

## **Course Description**

### **BSC2426 | Biotechnology Methods and Applications 1 | 3.00 credits**

This course addresses the basic principles, concepts and techniques of biotechnology necessary for an understanding of the field, and effective work in a pharmaceutical-biotechnology-and/or research laboratory setting(s). Practical applications of biotechnology are explored. Prerequisite: Previous knowledge of chemistry and biology strongly recommended; Corequisite: BSC2426L.

### **Course Competencies:**

**Competency 1:** The student will demonstrate knowledge of the field of biotechnology for the branches of science involved, the history of biotechnology, possible career choices, and the future of the biotech industry by:

1. Defining the concept of biotechnology
2. Explaining different biotechnology specialties and the scientific disciplines contributing to each
3. Listing examples of historic and contemporary products from biotechnology applications
4. Describing the history of domestication and agriculture as well as the history of fermented foods and beverages
5. Listing milestones of modern biotechnology development
6. Describing basic methods and applications of modern biotechnology
7. Showing basic methods and applications of modern biotechnology
8. Summarizing the organization and functions of biotechnology companies
9. Describing biotechnology workplaces
10. Defining essential skills and training required to become part of the biotechnology workforce
11. Discussing career opportunities and hiring trends in biotechnology

**Competency 2:** The student will demonstrate knowledge of biotechnology workplace and safety regulations by:

1. Defining safety rules in the workplace
2. Describing hazards and risk assessment
3. Naming regulatory agencies
4. Describing Occupational Safety and Health Administration (OSHA) worker safety regulations
5. Defining principles of labeling, documentation, and housekeeping practices
6. Summarizing actions directed to reduce risk in the laboratory setting

**Competency 3:** The student will demonstrate knowledge of cell structure by:

1. Describing the structures and functions of prokaryotic cells
2. Describing the structures and functions of eukaryotic cells
3. Listing examples of prokaryotic and eukaryotic cells
4. Comparing and contrasting prokaryotic and eukaryotic cells

**Competency 4:** The student will demonstrate an understanding of the use of microorganisms in biotechnology by:

1. Describing the features of bacteria that make them valuable tools for many applications in biotechnology
2. Listing examples of how yeast can serve valuable roles in biotechnology
3. Listing examples of how yeast can serve valuable roles in biotechnology
4. Differentiating between alcoholic and lactic acid fermentation and discussing the importance of each in the production of common foods and beverages
5. Differentiating between alcoholic and lactic acid fermentation and discussing the importance of each in the production of common foods and beverages
6. Showing principles of microbial fermentation
7. Showing principles of microbial fermentation

8. Describing how microorganisms play an essential role in the development and production of recombinant proteins
9. Listing examples of therapeutic proteins
10. Listing examples of therapeutic proteins
11. Identifying microorganisms that may pose a threat as bioweapons
12. Identifying microorganisms that may pose a threat as bioweapons
13. Categorizing biotechnology strategies that may be used to detect, identify, and combat bioweapons
14. Categorizing biotechnology strategies that may be used to detect, identify, and combat bioweapons
15. Describing the features of viruses that make them valuable tools for many applications in biotechnology

**Competency 5:** The student will demonstrate knowledge of the basic principles of recombinant DNA technology by:

1. Describing the basic structure of DNA, RNA, and proteins
2. Showing the principles of DNA isolation
3. Describing methods to cut and join DNA specifically
4. Describing methods to separate restricted DNA fragments and visualize DNA
5. Comparing methods of DNA cloning in different types of cloning vectors
6. Describing different methods of cell transformation, transient expression, and transfection
7. Explaining the use of DNA libraries
8. Comparing southern, Northern Comparing Southern, Northern, and Western blot hybridization
9. Showing the principles of the Polymerase Chain Reaction Showing the principles of the polymerase chain reaction
10. Listing the various methods of DNA sequencing
11. Explaining the principles of Sanger's method of DNA sequencing
12. Defining methods of DNA micro-array technology
13. Describing recombinant DNA production systems used to generate proteins
14. Listing examples of therapeutic proteins generated using recombinant DNA technology
15. Describing the use of recombinant DNA in the food industry
16. Summarizing the ethical issues associated with the utilization of recombinant DNA technology in food development and safety

**Competency 6:** The student will demonstrate an understanding of the importance of proteins and the methods for their production, isolation, and purification by:

1. Describing the qualitative analysis of proteins
2. Describing the principles of protein extraction and purification
3. Describing chemical assays such as turbidity, viscosity, and density of proteins
4. Describing the features unique to e. Coli that lead to its frequent use in protein production
5. Describing methods employed in sequencing short peptides and proteins
6. Explaining proteomics and how it may be applied to protein research and development

**Competency 7:** The student will demonstrate an understanding of genomics by:

1. Explaining differences between genetic, cytological, and physical maps
2. Exhibiting knowledge of applications for the human genome project
3. Listing other genome projects
4. Discussing the ethical, legal, and social implications of the human genome project

**Competency 8:** The student will demonstrate knowledge of molecular data collection and manipulation by:

1. Describing bioinformatics and utilizing computational information management systems in biological research and dissemination of biological information
2. Describing databases and websites available for sequence acquisition and analysis

3. Accessing the location of sequences available in GenBank
4. Utilizing a web cutter to generate restriction enzyme maps of a DNA sequence.
5. Performing blast search for homologous sequences and motifs in DNA sequences
6. Utilizing the ExPasy proteomic server to translate DNA sequences into amino acid sequences
7. Designing oligonucleotides of specific length, base composition, and nucleotide sequence using computer technologies.
8. Calculating the melting temperature for an oligonucleotide.
9. Describing factors that affect oligonucleotide binding and function in PCR and other biotechnology applications

**Competency 9:** The student will demonstrate knowledge of the legislation employed in the regulation of Biotechnology by:

1. Explaining the roles of federal and state agencies in the development and manufacturing of biotechnology products
2. Comparing and contrasting the guidelines of federal and state agencies that regulate the biotechnology industry
3. Explaining the use of state, local, and industry regulations
4. Explaining the use of current good laboratory practice standards (GLP) or good manufacturing practices (GMP).
5. Listing the criteria that make a plant eligible for “notification” under governmental guidelines
6. Explaining the precautions that must be taken to prevent the release of bioengineered plants into the environment
7. Identifying ethical issues about the development of bioengineered plants
8. Summarizing the functions of patents
9. Explaining why DNA sequences are considered patentable

**Learning Outcomes:**

- Use quantitative analytical skills to evaluate and process numerical data
- Solve problems using critical and creative thinking and scientific reasoning
- Formulate strategies to locate, evaluate, and apply information
- Demonstrate knowledge of ethical thinking and its application to issues in society