School of Management, Engineering and Technology
Department of Electrical Engineering and Renewable Energy

REE 451: Geothermal Energy & Ground-Source Heat Pumps

Catalogue Description (2009/2010):	An introduction to geothermal energy resources. Discussion of heat flow mechanisms. Investigation into heat exchange systems including: binary, flash, double flash, total flow. Application of thermal dynamics in analysis, design and control of heating/cooling systems.
Hours/Credits: (Lecture-Lab-Total)	(3-0-3)
Class Schedule:	Once a week, for a 2:50 hour lecture; offered in Spring. Includes a weekend lab field trip to evaluate geothermal resources and applications in Klamath Falls.
Prerequisites:	MECH 323
Required Text:	1. J.W. Lund, P.J. Lienau, B.C. Lunis, "Geothermal Direct-Use Engineering and Design Guidebook," 3rd Edition, 1998, Geo-Heat Center, Oregon Institute of Technology, Klamath Falls, Oregon 2. GeoSource Heat Pump Handbook, ECONAR Energy Systems, February, 2003. 3. Design and Installation of Residential and Light GSHP Systems (Final Draft), by the International Ground Source Heat Pump Association, Charles Remund, Ryan Carda, and Phil Rawlings, IGSHPA 2008.
Reference Text:	K. Rafferty, "Geothermal Power Generation: A Primer on Low-Temperature, Small-Scale Applications," Geo-Heat Center, Oregon Institute of Technology, Klamath Falls Oregon, January 2000. http://geoheat.oit.edu/pdf/powergen.pdf
Course Coordinator:	Tom White
Regular Instructors:	Tom White, John Lund and John Geyer (co-taught)
Course Objectives:	Upon completion of the course, a student should be able to: • Understand the basic principles of power and refrigeration cycles, including vapor compression cycles, binary systems, and absorption-based cycles. • Understand the fundamentals of geothermal geology and reservoirs. • Understand the principles of geothermal resource extraction; exploration, drilling, wells. • Know the similarities & differences between air-, ground-, and water-source heat pumps. • Understand the relationship between resource enthalpy and potential end-use applications. • Apply heat pump system design principles to the design of site-specific and load-specific applications. • Understand and distinguish among different forms of geothermal energy and their management and uses, including power systems used for generation and refrigeration systems operative in geothermal heat pumps. • Understand the design principles and installation practices of geothermal heat pump systems.
Topics Covered:	• Thermodynamics and vapor-power cycles. • Introduction to geothermal energy. • Geothermal information resources. Wells and drilling – OIT Klamath Falls. • Site tours: power generation, direct-use, cooling, balneology. • G-SHP Intro and Overview • G-SHP Design • G-SHP System Start-up and Check-out
Relevant Program Outcomes:	(a) an ability to apply knowledge of mathematics, science, and engineering (c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

	(e) an ability to identify, formulate, and solve engineering problems (k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice (l) an ability to apply the fundamentals of energy conversion and applications		
Required or Elective:	Elective		
Criterion 5:	Engineering Topics		
Prepared By:	Tom White	Updated:	5-4-10