SRI VENKATESWARA COLLEGE OF ENGINEERING

COURSE DELIVERY PLAN - THEORY

Department of **Biotechnology**	LP: BT18502 Rev. No: 02 Date: 03.07.2023
B.E/**B.Tech**/M.E/M.Tech : **Biotechnology** Regulation: **2018** PG Specialisation : **NA** Sub. Code / Sub. Name : **BT18502 / Mass Transfer Operations** Unit : **I - Diffusion and Mass Transfer**	

Unit Syllabus: **Diffusion and Mass Transfer (12 h)**
Molecular diffusion in fluids and solids; Inter phase Mass Transfer; Mass Transfer coefficients; Theories of Mass Transfer; Analogies in Transport Phenomenon..

Objective: To impart knowledge on mass transfer operations and basic principles of mass transfer.

Session No *	Topics to be covered	Ref	Teaching Aids
1	Introduction to Mass Transfer Operations	T1 (1-12), T3 (1.1 – 1.11)	LCD/BB
2	Molecular diffusion – Definition, Types, Fick's law of diffusion	T2 (410 – 414), T3 (2.1-2.6,2.12), R1 (573 – 575), R2 (588)	LCD/ Animations
3	Molecular diffusion in fluids	T1 (21 – 38, 88 - 93), T2 (414 - 446), R1 (575 - 599), R2 (597 - 614)	Animations/ LCD
4	Molecular diffusion in solids	T1 (21 – 38, 88 - 93), T2 (414 - 446), R1 (575 - 599), R2 (597 - 614)	LCD/BB
5	Mass transfer coefficients	T1 (45 - 66), T2 (466 - 474), T3 (3.1 – 3.16), R1 (619 - 625), R2 (624 - 629)	LCD/BB
6	Interface Mass Transfer	T1 (104 – 123) , T3 (4.1 - 4.17), R1 (599 – 619)	LCD/ Animations
7	Analogies of Transport phenomenon	T1 (66 - 78), T2 (474 – 486), R1 (694 - 731), R4 (112 – 124)	LCD/BB
8	Problems on Diffusion	T3 (2.42 – 2.129,3.26 – 3.78, 4.19 – 4.47)	LCD/BB
9	Problems on Diffusion – steady stage multicomponent	T1(30), T3 (2.42 – 2.129,3.26 – 3.78, 4.19 – 4.47)	LCD/BB
10	Problems on Diffusion – Gas diffusion	T1(32-34), T3 (2.42 – 2.129,3.26 – 3.78, 4.19 – 4.47)	LCD/BB
11	Problems on Diffusion - Liquids	T1(34-37)	LCD/BB
12	Problems on Diffusion - Liquids	R2 (592 – 595, 607 – 611, 614 – 615, 620,642 - 646)	LCD/BB
Content beyond syllabus covered (if any): -			

* Session duration: 50 minutes

Sub. Code / Sub. Name: **BT18502 / Mass Transfer Operations**

Unit : **II - Gas Liquid Operations**

Unit Syllabus: **Gas Liquid Operations (12 h)**

Principles of gas absorption; Single and Multi-component absorption; Absorption with Chemical Reaction; Design principles of absorbers; Industrial absorbers; HTU, NTU concepts.

Objective: To impart knowledge on principles of absorption and absorption equipments.

Session No *	Topics to be covered	Ref	Teaching Aids
13	Principles of gas absorption	T1 (275 - 282), T2 (625 – 636, 653 - 654) T3 (5.1, 5.3 – 5.16)	LCD/BB
14	Absorption with chemical reaction	T1 (333), T3 (5.28 – 5.29),	Animations/ LCD
15	Design principles of absorbers	T2 (662 - 688), T3 (5.21 – 5.37)	LCD/BB
16	Single component absorption and Multi-component absorption	T1 (282 – 304); T1 (322 – 332)	LCD/BB
17	Gas-liquid, vapour-liquid, liquid-liquid absorption equilibrium	T1 (282 – 304); T1 (322 – 332)	LCD/ Animations
18	Equipment for gas absorption	T2 (654 - 661), T3 (5.1 – 5.3),	LCD/BB
19	HTU & NTU	T1 (307 - 312), T3 (5.16 – 5.21)	LCD/BB
20	Analytical problems on absorption	T3 (5.38 – 5.76)	LCD/BB
21	Analytical problems on absorption – counter flow	T1 (286-289), T3 (5.38 – 5.76),	LCD/BB
22	Analytical problems on absorption - Multistage	T1 (295-298), T3 (5.38 – 5.76),	LCD/BB
23	Analytical problems on absorption - HTU	T3 (5.38 – 5.76),	LCD/BB
24	Analytical problems on absorption - NTU	T3 (5.38 – 5.76),	LCD/BB

Content beyond syllabus covered (if any): -

* Session duration: 50 mins

Sub. Code / Sub. Name: **BT18502 / Mass Transfer Operations**

Unit : **III - Vapour Liquid Operations**

Unit Syllabus: **Vapour Liquid Operations (12 h)**
Vapour - Liquid Equilibria; Simple, Steam and Flash Distillation; Continuous distillation; McCabe-Thiele and Ponchon-Savarit Principles; Industrial distillation equipments, HETP, HTU and NTU concepts.

Objective: To impart knowledge on basic principles and different types of distillation processes

Session No *	Topics to be covered	Ref	Teaching Aids
25	Vapour - Liquid Equilibria	T1 (342 - 360), T2 (696 - 699), T4 (1.1 – 1.7)	LCD/BB
26	Steam Distillation, Flash Distillation,	T1 (363 – 371, 455 - 463), T2 (700 - 705), T4 (1.8 – 1.18, 1.63 – 1.71)	Animations/ LCD
27	Continuous distillation and different types.	T1 (363 – 371, 455 - 463), T2 (700 - 705), T4 (1.8 – 1.18, 1.63 – 1.71)	LCD/BB
28	McCabe-Thiele method and Reflux ratio	T1 (402 - 419), T2 (706 - 724), T4 (1.18 – 1.45)	LCD/BB
29	Ponchon-Savarit Principles	T1 (374 - 402), T2 (731 - 740), T4 (1.45 – 1.62)	LCD/BB
30	Industrial distillation equipment's	T4 (1.71 – 1.75)	LCD/Videos
31	HETP, HTU & NTU concepts	T1 (426 - 429), T4 (1.75 – 1.80)	LCD/BB
32	Problems on distillation	T1 (349-350)	LCD/BB
33	Problems on distillation – immiscible liquids	T1 (354), T4 (1.81 – 1.100)	LCD/BB
34	Problems on distillation – Multi-component systems	T1 (366), T4 (1.101 – 1.154)	LCD/BB
35	Problems on distillation – reflux ratio	T1 (370), T4 (1.101 – 1.154)	LCD/BB
36	Problems on distillation - McCabe-Thiele method	T1(388-392, 412-414), T4 (1.101 – 1.154)	LCD/BB
Content beyond syllabus covered (if any): Extractive distillation of biological molecules			

* Session duration: 50 mins

Sub. Code / Sub. Name: **BT18502 / Mass Transfer Operations**

Unit : **IV - Extraction Operations**

Unit Syllabus : **Extraction Operations (12 h)**

Liquid - Liquid equilibria, Staged and continuous extraction, Industrial extraction equipments, Solid-liquid equilibria, Leaching Principles, Industrial leaching equipments.

Objective: To impart knowledge on basic principles of L-L equilibrium, solid-liquid equilibrium, leaching processes and associated mass transfer operations.

Session No *	Topics to be covered	Ref	Teaching Aids
37	Liquid - Liquid equilibrium	T1 (477 - 489), T2 (776 - 782),	LCD/BB
38	Methods of extraction processes	T4 (2.1 –2.11),	Animations/ LCD
39	Equipment's for extraction process	T1 (521 - 547), T2 (752 - 790), T4 (2.31-2.38)	LCD/BB
40	Counter current extraction	T1 (490 - 521), T2 (791 - 802), T4 (2.11-2.31)	Animations/ LCD
41	Problems related to extraction process	T4 (2.39 – 2.107)	LCD/BB
42	Leaching – Principles	T1 (717 - 721), T2 (802 - 806), T4 (4.1 –4.5)	Animations/ LCD
43	Equipments for leaching	T1 (723 - 744), T2 (806 - 808), T4 (4.14-4.20)	LCD/BB
44	Single stage & Multi stage leaching	T1 (748 - 760), T2 (809 - 817) T4 (4.5– 4.14)	LCD/BB
45	Problems related to leaching process	T1 (722-723)	LCD/BB
46	Problems on Extraction –Multistage cross current	T1 (749-751)	LCD/BB
47	Problems on Extraction – Multistage counter current	T1 (754 – 760)	LCD/BB
48	Problems on Extraction	T4 (4.21 – 4.68)	LCD/BB
Content beyond syllabus covered (if any): Centrifugal Extractors			

* Session duration: 50 mins

Sub. Code / Sub. Name: **BT18502 / Mass Transfer Operations**

Unit : **V - Solid Fluid Operations**

Unit Syllabus : **Solid Fluid Operations (12 h)**

Adsorption equilibria – Batch and fixed bed adsorption; Introduction to membrane separation process; Drying-Mechanism-Drying curves-Time of Drying; Batch and continuous dryers, Industrial drying equipments.

Objective: To impart knowledge on basic principles of solid-fluid associated mass transfer operations, adsorption and drying processes. To understand principle and operation of drying equipments.

Session No *	Topics to be covered	Ref	Teaching Aids
49	Adsorption equilibrium - Drying – Introduction	T1 (655 - 661), T2 (559 - 560), T3 (8.1 – 8.4), T4 (6.1 – 6.5)	LCD/BB
50	Adsorption & Membrane separation processes	T1 (565), T2 (760 – 763), T4 (3.1 – 3.2)	Animations/ LCD
51	Different types of adsorption process	T1 (566), T2 (763 – 771) T4 (3.2 – 3.3)	LCD/BB
52	Single stage & Multi stage adsorption process, Equipment	T4 (3.4 – 3.25), T1 (569 - 640)	Animations/ LCD
53	Problems related to adsorption	T1 (575)	LCD/BB
54	Rate of drying curve	T2 (572 - 596), T3 (8.4 – 8.7)	Animations/ LCD
55	Constant rate & falling rate period	T1 (667), T2 (572 - 596), T3 (8.8 – 8.10), T4 (6.5 – 6.12)	LCD/BB
56	Equipment for drying	T1 (661 – 667, 686 – 699), T2 (560 – 563), T3 (8.13 – 8.19), T4 (6.12 – 6.23)	Animations/ LCD
57	Problems related to drying	T1 (660,665, 671-672)	LCD/BB
58	Problems related to drying	T3 (8.19 – 8.51)	LCD/BB
59	Problems related to drying	T4 (6.24 - 6.66)	LCD/BB
60	Problems related to drying	T3 (8.19 – 8.51)	LCD/BB
Content beyond syllabus covered (if any): Membrane separation and Freeze drying of biological molecules			

* Session duration: 50 mins

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TEXT BOOKS

1. Treybal R.E., Mass Transfer Operations, 3rd Edition, McGraw-Hill, 1981.
2. Patil, K. D., Principles and Fundamentals of Mass Transfer Operations – I, 4th Edition, NiraliPrakashan, 2010.
3. Gavhane, K.A., Mass Transfer – I, 6th Edition, NiraliPrakashan, 2006.
4. Gavhane, K.A., Mass Transfer – II, 6th Edition, NiraliPrakashan, 2006.

REFERENCES

1. Coulson and Richardson, Chemical Engineering. Vol. I & II, Asian Books Pvt. Ltd, 1998.
2. Geankoplis C.J., Transport Processes and Unit Operations, 3rd Edition, Prentice Hall of India, 2002.

	Prepared by	Approved by
Signature	3/7/23	3/7/23
Name	Dr. K. Divakar	Dr. E. Nakkeeran
Designation	Associate Professor	Professor and Head
Date	03.07.2023	03.07.2023
Remarks *: -		
Remarks *: -		

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

8/7/23