Biochemistry

The Department of Biochemistry, Microbiology and Immunology located in the Faculty of Medicine offers graduate programs leading to the master’s (MSc) and doctoral (PhD) degrees in Biochemistry.

The programs prepare candidates for a variety of careers in teaching and research both within and outside of academia. Graduate students are actively involved in laboratory research, course work, and presentation of research seminars. Thus, they acquire autonomy in conducting research and in preparing publications. The programs create a stimulating and challenging environment which will allow students to achieve excellence in research. Graduates of the programs must demonstrate research skills and credibility as professionals in their area of research.

Members of the Department are involved in three main research fields: general biochemistry, molecular biology, and, nutrition and metabolism. Further information is posted on the departmental website.

The Department is a participating unit in the following collaborative programs: the Bioinformatics program (at the master’s level), the Human and Molecular Genetics program (at the master’s and doctoral levels), and the Pathology and Experimental Medicine program (at the master’s and doctoral levels).

The doctoral program participates in the Combined MD / PhD Program, which allows students to graduate with both a PhD in Biochemistry and an MD. For more information please see the website of the Faculty of Medicine.

Most of the courses in these programs are offered in English. Research activities can be conducted either in English, French or both, depending on the language used by the professor and the members of his or her research group.

In accordance with the University of Ottawa regulation, students have a right to produce their work, their thesis, and to answer examination questions in French or in English.

The programs are governed by the general regulations of the Faculty of Graduate and Postdoctoral Studies (FGPS).

Programs

- Master of Science Biochemistry
- Master of Science Biochemistry Specialization in Human and Molecular Genetics
- Master of Science Biochemistry Specialization in Bioinformatics
- Master of Science Biochemistry Specialization in Pathology and Experimental Medicine
- Doctorate in Philosophy Biochemistry
- Doctorate in Philosophy Biochemistry Specialization in Human and Molecular Genetics
- Doctorate in Philosophy Biochemistry Specialization in Pathology and Experimental Medicine

Professors

- Addison, Christina
- Aguer, Céline, Adjunct Professor
  Muscle metabolism, myokines, type 2 diabetes, physical activity
- Alain, Tommy, Assistant Professor
  Apoptosis; Cancer Research; Infectious Diseases; Oncology; Pediatric Cancer; Programmed Cell Death.
- Alarcon, Emilio, Assistant Professor
<table>
<thead>
<tr>
<th>Name</th>
<th>Title</th>
<th>Research Areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Altosaar, Illimar</td>
<td>Full Professor</td>
<td>Biotech foods as global medicines</td>
</tr>
<tr>
<td>Auer, Rebecca</td>
<td>Cross-appointment</td>
<td>Surgical stress, metastases, coagulation, immunotherapy, oncolytic viruses</td>
</tr>
<tr>
<td>Baenziger, John</td>
<td>Full Professor</td>
<td>Nicotinic receptors; membrane proteins; structure/function; crystallization; biophysics; lipid-protein interactions</td>
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<tr>
<td>Baetz, Kristin</td>
<td>Full Professor</td>
<td>Functional genomics</td>
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<tr>
<td>Bell, John</td>
<td>Cross-appointment</td>
<td>Oncolytic viruses; protein translation; cancer therapeutics</td>
</tr>
<tr>
<td>Bennett, Steffany</td>
<td>Full Professor</td>
<td>Neuroregeneration; degeneration; apoptosis; stem cells; Gap junctions; Alzheimer's; transgenic mouse models; Neural Regeneration; Lipidomics</td>
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<tr>
<td>Bertinato, Jesse</td>
<td>Adjunct Professor</td>
<td>Nutrition, mineral status and metabolism, nutrition standards</td>
</tr>
<tr>
<td>Bickel, David</td>
<td>Cross-appointment</td>
<td>Statistical bioinformatics: gene expression data analysis; molecular network reconstruction; model validation methodology; Bayesian and empirical Bayes inference; machine learning algorithms; and Monte Carlo simulation</td>
</tr>
<tr>
<td>Blais, Alexandre</td>
<td></td>
<td>Our lab studies the six family of transcription factors and the critical role its members play in muscle development; we are interested in understanding, at the molecular level, the mode of action of these transcription factors</td>
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<tr>
<td>Boycott, Kym Marie</td>
<td>Cross-appointment</td>
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<tr>
<td>Bulman, Dennis</td>
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<td>Chakraborty, Pranesh</td>
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<tr>
<td>Chrétien, Michel</td>
<td>Cross-appointment</td>
<td>Neural and hormonal peptides; proprotein convertases; atherosclerosis; diabetes; Alzheimer's</td>
</tr>
<tr>
<td>Cockell, Kevin</td>
<td>Adjunct Professor</td>
<td>Nutrition; mineral nutrients; metabolic interactions</td>
</tr>
<tr>
<td>Couture, Jean-François</td>
<td>Assistant Professor</td>
<td>Genetic information is packaged into a chromatin polymer which must be opened to increase the accessibility of gene regulatory factors, or compacted to restrict the access of the transcriptional machinery to target genes</td>
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<tr>
<td>Diallo, Jean-Simon</td>
<td>Replacement Professor</td>
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<tr>
<td>Dimitroulakis, Jim</td>
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<tr>
<td>Fairhead, Todd</td>
<td>Cross-appointment</td>
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</tr>
<tr>
<td>Figeys, Daniel</td>
<td>Full Professor</td>
<td>Proteomics technology and applications in systems biology</td>
</tr>
<tr>
<td>Fullerton, Morgan</td>
<td>Assistant Professor</td>
<td></td>
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<tr>
<td>Giguère, Patrick</td>
<td>Assistant Professor</td>
<td></td>
</tr>
<tr>
<td>Gray, Douglas</td>
<td>Cross-appointment</td>
<td>Proteins inside cells are normally degraded through elaborate and highly regulated cellular machinery; and failure to do so underlies many disease states, we are studying the role of protein degradation in neurodegenerative diseases; lung cancer and aging; these conditions are studied using transgenic mice</td>
</tr>
<tr>
<td>Harper, Mary-Ellen</td>
<td>Full Professor</td>
<td>Mitochondrial energetics; uncoupling proteins; metabolic regulation; obesity and diabetes</td>
</tr>
</tbody>
</table>
Hefford, Mary Alice, Adjunct Professor
Holcik, Martin, Cross-appointment
Apoptosis; cancer; IAP; translational control; RNA binding proteins; signal transduction

Hou, Sheng T., Adjunct Professor
Neurodegeneration; regeneration; apoptosis; axonal guidance; stroke

Ioshikhes, Ilya, Associate Professor
Transcriptional regulation of gene expression; nucleosome positioning as essential element of gene regulation, micro-RNA regulation.

Kuroski De Bold, Mercedes L, Cross-appointment

Labow, Rosalind, Cross-appointment
Biomaterials; cell signaling in macrophages on material surfaces during tissue regenerations

Lagace, Thomas, Cross-appointment
Atherosclerosis, Genetics and Cell Biology; Lipoprotein Receptor Biology

Laneuville, Odette, Full Professor
Understanding the regulation of expression of the enzyme cyclooxygenase

Lee, Hoyun

Lee, Jonathan, Associate Professor
Breast cancer and molecular biology of cell motility

Lessard, Benoit, Assistant Professor

Liu, Johne

Liu, Qing Yan, Adjunct Professor
Molecular genetics; genomics; apoptosis; neurodegeneration; DNA microarray; bioinformatics

Logan, Susan, Adjunct Professor
Bacterial pathogenesis; prokaryotic protein glycosylation systems

Lorimer, Ian

Mackenzie, Alexander, Cross-appointment
Spinal muscular atrophy (SMA); role of neuronal apoptosis inhibitory peptide

McBurney, Michael, Cross-appointment
Molecular basis of gene silencing in mammalian cells

McPherson, Phyllis, Cross-appointment
Regulation of HDL receptors; cholesterol trafficking, atherothrombotic risk

McPherson, Ruth

Mezl, Vasek, Associate Professor
Vitamin E (-tocopherol); regeneration of Vitamin E

Milne, Ross, Cross-appointment
Features of the LDL receptor and of lipoproteins that allow them to specifically recognize each other and interact

Nemer, Mona, Full Professor
Molecular mechanisms involved in cellular growth and differentiation, particularly as this relates to heart failure and congenital heart diseases

Pelchat, Martin
Host components involved in subviral RNA pathogen replication

Perkins, Theodore, Adjunct Professor
Bioinformatics, machine learning, stem cell, cancer biology

Picketts, David
Ramirez, Sandra, Adjunct Professor
Bacterial contamination in blood products; bacterial cell division and cell growth; cell division mechanisms of Staphylococcus epidermidis

Rayner, Katey, Assistant Professor
microRNA, atherosclerosis, inflammation, macrophages, obesity, cholesterol

Rosu-Myles, Michael, Adjunct Professor
Stem cells, flow cytometry, health product evaluation

Rotstein, Benjamin, Assistant Professor

Rudner, Adam, Assistant Professor
Chromosome structure and dynamics; yeast genetics; cell cycle regulation

Scott, Fraser, Full Professor
Nutritional modification of type 1 autoimmune diabetes; bioactive food components

Skerjanc, Ilona, Full Professor
Cardiac and skeletal muscle development; stem cells; gene expression

Sorisky, Alexander, Cross-appointment
Obesity; adipocyte differentiation; insulin action; apoptosis; diabetes

Stewart, Alexandre, Cross-appointment
Inherited cardiovascular disorders; genetic risk factors for Coronary Artery Disease

Stintzi, Alain, Associate Professor
Microbial genomics, campylobacter jejuni; iron acquisition and metabolism; and stress responses

Tanphaichitr, Nongnuj, Cross-appointment
Mammalian reproduction; contraceptives; fertilization; reproductive toxicology and biotechnology

Tian, Ruijun, Adjunct Professor

Trudel, Guy, Full Professor

Vincent, Renaud, Adjunct Professor
Environmental toxicology; pathology; proteomics; inhalation toxicology

Woulfe, John

Yao, Zemin, Full Professor
Factors required for hepatic assembly and secretion of apoB-containing lipoproteins; the LDL-receptor binding domain(s) within human apoB100; mechanisms responsible for the intracellular degradation of newly synthesized apoB; Structure/function relationships within LRP (the LDL-receptor Related Protein) and its potential role in post-prendial fat absorption by the adipose tissue

Zha, Xiaohui, Cross-appointment
Fluorescent microscopy; membrane trafficking; cholesterol
Admission

Master's

Admission to the graduate program in Biochemistry is governed by the general regulations of the FGPS.

To be considered for admission, applicants must:

- Hold a bachelor’s degree with a specialization or a major (or equivalent) in science, an MD (Doctor of Medicine) degree, or a DVM (Doctor of Veterinary Medicine) degree with a minimum average of 75% (B+).
- Demonstrate a good academic performance in previous studies as shown by official transcripts, research reports, abstracts or any other documents demonstrating research skills.
- Provide at least two confidential letters of recommendation from professors who have known the applicant and are familiar with the student work;
- Provide a statement of purpose indicating the career goals and the interests in the proposed research area.
- Identify at least one professor who is willing and available to act as thesis supervisor.
- Be proficient (understand, speak and write) in English. Most of the courses in these programs are offered in English. Research activities can be conducted either in English, French or both, depending on the language used by the professor and the members of his or her research group.

The Department may require students to take additional courses depending on their backgrounds.

Collaborative program in Bioinformatics

The Department of Biochemistry, Microbiology and Immunology is a participating unit in the collaborative program in Bioinformatics (master’s level only). Students should indicate in their initial application for admission that they wish to be accepted into the collaborative program. The thesis director must be a member of the collaborative program. For further details, see the description of the Bioinformatics program posted on the FGPS website.

Collaborative program in Human and Molecular Genetics

The Department of Biochemistry, Microbiology and Immunology is a participating unit in the collaborative program in Human and Molecular Genetics (master’s and doctoral levels). Students should indicate in their initial application for admission that they wish to be accepted into this program. The thesis director must be a member of the collaborative program. For further details, see the description of the Human and Molecular Genetics program posted on the FGPS website.

Collaborative program in Pathology and Experimental Medicine

The Department of Biochemistry, Microbiology and Immunology is a participating unit in the collaborative program in Pathology and Experimental Medicine (master’s and doctoral levels). Students should indicate in their initial application for admission that they wish to be accepted into this program. The thesis director must be a member of the collaborative program. For further details, see the description of the Pathology and Experimental Medicine program posted on the FGPS website.

Program Requirements

Master's
MSc in Biochemistry

The following requirements must be met:

- Successful completion of compulsory course MED8166 PROFESSIONALISM AND PROFESSIONAL SKILLS.
- Successful completion of 6 units of approved 8000-level and above BCH courses.
- Successful completion of the seminar BCH5366, which involves the presentation of a seminar and regular attendance at the departmental seminars until permission to write the thesis is granted.
- Successful presentation and defense of a thesis (BCH7999) based on original research carried out under the direct supervision of a research faculty member in the Department.

Collaborative program in Bioinformatics

The student is responsible for fulfilling both the participating unit requirements for the primary program and the requirements for the collaborative program.

The requirements specific to the collaborative program are as follows:

- 3 compulsory units in bioinformatics (BNF5106/BIO5106).
- Enrollment in the seminar course in bioinformatics (BNF6100), which involves a written report, the presentation of a seminar, and regular attendance at departmental seminars.
- Successful presentation and defense of a research thesis on a topic in bioinformatics based on original research carried out under the supervision of a faculty member participating in the bioinformatics collaborative program.

The primary program may require students to take additional courses, depending on their backgrounds.

Collaborative program in Human and Molecular Genetics

The student is responsible for fulfilling both the participating unit requirements for the primary program and the requirements for the collaborative program.

Six units of courses, three units of which must be from the student's primary program and three of which must be HMG units.

- Enrolment in the seminar course, presentation of one seminar and active participation in the seminar series in the student's primary program.
- Successful presentation and defense of a thesis based on original research carried out under the direct supervision of a member of the collaborative program.

Master's candidates intending to transfer directly to the doctoral program must meet the conditions set by their primary program.

Course selection is subject to the approval of the HMG program director.

The Department may require students to take additional courses, depending on their backgrounds. Students wishing to take a course in a related discipline must obtain prior approval from the Department.

Collaborative program in Pathology and Experimental Medicine

The requirements and regulations of both the primary program and of the collaborative program must be met.

The requirements specific to the collaborative program are as follows:

- One course (3 units) in the primary program.
- One Pathology and Experimental Medicine specialization course (3 units).
Successful completion of the Pathology and Experimental Medicine seminar course.

Successful presentation and defence of a thesis on a topic in pathology and experimental medicine based on original research carried out under the supervision of a professor who is a member of the Pathology and Experimental Medicine collaborative program. At least one of the thesis examiners must be a member of the Pathology and Experimental Medicine collaborative program.

Transfer from master’s to PhD

Outstanding students enrolled in the MSc program may be allowed to transfer to the PhD program without being required to write a master’s thesis. For additional information, please consult the “Admission” section of the PhD program.

Duration of program

The requirements of the program are usually fulfilled within two years of full-time studies. The maximum time permitted in four years.

Residence

All students must complete a minimum of three terms (sessions) of full-time enrollment.

Minimum standards

The passing grade in all courses is C+. Students who fail two courses (equivalent to 6 units) will be withdrawn from the program.

Courses

Not all of the listed courses are given each year. The course is offered in the language in which it is described.

**BCH5101 ANALYSIS OF –OMICS DATA (3 units)**
Theoretical and practical aspects of various methods currently used to analyze the plethora mountain of –omics data. Methods: sequence alignment and database searches; sequence analysis and bioinformatics of gene regulation; DNA microarray and sequencing technologies to identify transcription factor binding sites; analysis of proteomics data; statistical analysis of preprocessed gene expression and protein/metabolite abundance data; epidemiology applications. Critical reading of the literature and strategies for making informed choices of methods for the analysis of students’ own data. Prerequisites: BCH2333, BCH3170.

**BCH5366 MSc SEMINAR (3 units)**
Attendance and participation in the annual BMI Student Symposium and BMI Poster Day, attendance at BMI seminars relevant to Biochemistry. Students must present at least one poster and one oral presentation during the course of their program. Graded S/NS

**BCH7999 RECHERCHE POUR LA THÈSE DE MAÎTRISE / MSC THESIS RESEARCH**
À l'intention des étudiants faisant de la recherche en vue de l'obtention de la maîtrise. Les étudiants doivent soumettre au Département un plan détaillé de la recherche qu'ils se proposent de faire. Ils doivent rencontrer leur comité consultatif de thèse au moins une fois par année et soumettre un rapport de progrès au Département. / For students doing research leading to the master’s degree. Students must ensure that a detailed outline of their proposed research is on file with the Department. They must meet at least once per year with their thesis advisory committee and submit a progress report to the Department.

**BCH8101 PHYSICAL AND CHEMICAL METHODS IN BIOCHEMISTRY (3 units)**
Current applications of physical and chemical methods to the study of macromolecule structure-function relationships.

**BCH8102 SELECTED TOPICS IN PROTEIN STRUCTURE AND FUNCTION (3 units)**
An advanced study of recent literature dealing with structure-function relationships in selected proteins.

**BCH8103 ADVANCED TOPICS IN GENE EXPRESSION AND PROTEIN SYNTHESIS (3 units)**
An advanced study of the recent literature dealing with the chemistry, metabolism and function of nucleic acids, the biosynthesis of proteins, biochemical and genetic control mechanisms, genetic engineering and the control of gene expression. Offered every second year in alternation with BCH8105. Prerequisite: BPS 4101 or equivalent with the permission of the instructor.
BCH8104 ADVANCED TOPICS IN CELL REGULATION (3 units)
An advanced study of recent literature dealing with signal transduction processes and the regulation of metabolism, cell proliferation and differentiation. Prerequisites: Offered in alternate years.

BCH8105 ADVANCED TOPICS IN MOLECULAR BIOLOGY OF HUMAN DISEASES (3 units)
Topics will be selected and representative of current developments in the field. The course consists of a repeated series of a 3 hour lecture by an expert in the field one week, followed by student presentations, discussions and critique of assigned papers on that topic the following week. Topics on selected diseases will focus on various aspects of cancer, apoptosis, disease gene identification and gene therapy. In the past these topics have included the molecular aspects of various cancers, spinal muscular atrophy, tissue regeneration, the discovery of disease genes, infectious disease (HIV) and gene therapy. Students will write a grant proposal and participate in mock grant review panels. Depending on enrolment, the course may be limited to HMG students only. Prerequisite: Permission of the HMG program director.

BCH8106 ADVANCED TOPICS IN NUTRITION AND REGULATION OF METABOLISM (3 units)
An advanced study of the recent literature dealing with metabolism, nutrition and metabolic control theory, with emphasis on both whole body and cell metabolism in metabolic and nutritional disorders such as obesity and non-insulin-dependent diabetes mellitus (NIDDM).

BCH8107 ADVANCED TOPICS IN STRUCTURE AND FUNCTION OF PLASMA LIPOPROTEINS (3 units)
Recent advances in our knowledge of the plasma lipoproteins with a special emphasis on their role in the etiology of atherosclerosis. The subject will be introduced by an overview of the general structural properties of lipoproteins which will be followed by detailed discussion of the structure, metabolism and genetics of the apolipoproteins, the proteins and enzymes that modify lipoproteins and cell surface lipoprotein receptors. Other topics will include cholesterol homeostasis, plasma cholesterol transport and disorders of lipoprotein metabolism.

BCH8108 ADVANCED METHODS OF MACROMOLECULAR STRUCTURE DETERMINATION (3 units)
A detailed examination of modern methods used to determine the structures of proteins, nucleic acids, and carbohydrates. May include X-ray crystallography, electron diffraction, nuclear magnetic resonance, and other spectroscopic methods.

BCH8109 ADVANCED TOPICS IN CELL DEATH (3 units)
Molecular mechanisms of cell death. Particular attention to be paid to role of aberrant cell death in human disease. Offered in the Fall of odd numbered years.

BCH8110 ADVANCED TOPICS IN SYSTEMS BIOLOGY (3 units)
Recent advances in genomics, proteomics, bioinformatics, and neuroinformatics including functional and chemical genomics, RNA analyses, microarrays, mass spectrometry, and neural imaging. Course requirements include student presentations and writing a mock research proposal based on Canadian Institutes of Health Research (CIHR) guidelines. Limited enrollment. Offered in alternate years with BCH 8101 Physical and Chemical Methods in Biochemistry. Prerequisite: Permission of the program director.

BCH8111 CHROMOSOME AND CHROMATIN BIOLOGY (3 units)
Higher order chromosome structure and chromatin remodeling and their impact on regulation of gene expression, DNA replication, repair and recombination, and chromosome segregation. Histone modifications and nucleosome positioning and their influence on higher order chromosome structure. Importance of chromosome and chromatin in the context of the cell cycle, development, and disease. Critical reading of the literature on chromosome and chromatin biology.

BCH8114 ADVANCED TOPICS IN THE CELL CYCLE (3 units)
Mechanisms of cell cycle regulation. Model systems critical to deciphering the cell cycle in eukaryotes: budding and fission yeast, Xenopus laevis egg extracts, Aspergillus nidulans, Drosophila melanogaster, sea urchin and mouse oocytes and cultured vertebrate cells. Overview of the prokaryotic cell cycle.

BCH8116 MODEL ORGANISMS AND SYSTEMS BIOLOGY (3 units)
Utilization of model organisms in the development and advancement of the systems biology field. Particular attention will be paid to the use of organisms such as Saccharomyces cerevisiae as a model platform for cell cycle progression/cancer. Other models may also be included. The basics of the technology will be discussed along with the application of technology to complex biological questions, in particular relating to the cell cycle. Course offered in alternate years.

BCH8117 ADVANCED TOPICS RELATING TO THE CELL CYTOSKELETON AND MEMBRANES (3 units)
Advanced study of recent literature dealing with the mammalian cellular cytoskeleton and membrane with an emphasis on the regulation of cell motility, adhesion and cell division.

BCH8134 STRUCTURE AND EXPRESSION OF EUKARYOTIC AND PROKARYOTIC GENOMES (3 units)
Sequencing of eukaryote and prokaryote genomes with emphasis on recent technologies, sequence alignments and databases and assembly of genomes from massively parallel sequencing data. Focus on mapping studies, including linkage disequilibrium-based genome-wide association study (GWAS), to characterize functional variants associated with complex traits. Analysis and structure of microbial metagenomes from
environmental and human habitats, including structure-function analysis of microbial communities, microbiota-human disease correlations, and molecular phylogeny. Genome expression, including measures of RNA transcripts and proteins and statistical analysis of data. Combination of various -omics data to understand gene-environment interactions.

**BCH8165 SPECIAL TOPICS IN BIOCHEMISTRY I** (3 units)
A survey of recent advances in selected areas of biochemistry.

**BCH8166 Special Topics in Biochemistry II** (3 units)
A survey of recent advances in selected areas of biochemistry.

**BCH8310 CURRENT TOPICS IN RNA MOLECULAR BIOLOGY** (3 units)
Properties, mechanisms associated with regulation and the functions of RNAs and Ribonucleoprotein (RNPs) as well as RNA organisms. Current knowledge on RNA expression (synthesis, processing, transport and localization), the structure-function relationship and molecular mechanisms associated with RNAs and RNA genomes, RNA in evolution and in the origin of life, and RNA as therapeutic agents. Prerequisites: BCH/BIO 3570-3170 or equivalent with the permission of the program director. Exclusion : CMM 8310.

**BCH8366 PhD SEMINAR** (3 units)
Attendance and participation in the annual BMI Student Symposium and BMI Poster Day, attendance at BMI seminars relevant to Biochemistry. Students will present a poster in their first and every alternate year, and an oral presentation the second and every alternate year until they have permission to write their thesis. Graded S/NS

**BCH9998 EXAMEN DE SYNTHÈSE (DOCTORAT) / COMPREHENSIVE EXAMINATION (PhD)**
À l'intention des étudiants inscrits au programme de Ph.D. L'inscription à ce cours est limitée à trois sessions consécutives. / For students enrolled in the doctoral program. Enrollment in this course is limited to three consecutive academic sessions.

**BCH9999 RECHERCHE POUR LA THÈSE DE DOCTORAT / DOCTORAL THESIS RESEARCH**
À l'intention des étudiants faisant de la recherche en vue de l'obtention du doctorat. Les étudiants doivent soumettre au Département un plan détaillé de la recherche qu'ils se proposent de faire. Ils doivent rencontrer leur comité consultatif de thèse au moins une fois par année et soumettre un rapport de progrès au Département. / For students doing research leading to the doctoral degree. Students must ensure that a detailed outline of their proposed research is on file with the Department. They must meet at least once per year with their thesis advisory committee and submit a progress report to the Department.

**CMM5315 CELLULAR AND MOLECULAR BASIS OF CARDIOVASCULAR FUNCTION/DYSFUNCTION** (3 units)
Mechanism of failing heart and cardiovascular system, its associated functions and associated conditions. Therapies for restoring function. Topics include: regulation of heart development, cell signaling, cellular and molecular mechanisms of atherosclerosis and heart disease, hormonal regulation, hypertension, bioenergetics, cardiovascular genomics and genetics, cell therapy, and regenerative medicine.

**HMG8106 CLINICAL CYTOGENOMICS** (3 units)
Comprehensive review of the basic principles and technologies in cytogenomics and their clinical application for diagnostic and prognostic purposes. Registrations may be limited depending on enrolment. Prerequisite: Permission of the course coordinator.

**HMG8107 CLINICAL BIOCHEMICAL GENETICS** (3 units)
Presentation of the biomechanical and molecular bases of inborn errors of metabolism. The course consists of a series of lectures followed by student discussion of a related paper assigned the previous week. Registrations may be limited depending on enrolment. Prerequisite: Permission of the course coordinator.

**HMG8108 CLINICAL MOLECULAR GENETICS** (3 units)
Comprehensive review of all aspects of clinical molecular genetics acquainting students with clinical applications of various molecular technologies. Registrations may be limited depending on enrolment. Prerequisite: Permission of the course coordinator.

**MED8166 PROFESSIONALISM AND PROFESSIONAL SKILLS**
Basic professional skills related to academic integrity, proper referencing techniques, avoidance of plagiarism, professional etiquette, public speaking, time and stress management, conflict management, teamwork, knowing when and how to access student support services. Compulsory for all students enrolled in master’s or doctoral programs at the Faculty of Medicine. Graded S/NS (Satisfactory/Not satisfactory).