Course Number and Title: NRG 214 Capstone in Energy Use and Analysis

Campus Location:
Georgetown, Dover, Stanton, Wilmington

Effective Date:
2018-51

Prerequisite:
NRG 108, NRG 223, NRG 226, NRG 233, NRG 250, ENG 122 or concurrent

Co-Requisites:
none

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

Course Description:
In this course, students apply skills learned throughout the energy management program to a commercial building energy audit. Students present the results of the audit in a formal report and presentation. In addition, the course includes a review for the Certified Energy Manager (CEM) exam.

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:
Scientific calculator (preferably TI-83+ or TI-84+), Notebook

Schedule Type:
Classroom Course

Disclaimer:
None

Core Course Performance Objectives (CCPOs):

1. Engage in professional behavior. (CCC 1, 3, 4, 5)
2. Estimate energy end-use splits for various building equipment types. (CCC 2, 3, 4, 6; PGC 1, 2,3)
3. Complete an energy audit of a commercial building, including the envelope, lighting, and HVAC systems. (CCC 2, 3, 5, 6; PGC 1, 2, 3, 5)
4. Analyze some of the steps involved in an energy simulation of commercial buildings. (CCC 2, 3, 6; PGC 3)
5. Review the facility's operation and maintenance procedures, and recommend improvements. (CCC 2, 3, 5, 6; PGC 1, 5)
6. Analyze the energy and cost savings of energy efficiency improvements of a commercial building. (CCC 1, 2, 3, 4, 5, 6; PGC 3, 5, 6, 7)
7. Demonstrate skills needed for the successful completion of the CEM exam. (CCC 2, 4, 5, 6; PGC 3, 5, 7)

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 during presentations, reports, and homework.
    3. Demonstrate appropriate professional behavior when working with others.
2. Estimate energy end-use splits for various building equipment types.
    1. Identify equipment in a building by equipment schedules or a building walkthrough.
    2. Formulate an energy end-use split for a building by estimating run times of the equipment in the building and comparing to utility data.
    3. Compare the formulated energy end-use split to the end-use split predicted by a building model and to similar buildings using the commercial building energy consumption survey.
3. Complete an energy audit of a commercial building, including the envelope, lighting, and HVAC systems.
    1. Sketch a commercial building with all exterior walls and roofs labeled with construction type and area.
    2. Examine the construction type and appropriate resources to determine their U-values.
    3. Construct a spreadsheet that includes all the areas and U-values of exterior walls and roofs of a building.
    4. Calculate the total overall heat transfer coefficient (UA) value of the building.
    5. Identify and locate all HVAC equipment and pertinent nameplate data for the building.
    6. Evaluate HVAC control schemes by consulting with the facility manager and verifying by data logging.
    7. Create a spreadsheet to calculate the energy use of the HVAC systems in the building using bin hours or hourly weather data and the overall heat loss coefficient.
    8. Using a light meter, examine the light levels in a building.
    9. Identify type and number of lamps, ballasts, and fixtures in the building.
    10. Identify the power rating of each fixture.
    11. Identify the lighting use patterns of the building.
    12. Identify the lighting controls in the building.
    13. Measure the light levels in at least one room and the power of at least one fixture, and use data loggers to verify lighting system consumption patterns.
    14. Develop a spreadsheet to calculate the total annual energy use of the building's lights by using the aforementioned information.
    15. Design a spreadsheet that calculates the interaction between different building systems.
4. Analyze some of the steps involved in an energy simulation of commercial buildings.
    1. Identify, evaluate, and select the various building model inputs.
    2. Examine factors defining the building envelope and internal gains.
    3. Construct a simple building model using a building energy simulation software program.
    4. Formulate modifications to the construction materials, space, and surface geometry on the building model.
5. Review the facility's operation and maintenance procedures, and recommend improvements.
    1. Trend the previous year's performance, and compare it to the baseline year to determine rate of degradation in energy performance.
    2. Analyze operational factors that may have impacted energy usage and cost to include installation of more equipment, occupancy changes, and building additions.
    3. Review equipment operation, including pressure drops across air filters and coils, and make recommendations as appropriate.
    4. Analyze the effects of minimum efficiency reporting value (MERV) ratings for air filters on air quality and energy efficiency.
    5. Discuss sheave wear and alignment and belt tensioning practices to reduce wear and slippage of belts.
    6. Demonstrate pump shaft and coupling alignment procedures.
    7. Review the operation of all motors for excessive heat and vibration, and make recommendations for further analysis as necessary.
    8. Apply infrared technology and vibration testing as appropriate.
    9. Examine rogue zones and their impact on a system's energy performance.
    10. Identify the causes of rogue zones, and recommend solutions.
    11. Discuss the value of commissioning, recommissioning, and retro commissioning.
6. Analyze the energy and cost savings of energy efficiency improvements of a commercial building.
    1. Calculate energy savings of the following by using a spreadsheet program and with a building model: building envelope improvements, HVAC improvements, operation and maintenance improvements, and lighting improvements.
    2. Analyze the cost-effectiveness of proposed building envelope improvements using the life cycle cost analysis (LCCA) method.
    3. Evaluate the cost-effectiveness of suggested building HVAC improvements using the LCCA method.
    4. Evaluate the cost-effectiveness of proposed operation and maintenance improvements using the LCCA method.
    5. Analyze the cost-effectiveness of proposed lighting improvements using the LCCA method.
    6. Construct a measurement and verification plan for an energy efficiency measure.
    7. Prepare and present the results of a complete energy audit.
7. Demonstrate skills needed for the successful completion of the CEM exam.
    1. Discuss the content covered in each section of the CEM exam.

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):

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.