Course Number and Title: ELC 243 Programmable Logic Controllers

Campus Location:
Georgetown, Dover, Stanton

Effective Date:
2020-51

Prerequisite:
ELC 125, ELC 127

Co-Requisites:
none

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

Course Description:
This course covers the fundamentals of programmable logic controllers (PLC) systems. Topics include ladder logic programming, analog and digital interfacing, identification and isolation of common system faults, and writing specific task.

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:
Storage media for class and lab work, TI-84+ or TI-89 Calculator

Schedule Type:
Classroom Course
Hybrid Course

Disclaimer:
None

Core Course Performance Objectives (CCPOs):

1. Describe the principles, uses, and operating characteristics of mechanical relays. (CCC 1, 5; PGC EEN 1, 2, 3, 4; ETT 1, 2, 3, 4)
2. Identify and describe the major components of a PLC system. (CCC 1, 5; PGC EEN 1, 2, 3, 4; ETT 1, 2, 3, 4)
3. Develop basic PLC programs using ladder logic diagrams. (CCC 1, 2, 5, 6; PGC EEN 1, 2, 3, 4; ETT 1, 2, 3, 4)
4. Create ladder logic diagrams using advanced programming techniques. (CCC 1, 2, 5, 6; PGC EEN 1, 2, 3, 4; ETT 1, 2, 3, 4)
5. Create ladder logic diagrams using PLC control instructions. (CCC 1, 2, 5, 6; PGC EEN 1, 2, 3, 4; ETT 1, 2, 3, 4)
6. Describe guidelines for the installation, maintenance, and troubleshooting of a programmable logic controller system. (CCC 1, 2, 5; PGC EEN 1, 2, 3, 4; ETT 1, 2, 3, 4)
7. Apply sequential control of automated processes and ladder logic programming to emulate an industry process. (CCC 1, 2, 5; PGC EEN 1, 2, 3, 4; ETT 1, 2, 3, 4)

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. Describe the principles, uses, and operating characteristics of mechanical relays.
    1. Describe the characteristics of electromechanical, reed, and solid state relays.
    2. Define pull-in voltage, pull-in current, minimum holding voltage, sealed current, and explain their significance.
    3. Assemble and test single-pole, double-pole, and timer relay circuits given a relay logic diagram.
2. Identify and describe the major components of a PLC system.
    1. Describe the major components of a PLC and their functional operation.
    2. Define *pull-in voltage*, *pull-in current*, *minimum holding voltage*, and *sealed current*, and explain their significance.
    3. Explain the differences between a fixed and modular PLC.
    4. Explain the differences between discrete and analog modules.
    5. Describe sinking and sourcing as it relates to input/output (I/O) modules.
    6. Explain I/O addressing in a PLC system.
    7. Describe the PLC program scan sequence.
3. Develop basic PLC programs using ladder logic diagrams.
    1. Develop a ladder logic diagram to solve a given task.
    2. Convert wiring and ladder diagrams into PLC programs.
    3. Create ladder logic diagrams using standard logic functions such as AND, OR, NOT, NAND, NOR, XOR, and XNOR.
    4. Create ladder logic diagrams using examine if open (XIO), examine if closed (XIC), and output contacts to solve a given control problem.
    5. Create ladder logic diagrams using latch and unlatch instructions.
    6. Use PLC specific software to write, edit, and download basic ladder logic diagrams to a PLC.
4. Create ladder logic diagrams using advanced programming techniques.
    1. Write advanced ladder logic diagrams using timer on-delay and timer off-delay instructions to solve a given control problem.
    2. Write advanced ladder logic diagrams using interlocking timers.
    3. Write advanced ladder logic diagrams using count-up and count-down instructions to solve a given control problem.
    4. Write advanced ladder logic diagrams using cascaded timers and counters.
    5. Explain the differences between retentive and non-retentive timers and counters.
    6. Use PLC specific software to write, edit, and download advanced ladder logic diagrams to a PLC.
5. Create ladder logic diagrams using PLC control instructions.
    1. Create advanced PLC programs using compare, jump, and master control reset instructions.
    2. Create advanced PLC programs using shift-left, shift-right, and sequencer instructions to solve a given control problem.
    3. Use subroutines to shorten lengthy PLC programs for readability and troubleshooting.
6. Describe guidelines for the installation, maintenance, and troubleshooting of a programmable logic controller system.
    1. Describe and outline requirements for a PLC enclosure.
    2. Describe proper grounding practices and preventative maintenance tasks associated with PLC systems.
    3. List and describe PLC hardware and software troubleshooting procedures.
    4. Explain the hazards of forcing inputs and outputs while troubleshooting.
    5. Network PLCs.
7. Apply sequential control of automated processes and ladder logic programming to emulate an industry process.
    1. Configure the hardware portion of the system to emulate an industry process or operation.
    2. Configure the software portion of the system to emulate an industry process or operation.

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.

Final Course Grade:
Calculated using the following weighted average

Evaluation Measure	Percentage of final grade
Summative: 4 Exams (Equally weighted)	25%
Summative: (10-15) Laboratory Experiments (Equally weighted)	40%
Formative: Homework/Pop Quizzes (Equally weighted)	15%
Summative: Capstone Project	20%
TOTAL	100%

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):
EENAASEEN

1. Perform the duties of an entry-level technician using the skills, modern tools, theory, and techniques of the electronics engineering technology.
2. Apply a knowledge of mathematics, science, engineering, and technology to electronics engineering technology problems that require limited application of principles but extensive practical knowledge.
3. Conduct, analyze, and interpret experiments using analysis tools and troubleshooting methods.
4. Identify, analyze and solve narrowly defined electronics engineering technology problems.
5. Explain the importance of engaging in self-directed continuing professional development.
6. Demonstrate basic management, organizational, and leadership skills which commit to quality, timeliness and continuous improvement.

EENAASETT

1. Apply circuit analysis and design, computer programming, associated software, analog and digital electronics, and microcomputers, and engineering standards to the building, testing, operation, and maintenance of electrical/electronic(s) systems.
2. Apply a knowledge of mathematics, science, engineering, and technology to electronics engineering technology problems.
3. Conduct, analyze, and interpret experiments using analysis tools and troubleshooting methods.
4. Identify, analyze, and solve electronics engineering technology problems.
5. Explain the importance of engaging in self-directed continuing professional development.
6. Demonstrate basic management, organizational, and leadership skills that commit to quality, timeliness, and continuous improvement.

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.