SRI VENKATESWARA COLLEGE OF ENGINEERING

COURSE DELIVERY PLAN - THEORY

Department of **Biotechnology**	LP: BT22601 Rev. No: 00 Date: 20-01-2025
B.E/**B.Tech**/M.E/M.Tech : **Biotechnology** Regulation: **2022** PG Specialisation : **NA** Sub. Code / Sub. Name : **BT22601 / Biochemical Reaction Engineering** Unit : **I**	

Unit Syllabus: **INTRODUCTION TO REACTION KINETICS (9 h)**

Basic Reaction Theory: Reaction Thermodynamics – Reaction Yield – Reaction Rate - Effect of Temperature on Reaction Rate – Calculation of Reaction Rates from Experimental Data; General Reaction Kinetics for Biological Systems: Zero Order Kinetics – First Order Kinetics – Michaelis – Menton Kinetics.

Objective: To introduce the general reaction kinetics for biological systems.

Session No *	Topics to be covered	Ref	Teaching Aids
1.	Basic Reaction Theory: Reaction Thermodynamics	T1 (1,2); T2 (1-3); R1 (1-3); R2 (3,4)	BB & PPT
2.	Reaction Yield – Concept and Problems	T1 (1,2); T2 (4); R1 (309);	BB & PPT
3.	Reaction Rate – Concept and Problems	T1 (2-5, 13,14); T2 (4-8); R1(3,4)	BB & PPT
4.	Effect of Temperature on Reaction Rate	T1 (2-5, 13,14); T2 (4-8); R1(3,4)	BB & PPT
5.	Calculation of Reaction Rates from Experimental Data	T1(6-8)	BB & PPT
6.	General Reaction Kinetics for Biological Systems	T1(13-14); R2 (4-10)	BB & PPT
7.	Zero Order Kinetics – Derivation and Problems	T1(33-34); R2 (25-29)	BB & PPT
8.	First Order Kinetics – Derivation and Problems	T1(14-26); R1 (42,43)	BB & PPT
9.	Michaelis – Menton Kinetics	T1(22-25, 29, 73-74); T2 (20-22); R1 (44,45); R2 (27-37)	BB & PPT
Content beyond syllabus covered (if any): Nil			

* Session duration: 50 minutes; BB – Black Board; PPT – Power Point.

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Sub. Code / Sub. Name: **BT22601 / Biochemical Reaction Engineering**

Unit : **II**

Unit Syllabus : **HOMOGENOUS REACTIONS (9 h)**

Cell Growth Kinetics – Production Kinetics in Cell Culture – Kinetics of Substrate Uptake in Cell Culture Determining Cell Kinetic Parameters from Batch Data –Effect of Maintenance on Yields - Kinetics of Cell Death.

Objective: To impart the knowledge on the kinetics of microbial cell growth and death.

Session No *	Topics to be covered	Ref	Teaching Aids
10	Cell Growth Kinetics -Derivation	T1(83-88); T2(140-143)	BB & PPT
11	Cell Growth Kinetics -Problems	T2(144-150); R1(26-28)	BB & PPT
12	Production Kinetics in Cell Culture	T1(67-72); T2(151-168) R1(29-37, 309-312)	BB & PPT
13	Kinetics of Substrate Uptake in Cell Culture	T1(91-93); R1(296-308)	BB & PPT
14	Determining Cell Kinetic Parameters from Batch Data	T1(96-97); R2(67-79)	BB & PPT
15	Determining Cell Kinetic Parameters from Batch Data	T1(96-97); R2(67-79)	BB & PPT
16	Kinetics of Cell Death - Derivation	T1(96-97); R2(67-79)	BB & PPT
17	Kinetics of Cell Death - Problems	T1(96-97); R2(67-79)	BB & PPT
18	Kinetics of Cell Death - Problems	T1(96-97); R2(67-79)	BB & PPT
Content beyond syllabus covered (if any): Nil			

* Session duration: 50 minutes; BB – Black Board; PPT – Power Point.

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Sub. Code / Sub. Name: **BT22601 / Biochemical Reaction Engineering**

Unit : **III**

Unit Syllabus: **HETEROGENEOUS REACTIONS (9 h)**

Heterogeneous reactions in Bioprocessing – Concentration Gradients and Reaction Rate in Solid Catalysts – Internal Mass Transfer and Reaction – The Thiele Modulus and Effectiveness Factor – External Mass Transfer – Liquid-Solid Mass Transfer Correlations.

Objective: To acquire knowledge on heterogeneous reactions in bioprocessing

Session No *	Topics to be covered	Ref	Teaching Aids
19	Heterogeneous reactions in Bioprocessing	T1(257-260); T2(767-769); R1(318-324, 453-455)	Blended Learning Video 1
20	Concentration Gradients and Reaction Rate in Solid Catalysts - Derivation	T1(260-266); T2(771-776); R1(325-331)	BB & PPT
21	Concentration Gradients and Reaction Rate in Solid Catalysts - Problems	T1(260-266); T2(771-776); R1(325-331)	BB & PPT
22	Concentration Gradients and Reaction Rate in Solid Catalysts - Problems	T1(260-266); T2(771-776); R1(325-331)	BB & PPT
23	Internal Mass Transfer and Reaction	T1(267-273); T2(773-774, 779-781); R1(461-465)	BB & PPT
24	The Thiele Modulus and Effectiveness Factor - Derivation	T1(283-316); T2(808-809)	BB & PPT
25	The Thiele Modulus and Effectiveness Factor - Problems	T1(283-316); T2(808-809)	BB & PPT
26	External Mass Transfer	T2(874-877)	BB & PPT
27	Liquid-Solid Mass Transfer Correlations	T1(305-309); T2(874-877)	BB & PPT
Content beyond syllabus covered (if any): Nil			

* Session duration: 50 minutes; BB – Black Board; PPT – Power Point.

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Sub. Code / Sub. Name: **BT22601 / Biochemical Reaction Engineering**

Unit : **IV**

Unit Syllabus : **IDEAL BIOREACTOR OPERATION (9 h)**

Batch operation of a mixed reactor, Fed-batch operation of a mixed reactor, Continuous operation of a mixed reactor, Chemostat with immobilized cells, Chemostat cascade, Chemostat with cell recycle, Continuous operation of a plug flow reactor.

Objective: To familiarize the concept of ideal bioreactor operation

Session No *	Topics to be covered	Ref	Teaching Aids
27	Batch operation of a mixed reactor - Derivation	T1(369-374); R1(154-170)	BB & PPT
28	Batch operation of a mixed reactor - Problems	T1(369-374); R1(154-170)	BB & PPT
29	Fed-batch operation of a mixed reactor - Derivation	T1(376-406); R1(191-213)	BB & PPT
30	Fed-batch operation of a mixed reactor - Problems	T1(376-406); R1(191-213)	BB & PPT
31	Continuous operation of a mixed reactor - Derivation	T1(406-416); R1(215-223)	BB & PPT
32	Continuous operation of a mixed reactor - Problems	T1(406-416); R1(215-223)	BB & PPT
33	Chemostat with immobilized cells	R1(198-213)	BB & PPT
34	Chemostat cascade	T1(407-416)	BB & PPT
35	Chemostat with cell recycle	T1(407-416)	BB & PPT
36	Continuous operation of a plug flow reactor	T1(407-416)	BB & PPT

Content beyond syllabus covered (if any): Nil

* Session duration: 50 minutes; BB – Black Board; PPT – Power Point.

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Sub. Code / Sub. Name: **BT22601 / Biochemical Reaction Engineering**
Unit : **V**

Unit Syllabus : **NON-IDEAL REACTORS (9 h)**

Basics of Non-Ideal Flow – Flow Patterns Contacting and Non-Ideal Flow –Experimental Determination of Residence Time Distribution – Conversion in Non-Ideal Flow Reactors - The Tank-in-Series Model.

Objective: To gain knowledge on non-ideal conditions and RTD measurements.

Session No *	Topics to be covered	Ref	Teaching Aids
37	Introduction of Non-ideal flow	T1(447-451)	BB & PPT
38	Basics of Non-Ideal Flow	T1(451-470)	BB & PPT
39	Flow Patterns Contacting and Non-Ideal Flow	T1(451-470)	Blended Learning Video 2
40	Experimental Determination of Residence Time Distribution - Problems	T3(500-510)	BB & PPT
41	Experimental Determination of Residence Time Distribution - Problems	T3(500-510)	BB & PPT
42	Conversion in Non Ideal Flow Reactors - Derivation	T1(523-535); R1(614-618)	BB & PPT
43	Conversion in Non Ideal Flow Reactors - Problems	T1(523-535); R1(614-618)	BB & PPT
44	The Tank-in-Series Model - Derivation	T1(540-546)	BB & PPT
45	The Tank-in-Series Model - Problems	T1(540-546)	BB & PPT
Content beyond syllabus covered (if any): Nil			

* Session duration: 50 minutes; BB – Black Board; PPT – Power Point.

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TEXT BOOKS

1. Octave Levenspiel, Chemical Reaction Engineering Third Edition, An Indian Adaptation, Wiley, 2021.
2. Pauline M. Doran, Bioprocess Engineering Principles, Second Edition, Elsevier, 2012.
3. James E. Bailey and David F. Ollis, Biochemical Engineering Fundamentals, Second Edition, McGraw Hill Education, 2017.

REFERENCES

1. Elmar Heinzle, Irving J. Dunn, John Ingham, Jiří Přenosil, Biological Reaction Engineering, Third Ediiton, Wiley, 2021.
2. Jens Nielsen , John Villadsen , Gunnar Lidén, Bioreaction Engineering Principles, Second Edition, Springer, 2003.

	Prepared by	Approved by
Signature		
Name	Dr. K. Vasantharaj	Prof. E. Nakkeeran
Designation	Assistant Professor	HOD
Date	20.01.2025	20.01.2025
Remarks *: Nil		
Remarks *: Nil		

* If the same lesson plan is followed in the subsequent semester/year it should be mentioned and signed by the Faculty and the HOD