Course Number and Title: NRG 126 Fundamentals of HVAC Systems

Campus Location:
Georgetown, Dover, Stanton

Effective Date:
2018-51

Prerequisite:
NRG 101, MAT 153, PHY 120, SSC 100 or concurrent

Co-Requisites:
none

Course Credits and Hours:
4.00 credits
3.00 lecture hours/week
3.00 lab hours/week

Course Description:
In this in-depth course on HVAC systems, students identify and analyze the energy consumption of the various HVAC equipment and systems used in commercial buildings; learn the fundamentals of psychrometrics, fan laws, and air/water properties; and interpret fan tables and pump curves for energy calculations. Building heating and cooling load calculations are emphasized.

Required Text(s):
Obtain current textbook information by viewing the campus bookstore - https://www.dtcc.edu/bookstores online or visit a campus bookstore. Check your course schedule for the course number and section.

Additional Materials:
none

Schedule Type:
Classroom Course

Disclaimer:
none

Core Course Performance Objectives (CCPOs):

1. Engage in professional behavior. (CCC 1, 3, 4, 5)
2. Apply thermodynamics, heat transfer, and fluid flow dynamics concepts in solving heating, ventilation, and air conditioning problems. (CCC 1; PGC BAS 2, 3; PGC NRG 2)
3. Perform basic heating and cooling load calculations. (CCC 6; PGC BAS 1, 2, 3; PGC NRG 2, 3, 5)
4. Discuss psychrometrics, fan laws, and air/water properties as they are applied to residential and commercial building energy use. (CCC 1, 6; PGC BAS 2, 3; PGC NRG 2, 4, 5)
5. Assess energy efficiency of various systems and components to estimate energy consumption of the equipment. (CCC 5, 6; PGC BAS 2, 3; PGC NRG 2, 3, 4, 5)
6. Identify and evaluate the energy use of commercial HVAC equipment (CCC 2, 3, 5; PGC BAS 2, 3; PGC NRG 2, 4, 5)

See Core Curriculum Competencies and Program Graduate Competencies at the end of the syllabus. CCPOs are linked to every competency they develop.

Measurable Performance Objectives (MPOs):
Upon completion of this course, the student will:

1. Engage in professional behavior.
    1. Demonstrate punctuality when attending class, participating in off-site projects, and submitting assignments.
    2. Communicate using industry-appropriate language in presentations, reports, and homework.
    3. Demonstrate appropriate professional behavior when working with others.
2. Apply thermodynamics, heat transfer, and fluid flow dynamics concepts in solving heating, ventilation, and air conditioning problems.
    1. Discuss the physical properties of substances commonly used in HVAC systems.
    2. Calculate conversions between units commonly used in HVAC systems.
    3. Define the concepts of work, power, and energy, and explain their application to HVAC systems.
    4. Explain sensible and latent heat (temperature and enthalpy).
    5. Calculate flow rate in air and water systems.
    6. Explain how total, static, and velocity pressure are related and how they are used to describe the operation of heating, air conditioning, and ventilation systems.
    7. Determine fluid velocity and pressure loss in HVAC systems.
3. Perform basic heating and cooling load calculations.
    1. Discuss how different modes of heat transfer are used in heating load calculations.
    2. Estimate building component R and U values.
    3. Perform heating load calculations.
    4. Calculate the heat gain to a space.
    5. Describe the components of total cooling load.
    6. Determine peak load conditions.
    7. Perform a commercial cooling load analysis.
    8. Perform a residential cooling load analysis.
4. Discuss psychrometrics, fan laws, and air/water properties as they are applied to residential and commercial building energy use.
    1. Explain the effects of humidity on energy consumption.
    2. Use a psychrometric chart to calculate dew point.
    3. Explain heating and cooling degree days.
    4. Identify the four basic piping arrangements.
    5. Determine water temperatures and flow rate at a given point in each system.
    6. Identify different types of fans.
    7. Locate appropriate fan tables, and interpret fan table data.
    8. Compare static pressure, velocity pressure and total pressure, and use manometers and pitot tubes to take measurements.
    9. Describe the relationship among fan speed, air flow, pressure, and brake horsepower.
    10. Identify the different types of pumps.
    11. Locate appropriate pump curve, and interpret pump curve data.
    12. Describe the difference in fluid flow dynamics in open and closed systems.
    13. Discuss the relationship between water horsepower and brake horsepower.
    14. Describe the relationship between impeller diameter, speed, flow, and pressure in a closed system.
5. Assess energy efficiency of various systems and components to estimate energy consumption of the equipment.
    1. Describe the basic features of warm air furnace and boilers.
    2. Identify the main types of fossil fuels and their heat content.
    3. Define *combustion efficiency* and *annual fuel utilization efficiency* (AFUE).
    4. Describe the energy conservation methods associated with boilers and furnaces.
    5. Discuss the operating characteristics of heat engines and heat pumps.
6. Identify and evaluate the energy use of commercial HVAC equipment
    1. Identify and evaluate the energy use of commercial HVAC equipment.
    2. Identify important components in chillers and other refrigeration equipment such as evaporators, condensers, cooling towers, compressors, and expansion devices; discuss the function of these components.
    3. Explain air handling unit operation.
    4. Identify important data such as mixed, outside, return, and supply air temperatures; damper positions; and supply and return air fan motors.
    5. Identify different HVAC system configurations (single zone, multiple zone, all-air, all-water, air-water, unitary, and central), and justify the use of a particular configuration.
    6. Discuss economizer operation and the energy savings opportunities of an economizer.

Evaluation Criteria/Policies:
Students must demonstrate proficiency on all CCPOs at a minimal 75 percent level to successfully complete the course. The grade will be determined using the Delaware Tech grading system:

92	–	100	=	A
83	–	91	=	B
75	–	82	=	C
0	–	74	=	F

Students should refer to the Student Handbook - https://www.dtcc.edu/handbook for information on the Academic Standing Policy, the Academic Integrity Policy, Student Rights and Responsibilities, and other policies relevant to their academic progress.

Core Curriculum Competencies (CCCs are the competencies every graduate will develop):

1. Apply clear and effective communication skills.
2. Use critical thinking to solve problems.
3. Collaborate to achieve a common goal.
4. Demonstrate professional and ethical conduct.
5. Use information literacy for effective vocational and/or academic research.
6. Apply quantitative reasoning and/or scientific inquiry to solve practical problems.

Program Graduate Competencies (PGCs are the competencies every graduate will develop specific to his or her major):
Building Automation Systems

1. Utilize building system and energy technology hardware and software to gather data on building lighting systems operation and energy consumption.
2. Utilize building system and energy technology hardware and software to gather data on heating, ventilation, and air conditioning (HVAC) systems operation and energy consumption.
3. Evaluate commercial buildings and make recommendations for optimized building performance and occupant comfort.
4. Prepare and present technical reports.
5. Assemble, install, service, and repair direct digital controls (DDC) for building electrical and mechanical systems.
6. Program and explain operational sequences for building equipment and systems.
7. Integrate and commission building systems and components to ensure reliable performance and compliance with building codes.

Energy Management

1. Utilize building system and energy technology hardware and software to gather data on building lighting systems operation and energy consumption.
2. Utilize building system and energy technology hardware and software to gather data on heating, ventilation, and air conditioning (HVAC) systems operation and energy consumption.
3. Calculate, analyze, and verify the energy use of buildings based upon the interaction of energy consuming building systems.
4. Evaluate residential buildings and make recommendations for optimized building performance and occupant comfort.
5. Evaluate commercial buildings and make recommendations for optimized building performance and occupant comfort.
6. Prepare and present technical reports.
7. Analyze the economic, environmental, and business implications of potential energy measures.

Disabilities Support Statement:
The College is committed to providing reasonable accommodations for students with disabilities. Students are encouraged to schedule an appointment with the campus Disabilities Support Counselor to request an accommodation needed due to a disability. A listing of campus Disabilities Support Counselors and contact information can be found at the disabilities services - https://www.dtcc.edu/disabilitysupport web page or visit the campus Advising Center.