The information published in this Graduate Calendar outlines the rules, regulations, curricula, programs and fees for the 2020-2021 academic year, including the Summer Semester 2020, Fall Semester 2020 and the Winter Semester 2021.

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
520-824-4121

Revision Information:

<table>
<thead>
<tr>
<th>Date</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>May 25, 2020</td>
<td>Initial Publication</td>
</tr>
<tr>
<td>June 3, 2020</td>
<td>Revision 1</td>
</tr>
</tbody>
</table>
Disclaimer

The information published in this Graduate Calendar outlines the rules, regulations, curricula, programs and fees for the 2020-2021 academic year, including the Summer Semester 2020, the Fall Semester 2020 and the Winter Semester 2021.

The University reserves the right to change without notice any information contained in this calendar, including but not limited to that related to tuition and other fees, standards of admission, course delivery or format, continuation of study, and the offering or requirements for the granting of, degrees or diplomas in any or all of its programs. The publication of this calendar does not bind the University to the provision of courses, programs, schedules of study, or facilities as listed herein.

The University will not be liable for any failure or delay in performance arising out of any cause or causes beyond its reasonable control. Such causes may include but are not limited to fire, strike, lock-out, inability to procure materials or trades, war, mass-casualty event, flood, local, regional or global outbreak of disease or other public health emergency, social distancing or quarantine restriction, legislative or regulatory requirements, unusually severe weather, failure of public utility or common carrier, or attacks or other malicious act, including but not limited to attacks on or through the internet, or any internet service, telecommunications provider or hosting facility.

In March 2020 the World Health Organization declared a global pandemic of the virus leading to COVID-19. The Governments of Canada, the Province of Ontario, and local Governments responded to the pandemic with legislative amendments, controls, orders, by-laws, requests and requirements (collectively, the “Governmental Response”). It is uncertain how long the pandemic, and the related Governmental Response, will continue, and it is unknown whether there may be a resurgence of the virus leading to COVID-19 or any mutation thereof (collectively, the “Virus”) and resulting or supplementary renewed Government Response. Without limiting the foregoing paragraph, the University shall not be liable for costs associated with any failure or delay in performance arising out of:

a. the continued spread of the Virus;

b. the continuation of or renewed Governmental Response to control the spread of the Virus; and

c. a University decision, made on an organization-wide basis and in good faith, to control the spread of the Virus, even if exceeding the then current specific Government Response.

In particular, the COVID-19 pandemic may necessitate a revision of the format of course offerings such that courses are offered in whole or in part on an alternate delivery model to in-person classes. Tuition and mandatory fees have been set regardless of the method of instruction and will not be refunded in the event instruction occurs remotely for any part of the academic year.

Dates or times of performance including the Schedule of Dates may be extended as appropriate and the University will notify students promptly of the existence and nature of such delay and shall, so far as practicable, use reasonable efforts to minimize and mitigate any such delay or non-performance.

In the event of a discrepancy between a print version (downloaded) and the Web version, the Web version will apply.

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.
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.
# Table of Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry</td>
<td>56</td>
</tr>
<tr>
<td>Administrative Staff</td>
<td>56</td>
</tr>
<tr>
<td>Graduate Faculty</td>
<td>56</td>
</tr>
<tr>
<td>Graduate Faculty from University of Waterloo</td>
<td>56</td>
</tr>
<tr>
<td>MSc Program</td>
<td>57</td>
</tr>
<tr>
<td>PhD Program</td>
<td>57</td>
</tr>
<tr>
<td>Collaborative Specializations</td>
<td>57</td>
</tr>
<tr>
<td>Courses</td>
<td>57</td>
</tr>
</tbody>
</table>
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 Administrative Assistant. 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 (ESC 228, University of Waterloo, (519) 888-4567, Ext. 32254)
gwc@uwaterloo.ca

Chair of the Department at Guelph
Kathryna Preuss (2515 Science Complex, Ext. 53061)
kppreuss@uoguelph.ca

Departmental Graduate Program Coordinator
Marcel Schlaf (339 MacNaughton, Ext. 53002)
mschlaf@uoguelph.ca

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, Shao Yang University, MSc, Xiamen University, PhD Guelph - Professor, Director of the Electrochemical Technology Centre

Leanne Chen
BSc Queen's, PhD Stanford University - Assistant Professor

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

Wojciech Gabryelski
BSc, MSc Technical University of Gdańsk (Poland), PhD Alberta - Associate Professor

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

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

Rui Huang
BSc Peking, PhD Michigan - Assistant 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

Derek O’Flaherty
BSc, PhD Concordia - Assistant Professor

Kathryn E. Preuss

BSc Lethbridge, PhD Waterloo - Professor and Tier II Canada Research Chair
Paul A. Rowntree
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. Schwann
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

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

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

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 Duhamel
BEng, MSc, PhD (ENSIC, Nancy, France) - Professor and Canada Research Chair

Eric Fillion
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

Subha Kalyaanamoorthy
MSc Annamalai, PhD La Trobe - Assistant Professor

Vassili Karanassios
BSc Thessaloniki, PhD La Trobe - Professor

Holger Kleinke
BSc, MSc Westfälische-Universität Munster, 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

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

Vivek Maheshwari
BTech Delhi, MSc Wayne State, PhD Virginia - Assistant Professor

Terrance B. McMahon
BS, 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

2020-2021 Graduate Calendar
January 28, 2020
The co-operative education requirements are to successfully complete two 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 Co-operative Education & Career Services, including an official site visit during the co-op work term and a review of the student’s official Learning Goals. A Co-op Work Term Report is required for each work term and is graded by an assigned Co-op Faculty Advisor. All evaluation grades will appear on the student’s official transcript.

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

All evaluation grades will appear on the student’s official transcript. 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/phdoral collaborative specialization in toxicology. Please consult the Toxicology listing for a detailed description of the masters/phdoral 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

*Location(s):* Guelph, Waterloo

**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

*Location(s):* Guelph, Waterloo

**CHEM*7150 Structure and Bonding in Inorganic Chemistry U [0.50]**
Free electron, Hueckel and extended Hueckel 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]**
Magnetoochemistry of transition metal compounds. Electronic spectra of complex ions including applications of molecular orbital and ligand field theories. Stabilization of unusual oxidation states and co-ordination numbers. Bonding, structure and reactivity of certain important classes of metal complexes, e.g., metal hydrides, metal-metal bonded species, biologically significant model systems such as macrocycles.

*Department(s):* Department of Chemistry

**CHEM*7180 Advanced Organometallic 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

*Location(s):* Guelph, Waterloo

**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

*Location(s):* Guelph, Waterloo

**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, speciation, measurements of equilibrium, etc. Sources and control of errors and interferences. Determination and description of colour.

*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 (LLC, LSC, GPC, IEC), supercritical fluid (SFC) chromatographies; GC-MS, CG-FTR; 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]**
A study of modern methods of surface 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*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 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

*Location(s):* Guelph, Waterloo

**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

*Location(s):* Guelph, Waterloo

**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

*Location(s):* Guelph, Waterloo
### Polymer

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<tr>
<th>Course Code</th>
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<th>Description</th>
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<tr>
<td>CHEM*7700 Principles of Polymer Science U [0.50]</td>
<td>Introduction to the physical chemistry of high polymers, principles of polymer synthesis, mechanisms and kinetics of polymerization reactions, copolymerization theory, polymerization in homogeneous and heterogeneous systems, chemical reactions of polymers. Theory and experimental methods for the molecular characterization of polymers.</td>
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<tr>
<td>Location(s): Guelph, Waterloo</td>
<td>Department(s): Department of Chemistry</td>
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<th>Course Code</th>
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<tr>
<td>CHEM*7710 Physical Properties of Polymers U [0.50]</td>
<td>The physical properties of polymers are considered in depth from a molecular viewpoint. Rubber elasticity, mechanical properties, rheology and solution behaviour are quantitatively treated.</td>
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<td>Location(s): Guelph, Waterloo</td>
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### Research

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Description</th>
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<tbody>
<tr>
<td>CHEM*7840 Foundations of Chemistry and Biochemistry Research Literature Review F,W [0.50]</td>
<td>Students learn how to search and vet scientific review literature. They develop writing and peer review skills culminating in writing their own review on a topic relevant to their research project.</td>
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<tr>
<td>Location(s): Guelph, Waterloo</td>
<td>Department(s): Department of Chemistry</td>
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<tr>
<td>CHEM*7940 Master's Seminar F,W [0.50]</td>
<td>Preparation of a research proposal on the research proposal, which will be presented and defended in a 30-minute public seminar.</td>
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<tr>
<td>Location(s): Guelph, Waterloo</td>
<td>Department(s): Department of Chemistry</td>
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### Organic

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<tr>
<td>CHEM*7600 Selected Topics in Organic Chemistry U [0.50]</td>
<td>Two or three topics from a range including: bio-organic chemistry; environmental organic chemistry; free radicals; heterocyclic molecules; molecular rearrangements; organometallic chemistry; photochemistry; natural products.</td>
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<tr>
<td>Location(s): Guelph, Waterloo</td>
<td>Department(s): Department of Chemistry</td>
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<tr>
<td>CHEM*7640 Synthetic Organic Reactions U [0.50]</td>
<td>Named organic reactions and other synthetically useful reactions are discussed. The mechanism, stereochemical implications and use in organic synthesis of these reactions will be presented. Examples from the organic literature will be used to illustrate these aspects.</td>
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<tr>
<td>CHEM*7650 Strategies in Organic Synthesis U [0.50]</td>
<td>The synthesis of organic compounds is discussed and emphasis is placed on the design of synthetic routes. Examples drawn from the literature are used to illustrate this synthetic planning.</td>
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<tr>
<td>CHEM*7660 Organic Spectroscopy U [0.50]</td>
<td>Ultraviolet, infrared, resonance spectroscopy and mass spectrometry, with emphasis on applications to studies of organic molecules.</td>
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<tr>
<td>CHEM*7690 Physical Organic Chemistry U [0.50]</td>
<td>Linear free energy relationships; substituent effects and reactive intermediates.</td>
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### Spectroscopy

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<tr>
<td>CHEM*7500 Selected Topics in Physical Chemistry U [0.50]</td>
<td>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.</td>
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<tr>
<td>CHEM*7560 Spectroscopy U [0.50]</td>
<td>Aspects of electronic vibrational and rotational spectroscopy of atoms, molecules, and the solid state. Relevant aspects of quantum mechanics, Dirac notation, and angular momentum will be discussed. Group Theory will be presented and its implications for spectroscopy introduced. Prerequisites: one semester-long undergraduate course in quantum mechanics or the approval of the instructor.</td>
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<tr>
<td>CHEM*7710 Physical Properties of Polymers U [0.50]</td>
<td>Lecture.</td>
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### Thesis

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<tr>
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<tbody>
<tr>
<td>CHEM*7840 Foundations of Chemistry and Biochemistry Research Literature Review F,W [0.50]</td>
<td>Students learn how to search and vet scientific review literature. They develop writing and peer review skills culminating in writing their own review on a topic relevant to their research project.</td>
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<tr>
<td>CHEM*7940 Master's Seminar F,W [0.50]</td>
<td>Preparation of a research proposal on the research proposal, which will be presented and defended in a 30-minute public seminar.</td>
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<tbody>
<tr>
<td>CHEM*7950 PhD Seminar U [0.00]</td>
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<tr>
<td>CHEM*7970 MSc Research Paper U [0.50]</td>
<td>An experimental project normally based on the CHEM<em>7940 research proposal, supervised by the advisor, taking three to four months to complete. This project may be completed at any time during the student's program, but it must follow CHEM</em>7940. A written report is required, and a seminar based on the content of the report will be presented. The report must be completed as per the project/thesis guidelines of the University campus on which the student is registered. This course normally will follow the course CHEM*7940 Master's Seminar.</td>
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<tr>
<td>CHEM*7980 MSc Thesis U [0.00]</td>
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<tr>
<td>CHEM*7990 PhD Thesis U [0.00]</td>
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