

## Course Number and Title: ELM 243 Industrial Programmable Logic Controllers

**Campus Location:**

Dover

**Effective Date:**

2018-51

**Prerequisite:**

ELM 230

**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 tasks.

**Required Text(s):**

Obtain current textbook information by viewing the [campus bookstore - https://www.dtcc.edu/bookstores](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

**Disclaimer:**

This workforce solution was funded by a grant awarded by the U.S. Department of Labor's Employment and Training Administration. The solution was created by the grantee and does not necessarily reflect the official position of the U.S. Department of Labor. The Department of Labor makes no guarantees, warranties, or assurances of any kind, express or implied, with respect to such information, including any information on linked sites, and including, but not limited to accuracy of the information or its completeness, timeliness, usefulness, adequacy, continued availability or ownership.

Unless otherwise specified, this work by Delaware Technical Community College is licensed under a [Creative Commons Attribution 4.0](https://creativecommons.org/licenses/by/4.0/)

[International License - http://creativecommons.org/licenses/by/4.0/](http://creativecommons.org/licenses/by/4.0/) .



**Core Course Performance Objectives (CCPOs):**

1. Describe the principles, applications, and operating characteristics of mechanical relays. (CCC 1, 5; PGC 1, 2, 3, 4)
2. Identify and describe the major components of a PLC system. (CCC 1, 5; PGC 1, 2, 3, 4)
3. Develop basic PLC programs using ladder logic diagrams. (CCC 1, 2, 5, 6; PGC 1, 2, 3, 4)
4. Create ladder logic diagrams using advanced programming techniques. (CCC 1, 2, 5, 6; PGC 1, 2, 3, 4)
5. Create ladder logic diagrams using PLC control instructions. (CCC 1, 2, 5, 6; PGC 1, 2, 3, 4)
6. Describe guidelines for the installation, maintenance, and troubleshooting of a PLC system. (CCC 1, 2, 5; PGC 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 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, applications, 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*, and *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 function.
  2. Describe the PLC memory organization.
  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 modules.
  6. Explain input/output (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 ease of troubleshooting.
6. Describe guidelines for the installation, maintenance, and troubleshooting of a PLC 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 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](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. Under engineers' direction, design basic circuitry and draft sketches to clarify details of design documentation.
2. Build, modify, and test circuitry or electronic components according to engineering instructions, technical manuals, and knowledge of electrical or electronic systems.
3. Install, maintain, adjust, and calibrate electrical or electronic equipment.
4. Identify and resolve equipment malfunctions.
5. Read blueprints, wiring diagrams, schematic drawings, and engineering instructions for assembling, maintaining, or repairing equipment.
6. Employ ethical standards, sound leadership and management principles, and participate in lifelong learning.

**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](https://www.dtcc.edu/disabilitysupport) web page or visit the campus Advising Center.