***ILLINOIS VALLEY COMMUNITY COLLEGE***



## COURSE OUTLINE

**DIVISION: Workforce Development**

**COURSE: ELE 1204; Programmable Logic Controllers I**

Date: Spring 2013

Instructor: Tim Bias

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Credit Hours:  3.0

Prerequisite(s): ELE 1200 or ELT 1204

Delivery Method: **[x]  Lecture** **2 Contact Hours (1 contact = 1 credit hour)**

[ ]  **Seminar Contact Hours (1 contact = 1 credit hour)**

[x]  **Lab 2 Contact Hours (2 contact = 1 credit hour)**

[ ]  **Clinical Contact Hours (3 contact = 1 credit hour)**

**[ ]  Online**

**[ ]  Blended**

Offered: [x]  **Fall** **[x]  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.]

[x]  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.

[x]  To understand and use contemporary technology effectively and to

 understand its impact on the individual and society.

[x]  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.

[x]  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.
	1. State why use PLC’s at all.
	2. Explain advantages to using.
	3. Calculate monetary advantages to PLC use over Relay Logic.
	4. Correctly Identify and state uses for each component of a PLC system.
	5. Initialize a PLC.
2. Understand differences in Programmable Controller CPU and numbering systems.
	1. Define types of memory.
	2. Tell when each type of memory could and should be used.
	3. Choose the appropriate processor for the PLC application.
	4. Convert between decimal, octal, hex, binary and BCD numbers.
3. Use the correct I/O Systems.
	1. Identify Input and output modules.
	2. State uses for each module.
	3. Correctly use modules in a lab setting.
	4. Swap modules in an approved manner.
4. Properly use Programming Terminals and Peripheral Devices.
	1. Define swart and dumb terminals.
	2. State different types of programming devices.
	3. Choose the appropriate terminal for a system.
5. Design Installation and Maintenance procedures for a PLC system.
	1. Choose the correct system for a job.
	2. Choose the correct wiring for the system.
	3. Troubleshoot some common problems.
	4. Develop a maintenance checklist.
	5. Correctly enter and run a program.
6. Read Relay Logic and Ladder Logic Programs.
	1. Correctly interpret relay symbols
	2. Use relay symbols to develop a simple program.
	3. Correctly interpret ladder logic symbols
	4. Convert a relay logic program into a ladder logic program.
7. Utilize Timers and Counters.
	1. Define timers and counters.
	2. Show uses for counters and timers.
	3. Enter programs using counters and timers
	4. Edit programs using counters and timers.
	5. Correctly use ONE SHOTS.
8. Correctly use MCR's, ZCL's, and Jump Instructions.
	1. Enter programs using MCR, ZCL and Jump instructions.
	2. Explain PLC actions in a file control program.
	3. Use the jump subroutine commands.
	4. Use and explain uses for each command.

**COURSE TOPICS AND CONTENT REQUIREMENTS~~:~~**

1. An overview
	1. PLC’s
	2. Parts of a PLC
	3. Principles of operation
	4. PLC Application
2. PLC Hardware
	1. Discrete I/O
	2. Analog I/O
	3. I/O Specifications
	4. The CPU
	5. Memory types
	6. Programming devices
3. Number Systems
	1. Decimal
	2. Binary
	3. Octal
	4. Hexadecimal
	5. BCD
	6. Encoding and Decoding
4. Fundamentals of Logic
	1. The binary concept
	2. Logic Gates
	3. Boolean Algebra
	4. Hard-wired logic verses Soft logic
	5. Programming
5. PLC Programming
	1. Memory organization
	2. Scan times
	3. Languages
	4. Relay instructions
	5. Addressing
	6. Branching
	7. Internal relays
	8. Ladder logic
	9. Entering a program
	10. Modes of operation
6. PLC Installation and Maintenance
	1. Enclosures
	2. Noise and Surges
	3. Grounding
	4. Editing and monitoring
	5. Troubleshooting and Maintenance
7. Wiring diagrams
	1. Relays
	2. Starters
	3. Seal-in circuits
	4. Latching circuits
	5. Circuit Conversion
8. Programming Timers
	1. Timer instructions
	2. Time on delay
	3. Time off delay
	4. Retentive timers
	5. Timer bits
	6. Cascading timers
9. Programming Counters
	1. Counter instructions
	2. Up-counter
	3. Down-counter
	4. Cascading counters
	5. Combining timers and counters
	6. One shots
10. Program Control
	1. Jumps
	2. Jump subroutines
	3. Forcing
	4. Faults
	5. 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. 3rd Edition Rabiee

Programmable Logic Controllers Lab Manual 3rd Edition Rabiee

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.

Required assignments: Methods of Evaluation:

Mandatory lab attendance A students' grade will be based on multiple

Weekly lab assignments measures of performance:

Short quizzes

Assigned reading Completion of lab assignments

Assigned homework Quizzes based on lab and text assignments

Midterm exams

Lab practical exams Completion of homework assignments

Final exam Midterm, final, and lab final exams

Tests

90% - 100% A Lab 30%

80% - 89.9% B Quizzes and Tests 40%

70% - 79.9% C Midterm and Final 30%

60% - 69.9% D

below 60% F

**OTHER REFERENCES**

Allen-Bradley Manuals

Rockwell Automation Manuals

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Course Competency/Assessment Methods Matrix

| **ELE 1204; Programmable Logic Controllers I** | **Assessment Options** |
| --- | --- |
| For each competency/outcome place an “X” below the method of assessment to be used. | **Assessment of Student Learning**  | Article Review | Case Studies | Group Projects | Lab Work | Oral Presentations | Pre-Post Tests | Quizzes | Written Exams | Artifact Self Reflection of Growth | Capstone Projects | Comprehensive Written Exit Exam | 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 | Employer Surveys | Graduate Surveys | Internship/Practicum /Site Supervisor Evaluation | Licensing Exam | In Class Feedback | Simulation | Interview | Written Report | Assignment |
| Assessment Measures – Are direct or indirect as indicated. List competencies/outcomes below. | **Direct/****Indirect** | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | I | I | I | I | D | D |  |  |  |  |  |  |
| * 1. State why use PLC’s at all.
 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | x |  |  |  |  |
| * 1. Explain advantages to using.
 |  |  |  |  |  |  |  |  | x |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | x |  |  |  |  |
| * 1. Calculate monetary advantages to PLC use over Relay Logic.
 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | x |  |  |  |  |
| * 1. Correctly Identify and state uses for each component of a PLC system.
 |  |  |  |  | x |  |  |  | x |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| * 1. Initialize a PLC.
 |  |  |  |  | X |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | x |  |  | x |
| Competency 2.1. Define types of memory. |  |  |  |  |  |  |  | x | x |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | X |  |  |  |  |
| Competency 2.2. Tell when each type of memory could and should be used. |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | X |  |  |  |  |
| Competency 2.3. Choose the appropriate processor for the PLC application. |  |  |  | x | x |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Competency 2.4. Convert between decimal, octal, hex, binary and BCD numbers. |  |  |  |  | x |  |  |  | X |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Competency 3.1. Identify Input and output modules. |  |  |  |  | x |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Competency 3.2. State uses for each module. |  |  |  |  | x |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | X |  |  |  |  |
| Competency 3.3. Correctly use modules in a lab setting. |  |  |  |  | x |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Competency 3.4. Swap modules in an approved manner. |  |  |  |  | x |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Competency 4.1. Define swart and dumb terminals. |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | X |  |  |  |  |
| Competency 4.2. State different types of programming devices. |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | X |  |  |  |  |
| Competency 4.3. Choose the appropriate terminal for a system. |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | X |  |  |  |  |
| Competency 5.1. Choose the correct system for a job. |  |  |  | x | x |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | x |  |  |  |  |
| Competency 5.2. Choose the correct wiring for the system. |  |  |  |  | x |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Competency 5.3. Troubleshoot some common problems. |  |  |  |  | x |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Competency 5.4. Develop a maintenance checklist. |  |  |  | x | x |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Competency 5.5. Correctly enter and run a program. |  |  |  |  | x |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | X |  |  |  |  |
| Competency 6.1. Correctly interpret relay symbols |  |  |  | x | x |  |  | x | x |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Competency 6.2. Use relay symbols to develop a simple program. |  |  |  |  | X |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Competency 6.3. Correctly interpret ladder logic symbols |  |  |  | x | X |  |  | x | x |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Competency 6.4. Convert a relay logic program into a ladder logic program. |  |  |  |  | X |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | x |  |  |  | x |
| Competency 7.1. Define timers and counters. |  |  |  |  |  |  |  |  | x |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | X |  |  |  |  |
| Competency 7.2. Show uses for counters and timers. |  |  |  | x | X |  |  | x | x |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Competency 7.3. Enter programs using counters and timers |  |  |  |  | X |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Competency 7.4. Edit programs using counters and timers. |  |  |  |  | X |  |  |  | x |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Competency 7.5. Correctly use ONE SHOTS. |  |  |  | x | X |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Competency 8.1. Enter programs using MCR, ZCL and Jump instructions. |  |  |  |  | X |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | x | X |  |  |  |
| Competency 8.2. Explain PLC actions in a file control program. |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | X | x |  |  |  |
| Competency 8.3. Use the jump subroutine commands. |  |  |  |  | x |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Competency 8.4. Use and explain uses for each command. |  |  |  |  | x |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | x |  |  |  |  |