

GUJARAT TECHNOLOGICAL UNIVERSITY

CHEMICAL ENGINEERING (05)

BIOTECHNOLOGY

SUBJECT CODE: 2160509

B.E. 6th SEMESTER

Type of course: Department Elective – I

Prerequisite: Basics of Biology and Chemistry

Rationale: This subject is an integration of chemistry with biological systems. It deals with basic aspects of biological systems, their operations and their applications.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks						Total Marks
L	T	P		Theory Marks			Practical Marks			
				ESE (E)	PA (M)		ESE (V)		PA (I)	
				PA	ALA	ESE	OEP			
4	0	2	6	70	20	10	20	10	20	150

Sr. No.	Content	Total Hrs.	% Weightage
1	Introduction to Biotechnology and rDNA technology. Introduction, Old and New Biotechnology, an Interdisciplinary Activity, Scope and Importance, Commercial Potential, Biotechnology in India. Introduction to rDNA technology and genetic engineering, basic techniques and tools. Applications of rDNA technology.	5	7
2	Animal Biotechnology Introduction, The Immune System, Monoclonal Antibodies and Cell Culture Products, In Vitro Fertilization and Embryo Transfer, Babies of a Specified Sex, Animal Cloning, Genome Maps, DNA Fingerprinting in Forensic Medicine	6	8
3	Plant Biotechnology Introduction, History of Tissue Culture Techniques, General Techniques and terminologies. Different culturing techniques, micropropagation, Somaclonal variation, Germplasm conservation.	5	7
4	Biotechnology and Health care Introduction, Disease Prevention (Vaccines), Disease Diagnosis, Disease Treatment, Gene Therapy, Immunodeficiency's, Cancer 417, Forensic Medicine.	6	8
5	General and Industrial Microbiology	12	17

	Introduction, Historical Landmarks, Isolation and Screening of Microorganisms, Maintenance of Isolates/Strains, Inoculum Development, Sterilization, Strain Improvement, Process Development, Downstream Processing, In Situ Recovery of Products, Applications, Metabolite Production, Biotransformation, Recovery of Metals, Biocontrol Agents, Biofertilizers, Genetically Engineered Microbes (GEMS)		
6	Enzyme Technology Introduction, Historical, Coenzymes and Cofactors, Enzymes Vs. Catalysts, Enzymes Vs. Whole Cells, Production of Enzymes, Classification and Nomenclature, Chemical Energetics, Mechanism of Enzyme Action, Enzyme Kinetics, Nontraditional Enzymes, Immobilization of Enzymes, Uses of Enzymes in Solution, Uses of Immobilized Enzymes, Enzyme Reactors, Biosensors, Enzyme Engineering, Bi- and Poly –Functional Enzymes, Safety and Regulatory Aspect.	8	11%
7	Foods and Beverages Introduction, Fermented Foods, Cheese Production, Use of enzymes in Food Industry, Use of Lactase in Dairy Industry, Enzymes in fruit Juice and Brewing Industries, Microbial Biomass, Mushrooms, Single Cell Protein	7	10
8	Fuel Biotechnology Introduction, Useful Features of Biofuels, Undesirable Features of Biofuels, Areas for Future Research Focus, Energy Crops, Modes of Utilization of Biomass, Biogas, Bioethanol, Biobutanol, Biodiesel, Biohydrogen	5	7
9	Environmental Biotechnology Introduction, Wastes and Pollutants, Hazards from Wastes and Pollutants, Waste Treatment, Landfill, Aerobic Waste Water Treatment, Anaerobic Treatment of Waste Water, Biodegradation of Xenobiotic Compounds, Bioremediation, Water Quality	8	11
10	Biosafety Introduction, Historical 615, Definitions, Objectives of Safety Guidelines, Risk Assessment, Containment, Planned Introduction of Genetically Modified Organisms (GMOs) Biosafety during Industrial Production, Biosafety Guidelines in India.	5	7
11	Intellectual Property Rights Introduction, Intellectual Property, Protection of Intellectual Property Rights, Choice of IPR Protection, International Harmonization of Patent Laws, Protection of Biotechnological Inventions, Plant Breeder's Rights (PBR), Management of IPR, Benefits from IPR, Problems From IPR.	5	7

Suggested Specification table with marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	20	15	10	10	05

Legends: R= Remembrance; U= Understanding; A= Application; N = Analyze; E = Evaluate, C = Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

List of Experiments:

1. To perform monochrome staining.
2. To perform callus culture
3. Screening of potential micro organism
4. Sterilization techniques
5. Development of Inoculum
6. Production of bioethanol through fermentative method.
7. Production of biomass in laboratory
8. Basic techniques for waste water analysis.

Reference Books:

1. Basic Biotechnology by Colin Ratledge and Bjorn Kristiansen, Cambridge University Press, 3rd Edition.
2. Biotechnology by B. D. Singh, Kalyani Publisher.
3. Principles of Fermentation Technology, by Whitaker, Peter F Stanbury, S. Hall and A. Whitaker, Publisher: Butterworth-Heinemann; 2nd edition.
4. Plant Biotechnology by Dr. P. K. Gupta, Rastogi Publication.

Course Outcome:

After learning the course, the students should be able to:

1. Develop a fundamental understanding interdisciplinary approach of Biotechnology and Chemical Engineering.
2. Understand different branches of biotechnology and its applications in real field.

Open Ended Problems:

Students are free to select any project related to Biochemical engineering based on its application in the field of Biotechnology. Some of the suggested projects are:

1. To design downstreaming process using fundamentals of industrial biotechnology and chemical engineering.
2. To perform biodegradation of chemical compounds using combination of chemical and biological methods.

List of Open Source Software/learning website:

Students can refer to video lectures available on the websites including NPTEL. Students can refer to the CDs which are available with some reference books. Students can develop their own flowsheets for demonstration of various fermentation processes and the downstreaming process.

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.