

MECHANICAL ENGINEERING PROGRAM
ABET COURSE SYLLABUS

ME 450 Solar Power Systems (4 Units) Elective

Course Description: (2013-15 Catalog) High and intermediate temperature systems for the conversion of solar energy to mechanical power and heat. Thermal energy storage and total thermal energy system design. Recommended as a complement to ME 415. 3 lectures, 1 laboratory

Prerequisite Courses: ME 343 (RECOMMENDED: ME 415)

Prerequisites by Topic: Heat Transfer (RECOMMENDED: Energy Conversion)

Textbook: (and/or other required material) Duffie, J. A., and Beckman, W. A., *Solar Engineering of Thermal Processes*, 4th ed., John Wiley and Sons, 2013.

References: Bergman, Lavine, Incropera, and Dewitt, *Introduction to Heat Transfer*, 6th ed., John Wiley and Sons, 2011.
 Moran, Shapiro, Boettner, and Bailey, *Fundamentals of Engineering Thermodynamics*, 7th ed., John Wiley and Sons, 2011.
 Munson, Okiishi, Huebsch, and Rothmayer, *Fundamentals of Fluid Mechanics*, 7th ed., John Wiley & Sons, 2013.

Course Coordinator/Instructor: Kim Shollenberger, Professor of ME

Course Learning Outcomes:

1. Reinforce fundamental concepts from Heat Transfer as they relate to solar power systems.
2. Establish a fundamental familiarity of solar thermal energy conversion methods and systems to serve as a basis for further study, research, and/or work in solar power industry.
3. Analyze the design and principles of operation of chosen solar energy systems.
4. Synthesize existing knowledge to evaluate future types of solar energy conversion technologies.

Relationship of Course to MECHANICAL ENGINEERING Program Outcomes:												
<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>h</i>	<i>i</i>	<i>j</i>	<i>k</i>	<i>l</i>	<i>m</i>
H	H	H	M	H	L	M	H	M	M	M	H	H

Topics Covered: Part I. Solar radiation fundamentals
 A. Properties of the sun
 1. Radiation review
 2. Solar radiation distribution

- B. Geometry for solar positioning
 - 1. Angles for sun and surfaces
 - 2. Time related calculations
- C. Shading
- D. Definitions for calculating solar radiation
- Part II. Available solar radiation
 - A. Measuring solar radiation
 - B. Solar radiation data
 - C. Models for estimating solar radiation
 - 1. Clear-sky (transmissivity) and cloudy (clearness index)
 - 2. Beam and diffuse (hourly, daily, and monthly)
 - 3. Hourly from daily data
 - 4. Tilted surfaces: isotropic and anisotropic sky models
 - D. Utilizability
- Part III. Solar thermal collectors
 - A. History of water heating industry in U.S.
 - B. Introduction to solar thermal systems
 - C. Flat plate collectors
 - 1. Thermal analysis for useful energy and efficiency
 - Optical efficiency
 - Fin and flow efficiencies
 - 2. Standards and performance characterization
 - D. Concentrating collectors
- Part IV. Solar thermal systems
 - A. Energy storage
 - B. Solar process loads
 - C. Solar process economics
 - D. Solar thermal modeling and simulation

Laboratory Projects: Learn how to operate equipment for solar radiation measurement and perform a performance analysis for a solar energy system.

Class/Lab Schedule: Three 50-minute lectures per week and one 3-hour laboratory

Contribution of Course to Meeting the Professional Component:

(a) College-level mathematics and basic sciences:	0 credits
(b) Engineering Topics:	3 credits
Design:	1 credit
(c) General Education:	0 credits
(d) Other:	0 credits

Prepared by:
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Date:
10/1/14
