

**ITT Technical Institute**

**ET345T**

**Control Systems**

**Onsite Course**

# **SYLLABUS**

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**Credit hours:** 4

**Contact/Instructional hours:** 60 (36 Theory Hours, 24 Lab Hours)

**Prerequisite(s) and/or Corequisite(s):**

Prerequisites: ET285T Digital Electronics II

**Course Description:**

Students examine the control of systems with programmable units. Applying digital logic to control industrial processes is emphasized.



# STUDENT SYLLABUS

Instructor: \_\_\_\_\_

Office hours: \_\_\_\_\_

Class hours: \_\_\_\_\_

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## Major Instructional Areas

- PLC Hardware Components
- PLC Programming
- Fundamentals of Logic
- Developing Fundamental PLC Wiring Diagrams and Ladder Logic Programs
- Programming Timers and Counters
- Program Control Instructions
- Data Manipulation and Math Instructions
- Sequencer and Shift Register Instructions
- PLC Installation Practices, Editing, and Troubleshooting

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## Course Objectives

Upon successful completion of this course, the student should be able to:

1. Differentiate between conventional hard-wired relay systems and PLC controlled systems.
2. Describe the operation of a PLC system.
3. Explain I/O Addressing and corresponding file image tables.
4. List and describe the components of a PLC system, specifically the Allen Bradley SLC 500/02.
5. Describe the PLC scan sequence and PLC operating modes.
6. Create correct ladder logic programs.
7. Interpret relay ladder schematics and convert to ladder logic diagrams.
8. Identify sensors, actuators, and controls used in PLC systems.
9. Explain the operation of timers and counters in PLC systems.
10. Use PLC timers and counters with associated circuitry to control a system.
11. Explain the methods used for program control in a PLC system.
12. Differentiate between data manipulation methods and explain purposes of data instructions.
13. Differentiate between word and file operations.
14. Explain the operation of sequencers and shift-registers in PLC systems.
15. Use PLC sequencers and shift-registers with associated circuitry to control a system.
16. Identify electrical and safety requirements to install and interface a PLC system.
17. Describe proper preventive maintenance and troubleshooting procedures.
18. Design and implement a final lab project that reflects the culmination of skills learned in this course.

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## Teaching Strategies

Students examine the control of systems with programmable logic control units. Applying digital logic to control industrial processes is emphasized. A lab project in laboratory provides the students with the opportunity to apply knowledge of industrial systems gained in this course.

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## Student Textbook and Materials

*Programmable Logic Controllers, 4th ed. Frank D. Petruzella, McGraw-Hill*

*Programmable Logic Controllers Activities Manual, 4th ed. Frank D. Petruzella, McGraw-Hill*

*Lab Manual with LogixPro PLC Simulator for Programmable Logic Controllers, 4th ed. Frank D. Petruzella, McGraw-Hill*

## Course Outline

| Unit | Topic (Lecture Period)   | Chapters         | Lab and Other Coverage   |
|------|--|------------------|--|
| 1    | PLCs: An Overview<br>PLC Hardware Components<br>Number Systems & Codes:<br>REVIEW  | 1<br>2<br>3      | Homework<br>Lab & Project  |
| 2    | Basics of PLC Programming<br>Fundamentals of Logic<br>Process Control: Types of<br>Processes                                   | 5<br>4<br>14-1   | Homework<br>Lab & Project  |
| 3    | Developing Fundamental PLC<br>Wiring Diagrams and Ladder Logic<br>Programs<br>Process Control: Structure of<br>Control Systems | 6<br>14-2        | Homework<br>Lab & Project  |
| 4    | Programming Timers<br>Process Control: On/Off Control  | 7<br>14-3        | Unit Exam I- Units 1, 2 & 3<br>Homework<br>Lab & Project                           |
| 5    | Programming Counters<br>Process Control: PID Control   | 8<br>14-4        | Homework<br>Lab & Project  |
| 6    | Program Control Instructions<br>Process Control: Motion Control  | 9<br>4-7<br>14-5 | Homework<br>Lab & Project  |
| 7    | Data Manipulation Instructions<br>Process Control: Data<br>Communication- Hardware   | 10<br>14-6       | Unit Exam II- Units 4, 5 &<br>6<br>Homework<br>Lab & Project                       |
| 8    | Math Instructions<br>Process Control: Data<br>Communication- Protocol  | 11<br>14-6       | Homework<br>Lab & Project  |
| 9    | Sequencer and Shift Register<br>Instructions<br>Process Control: SCADA   | 12<br>14-7       | Homework<br>Lab & Project  |
| 10   | PLC Installation and<br>Troubleshooting  | 13               | Unit Exam III- Units 7, 8, &<br>9<br>Homework<br>Lab & Project                     |
| 11   | Review and Final Examination   |                  | The final examination will<br>be based on the content<br>covered in chapters 1-13. |

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## Evaluation Criteria and Grade Weights

|                   |     |
|-------------------|-----|
| Quizzes           | 10% |
| Homework          | 20% |
| Exams             | 15% |
| Lab exercises     | 20% |
| Final exam        | 15% |
| Final Lab Project | 20% |

Final grades will be calculated from the percentages earned in class as follows:

|    |           |     |
|----|-----------|-----|
| A  | 90 - 100% | 4.0 |
| B+ | 85 - 89%  | 3.5 |
| B  | 80 - 84%  | 3.0 |
| C+ | 75 - 79%  | 2.5 |
| C  | 70 - 74%  | 2.0 |
| D+ | 65 - 69%  | 1.5 |
| D  | 60 - 64%  | 1.0 |
| F  | <60%      | 0.0 |

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## Final Lab Project

### Final Lab Project:

Is worth 20% of your final grade

Is a program project that demonstrates industrial systems control competence.

Is a team effort, with a maximum team size established by the instructor.

Approved by the Instructor and Program Chair

### Requirement

The final lab project must be a system controlled by the PLC.

The minimum requirement of the electronics system is as follows:

1 signal input

1 user controlled input

1 signal output

1 user controlled output

System level process that demonstrates integrates an industrial process with PLC control

1. Implement a functioning system.
2. Detailed documentation must be provided. (schematic and theory of operation)
3. Project management plan that is correctly tracked. (MS Project or format approved by the instructor)
4. Must look be professionally dressed for the presentation. (you are selling yourself via this project)
5. You will present your project in a formal presentation, an appropriate presentation is expected.

### Grading

|          |  |
|----------|--|
| <b>F</b> | Does not meet the requirement  |
| <b>D</b> | Does meet the requirement  |
| <b>C</b> | A Portfolio entry for the lab project and a report on an associated industrial system.           |
| <b>B</b> | Demonstrates the ability to use DC and AC input and output devices.                              |
| <b>A</b> | Demonstrates the ability to integrate an analog to digital or digital to analog input or output. |

### Milestones

Week 2- Written Proposal that describes operation of your system.

Week 3- MS Project plan laying out the required steps, due dates, etc.

Week 4- Functional technical description of the system with block diagram

Week 5- Component list with I/O schematic

Week 6- Review of work completed to date

Week 7- See what is working

Week 8- See what is working

Week 9- Practice demo, see what is working

Week 10- Practice presentation

Week 11- Final presentation