Biotechnology (BIOT)

BIOT 5040. Fundamentals of Biochemistry for Biotechnology. 4 Hours.
Covers the fundamentals of biochemistry for biotechnology applications, including protein structure and function, DNA technologies, bioenergetics, and biosynthesis. Requires permission of instructor for those students not majoring in biotechnology.

BIOT 5050. Organic Chemistry for Biotechnology. 4 Hours.
Offers an introduction to organic chemistry that seeks to prepare students for the MS in biotechnology program. Explores the nature of and the biological aspects of organic compounds. Covers the fundamentals of the structure, nomenclature, properties, and reactions of carbon compounds. Also introduces the chemistry of biological molecules, including amino acids, proteins, carbohydrates, and lipids, as well as spectroscopic structure determination known as nuclear magnetic resonance (NMR). Requires prior completion of chemical principles 2/ general chemistry 2 with lab; restricted to biotechnology students or by permission of instructor.

BIOT 5120. Introduction to Biotechnology. 3 Hours.
Provides an interdisciplinary, state-of-the-art introduction to biotechnology to students of the Master of Science in Biotechnology program. Covers the molecular foundations of biotechnology, molecular microbiology, receptor pharmacology, drug development processes, biotech process development and scale-up, drug approval and regulatory affairs, genomics, microarray analysis, proteomics, computational biology, molecular modeling, analytical biotechnology, and bioterrorism and biotechnology.

BIOT 5130. Team Skills in Biotechnology. 2 Hours.
Focuses on project management and leadership skills in the biotechnology industry. Emphasizes professional etiquette, teamwork, and team leadership in a diverse, multidisciplinary workplace. Also offers students an opportunity to develop their technical communication skills (scientific writing, public speaking, and technical presentations).

BIOT 5145. Basic Biotechnology Lab Skills. 1 Hour.
Introduces selected key skills and techniques central to life sciences research. Combines hands-on training in basic laboratory skills with lecture and live demonstration. Laboratory exercises highlight the importance of precision/accuracy in dispensation of liquids and in the preparation of solutions and standards, documentation and record keeping, and maintaining a safe and sterile work environment while performing scientific research.

BIOT 5219. The Biotechnology Enterprise. 2 Hours.
Exposes students to a broad spectrum of concepts and issues that are common to biotechnology companies. Provides an overview of innovation, intellectual property, planning, government regulation, and strategic alliances. Introduces biotechnology entrepreneurship; management; and the legal aspects of science, technology, and research in the biotechnology context.

BIOT 5220. The Role of Patents in the Biotechnology Industry, Past and Future. 1 Hour.
Covers the basics of patenting and the application of patents to the biotechnology industry, including the controversial area of gene patents.

BIOT 5225. Managing and Leading a Biotechnology Company. 3 Hours.
Covers managing projects and personnel in a technology-based organization Such activities are best carried out by those who combine the technical knowledge of their industry with the insight into the best practices for working with groups of highly educated, and often very experienced people. The biotechnology industry is strongly dependent on the concept that knowledge is always shared and ownership is collective. As the fundamental organizational mantra is teamwork, the principles of managing in this environment are key to achieving important goals. How to accomplish this and make decisions that drive innovation and success have common threads with other technology based industries, but with the added complexity of the scientific challenges facing the biotechnology industry. Restricted to students in the Bouvé College of Health Sciences and in the College of Science or by permission of the program office.

BIOT 5226. Biotechnology Entrepreneurship. 3 Hours.
Biotechnology by its very nature is an innovative multidisciplinary industry. This is especially true for the biopharmaceutical industry in which the process of discovering new drugs and new drug targets requires novel approaches to solving difficult questions about disease processes and human health. This course focuses on the essential nature of innovation in the biotech industry, exposes students to the basics of creating startup organizations, explains the key role of business planning in enterprise creation, describes means for assessing risks, making choices from available options and how to measure success. Various business models, outsourcing work and establishing strategic partnerships are examined. Restricted to students in the Bouvé College of Health Sciences and in the College of Science or by permission of the program office.

BIOT 5227. Economics and Marketing for Biotechnology Managers. 3 Hours.
Provides a foundation for making financial decisions in the biotechnology industry. Examines accounting methods, forecasting, corporate valuation, exit strategies and drug pipeline economics. Introduces concepts for marketing pharmaceutical products. Restricted to students in the Bouvé College of Health Sciences and in the College of Science or by permission of the program office.

BIOT 5340. Introduction to Biotherapeutic Approvals. 3 Hours.
Introduces students to biologics. The class of drugs referred to as biologics or biotherapeutics, proteins drugs, makes up a large portion of the drugs in development and on the market today. Focuses on considerations for approval for such drugs. Offers students an opportunity to learn how to be able to describe and explain both biologics and biosimilars.

BIOT 5360. Drug Stability. 2 Hours.
Focuses on stability testing of both small molecule and protein drugs. Studies the difference between small molecule and protein drug stability testing. Offers students an opportunity to learn how to explain the International Council on Harmonisation (ICH)-Quality (Q1) guidelines and how they are applied to drug development and approvals.

BIOT 5400. Scientific Information Management for Biotechnology Managers. 3 Hours.
Introduces biotechnology students to scientific information management specifically related to the biotechnology field. Covers an introduction to data sciences, its history, and how it is relevant to biotech today. Offers students an opportunity to obtain the background needed to assess and use modern data management capabilities such as "the cloud," big data, etc. Covers recent developments in origination of data, metadata, data models, data management, and organization and storage of data in biotechnology.

BIOT 5500. Introduction to Regulatory Science. 3 Hours.
Introduces the science that supports regulatory affairs in the biopharmaceutical industry. Focuses on the methods and instruments used to characterize the processes and products of biotechnology including the production, separation, purification, characterization, and formulation of biologics; the pharmacokinetics of proteins; chemical and biological equivalencies of biogenerics; stability testing; high throughput assays; cell system expression; variants; method validation; and quality control.

BIOT 5560. Bioprocess Fundamentals. 3 Hours.
Focuses on the fundamental principles and elements in the process of manufacturing biopharmaceuticals. Covers kinetics of enzymatic reactions; selected microbial and cell metabolism and relevant control mechanisms; kinetics of cell growth, cell death, substrate consumption, and product formation; mathematical modeling and representation of bioprocesses; examples of industrial bioprocesses to illustrate types and operations of upstream and downstream unit operations and mass transfers in fermentation systems—the affecting factors and the impact on process development and scale-up. Also includes an overview of economic considerations. Emphasizes bioprocesses for recombinant protein production.

BIOT 5631. Cell Culture Processes for Biopharmaceutical Production. 3 Hours.
Covers the principles and concepts involved in the development of mammalian and other types of cell culture processes for the manufacturing of biopharmaceutical products such as monoclonal antibodies and recombinant proteins. Topics include protein expression and clone generation, batch and perfusion processes and media development, bioreactor operations and scale-up, and innovations in cell culture processes. Regulatory concepts include quality assurance in a cGMP environment.

BIOT 5635. Downstream Processes for Biopharmaceutical Production. 3 Hours.
Addresses the development of recombinant protein purification processes in biotechnology. Provides an overview of the scientific principles, engineering strategies, and unit operations facilities involved in scalable protein purification processes. Also discusses viral clearance and inactivation strategies; cGMP considerations; and technological advances to improve effectiveness and efficiency, such as membrane-based disposable systems.

BIOT 5640. Drug Product Processes for Biopharmaceuticals. 3 Hours.
Covers the development and implementation of the drug product manufacturing process for biopharmaceuticals. Focuses on biologic products, specifically proteins. Covers the workflow required for the development and implementation of the production process with the scientific and engineering principles highlighted. Topics include the preformulation process for early stage product development, the selection of formulation compatible with the targeted product presentation, optimization of formulations to meet stability and usage objectives, the design of a scalable process for production, large-scale process equipment and operations, process scale-up considerations, and regulatory compliance issues for drug product manufacturing facilities and operations. Students who do not meet course prerequisites may seek permission of instructor.

BIOT 5700. Molecular Interactions of Proteins in Biopharmaceutical Formulations. 3 Hours.
Offers an up-to-date survey and review of the research and understanding of the molecular interactions of proteins in biopharmaceutical formulations, including both liquid and solid formats, during the process of drug product manufacturing. Focuses on protein-protein interactions, protein-excipients (e.g., stabilizers, surfactants) interactions, and protein at interface surfaces interactions that are critical and impactful on the stability and integrity of therapeutic proteins of interest. Emphasizes understanding the mechanistic aspect of the interactions; the approaches, methods, and techniques employed to study these phenomena; and measures considered to modulate such interactions to enhance the performance of the biopharmaceutical formulations. Students who do not meet course prerequisites may seek permission of instructor.

BIOT 5810. Cutting-Edge Applications in Molecular Biotechnology. 3 Hours.
Introduces the uses of molecular biology in a biotechnology setting. Includes a brief review of the basics and then dives into state-of-the-art molecular biology applications used in biotechnology today. These applications include stability and expression of cloned gene products, gene cloning strategies, transgenic species, mutation creation and analysis, DNA fingerprinting, PCR technology, microarray technology, gene probes, gene targeting, gene therapy, stem cell technology, antisense RNA, CAR T-cell therapy, RNA interference, and CRISPR/Cas9.

BIOT 5820. Cellular Therapies. 2 Hours.
The ever-changing landscape of the biotechnology field requires constant training. This course is designed to familiarize participants with some of the most cutting-edge topics available in molecular biology today: stem cells, RNA interference, CRISPR/CAS9, CAR T-cells, gene therapy, and more. Offers participants an opportunity to learn the theory behind these new technologies, how they are done, and their power in scientific discovery and treatment.

BIOT 5821. Introduction to Biopharmaceutical Technologies. 1 Hour.
Covers the basic techniques used to develop a modern-day biopharmaceutical product. Topics include DNA fingerprinting, PCR technology, microarrays, gene probes and targeting, expression of cloned gene products, gene cloning strategies, transgenic species, and mutation creation and analysis. Offers students an opportunity to learn the theory and practical application behind these technologies—how they are done and their power in scientific discovery and treatment. Emphasizes the latest advances in these classic technologies.

BIOT 5850. Higher-Order Structure Analytics. 3 Hours.
Offers a comprehensive look at various aspects of higher- order protein structures in biotherapeutics and their implications on biological drug design. Focuses heavily on protein aggregation, a type of HOS, and analysis of those aggregates including functional implications. Topics include a review of protein structure, protein aggregation, functional aspects, and techniques to reduce HOS using protein expression and purification strategies, protein folding in disease, macromolecular crystallography, nuclear magnetic resonance, analytical ultracentrifugation, circular dichroism, light scattering, electron spin labelling, cryo-EM, WAXS, and HDX-MS. Highlights experimental design and application to the biotechnology industry in identifying and reducing HOS.

BIOT 5976. Directed Study. 1-4 Hours.
Offers independent work under the direction of members of the department on chosen topics. May be repeated without limit.

BIOT 6214. Experimental Design and Biostatistics. 2 Hours.
Explores the principles of experimental design and statistical analysis. Emphasizes research in the molecular and biological sciences and biotechnology. Topics include probability theory, sampling hypothesis formulation and testing, and parametric and nonparametric statistical methods.

BIOT 6400. Pre-co-op Experience. 0 Hours.
Offers students an opportunity to gain necessary skills and practical experience in order to prepare for graduate co-op.

BIOT 6500. Professional Development for Co-op. 0 Hours.
Introduces the cooperative education program. Offers students an opportunity to develop job-search and career-management skills; to assess their workplace skills, interests, and values and to discuss how they impact personal career choices; to prepare a professional resumé; and to learn proper interviewing techniques. Explores career paths, choices, professional behaviors, work culture, and career decision making.

BIOT 6962. Elective. 1-4 Hours.
Offers elective credit for courses taken at other academic institutions. May be repeated without limit.

BIOT 6964. Co-op Work Experience. 0 Hours.
Provides eligible students with an opportunity for work experience. May be repeated without limit.

BIOT 7245. Biotechnology Applications Laboratory. 3 Hours.
Presents a laboratory course in biotechnology with a focus on cutting-edge instrumentation that is currently used in the field. Directs special attention at the practical aspects of laboratory work in this field, for example, techniques in sample preparation, procedures for protein analysis, and new bioinformatic approaches. Focuses on the emerging field of chemiproteomics, which is the study of the interaction of small molecules with the proteome, that is, the full complement of proteins expressed in an individual cell or organism. Exposes the student to hands-on experience with modern instrumentation, such as mass spectrometry and high performance liquid chromatography.