

1. Introduction

Objectives: To understand the importance and applications of membrane technology in water treatment. Basic understanding of the different types of membranes and their applications.

Content: Historical background of membrane technology. Overview of membrane technology in water treatment. Significance and advantages of using membranes.

2. Basic principles of mass transfer.

Objectives: Basic knowledge of mass transfer principles and their relevance to membrane systems. Deepen the understanding of the mechanisms and factors of mass transfer.

Understand the factors that influence mass transfer. Understand complex phenomena such as diffusion and convection in membrane processes.

Content: Introduction to mass transfer: driving forces and resistances. Diffusion through membranes, convective and coupled transport mechanisms. Models and applications

3. Fabrication of membranes.

Objectives: Knowledge of the different methods of membrane fabrication. Ability to select the appropriate membrane for specific applications.

Content: Materials for membranes. Phase inversion method, sintering, track-etching. Influence of manufacturing parameters on membrane properties.

4 Characterisation of membranes.

Objectives: Ability to understand and apply different characterisation techniques for membranes. Ability to evaluate the performance of a membrane based on characterisation data.

Content: Pore sizing, contact angle, surface roughness. Permeability tests, retention studies. Advanced techniques: electron microscopy, FTIR, XPS.

5. Membrane modules

Objectives: Understand the different types of membrane modules and their specific applications. Knowledge of the structure and function of different types of modules.

Content: Flat membrane modules, spiral wound modules, hollow fibre modules. Design and operational considerations for membrane modules. Problems and challenges in module integration.

6. Operating modes.

Objectives: Understand the different operating modes of membrane systems. Knowledge of the advantages and limitations of each operating mode.

Content: Dead-end vs. crossflow filtration. Batch vs. continuous operation.

7. Fouling and scaling

Objectives: Recognise the mechanisms and effects of fouling and scaling on membranes. Ability to develop strategies to minimise fouling and scaling.

Content: Types of fouling: organic, inorganic, biological, colloidal. Strategies for control and prevention. Effects of scaling on membrane performance and lifetime.

8. Pre-treatment

Objectives: Understand the need for and methods of pre-treatment. Ability to select appropriate pretreatment strategies based on water properties and membrane type.

Content: Role of pretreatment in membrane systems. Different pretreatment methods: sedimentation, flocculation, microfiltration and ultrafiltration.

9. Cleaning

Objectives: Understand the importance and methods of membrane cleaning. Ability to develop cleaning protocols based on membrane type and fouling type.

Content: Mechanisms of fouling and its removal. Chemical and physical cleaning methods.

10. System design & exercise system design.

Objectives: Ability to design membrane systems based on given water properties and desired output specifications. Apply acquired knowledge in practical design exercises.

Content: Fundamentals of membrane system design. Practical system design exercises considering real operating conditions.