

# Biotechnology - CPS (BTC)

## **BTC 1300. Introduction to Biotechnology. (3 Hours)**

Introduces the integrated science of genomics, proteomics, and bioinformatics using a case study, hands-on, problem-solving approach. Offers students an opportunity to practice accessing and using online databases to engage in real-time discoveries using the same approach current scientists use in their own research. Focuses on the process of doing genomic analysis and thinking from a genomics perspective. Uses integrated multimedia and web resources to introduce new technologies and to allow students to research and analyze real genomics data.

**Prerequisite(s):** BIO 1200 with a minimum grade of D- ; BIO 1201 with a minimum grade of D-

**Corequisite(s):** BTC 1301

## **BTC 1301. Lab for BTC 1300. (1 Hour)**

Accompanies BTC 1300. Designed to introduce cutting-edge skills and techniques used in research labs and biopharmaceutical companies. Offers students an opportunity to learn the theoretical background of a technique in the lecture portion of the course and to be able to practice the techniques in the lab—to learn to read and write protocols; to accurately and precisely measure liquids and solids; to prepare solutions and media; to keep a virtual lab notebook, all while working in a safe and aseptic lab setting; and to learn how to perform electrophoresis, protein quantification, DNA extraction, and the basic use of a bioreactor.

**Prerequisite(s):** BIO 1200 with a minimum grade of D- ; BIO 1201 with a minimum grade of D-

**Corequisite(s):** BTC 1300

## **BTC 1990. Elective. (1-4 Hours)**

Offers elective credit for courses taken at other academic institutions. May be repeated without limit.

## **BTC 2990. Elective. (1-4 Hours)**

Offers elective credit for courses taken at other academic institutions. May be repeated without limit.

## **BTC 3210. Immunology. (4 Hours)**

Provides an overview of the structure and function of genes, proteins, and cells involved in the generation of the immune response. Emphasizes molecular immunology and immunogenetics.

**Prerequisite(s):** BIO 1100 with a minimum grade of D- ; BIO 1101 with a minimum grade of D- ; BIO 1200 with a minimum grade of D- ; BIO 1201 with a minimum grade of D-

## **BTC 3990. Elective. (1-4 Hours)**

Offers elective credit for courses taken at other academic institutions. May be repeated without limit.

## **BTC 4200. Genomics, Proteomics, and Bioinformatics. (3 Hours)**

Presents a comprehensive overview on genomics, proteomics, and bioinformatics, emphasizing their practical importance and applications in biotechnology. Integrates artificial intelligence (AI) and machine learning (ML) tools with bioinformatics techniques to address present-day challenges in genomic and proteomic research. Emphasizes protein structure prediction, gene annotation, protein property prediction, and data mining of bioactive molecules. Offers hands-on experience. Offers students an opportunity to enhance students' skills in bioinformatics, data analysis, problem-solving, and communication.

**Prerequisite(s):** (ITC 1000 with a minimum grade of C- or ITC 2016 with a minimum grade of C- ); (BTC 1300 with a minimum grade of C- ; BTC 1301 with a minimum grade of C- )

**BTC 4300. Biotechnology and Pharmaceutical Processing. (3 Hours)**

Focuses on the fundamental principles and elements in the process of manufacturing biopharmaceuticals using current good manufacturing practices (CGMPs). 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; and examples of industrial bioprocesses to illustrate types and operations of upstream and downstream unit operations and mass transfers in fermentation systems. Emphasizes bioprocesses for recombinant protein production. Explores in-depth selected methods, techniques, and instruments used in biotechnology.

**Prerequisite(s):** BTC 1300 with a minimum grade of D- ; BIO 2300 with a minimum grade of D-

**Corequisite(s):** BTC 4301

**BTC 4301. Lab for BTC 4300. (1 Hour)**

Accompanies BTC 4300. Offers students an opportunity to learn important technical and safety concepts relevant to biotechnology and pharmaceutical processing while gaining hands-on experiences in a modern laboratory. Employs upstream equipment (e.g., cell culture vessels and sonication device); covers downstream operations (e.g., centrifuge and chromatography columns) and analytical tools (e.g., sensors, spectrophotometer, gel electrophoresis) for studying cell metabolism; recovering and separating cell components (e.g., organelles, DNA, proteins); purifying the target product (e.g., recombinant green fluorescent protein); and analyzing the efficacy of process steps through mass balancing.

**Prerequisite(s):** BTC 1301 with a minimum grade of D ; BIO 2300 with a minimum grade of D

**Corequisite(s):** BTC 4300

**BTC 4450. Quality Control and Validation Issues. (3 Hours)**

Introduces the regulations and guidelines affecting the development, production, registration, and sale of medical devices, diagnostics, pharmaceuticals, and biotechnology products worldwide. Focuses on why regulations are necessary, ethical considerations, and international standards. Offers practical instruction in the basics of quality control and process/facility validation for the biotechnology industry. Reviews appropriate regulations, including personnel and process flow, environmental and water testing, sterility testing, and incoming material and in-process testing. Other topics include the establishment of a master validation plan; description of facility, equipment, and process validations; and cleaning validations.

**Prerequisite(s):** BTC 1300 with a minimum grade of D- ; (MTH 2300 with a minimum grade of D- or MTH 2310 with a minimum grade of D- or MTH 3300 with a minimum grade of D- )

**BTC 4850. Biotechnology Senior Project. (3 Hours)**

Focuses on an in-depth project in which a student conducts research or produces a product related to the student's major field.

**Prerequisite(s):** BIO 2300 with a minimum grade of D- ; BIO 2500 with a minimum grade of D-

**Attribute(s):** NUPath Capstone Experience, NUPath Writing Intensive

**BTC 4955. Project. (1-4 Hours)**

Focuses on in-depth project in which a student conducts research or produces a product related to the student's major field. May be repeated without limit.

**BTC 4990. Elective. (1-4 Hours)**

Offers elective credit for courses taken at other academic institutions. May be repeated without limit.

**BTC 5210. Human Experimentation: Methodological Issues Fundamentals. (3 Hours)**

Explores issues related to human experimentation, including scientific, technical, and methodological issues and the ethical, clinical, and financial repercussions of clinical trial studies. Covers how effective study designs can mitigate the common limitations and problems of clinical trials. Considers ethical issues, such as selective reporting of clinical research, informed consent, and protection of research participants in domestic and international clinical trials. Offers students an opportunity to develop and study statistical modeling and methodologies utilized in constructing clinical study designs.

**BTC 6210. Human Experimentation: Methodological Issues Fundamentals. (4 Hours)**

Explores issues related to human experimentation, including scientific, technical, and methodological issues and the ethical, clinical, and financial repercussions of clinical trial studies. Covers how effective study designs can mitigate the common limitations and problems of clinical trials. Considers ethical issues, such as selective reporting of clinical research, informed consent, and protection of research participants in domestic and international clinical trials. Offers students an opportunity to develop and study statistical modeling and methodologies utilized in constructing clinical study designs.

**BTC 6211. Validation and Auditing of Clinical Trial Information. (4 Hours)**

Presents a comprehensive overview of the management of quality assurance in clinical trials, Good Clinical Practices (GCP), and management of audit outcomes, as well as current issues and trends in the validation and auditing of clinical studies.

**Prerequisite(s):** BTC 6210 with a minimum grade of C- ; (RGA 6000 with a minimum grade of C- or RGA 6001 with a minimum grade of C- )

**BTC 6213. Clinical Trial Design Optimization and Problem Solving. (4 Hours)**

Discusses quantitative data analysis in creating dynamic drug-disease models, strategic market models, trial simulation models, and integrated financial models, which enable key variable analysis in clinical trial developments in real time. This integrated approach allows all decisions in the design to optimize value against both scientific and business criteria simultaneously and continuously. Offers students an opportunity to learn to take a complete view of the development process at the outset—across time, across the portfolio, and at all levels in the organization. This allows for greater insight into a drug's potential early in the process and leads to a more focused program for promising compounds, including an optimized clinical trial design. It also allows for earlier cessation of unpromising clinical trials, saving time and funds.

**Prerequisite(s):** (BTC 6210 with a minimum grade of C- ; RGA 6000 with a minimum grade of C- ) or RGA 6001 with a minimum grade of C-

**BTC 6962. Elective. (1-4 Hours)**

Offers elective credit for courses taken at other academic institutions. May be repeated without limit.