

Biochemical Engineering

- 1.1 Course Number: CH405
- 1.2 Contact Hours: 2-0-0 Credits: 6
- 1.3 Semester-offered: 4TH Year-even
- 1.4 Prerequisite: Chemical Reaction Engineering-1 & 2
- 1.5 Syllabus Committee Member: Dr G K Agrahari, Dr Amit Ranjan

2. **Objective:** In recent years, advances have been made in the production of compounds and goods from biological sources, particularly incorporating cells sourced from animals and plants. Manufacturing of food products, medicines, and proteins incorporates cell-culture for commercial applications. The course will provide a window to the chemical engineering students to learn processes that are based on biochemical reactions and related concepts.

3. **Course Content:**

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-topic	Lectures
1	Introduction & Overview	Basics of micro-organisms, prokaryotes & eukaryotes, cell structure, amino acids, lipids, proteins, nucleic acids, macro- and micronutrients	3
2	Enzyme Kinetics	Michaelis-Menten kinetics, effects of process variables, multiphase enzyme reactions, Immobilized Enzyme Systems, Large scale production of enzymes	4
3	Metabolism	Glucose metabolism, metabolism of nitrogenous compounds and nitrogen fixation, metabolism of hydrocarbons, Overview of anaerobic, and autotrophic metabolism	5
4	Bioreactors	Cell growth kinetics, batch & continuous culture, stoichiometry, operating considerations of reactors for suspension and immobilized cultures, solid state fermentations, hybrid reactors	6
5	Scale-up & Scale-down Considerations	Overview, bubble column and loop reactors, aeration, agitation and heat transfer considerations, approaches to scale-up & scale-down, micro-bioreactors	5
6	Separation and Purification of Products	Techniques for insoluble and soluble product purification, liquid-liquid extraction, integration of reaction and separation	5
		Total	28

4. Readings

4.1 Textbook:

- i) Michael L. Shuler, F. Kargi, & M. Delisa; Bioprocess Engineering: Basic Concepts. 3rd Edition, Prentice Hall International Series, 2017
- ii) Ghasem D. Najafpour, Biochemical Engineering and Biotechnology, 2nd edition; Elsevier B.V., 2015

4.2 Reference books:

- i) James Allen Bailey, James Edwin Bailey, Jay Bailey, David F. Ollis, David F. Ollis; Biochemical Engineering Fundamentals; McGraw-Hill, 1986

- 5 Outcome of the Course:** The students will be able to apply the principles of chemical engineering discipline to the design and development of manufacturing processes consisting of enzymes, microbes, and animal/plant cells as materials.