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COURSE INFORMATION

Alternate Title: Commercial HVACR Analysis

Description:

10-481-109 COMMERCIAL HVACR ANALYSIS ...identify commercial HVAC system types and the general energy use impact of each type. Calculations of system equipment efficiencies will be used to determine EER, SEER, AFUE, COP, combination and seasonal efficiency in boilers, balance point partial efficiency. (Corequisites: 10-481-114, Intro to Energy Management)

Instructional Level: 10

Total Credits: 3

Total Hours: 72

COURSE HISTORY

Status: Active

Active Date: 12/5/2011

Last Revision Date: 7/24/2020

Revised By: SYSTEM IMPORT

Last Approval Date: 5/21/2019

Approved By: Kristina Wendricks (15002977)

EMPLOYABILITY SKILLS

1. Communicate Effectively

Type: NWTC Status: Active

2. Demonstrate Community and Global Accountability

Type: NWTC Status: Active

3. Demonstrate Personal Accountability

Type: NWTC Status: Active

4. Think Critically and Creatively

Type: NWTC Status: Active

5. Value Individual Differences and Abilities

Type: NWTC Status: Active

6. Work Cooperatively and Professionally

Type: NWTC Status: Active

PROGRAM OUTCOMES

1. **TSA1 - Evaluate renewable, fossil and other energy resources in context of sustainability, environment, society and economics**

Type: TSA Status: Active

Summative Assessment Strategies

1.1. WTCS TSA Scoring Guide

Criteria

- 1.1. you summarize energy sources and associated power generation technologies
- 1.2. you compare and contrast the impacts of using fossil fuels, renewable energy, energy efficiency and energy conservation
- 1.3. you analyze the potential for renewable energy generation, energy efficiency and conservation

2. **TSA2 - Evaluate building performance and energy use**

Type: TSA Status: Active

Summative Assessment Strategies

2.1. WTCS TSA Scoring Guide

Criteria

- 2.1. you document or estimate energy use
- 2.2. you analyze energy use patterns
- 2.3. you assess integrity of the building components
- 2.4. you analyze the quality of the building and site environmental conditions

3. **TSA3 - Recommend building/site solutions to optimize performance**

Type: TSA Status: Active

Summative Assessment Strategies

3.1. WTCS TSA Scoring Guide

Criteria

- 3.1. you design and specify solution(s)
- 3.2. you generate technical project proposals and estimates
- 3.3. you conduct a feasibility study
- 3.4. you present proposal to stakeholders

4. **TSA4 - Install equipment and materials to optimize performance**

Type: TSA Status: Active

Summative Assessment Strategies

4.1. WTCS TSA Scoring Guide

Criteria

- 4.1. you comply with safe practices, procedures and license requirements
- 4.2. you follow installation guidelines, construction documents and instructions
- 4.3. you verify system operation

5. **TSA5 - Service equipment and systems**

Type: TSA Status: Active

Summative Assessment Strategies

5.1. WTCS TSA Scoring Guide

Criteria

- 5.1. you monitor the equipment and systems
- 5.2. you maintain the equipment and systems
- 5.3. you troubleshoot the equipment and systems as necessary
- 5.4. you refer to outside technicians as needed

COURSE COMPETENCIES

1. Review heat transfer principles for buildings.

Status: Active

Assessment Strategies

- 1.1. by reviewing heat transfer principles for buildings.

Criteria

Your performance will be successful when:

- 1.1. you describe the typical materials used for insulating buildings.
- 1.2. you calculate thermal resistances (R-values) and conductances (U-values) of walls, roofs, floors, windows, doors and other building materials.
- 1.3. you calculate the total heat transfer for buildings under heating and cooling conditions.

Learning Objectives

- 1.a. Describe the physics of heat transfer by conduction, convection and radiation.
- 1.b. Distinguish between insulators and conductors.
- 1.c. Analyze the effects of thermal mass on heat transfer.

2. Describe thermodynamic processes in buildings.

Status: Active

Assessment Strategies

- 2.1. by describing thermodynamic processes in buildings.

Criteria

Your performance will be successful when:

- 2.1. you define heat, work, pressure, temperature, density, specific heat, internal energy, enthalpy and entropy.
- 2.2. you apply the first law of thermodynamics to heating and cooling systems in buildings.
- 2.3. you apply the second law of thermodynamics to heating and cooling systems in buildings.

Learning Objectives

- 2.a. Define the thermodynamic properties used to describe HVACR systems.
- 2.b. Describe the first law of thermodynamics.
- 2.c. Describe the second law of thermodynamics.

3. Analyze the psychrometrics of HVACR systems.

Status: Active

Assessment Strategies

3.1. by analyzing the psychrometrics of HVACR systems.

Criteria

Your performance will be successful when:

- 3.1. you define partial pressure of water vapor, relative humidity, humidity ratio, dew point temperature and wet-bulb temperature.
- 3.2. you analyze heating and cooling processes using a psychrometric chart, including heating, cooling, humidification and dehumidification, mixing of air streams and evaporative cooling.
- 3.3. you describe the human comfort zone on the psychrometric chart.
- 3.4. you calculate minimum outdoor air ventilation rates required for various types of buildings.

Learning Objectives

- 3.a. Define the basic properties of moist air at varying temperatures.
- 3.b. Describe the variables shown on a psychrometric chart.
- 3.c. Interpret air quality standards that apply to buildings.

4. Analyze the heating and cooling loads of buildings.

Status: Active

Assessment Strategies

4.1. by analyzing the heating and cooling loads of commercial buildings.

Criteria

Your performance will be successful when:

- 4.1. you define infiltration, internal heat gains (from lights, people and equipment), solar radiation and conduction heat transfer.
- 4.2. you calculate building heating loads using the degree-day method.
- 4.3. you calculate annual heating and cooling costs for buildings.

Learning Objectives

- 4.a. Define the components that make up the heating and cooling loads of buildings.
- 4.b. Distinguish between sensible and latent loads.
- 4.c. Describe the effect of mass on heating and cooling loads.
- 4.d. Describe the degree-day method for calculating annual heating loads.

5. Analyze types of heating equipment for buildings.

Status: Active

Assessment Strategies

5.1. by analyzing heating equipment for commercial buildings.

Criteria

Your performance will be successful when:

- 5.1. you explain how fossil fuels, electricity and solar energy can be used for space and water heating.
- 5.2. you describe the components and operation of a furnace.

- 5.3. you describe the components and operation of a boiler.
- 5.4. you describe the components and operation of a water heater.
- 5.5. you describe the components and operation of a heat pump.

Learning Objectives

- 5.a. List the fuels that can be used for space and water heating in buildings.
- 5.b. Describe the equipment used for space and water heating in buildings.
- 5.c. Explain the cogeneration process.

6. Analyze types of cooling equipment for buildings.

Status: Active

Assessment Strategies

- 6.1. by analyzing cooling equipment for commercial buildings.

Criteria

Your performance will be successful when:

- 6.1. you describe the role and properties of refrigerants used in chillers.
- 6.2. you explain the purpose of cooling towers.

Learning Objectives

- 6.a. Explain how commercial buildings are cooled.
- 6.b. Describe the components that make up a cooling system for commercial buildings.

7. Analyze types of duct systems for HVACR equipment in buildings.

Status: Active

Assessment Strategies

- 7.1. by analyzing duct systems for HVACR equipment in commercial buildings.

Criteria

Your performance will be successful when:

- 7.1. you describe the operation of duct systems in commercial buildings.
- 7.2. you describe the purpose and operation of fans and pumps in HVACR equipment.
- 7.3. you distinguish between dual duct systems, single duct terminal reheat systems, variable air volume systems, steam systems, fan coil units and heat pump systems.
- 7.4. you calculate air flow using the fan laws.

Learning Objectives

- 7.a. Describe how heat, moisture and air are circulated in HVACR systems.
- 7.b. Distinguish between the various types of duct systems used in HVACR systems.
- 7.c. Explain the mathematical laws that govern the flow of air through fans.

8. Develop strategies to operate HVACR systems efficiently.

Status: Active

Assessment Strategies

- 8.1. by developing strategies to operate HVACR systems efficiently.

Criteria

Your performance will be successful when:

- 8.1. you define annual fuel utilization efficiency (AFUE), coefficient of performance (COP), energy efficiency ratio (EER), seasonal energy efficiency ratio (SEER), energy factor (EF) and other measures of HVACR efficiency.
- 8.2. you calculate the energy savings resulting from changes in efficiency of heating and cooling equipment.
- 8.3. you propose specific strategies to save energy in HVACR systems, including changes in equipment type, thermostat settings, fan flow rates, zoning, scheduling, controls and other approaches.
- 8.4. you analyze and prioritize energy-saving strategies for HVACR systems.

Learning Objectives

- 8.a. Define the measures used for efficiency of heating, cooling and water heating equipment.
- 8.b. Describe feasible modifications to HVACR systems and their impact on building energy consumption.

9. Analyze the vapor compression cycle of a refrigeration system.

Status: Active

Criteria

Learners will be successful when they are able to:

- 9.1. you distinguish between the four main types of compressors: reciprocating , centrifugal, screw and scroll.

Learning Objectives

- 9.a. Explain the fundamental principles behind the refrigeration cycle.
- 9.b. Identify the four major components of the vapor compression cycle.
- 9.c. Identify where in the refrigeration system the refrigerant is saturated, superheated, or subcooled.
- 9.d. Draw a basic vapor compression refrigeration cycle with the appropriate components in order.