

ENRG 55A - HVAC Fundamentals and Components

COURSE DESCRIPTION: Fundamentals and concepts of HVAC with emphasis on types of equipment and conveyance. Principles of work, power and energy. Refrigeration cycle, psychrometric chart, load calculations, nameplate identification, media.

52 Hours (34 lecture, 18 lab)

LEARNING OUTCOMES:

- Describe the principles and concepts of work, power, and energy
- Describe the basic principles of thermodynamics and heat transfer
- Measure and calculate conversion of units, such as temperature, pressure, power, British Thermal Units (BTU), etc.
- Analyze and interpret room conditions using the psychrometric chart and software such as Trace 700 or e-Quest
- Estimate various types of heating and cooling loads as applied to buildings, rooms, and mechanical systems
- Define the purpose of various heating, cooling, and conveyance equipment
- Identify various heating, cooling, and conveyance equipment in the field
- Interpret name plate data of various heating, cooling, and conveyance equipment

COURSE TOPICS:

- I. Introduction to physical principles of HVAC & systems
 - A. Conversion of units
 1. Temperature
 2. Pressure
 3. Horse power
 4. Power (kWh)
 5. British Thermal Units/hr (BTU/hr)
 6. Tons
 - B. Concept of work, power, and energy
 - C. Overview of psychrometric analysis of the air conditioning system
 1. Psychrometric processes and calculations
 - a. Sensible or latent processes
 - b. Air side equations
 - c. Air side mixing
 - d. Summary of process line calculations
 2. Room sensible heat ratio (RSHR) and room CFM (cubic feet per minute)
 - a. Room sensible heat ratio
 - b. Room sensible heat ratio line
 - c. Design CFM (Room)
 - d. Multiple room sensible heat ratios
 3. The coil sensible heat ratio (CSHR)
 - a. Coil sensible heat ratio without ventilation
 - b. Coil sensible heat ratio with ventilation
 - c. Construction of the RSHR and CSHR lines
 - d. Coil By-pass factor
 - D. Thermodynamic laws and heat transfer principles
 - E. Estimate of sensible and latent heat changes
 - F. Analysis of thermal comfort
- II. Load calculations
 - A. Heating loads
 1. Building net heating load

2. System heat losses
 3. Heating coil load
 - B. Cooling loads
 1. Room and building peak cooling load
 2. Cooling load calculations for lighting, people, equipment & appliances
 3. Infiltration and ventilation
 4. Cooling coil load
 - C. Use of psychrometric tables and various software packages for heating and cooling estimates
- III. Conveyance systems
- A. Principles of conveyance systems
 - B. Types of conveyance equipment and components
 1. Open and closed loops
 2. Media
 - a. Air
 - b. Water
 - c. Refrigerant
 - d. Steam
 - e. Others
 3. Mechanisms
 - a. Pumps
 - b. Fans
 - c. Motors
 4. Distribution systems
 - a. Pipes
 - b. Ducts
 - c. Dampers
 - d. Valves
 - e. Filters
 5. Heat exchangers
 - a. Coils
 - b. Radiators
 - c. Others
 - C. Name plate interpretation
- IV. Principles of heating systems
- A. Types of heating equipment & components
 1. Boilers
 2. Furnaces
 3. Combustion processes and fuel
 4. Fuel-Burning equipment
 5. Boiler feed water and systems
 6. Direct-and Indirect-Fired heating equipment
 7. Unit heater and duct heaters
 8. Terminal heating equipment
 9. Heat pumps
 10. Heat recovery and reclaim
 - B. Name plate interpretation
- V. Cooling systems
- A. Principles of the refrigeration cycle
 - B. Types of equipment & components
 1. Compressors
 2. Chillers
 3. Condensers
 4. Cooling towers

- 5. Cooling coils
- 6. Radiant cooling
- 7. Evaporative cooling
- 8. Evaporators
- C. Name plate interpretation
- VI. Air-handling systems
 - A. Diffusers and registers
 - B. Dampers, louvers, filters, fans

TYPES OF ASSIGNMENTS:

- I. In-class
 - A. Class discussions and demonstrations of various equipment types
 - B. Simple and rule-of-thumb load calculations
 - C. Field simulation exercises such as name plate interpretation of various HVAC equipment and components
 - D. Describe or draw refrigeration cycle
 - E. Describe or draw two or four loops distribution systems
 - F. Psychrometric chart analysis and calculations
 - G. Field trips such as to the Pacific Energy Center, or site visits to various campus facilities to observe equipment
- II. Out-of-class
 - A. Load calculations
 - B. Research codes and service or safety factors of various types of equipment, and prepare a brief (1-2 page) report
 - C. Psychrometric chart analysis and calculations
 - D. Research and interpret name plate data from equipment

TEXTBOOKS & RESOURCES:

- Instructor handouts on topics such as the refrigeration cycle, or illustrations of various types of equipment