SARDAR PATEL UNIVERSITY
VALLABH VIDYANAGAR

Programme: MSC (CBCS)
Syllabus with effective from: JUNE-2017

Industrial Biotechnology

M. Sc. Industrial Biotechnology				
Semester	**I**	**II**	**III**	**IV**
Core I (4 Credits)	Molecular Biology (PS01CIBT21)	Bioprocess Technology (PS02CIBT21)	Immunotechnology (PS03CIBT21)	Dissertation (PS04CIBT21) (24 credits)
Core II (4 Credits)	Genetic Engineering (PS01CIBT22)	Animal and Plant Biotechnology PS02CIBT22)	Downstream Processing (PS03CIBT22)	
Core III (4 Credits)	Cellular Metabolism (PS01CIBT23)	Environmental Biotechnoloy PS02CIBT23)	Enzyme Technology and Enzyme Engineering (PS03CIBT23)	
Core IV (4 Credits)	Lab I (PS01CIBT24) Practicals based on PS01CIBT21 and PS01CIBT22	Lab I (PS02CIBT24) Practicals based on PS02CIBT21 and PS02CIBT22	Lab I (PS03CIBT24) Practicals based on PS03CIBT21 and PS03CIBT22	
Core V (4 Credits)	Lab II (PS01CIBT25) Practicals based on PS01CIBT23 and PS01EIBT2X	Lab II (PS02CIBT25) Practicals based on PS02CIBT23 and PS02EIBT2X	Lab II (PS03CIBT25) Practicals based on PS03CIBT23 and PS03EIBT2X	
Elective I (4 Credits)	Biostatistics (PS01EIBT21)	Bioinformatics (PS02EIBT21)	Biomanufacturing Principles and Practices (PS03EIBT21)	
Elective II (4 Credits)		IPR and Biosafety (PS02EIBT22)	Metabolic Engineering (PS03EIBT22)	
Elective III (4 Credits)			Omics and Computational Biology (PS03EIBT23)	
Elective IV (4 Credits)				

PS01CIBT21: Molecular Biology

Unit I: DNA structure

DNA structure: Chemistry of DNA, DNA structure, Different conformations of DNA (B, A and Z), Denaturation and Renaturation (Cot curves) of DNA.

DNA topology: Supercoiling, Biology of Supercoiled DNA, DNA topoisomerases and their mechanism of action.

DNA- protein interactions: General features, Sequence specific DNA binding protein motifs, ss DNA binding proteins.

Unit II: Organization of genome and its replication

Organization of DNA into chromosomes: Packaging of DNA and organization of chromosome in bacterial cells; Packaging of DNA in eukaryotic nucleosome and chromatin condensation, assembly of nucleosomes upon replication, chromatin modification.

DNA replication: Mechanism of DNA polymerase catalyzed synthesis of DNA, Types of DNA polymerases in bacteria, Initiation of DNA replication and its regulation in prokaryotes, assembly of replisome and progress of replication fork, termination of replication. DNA replication in eukaryotes and archaea. Inhibitors of DNA replication.

Unit III: Gene expression in prokaryotes and eukaryotes

Transcription: RNA polymerases, features of prokaryotic and eukaryotic promoters, assembly of transcription initiation complex in prokaryotes and eukaryotes, and its regulation; synthesis and processing of prokaryotic and eukaryotic transcripts.

Translation: structure and role of t-RNA in protein synthesis, ribosome structure, basic features of genetic code and its deciphering, translation (initiation, elongation and termination in detail in prokaryotes as well as eukaryotes).

Unit IV: Regulation of gene expression

Regulation of gene expression in prokaryotes: Operon concept, positive and negative regulation. Examples of lac (including mutational analysis), ara, and trp operon regulation; global regulatory responses.

Regulation of gene expression in eukaryotes: Transcriptional, translational and processing level control mechanisms.

References Books:

- Genes X: Lewin
- Molecular Biology of the Gene: Watson et al
- Molecular Genetic of Bacteria: Snyder and Champness
- Molecular Biology, 4th Edition: Burton E Tropp
- Principles of Genetics: Snustad and Simmons

PS01CIBT22: Genetic Engineering

Unit-I
Concept and importance of Genetic Engineering; General strategies and Steps involved in gene cloning: Extraction and purification of DNA and RNA from bacteria, virus, plant and animal cells; physical and enzymatic methods for cutting DNA; DNA ligase and other enzymes involved in gene cloning; introduction of DNA into host cells; screening and selection methods for recombinant clones.

Unit-II
Cloning vectors- Basic properties and cloning strategies for vectors derived from Plasmids, λ-bacteriophages, M-13 phage, Cosmids, Fosmids, Phagemids, Phasmids, YAC, BAC, HAC/MAC and viral vectors for Plant and animal cells.
Salient features of expression vectors for heterologous expression in E. coli, Yeast, Insect and Mammalian system, factors influencing heterologous gene expression.

Unit-III
DNA sequencing and sequence assembly: Maxam-Gilbert's and Sanger's methods, Shot gun sequencing, Next generation sequencing strategies for large genomes. DNA mapping and DNA fingerprinting: Physical and molecular mapping, Hybridization and PCR based methods of fingerprinting. Site directed mutagenesis: Methods and applications.
Synthesis and screening and applications of genomic and cDNA libraries. Polymerase Chain Reaction; Principle and basic types of PCR; Reverse Transcription and Real Time PCRs.

Unit-IV
Applications of Genetic engineering in improvement of plants, animals and microbes; Metagenomics and Metabolic engineering. Gene therapy.
Restriction and regulation for the release of GMOs. Biosafety and levels of Physical and Biological containment. The Indian Guidelines for release and use of GM organisms.

References:
- Genome 3rd Edition – Brown
- Molecular Biotechnology – Glick
- Principles of Genetic Manipulation – Old and Primrose
- Applied Molecular Genetics – Roger Miesfeld
- Biotechnology – H. K. Das
- Recombinant DNA – Watson et. al.
- Molecular cloning – Sambrook and Russel
- From genes to clones – Ernst Whittaker

PS01CIBT23: Cellular Metabolism

Unit I
Basic concept of metabolism, Concepts of energy transformation in metabolic reactions, Biological oxidations, free energy changes and redox potentials.The mitochondrial respiratory chain, order and organization of carriers, proton gradient, iron Sulphur proteins, cytochromes and their characterization.The Q cycle and the stoichiometry of proton extrusion. Respiratory controls and oxidative phosphorylation.Un-couplers andinhibitors of energy transfer. ATP- synthetase complex.

Glycolysis, citric acid cycle its function in energy generation and biosynthesis of energy rich bonds, coordinated regulation of glycolysis and citric acid cycle, pentose phosphate pathway and its regulation, Gluconeogenesis, interconversions of sugars, Biosynthesis of glycogen, starch and oligosaccharides. Regulation of blood glucose homeostasis. Hormonal regulation of carbohydrate metabolism.

Unit II
Metabolism of circulating lipids: Chylomicrons, LDL,VLDL and HDL. Free fatty acids.

Fatty acid oxidation: α, β, ω oxidation and lipid peroxidation. Fatty acid biosynthesis: Acetyl CoA carboxylase, Fatty acid synthase, desaturase andelongase. Lipid biosynthesis:Biosynthesis of triacylglycerol, phosphoglycerides, sphingolipids. Biosynthesis pathways for terpenes, steroids and prostaglandins. Ketonebodies –formation and degradation.

Unit III
Degradation of amino acid and their regulation, oxidative deamination,Urea cycle and its regulation. Linkage between urea cycle and citric acid cycle

Biosynthesis of amino acids and regulation.

Unit IV
Biosynthesis of purines and pyrimidines and regulation, Degradation of purines and pyrimidines, and regulation

Biosynthesis, Structure and regulation of ribonucleotide reductase,biosynthesis ofribonucleotides, deoxyribonucleotides and polynucleotides

Integration of metabolism

Reference Books:
Lehninger's Principles of Biochemistry : D. L. Nelson and M. M. Cox, Macmillan, Worth Pub.Inc., NY.

Biochemistry :LubertStryer WH Freeman & Co., NY.

Harper's Biochemistry : R. K. Murray and others. Appleton and Lange, Stanford.

Text book of Biochemistry with clinical correlations by Delvin

PS01EIBT21: Biostatistics

Unit - I
Definition of Biostatistics
Data Collection:
Types of Biological Data:
Qualitative (Categorical) Data: Nominal and Ordinal Data
Quantitative (Numerical) Data: Discrete and Continuous Data
Methods of Collecting Data:
Survey Method: Concept of a statistical population and sample from a population; Methods of drawing sample from the population, Simple Random Sampling (SRS), Stratified Random Sampling, Cluster Sampling; Experimental Method
Presentation:
Construction of frequency distribution (Simple or Discrete and Grouped): Rules for constructing Grouped frequency distribution
Diagrammatic Presentation: Bar Diagram (Chart), Simple, Sub – divided (Component), Percentage, Multiple, Pie Chart
Graphical Presentation: Line Graph, Histogram (For uniform class width only), Frequency Polygon, Frequency Curve, Ogives or Cumulative Frequency Curves
Descriptive Statistics:
Measures of Central Tendency (Averages): Mean or Arithmetic Mean, Median, Mode, Partition Values (For Raw and Grouped Data),Quartiles, Deciles, Percentile, Partition values using graphs (Ogives).
Measures of Dispersion (Variation): Range, Quartile Deviation (Q.D), Inter Quartile Range (IQR), Standard Deviation (SD) and Variance, Coefficient of Variation (C.V), Box – and – Whisker Plot.
Measures of Skewness and Kurtosis: Karl – Pearson's Coeff. of Skewness, Bowley's Coeff. Of Skewness, Kurtosis (Definition Only).

Unit - II
Probability and Probability Distributions:
Elements of Probability theory: Concept, Classical definition of Probability, Laws of Probabilities (Statements Only), Conditional Probability, Examples
Probability Distributions: Binomial Distribution**.** Definition, Conditions for applicability of Binomial Distribution,   Examples applicable in the field of Biosciences; **Normal Distribution,** Definition (Normal and Standard Normal Distribution), Properties of Normal Distribution, Examples applicable in the field of Biosciences

Unit - III
Correlation and Regression Analysis:
Correlation: Meaning, Types of Correlation, Positive, Negative, Non – Sense or Spurious, Methods of studying correlation,   Scatter Plot (diagram) method, Karl-Pearson's Correlation Coefficient (Product Moment) Method; Properties of Correlation Coefficient
 Coefficient of determination and its meaning: Spearman's Rank Correlation Coefficient; Properties of Rank Correlation Coefficient
Regression: Meaning, Properties of Regression Coefficients, Applications in the field of Biosciences
Testing Of Hypothesis: Contingency tables, Goodness of Fit

Unit - IV
Large Sample Test: Z - test for (Single) population proportion; Z - test for difference between two population proportions; Z - test for (Single) population mean; Z - test for difference between two population means
Small Sample Test: t – test for (Single) Population Mean, t – test for difference between two population means (Unpaired t-test), t – test for difference between two population means (Paired t-test)
Analysis Of Variance (ANOVA) : One – Way Classification , Two – Way Classification

References:

- Fundamentals of statistics by S.C. Gupta
- Principles of Biostatistics by Marcello Pagano and Kimberlee Gaurea
- Biostatistics: A Foundation For Analysis in the Health Sciences by Daniel, Wayne (Seventh Edition), Wiley India Pub.

PS01IBTC24: Lab I Practicals based on PS01CIBT21 and PS01CIBT22

PS01CIBT25: Lab II Practicals based on PS01CIBT23 and PS01EIBT2X