## DISCIPLINE SPECIFIC ELECTIVE(DSE-18)

**Credit distribution, Eligibility and Pre-requisites of the Course**

| Course title & Code | Credits | Credit distribution of the course | | | Eligibility criteria | Pre-requisite of the course |
|---|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical/ Practice | | |
| **Polymeric Membrane** | **4** | **2** | **0** | **2** | **12$^{Th}$ with PCM/PCB** | **---** |

### COURSE OBJECTIVES:

The Learning Objectives of this course are as follows:

1. To apprise students with the concept of polymer-based membrane along with their properties and application in water purification, electro dialysis, reverse osmosis and proton conduction.
2. To impart knowledge of synthesis, device fabrication and application of membranes
3. Testing of different polymeric membranes for ion exchange capacity, electrical conductivity and life cycle etc.

### LEARNING OUTCOMES

The Learning Outcomes of this course are as follows:

After studying this paper, students will be able to

1. Acquire knowledge about membrane and their preparation.
2. Apply the use polymer membranes for resolving environmental hazards.
3. Develop skills to select different type of polymeric membranes for different type of separations.
4. Use appropriate methods to reduce membrane fouling.

### SYLLABUS OF DSE-18

### THEORY: (30 Hours)

### UNIT 1: INTRODUCTION (5Hours)

Basics of polymer membrane, classifications of membrane: porous vs. non-porous membranes, Charged and neutral membranes,electrical double layer theory, scale-up and commercialization challenges, Policy, regulation, and sustainability aspects

### UNIT 2:FABRICATION TECHNIQUES (10Hours)

Polymer used in membrane: PE, PET, PS, biopolymers, etc. Phase inversion techniques, Non-solvent and thermal, Electrospinning and nanofiber membranes, Interfacial polymerization, solvent casting method, and Surface modifications of membrane for enhanced performance

### UNIT 3:PROPERTIES AND TESTING (7Hours)

Properties of membrane: mechanical, chemical, permeability, selectivity, flux, dimension, morphology, permeability and selectivity measurements, thermal properties (DSC and TGA), fouling resistance and stability evaluations,

## UNIT 4: APPLICATIONS (8 Hours)

Water treatment**:** Reverse osmosis, Desalination and water treatment,

Gas separation**:** Carbon dioxide capture, oxygen enrichment, hydrogen purification.

Energy applications**:** Proton exchange membranes for fuel cells and Batteries

Biomedical applications**:** Hemodialysis membranes, and drug delivery systems

## PRACTICALS: (60Hours)

- Prepare a membrane by i) casting ii) analyse its morphology
- Preparation of membrane for Ultrafiltration using Phase Inversion and test its permeability
- Fabricate a membrane by interfacial polymerisation and study its condition
- Determine the ion exchange capacity of a membrane using titration method
- Evaluate the sieving nature of a laboratory prepared polymer membrane
- Evaluate the swelling index and percentage porosity of representative membrane
- Determine the performance and fouling nature of a standard membrane
- Demonstrate the decontamination of polluted water after using membrane
- Evaluate the proton conducting of a standard membrane.

## ESSENTIAL/RECOMMENDED READINGS


1. Winston W. S. Ho, Sirkar K. K., (1992), Membrane handbook, Springer.
2. Baker R. W., (2012) Membrane Technology and Applications, John Wiley and Sons.
3. Mulder M., (1996) Basic Principles of Membrane Technology, Springer.
4. Batrinescu, G., Constantin, L. A., Cuciureanu, A., & Constantin, M. A. (2016). Conductive polymer-based membranes, Intehopen Ltd.
5. Mahmoud A. A., (2024) Polymer Membrane, De Gruyter


## SUGGESTIVE READINGS


1. Wang, L. K., Chen, J. P., Hung, Y. T., & Shammas, N. K. (Eds.). (2008). Membrane and desalination technologies (Vol. 13). Springer Science, Business Media, LLC.
2. Porter, M. C. (1989). Handbook of industrial membrane technology.US Department of Energy.


## ASSESSMENT METHODS:

All the examiniations and assement methods shall be in the line with the University of Delhi gidelinceissused from time to time

## KEYWORDS:

Neutral membranes, Fabrication,Electrospinning, Standard membrane, Fuel cells