Department of Bio-Tech

Course outcome

This course is the first course in the Biotechnology Program. It is a workforce programand thus, these objectives have been written to accommodate changes/additions thatmay be made to take advantage of the newest teaching protocols and advances in thefield of Biotechnology.

Students may be enrolled in this course for several reasons; they are enrolled in theBiotechnology Program, they need a science elective with lab, or they have a generalinterest and are unsure if they want to be part of the Biotechnology Program.

- Students are familiar with basic high school level biology and chemistry
- Students may not be familiar with cellular biology, general chemistry, orbiotechnology topics and applications
- Students may not have experience using lab equipment such as micropipettes,balances and centrifuges.
- Students may not have basic computer experience; lack knowledge of excel,PowerPoint, MS word.

CO1 Introduction to Biotechnology

- Define biotechnology, provide examples of biotechnology products
- Give examples of job responsibilities associated with different jobs inbiotechnology
- Describe how scientific methodologies are used to conduct experiments anddevelop products
- Define and apply bioethics
- Discuss the importance of quality in a biotechnology company
- Distinguish between quality assurance and quality control job functions
- Distinguish between GMP and ISO quality systems in different bioscience labs

CO2 Introduction to Biology

- Identify the levels of biological organization
- Describe cell structure and its significance in biotechnology
- Discuss the types of organisms researched and the types of cells grown andstudied in biotechnology

- Distinguish between the cellular organization of prokaryotic and eukaryotic cells
- List the four main classes of macromolecules and describe their structure andfunction
- Define genetic engineering and identify products created with this technology
- Explain the Central Dogma of Biology and its importance in genetic engineering

CO3 Preparing Solutions in a Biotechnology Laboratory

- Determine the most appropriate tool for measuring specific volumes or masses
- Describe how to select, set, and use a variety of micropipettes within theirdesignated ranges to accurately measure small volumes
- Recognize the different expressions for units of concentration measurementsand use their corresponding equations to calculate the amount of solute neededto prepare a specified solution: single component, multicomponent, serialdilutions and parallel dilutions
- Describe what pH is and why it is important in solution preparation

CO4 Introduction to studying nucleic acid (DNA & RNA)

- Describe the structure and function of DNA and RNA in the cell
- Describe how DNA is replicated in the cell
- Differentiate between eukaryotic and prokaryotic chromosomal structure andexplain how this difference impacts gene regulation in the two cell types
- Describe the process of gel electrophoresis and explain how the characteristicsof nucleic acids affect their migration through a gel

CO5 Introduction to studying Protein

- Describe the structure of proteins, including the significance of amino acid R-groupsand their impact on the three-dimensional structure of proteins.
- Explain the steps of transcription and translation in protein synthesis.
- Discuss the role of naturally occurring proteins and recombinant proteins inbiotechnology.
- Differentiate proteins that function as part of structure, as antibodies, and asenzymes.

- Describe the structure of antibodies and explain the relationship betweenantibodies and antigens.
- Discriminate among the classes of enzymes and discuss the effect of reactionconditions on enzyme activity.
- Summarize polyacrylamide gel electrophoresis and identify its usefulness forstudying proteins.

CO6 Assays

- Give examples of biotechnology products derived from plant and animal sourcesand discuss the challenges of extracting compounds
- Identify the steps in a Comprehensive Product Development Plan
- Discuss the types of assays done as potential products move through processdevelopment
- Describe how an ELISA or a Western blot is conducted and what the results ofeach assay can reveal
- Describe the role of bacterial and cell culture in protein product development
- Describe the typical recombinant DNA protein product pipeline, additional stepsrequired by the FDA for pharmaceutical proteins, and possible formulations ofthe final product

CO7 Spectrophotometers in determining molecular concentration & purity

- Describe how a spectrophotometer operates, and give examples of their uses
- Explain the relationship between absorbance and transmittance inspectrophotometry
- Explain the relationship between the concentration of H+ and OH- ions in acidsand bases
- Describe the proper way to use pH paper and pH meters and which should beused in a specified situation
- Justify the need for buffers, describe how buffers are prepared, and calculate theamount of buffering agent needed when making a particular buffer
- Explain how protein indicator (solutions) are used

- Describe how VIS and UV/VIS spectrophotometers are used to measure proteinor DNA concentration

CO 8 Recombinant DNA technology

- Outline the fundamental steps in a genetic engineering procedure
- Describe the mechanism of action and the use of restriction enzymes inbiotechnology research and recombinant protein production
- Discuss techniques used to probe DNA for specific genes of interest
- Explain the steps of a bacterial transformation and various selection processesfor identifying transformants
- Explain the usefulness of plasmid preparations, how they are performed, andhow the concentration and purity of plasmid samples can be determined

CO9 Purification of Recombinant Protein

- Outline the major steps in bring a genetically engineered protein productthrough biomanufacturing to market
- Compare and contrast the methods of harvesting intracellular and extracellularproteins
- Define chromatography and distinguish between paper, thin-layer, and columnchromatography, giving examples of each procedure
- Discuss the variables used to optimize column chromatography
- Explain how product quality is maintained for key types of biotechnology andpharmaceutical products
- Describe the clinical testing process for pharmaceuticals
- Discuss the final marketing and sales considerations in bringing a product tomarket

CO10 Plant Biotechnology

- Describe mechanisms of plant pollination and differentiate between haploid anddiploid cells and their role in sexual reproduction
- Identify various natural and artificial ways to propagate plants to increasegenetic variety or maintain the genetic composition

- Discuss the function and composition of different plant structures, tissues, andorganelles and give examples of foods that are derived from various plantorgans
- Describe the processes of germination and plant growth
- Perform the calculations to predict expected plant phenotypes for specificgenetic genotypes, using Punnett Square analysis in a plant breedingexperiment
- Describe the role of meristematic tissue in asexual plant propagation
- Explain the role of plant growth regulators, as well as the advantages anddisadvantages of plant tissue culture

CO11 Biotechnology in Agriculture

- Give specific examples of agricultural and horticultural biotechnologyapplications, including genetically modified organism (GMO) crops, hydroponics,and plant-made pharmaceuticals
- Explain how genomic and plasmid DNA can be isolated from cells, including theadditional steps required for plant cell DNA isolation
- Discuss how proteins of interest may be purified from plant samples and howDNA or protein samples may be assayed for their concentration and purity
- Describe the role that Agrobacterium tumefaciens plays in producing geneticallymodified plant crops
- Summarize the methods used to produce transgenic plants, and explain theselection processes for identifying transformed plant cells
- Describe the role of biotechnologies in food production, food processing, andfood security

CO12 Medical Biotechnology

- Discuss the scope and role of medical biotechnology in the healthcare industry
- Describe the function of drugs and how they may be created with combinatorialchemistry
- Explain how high-throughput screening methods are used to discover potentialdrug activity
- Describe the methods for synthesizing peptides and oligonucleotides anddiscuss the uses of each

- Detail the multiple uses of antibodies and vaccines in medical biotechnology
- List examples of recent advances in medical biotechnology and expected newapplications

CO13 Molecular Biotechnology & Advanced Biotechnology Techniques

- Describe the process of semi-conservative DNA replication in cells and comparethis method with DNA synthesis in the laboratory
- Discuss the uses of synthesized oligonucleotides and identify the attributes ofgood primers
- Explain the steps of PCR and discuss the components and optimization of theprocess
- Describe the function of a thermal cycler and how PCR results are visualized
- Discuss the benefits and implications of knowing the DNA sequences of humansand other organisms
- Explain how DNA is sequenced using the Sanger Method and the recentimprovements that have increased the efficiency of this process
- Describe how bioinformatics and microarray technology are speeding geneticstudies and the search for novel pharmaceuticals.
- Give examples of how RNA technologies impact research and development ofnew therapeutics.
- Discuss the field of proteomics, the methods used for protein study, and thepotential benefits of proteomic research.
- Explain how advances in stem cell research, regenerative medicine, andsynthetic biology may lead to improved health care.
- Describe how biotechnologies are being used to understand and protect theenvironment.
- Outline the important applications of the growing biotechnology fields ofveterinary biotech, dental biotech, nanotechnology, bioterrorism, andbiodefense.

CO14 Careers in Biotechnology

- Explore different potential careers in biotechnology both regionally andnationally

- Generate a working resume

PROGRAM OUTCOMES (POs) (BIOTECHNOLOGY)

Program Outcomes of biotechnology branch

1. Graduates will gain and apply knowledge of Biotechnology, Science and Engineering concepts to solve problems related to field of Biotechnology.

2. Graduates will be able to identify, analyze and understand problems related to biotechnology Engineering and finding valid conclusions with basic knowledge in biotechnology Engineering.

3. Graduates will be able to design and develop solution to Biotechnology Engineering problems by applying appropriate tools while keeping in mind safety factor for environmental & society.

4. Graduates will be able design, perform experiments, analyze and interpret data for investigating complex problems in biotechnology Engineering and related fields.

5. Graduates will be able to decide and apply appropriate tools and techniques in biotechnological manipulation.

6. Graduates will be able to justify social, health, safety and legal issues and understand his responsibilities in biotechnological engineering practices.

7. Graduates will be able to understand the need and impact of biotechnological solutions on environment and societal context keeping in view need for sustainable solution.

8. Graduates will have knowledge and understanding of related norms and ethics in Biotechnology Engineering product/technique development.

9. Graduates will be able to undertake any responsibility as an individual and as a team in a multidisciplinary environment.

10. Graduates will develop oral and written communication skills.

11. Graduates will have through knowledge in Biotechnology Engineering and will also be ready to engage themselves in lifelong learning.

12. Graduates will be able to demonstrate knowledge of project and finance management when dealing with Biotechnology Engineering problems.

BIOTECHNOLOGY (AS) PROGRAM STUDENT LEARNING OUTCOMES

Upon completion of the AS in Biotechnology degree students will be able to:

1. Exhibit effective oral and written communication skills.

2. Demonstrate critical reading, thinking and problem solving skills

3. Demonstrate quantitative reasoning skills in calculus and statistics.

4. Utilize scientific methods to explore natural phenomena.

5. Demonstrate a solid foundation in Chemistry and Organic Chemistry.

6. Demonstrate basic laboratory skills necessary for Biotechnology research.

7. Demonstrate a base of knowledge in Biology, Molecular Biology and Microbiology to qualify for upper divisional study.

8. Possess the requisite knowledge, skills and abilities to successfully transfer to a baccalaureate degree program in Biotechnology related degree area with junior status.

PROGRAM SPECIFIC OUTCOMES (PSOs)

Program Specific Outcomes for B.Sc. programme in Biotechnology set by Faculty in Biotechnology are as follows:

PSO1 Demonstrate proficiency in basic science and foundation engineering courses.

PSO2 Demonstrate a working knowledge of advanced biological sciences.

PSO3 Demonstrate competence in application of engineering principles to biological systems.

PSO4 Higher education preparedness: Demonstrate an ability to appear for National level examination to pursue higher studies. Demonstrate practical and theoretical knowledge essential for pursuing higher studies.

PSO5 Biotechnology industry oriented preparedness: Demonstrate an ability to identify careers in biotechnology, domain like Pharmaceutical, Food Industry etc, and skills required to work in a biotechnology laboratory or manufacturing facility.

PSO6 Association activities

Genes association of our department will carry out active research with illustrations from different spectrums in the field of Biotechnology. The association will also organize special guest lectures regularly with eminent resource persons from industry and academia.