SEMESTER: S5

BIOREACTOR DESIGN

Course Code	PEPOT526	CIE Marks	60
Teaching Hours/Week (L: T:P: R)	3: 0:0: 0	ESE Marks	40
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To impart basic knowledge on bioreactors.

2. To impart knowledge on different modes of operation bioreactor.

SYLLABUS

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Module No.	Syllabus Description	Contact Hours
1	**Bioreactors** - Function, description, working, advantages and limitations of stirred tank, airlift, airlift pressure cycle bioreactor, packed bed, fluidized bed, trickle bed and flocculated cell bioreactors. Novel Bioreactors-inverse fluid flow units, hollow fiber reactors, centrifugal field reactors, rotating drum bioreactor, spin filter bioreactor, disposable culture systems and wave bioreactor.	9
2	Batch bioreactor, cell death in batch reactor, endogenous metabolism, maintenance, calculation of batch reaction time from ideal system for enzyme reaction and cell culture, batch reaction time with enzyme deactivation, calculation of total batchtime. Ideal continuous flow stirred tank bioreactor (CFSTBR)-chemostat, substrate conversion and biomass productivity, mean residence time	9

3	comparison of batch bioreactor and single stage CFSTBR, wash out condition, stability of the chemostat, chemostat with cell recycle, comparison of steady-state biomass concentration and volumetric biomass productivity for a chemostat with and without cell recycle.**:** reactors, calculation Plug flow tubular reactor (PFTR), comparison of ideal mixed flow (batch and CFSTBR) and plug flow tubular of reactor length and residence time, recycling in PFTRs, analysis of recycle reactors.	**9**
4	Design aspects of bioreactors, bioreactor geometry, guidelines for bioreactor design, bioreactor vessels, agitator assembly, mass transfer aspects, rheology and mixing, design, operation and types of agitators, power requirements for agitation, effects of agitation on mass transfer, oxygen delivery system - spargers, foam control system, factors affecting antifoam requirements, mass transfer between phases–factors affecting mass transfer between phases, oxygen uptake in fermenters	**9**

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Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Micro project	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

	Course Outcome	Bloom's Knowledge Level (KL)
CO1	Explain how different bioreactors work	**K2**
CO2	Estimate substrate conversion and biomass productivity in a chemostat	**K5**
CO3	Define the reactor length and residence time	**K1**
CO4	Develop the design aspects of bioreactors	**K6**
CO5	Analyze the basic knowledge in bioprocess industries	**K4**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											
CO2	3											
CO3	3											
CO4	3											
CO5	3											

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Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Bio process Engineering Principles	Pauline M Doran	Academic Press,	2013
2	Bio chemical Engineering	Douglas S Clark,Harvey W Blanch	Marcel Dekker,	1997

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Basic Bioreactor Design	Klaasvan't Riet ,Johannes Tramper	Marcel Dekker,	1991.
2	Bioreactors: Analysis and Design	Tapobrata Panda	Tata McGraw-Hill	2011.
3	Bioreactors in Biotechnology A Practical Approach	Alan H Scragg	Ellis Horwood,	1991

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Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://youtu.be/uooShNgPhIQ
2	https://youtu.be/azdVSr7DBlg
3	https://youtu.be/xq9HTNCsWXM
4	https://youtu.be/1LwT7C2bxhU