

M. Tech. I Semester II

Subject Name: Membrane Technology

Subject Code: MTEN14205

Type of course: PE IV

Prerequisite: Students should know the conventional methods available for the treatment of wastewater.

Rationale: Students will be able to understand the fundamental of Membrane separation process, its basic terminology, Separation of membranes and their application to be used in the treatment of wastewater for the purpose of its reuse. The importance of technology for its industrial application is to be well understood in the course.

Teaching and Examination Scheme:

TEACHING SCHEME				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	150
3	0	2	4	60	25	15	30	20	

CA1: Continuous Assessment (assignments/projects/open book tests/closed book tests) **CA2:** Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems **TEE:** Term End Examination **TEP:** Term End Practical Exam (Performance and viva on practical skills learned in course) **CA3:** Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in course

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1.	Introduction Membrane Separation Process, Phenomena governing process operation; driving forces, concentration polarization, hydrodynamics, sealing, fouling, Module Configurations, Applications.	10	22%
2.	Principles and application of Membrane Filtration Reverse Osmosis fundamentals, process design and operation: municipal and industrial applications, Desalination of sea water, pure/ultrapure water production, Fouling and pretreatment	12	26%
3.	Electro Dialysis Process and Applications Electro dialysis, Definition of process operation conditions, Definition of process operation conditions from first principles. Water and industrial wastewater applications with reference to recent case studies.	10	22%
4.	Nano-filtration and Ultra-filtration applications NF for surface water treatment. UF in ultrapure and potable water production in membrane bioreactors.	7	15%
5.	Dead-end cartridge filtration applications Potable and pure water treatment. Choice of media: filtration mechanism, filter media structure.	7	15%

PE IV: Program Elective IV

W.e.f. AY 2021-22

Suggested Specification table with Marks (Theory/Practical):

% Distribution of Marks					
R Level	U Level	A Level	N Level	E Level	C Level
25	25	20	10	10	10

Legends: R: Remembrance, **U:** Understanding; **A:** Application, **N:** Analyze, **E:** Evaluate **C:** Create and above Levels (**Revised Bloom's Taxonomy**)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Text Books:

Sr. No.	Title of book /article	Author(s)	Publisher and details like ISBN	Year of publication	Publication Edition
1.	Membrane technology in water and wastewater treatment	Hillis, P	The Royal Society of Chemistry, ISBN: 0-85404-800-6	2000	2 nd
2.	Membrane Separation Processes	Nath Kaushik	PHI	2016	1 st
3.	Membrane Technology and Applications	Richard W. Baker	Wiley, ISBN-10 0470743727, ISBN-13 978-0470743720	2012	3 rd
4.	Membrane Technology and Environmental Applications	Tian C. Zhang, Rao Y. Surampalli, Saravanamuthu Vigneswaran, R. D. Tyagi	American Society of Civil Engineers, ISBN-10 0784412278 ISBN-13 978-0784412275	2013	1 st
5.	Emerging Membrane Technology for Sustainable Water Treatment	Rajindar Singh, Nicholas Hankins	Elsevier Science, ISBN-10 044463312X ISBN-13 978-0444633125	2016	1 st

Course Outcome:

Sr. No.	CO Statement After learning this subject, students will be able to	Marks % weightage
CO-1	To understand the basic terminology of Membrane Process. (R & U-Cognitive Level)	20
CO-2	To understand the basic principals & application of Membrane filtration process. (U & A-Cognitive Level)	10
CO-3	To study the membrane separation processes. (U & A-Cognitive Level)	20
CO-4	Application of membrane technology for desalination of sea water. (A-Cognitive Level)	25
CO-5	Use of Ultra-filtration & Nano-filtration in Membrane bioreactors. (U & A-Cognitive Level)	25

FOR LAB SESSIONS:

List of Tasks:

Demonstration of different membrane equipments.

Major Equipments:

1. UF test rig: Hallow fiber, UF model, provided with feed and backwash pump, compact and table top mounted.
2. Membrane Bioreactor: Submerged Hallow fiber MBR. Compact and table top mounted (Pump on ground).
3. Membrane Distillation: Hydrophobic membrane of composite membrane. Hallow fiber membrane module.
4. RO test rig: Membrane material Composite membrane (Polyamide) Permeate flux and MWCO characteristic study provided with high pressure pump. Compact and table top mounted (Pump on ground).
5. Evaporation: 1 lit (consist of 2 half, 500 ml each) Glass flange vessel. ID 90 mm, OD 100 mm. Length 125 mm. SS 316 perforated membrane support plate Teflon gaskets.

List of Open Source/learning website:

- <https://www.journals.elsevier.com/membrane-technology/>
 - Different applications of Membrane Technology in Industrial Wastewater Treatment
- <https://www.nano.gov/nanotech-101/what/definition>
 - Fundamental Concepts of Nano-Teachnology
- <https://nptel.ac.in/courses/103/103/103103163/>
 - Different Membrane Technologies for Wastewater Treatment

List of Open Source Software:

- Winflow
- MBMS1.0: An Open-Source Code for Modeling and Simulation of Membrane-Based Dehumidification and Energy Recovery