UNIVERSITY OF NORTH TEXAS
Department of Mechanical and Energy Engineering

MEEN 4470.001 Geothermal Heat Pumps

MEEN 5800.001 Geothermal Heat Pumps

(Web assisted online on Black Board at https://learn.unt.edu/)

Fall 2019

A. LOGISTICS

INSTRUCTOR :	Dr. Shaojie Wang, Adjunct Professor
	Office: F101T, email: shaojie.wang@unt.edu
OFFICE HOURS:	TBD
CLASS SCHEDULE:	Tu 18:30-21:20, Room: F175
TEXTBOOK:	Geothermal Heating and Cooling-Design of Ground-Source Heat Pump Systems by Steve Kavanaugh and Kevin Rafferty, ISBN#:978-1-936504-85-5, 2014, ASHRAE.

B. CATALOG COURSE DESCRIPTION

MEEN 4470. Geothermal Heat Pumps. 3 hours. Introduction to the fundamental principle, calculation and design methods of various geothermal heat pump systems. The whole building energy modeling of geothermal heat pumps system. Prediction of long-term performance of ground loop heat exchanger Annual energy consumption and Electric Peak demand. Borehole field configurations.

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C. COURSE OBJECTIVES

1. Understanding the definition, scope and features of various geothermal heat pump systems
2. Understanding the design methods of exterior heat exchangers
3. Conducting engineering analysis for geothermal energy
4. Analyzing the geothermal heat pump applications: ground coupled heat pump, ground water heat pump, and surface water heat pump
5. Understanding the inputs and output of whole building energy modeling
6. Being knowledgeable about thermal imbalance and temperature penalty
7. Conducting a project-level design for a water-to-air heat pump system

D. RELATIONSHIP OF COURSE TO ACHEIVING MECHANICAL AND ENERGY ENGINEERING STUDENT OUTCOMES (MEEN 4800.001)

(a) Ability to apply knowledge of mathematics, science, and engineering
(d) Ability to function on multi-disciplinary teams
(e) Ability to identify, formulate, and solve engineering problems

(f) Understanding of professional and ethical responsibility
(g) Ability to communicate effectively
(h) Broad education necessary to understand the impact of engineering solutions in a global and societal context
(i) Recognition of the need for, and an ability to engage in, lifelong learning
(j) Knowledge of contemporary issues
(k) Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

E. PREREQUISITE KNOWLEDGE:

1. Techniques and applications of derivatives and integrals.
2. Mass conservation in fluid flow.
3. Momentum conservation in fluid flow.
4. Energy conservation in control volume.
5. Viscous flow characteristics.
6. Thermal conduction, convection and radiation
7. Computational skills using a mathematically functional spreadsheet such as Excel.
8. Understanding programming flow chart.
9. Conduct research using the literature database and web.

F. COURSE REQUIREMENTS:

General Plan

The class will focus on both understanding of concepts and problem solving. It will emphasize your figuring out things using your own mind, not simply memorizing what is in a textbook. On a typical day you will be given lecture on main concepts and typical problem solving methods. You will then be engaged in questioning and discussion in class for the problem solving practice. You are encouraged to assess and monitor your own progress using criteria and standards discussed in class. If at any time in the semester you feel unsure about your "grade", you should request an assessment from the professor.

The knowledge acquired through your learning experience in this course will be reinforced by a combination of written assignment, either from the textbook or from the professor, and class projects. Those assignments should follow the recommended format and reflect a logical reasoning of your thinking. At different stages of the course, an assessment will be given in a form of a written quiz. At the mid semester and near the end of the semester, a test will be given in place of a quiz.

You are encouraged to improve your performance, increase your strengths and diminishing your weaknesses.

Requirements

All students must complete all of the following:

1. Homework assignments. Due on Thursday of the following week unless announced in class.
2. Close-book quizzes, all in a closed book format.
3. Progressive Test, all in a closed book format.
4. Consistent classroom attendance and active participation (extra credit).

Grade Evaluation

The class will be graded based on a percentage and point system. Following weigh factors are applied to calculation of the final grade:

ASSIGNMENTS	20%
QUIZZES	20%
TEST ONE	20%
PRESETATION	20%

CLASS PROJECT	20%
ACTIVE CLASS PARTICIPATION (for extra credit. A class roll will be circulated.)	5%
TOTAL	100% +5%

Class Policies

Each homework assignment gains a point (total points for the homework equal to the total number of assignments). The late submission after the due date but before the next class day gets a half point. No-submission within those days gets zero point. The final grade for the assignments is calculated as (No. of points/Total points) x 100%x0.20.

Excusable absence from the quizzes is accepted only if the student informs the professor before the event such as illness and non-reschedulable prior appointment, or after the event, such as medical or other emergencies, within a reasonable time frame. In all the cases, academic honesty is expected.

Quizzes will be evaluated on a median average basis.

***Grade Significance*:**

GRADE	SCORE RANGE	GRADE	SCORE RANGE
A	100 - 90 %	C	69.9 - 55 %
B	89.9 - 70 %	D	54.9 - 40 %
		F	< 40 %

Dishonesty
Any form of dishonesty during the semester will result in a final grade of F for the course and a recommendation for expulsions to the Provost. No exceptions. Please avoid cheating or any other form of misconduct. If you are having personal problems, come and talk to the instructor.

G. CONTENTS:

1. Introduction to Ground-Source Heat Pumps
2. Equipment for Ground-Source Applications
3. Fundamentals of Vertical Ground Heat Exchanger Design
4. Applied Ground-Coupled Heat Pump System Design
5. Surface-Water Heat Pumps
6. Piping and Pumps for Closed-Loop Ground-Source Heat Pumps
7. Hydrology, Water Wells, and Site Evaluation
8. Groundwater Heat Pump System Design
9. Whole building energy modeling of GSHP System

H. TENTATIVE SCHEDULE OF READING ASSIGNMENT

WEEK	OF DATE	READING ASSIGNMENT*	QUIZ**
1	8/27	Introduction to ground-source heat pumps	
2	9/3	Equipment for ground-source applications	
3	9/10	Fundamentals of vertical ground heat exchanger design	Quiz 1
4	9/17	Fundamentals of vertical ground heat exchanger design (continued.)	
5	9/24	Applied ground-coupled heat pump system design	Quiz 2
6	10/1	Applied ground-coupled heat pump system design (continued.)	
7	10/8	Surface-water heat pumps	Test 1
8	10/15	Piping and pumps for closed-loop ground-source heat pumps	
9	10/22	Hydrology, water wells, and site evaluation	Quiz 3
10	10/29	Groundwater heat pump system design	
11	11/5	Schematic Design/Design development Wizard and Detailed interface	Quiz 4
12	11/12	Ground loop heat exchanger	
13	11/19	Ground loop heat exchanger(new feature)	
14	11/26	Detailed simulation reports summary	
15	12/3	**Final report due**	
16	12/10	**Final project presentations**	

* The reading assignments are approximate. It is possible that in-class adjustments are made.

** All the quizzes and tests will be administrated on Monday of the week.

Disclaimer
The course schedule, content, and assignments are subject to modification when circumstances dictate and as the course progresses. If changes are made, you will be given due notice.