RC322

Geo Energy Exchange -- Design Principles

3 Credits

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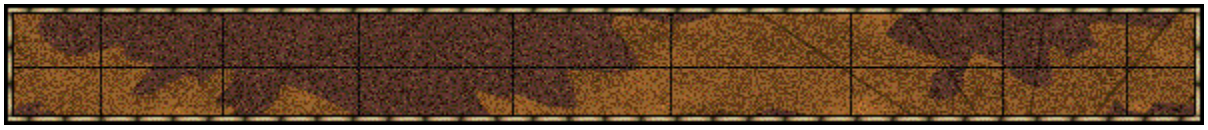

Geo Energy Exchange -- Design Principles

Calendar Description

This course examines the design aspects of Geo-Exchange systems related to a residential application.

Rationale

This is a required course for the Renewable Energy and Conservation program. Energy Exchange is a critical aspect of sustainable energy. The process of taking heat from where we don't want it, or don't need it, and efficiently moving it to where we do want it is an important consideration in Renewable Energy and Conservation. The design process is extremely important in successful Energy Exchange projects (whether geo, air, or exchange based). If an Energy Exchange project fails or underperforms, the initial design will very likely be a factor in the failure. This course is intended to provide information and considerations that will help to ensure that systems are designed properly. With a significant focus on Geo-Exchange, consideration will also be given to other approaches that can, in fact be even more efficient and cost effective.

Prerequisites

RC206

Co-Requisites

None

Course Learning Outcomes

Upon successful completion of this course, students will be able to

1. Module One – Thermodynamics

   Delineate the role that Thermodynamics has within the Energy Exchange Process

   - Describe the ways that heat is transferred
   - Describe the things that affect heat transfer

- Define, on a molecular basis, heat
- Indicate the definitional difference between heat and cold
- Give a formula for the relationship between entropy, enthalpy, and energy
- Develop a critical, but respectful, relationship with classmates

2. Module Two - Building Energy Analysis

   Apply the principles that will generate a heat loss calculation for a simple building
   - Describe the heat transfer formula and its applications
   - Apply the heat loss formula and related information to determine the heat loss through a
   - Comment on the importance and the procedure involved in Building Energy Analysis

3. Module Three – Choosing a Heat Pump

   Choose an appropriate heat pump for the given situation
   - Determine the output of heat pumps as they vary with different input conditions
   - Relate heat pump capacity to building loads
   - Indicate the advantages and disadvantages of water to air systems
   - Indicate the advantages and disadvantages of water to water systems
   - Collaborate with other participants to fully determine where and why you would choose any
     simple building
     given heat pump

4. Module Four – The Ground Connection

   Describe the operational concepts behind both open and closed loop systems

   Specify the advantages and disadvantages of open loop systems

   Specify the advantages and disadvantages of closed loop systems
   - Explain how delta T affects energy transfer to and from the ground, elaborating why this is
   - Describe the operational differences between open and closed loop

- Recognize the potential water structure within the ground
- Indicate the effect that a significant aquifer will have on the region of influence of an energy
  so important
  exchange field
- Describe the advantages and disadvantages of an open loop system
- Describe the advantages and disadvantages of a closed loop system
- Collaborate with other participants to fully determine where and why you would choose
- Detail the importance of water in the ground, whether in open or closed loop applications

5. Module Five – Ground Exchange Design Considerations I
   Describe what impacts on closed loop field design on an annual basis
   - Determine how building loads will impact on immediate ground load
   - Detail the control that we have over pipe and grout
   - Describe how the choice of pipe and/or grout becomes part of the total field design
   - Detail the effect of consistent running of the system
   - Determine the effect of Energy Load in the worst month on field design
   - Collaborate with other participants to determine some of the factors affecting loop length
   - State why “rules of thumb” for field design are unacceptable

6. Module Six – Ground Exchange Design Considerations II
   Describe the things that impact on closed loop field design on a long term basis
   - Determine if load imbalance will affect field design
   - Manage imbalanced loads
   - Design to avoid loop degradation
   - Describe the advantage of the horizontal field with respect to imbalanced loads
   - Collaborate with other participants to examine the issue of load imbalance

7. Module Seven – Hydrodynamics

   Design an effective and efficient hydrodynamics component of the Energy Exchange system

   - Determine the pressure drop through a pipe and through a system
   - Design a system to manage pressure drop
   - Determine the Reynolds Number (indicator of turbulent or laminar flow) in a system
   - Design a system to manage Reynolds Number
   - Determine the balance point between minimizing pressure drop and generating reasonable
   - Describe how a pump works, particularly with respect to the relationship between pressure
   - Choose an appropriate pump to generate the flow required against the pressure drop it will
   - Design a manifold and system such that purging requirements are achievable
   - Collaborate with other participants to examine the issue of hydro or fluid dynamics

     open loop over closed loop or vice versa

     turbulence in the flow

     and flow

     face
   - Indicate hydrodynamics pitfalls and how to avoid them

8. Module Eight – Gathering Together

   Explain the whole concept of Energy Exchange to someone who knows very little about it

   Given the length of the pipe that is needed in the ground, design a functional Energy Exchange

   ground exchanger

Resource Materials

***Required Text(s)*:**
Dickie, E. J. 2010. Energy Exchange – Geothermal Exchange and Beyond - Design and Installation Guide. 3rd ed.

***Reference Text(s)*:**
None

Conduct of Course

This course consists of the equivalent of 45 hours of lecture delivered on-line using an online learning manager program. The course is delivered over a set 8-week period. Course content modules and links to assigned readings will be available on-line. A course facilitator will be available to guide the learner through the course, answer any questions, and grade assignments and exams. Learners are expected to participate in on-line discussion forums with other classmates and the course facilitator. Assignments will be submitted electronically through the learning manager program. Open book unit exams will be taken on-line. Exams and assignments will be marked by the instructor and returned to the student with a grade and comments in the learning manager program. Students can monitor their progress though the course using utilities available in the learning manager program. In order to complete the course on time, deadlines for assignments, exam, and projects will be enforced.

Evaluation Procedures

Activity	General Topic	Approximate Time Allotment	Percent of Course Grade
Module 1 Questions	Thermodynamics	Five hours	7.5%
Module 1 Discussion			2.5%
Module 2 Heat Loss Calculation	Building Energy Analysis	Five hours	7.5%
Module 2 Discussion			2.5%
Module 3 Questions	Choosing a Heat Pump	Five hours	7.5%
Module 3 Discussion			2.5%
Module 4 Questions	The Ground Connection	Five hours	6%
Module 4 Discussion			4%
Module 5 Essay	Ground Exchange Design Considerations I	Five hours	6.25%
Module 5 Discussion			3.75%
Module 6 Questions	Ground Exchange Design Considerations II	Five hours	7.5%
Module 6 Discussion			2.5%
Module 7 Questions	Hydrodynamics	Five hours	6%
Module 7 Discussion			4%
Module 8 Question 1	Gathering Together (Final Assignment)	Ten hours	15%
Module 8 Question 2			15%

Grade Equivalents and Course Pass Requirements

A minimum grade of D (50%) (1.00) is required to pass this course.

Letter	F	D	D+	C-	C	C+	B-	B	B+	A-	A	A+
Percent Range	0-49	50-52	53-56	57-59	60-64	65-69	70-74	75-79	80-84	85-89	90-94	95-100
Points	0.00	1.00	1.30	1.70	2.00	2.30	2.70	3.00	3.30	3.70	4.00	4.00

Students must maintain a cumulative grade of C (GPA - Grade Point Average of 2.00) in order to qualify to graduate.

Attendance

Active participation is required in all courses within the Renewable Energy and Conservation certificate and diploma programs. Each facilitator designates these requirements through the use of tools within the management system and personal contact with learners.

These expectations can be given marks as part of the assessment process. Each course outlines these expectations within the course structure.

For example, learners can be asked to demonstrate their participation/attendance through discussion forums, sharing research results, contributing relevant information, submitting assignments, communicating with colleagues and the facilitator, and participating in synchronous meetings or asynchronous activities.

Attendance is considered vital to the learning process. Absenteeism is recorded. For example, if a discussion forum is organized; the learner is expected to attend as per the guidelines set by the facilitator.

Students can request for an excused absence. An excused absence is one that is verified with your facilitator.

NOTE: Any exceptions to the above attendance policy (e.g. family or work-related issues) **must** be approved in writing by the Department Chair **prior** to the beginning of the course.

It is the student's responsibility to know their own absentee record.

Course Units/Topics

Thermodynamics

Building Energy Analysis

Choosing a Heat Pump

The Ground Connection

Ground Exchange Design Considerations I

Ground Exchange Design Considerations II

Hydrodynamics

Gathering Together (Final Assignment)

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