

Subject Code: 01CH0606
Subject Name: Biochemical Engineering
B. Tech. Year: III (Semester VI)

Objective: This subject puts emphasis on the basic engineering principles of biochemical process. It also highlights the modern application of biotechnological process and the role of chemical engineer in biotechnological industry.

Credits Earned: 4 Credits

Course Outcomes: After completion of this course, student will be able to:

1. To judge the development of bio process technology design and construction of fermentor.
2. To predict the various media for Fermentation Process.
3. To analyse the principles and kinetics of Sterilization methods and compare the batch, fed-batch and continuous systems.
4. To evaluate different mass transfer operations used in biochemical industries..

Pre-requisite of course: Basic concepts of Biology and Science.

Teaching and Examination Scheme

Teaching Scheme (Hours)			Credits	Theory Marks			Tutorial/ Practical Marks		Total Marks
Theory	Tutorial	Practical		ESE (E)	CSE	Internal (I)	Viva (V)	Term work (TW)	
3	0	2	4	50	20	30	25	25	150

CONTENTS

Unit	Topics	Contact Hours
1	FERMENTATION PROCESSES Evolution and Outline of Fermentation processes, Range of fermentation processes, Unit operations involved in bioprocess engineering, Fermenter design, various parameters in fermentation process, types of fermentation process	8
2	RAW MATERIALS AND MEDIA DESIGN Various raw materials and its applications, Selection criteria of appropriate medium, types of media-simple, complex, crude and synthetic, design and usage of various commercial media for industrial fermentations.	8
3	GROWTH AND PRODUCT FORMATION KINETICS	8

	Batch Culture, Continuous Culture – Multistage systems, Enzyme kinetics Feedback systems, Fed Batch Culture – Variable volume, fixed volume, Cyclic. Applications.	
4	AERATION AND AGITATION Introduction, Oxygen requirement in fermentations, Oxygen supply, Determination of KLa values, Fluid rheology, Factors affecting KLa values, Balance between oxygen demand and supply, Scale up and Scale down.	8
5	STERILIZATION Definition and process, types of sterilization methods- batch and continuous, Thermal death kinetics, filter sterilization of liquid media and air. Isolation, preservation and improvement of microorganisms	6
	Total Hours	38

List of Experiments:

1. Determination of Oxygen Transfer rate.
2. Determination of KLa value.
3. To obtain growth curve of bacteria under batch culture.
4. To obtain growth curve of bacteria under fed batch culture.
5. To carry out precipitation of protein.
6. To perform column chromatography.
7. To perform drying operation.
8. To perform crystallization operation.

References:

1. James E. Bailey and David F Ollis- Biochemical Engineering Fundamentals.
2. Bioprocess Engineering Principles by Pauline Doran, Publisher: Elsevier Science & Technology Books.
3. Introduction to Biochemical Engineering by D. G. Rao, Tata McGraw-Hill Education, 2005.
4. Biochemical Engineering and Biotechnology by Ghasem D. Najafpour, Publisher: Elsevier Science & Technology Books

Suggested Theory distribution:

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery and evaluation					
Remember	Understand	Apply	Analyse	Evaluate	Create
15%	20%	15%	15%	5%	-

Instructional Method:

- a. The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.
- b. The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and class-room.
- c. Practical examination will be conducted at the end of semester for evaluation of performance of students in laboratory.
- d. Students will use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory

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:

- To perform formulation of some bioproducts.
- To perform downstreaming of some bioproducts.

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.