Solar Energy

Course Code: 28137
Course Type: Theoretical
Credits: 3
Course Status: Elective Specialized Course
Prerequisite: Heat transfer I, Thermodynamics I

***Aim/Scope/Objectives*:** The aim of this course is to overview the fundamental topics in solar energy systems and familiarizes the BSc and MSc students with theory and principles of operation, application, modeling, and control of solar thermal systems and direct solar electricity converters.

Course Outline:

1- Introduction

Reckoning of Time, Solar Angles, Incident Angle for Moving Surfaces, Sun Path Diagrams, Solar Radiation, Thermal Radiation, Transparent Plates, Radiation Exchange between Surfaces, Extraterrestrial Solar Radiation, Atmospheric Attenuation, Terrestrial Irradiation, Total Radiation on Tilted Surfaces, Solar Radiation Measuring Equipment.

2- Solar Energy Collectors

Stationary Collectors, Sun-Tracking Concentrating Collectors, Thermal Analysis of Flat-Plate Collectors, Thermal Analysis of Air Collectors, Practical Considerations for Flat-Plate Collectors, Concentrating Collectors.

3- Performance of Solar Collectors

Collector Thermal efficiency, Effect of Flow Rate, Collectors in Series.

4- Solar Water Heating Systems

Passive Systems, Active Systems, Heat Storage Systems, Module and Array Design, Differential Temperature Controller, Solar Water Heater Performance Evaluation, Simple System Models, Practical Considerations.

5- Solar Space Heating and Cooling

Solar Space Heating and Cooling, Solar Cooling, Solar Cooling with Absorption Refrigeration.

6- Industrial Applications of Solar Systems

General Design Considerations, Solar Steam Generation Systems, Solar Chemistry Applications, Solar Dryers, Solar Hydrogen Generation.

7- Solar Desalination Systems

Introduction, Desalination Process, Direct Collection Systems, Indirect Collection Systems.

8- Photovoltaic Systems

Semiconductors, Photovoltaic Panels, Related Equipment, Applications, Design of PV Systems, Concentrating PV, Hybrid PV/T Systems.

9- Solar Thermal Power Systems

Parabolic Trough Collector Systems, Power Tower Systems, Dish Systems, Thermal Analysis of Solar Power Plants, Solar Ponds.

Grading: 40% Final exam, 35% Mean term exam, 10% Homework, 10% Research Project, 5% Class Attendance

References:

- Soteris A. Kalogirou, "Solar Energy Engineering, Process and Systems", Academic Press, 2014.
- John A. Duffie, William A. Beckman, "Solar Engineering of Thermal Process", John Wiley & Sons, 2013.
- Krishnan Rajeshwar, "Solar Hydrogen Generation", Springer, 2008.
- Eduardo F. Camacho, Manuel Berenguel, "Control of Solar Energy Systems, Springer, 2012.
- Richard Petela, "Engineering Thermodynamics of Thermal Radiation", McGraw-Hill, 2010.
- Mukund R. Patel, "Wind and Solar Power Systems: Design, Analysis, and Operation", CRC Press, 2006.