MECHANICAL ENGINEERING PROGRAM

ABET COURSE SYLLABUS

ME 450 Solar Thermal Power Systems (4 Units) Elective

Course Description: (2019-20 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 350 (RECOMMENDED: ME 415)
Prerequisites by Topic:	Heat Transfer (RECOMMENDED: Energy Conversion)
Textbook: (and/or other required material)	Solar Engineering of Thermal Processes, by J. A. Duffie and W. A. Beckman, 4th ed., John Wiley and Sons, 2013.
References:	Fundamentals of Heat and Mass Transfer, by Bergman and Lavine, 8th Edition, John Wiley, 2017. Fundamentals of Engineering Thermodynamics, by Moran, Shapiro, Boettner, and Bailey, 8th Edition, 2014. Fox and McDonald's Introduction to Fluid Mechanics, by Pritchard and Mitchell, 9th Edition, John Wiley, 2015.
Course Coordinator/Instructor:	Kim Shollenberger, Professor of Mechanical Engineering
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 Student Outcomes:	SO 1: Mastered (M) SO 2: Mastered (M) SO 3: Mastered (M) SO 4: SO 5: Mastered (M) SO 6: Mastered (M) SO 7: Mastered (M)

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
  2. Standards and performance characterization
- D. Concentrating collectors

Part IV. Solar thermal systems
- A. Energy storage
- B. Solar process loads
- C. Solar process economics/ Solar thermal modeling

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:
11/26/2019