

Name of the Programme: M.Sc. Part-I (Biochemistry)

Course Code: CHB-507

Title of the Course: Industrial Biochemistry

Number of Credits: 4

Effective from AY: 2022-23

Pre-requisites for the Course:	Students should have graduate level knowledge either in chemical or life sciences or should have qualified change of discipline test.	
Course Objectives:	1. To Introduce various techniques used for handling and processing of biomolecule. 2. To evaluate the utility of various techniques as a qualitative and quantitative tool for handling biomolecule on industrial scale. 3. To develop the concepts for managing biomolecules at commercial scale.	
Content:	1. Fermentation and bioreactors a. Introduction to Fermentation: Industrial fermentation and its range, advantages of industrial fermentations over chemical manufacturing process, types of fermentation processes: submerged and solid-state fermentation, modes of fermentation: batch, fed-batch and continuous, microbial growth curve and its use in designing modes of fermentation. b. Fermenters: Basic components of a fermenter, types of fermenters with their advantages and disadvantages, solid state fermentation, anaerobic fermentation. c. Significance and control of various fermentation parameters: Maintenance of aseptic conditions, methods of sterilisation, aeration and agitation, Industrial media and the nutrition of industrial organisms, scale up and scale down of a fermentation process, rheological properties of fermenter, Online and offline monitoring, computerization of fermenter operation. D. Downstream processing: Steps of downstream processing: Details of removal of insolubles, disruption of cell, isolation/extraction/purification, recovery and final product isolation of fermentation products	No of hours 16
	2. Food technology a. Characteristics of industrial microorganisms; strain improvement; use of auxotrophic mutants; cultivation of microorganisms. b. Introduction to processed foods: Introduction about different food industries, general properties and microorganisms involved in it c. Industrial production of few food products; i. Production of foods made from milk: Cheese, Probiotics – yoghurt/ curd. ii. Production of alcohol-based fermentation products: wine, beer, vinegar.	16

	iii. Production of oriental fermented foods: Soy sauce, tofu, tempeh. iv. Production of Indian fermented foods: Idli, dosa, dokhla. v. Production of ethnic fermented foods and beverages of Goa.	
	3. Industrial production of biochemically important products a. Production of industrially important proteins. i. Industrially important enzymes - amylase / protease / pectinase / lipase. b. Production of industrially important carbohydrates. i. Manufacturing and refining of cane sugar, pectin/cellulose ii. Manufacturing of polysaccharides. Plant polysaccharide (Gum Arabic), microbial polysaccharides, modified carbohydrates – modified starches, modified celluloses c. Production of industrially important lipids. i. Extraction and refining of vegetable oils and animal fats in general. ii. Extraction and applications of chlorophyll, carotene, lycopene, curcumin, and essential oils.	9
	4. Production of pharmaceuticals, nutraceuticals and biochemicals a. Production of Antibiotics: penicillins/ streptomycins. b. Production of Vitamins: B12/ascorbic acid. c. Production of Amino acids: lysine/glutamine. d. Production of Alcohol: ethanol. e. Production of Organic acid: citric acid/ lactic acid.	9
	5. Microbial cells as fermentation products: a. Production of Baker's yeast. b. Single cell proteins/Spirulina. c. Bacterial insecticides. d. Mushrooms.	5
	6. Immobilized Biocatalysts: Enzymes and Cells a. Rationale for immobilizing enzymes and whole cells. b. Methods for enzyme and whole cell immobilization, supports and their selection. c. Properties of immobilized biocatalysts. d. Industrial applications of immobilized biocatalysts.	5
Pedagogy:	Mainly lectures and tutorials. Seminars / term papers / assignments / presentations / self-study or a combination of some of these can also be used. ICT mode should be preferred. Sessions should be interactive in nature to enable peer group learning.	
References/ Readings:	1. Okafor N., Modern Industrial Microbiology and Biotechnology, Science Publishers, 2007, 4th Edition. 2. Casida, JR L. E.; Industrial Microbiology, New Age International Publishers, 2019, 2nd Edition. 3. Clarke, W.; Biotechnology: Industrial Microbiology a Textbook, CBS Publishers and distributors, 2016. 4. TamangJ P., Ethnic Fermented Foods and Beverages of India: Science History and Culture. Springer Nature, 2020.	

	5. Frazier W. C. and Westhoff D. C., Food Microbiology –Tata McGraw Hill Publishers, 1995. 6. Stanbury P. F., Whitakar A. and Hall S.; Principles of fermentation technology, Butterworth-Heinemann, 1995, 2nd Edition. 7. Kuila, A., Sharma, V.; Principles and Applications of Fermentation Technology, Wiley-Scrivener Publishing, 2019, 1st Edition.
Course Outcomes:	1. Students will be able to understand the principles of biochemistry techniques used in various settings of industrial processes. 2. Students will be able to apply the principles of techniques learned in biochemistry in various settings of industrial processes. 3. Students will be able to develop strategies for production of various types of biomolecules. 4. Students will be capable to handle various tools used for production and recovery of products on industrial site.