

# BIOTECHNOLOGY (BT-GY)

## BT-GY 871X Project in Biotechnology (0.5-3 Credits)

*Typically offered Fall, Spring, and Summer terms*

Special project based on experimental, theoretical, computational, or literature research. The project can be carried out in an academic institution or in industry involved in biotech/life sciences research. | Prerequisite: Adviser's approval.

**Grading:** Grad Poly Graded

**Repeatable for additional credit:** Yes

## BT-GY 6013 Biotechnology and the Pharmaceutical Industry (3 Credits)

*Typically offered Spring*

The course offers an in-depth look at the modern process of drug development, from the early stage of target identification and generation of lead compounds to modern methods of drug delivery and the role of biotechnology in this complex process. All the key aspects, including preclinical development, clinical trials and regulatory requirements, are covered with considerable contributions from pharmaceutical professionals. Real-life case studies are presented to illustrate critical points in the development process. Major classes of biotech drugs are discussed. Many course lectures are delivered by scientists from the major U.S. pharmaceutical companies. | Prerequisite: Adviser's approval.

**Grading:** Grad Poly Graded

**Repeatable for additional credit:** No

## BT-GY 6023 Biotechnology and Health Care (3 Credits)

*Typically offered Fall*

Biotechnology's contribution to modern health care stretches far beyond developing new therapeutic entities. This course provides an overview of key cutting-edge technologies such as stem-cell research and therapeutic cloning and demonstrates how their applications change "the conventional" in terms of availability of new treatments, monitoring services and diagnostics. The course also covers the Human Genome Project and its implications for health care and epigenetic modifications of the genome and their role in disease. The course also highlights the role of biotechnology in managing a number of sociologically high-impact diseases in developed and developing countries. | Prerequisite: Adviser's approval.

**Grading:** Grad Poly Graded

**Repeatable for additional credit:** No

## BT-GY 6033 Biosensors and Biochips (3 Credits)

*Typically offered Fall*

Biosensors and biochips are two of the most exciting, complex and fast-growing areas of biotechnology today—the interface between biotechnology, nanotechnology and micro-electronics industries. The course covers both conventional biosensors based on whole cells, nucleic acids, antibodies and enzymes (e.g., enzymatic glucose monitoring) as well as new and emerging technologies related to designing, fabricating and applying multi-array biochips and micro-fluidic systems (lab-on-the-chip). The course goal is to familiarize students with basic principles of biosensors design and applications. The course also covers practical applications of this technology in health care, medical diagnostics, defense and other areas. | Prerequisite: Adviser's approval.

**Grading:** Grad Poly Graded

**Repeatable for additional credit:** No

## BT-GY 6043 Biocatalysis in Industry (3 Credits)

*Typically offered occasionally*

The course focuses on the commercial use of biological catalysts across various industry segments, including pharmaceuticals, health care, fine chemicals and food. The course combines a broad overview of cutting-edge technologies with industrial insights into the economics of bio-processing. The course also covers emerging biomaterials trends. Case studies are presented to facilitate analysis, formulate trends and underline major challenges. | Prerequisite: Adviser's approval.

**Grading:** Grad Poly Graded

**Repeatable for additional credit:** No

## BT-GY 6053 Introduction to Neuroscience for Biotechnologists (3 Credits)

*Typically offered Fall*

The understanding of brain function represents a unique challenge by virtue of the tremendous complexity of neural circuits and their role in controlling behavior. This course is designed to provide graduate students with a comprehensive introduction to the basic mechanisms of brain function. It covers the basic mechanisms of neuronal excitability, how neuronal function is connected to cellular structures, how neurons act as elements of networks and how malfunctions lead to mental and neurological disorders. The goal is to provide graduate students a foundation of knowledge which will guide them in their decision to enter and navigate the vast field of neurobiology. | Advisor/Instructor Permission Required

**Grading:** Grad Poly Graded

**Repeatable for additional credit:** No

## BT-GY 6063 Immunology: Concepts, Mechanisms and Applications in Biotechnology (3 Credits)

*Typically offered Spring*

The purpose of this course is to develop a general understanding of the established biochemical, molecular, cellular, and organ-level principles that govern the workings of the mammalian immune system, and to prepare the student for immunological research in the academic, government, or industrial laboratory. Topics covered include cells of the immune system and their development, pattern recognition receptors and innate immunity, molecular mechanisms of antigen processing and presentation, long distance communication and immune cells' migration, homing, and trafficking. Applications in Biotechnology and autoimmune diseases and the use of immunotherapy in industry will also be discussed. | Advisor/Instructor Permission Required

**Grading:** Grad Poly Graded

**Repeatable for additional credit:** No

## BT-GY 6073 Genetic Engineering (3 Credits)

*Typically offered Spring*

Genetic engineering underpins practically every aspect of modern biotechnology. This course aims at familiarizing students with the current methods of DNA manipulation and practical applications of recombinant DNA technology, including the use of vectors, construction of libraries, PCR, restriction digests, mapping, and cloning. The class includes lectures as well as a semester-long 3h/week lab. | Advisor/Instructor Permission Required

**Grading:** Grad Poly Graded

**Repeatable for additional credit:** No

**BT-GY 6083 Advanced Cell and Molecular Biology (3 Credits)***Typically offered Fall*

The course aims to advance students' knowledge in key areas of cell and molecular biology. Topics covered included cell-cell communications, organization of the cytoskeleton, mechanisms of cell signaling and signal transduction, chromatin organization and structure and genome regulation, maintenance and repair. The lab component of the class is designed to provide students with advanced bench-top skills used in modern cell and molecular biology experimentation. | Advisor/Instructor Permission Required

**Grading:** Grad Poly Graded**Repeatable for additional credit:** No**BT-GY 6093 Biomedical Materials & Devices for Human Body Repair (3 Credits)***Typically offered Fall*

The main objective of this multidisciplinary course is to provide students with a broad survey of currently used biomaterials and their use in medical devices for reconstructing or replacing injured, diseased, or aged human tissues and organs. Topics include a broad introduction to the materials used in medicine and their chemical, physical, and biological properties, basic mechanisms of wound healing and materials-tissue interactions. | Advisor/Instructor Permission Required

**Grading:** Grad Poly Graded**Repeatable for additional credit:** No**BT-GY 7013 Special Topics in Biotechnology (3 Credits)***Typically offered occasionally*

Special topics include a number of courses, such as Advanced Cell Biology and Advanced Molecular Biology (lectures only or lectures and labs). | Prerequisite: Adviser's approval.

**Grading:** Grad Poly Graded**Repeatable for additional credit:** Yes**BT-GY 7043 Computer-Aided Protein and Drug Design (3 Credits)***Typically offered Fall*

This course is aimed at familiarizing students with the fundamental principles of computational drug design, including both engineered protein drugs (biologics) and small molecules. Basic concepts in bioinformatics, cheminformatics and molecular modeling (homology modeling, ab initio structure prediction, computational molecular docking) will be taught as a foundation for advanced, specific case studies in protein engineering and drug design applied to specific biomedical problems such as cancer and infectious diseases. | Prerequisites: Advisor's or instructor's permission

**Grading:** Grad Poly Graded**Repeatable for additional credit:** No**BT-GY 7053 Introduction to Bioinformatics (3 Credits)***Typically offered Fall*

This course is aimed at familiarizing students with application of computational and statistical methods to analysis of large data sets from biological and medical experiments. It will introduce fundamental concepts of major branches of bioinformatics, from the study of DNA sequences to high throughput gene expression data. Students will be introduced to the statistical programming language R to illustrate concepts and practical applications. Also, students will perform hands-on analyses of publicly available data from genome projects and high-throughput experiments. | Prerequisites: Advisor/Instructor approval

**Grading:** Grad Poly Graded**Repeatable for additional credit:** No**BT-GY 8723 Capstone Project in Biotechnology (3 Credits)***Typically offered Fall, Spring, and Summer terms*

Special project based on experimental, theoretical, computational, or literature research. The project can be carried out in an academic institution or in industry involved in biotech/life sciences research. Students can enroll in this course after a minimum of two full time semesters in the program. | Prerequisite: Adviser's approval.

**Grading:** Grad Poly Graded**Repeatable for additional credit:** No**BT-GY 8733 Capstone Innovation Experience Course (3 Credits)***Typically offered Fall and Spring*

The Capstone Innovation Experience course is designed to bridge the gap between academic learning and real-world application for graduate students. This capstone course prepares students by equipping them with essential multidisciplinary prototyping skills and entrepreneurial thinking. Through hands-on labs, customer discovery processes, and collaborative team formation, students will be primed to develop innovative prototypes and understand the journey of transforming ideas into viable commercial ventures. The course exposes students to a broad range of multidisciplinary technologies while providing an entrepreneurial lens leading to innovations culminating into a capstone.

**Grading:** Grad Poly Graded**Repeatable for additional credit:** No**BT-GY 9433 Protein Engineering (3 Credits)***Typically offered occasionally*

This course introduces modern protein-engineering techniques available to researchers to understand protein structure and function and to create entirely new proteins for many purposes. This new field lies at the interface of chemistry, biology and engineering. The first section discusses protein composition and structure, and various genetic, biochemical and chemical techniques required to engineer proteins, followed by specific topics. Topics include designing highly structured proteins that are active at high temperatures and in non-aqueous solvents; that interact selectively with other proteins, small molecules and nucleic acids for therapeutic purposes; and that catalyze new reactions. | Prerequisite: Adviser's approval.

**Grading:** Grad Poly Graded**Repeatable for additional credit:** No