

# Department of Biochemistry and Molecular Genetics

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The Department of Biochemistry and Molecular Genetics offers undergraduate courses to Nursing students and to Health Profession students enrolled in the Medical Laboratory Sciences Degree Program.

It also offers graduate level courses to medical students and to graduate students in the graduate program leading to a master's degree in Biomedical Sciences, MSc Biochemistry and a doctoral degree (PhD) in Biomedical Sciences or Biomedical Engineering.

The requirements for admission to the graduate program are a BA with prerequisites in chemistry and biology courses or a BS degree from a university and an academic record with a cumulative average of 80 and above. Students should have a background in chemistry, biology, or a related medical science degree. Students will spend a minimum of two years in the graduate program during which they must complete 21 credits of graduate courses, pass a comprehensive exam (BIOC 395 A/B), and submit a thesis (9 credits, BIOC 399 A/B/C/D/E) based on independent research. The 21 credits of graduate courses include a total of 14 credits of required core courses and 7 credits of elective courses.

Required MSc courses in Biomedical Sciences track Biochemistry include: BIOC 302 (1 cr); BIOC 305 (1cr) ; BIOC 321 (1 cr.); BIOC 322 (1 cr.), BIOC 323 (2 cr.), BIOC 325 (2 cr.); BIOC 326 (2 cr); BIOC 330 (2 cr) and IDTH 301 (2cr).

Required PhD courses in Biomedical Sciences are listed on page 547 of the Graduate Catalogue.

## Undergraduate courses

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**BIOC 246 Biochemistry for Nursing 60.0; 4 cr.**  
 A course that provides an introduction to basic concepts in biochemistry. It discusses the main biochemical pathways in the cell and defines the interrelations between the different metabolic pathways. The course is composed of three units: (a) general chemistry (b) organic chemistry (c) biochemistry. Offered to BS Nursing and is open to undergraduates in related sciences. *First term.*

**BIOC 255 Biochemistry for MLSP 45.0; 3 cr.**  
 A course that provides an overview of structure, function, and metabolism of basic biological micro/macro molecules; a general review of the genetic makeup; and emphasizes the clinical relevance by correlating disease to basic information. The course is an introductory biochemistry course offered to undergraduate students in the Medical Lab Technology Program and related fields. *Second term.*

## Graduate courses

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Courses in the graduate program are open to all graduate students enrolled in the various Biomedical Sciences departments and in Biomedical Engineering as well as to science major graduates, such as Biology, Chemistry or related sciences upon the consent of the coordinator.

### Required Courses

**BIOC 302 Genetic Pathways in Organogenesis 15.0; 1 cr.**  
 A course that aims at drawing all the pathways involved in early organogenesis in mammals. The students will be exposed to all the techniques that helped in understanding these pathways. Detailed mechanisms governing cell differentiation and tissue-specific gene regulation will be explained for select organs. Genetic networks involving genes encoding growth factors and transcription factors will be exposed and contrasted between the different organs. Examples of Mendelian inherited disorders caused by mutations in these genes will be discussed at the end. *Required. Prerequisites: BIOC 321 and BIOC 322, or consent of the coordinator. Second term.*

**BIOC 305 a, b, c Biochemistry Research Seminars 0.30; 1 cr.**  
 A required course that spreads over three terms. During their residency in the master's program, graduate students will register for: BIOC 305 a (0 cr.) during the second term of their first year; BIOC 305 b (0 cr.) during the first term of their second year; and BIOC 305 c (1 cr.), following their completion of a and b, during the second term of their second year.

Each of BIOC 305 a, b, c will emphasize one or two biochemical or genetic themes. Students will be asked to present published research or literature reviews on a specific topic as advised by the different coordinators. *Required from MS Biochemistry students.*

**BIOC 321                    Nucleic Acids and Basic Genetics                    15.0; 1 cr.**  
 This course discusses the principles of nucleic acids structure and function in eukaryotes. It includes the information for basic genetics in terms of genome structure as well as the diversity of gene regulation. Required from MS and PhD students in Biomedical Sciences. *Requires consent of coordinator for other graduate disciplines. First term.*

**BIOC 322                    Protein Biochemistry                    10.10; 1 cr.**  
 This course deals with the biochemistry of proteins including their basic units, different structures, folding process and protein-protein interactions. It focuses on how changes at the structural level modify function. The course also covers the principles of protein purification and sequencing and introduces students to protein database, molecular modeling and systems biology. *Required from MS and PhD students in Biomedical Sciences. Requires coordinator approval for other graduate disciplines. First term.*

**BIOC 323                    Cellular Metabolism and Regulation                    25.10; 2 cr.**  
 The course provides a coherent account of structural and metabolic biochemistry. It emphasizes basic concepts of dynamic state and regulatory mechanisms that allow conflicting pathways and reactions to occur while maintaining homeostasis at the organ and inter-organ levels. *Required from MS and PhD students in Biomedical Sciences. Requires coordinator approval for other graduate disciplines. First term.*

**BIOC 325                    Receptors and Signal Transduction                    25.10; 2 cr.**  
 This course covers classical pathways involved in receptor signaling and activation of downstream targets and the molecular mechanisms involved. It deals with inter- and intracellular communication, from the generation of signaling molecules through the cellular responses. *Required from MS and PhD students in Biomedical Sciences. Requires consent of coordinator for other graduate disciplines. First term.*

**BIOC 326 A, B            Bioinformatics Tools and Applications in Genomics                    32.0; 2 cr.**  
 This two-module course (1 credit/module) introduces students to the new field of Next Generation Sequencing (NGS). It covers different NGS applications involved in basic research and precision medicine. Students will learn about modern methods, concepts and techniques that are widely used in the field. The hands-on sessions will allow students to acquire basics of bioinformatics and genomics data analysis using state of the art tools and methods. Cases from the literature on genetics, cancer genomics and diseases in general will be discussed. *Open to all graduate students from FM, FAS, FHS, FAFS and FEA. Both modules are required for the students of the Biochemistry and Molecular Genetics Department. Required. Prerequisite: Consent of coordinator. Second term.*

**BIOC 326A                Bioinformatics Tools and Applications in Genomics:                    1 cr.**  
**A focus on the Basics of Next Generation Sequencing**

**BIOC 326B                Bioinformatics Tools and Applications in Genomics:                    1 cr.**  
**Next Generation Sequencing analysis for functional genomics and precision medicine**

**BIOC 330 Translational Genetics and Genomics 32.0; 2 cr.**  
 This course discusses the different types of genetic and genomic aberrations often encountered in human disease. The course also explores the spectra of genetic and genomic alterations in the pathobiology of various human diseases including congenital heart disease, diabetes, adult and pediatric cancer as well as cardiovascular, neurological, dermatological and autoimmune disorders. The course also discusses the translation of human disease genomics to improved precision medicine such as risk assessment, early detection, diagnosis and personalized therapy. *Required.*  
*Prerequisite: Consent of coordinator. Open to MS and PhD students in Biomedical Sciences. Requires coordinator approval for other graduate disciplines. Second term.*

**BIOC 395A/B Comprehensive Exam 0 cr.**  
*Prerequisites: Completion of 4 credits with an average of 80 and consent of advisor.*

**BIOC 399 MS Thesis 9 cr.**  
**A/B/C/D/E**

A 9 credit-hour course in which students conduct original research under faculty supervision. Faculty research focus includes: molecular mechanisms of inflammation, vascular biology, congenital heart problems, metabolism, metabolic disorders, mitochondrial toxicology, phenotype-genotype studies, Wilson's disease, diabetes and its complications (microvascular and macrovascular), atherosclerosis, sphingolipid metabolism, genetics of autism, dermatological disorder, cancer, cell death, herbal medicine, natural product remedies, liver injury, inflammation, traumatic brain injury causes and mechanisms, proteomics, bioinformatics.

## Elective Courses

**BIOC 303 a, b Molecular Biology of Cancer a) 15.0; 1 cr ; b) 30.0; 2 cr.**  
 A 2-module course composed of BIOC 303 a (1 cr.) and BIOC 303 b (2 cr.) that is open to MSc. and or Ph.D.

**BIOC 303 a:** A course that deals with the regulatory mechanisms of tumor cell growth and cancer formation at the cellular, molecular, genetic and epigenetic levels. This course includes a discussion of recent developments in the intra- and/or inter-cellular mechanisms involved in cellular proliferation, cell death and resistance to cancer therapeutics. *The 1-credit elective course is open to all graduate students in basic Biomedical Sciences, Biomedical Engineering and Biology. Second term.*

**BIOC 303 b:** A course that deals with more advanced topics in tumor biology, such as invasion and metastasis, cancer stem cells and animal models. The 2-credit elective course is recommended for graduate students whose research interest can benefit from a thorough knowledge of tumor biology. *BIOC 303 is a prerequisite for BIOC 303 b. Students can register for both BIOC 303 a and BIOC 303 b. Second term.*

**BIOC 306 Mediators in Vascular Biology and Inflammation 32.0; 2 cr.**  
 An elective course that describes the different mediators and their role in vascular biology and inflammation. *Elective. Open to graduate students in basic Biomedical Sciences and Biology, and to medical doctors. Second term; alternating years.*

**BIOC 310                    Molecular Basis of Genetic and Metabolic Disorders                    16.32; 2 cr.**

A course that deals with the molecular basis of genetic and metabolic disorders. This course presents a detailed overview of the molecular basis of known genetic diseases. Students also learn the methods used to map chromosomal aberrations or DNA mutations implicated in congenital diseases. A PhD elective course. *Open to all graduates in Biomedical Sciences or related fields of study. Prerequisites: BIOC 321 and BIOC 322, or a background in biology. Second term; alternating years.*

**BIOC 314                    Mitochondria: Genetics, Protein and Disease                    15.0; 1 cr.**

A course that provides a clear understanding of the biochemistry, molecular genetics and bioenergetics of the mitochondria (mt). It emphasizes the role of the mitochondrial dysfunction (mt-DNA mutations, environmental toxins) in the pathogenesis of mitochondrial diseases. *Elective course open to all graduate students in basic Biomedical Sciences and Biology. Second term or summer; alternating years.*

**BIOC 316                    Bioinformatics                    0.30; 1 cr.**

A course that introduces students to the latest bioinformatics literature. The format is a journal club in which recent journal articles are circulated and discussed. Guest lecturers are invited to present research related to the field. Students are also given an orientation on software currently available in the Computational Science and Bioinformatics Lab. *Elective. Open to both basic Biomedical Sciences as well as Arts and Sciences graduate students. Prerequisites: Consent of instructor and graduate standing.*

**BIOC 317 (a-j)            Special Topics in Biochemistry and Genetics                    15.0; 1 cr.**

A series of special elective courses (a-i), 1 credit each, which will emphasize the basic concepts and introduce recent developments in the fields of (a) Proteomics; (b) Metabolomics; (c) Genomics; (d) Lipidomics; (e) Enzymology; (f) Apoptosis; (g) Biochemistry of Inflammation; (h) Biochemical Toxicology; (i) Congenital Heart Problems; (j) Grant and Proposal Writing. Courses are open to medical doctors who would like to update their knowledge and to MSc/PhD graduates in biomedical and /or related fields. *Elective. Prerequisite: Consent of coordinator. First/second /summer term.*

**BIOC 327                    Cancer Genomics                    15.0; 1 cr.**

This course explores genetic and genomic alterations in cancer and their role in the onset and progression of various malignancies. The course also discusses how understanding cancer genomes is advancing precision cancer medicine via molecular-based risk assessment, early detection, diagnosis and targeted personalized therapy. Lastly, the course also explores emerging concepts in cancer genomics including intratumoral heterogeneity and immunogenomics. *Elective. Prerequisite: Consent of coordinator. Open to MS and PhD students in Biomedical Sciences. Requires coordinator approval for other graduate disciplines. First term.*