GUJARAT TECHNOLOGICAL UNIVERSITY
CHEMICAL ENGINEERING
B. E. SEMESTER: VII

Subject Name: **Biochemical Engineering (Department Elective-I)**
Subject Code: **170506**

Teaching Scheme				Evaluation Scheme			
Theory	Tutorial	Practical	Total	University Exam (E)		Mid Sem Exam (Theory) (M)	Practical (Internal)
				Theory	Practical		
4	0	2	6	70	30	30	20

Sr. No	Course Content	Total Hrs.
1.	**Microbiology fundamentals:** Scope of microbiology, Prokaryotic and Eukaryotic cells and their comparison, cell fractionation, elementary idea about bacteria, yeast, moulds, algae and protozoa, their properties, Oxygen, carbon and nitrogen cycle.	6
2.	**Chemicals of life:** carbohydrates- types and functions, functions of proteins, elemental composition and classification of proteins, Primary, secondary and tertiary structure of proteins, protein denaturation. Lipids- classifications and functions. Nucleic acids and their basic structures.	6
3.	Enzyme and enzyme kinetics; nomenclature and classifications of enzymes, properties of enzymatic reactions, lock and key model, induced fit theory, proximity and orientation effect. Types of enzyme selectivity, factors affecting enzyme activity: effect of temperature, pH, shear force etc., Enzyme inhibition, competitive, uncompetitive and noncompetitive inhibition. Michaelis- Menten equation: derivation and graphical evaluation of kinetic parameters, Modulation and regulation of enzyme activity, Immobilized enzyme technology, physical and chemical methods of immobilization, their relative advantages and disadvantages Industrial enzymes and their applications.	6
4.	Stoichiometry of microbial growth and product formation, stoichiometric calculation, elemental balances, degree of reduction, yield coefficient, respiratory quotients. Oxygen uptake rate, Metabolism of glucose, EMP pathway, Glycolyss and TCA cycle.	6
5.	Sterilization and media preparation, different types of solid media, cell death kinetics, Air sterilization, steam sterilization, batch and continuous sterilization. Air filter design	6

6.	Biomass production in cell cultures, phases of microbial growth, Measurement of microbial growth by various methods, Monod growth kinetics, Evaluation of kinetic parameters, substrate and product inhibition, maintenance energy, environmental factors affecting microbial growth, heat generation by microbial growth.	6
7.	Design and analysis of biological reactors, growth of organisms in batch reactor, continuous culture of organism, comparison between batch and continuous biomass culture, Stirred tank reactor in series and stirred tank reactor with recycle of biomass. Fed batch reactor, plug flow reactor, Design of fermentor.	6
8.	Selection, scale up operation and control of bioreactors, some considerations of aeration, agitation and heat transfer, scale up and its difficulties	6
9.	Product recovery operations, applications of filtration, cell disruption, centrifugation, liquid-liquid extraction, membrane processes, HPLC, Chromatography, electrophoresis, isoelectric focusing in downstream processing.	6
10.	Introduction to biochemical process industries- production of industrial alcohols, single cell proteins, vitamins, alkaloids, enzymes, lactic acid.	12
11.	Environmental biotechnology- biological waste water treatment, activated sludge process, Anaerobic digestion, denitrification, biodegradation, bioleaching, biogas production, biomethane and biohydrogen.	6

Practical and Term Work:

Experiments based on above topics should be given to the students.

Text Book:

1 James E Bailey, David F Oillis, Biochemical Engineering Fundamentals, New York, 2nd Edition, McGraw Hill Company

Reference Books:

1. M L Shuler and F. Kargi , Bioprocess Engineering: Basic Concepts, Pearson education International Series,
2. Coulson and Richardson's Chemical Engineering- Vol-3, Chemical and Biochemical Reactors and process control, Asian Book Pvt. Ltd.
3. D G Rao, Introduction to Biochemical Engineering, Tata McGraw Hill Publishing Company, New Delhi
4. Biochemical Engineering: Principles and concepts, Syed Tanveer Ahmed Inamdar, PHI Learning Pvt. Ltd.
5. Introduction to Biotechnology by Thieman & Palladino