THE OHIO STATE UNIVERSITY
COLLEGE OF ENGINEERING

Polymer Membranes

CBE 5774

Credit Hours:
3.00 - 3.00

Course Levels:
Undergraduate (1000-5000 level)
Graduate (5000-8000 level)

Course Components:
Lecture

Course Description:
Membrane separation mechanisms, transport models, permeability computations/measurements, membrane materials/types/modules, membrane contactors/reactors, and applications.

Prerequisites and Co-requisites:
Prereq: 3508 (509), or Grad standing; or permission of instructor.

Course Goals / Objectives:

- Acquire in-depth knowledge in the areas of membrane separation mechanisms, transport models, membrane permeability computations / measurements, membrane materials / types / modules, and membrane contactors / reactors.
- Develop skills in applying transport models for the calculation of membrane permeability, flux, and the extent of separation for various membrane separations / systems.
- Determine the types of experimental data needed for the calculation of membrane permeability parameters.
- Select membrane processes for solving relevant separation / reaction problems.
- Use polymer membranes for solving environmental / energy problems.
- Use a computer tool to calculate and analyze membrane separation characteristics.

Course Topics:

- Introduction to Membrane Separation Concepts: diffusion across a thin film, terminology, driving force, modules, separation processes.
- Selection of Membrane Processes: separation goal, species retained / transported, major / minor components, transport / selectivity mechanism.
- Membrane Materials: polymers, polymer-inorganic hybrids, inorganics.
- Membrane Preparation: coating, phase inversion, liquid-liquid demixing, interfacial polymerization.
- Gas Permeation: definitions, rubbery and glassy membranes, theory, dual-mode model, free-volume model, resistance-in-series model.
- Gas Permeation: membrane modules, gas permeation performance modeling, applications.
- Pervaporation: definitions, membranes, membrane properties, theory, concentration polarization, temperature polarization, applications, organics dehydration, azeotrope splitting.
- Dialysis: polymer types, membranes, theory, applications, artificial kidney.
- Electrodialysis: definitions, ion-exchange membranes, theory, cell resistances, limiting current, Donnan equilibrium, applications.
- Membrane Electrolysis: chlor-alkali process, bipolar membranes, fuel cells.
- Reverse Osmosis: interfacially polymerized membranes.
- Reverse Osmosis: osmotic pressure, solution-diffusion model, concentration polarization, modules, applications, desalination, nanofiltration, water softening.
- Ultrafiltration: definitions, membranes, theory, transport through porous membranes, boundary layer model, applications, electrophoretic paint recovery, protein fractionation / concentration.
- Microfiltration: particulates, crossflow vs. deadend microfiltration, membranes.
- Microfiltration: theory, Darcy’s law, concentration polarization, applications, sterilization of beverages and pharmaceuticals.
- Membrane Contactors / Reactors: height and number of transfer unit.
- Nano-Structures by Surface Modification – Platforms for Chemical and Biomedical Applications.
- Membrane Contactors / Reactors: drug recovery, facilitated transport, applications, metal removal and recovery.

Designation:
Elective