Course Number and Title: NRG 123 Fundamentals of Control Systems

Campus Location:
Georgetown, Dover, Stanton

Effective Date:
2018-51

Prerequisite:
NRG 140, PHY 120, SSC 100 or concurrent

Co-Requisites:
None

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

Course Description:
This course introduces the concepts of building automated control systems. Topics include sensors, controlled variables, devices, controllers, and signals with an emphasis on design characteristics, sensor calibration, and maintenance of major components. Control drawings, schematics, and process and instrumentation diagrams are also introduced.

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:
Honeywell Control Manual (online PDF)

Schedule Type:
Classroom Course

Disclaimer:
None

Core Course Performance Objectives (CCPOs):

1. Engage in professional behavior. (CCC 1, 3, 4, 5)
2. Identify and describe controlled variables and sensor operation. (CCC 1, 5, 6; PGC BAS 1, 2, 5)
3. Explain the fundamental operating characteristics of various controlled devices. (CCC 6; PGC BAS 1, 2, 6)
4. Describe the various types of controllers and their operation. (CCC 1, 5, 6; PGC BAS 1, 2, 5)
5. Perform instrument and device installation and calibration. (CCC 2, 5, 6; PGC BAS 5)
6. Explain the installation, operation, and maintenance of a control system given a set of plans, schematics, and specifications. (CCC 2, 3, 5, 6; PGC BAS 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 in presentations, reports, and homework.
    3. Demonstrate appropriate professional behavior when working with others.
2. Identify and describe controlled variables and sensor operation.
    1. Define *input, output, analog,* and *digital signal,* and explain their functions.
    2. Explain accuracy, gain, and repeatability as they apply to sensors and calibration procedures.
    3. Describe the operation of bellows, bourdon tube, and resistance pressure sensors.
    4. Discuss Bernoulli's principle as it relates to flow measurement.
    5. Describe the operation of differential pressure, velocity, and area type flow meters.
    6. Describe the fundamental types of liquid level sensors and their applications.
    7. Explain the operating principles of thermocouple, resistance temperature detector (RTD), thermistor, and integrated circuit temperature sensors; identify the uses for each.
3. Explain the fundamental operating characteristics of various controlled devices.
    1. Explain the operating principles of pneumatic actuators.
    2. Discuss the operation of multi-turn and quarter-turn electric actuators.
    3. Select appropriate actuators based upon operational devices and parameters.
    4. Calculate the torque required by a controlled device.
    5. Identify and describe the operating principles of electronic/pneumatic (I/P) and electric *pneumatic (*E/P) transducers.
    6. Identify the various types of dampers and valves, and describe the fluid flow characteristics of each.
4. Describe the various types of controllers and their operators.
    1. Compare and contrast automatic and manual control concepts.
    2. Identify and describe various inputs and outputs used by a controller.
    3. Describe a microprocessor's components and their functions.
    4. Explain the operation of both open and closed loop control.
    5. Define *resistance*, *capacity*, *dead time*, and *transfer lag* as they apply to controller functions.
    6. Discuss the effects of dead-band and throttling range on controller response.
    7. Describe two-position, floating, and proportional control.
    8. Discuss proportional, proportional-integrated (PI), proportional-derivative (PD), and proportional integrated and derivative (PID) controllers.
    9. Compare and contrast the functions of application specific and advanced application controllers.
    10. Identify Building Automation and Control Network (BACnet), Native BACnet, LONtalk, and proprietary communication protocols.
5. Perform instrument and device installation, calibration, and maintenance actions.
    1. Install sensors.
    2. Calibrate sensors.
    3. Install controllers.
    4. Perform point-to-point commissioning.
    5. Install controlled devices.
    6. Check and calibrate actuator performance.
    7. Install a program to support the sequence of operations for an air handler.
    8. Loop-tune a control signal.
6. Explain the installation, operation, and maintenance of a control system given a set of plans, schematics, and specifications.
    1. Discuss the purpose of plans and specifications in the installation, operation, and maintenance of a building automation system.
    2. Identify control symbols.
    3. Read and apply a manufacturer's instrument specifications.
    4. Fill out calibration data sheets.
    5. Complete maintenance action reports.

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. 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.

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.