



## **Course Syllabus**

### **ELMT 1301 - Programmable Logic**

**Catalog Description:** An introduction to programmable logic controllers as used in industrial environments including basic concepts, programming, applications, troubleshooting of ladder logic, and interfacing of equipment.

**Lecture hours = 2, Lab hours = 4**

**Prerequisites:** ELPT 1311 – Basic Electrical

**Semester Credit Hours: 3**

**Lecture Hours per Week: 2**

**Lab Hours per Week: 4**

**Extended hours:**

**Contact Hours per Semester: 96**

**State Approval Code: 15.0403**

**Class section meeting time:**

**Instructional Goals and Purposes:** Explain terminology; select hardware components; predict PLC operation based on ladder logic diagrams; program a PLC to perform various control functions.

#### **Learning Outcomes:**

1. Define the four main units of a PLC.
2. List the factors to consider in the selection of a PLC.
3. Define and sketch the schematic symbol for the following. Temperature switch, pressure switch, liquid level switch, flow switch, float switch, foot switch, proximity switch.
4. List the rules for drawing relay logic diagrams.
5. Define NOT, AND, OR, NAND, NOR, XOR, XNOR.
6. List and define the two types of timer instructions.
7. List and define the three registers related to timer instructions.
8. List and define the two types of counters.
9. List and define the three registers related to timer instructions.

#### **Specific Course Objectives (includes SCANS):**

After studying all materials and resources presented in the course, the student will be able to:

1. **Define the four main units of a PLC.** (1 A-I, 1A-II, 1A-IV, 1B-III, 1B-IV, 1 C-I, 1C-IV, 2A-I, 2A-III, 2B-I, 2C-I, 2C- II, 2C-III, 2D-II, 2D-III, 2E-II)

- a. Define a central processing unit.
  - b. Describe the different types of memory devices.
  - c. Identify the plc power supply components.
2. **List the factors to consider in the selection of a PLC.** (1 A-I, 1A-ii, 1A-iv, 1B-iii, 1B-iv, 1 C-I, 1C-iv, 2A-I, 2A-iii, 2B-I, 2C-i, 2C- ii, 2C-iii, 2D-ii, 2D-iii, 2E-ii)
    - a. Identify a plc memory selection and expansion.
    - b. Describe the different communication systems in a PLC.
  3. **Define the following. Temperature switch, pressure switch, liquid level switch, flow switch, float switch, foot switch, proximity switch.** (1 A-I, 1A-ii, 1A-iv, 1B-iii, 1B-iv, 1 C-I, 1C-iv, 2A-I, 2A-iii, 2B-I, 2C-i, 2C- ii, 2C-iii, 2D-ii, 2D-iii, 2E-ii)
    - a. Identify the different types of switches.
    - b. Sketch the schematic symbols for the different types of switches
    - c. Define the operation of the different types of switches.
  4. **List the rules for drawing relay logic diagrams.** (1 A-I, 1A-ii, 1A-iv, 1B-iii, 1B-iv, 1 C-I, 1C-iv, 2A-I, 2A-iii, 2B-I, 2C-i, 2C- ii, 2C-iii, 2D-ii, 2D-iii, 2E-ii)
    - a. Define the construction of a relay logic diagram.
    - b. Define the rules for drawing a relay logic diagram.
    - c. Demonstrate the ability to properly draw a relay logic diagram.
  5. **Define NOT, AND, OR, NAND, NOR, XOR, XNOR.** (1 A-I, 1A-ii, 1A-iv, 1B-iii, 1B-iv, 1 C-I, 1C-iv, 2A-I, 2A-iii, 2B-I, 2C-i, 2C- ii, 2C-iii, 2D-ii, 2D-iii, 2E-ii)
    - a. Identify the seven logic gates in a PLC.
    - b. Describe the purpose of logic gate circuits.
    - c. Simplify a circuit using logic gates.
  6. **List and define the two types of timer instructions.** (1 A-I, 1A-ii, 1A-iv, 1B-iii, 1B-iv, 1 C-I, 1C-iv, 2A-I, 2A-iii, 2B-I, 2C-i, 2C- ii, 2C-iii, 2D-ii, 2D-iii, 2E-ii)
    - a. Define non-retentive on-delay timers.
    - b. Define retentive on-delay timers.
    - c. Define non- retentive off-delay timers.
    - d. Define retentive off-delay timers.
  7. **List and define the three bits related to timer instructions.** (1 A-I, 1A-ii, 1A-iv, 1B-iii, 1B-iv, 1 C-I, 1C-iv, 2A-I, 2A-iii, 2B-I, 2C-i, 2C- ii, 2C-iii, 2D-ii, 2D-iii, 2E-ii)
    - a. Define the enable bit.
    - b. Define the timer timing bit.
    - c. Define the done bit.
  8. **List and define the two types of counters.** (1 A-I, 1A-ii, 1A-iv, 1B-iii, 1B-iv, 1 C-I, 1C-iv, 2A-I, 2A-iii, 2B-I, 2C-i, 2C- ii, 2C-iii, 2D-ii, 2D-iii, 2E-ii)
    - a. Define non-retentive on-delay counters.
    - b. Define retentive on-delay counters.
    - c. Define non- retentive off-delay counters.
    - d. Define retentive off-delay counters.
  9. **List and define the three registers related to counter instructions.** (1 A-I, 1A-ii, 1A-iv, 1B-iii, 1B-iv, 1 C-I, 1C-iv, 2A-I, 2A-iii, 2B-I, 2C-i, 2C- ii, 2C-iii, 2D-ii, 2D-iii, 2E-ii)
    - a. Define the preset register
    - b. Define the accumulated register.
    - c. Define the status register.

- **Course Content:**

A general description of lecture/discussion topics included in this course are listed in the Learning Objectives / Specific Course Objectives sections of this syllabus.

Students in all sections of this course will be required to do the following:

1. Students will study assigned materials and complete quizzes and exams to assess understanding and comprehension.
2. Students will complete all lab assignments as scheduled and all students are required to wear Personal Protective Equipment (PPE) in the lab.

- **Methods of Instruction/Course Format/Delivery:**

Students in traditional, hybrid and Internet classes will have access to courses via Canvas. Students in the traditional class will meet regularly for lecture. Students in the Internet class will be required to take quizzes and exams at an approved testing facility or, they may also be administered by the instructor. Students in hybrid classes will have both in class and online assignments. Hybrid classes are required to read assigned material, take quizzes and exams as assigned by instructor, and complete assigned home work prior to meeting for the face to face labs. Resources for this course, provided through Canvas, include the following Sections in Canvas....

- Modules: Chapter study materials, self-assessment exercises, quizzes and exams
- Announcements and Recent Activities List: Instructor Announcements
- Inbox: Email (to communicate with instructor and classmates inside Canvas)
- Grades: Student grades
- Other sections, as assigned by the Instructor: Students in both the traditional and Internet classes should use the People feature within Canvas (includes Canvas Email) to communicate with the instructor. Using Canvas Email located in the "In Box" menu, gives the student access to the instructor and other classmates without having to remember or type email addresses; the student just selects a name from the list. The instructor will attempt to respond to all Canvas email within 24 hours. For example, if a student makes an appointment with the instructor through Canvas email to take an exam, the instructor will reply to the student's Canvas email – if the instructor does not reply within the time needed, call the instructor's at his or her office. Please, always include in the subject line of the Canvas email, the student's name, course number and course section number.

- **Major Assignments / Assessments:**

The following items will be assigned and assessed during the semester and used to calculate the student's final grade.

- Lab Exercises

Hands on lab exercises will be conducted with one or more students in a group, full participation and demonstration of the skill is required in order to pass the skill and move to the next.

- Exams

Multiple exams may be given during the semester with the final exam being cumulative in one or two parts, will assess the students various skills and may include lab exercises.

- Attendance

Students are expected to attend face to face classes and labs, and be on time. Students are also required to participate with other students during class exercises. Attendance is based on the student missing no more than 10% out of the semester without a valid excuse. After the 10% the instructor may withdraw the student at their discretion. Any student thirty or more minutes late will be counted absent. Students that leave before class is

- Quizzes

After working through the chapter or chapters and completing the assignments, the student will take online or paper quizzes over the chapters studied. Quizzes will generally contain True/False, Multiple Choice, Matching and/or Fill In-The-Blank questions.

- Lab Exercises

Weekly lab exercises and or assignments will be administered during face to fac meetings as assigned by instructor.

- **Course Grade:**

The grading scale for this course is as follows:

Category Percentage:

Exams = 40%

Quizzes = 30%

Lab Exercises = 20%

Attendance = 10%

- **Grading Notes:**

**Missed Exams:** Missed exams due to legitimate reasons should be taken prior to the reporting of mid-term or final grades as applicable. It is the responsibility of the student to reschedule the makeup with the instructor. The Instructor reserves the right to change the test format of any makeup. Instructors are not required to make up work for an unexcused class absence. The Instructor also reserves the right to give full or partial credit for any makeup work that is allowed and that resulted from an unexcused absence.

**Missed Quizzes:** Missed quizzes due to legitimate reasons should be rescheduled within one week of the scheduled quiz or a date assigned by the Instructor. It is the responsibility of the student to reschedule makeup quizzes. The Instructor reserves the right to change the test format of the makeup quiz. Instructor is not required to make up work for unexcused class absences. Instructor reserves the right to give full or partial credit for any make up work that is allowed and that resulted from an unexcused absence.

**Attendance:** Attendance is based on the student missing no more than 10% out of the semester without a valid excuse. After the 10% the instructor may withdraw the student at their discretion. Any student thirty or more minutes late will be counted absent. Students that leave before class is dismissed will be counted absent. The Instructor reserves the right to dock points for any missed class without a legitimate excuse.

**Missed Lab Exercises:** Students will have one day out of the semester assigned by the instructor to make up any lab exercises missed due to the student being absent for legitimate reasons. Instructors are not required to make up work for unexcused class absences. Instructors reserve the right to give full or partial credit for makeup work that is given because of unexcused absences.

**Plagiarism:** Plagiarism shall be defined as appropriating, buying, receiving as a gift or obtaining by any other means, another person's work and the unacknowledged submission or incorporation of it in one's own written work. All papers submitted to Canvas will be scanned with *turnitin.com* and the instructor reserves the right to dock points based on the results.

**Cheating:** Cheating on a test shall include:

- a. Copying from another student's test
- b. Using test materials not authorized by the person administering the test
- c. Collaborating with or seeking aid from another student during a test without permission from the test administrator
- d. Knowingly using, buying, selling, stealing, or soliciting, in whole or in part, the contents of an unadministered test.
- e. The unauthorized transporting or removal, in whole or in part, of the contents of the unadministered test.
- f. Substituting for another student, or permitting another student to substitute for one's self, to take a test.

g. Bribing another person to obtain an unadministered test or information about an unadministered test Absolutely no cheating is tolerated.

h. If a student is observed cheating they will be sent home immediately counted absent and given a zero on the assignment they were cheating on.

Safety: All students are required in lab exercises to bring and wear the proper PPE as instructed by your instructor. Failure to do so will result in one warning; if a student continues to violate safety rules the student will be sent home and counted absent.

Class Conduct: All cell phones should be turned off in all classes. If you must receive a call notify your instructor and step out of the classroom. No cell phones are allowed during testing. No disruptive behaviour is allowed in class; if a student is being disruptive as determined by the instructor one warning will be given. If behavior persists student will be sent home and counted absent.

Grading Scale A=90-100, B=80-89, C=70-79, D=60-69, F=69 and below

**Texts, Materials, and Supplies:**

- ***PROGRAMMABLE LOGIC CONTROLLERS 3rd Edition***
- Notepad

**Required Readings:**

- ***PROGRAMMABLE LOGIC CONTROLLERS 3rd Edition***

**Recommended Readings:**

- none

**Other:**

- For current texts and materials, use the following link to access bookstore listings: <http://www.panolacollegestore.com>
- For testing services, use the following link: <http://www.panola.edu/elearning/testing.html>
- If any student in this class has special classroom or testing needs because of a physical learning or emotional condition, please contact the ADA Student Coordinator in Support Services located in the Administration Building or go to <http://www.panola.edu/student-success/disability-support-services/> for more information.
- Withdrawing from a course is the student's responsibility. Students who do not attend class and who do not withdraw will receive the grade earned for the course.
- Student Handbook, *The Pathfinder*: <http://www.panola.edu/student-success/documents/pathfinder.pdf>

## SCANS CRITERIA

### 1) Foundation skills are defined in three areas: basic skills, thinking skills, and personal qualities.

- a) **Basic Skills:** A worker must read, write, perform arithmetic and mathematical operations, listen, and speak effectively. These skills include:
  - i) Reading: locate, understand, and interpret written information in prose and in documents such as manuals, graphs, and schedules.
  - ii) Writing: communicate thoughts, ideas, information, and messages in writing, and create documents such as letters, directions, manuals, reports, graphs, and flow charts.
  - iii) Arithmetic and Mathematical Operations: perform basic computations and approach practical problems by choosing appropriately from a variety of mathematical techniques.
  - iv) Listening: receive, attend to, interpret, and respond to verbal messages and other cues.
  - v) Speaking: Organize ideas and communicate orally.
- b) **Thinking Skills:** A worker must think creatively, make decisions, solve problems, visualize, know how to learn, and reason effectively. These skills include:
  - i) Creative Thinking: generate new ideas.
  - ii) Decision Making: specify goals and constraints, generate alternatives, consider risks, and evaluate and choose the best alternative.
  - iii) Problem Solving: recognize problems and devise and implement plan of action.
  - iv) Visualize ("Seeing Things in the Mind's Eye"): organize and process symbols, pictures, graphs, objects, and other information.
  - v) Knowing How to Learn: use efficient learning techniques to acquire and apply new knowledge and skills.
  - vi) Reasoning: discover a rule or principle underlying the relationship between two or more objects and apply it when solving a problem.
- c) **Personal Qualities:** A worker must display responsibility, self-esteem, sociability, self-management, integrity, and honesty.
  - i) Responsibility: exert a high level of effort and persevere toward goal attainment.
  - ii) Self-Esteem: believe in one's own self-worth and maintain a positive view of oneself.
  - iii) Sociability: demonstrate understanding, friendliness, adaptability, empathy, and politeness in group settings.
  - iv) Self-Management: assess oneself accurately, set personal goals, monitor progress, and exhibit self-control.
  - v) Integrity and Honesty: choose ethical courses of action.

### 2) Workplace competencies are defined in five areas: resources, interpersonal skills, information, systems, and technology.

- a) **Resources:** A worker must identify, organize, plan, and allocate resources effectively.
  - i) Time: select goal-relevant activities, rank them, allocate time, and prepare and follow schedules.
  - ii) Money: Use or prepare budgets, make forecasts, keep records, and make adjustments to meet objectives.
  - iii) Material and Facilities: Acquire, store, allocate, and use materials or space efficiently.  
Examples: construct a decision time line chart; use computer software to plan a project; prepare a budget; conduct a cost/benefits analysis; design an RFP process; write a job description; develop a staffing plan.
- b) **Interpersonal Skills:** A worker must work with others effectively.
  - i) Participate as a Member of a Team: contribute to group effort.

- ii) Teach Others New Skills.
- iii) Serve Clients/Customers: work to satisfy customer's expectations.
- iv) Exercise Leadership: communicate ideas to justify position, persuade and convince others, responsibly challenge existing procedures and policies.
- v) Negotiate: work toward agreements involving exchange of resources, resolve divergent interests.
- vi) Work with Diversity: work well with men and women from diverse backgrounds.

Examples: collaborate with a group member to solve a problem; work through a group conflict situation, train a colleague; deal with a dissatisfied customer in person; select and use appropriate leadership styles; use effective delegation techniques; conduct an individual or team negotiation; demonstrate an understanding of how people from different cultural backgrounds might behave in various situations.

c) **Information:** A worker must be able to acquire and use information.

- i) Acquire and Evaluate Information.
- ii) Organize and Maintain Information.
- iii) Interpret and Communicate Information.
- iv) Use Computers to Process Information.

Examples: research and collect data from various sources; develop a form to collect data; develop an inventory record-keeping system; produce a report using graphics; make an oral presentation using various media; use on-line computer data bases to research a report; use a computer spreadsheet to develop a budget.

d) **Systems:** A worker must understand complex interrelationships.

- i) Understand Systems: know how social, organizational, and technological systems work and operate effectively with them.
- ii) Monitor and Correct Performance: distinguish trends, predict impacts on system operations, diagnose deviations in systems' performance and correct malfunctions.
- iii) Improve or Design Systems: suggest modifications to existing systems and develop new or alternative systems to improve performance.

Examples: draw and interpret an organizational chart; develop a monitoring process; choose a situation needing improvement, break it down, examine it, propose an improvement, and implement it.

e) **Technology:** A worker must be able to work with a variety of technologies.

- i) Select Technology: choose procedures, tools or equipment including computers and related technologies.
- ii) Apply Technologies to Task: understand overall intent and proper procedures for setup and operation of equipment.
- iii) Maintain and Troubleshoot Equipment: Prevent, identify, or solve problems with equipment, including computers and other technologies.

Examples: read equipment descriptions and technical specifications to select equipment to meet needs; set up and assemble appropriate equipment from instructions; read and follow directions for troubleshooting and repairing equipment.