Programmable Controllers

EET 2920

Class Hours: 0.0
Laboratory Hours: 4.0
Credit Hours: 2.0
Revised: Spring 04

NOTE: This course is not intended for transfer credit.

Catalog Course Description:

An introductory course in programmable logic controllers (PLC’s) and basic applications in which they are used. Topics include an overview of PLC’s, PLC hardware components, basics of PLC programming, development of fundamental PLC wiring diagrams and ladder programs, programming timers and counters, advanced programming techniques, and PLC control of motors and processes.

Entry Level Standards:

The student must have knowledge of basic DC and AC circuits, and digital fundamentals.

Prerequisite:

EET 1010

Textbook(s) and Other Reference Materials Basic to the Course:

Programmable Logic Controllers, Petruzella, Frank D., Glencoe/McGraw-Hill.

Instructor’s Course Notes: Available to purchase at the Copy Center.

I. Week/Unit/Topic Basis:

The following is intended as a guide to the instructor. The material covered in the course may be changed by the instructor depending upon the progress, etc., of the class.

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>An overview of programmable logic controllers (PLC’s); overview of number systems; fundamentals of logic</td>
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<tr>
<td>2</td>
<td>PLC hardware components</td>
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<tr>
<td>3</td>
<td>Wiring diagrams, ladder diagrams, and basic PLC programming software on a personal computer</td>
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<tr>
<td>4</td>
<td>Discrete programming PLCs; constructing PLC programs with programming software</td>
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</tbody>
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on a personal computer
5   Testing, debugging, and saving programs with programming software
6   Documenting programs and integrating program segments with programming software
7   Programming start/stop circuits
8   Programming simple counting and timing events
9   Tracking parts on assembly lines
10  Programming time-driven sequencer circuits
11  Advanced programming
12  Advanced programming continued
13  Machine and process control with PLC's (applications)
14  Machine and process control with PLC’s continued
15  Machine and process control with PLC’s continued
16  FINAL EXAM

II. Course Objectives*:

A. Understand the hardware components of a PLC and understand the basic principles of operation of a PLC. I, II, III
B. Develop wiring diagrams and ladder diagrams. I, II, III, IV
C. Generate PLC programs using applications software on a personal computer (PC), save the program to disks, and download the program(s) to a PLC. I, II, III, IV, V
D. Utilize advanced programming techniques in conjunction with programming software on a PC to program a PLC. I, II, III, IV, V
E. Use a PLC in machine and process control, such as controlling motor speed. I, II, III, IV, V, VI
F. Demonstrate, as an individual and as a team member, library/information skills, time-management skills, problem-solving skills, material management skills, and communication skills. I, IV, V, VI

*Roman numerals after course objectives reference goals of the EET program.

III. Instructional Processes*:

Students will:

1. Participate in classroom discussions which challenge their abilities to think creatively and visualize complex spatial and mathematical relationships to solve problems. Problem Solving and Decision Making Outcome
2. Work in teams to conduct laboratory experiments and also to solve special problem
assignments. These activities are designed to foster interpersonal skills in teamwork and
develop and enhance leadership skills, students' abilities to express ideas, and students'
abilities to reach consensus solutions for the team through negotiation. *Active Learning
Strategy, Problem Solving and Decision Making Outcome, Personal Development Outcome*

3. Use electronic test equipment to test electrical circuits constructed from schematics in the
laboratory and acquire data. Use computers with applications software to simulate, analyze,
and predict the behavior of electrical circuits. Compare expected responses to experimental
responses of electrical circuits. Use the Internet for special assignments such as locating
data sheets on electronic components. Use computers with word processing software to
prepare reports. *Technological Literacy Outcome, Information Literacy Outcome,
Numerical Literacy Outcome*

4. Prepare reports on laboratory experiments which include methodology, mathematical
analyses of electrical circuit models, a comprehensive comparison of calculated results
with experimental results, and conclusions. *Communication Outcome, Numerical Literacy Outcome*

5. Discuss the importance of personal qualities such as personal responsibility, time
management principles, self-esteem, sociability, self-management, integrity and honesty in
school and in the workplace, and dynamics of change in the workplace. *Personal
Development Outcome, Cultural Diversity and social Adaptation Outcome, Transitional
Strategy*

*Strategies and outcomes listed after instructional processes reference Pellissippi State’s goals for
strengthening general education knowledge and skills, connecting coursework to experiences beyond the
classroom, and encouraging students to take active and responsible roles in the educational process.

**IV. Expectations for Student Performance**: 

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

1. Identify the basic components of a PLC. A
2. Develop a PLC block diagram. A
3. Explain the purpose and function of input/output assemblies, the central processor unit,
power supply, and programming device. A
4. Identify the functions of electromagnetic control relays. B
5. Identify the switches commonly found in PLC’s. B
6. Describe the operation of an electromagnetic latching relay and the PLC-programmed
LATCH/UNLATCH instruction. B
7. Compare sequential and combination control processes. A, B
8. Convert fundamental relay ladder diagrams to PLC logic ladder diagrams. B
9. Generate a flow chart. C
10. Access the programming software ladder display on a PC. C
11. Enter and edit control programs using programming software on a PC. C
12. Insert rungs and element on the programming software on a PC. C
13. Copy, move, delete, and merge rungs of relay ladder logic on the programming software on a PC. C
14. Test and debug programs with the programming software on a PC. C
15. Save PLC programs (generated on a PC) on disk and on EPROM. C
16. Document and print PLC programs using programming software on a PC. C
17. Integrate PLC program segments using programming software on a PC. C
18. Program start/stop circuits for a PLC. C
19. Program simple counting and timing events for a PLC. C, D
20. Program a PLC to track parts on assembly lines. C, D
21. Program a PLC to manipulate time-driven sequencer. C, D, E
22. Use advanced programming techniques as a tool to simplify RLL code. C, D, E, F
23. Control the speed of a DC or AC motor using a PLC and interfaces. C, D, E
24. Acquire technical information from various media in the Educational Resource Center or elsewhere. F
25. Function as an effective team member in the lab or in classroom team assignments. F
26. Prepare a technical report. F

*Letters after performance expectations reference the course objectives listed above.

V. Evaluation:

A. Testing Procedures: 80% of grade

Evaluation in the course will consists of a combination of at least three one-hours exams, at least six, pop quizzes of 5 to 10 minutes duration each, one two-hour final comprehensive exam, homework, and laboratory work. The percentage that each of these factors count toward the grade for the course is left to the discretion of the instructor. Correct usage of English is necessary (on tests, laboratory reports, or any other documents submitted to the instructor), and will be evaluated.

Exams 50%
Pop quizzes 5%
Homework 5%
Final exam 20%

B. Laboratory Expectations: 20% of grade

Laboratory topics may vary at the discretion of the instructor, but will be related in a timely manner to the course work. Lab reports will include a computer printout of programs completed and tested on a PLC simulator panel. The lab reports will include an analysis of the lab assignment and must be prepared with the use of a computer. English usage will be evaluated. Students must attend the laboratory sessions to successfully complete the course. The following list of topics is suggested for inclusion in the lab work:

A. Use of wiring diagrams and ladder diagrams in writing basic PLC programs
B. Programming the PLC with programming software on a PC
C. Testing, debugging and saving programs with programming software
D. Documenting programs and integrating program segments with programming software
E. Programming start/stop circuits
F. Programming counting and timing events
G. Programming time-driven sequencer circuits
H. Advanced programming techniques
I. Special problem - Tracking parts on an assembly line
J. Special problem - Motor speed control with a PLC

C. Field Work:

N/A

D. Other Evaluation Methods:

N/A

E. Grading Scale:

<table>
<thead>
<tr>
<th>Score Range</th>
<th>Grade</th>
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<tbody>
<tr>
<td>93-100</td>
<td>A</td>
</tr>
<tr>
<td>88-92</td>
<td>B+</td>
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<tr>
<td>83-87</td>
<td>B</td>
</tr>
<tr>
<td>78-82</td>
<td>C+</td>
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<tr>
<td>70-77</td>
<td>C</td>
</tr>
<tr>
<td>60-69</td>
<td>D</td>
</tr>
<tr>
<td>Below 60</td>
<td>F</td>
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VI. Policies:

A. Attendance Policy:

Pellissippi State Technical Community College expects students to attend all scheduled instructional activities. As a minimum, students in all courses must be present for at least 75% of their scheduled class and laboratory meetings in order to receive credit for the course. Individual departments/programs/disciplines, with the approval of the vice president of Academic and Student Affairs, may have requirements that are more stringent. Attendance is required to all lab sessions unless excused by the instructor. Students missing more than four unexcused sessions will receive an "F" and no credit will be received. Students tardy past half an hour will be considered absent.

B. Other Policies:

The student is encouraged to read the regulations for student conduct in the PSTCC Catalog and Handbook.