MOLECULAR SCIENCE

CURRICULUM

Master of Science

DEGREE REQUIREMENTS		**Credits**
Master's Thesis		(Milestone)
MS8201	Master's Seminar 1	Pass/Fail
MS8202	Master's Seminar 2	Pass/Fail
Three Credits from Field I or Field II		3

Doctor of Philosophy

First Offered all 2011

DEGREE REQUIREMENTS		**Credits**
Candidacy Examination		(Milestone)
Dissertation		(Milestone)
MS9201	PhD Seminar	Pass/Fail
Three Credits from Field I or Field II		3

Field I: Materials, Surfaces and Interfaces

ES 8909	Environmental Biotechnology	1
MS8101	Adv Analytical Chemistry	1
MS8102	Adv Microscopy and Imaging	1
MS8104	Interfacial Phenomena	1
MS8105	Molecular Recognition	1
MS8106	Materials Science	1
MS8108	Adv Structure Determination	1
MS8109	Directed Studies Molecular Sci	1
MS8110	Advanced Organometallics	1
MS8111	Experimental Design and Statistical Analysis	1
MS8112	Molecular Machines of the Cell	1

Field II: Molecular BioScience

ES 8909	Environmental Biotechnology	1
MS8101	Adv Analytical Chemistry	1
MS8102	Adv Microscopy and Imaging	1
MS8103	Genomics and Proteomics	1
MS8105	Molecular Recognition	1
MS8107	Molecular Virology	1
MS8108	Adv Structure Determination	1
MS8109	Directed Studies Molecular Sci	1
MS8111	Experimental Design and Statistical Analysis	1
MS8112	Molecular Machines of the Cell	1
MS8113	Molecular Basis of Pathogen, Host and Env Interactions	1

COURSE LISTING

Doctoral Candidacy Examination
Each student is required to complete a Candidacy Examination. The examination is normally conducted during a candidate's fourth term of residence, and must be held no later than 20 months from the date of initial registration. The examination consists of two parts: a written examination of three hours duration, the questions to be set by the student's Supervisory Committee; and an oral

defense of the written examination and of the dissertation proposal. Only students who have entered the PhD program via a Transfer Exam are exempt from the Candidacy Exam. This is a Milestone. Pass/Fail

Doctoral Dissertation
This is a laboratory-based research project. Students are required to conduct research, submit their completed research in a thesis format to an examination committee, and make an oral presentation and defence of the research thesis and results to this committee. Through the thesis, students are expected to demonstrate competence in oral and written communication, experimental design and scientific thought processes, as well as a sound understanding of the specialty area associated with the research. The PhD Thesis is a "Milestone." Pass/Fail.

Master's Thesis
This is a laboratory-based research project. Students are required to conduct research, submit their completed research in a thesis format to an examination committee, and make an oral presentation and defence of the research thesis and results to this committee. Through the thesis, students are expected to demonstrate competence in oral and written communication, experimental design and scientific thought processes, as well as a sound understanding of the specialty area associated with the research. The Master's Thesis is a "Milestone." Pass/Fail.

ES 8909 – Environmental Biotechnology
This course, as a series of lectures and student-led discussions, covers the application of biologically-based technologies in bioenergy and bio-remediation. Areas of application covered include biologically-based remediation of air, soil, solid waste, wastewater, bio-energy, and biofuels. The relevant technologies are discussed along with the potential positive and negative impacts which may be associated with the use of biotechnologies in the environment. 1 Credit

MS 8101 - Adv Analytical Chemistry
This course focuses on the principles and applications of modern methodologies for identifying and quantifying analytes. Topics may include advanced instrumentation (e.g. mass spectrometry, x-ray spectrometry, 2D chromatography) and chemometric techniques (e.g. PCA, PCR, PLS). Examples or case studies will be derived from the chemical literature, and may include applications to chemical, biochemical (e.g. protein analysis), clinical, environmental, food or pharmaceutical analysis. 1 Credit

MS8102 Adv Microscopy and Imaging
This course will provide students with an understanding of modern microscopic methods in chemistry and biology. Emphasis will be on theory and application of confocal microscopy, atomic force microscopy (AFM), confocal Raman microscopy and ultrasound-based approaches. All topics will be discussed in the context of scientific research based on recent publications. 1 Credit

MS8103 Genomics and Proteomics
This course is an introduction to genomics and proteomics. Topics may include the relationship between structure and function of a gene; tools used in discovering and identifying sequences in a particular genome; an overview of protein structure and function; tools for structural determination; analysis of protein-protein interactions; introduction to the high throughput identification and quantification of protein expression; review of the Human Genome project; application of genomics and proteomics to drug design. Graduate students will require additional evaluation to the undergraduate requirements and may give a seminar or lecture. **Antirequisite BLG800**. 1 Credit

MS8104 Interfacial Phenomena
This course introduces fundamental concepts of interface science in relation to biological and chemical systems. Topics may include artificial assemblies of biomolecules (e.g. lipids, proteins, polysaccharides) that perform novel functions, self-assembled monolayers, nanoparticles, and physiochemistry of microbial adhesion. Selected experimental methods may be discussed. Student-led seminars are an essential component of the course. 1 Credit

MS8105 Molecular Recognition
This course provides a selective introduction to topics in molecular recognition from a chemical and biological perspective. Model systems are used to understand fundamental principles of molecular recognition and these concepts are then used to examine topics may include antibody-antigen interactions, adhesin-receptor recognition, drug-ligand interactions and macromolecular interactions in gene expression and signal transduction. Investigating techniques including molecular graphics and modeling, NMR, mass spectrometry, X-ray crystallography and circular dichroism will be discussed. 1 Credit

MS8106 Materials Science
This course focuses on the relationship between the synthesis, properties and function of specialty materials with extended structures. Topics may include important conducting materials such as charge-transfer salts, semiconductors, superconductors, and organic and inorganic polymers; optoelectric materials; zeolites and nonporous structures, supramolecular assemblies such as liquid crystals and piezoelectric thin films. Biological topics may include artificial bone, synthetic blood, and bio-polymers for drug delivery. Student-led discussions and seminars are essential components of the course. 1 Credit

MS8107 Molecular Virology
An overview of virology with emphasis on the contribution virology has made to molecular biology will be presented. Detailed analysis will be done of molecular structure/function relationships of specific viruses with impact on societal issues. Included will be viruses causing the AIDS, common cold, influenza, hepatitis, SARS, herpes and adenovirus infections, and others. Molecular pathogen-host interactions will be examined and current and/or potential therapeutic targets and uses will be identified. 1 Credit

MS8108 Advanced Structure Determination

This course focuses on the modern methods used to determine the structures of small molecules, polymers and biopolymers (proteins and nucleic acids), using nuclear magnetic resonance spectroscopy, mass spectrometry and X-ray crystallography. The course will cover the theory behind the techniques and advanced applications of the techniques in the determination of structures. Emphasis will be placed on deciding which technique(s) are most appropriate for solving a given structural problem, as well as the interpretation of spectra/data. 1 Credit

MS8109 Directed Studies in Molecular Science
Individual directed study in a specific area of molecular science not addressed in the current curriculum can be undertaken by a student under the supervision of a faculty member, usually the thesis supervisor. A program of supervised, advanced study related to the student's area of concentration and reflecting the interdisciplinary nature of the program will be developed on an individual basis with the supervising faculty member. The program of study must be approved by the supervising faculty member and the program director at the beginning of the term of study. 1 Credit

MS8110 Advanced Organometallics
This course will cover the preparation, mechanisms and application of organometallic catalysts for a wide variety of purposes ranging from synthetic improvements in organic chemistry to the applications that have revolutionized the polymer industry, solar cell and fuel cell designs. The course will also examine the role of these catalysts in the environment and the environmental impact of these highly useful materials. The course will explore questions including: "Is there such a thing as a green metal catalyst?" "What are the tangible environmental impacts?" and "How can we design materials that improve function with a net zero environmental impact?" 1 Credit

MS8111 Experimental Design and Statistical Analysis
This course will cover some basic experimental designs (e.g. factorial, fractional factorial, Plackett-Burman, Latin square and blocking designs) used in chemistry and biology. Modern statistical methods for calibration and pattern recognition and methods for analysing time-series data will be discussed. It is expected that students will be familiar with basic statistical concepts, such as t tests, F test, linear regression, and ANOVA. **Antirequisite BLG409.** 1 Credit

MS8112 Molecular Machines of the Cell
This course will discuss the molecular structure and function of various cellular macromolecular machines such as the proteosome, or ribosome. The course will address how structure determines biochemical and cellular function, how subunit interface and surface properties drive complex assembly and/or disassembly and how cells modulate and integrate the function and activity of such molecular assemblies. Students will learn about the molecular machines of the cell by reading original research and review articles. Classes will consist of invited seminars, lectures and discussion of research articles. Assessment will be undertaken by participation during class, a presentation and a major research essay. 1 Credit

MS8113 Molecular Basis of Pathogen, Host and Env Interactions
This course aims at understanding the interplay between hosts, bacterial pathogens and environmental factors at the molecular level. Specifically, molecular mechanisms of pathogenesis will be addressed at the interface of host, pathogen and their environment. Following initial team-taught introductory lectures, students will lead deconstructive analyses of current publications on relevant topics suggested by instructors. 1 Credit

MS8201 Master's Seminar 1
This seminar course features presentations by guest speakers and students in the program. Each student is required to present a seminar on a topic not directly related to the student's thesis research. All program students are required to attend and to actively participate in all seminars provided in this course. Pass/Fail

MS8202 Master's Seminar 2
This seminar course features presentations by guest speakers and students in the program. Each student is required to present a seminar on his/her thesis research including background, proposal and results. All program students are required to attend and to actively participate in all seminars provided in this course. Pass/Fail

MS9201 PhD Seminar
This course features presentations by guest speakers and PhD students. All students are required to attend and actively participate in seminars every semester. Students will present one seminar on a topic relevant to their dissertation and one seminar on their dissertation, normally in their final year. Students will also participate on panels which will introduce and question the speakers. This course aims to improve the communication skills of students. To facilitate this goal, student presentations will be assessed by attending faculty and the student panel. Pass/Fail