BTL331	BIOPROCESS ENGINEERING LAB	CATEGORY	L	T	P	CREDIT
		PCC	0	0	3	2

Preamble: Bioprocess engineering is an integral part of Biotechnology which is essential for the production of Biomolecules in large quantities

Prerequisite: Bioprocess Calculation of S3 Semester

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

CO 1	Development of an ability to design and conduct bioprocess experiments as well as to analyze and interpret data.
CO 2	Calculate the kinetic parameters of enzymatic reactions as well as microbial growth
CO 3	Development of research attitude and technical skills to secure a job in bioprocess labs.
CO 4	Exhibit ethical principles in the engineering profession by practicing ethical approaches in experimental investigation, collection and reporting of data and adhering to the relevant safety practices in the laboratory.

Mapping of course outcomes with program outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	3	3	-	3	2	-	-	3	3	3	3	-
CO2	3	3	-	3	-	-	-	-	-	-	-	-
CO3	3	3	-	3	2	-	-	3	3	3	-	3
CO4	3	3	-	3	-	-	-	3	-	-	3	-

Assessment Pattern

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	75	75	2.5 hours

Continuous Internal Evaluation Pattern:

Attendance	:	15 marks
Continuous Assessment	:	30 marks
Internal Test (Immediately before the second series test)	:	30 marks

End Semester Examination Pattern: The following guidelines should be followed regarding award of marks

(a) Preliminary work : 15 Marks

(b) Implementing the work/Conducting the experiment : 10 Marks

(c) Performance, result and inference (usage of equipments and troubleshooting: 25 Marks

(d) Viva voice : 20 marks

(e) Record : 5 Marks

General instructions: Practical examination to be conducted immediately after the second series test covering entire syllabus given below. Evaluation is a serious process that is to be conducted under the equal responsibility of both the internal and external examiners. The number of candidates evaluated per day should not exceed 20. Students shall be allowed for the University examination only on submitting the duly certified record. The external examiner shall endorse the record.

Course Level Assessment Questions

Course Outcome 1 (CO1): Development of an ability to design and conduct bioprocess experiments as well as to analyze and interpret data

1. Determine the growth pattern of E.coli.
2. Formulation of simple and complex culture media.
3. Medium Optimization by Plackett Burman Design and Response Surface Methodology

Course Outcome 2 (CO2): Calculate the kinetic parameters of enzymatic reactions as well as microbial growth

1. Determination of Kinetics of growth in batch culture - Estimation of Biomass, Calculation of Specific Growth Rate, Yield Coefficient
2. Temperature effect on growth-estimation of energy of activation and Arrhenius Constant for microorganisms.
3. Study of kinetics of enzyme catalyzed reaction- Determination of Michaelis – Menten parameters

Course Outcome 3(CO3): Development of research attitude and technical skills to secure a job in bioprocess labs

1. Determination of Effect of Temperature on enzyme activity and Deactivation Kinetics
2. Effect of pH on enzyme activity
3. Kinetics of enzyme inhibition

Course Outcome 4 (CO4): Exhibit ethical principles in the engineering profession by practicing ethical approaches in experimental investigation, collection and reporting of data and adhering to the relevant safety practices in the laboratory

1. Molecular weight determination of enzyme by Gel filtration method.
2. Bioconversion studies with immobilized enzyme reactors.
3. Demonstration of stirred tank bioreactor system, various parts and process control systems.

Syllabus

A minimum of 12 Experiments is mandatory

1. Determine the growth pattern of E.coli.
2. Formulation of simple and complex culture media.
3. Medium Optimization by PlackettBurman Design and Response Surface Methodology
4. Determination of Kinetics of growth in batch culture - Estimation of Biomass, Calculation of Specific Growth Rate, Yield Coefficient
5. Temperature effect on growth-estimation of energy of activation and Arrhenius Constant for microorganisms.
6. Estimation of KLa – Sulphite Oxidation Method
7. Enzyme isolation and assay- quantification of enzyme activity and specific activity
8. Study of kinetics of enzyme catalysed reaction- Determination of Michaelis – Menteen parameters
9. Determination of Effect of Temperature on enzyme activity and Deactivation Kinetics
10. Effect of pH on enzyme activity
11. Kinetics of enzyme inhibition
12. Enzyme immobilization – Gel entrapment
13. Molecular weight determination of enzyme by Gel filtration method.
14. Bioconversion studies with immobilized enzyme reactors.
15. Demonstration of stirred tank bioreactor system, various parts and process control systems.

Text Books

1. Weith, John W.F., Biochemical Engineering – Kinetics, Mass Transport, Reactors and Gene Expression, Wiley and Sons Inc. (1994).

2. Bailey, J.E. and Ollis, D.F, Biochemical Engineering Fundamentals, McGraw Hill, New York (1986)
3. Doran, P.M Bioprocess Engineering Principles, Academic Press (2012)
4. Aiba, S., Humphrey, A.E and Millis, N.F., Biochemical Engineering, Academic Press (1973)

Reference Books

1. Stanbury P. F., Whittaker, A. and Hall, S. J., Principles of Fermentation Technology, Butterworth-Heinemann (2007).
2. Shuler M., Kargi F., Bioprocess Engineering: Basic Concepts, PHI (2012).

Course Contents and Lecture Schedule

No	Topic	No. of hours
1	Determine the growth pattern of E.coli.	3
2	Formulation of simple and complex culture media.	3
3	Determination of Kinetics of growth in batch culture - Estimation of Biomass, Calculation of Specific Growth Rate, Yield Coefficient	3
4	Medium Optimization by PlackettBurman Design and Response Surface Methodology	3
5	Temperature effect on growth-estimation of energy of activation and Arrhenius Constant for microorganisms.	3
6	Estimation of KLa – Sulphite Oxidation Method	3
7	Enzyme isolation and assay- quantification of enzyme activity and specific activity	3
8	Study of kinetics of enzyme catalysed reaction- Determination of Michaelis – Menten parameters	3
9	Determination of Effect of Temperature on enzyme activity and Deactivation Kinetics	3
10	Effect of pH on enzyme activity	3
11	Kinetics of enzyme inhibition	3
12	Enzyme immobilization – Gel entrapment	3
13	Molecular weight determination of enzyme by Gel filtration method.	3
14	Bioconversion studies with immobilised enzyme reactors.	3
15	Demonstration of stirred tank bioreactor system, various parts and process control systems.	3