety of resources, assess the quality and validity of the material, and use it to discover new knowledge. The comfort in using quantitative literacy also exists in this definition, as does using technology effectively and developing visual literacy.

In addition, Literacy includes, but is not limited to, the following outcomes: Information Literacy, Quantitative Literacy, Technological Literacy, and Visual Literacy.

Global Understanding

Global understanding encompasses the knowledge of cultural similarities and differences, the context (historical, geographical, political and environmental) from which these arise, and how they are manifest in modern society. Global understanding is exercised as civic engagement, intercultural competence and the ability to understand an academic discipline outside of the domestic context.

In addition, Global Understanding includes, but is not limited to, the following outcomes: Global Understanding, Sense of Historical Development, Civic Knowledge and Engagement, and Intercultural Competence.

Communication

Communication is the ability to interact effectively with a variety of individuals and groups, and convey information successfully in a variety of formats including oral and written communication. Communication also comprises attentiveness and listening, as well as reading comprehension. It includes the ability to communicate and synthesize information, arguments, and analyses accurately and reliably.

In addition, Communication includes, but is not limited to, the following outcomes: Oral Communication, Written Communication, Reading Comprehension, and Integrative Communication.

Professional and Ethical Behaviour

Professional and ethical behaviour requires the ability to accomplish the tasks at hand with proficient skills in teamwork and leadership, while remembering ethical reasoning behind all decisions. The ability for organizational and time management skills is essential in bringing together all aspects of managing self and others. Academic integrity is central to mastery in this outcome. At the graduate level, intellectual independence is needed for professional and academic development and engagement.

In addition, Professional and Ethical Behaviour includes, but is not limited to, the following outcomes: Teamwork, Ethical Reasoning, Leadership, Personal Organization and Time Management, and Intellectual Independence.
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Chemistry

The Guelph-Waterloo Centre for Graduate Work in Chemistry and Biochemistry combines the Department of Chemistry at the University of Waterloo and the Department of Chemistry at the University of Guelph into a comprehensive and all-inclusive school of graduate chemistry and biochemistry. The members of the centre conduct research in virtually all areas of modern chemistry and biochemistry.

Professional personnel in the centre comprise those faculty members of the two departments who have been appointed as PhD advisors and have a record of recent research achievement. The centre is administered by the director and its affairs are guided by the co-ordinating committee, which consists of the director, the two departmental chairs, the two departmental Graduate Program Coordinators, two elected centre members from each campus, and one elected representative of the graduate student body from each campus. The regulations applying to graduate study in the centre meet the requirements of the graduate councils and the Senates of the two universities.

The fields of research in which theses can be written normally fall within the categories of:

- Analytical chemistry
- Inorganic chemistry
- Nanoscience
- Organic chemistry
- Theoretical chemistry
- Polymer chemistry
- Biological chemistry or Biochemistry
- Physical Chemistry

The category chosen will normally be referred to as the candidate's major. However, if a suitable topic is chosen, a candidate may pursue research which involves more than one of the categories listed above. Certain course requirements must be fulfilled both for the MSc and for the PhD. These courses are chosen in consultation with the candidate's advisory committee and the graduate officers of the centre.

Administrative Staff

**Director of the Centre**
Elizabeth Meiering (ESCC 228, University of Waterloo, (519) 888-4567, Ext. 32254)
gwc@uwaterloo.ca

**Administrative Assistant for the Centre**
Kim Rawson (263 Chemistry 2 Bldg., Univ. of Waterloo, (519) 888-4567 or (519) 824-4120, Ext. 38111/53484)
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**Chair of the Department at Guelph**
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**Departmental Graduate Program Coordinator**
Marcel Schlaf (339 MacNaughton, Ext. 53002)
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**Departmental Graduate Program Assistant**
Lisa O’Dwyer (2513 Science Complex, Ext. 53044)
chemgrad@uoguelph.ca

Graduate Faculty

**France-Isabelle Auzanneau**
Maitrise, DEA, PhD Paris XI-Orsay - Professor

**Aicheng Chen**
Diploma, Shaoyang University, MSc, Xiamen University, PhD Guelph - Professor, Director of the Electrochemical Technology Centre

**Michael K. Denk**
Diplom-Chemiker, PhD Ludwig-Maximilians Universität Munich - Associate Professor

**Wojciech Gabryelksi**
BSc, MSc Technical University of Gdansk (Poland), PhD Alberta - Associate Professor

**Khshayar Ghandi**
BSc Shiraz University, MSc University of Tehran, PhD, Simon Fraser University - Professor

**Abdelaziz Houmam**
Maitrise Casablanca I, DEA, PhD Paris 7 - Associate Professor

**Lori Jones**
BSc New Brunswick, PhD Guelph - Associate Professor

**Richard A. Manderville**
BSc, PhD Queen's - Professor

**Mario A. Monteiro**
BSc, PhD York University - Professor

**Kathryn E. Preuss**
BSc Lethbridge, PhD Waterloo - Professor and Tier II Canada Research Chair

Graduate Faculty from University of Waterloo

**Monica Barra**
BSc, PhD National Univ. of Cordoba (Argentina) - Associate Professor

**Jonathan Baugh**
BSc Tennessee (Chattanooga), PhD North Carolina (Chapel Hill) - Assistant Professor

**J. Michael Chong**
BSc, PhD British Columbia - Professor

**Daniel F. Thomas**
BSc Alberta, PhD Toronto - Associate Professor

**Peter Tremaine**
BSc Waterloo, PhD Alberta - Professor and NSERC Industrial Research Chair

**Graduate Programs, Chemistry**

BSc, MSc Waterloo, PhD, MA Princeton - Professor and Chair

**Marcel Schlaf**
Diplom-Chemiker Bayerische Julius-Maximilian Universität, PhD Toronto - Professor and Graduate Program Coordinator

**Adrian L. Schwan**
BSc Western Ontario, PhD McMaster - Professor

**Dmitry V. Soldatov**
MSc Novosibirsk State, PhD Russian Academy of Sciences - Associate Professor

**W.W.L. Tam**
BSc Hong Kong, PhD Toronto - Professor

**David Cory**
BA, PhD (Case Western Reserve) - Professor and Canada Excellence Research Chair

**Thorsten Dieckmann**
Dipl., Dr. rer. nat. Braunschweig - Associate Professor

**Gary I. Dmitrienko**
BSc, PhD Toronto - Associate Professor

**Jean Dubamel**
BEng, MSc, PhD (ENSIC, Nancy, France) - Professor and Canada Research Chair

**Eric Fillon**
BSc Sherbrooke, MSc Montreal, PhD Toronto - Professor

**Mario Gauthier**
BSc, PhD McGill - Professor

**Tadeusz Gorecki**
MSc, PhD (Technical University of Gdansk) - Professor

**J. Guy Guillemette**
BSc, PhD Toronto - Associate Professor and Graduate Officer

**John F. Honek**
BSc, PhD McGill - Professor and Chair

**Scott Hopkins**
BSc, PhD New Brunswick - Assistant Professor

**Vassili Karanassios**
BSc Thessaloniki, PhD Alberta - Professor

**Holger Kleinke**
BSc, MSc Westfalische-Universität Münster, PhD Johannes-Gutenberg Universität Mainz - Professor and Canada Research Chair

**Anna Klinkova**
B.Sc., Saint Petersburg State University, Russia, M.Sc., Bowling Green State University, Ph.D., Toronto - Assistant Professor

**Sonny C. Lee**
BS California Institute of Technology, PhD Harvard - Associate Professor

**Bob Lemieux**
BA(Hons.), Colgate University (New York), PhD Illinois (Urbana) - Professor and Dean of Science

**K. Tong Leung**
BSc, PhD British Columbia - Professor

**Juewen Liu**
BS Science and Technology (China), PhD Illinois (Urbana-Champaign) - Assistant Professor

**Vivek Maheshwari**
B.Tech Delhi, MSc Wayne State, PhD Virginia - Assistant Professor

**Terrance B. McMahon**
BSc Alberta, PhD California Institute of Technology - University Professor and Dean of Science

**Elizabeth M. Meiering**
BSc Waterloo, PhD Cambridge - Associate Professor and Associate Dean, Graduate Studies

**Susan R. Mikkelsen**
BSc (British Columbia), PhD (McGill) - Professor

**Graham K. Murphy**
BSc (Victoria BC), PhD (Alberta) - Assistant Professor
IX. Graduate Programs, Chemistry

Linda F. Nazar  
BSc British Columbia, PhD Toronto - Professor and Canada Research Chair

Marcel Nieuwenhuis  
BSc, PhD Vrije Universiteit van Amsterdam - Associate Professor

Michael Palmer  
MD Giessen - Associate Professor

Janusz Pawlisiyn  
BSc, MSc Gdańsk (Poland), PhD Southern Illinois - Professor and University/NSERC Industrial Research Chair and Canada Research Chair

William P. Power  
BSc, PhD Dalhousie - Associate Professor and Department Chair

Eric Prouzet  
MSc, PhD Nantes - Associate Professor

Pavle Radovanovic  
MS Georgetown, PhD Washington - Assistant Professor and Canada Research Chair

Pierre-Nicholas Roy  
BSc McGill University, MSc. and PhD, Université de Montréal - Professor and Tier 1 Canada Research Chair in Quantum Molecular Dynamics

Derek Schipper  
BSc University of PEI, PhD University of Ottawa - Assistant Professor

German Sciai  
BSc, PhD University of Buenos Aires - Associate Professor

Rodney Smith  
BSc Honours University of Manitoba, PhD Memorial University of Newfoundland - Assistant Professor

Xiao-Wu (Shirley) Tang  
BS Huazhong University of Science and Technology, PhD Massachusetts Institute of Technology - Assistant Professor

Scott Taylor  
BSc McGill, MSc, PhD Toronto - Professor

Xiaosong Yang  
BSc, MSc Zhejiang University, PhD East China University of Science & Technology - Associate Professor

Adam Wei Tsen  
BS University of California, Berkeley, PhD Cornell University, New York - Assistant Professor

MSc Program

The fields of research in which theses can be written normally fall within: 1) analytical; 2) inorganic; 3) nanoscience; 4) organic; 5) theoretical (also chemical physics); 6) polymer chemistry; 7) biological chemistry or biochemistry; and 8) physical chemistry.

An applicant is encouraged to apply for admission if they have an honours bachelor of science degree, or the equivalent, with a minimum standing of 75% in the last two years from an accredited university. The co-op MSc option is not available to students who have completed a co-op program as undergraduates. Students are, however, eligible for admission to the co-op PhD program.

Applicants whose first language is not English are required to submit evidence of proficiency in the English language or pass the Test of English as a Foreign Language (TOEFL).

Program Requirements

Students enroll in one of three study options: 1) thesis, 2) co-op, or 3) course work and major research project.

Thesis

Students must successfully complete at least four semester-long graduate courses, one of which is the MSc Seminar, CHEM*7940, and submit and defend an acceptable thesis.

Co-op

The academic requirements are the same as in the regular MSc program, but at least two of the required four semester-long courses (including CHEM*7940) must be completed during the first two semesters of study. COOP*1100 - Introduction to Co-operative Education, a mandatory, non-credit course, is a prerequisite for the first work term and prepares the student for the employment process. This course must be completed the semester prior to the competitive co-op job search semester.

After successful completion of the academic semesters of course work, the co-operative education requirements are to successfully complete three consecutive 4-month co-op work terms in an approved laboratory. The student’s performance in the workplace is supervised and evaluated by the student’s employer using the Work Performance Evaluation tool. The student’s progress during the work term is also monitored by the student’s faculty advisor at the University of Guelph.

Graduate Programs, Chemistry

After returning to campus, the student will complete their course work and research and prepare the MSc thesis.

Course Work and Major Research Project (MRP)

Students who elect this option must successfully complete eight graduate courses, including MSc Seminar, CHEM*7940, and MSc Research Project, CHEM*7970. Part-time studies are designed for students whose employment or family responsibilities allow free time for study only in the evenings.

PhD Program

The fields of research in which theses can be written normally fall within: 1) analytical; 2) inorganic; 3) nanoscience; 4) organic; 5) theoretical (also chemical physics); 6) polymer chemistry; 7) biological chemistry or biochemistry; and 8) physical chemistry.

An applicant is eligible for admission to the PhD program at the discretion of the director.

In general, an applicant must possess the qualifications listed for the MSc program, together with a Master of Science degree comparable to those awarded by North American universities and suitable references from the institution at which the MSc degree was awarded. However, direct admission to the PhD program is available to applicants with an overall A standing in an Honours BSc degree.

Applicants whose first language is not English are required to submit evidence of proficiency in the English language or pass the Test of English as a Foreign Language (TOEFL).

Program Requirements

PhD Program

Students in the PhD program must successfully complete three semester-long courses beyond those required for the master of science degree. One of these courses will be the PhD Seminar, CHEM*7950. Students must also pass an oral qualifying examination in their major field, and submit and defend an acceptable thesis.

Students admitted directly to the PhD program from a BSc must successfully complete one semester-long course beyond those required for the master of science degree. In addition, students must also complete CHEM*7950 (PhD Seminar), pass an oral qualifying examination in their major field, and submit and defend an acceptable thesis.

PhD Co-operative Option

Students registered in the PhD program may proceed to that degree under the co-operative option. Under this option one of the two required one-term courses, in addition to CHEM*7950 and qualifying, must be completed within the first two academic semesters of study in the centre. COOP*1100 - Introduction to Co-operative Education, a mandatory, non-credit course, is a prerequisite for the first work term and prepares the student for the employment process. This course must be completed the semester prior to the competitive co-op job search semester.

After successful completion of the academic semesters of course work, the co-operative education requirements are to successfully complete three consecutive 4-month co-op work terms in an approved laboratory. The student’s performance in the workplace is supervised and evaluated by the student’s employer using the Work Performance Evaluation tool. The student’s progress during the work term is also monitored by the student’s faculty advisor at the University of Guelph.

Graduate Programs, Chemistry

An altered co-op fee payment schedule will be proposed during the admission offer stage.

Following successful completion of the work year, the student will return to the centre to continue work on a PhD research project and complete the regular PhD.

Collaborative Specializations

Toxicology

The Department of Chemistry participates in the masters/dotalor collaborative specialization in toxicology. Please consult the Toxicology listing for a detailed description of the masters/dotalor collaborative specialization. Students choosing this option must meet the requirements of the toxicology collaborative specialization, as well as those of (GWC)2 for their particular degree program. Three toxicology courses must be completed including Advanced Topics in Toxicology, TOX*6200, and a research project must be conducted with a participating faculty member at the University of Guelph.

Courses

Except where specified, courses in the following list may be offered in any semester subject to student demand and the availability of an instructor.

All courses are given an eight character code with the sixth having the following significance: 1 (inorganic), 2 (analytical), 3 (biochemistry), 4 (theoretical), 5 (physical), 6 (organic), and 7 (polymer).
Inorganic

CHEM*7100 Selected Topics in Inorganic Chemistry U [0.50]
Discussion of specialized topics related to the research interests of members of the centre. Special topics could include, for example: bioinorganic chemistry; inorganic reaction mechanisms; synthetic methods in inorganic and organometallic chemistry; homogeneous and heterogeneous catalysis; chemistry of polynuclear compounds.
Department(s): Department of Chemistry

CHEM*7120 X-ray Crystallography U [0.50]
Introduction: crystals, basic concepts; space groups; the reciprocal lattice; x-ray diffraction, the phase problem; structure factors; electron density; small molecule structure solution, structure refinement, structure results, journals and databases, paper writing.
Department(s): Department of Chemistry

CHEM*7130 Chemistry of Inorganic Solid State Materials U [0.50]
Introduction to solid state chemistry, common crystal structures, principles of solid state synthesis, theory and experimental methods for characterizing solids, including thermal analysis techniques, powder x-ray and neutron diffraction methods; special topics to include one or more of the optical, electronic, magnetic, or conductive properties of inorganic materials. Prerequisites: one semester-long undergraduate course (at least third-year level) in inorganic chemistry, preferably with content in structural and/or solid state.
Department(s): Department of Chemistry

CHEM*7150 Structure and Bonding in Inorganic Chemistry U [0.50]
Free electron, Hückel and extended Hückel methods for molecules and clusters. Perturbation theory. Applications of group theory in inorganic chemistry; Jahn-Teller effects in molecules and solids. Energy bands in one, two and three dimensions. Prerequisites: three semester-long undergraduate courses in inorganic chemistry and one semester-long undergraduate course in quantum mechanics or group theory.
Department(s): Department of Chemistry

CHEM*7170 Advanced Transition Metal Chemistry U [0.50]
Reactions, structure and bonding of organometallic compounds of transition and non-transition metals.
Department(s): Department of Chemistry

Analytical

CHEM*7200 Selected Topics in Analytical Chemistry U [0.50]
Special topics could include, for example: trace analysis using modern instrumental and spectroscopic methods; advanced mass spectrometry (instrumentation and interpretation of spectra); analytical aspects of gas and liquid chromatography.
Department(s): Department of Chemistry

CHEM*7240 Chemical Instrumentation U [0.50]
Instrumental components and optimum application; rudiments of design; electrical, spectral, migrational and other methods.
Department(s): Department of Chemistry

CHEM*7260 Topics in Analytical Spectroscopy U [0.50]
Atomic emission and absorption spectroscopy; methods of excitation and detection; quantitative applications. Molecular electronic spectroscopy, UV, visible and Raman, instrumental characteristics; applications to quantitative determinations, spectocation, measurements of equilibrium, etc. Sources and control of errors and interferences.
Department(s): Department of Chemistry

CHEM*7270 Separations U [0.50]
Material to be covered is drawn from the following topics: diffusion; isolation of organic material from the matrix; chromatographic techniques - principles of chromatographic separation, gas (GLC, GSC), liquid (LC, LSC, GPC, IEC), supercritical fluid (SFC) chromatographies; GC-MS, CG-FTIR; electrophoresis, flow field fractionation. Prerequisites: undergraduate level course in instrumental analysis.
Department(s): Department of Chemistry

CHEM*7280 Electroanalytical Chemistry U [0.50]
A study of electroanalytical techniques and their role in modern analytical chemistry. The underlying principles are developed. Techniques include chronamperometry, chronocoulometry, polarography, voltammetry, chronopotentiometry, coulometric titrations, flow techniques, electrochemical sensors and chemically modified electrodes.
Department(s): Department of Chemistry

CHEM*7290 Surface Analysis U [0.50]
Department(s): Department of Chemistry

Biochemistry

CHEM*7300 Proteins and Nucleic Acids U [0.50]
Determination of protein sequence and 3-dimensional structure, protein anatomy; prediction of protein structure; intermolecular interactions and protein-protein association; effects of mutation. Nucleic acid structure and anatomy; DNA and chromatin structure; RNA structure; snRNPs and ribozymes; protein-nucleic acid interactions.
Department(s): Department of Chemistry

CHEM*7310 Selected Topics in Biochemistry U [0.50]
Discussion of specialized topics related to the research interests of members of the centre; for example, recent offerings have included peptide and protein chemistry, biochemical toxicology, medical aspects of biochemistry, glycolipids and glycoproteins, redox enzymes, biological applications of magnetic resonance, etc.
Department(s): Department of Chemistry

CHEM*7360 Regulation in Biological Systems U [0.50]
Department(s): Department of Chemistry

CHEM*7370 Enzymes U [0.50]
Department(s): Department of Chemistry

CHEM*7380 Cell Membranes and Cell Surfaces U [0.50]
Membrane proteins and lipids - structure and function; dynamics; techniques for their study; model membrane systems. Membrane transport. The cytoskeleton. Membrane protein biogenesis, sorting and targeting. Signal transduction across membranes. The cell surface in immune responses.
Department(s): Department of Chemistry

Physical/Theoretical

CHEM*7400 Selected Topics in Theoretical Chemistry U [0.50]
Discussion of specialized topics related to the research interests of the members of the centre. Special topics could include for example: theory of intermolecular forces; density matrices; configuration interaction; correlation energies of open and closed shell systems; kinetic theory and gas transport properties; theory of the chemical bond.
Department(s): Department of Chemistry

CHEM*7450 Statistical Mechanics U [0.50]
Review of classical and quantum mechanics; principles of statistical mechanics; applications to systems of interacting molecules; imperfect gases, liquids, solids, surfaces and solutions.
Department(s): Department of Chemistry

CHEM*7460 Quantum Chemistry U [0.50]
Approximate solutions of the Schrodinger equation and calculations of atomic and molecular properties.
Department(s): Department of Chemistry

CHEM*7500 Selected Topics in Physical Chemistry U [0.50]
Discussion of specialized topics related to the research interests of the members of the centre. Special topics could include for example: principles of magnetic resonance in biological systems; collisions, spectroscopy and intermolecular forces, surface chemistry; catalysis; electrolyte theory; non-electrolyte solution theory, thermodynamics of biological systems; thermodynamics.
Department(s): Department of Chemistry

CHEM*7550 Kinetics - Dynamics U [0.50]
Department(s): Department of Chemistry
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<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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<tr>
<td>CHEM*7560</td>
<td>Spectroscopy U [0.50]</td>
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<td></td>
<td>Aspects of electronic vibrational and rotational</td>
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<td>spectroscopy of atoms, molecules, and the solid</td>
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<td>state. Relevant aspects of quantum mechanics,</td>
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<td>Dirac notation, and angular momentum will be</td>
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<td>discussed. Group Theory will be presented and its</td>
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<td>implications for spectroscopy introduced.</td>
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<td>Prerequisites: one semester-long undergraduate</td>
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<td>course in quantum mechanics or the approval of</td>
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<td>the instructor.</td>
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<td>Department(s): Department of Chemistry</td>
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<tr>
<td>CHEM*7600</td>
<td>Selected Topics in Organic Chemistry U [0.50]</td>
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<td>Two or three topics from a range including:</td>
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<td>bio-organic chemistry; environmental organic</td>
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<td>chemistry; free radicals; heterocyclic molecules;</td>
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<td>molecular rearrangements; organometallic</td>
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<td>chemistry; photochemistry; natural products.</td>
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<td>Department(s): Department of Chemistry</td>
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<td>CHEM*7640</td>
<td>Synthetic Organic Reactions U [0.50]</td>
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<td>Department of Chemistry</td>
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<td>Named organic reactions and other synthetically</td>
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<td>useful reactions are discussed. The mechanism,</td>
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<td>stereochemical implications and use in organic</td>
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<td>synthesis of these reactions will be presented.</td>
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<td>Examples from the organic literature will be</td>
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<td>used to illustrate these aspects.</td>
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<td>Department(s): Department of Chemistry</td>
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<td>CHEM*7650</td>
<td>Strategies in Organic Synthesis U [0.50]</td>
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<td></td>
<td>The synthesis of organic compounds is discussed</td>
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<td>and emphasis is placed on the design of</td>
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<td>synthetic routes. Examples drawn from the</td>
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<td>literature are used to illustrate this synthetic</td>
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<td>planning.</td>
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<td>Prerequisite(s): CHEM*7640</td>
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<td>Department(s): Department of Chemistry</td>
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<tr>
<td>CHEM*7660</td>
<td>Organic Spectroscopy U [0.50]</td>
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<td></td>
<td>Ultraviolet, infrared, resonance spectroscopy</td>
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<td>and mass spectrometry, with emphasis on</td>
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<td>applications to studies of organic molecules.</td>
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<td>Department(s): Department of Chemistry</td>
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<td>CHEM*7690</td>
<td>Physical Organic Chemistry U [0.50]</td>
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<td>Linear free energy relationships; substituent</td>
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<td>effects and reactive intermediates.</td>
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<td>Department(s): Department of Chemistry</td>
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<td>Polyam</td>
<td>Principles of Polymer Science U [0.50]</td>
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<td>CHEM*7770</td>
<td>Introduction to the physical chemistry of high</td>
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<td>polymers, principles of polymer synthesis,</td>
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<td>mechanisms and kinetics of polymerization</td>
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<td>reactions, copolymerization theory, polymerization</td>
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<td>in homogeneous and heterogeneous systems,</td>
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<td>chemical reactions of polymers. Theory and</td>
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<td>experimental methods for the molecular</td>
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<td>characterization of polymers.</td>
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<td>Department(s): Department of Chemistry</td>
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<td>CHEM*7710</td>
<td>Physical Properties of Polymers U [0.50]</td>
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<td>The physical properties of polymers are</td>
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<td>considered in depth from a molecular viewpoint.</td>
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<td>Rubber elasticity, mechanical properties,</td>
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<td>rheology and solution behaviour are</td>
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<td>quantitatively treated.</td>
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<td>Prerequisite(s): CHEM*7700 or equivalent</td>
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<td>Department(s): Department of Chemistry</td>
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<td>CHEM*7720</td>
<td>Polymerization and Polymer Reactions U [0.50]</td>
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<td>The reactions leading to the production of</td>
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<td>polymers are considered with emphasis on</td>
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<td>emulsion and suspension polymerization and</td>
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<td>polymerization reaction engineering. Polymer</td>
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<td>degradation, stabilization and modification</td>
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<td>reactions are also considered in depth.</td>
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<td>Prerequisite(s): CHEM*7700 or equivalent</td>
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<td>Department(s): Department of Chemistry</td>
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<td>CHEM*7730</td>
<td>Selected Topics in Polymer Chemistry U [0.50]</td>
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<td></td>
<td>Discussion of specialized topics of polymer</td>
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<td>chemistry related to the research interests of</td>
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<td>the faculty or prominent scientific visitors.</td>
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<td>Special topics could include, for example:</td>
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<td>polymer stabilization and degradation; mechanical</td>
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<td>properties; polymer principles in surface</td>
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<td>coatings; organic chemistry of synthetic high</td>
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<td>polymers; estimation of polymer properties;</td>
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<td>reactions of polymers; polymerization kinetics.</td>
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<td>Department(s): Department of Chemistry</td>
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<td>Research</td>
<td>MSc Seminar U [0.50]</td>
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<td>CHEM*7950</td>
<td>A written literature review and research proposal</td>
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<td>on the research topic will be presented</td>
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<td></td>
<td>and defended in a 30-minute public seminar.</td>
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<td>This requirement is to be completed by all</td>
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<td>thesis-option MSc students within two semesters</td>
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<td>of entering the program.</td>
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<td>CHEM*7970</td>
<td>MSc Research Paper U [0.50]</td>
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<td>An experimental project normally based on the</td>
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<td>CHEM*7940 research proposal, supervised by the</td>
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<td>advisor, taking three to four months to complete.</td>
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<td>This project may be completed at any time during</td>
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<td>the student's program, but it must follow</td>
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<td>CHEM*7940. A written report is required, and a</td>
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<td>seminar based on the content of the report will</td>
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<td>be presented. The report must be completed as</td>
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<td>per the project/thesis guidelines of the</td>
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<td>University campus on which the student is</td>
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<td>registered. This course normally will follow the</td>
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<td>course CHEM*7940 MSc Seminar.</td>
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<td>Department(s): Department of Chemistry</td>
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<td>CHEM*7980</td>
<td>MSc Thesis U [0.00]</td>
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<td>CHEM*7990</td>
<td>PhD Thesis U [0.00]</td>
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