001-2-5033 Introduction to Desalination Processes 3 credits

Lectures (hrs/week)	Exercise (hrs/week)	Laboratory	Field Trip
3			

Prerequisite: General chemistry (or physics) course which included presentation of basic concepts in thermodynamics.

Aims: This course is intended as an overview of the available technologies for reducing the salinity of water for drinking, industrial and/or agricultural use. In the introductory lecture, the need for desalination in various spheres of human activity will be presented as well as the thermodynamic underpinning of desalination processes. The principles of each technology will then be presented. After this, a more detailed presentation will be provided with presentation of equipment, design and economic considerations. During the course several case studies will be presented to illustrate the general material.

Course contents: Introduction: Need for desalination, global water stress, salinity problem in land and water, potential consumers of desalinated water, examples of desalination processes presently practiced in the world.

Thermodynamics underpinning desalination: Review of thermodynamic principles/concepts, free energy of mixing, chemical potential, thermodynamics of phase change

Overview of desalination processes and principles: Thermal (accompanied by phase change): Multistage flash (MSF), Multiple effect (MED), vapor compression (VC), membrane distillation (MD)

Membrane based: Pressure driven (Reverse osmosis and nanofiltration), electrically driven (Electrodialysis)

Electrically based: Capacitive deionization

Thermally based processes: Presentation of GOR concept, Using enthalpy temperature diagrams, heat sources, heat exchange materials, design equations for three different thermal processes (MSF, MED, VC), process considerations (corrosion, scaling), Thermal processes for ZLD, economics

Pressure-driven Membrane processes: Transport equations for water and salt transport through membrane, mechanism of transport, membrane materials and modules, membrane systems. Basic design equations and examples. Process considerations (organic fouling, colloidal fouling, biofouling and scaling), Boron removal, pretreatment. Post-treatment. Brine removal, economics

Electrically driven membrane processes. Principles of electrodialysis and EDI. Transport equations for water and salt transport through membrane, mechanism of transport, membrane materials and modules, membrane systems. Basic design equations and examples. Process considerations (organic fouling, colloidal fouling, biofouling and scaling) pretreatment. Post-treatment. Brine removal , economics

Desalination and renewable energy – matching energy source to desalination technology, solar, wind, wave driven desal. Low-tech vs. high tech approaches.

Requirements:

- It is required to attend at least 80% of the classes
- The final grade will be based on one or two exams.

Literature: References will be given during the course.

Lecturer: Avraham Be'er