COURSE OUTLINE

DIVISION: Workforce Development

COURSE: ELE 1204; Programmable Logic Controllers I

Date: Spring 2013

Credit Hours: 3.0

Prerequisite(s): ELE 1200 or ELT 1204

Delivery Method:
- Lecture 2 Contact Hours (1 contact = 1 credit hour)
- Lab 2 Contact Hours (2 contact = 1 credit hour)

Offered: Fall Spring Summer

IAI Equivalent – Only for Transfer Courses go to http://www.itransfer.org:

CATALOG DESCRIPTION:
This course introduces students to Programmable Logic Controllers (PLCs). Course content includes: PLC logic concepts, basic PLC programming, and PLC hardware components and their installation, application, and maintenance. Troubleshooting techniques will be emphasized throughout this course.
GENERAL EDUCATION GOALS ADDRESSED

[See the last page of this form for more information.]

Upon completion of the course, the student will be able:

[Choose those goals that apply to this course.]

☒ To apply analytical and problem solving skills to personal, social and professional issues and situations.
☒ To communicate orally and in writing, socially and interpersonally.
☒ To develop an awareness of the contributions made to civilization by the diverse cultures of the world.
☒ To understand and use contemporary technology effectively and to understand its impact on the individual and society.
☒ To work and study effectively both individually and in collaboration with others.
☒ To understand what it means to act ethically and responsibly as an individual in one’s career and as a member of society.
☒ To develop and maintain a healthy lifestyle physically, mentally, and spiritually.
☒ To appreciate the ongoing values of learning, self-improvement, and career planning.

EXPECTED LEARNING OUTCOMES AND RELATED COMPETENCIES:

[Outcomes related to course specific goals.]

Upon completion of the course, the student will be able to:

1. Explain Programmable Controller uses, advantages, and components.
   Competency 1.1. State why use PLC’s at all.
   Competency 1.2. Explain advantages to using.
   Competency 1.3. Calculate monetary advantages to PLC use over Relay Logic.
   Competency 1.4. Correctly Identify and state uses for each component of a PLC system.
   Competency 1.5. Initialize a PLC.

2. Understand differences in Programmable Controller CPU and numbering systems.
   Competency 2.1. Define types of memory.
   Competency 2.2. Tell when each type of memory could and should be used.
   Competency 2.3. Choose the appropriate processor for the PLC application.
   Competency 2.4. Convert between decimal, octal, hex, binary and BCD numbers.

3. Use the correct I/O Systems.
   Competency 3.1. Identify Input and output modules.
   Competency 3.2. State uses for each module.
   Competency 3.3. Correctly use modules in a lab setting.
   Competency 3.4. Swap modules in an approved manner.

   Competency 4.1. Define swart and dumb terminals.
   Competency 4.2. State different types of programming devices.
   Competency 4.3. Choose the appropriate terminal for a system.
5. Design Installation and Maintenance procedures for a PLC system.
   Competency 5.1. Choose the correct system for a job.
   Competency 5.2. Choose the correct wiring for the system.
   Competency 5.3. Troubleshoot some common problems.
   Competency 5.4. Develop a maintenance checklist.
   Competency 5.5. Correctly enter and run a program.

6. Read Relay Logic and Ladder Logic Programs.
   Competency 6.1. Correctly interpret relay symbols
   Competency 6.2. Use relay symbols to develop a simple program.
   Competency 6.3. Correctly interpret ladder logic symbols
   Competency 6.4. Convert a relay logic program into a ladder logic program.

7. Utilize Timers and Counters.
   Competency 7.1. Define timers and counters.
   Competency 7.2. Show uses for counters and timers.
   Competency 7.3. Enter programs using counters and timers
   Competency 7.4. Edit programs using counters and timers.
   Competency 7.5. Correctly use ONE SHOTS.

8. Correctly use MCR’s, ZCL’s, and Jump Instructions.
   Competency 8.1. Enter programs using MCR, ZCL and Jump instructions.
   Competency 8.2. Explain PLC actions in a file control program.
   Competency 8.3. Use the jump subroutine commands.
   Competency 8.4. Use and explain uses for each command.

COURSE TOPICS AND CONTENT REQUIREMENTS:
1) An overview
   a) PLC’s
   b) Parts of a PLC
   c) Principles of operation
   d) PLC Application
2) PLC Hardware
   a) Discrete I/O
   b) Analog I/O
   c) I/O Specifications
   d) The CPU
   e) Memory types
   f) Programming devices
3) Number Systems
   a) Decimal
   b) Binary
   c) Octal
   d) Hexadecimal
   e) BCD
   f) Encoding and Decoding
4) Fundamentals of Logic
   a) The binary concept
   b) Logic Gates
c) Boolean Algebra  
d) Hard-wired logic verses Soft logic  
e) Programming  

5) PLC Programming  
a) Memory organization  
b) Scan times  
c) Languages  
d) Relay instructions  
e) Addressing  
f) Branching  
g) Internal relays  
h) Ladder logic  
i) Entering a program  
j) Modes of operation  

6) PLC Installation and Maintenance  
a) Enclosures  
b) Noise and Surges  
c) Grounding  
d) Editing and monitoring  
e) Troubleshooting and Maintenance  

7) Wiring diagrams  
a) Relays  
b) Starters  
c) Seal-in circuits  
d) Latching circuits  
e) Circuit Conversion  

8) Programming Timers  
a) Timer instructions  
b) Time on delay  
c) Time off delay  
d) Retentive timers  
e) Timer bits  
f) Cascading timers  

9) Programming Counters  
a) Counter instructions  
b) Up-counter  
c) Down-counter  
d) Cascading counters  
e) Combining timers and counters  
f) One shots  

10) Program Control  
a) Jumps  
b) Jump subroutines
c) Forcing  
d) Faults  
e) Master control resets  
11) Zone control

**INSTRUCTIONAL METHODS:**  
Laboratory work  
Demonstrations  
Lecture - discussion  
Reading assignments  
Homework  
Quizzes  
Tests  
Socratic method

**INSTRUCTIONAL MATERIALS:**  
Text: Programmable Logic Controllers. Petruzella  
Allen-Bradley SLC-500 Trainers  
Rockwell Automation Software (Windows NT)  
Pics for DH-485

**STUDENT REQUIREMENTS AND METHODS OF EVALUATION:**  
The student must meet the objectives of the course stated previously.  
Laboratory reports must be completed as directed and receive an evaluation for accuracy of 70% or more using criteria set forth in the laboratory directions.

<table>
<thead>
<tr>
<th>Required assignments:</th>
<th>Methods of Evaluation:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mandatory lab attendance</td>
<td>A students’ grade will be based on multiple measures of performance:</td>
</tr>
<tr>
<td>Weekly lab assignments</td>
<td></td>
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<tr>
<td>Short quizzes</td>
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<tr>
<td>Assigned reading</td>
<td>Completion of lab assignments</td>
</tr>
<tr>
<td>Assigned homework</td>
<td>Quizzes based on lab and text assignments</td>
</tr>
<tr>
<td>Midterm exams</td>
<td></td>
</tr>
<tr>
<td>Lab practical exams</td>
<td>Completion of homework assignments</td>
</tr>
<tr>
<td>Final exam</td>
<td>Midterm, final, and lab final exams</td>
</tr>
<tr>
<td>Tests</td>
<td></td>
</tr>
</tbody>
</table>

90% - 100% A  
80% - 89.9% B  
70% - 79.9% C  
60% - 69.9% D  
below 60% F
OTHER REFERENCES
Allen-Bradley Manuals
Rockwell Automation Manuals

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Course Competency/Assessment Methods Matrix

<table>
<thead>
<tr>
<th>ELE 1204; Programmable Logic Controllers I</th>
<th>Assessment Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>For each competency(outcome) place an “X” below the method of assessment to be used.</td>
<td></td>
</tr>
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</table>

| Assessment Measures – Are direct or indirect as indicated. List competencies(outcomes) below. | Direct/Indirect | Article Review | Case Studies | Group Projects | Lab Work | Pre/Post Tests | Quizzes | Written Exams | Artif Self Reflection | Growth | Capstone Projects | Course Embedded Questions | Multi-Media Projects | Observation | Writing Samples | Portfolio Evaluation | Real World Projects | Reflective Journals | Applied Application skills Test | Oral Exit Interviews | Accreditation Reviews/Reports | Advisory Council Feedback | Employ Surveys | Graduate Surveys | Internship/Practicum/Site Supervisor Evaluation | In Class Feedback | Simulation | Interview | Written Report | Assignment |
|-----------------------------------------------|-----------------|----------------|--------------|---------------|----------|----------------|--------|----------------|------------------------|--------|----------------|------------------------|----------------------|-------------|-----------------|------------------------|---------------------|----------------------|------------------------|-----------------|-----------------|------------------------|-----------------|-------------|-----------|-------------|-------------|
| Competency 1.1. State why use PLC’s at all.     | D               | D              | D            | D             | D        | D              | X      | D              | X                      |       | D              | X                      | X                    | X           | X               | D                      | X                   | X                    | X                      | X               | X               | X                      | X               | X           | X          | X           | X           |
| Competency 1.2. Explain advantages to using.   | D               | D              | D            | D             | D        | D              |        | D              | X                      |       | D              | X                      | X                    | X           | X               | X                      | X                   | X                    | X                      | X               | X               | X                      | X               | X           | X          | X           | X           |
| Competency 1.3. Calculate monetary advantages to PLC use over Relay Logic. | D               | D              | D            | D             | D        | D              |        | D              | X                      |       | D              | X                      | X                    | X           | X               | X                      | X                   | X                    | X                      | X               | X               | X                      | X               | X           | X          | X           | X           |
| Competency 1.4. Correctly Identify and state uses for each component of a PLC system. | D               | D              | D            | D             | D        | D              |        | D              | X                      |       | D              | X                      | X                    | X           | X               | X                      | X                   | X                    | X                      | X               | X               | X                      | X               | X           | X          | X           | X           |
| Competency 1.5. Initialize a PLC.              |                |                |              |               |          |                | X      |                | X                      |       |                | X                      | X                    | X           | X               | X                      | X                   | X                    | X                      | X               | X               | X                      | X               | X           | X          | X           | X           |
| Competency 2.1. Define types of memory.        |                |                |              |               |          |                |        |                | X                      |       |                | X                      | X                    | X           | X               | X                      | X                   | X                    | X                      | X               | X               | X                      | X               | X           | X          | X           | X           |
| Competency 2.2. Tell when each type of memory could and should be used. |                |                |              |               |          |                |        |                | X                      |       |                | X                      | X                    | X           | X               | X                      | X                   | X                    | X                      | X               | X               | X                      | X               | X           | X          | X           | X           |
| Competency 2.3. Choose the appropriate processor for the PLC application. |                |                |              |               |          |                |        |                | X                      |       |                | X                      | X                    | X           | X               | X                      | X                   | X                    | X                      | X               | X               | X                      | X               | X           | X          | X           | X           |
### ELE 1204; Programmable Logic Controllers I

For each competency/outcome place an "X" below the method of assessment to be used.

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<td>Competency 2.4. Convert between decimal, octal, hex, binary and BCD numbers.</td>
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### Assessment Options

For each competency/outcome place an “X” below the method of assessment to be used.

| Competency 5.2. Choose the correct wiring for the system. | D | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Competency 5.3. Troubleshoot some common problems. | D | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Competency 5.4. Develop a maintenance checklist. | D | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Competency 5.5. Correctly enter and run a program. | D | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Competency 6.1. Correctly interpret relay symbols | D | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Competency 6.2. Use relay symbols to develop a simple program. | D | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Competency 6.3. Correctly interpret ladder logic symbols | D | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Competency 6.4. Convert a relay logic program into a ladder logic program. | D | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Competency 7.1. Define timers and counters. | D | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Competency 7.2. Show uses for counters and timers. | D | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
**ELE 1204; Programmable Logic Controllers I**

For each competency/outcome place an “X” below the method of assessment to be used.

| Assessment Measures – Are direct or indirect as indicated. List competencies/outcomes below. | Direct/Indirect | Assessment of Student Learning | Assessment Options |
| Competency 7.4. Edit programs using counters and timers. | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| Competency 7.5. Correctly use ONE SHOTS. | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| Competency 8.1. Enter programs using MCR, ZCL and Jump instructions. | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| Competency 8.2. Explain PLC actions in a file control program. | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| Competency 8.3. Use the jump subroutine commands. | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| Competency 8.4. Use and explain uses for each command. | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |