Course Type	Course Code	Name of Course	L	Т	Р	Credit
DE	NCYD540	Biotechnology in Pharmaceutical Sciences		0	0	3

Course Objective

- To understand the basic principles that are utilized to drive today's biotechnological advances.
- To understand how these biotechnological advances are fueling the pharmaceutical industry.
- To apply the principles of biotechnology in the development of drugs.

Learning Outcomes

- Manipulation of biological system to produce more effective drugs.
- The knowledge gained in this course would be used to understand and evaluate the different pharmaceutical parameters of the current and future biotechnology related products on the market.

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1	Title: Genomics in Pharmaceutical Sciences Discovery of DNA as the genetic element, Concept of genome, genes, and gene expression; DNA sequencing and NGS, gene expression and microarray; Systems and methods of molecular biology: Isolation and validation of targets; PCR, RT-PCR nucleic acid isolation; cloning vectors (some examples), enzymes used in molecular cloning methods (some examples); cloning and characterization of biopharmaceuticals.	12L	Basic understanding of DNA and its role in biology. Different molecular biology techniques and their utilization in analysis and manipulation of DNA.
2	Title: Protein expression and purification Protein expression in bacteria yeast, insect and mammalian cells. Optimization of protein expression: Codon bias and Codon Optimization, Turn-On and Turn-Off protein expression systems. Various protein purification methods; enzyme- based assays for small molecule screening.	9 L	Basic knowledge of different methods to prepare proteins and enzymes, optimization of these processes, purification of proteins/enzymes and their utility.
3	Title: Bioprocess technology Introduction to microbial growth, media formulation; sterilization, inoculum preparation. Fermentation process design, operation and characteristics of fermentation processes; batch, fed-batch and continuous culture systems and bioprocess control. Major areas of biotechnology in the pharmaceutical industry such as antibiotics, vaccines, diagnostics, biopharmaceuticals (insulin, interferon, GSF, CSF and therapeutic proteins etc.); commercial aspects, priorities for future biotechnological research.	9 L	Basic understanding of the growth/culture of different microorganisms and their utility in the pharmaceutical industry.
4	Title: Industrial enzymes in drug development Penicillin amidase, lipase, oxidoreductase, nitrilase, protease etc.; use of these enzymes for enantioselective synthesis of pharmaceutically important drugs/drug intermediates.	5 L	Commercially valuable enzymes and their utility in the synthesis of different drug molecules.

5	Title: Modern advances in biotechnology Nucleic acids as drugs (anti-sense oligos and siRNAs), nucleic acids as drug targets, gene editing technologies (TALEN, Zinc-finger and CRISPR), mRNA vaccines, PROTACs and RIBOTACs.	7 L	To learn about the latest developments in biotechnology and how they are being utilized to develop better drugs.
Total		42	

Textbooks:

- 1. Biotechnology by David P. Clark and Nanette J. Pazdernik, Academic Cell Press, 2nd Edition 2015.
- 2. Lehninger Principles of Biochemistry by David L. Nelson & Michael M. Cox, W. H. Freeman; 6th edition 2013.

Reference books:

1. Pharmaceuticals Biotechnology Concepts and Applications, Gary Walsh, Wiley, 2013.