

**King Fahd University of Petroleum and Minerals (KFUPM)**  
**Mechanical Engineering Department**  
 ME 460 : Thermal Desalination Systems  
 Fall Semester 2013-2014 (141)

**Catalog Data**      **ME 460: Thermal Desalination Systems. Credits 3.** Seawater composition. The need for water desalination. Classification of desalination processes. Single effect evaporation. Thermal vapor compression systems. Multiple effect evaporation. Multistage flash distillation, once through MSF, Brine mixing and recirculation MSF. Reverse osmosis. Desalination using renewable energy sources. Economic analysis of desalination processes

*Prerequisite: ME 315, ME204*

**Textbook**              Course Notes

**References**            El-Desouky H. T. and Ettouney H. M. Fundamentals of Salt Water Desalination. Elsevier, 2002.

- Objectives**
- To provide a comprehensive study on the fundamentals of water desalination.
  - To enable students to master different desalination processes and systems.
  - To develop students ability to use course concepts in thinking, design and problem solving including desalination economics
  - Prepare students to be life-long-learners.
  - Develop students interpersonal and team learning skills
  - To enjoy learning about desalination.

- Pre/Co-Requisites**
- 1) The First Law of Thermodynamics.
  - 2) The Second Law of Thermodynamics.

- by Topic**
- 3) Thermodynamic power cycles.
  - 4) Principles of convection and radiation heat transfer.

**Course Outline and Breakdown of Topics**

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|--|-----------|
| 1. Need for desalination, Composition of seawater, classification of desalination systems                                | 2 classes |
| 2. Desalination using renewable energy Sources   |           |
| Solar stills   | 3 classes |
| Humidification dehumidification (HDH) systems  | 7 classes |
| 3. Single effect evaporation, process modeling (single effect, vapor compression both thermal; TVC, and mechanical; MVC) | 5 classes |

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|--|-----------|
| 4. Multiple effect evaporation, process modeling | 6 classes |
| 5. Vapor compression systems                     | 2 classes |
| Multistage flash desalination                    |           |
| 5.1 Introduction & single stage flashing         | 3 classes |
| 5.2 Once through system                          | 4 classes |
| 5.2 Brine recirculation system                   | 2 classes |
| 5.3 MSF with thermal vapor compression           | 2 classes |
| 5.4 Fouling, scale and material selection        | 2 classes |
| 7. Reverse Osmosis                               | 2 classes |
| 8. MD  | 1 class   |
| 9. Economic Analysis, Presentations              | 2 classes |
| Exams  | 2 classes |

### **Design Activities/Projects**

One design project on either one of the desalination systems is assigned to be done using the Thermodynamic software “EES,” covering design calculations and parametric studies.

### **Computer Usage**

Students use computer software (EES) on the Thermodynamic data, and design calculations of desalination system(s).

### **Evaluation Methods (G: Group, I: Individual)**

1. Homework (10 %)
2. Design/Computer Assignments (15 %) 60% G and 40% I
3. Major exams (35 %), Midterm exams (12-10 and 23-11)
4. Quizzes and in-class Tests (10 %) 60% G and 40% I
5. Final Exam (30%) December 24<sup>th</sup>, 2015, 7:00 – 9:30 PM

### **Student Learning Outcome**

#### ***Course Objective 1***

Students will demonstrate a basic understanding of various desalination systems. [1, 5]

#### ***Course Objective 2***

Students will demonstrate ability to apply first and second law of Thermodynamics to analyze the details and carry out performance evaluation of various thermal desalination systems [2-5] with and without computer software programs. [2]. In addition, design parameters of these systems are achieved through a term project.

#### ***Course Objective 3***

Students will demonstrate the ability to give a professional and well-organized presentation of their design and analysis through a written report. [2].

## **Academic Policies:**

**Academic Integrity:** As a student at KFUPM, you are expected uphold the highest moral and ethical standards with respect to academic integrity. Academic integrity involves many things, including:

- Acknowledging all sources of information.
- Doing your assignments independently or acknowledging any collaboration (group work).
- Reporting your results accurately when conducting original research or when doing a lab.
- Remaining honest during an examination.

**Late Assignments:** Late assignments are docked 10% per day (including weekend days). Late assignments are not accepted after 7 days.