

**STATE UNIVERSITY OF NEW YORK !  
COLLEGE OF TECHNOLOGY !  
CANTON, NEW YORK !**



**MASTER SYLLABUS**

**COURSE NUMBER – COURSE NAME  
AREA 340 - GEOTHERMAL ENERGY**

**Created by: Michael J. Newtown, P.E.**

**Updated by: Kibria Roman, Ph.D, P.E.**

**Canino School of Engineering Technology !**

**Department: Mechanical & Energy Technology !**

**Semester/Year: Fall/2018 !**

A. **TITLE:** Geothermal Energy

B. **COURSE NUMBER:** AREA 340

C. **CREDIT HOURS:** (Hours of Lecture, Laboratory, Recitation, Tutorial, Activity)

# Credit Hours: 3

# Lecture Hours: 3 per week

# Lab Hours:        per week

Other:            per week

Course Length: 15 Weeks

D. **WRITING INTENSIVE COURSE:** Yes  No

E. **GER CATEGORY:** None:  Yes: GER !  
*If course satisfies more than one: GER !*

F. **SEMESTER(S) OFFERED:** Fall  Spring  Fall & Spring

G. **COURSE DESCRIPTION:**

Applications of thermodynamics and heat transfer principles will explain how energy is transformed from geothermal energy to useable energy for large and small scale systems. Students will determine heating and cooling loads leading to the selection of the correct system installation to meet the demand. Correct system sizing and installation procedures will be explored along with the environmental issues related to geothermal energy production.

H. **PRE-REQUISITES:** None  Yes  If yes, list below:

AREA 110, Intro to Alternative Energy, or ENGS 101, Intro to Engineering

**CO-REQUISITES:** None  Yes  If yes, list below:

**I. STUDENT LEARNING OUTCOMES: (see key below)**

By the end of this course, the student will be able to:

<u>Course Student Learning Outcome</u> <i>[SLO]</i>	<u>Program Student Learning Outcome</u> <i>[PSLO]</i>	<u>GER</u> <i>[If Applicable]</i>	<u>ISLO &amp; SUBSETS</u>	
Analyze soil and rock conditions leading to design of ground loop	SO # 6 An ability to identify, analyze and solve technical problems		2-Crit Think 5-Ind, Prof, Disc, Know Skills ISLO	PS Subsets Subsets Subsets
Determine suitable site for geothermal development around the world and its impact on the existing technologies.	SO #10: A knowledge of the impact of engineering technology solutions in a societal and global context.		4-Soc Respons 5-Ind, Prof, Disc, Know Skills ISLO	GL Subsets Subsets Subsets
Determine the heating/ cooling load for various sized buildings.	SO # 6 An ability to identify, analyze and solve technical problems.		2-Crit Think 5-Ind, Prof, Disc, Know Skills ISLO	PS Subsets Subsets Subsets
Select and size a heat pump	SO # 4 An ability to apply creativity in the design of systems, components, or processes.		2-Crit Think 5-Ind, Prof, Disc, Know Skills ISLO	CA Subsets Subsets Subsets
Determine the size of the earth component of a geothermal system for vertical shaft closed loop, open loop water well, horizontal closed loop, or closed loop immersion system for a surface water resource.	SO #2 An ability to apply current knowledge and adapt to emerging applications of mathematics, science, engineering, and technology by applying these areas to renewable energy systems		2-Crit Think 5-Ind, Prof, Disc, Know Skills ISLO	CA Subsets Subsets Subsets

<b>KEY</b>	<b><u>Institutional Student Learning Outcomes [ISLO 1 – 5]</u></b>
<b>ISLO #</b>	<b>ISLO &amp; Subsets</b>
<b>1</b>	<b>Communication Skills</b> Oral [O], Written [W]
<b>2</b>	<b>Critical Thinking</b> <i>Critical Analysis [CA], Inquiry &amp; Analysis [IA], Problem Solving [PS]</i>
<b>3</b>	<b>Foundational Skills</b> <i>Information Management [IM], Quantitative Lit./Reasoning [QTR]</i>
<b>4</b>	<b>Social Responsibility</b> <i>Ethical Reasoning [ER], Global Learning [GL], Intercultural Knowledge [IK], Teamwork [T]</i>
<b>5</b>	<b>Industry, Professional, Discipline Specific Knowledge and Skills</b>

\*Include program objectives if applicable. Please consult with Program Coordinator !

J. **APPLIED LEARNING COMPONENT:** Yes  No

If YES, select one or more of the following categories:

- |   |  |
|---|--|
| <input checked="" type="checkbox"/> Classroom/Lab | <input type="checkbox"/> Civic Engagement              |
| <input type="checkbox"/> Internship               | <input type="checkbox"/> Creative Works/Senior Project |
| <input type="checkbox"/> Clinical Placement       | <input type="checkbox"/> Research                      |
| <input type="checkbox"/> Practicum                | <input type="checkbox"/> Entrepreneurship              |
| <input type="checkbox"/> Service Learning         | (program, class, project)                              |
| <input type="checkbox"/> Community Service        |  |

K. **TEXTS:**

Kavanaugh, Stephen P., Kevin Rafferty, Ground-Source Heat Pumps, Atlanta: ASHRAE, 1997

L. **REFERENCES:**

M.H. Dickson, M. Fanelli, "Geothermal Energy", John Wiley&Sons, 1995  
P. J. Lienau, B.C. Lunis, "Geothermal Direct Use Engineering and Design Guide Book", Geo-Heat Center, 2nd Ed., 1991  
R. Harrison, N.D. Mortimer, O.B. Smarason, "Geothermal Heating: A Handbook of Engineering Economics", Pergamon Press, 1990.  
S. Kakac, H. Liu, "Heat Exchangers: Selection, Rating and Thermal Design" CRC Press, 1998  
W.M. Rohsenow, J.P. Harnett Y.I. Cho, "Handbook of Heat Transfer", McGraw-Hill Handbooks, 1998

M. **EQUIPMENT:** None  Needed: Technological enhance classroom

N. **GRADING METHOD:** A - F

O. **SUGGESTED MEASUREMENT CRITERIA/METHODS:**

Test, Quizzes, Homework, Research Papers

P. **DETAILED COURSE OUTLINE:**

I. Geology

- a. Field geology
- b. Maps and photographic reading
- c. Structure analysis
- d. Hydrogeology

II. Heating and cooling

- a. Heat and cooling load calculations
- b. Psychrometrics and sensible heat
- c. Types of building construction

**III. Equipment sizing and selection**

- a. Sizing of heat pumps based on heating/ cooling loads
- b. Fluid selection for geothermal systems
- c. Vertical open and closed loop systems
- d. Horizontal open and closed loop systems
- e. Below earth grade and immersion piping systems sizing.

**IV. Installation procedures**

- a. Design Considerations
- b. Drilling and digging of site
- c. Mechanical systems
- d. Piping connections
- e. Testing of system
- f. Initial start-up operation

**V. Cost Analysis**

- a. Cost of large and small scale geothermal systems.
- b. Cost comparisons between traditional fuels and other alternative energy

**VI. Environmental Studies and Assessment**

- a. Biological and chemical monitoring of large scale systems
- b. Re-vegetation of geothermal heat transfer sites
- c. Health and safety concerns

Q. LABORATORY OUTLINE: None  Yes