SRI VENKATESWARA COLLEGE OF ENGINEERING

COURSE DELIVERY PLAN - THEORY

Department of Biotechnology	LP: BT BT22402 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 **: BT22402/TRANSPORT PHENOMENA OF BIOPROCESSES** Unit : I	

UNIT I FLUIDS & FLUID PROPERTIES 6+3

Properties of Fluids-Specific weight, specific volume, specific gravity, viscosity; Newton's law of viscosity; Classification of Fluids-Non-Newtonian Fluids; Pressure and its measurement – Simple manometer, U-tube manometer and differential manometer; Viscosity Measurement; Factors affecting Broth Viscosity.

OBJECTIVE: To study about the basics of fluids and fluid properties.

Session No *	Topics to be covered	Ref	Teaching Aids
1.	Properties of Fluids- Specific weight, specific volume, specific gravity	RB3 Pg. 1-3	LCD/BB
2.	Newton's law of Viscosity	RB1 Pg 62-63	LCD/BB
3.	Classification of Fluids-Non-Newtonian Fluids	TB1 Pg. 153-158	LCD/BB
4.	Pressure and its measurement	RB3 Pg. 35-45	LCD/BB/ Lab demo
5.	Simple manometer, U-tube manometer, Differential manometer	RB3 Pg. 45-68	LCD/BB/ Lab demo
6.	Viscosity, Viscosity Measurement, Factors affecting Broth Viscosity	TB1 Pg.139-142 RB3 Pg. 3-17	LCD/ BB/ Lab demo
7.	Problems- Properties of Fluids	RB3 Pg. 1-3	LCD/BB
8.	Problems- Manometer	RB3 Pg. 35-68	LCD/BB
9.	Problems- Viscosity	RB3 Pg. 3-17	LCD/BB
Content beyond syllabus covered (if any):-			

* Session duration: 50 minutes

Sub. Code / Sub. Name	: **BT22402/TRANSPORT PHENOMENA OF BIOPROCESSES**
Unit	: II

UNIT II FLUID FLOW AND MIXING 6+3

Fluids in Motion; Rheological properties of Fermentation Broths; Flow Measurement Devices; Pumps and Valves; Mixing Equipment; Flow Pattern in Agitated Tanks; Mechanism of Mixing; Mixing Time; Power Requirements for Mixing; Scale up of Mixing Systems; Effect of Rheological Properties on Mixing.

OBJECTIVE:. To understand the fundamental principles of fluid flow and mixing

Session No *	Topics to be covered	Ref	Teaching Aids
10.	Fluids in Motion , Rheological properties of Fermentation Broths	TB2 , Pg. 130-140	LCD/BB
11.	Flow Measurement Devices	RB1 Pg. 232-242	LCD/BB/ Lab demo
12.	Pumps and Valves	RB1 Pg. 314-329	Experiential learning
13.	Mixing Equipment; Flow Pattern in Agitated Tanks	TB2 , Pg. 141-147	LCD/BB/ Lab demo
14.	Mechanism of Mixing; Mixing Time; Power Requirements for Mixing	TB2 , Pg. 150-154	LCD/BB/ Lab demo
15.	Scale up of Mixing Systems; Effect of Rheological Properties on Mixing.	TB2 , Pg. 156-158	LCD/BB
16.	Problems- Flow Measurement	RB1 Pg. 232-242	LCD/BB
17.	Problems- Pumps and Valves	RB1 Pg. 314-329	LCD/BB
18.	Problems- Mixing	TB2 , Pg. 141-154	LCD/BB
Content beyond syllabus covered (if any):			

* Session duration: 50 mins

Sub. Code / Sub. Name : **: BT22402/TRANSPORT PHENOMENA OF BIOPROCESSES**
Unit : III

UNIT III MECHANISM OF HEAT TRANSFER 6+3

Various modes of heat transfer-Conduction, Convection and Radiation; Steady state Conduction; Fourier‟s Law; Thermal conductivity; Combining Thermal Resistances in Series; Heat Transfer between Fluids; Thermal Boundary Layers; Individual and Overall Heat Transfer Coefficients; Fouling Factor.

OBJECTIVE: To learn the mechanism of heat transfer in bioprocesses.

Session No *	Topics to be covered	Ref	Teaching Aids
19.	Various modes of heat transfer-Conduction, Convection and Radiation	RB2, Pg. 3-9	LCD/BB
20.	Steady state Conduction; Fourier‟s Law; Thermal conductivity	RB2, Pg. 57-66	LCD/BB
21.	Combining Thermal Resistances in Series	RB2, Pg. 95-112	LCD/BB
22.	Heat Transfer between Fluids, Thermal Boundary Layers	RB1, Pg. 413-438	LCD/BB
23.	Individual and Overall Heat Transfer Coefficients	TB2, Pg. 173-175	LCD/BB
24.	Fouling Factor	RB1, Pg. 517-540	LCD/BB
25.	Problems- Heat transfer by Conduction,	RB1, Pg. 387-412	LCD/BB
26.	Problems- Heat transfer by Convection	RB1, Pg. 414-438	LCD/BB
27.	Problems- Heat transfer by Radiation	RB1, Pg. 438-465	LCD/BB
Content beyond syllabus covered (if any):			

* Session duration: 50 mins

Sub. Code / Sub. Name : **: BT22402/TRANSPORT PHENOMENA OF BIOPROCESSES**
Unit : IV

UNIT IV HEAT TRANSFER EQUIPMENTS 6+3

Heat-transfer configurations for bioreactors; Equipment for Heat Transfer: Double-pipe Heat Exchanger, Shell-and Tube- Heat Exchangers; Design Equations for Heat Transfer Systems; Logarithmic- and Arithmetic-Mean Temperature Differences; Calculation of Heat-Transfer Coefficients

OBJECTIVE: To study about different heat exchangers and their design

Session No *	Topics to be covered	Ref	Teaching Aids
28.	Heat-transfer configurations for bioreactors;	RB1, Pg.496-503	LCD/BB/ Lab demo
29.	Equipment for Heat Transfer: Double-pipe Heat Exchanger,	RB2, Pg. 670-675	LCD/BB/ Lab demo
30.	Shell-and Tube- Heat Exchangers	RB1, Pg.503-535	LCD/BB
31.	Design Equations for Heat Transfer Systems	RB2, Pg. 675-707	LCD/BB
32.	Logarithmic- and Arithmetic-Mean Temperature Differences	TB2, Pg. 180-182	LCD/BB
33.	Calculation of Heat-Transfer Coefficients	TB2, Pg. 182-184	LCD/BB
34.	Problems- Logarithmic- Mean Temperature Differences	TB2, Pg. 180-182	LCD/BB
35.	Problems- Arithmetic-Mean Temperature Differences	TB2, Pg. 180-182	LCD/BB
36.	Problems- Heat-Transfer Coefficients	TB2, Pg. 182-184	LCD/BB
Content beyond syllabus covered (if any):			

* Session duration: 50 mins

Sub. Code / Sub. Name : **: BT22402/TRANSPORT PHENOMENA OF BIOPROCESSES**
Unit : V

UNIT V MASS TRANSFER 6+3

Molecular Diffusion; Fick‟s Law; Role of Diffusion in Bioprocessing; Film Theory; Convective Mass Transfer-Liquid-Solid Mass Transfer, Liquid-Liquid Mass Transfer, Gas-Liquid Mass Transfer; Oxygen Uptake in Cell Cultures; Oxygen Transfer in Fermenters; Measuring Dissolved-Oxygen Concentrations and Oxygen Solubility

OBJECTIVE: To understand the basic concepts of mass transfer principles in bioprocess.

Session No *	Topics to be covered	Ref	Teaching Aids
37.	Molecular Diffusion; Fick's Law	TB1, Pg. 381-385	LCD/BB
38.	Role of Diffusion in Bioprocessing, Film Theory;	TB2, Pg. 192-193	LCD/BB
39.	Convective Mass Transfer-Liquid-Solid Mass Transfer	TB2, Pg. 193-194	LCD/BB
40.	Liquid-Liquid Mass Transfer, Gas-Liquid Mass Transfer	TB2, Pg. 194-196	LCD/BB
41.	Oxygen Uptake in Cell Cultures; Oxygen Transfer in Fermenters;	TB3, Pg. 54-59	LCD/BB/ Lab demo
42.	Measuring Dissolved-Oxygen Concentrations and Oxygen Solubility	TB2, Pg. 205-214	LCD/BB/ Lab demo
43.	Problems- Diffusion	TB2, Pg. 192-193	LCD/BB
44.	Problems- Oxygen uptake and oxygen transfer	TB3, Pg. 54-59	LCD/BB
45.	Problems- Dissolved-Oxygen Concentrations and Oxygen Solubility	TB2, Pg. 192-193	LCD/BB
Content beyond syllabus covered (if any):			

* Session duration: 50 mins

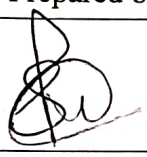
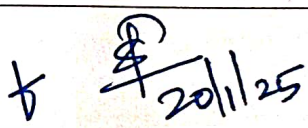
Sub. Code / Sub. Name : : **BT22402/TRANSPORT PHENOMENA OF BIOPROCESSES**

TEXTBOOKS:

1. Geankoplis, C.J., Transport Processes and Separation process Principles, 4th Edition, PHI, 2015.
2. Pauline M Doran, Bioprocess Engineering Principles, 2nd Edition, Academic Press, 2013.
3. Ghasem D.Najafpour, Biochemical Engineering and Biotechnology, 1st Edition, Elsevier, 2007

REFERENCE BOOKS:

1. J.M.Coulson and J.F.Richardson: Chemical Engineering VoI 1. Fluid flow, Heat Transfer and Mass Transfer. Butterworth,Heinemann, an imprint of Elservier, Sixth Edition, Indian Reprint, 2006.
2. Theodore L Bergman, Adrienne S Lavine, Frank P Incropera, David P DeWitt, Fundamentals of Heat and Mass Transfer, 7th Edition, Willey, 2011

	Prepared by	Approved by
Signature		
Name	Dr. V. Sumitha	Prof. E. Nakkeeran
Designation	Professor	Professor & HOD
Date	20.1.2025	20.1.2025
Remarks *: The Same lesson plan will be followed in the subsequent year		
Remarks *: -		