Biotechnology (BTEC)

BTEC 1010. Fundamentals of Biotechnology. 3 Hours.
Introductory course required of all students in the biotechnology program. This course explores careers in biotechnology with emphasis on central dogma of biology, DNA techniques, recombinant DNA technology and their applications in biotech careers, and bioethics. Using a variety of teaching methods including lecture/discussion, laboratory, power points, videos, quizzes and exams. ** Course Learning Outcomes (CLOs) At the successful conclusion of this course, students will be able to: 1. Identify the fundamental techniques and the basic principles of molecular biology and recombinant DNA technology that are essential in biotechnology. 2. Describe the applications and impact of biotechnology in the areas of agriculture, medicine, and industry. 3. Apply knowledge of the fundamental ethical and regulatory issues surrounding the biotechnology field. 4. Communicate biotechnology findings effectively in the form of oral and written scientific reports. 5. Apply some of the basic methods of Biotechnology in a laboratory setting. FA.

BTEC 2010. DNA Methods and Analysis. 2 Hours.
Course required for all students in the biotechnology program. This course develops the lab skills consistent to DNA technology including recombinant DNA cloning, DNA gel electrophoresis, polymerase chain reaction (PCR) and DNA sequencing. **Course Learning Outcomes (CLOs) At the successful conclusion of this course, students will be able to: 1. Demonstrate proper laboratory safety techniques. 2. Describe the structure of DNA and RNA and successfully prepare laboratory solutions 3. Describe the principles and methods used in genetic engineering. 4. Perform end-point PCR and agarose gel electrophoresis and other DNA and RNA technologies. 5. Maintain a laboratory note book and perform necessary calculations. Prerequisites: BTEC 1010 or BIOL 1610 & BIOL 1620 or BIOL 1620 (can be taken concurrently). FA.

BTEC 2020. Protein Purification and Analysis. 2 Hours.
Course required for all students in the biotechnology program. This course develops current techniques in protein production, extraction, purification, and analysis. Includes instruction and practice with polyacrylamide gel electrophoresis (PAGE), chromatography, western blot, and FPLC analysis. **Course Learning Outcomes (CLOs) At the successful conclusion of this course, students will be able to: 1. Demonstrate proper laboratory safety techniques. 2. Explain the relationship between protein structure and function as they apply to biotechnology. 3. Describe and perform the methods of protein purification and protein analysis. 4. Perform protein manipulations. 5. Determine the physical properties of a protein using current methodology. Prerequisites: BTEC 1010 or BIOL 1610 & BIOL 1620 or BIOL 1620 (can be taken concurrently). SP.

BTEC 2030. Cell Culture Techniques. 2 Hours.
Course required for all students in the biotechnology program. This course develops basics skills of eukaryote cell culture. Includes handling, storage, and maintenance of mammalian and insect cell lines. Emphasizes media preparation, sterile and aseptic techniques. ** Course Learning Outcomes (CLOs) At the successful conclusion of this course, students will be able to: 1. Demonstrate proper aseptic and sterile laboratory techniques. 2. Describe and explain the characteristics of mammalian & insect cells grown in vitro. 3. Perform routine cell culture tasks in cell counting, cell passaging, and cell feeding. 4. Record, analyze, and evaluate data related to the growth, maintenance, and evaluation of cell cultures. Prerequisites: BTEC 1010 or BIOL 1610 & BIOL 1620 or BIOL 1620 (can be taken concurrently). SP.

BTEC 2040. Advanced Nucleic Acids Laboratory. 3 Hours.
Course required for all students in the biotechnology program. This course develops advanced nucleic acid techniques. Includes site-directed mutagenesis, DNA sequencing, and RNA analysis methods, and real-time PCR to quantitate DNA in samples. Incorporates methods to mutate 2 genes using CRISPR gene editing technology followed by RT-PCR to analyze gene expression (RNA isolation, creating cDNA, followed by real-time PCR). **Course Learning Outcomes (CLOs) At the successful conclusion of this course, students will be able to: 1 Contrast DNA and RNA, their relative stabilities, and considerations when working with either molecule in vitro. 2. Outline the different DNA sequencing platforms and the technologies each is based on 3. Describe different methods for studying nucleic acids including PCR, quantitative PCR, RT-PCR, digital PCR, high-resolution melt curve analysis, and fragment analysis 4. Contrast various techniques used for the manipulation of genetic material, including site-directed mutagenesis, CRISPR, zinc-finger nuclease, and TALENS. Prerequisites: BTEC 2010. SP.

BTEC 2050. Zebrafish Maintenance & Methodology. 2 Hours.
This course will give a broad introduction to zebrafish husbandry, maintenance, breeding, egg collection, and embryo microscopy. It will prepare students for advanced functional genomics coursework and research. **COURSE LEARNING OUTCOMES (CLOs)** At the successful conclusion of this course, students will be able to: 1. Employ proper maintenance of zebrafish colonies. 2. Practice zebrafish breeding and embryo collection. 3. Detail the mechanisms of light microscope usage. 4. Collect microscope images of developing zebrafish at various stages. 5. Detail the developmental stages of zebrafish. Prerequisites: BIOL 1610 and BIOL 1620 or concurrently taking BIOL 1620. FA, SP.

BTEC 3010. Sequencing Methods and Techniques. 1 Hour.
Recent advances in sequencing technologies allow for the large scale sequencing of genomes. This course will explore various sequencing methodologies, and techniques, and give students hand on training in Sanger and Next-Generation Sequencing. **COURSE LEARNING OUTCOMES (CLOs)** At the successful conclusion of this course, students will be able to: 1. Describe the history of DNA sequencing technologies and the advances that made modern day sequencing platforms possible. 2. Discuss the chemistry involved in sequencing reactions. 3. Contrast the different sequencing technologies and platforms. 4. Apply Sanger sequencing of a unique sample. 5. Apply next-generation sequencing run using the illumina iSeq. Prerequisites: BIOL 3030 (Grade C- or higher). SP.

BTEC 3020. Protein Cloning, Expression, and Purification. 1 Hour.
This course provides hands-on experience with techniques and concepts used for recombinant protein production and purification. This will be accomplished through a lecture and laboratory experience that will involve directed reading, design and performance of experiments, data analysis, and completion of laboratory reports. The course is appropriate for all pre-health and pre-vet professionals, and those preparing for life science-oriented graduate programs and industrial careers. **COURSE LEARNING OUTCOMES (CLOs)** At the successful conclusion of this course, students will be able to: 1. Summarize the principal processes involved in protein synthesis and the relationship between protein structure and function; 2. Describe and implement alternative approaches used for recombinant protein expression in different expression systems; 3. Demonstrate common techniques used for protein purification and preparation strategies: including ion exchange, affinity, and size exclusion chromatography methods. Prerequisites: BTEC 2020 (Grade C- or higher). FA.

BTEC 3040. Zebrafish Maintenance and Microscopy. 1 Hour.
This Course is on HIATUS. This course will give a broad introduction to zebrafish husbandry, maintenance, breeding, egg collection, and embryo microscopy. It will prepare students for advanced functional genomics coursework and research. **COURSE LEARNING OUTCOMES (CLOs)** At the successful conclusion of this course, students will be able to: 1. Employ proper maintenance of zebrafish colonies. 2. Practice zebrafish breeding and embryo collection. 3. Detail the mechanisms of light microscope usage. 4. Collect microscope images of developing zebrafish at various stages. 5. Detail the developmental stages of zebrafish. Prerequisites: Must be matriculated in a major in Biological Science, Computer Science, or Mathematics Department. FA, SP.

BTEC 3050. CRISPR/Cas9 Techniques. 1 Hour.
This course will introduce foundational techniques of gene knockout using the CRISPR/Cas9 System. Students will gain hands on experience in a variety of techniques and carry out several experiments using CRISPR/Cas9. This class will prepare students for advanced functional genomics coursework and research. **COURSE LEARNING OUTCOMES (CLOs)** At the successful conclusion of this course, students will be able to: 1. Apply the fundamental principles of gene knockdown using CRISPR/Cas9. 2. Carry out a gene knockout using CRISPR/Cas9 in the zebrafish model systems. Prerequisites: BTEC 2050 (Grade C- or higher). FA.

BTEC 4020. Advanced Protein Characterization. 1 Hour.
This course provides an introduction to advanced methods use in characterization of proteins. This will be accomplished through hands-on experience in the lab as well as extensive lecture and discussion. Students will become familiar with key approaches for characterizing protein-protein interactions, enzyme activity, and protein structure. **COURSE LEARNING OUTCOMES (CLOs)** At the successful conclusion of this course, students will be able to: 1. Apply common analytical methods for analysis of soluble and membrane proteins and protein complexes; 2. Demonstrate common techniques used to evaluate protein activity including enzymatic assays, binding assays, and site directed mutagenesis; 3. Employ approaches use to analyze protein structure including protein crystallization techniques and structure evaluation. Prerequisites: BTEC 3020 (Grade C- or higher). SP.

BTEC 4040. Techniques in Functional Genomics. 1 Hour.
This course will introduce foundational techniques used in functional genomics experiment using the zebrafish model. It will prepare students for advanced functional genomics coursework and research. **COURSE LEARNING OUTCOMES (CLOs) ** At the successful conclusion of this course, students will be able to: 1. Demonstrate competencies in all techniques carried out as part of the course. 2. Employ manipulation techniques and microinjection of zebrafish embryos. 3. Detail scientific principles of functional genomics. 3. Generate a morpholino. Prerequisites: BTEC 3050 (Grade C- or higher). FA, SP.

BTEC 4050. In Situ Hybridization. 1 Hour.
This course will introduce foundational techniques of in situ hybridization, and provide applied lab experiences in identifying abnormal phenotypes using in situ hybridization techniques. It will prepare students for advanced functional genomics coursework and research. ** COURSE LEARNING OUTCOMES (CLOs) ** At the successful conclusion of this course, students will be able to: 1. Describe the theory of in situ hybridization. 2. Identify suitable research questions that can be answered using in situ hybridization. 3. Apply in situ hybridization to identify a phenotype. Prerequisites: BTEC 3050 (Grade C- or higher). SP.

BTEC 4060. Variant Validation in Zebrafish. 1 Hour.
This applied lab allows students to perform a functional genomics validation experiment in the zebrafish model. Students will be given a variant of unknown significance identified by hospital collaborators, and will carry out all steps required to validate the variant of unknown significance including: zebrafish mating and effective collection, microinjection, microscopic and in situ hybridization identification of phenotype, knockout rescue and variant validation. ** COURSE LEARNING OUTCOMES (CLOs) ** At the successful conclusion of this course, students will be able to: 1. Demonstrate all techniques required for functional validation zebrafish. 2. Assemble results to be shared with collaborators within hospital and research centers. Prerequisites: BTEC 4050 (Grade C- or higher). FA, SP.