Programmable Controllers (RBTC 1401)

Credit: 4 semester credit hours (3 hours lecture, 4 hours lab)

Prerequisite: CETT 1403 and CETT 1405

Course Description
A study in programmable controllers (PLC). Topics include processor units, numbering systems, memory organization, relay type devices, timers, counters, datamanipulators, and programming.

Required Textbook and Materials

1. *Programmable Controller 4th Edition by Frank Petruzella,McGraw-Hill*
   a. ISBN number is 978-0-07-351088-0
2. *Programmable Controllers 4th Edition Activities Manual*
   a. ISBN number is 978-0-07-330342-0
3. Scientific Calculator
4. Notebook.

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

A. Demonstrate a knowledge of programming basics for PLCs. (Scans C 3.2, C 5.4, C 6.2, C 7.2, C 8.5, C 9.3, C 14.3, C15.3, C 17.3, C 19.4, C 20.4, F 1.5, F 2.3, F 3.5, F 4.5, F 5.6, F 7.2, F 9.4, F 10.5, F 11.3, F 12.5, F 16.3)
B. Demonstrate integration of PLCs into systems. (Scans C 3.2, C 5.4, C 6.2, C 7.2, C 8.5, C 9.3, C 14.3, C15.3, C 17.3, C 19.4, C 20.4, F 1.5, F 2.3, F 3.5, F 4.5, F 5.6, F 7.2, F 9.4, F 10.5, F 11.3, F 12.5, F 16.3)
C. Diagnose faults in PLC programming. (Scans C 5.5, C 7.3, C 8.5, C 15.3, C 16.2, C 17.3, C 20.5, F 1.5, F 5.5, F 7.3, F 9.3, F 10.5, F 12.5)
D. Write working programs using ladder logic. (Scans C 5.5, C 7.3, C 8.5, C 15.3, C 16.2, C 17.3, C 20.5, F 1.5, F 5.5, F 7.3, F 9.3, F 10.5, F 12.5)

SCANS Skills and Competencies
Beginning in the late 1980's, the U.S. Department of Labor **S**ecretary's **C**ommission on **A**chieving **N**ecessary **S**kills (SCANS) conducted extensive research and interviews with business owners, union leaders, supervisors, and laborers in a wide variety of work settings to determine what knowledge workers needed in order to perform well on a job. In 1991 the Commission announced its findings in *What Work Requires in Schools.* In its research, the Commission determined that "workplace know-how" consists of two elements: foundation skills and workplace competencies.

Course Outline

A. Programmable Logic Controllers (PLCs): An Overview
   1. Programmable Logic Controllers
   2. Parts of a PLC
   3. Principles of Operation
   4. Modifying the Operation
   5. PLC's versus Computers
   6. PLC Size and Application

B. PLC Hardware Components
   1. The I/O Section
   2. Discrete I/O Modules
   3. Analog I/O Modules
   4. Special I/O Modules
   5. I/O Specifications
   6. The CPU
   7. Memory Design and Types
   8. Programming Devices
   9. Recording and Retrieving Data
   10. PLC Workstations

C. Number Systems and Codes
   1. Decimal System
   2. Binary System
   3. Negative Numbers
   4. Octal System
   5. Hexadecimal System
   6. BCD System
   7. Gray Code and ASCII Code
   8. Parity Bit
   9. Binary Arithmetic

D. Fundamentals of Logic
   1. The Binary Concept
   2. AND, OR, and NOT Functions
   3. Boolean Algebra
   4. Developing Circuits
   5. Producing the Boolean Equation
   6. Hardwired Logic/ Programmed Logic
   7. Word Level Instructions

E. Basics of PLC Programming
   1. Processor Memory Organization
   2. Program Scan
   3. PLC Programming Languages
   4. Relay Type Instructions
   5. Instruction Addressing
   6. Branch Instructions
   7. Internal Relay Instructions
   8. Entering the Ladder Diagram
   9. Modes of Operation

F. Developing Wiring Diagrams and Ladder Logic
   1. Control Relays
   2. Contactors and Motor Starters
   3. Manually and Mechanically Operated Switches
   4. Transducers and Sensors
   5. Output Control Devices
   6. Seal-In Circuits
   7. Latching Relays
   8. PLC Ladder Programs

G. Programming Timers
   1. Mechanical Timing Relay
   2. Timer Instructions
   3. On-Delay Timer Instruction
   4. Off-Delay Timer Instruction
   5. Retentive Timer
   6. Cascading Timers

H. Programming Counters
   1. Counter Instruction
   2. Up-Counter
   3. Down-Counter
   4. Cascading Counters

5. Incremental Encoder-Counter Applications

Grade Scale

90 – 100	A
80 – 89	B
70 – 79	C
60 – 69	D
0 – 59	F

Course Evaluation

Final grades will be calculated according to the following criteria:

Activity	***Percentage***
Homework/Labs	10%
Quizzes	10%
Major Test	50%
Final	30%
Total	***100%***

Late Penalties will be assessed on all work turned in late. 5 points per day

Course Requirements

1. Identify the main parts of a PLC and describe their function.
2. Describe the basic circuitry and applications for I/O modules and interpret I/O and CPU specifications.
3. Define the decimal, binary, octal, and hexadecimal, numbering systems and explain BCD, Gray, and ASCII Codes and be able to convert from one numbering or coding system to another.
4. Convert relay ladder schematics to ladder logic programs and program instructions that perform logical operations.
5. Write and enter ladder logic programs and use internal relay instructions.
6. Explain the operation of sensors and output control devices commonly found in PLC installations.
7. Analyze and interpret typical PLC timer ladder logic programs.
8. Analyze and interpret typical PLC counter ladder logic programs.
9. Apply combinations of counter and timers to control systems.

Attendance Policy

1. Missing more than 20% of classes will result in an automatic “F” for the course.
2. Absences are counted for unexcused, excused and coming to class late.
3. Missing more than 20% of a class period will count as an absence.
4. Being tardy 3 times equals 1 absence.

Course Policies

1. No food, drinks, or use of tobacco products in class.
2. No foul or harsh language will be tolerated
3. Turn off all Cell Phones during lectures
4. Headphones may be worn only upon Instructor approval
5. Do not bring children to class.
6. No Cheating of any kind will be tolerated. Students caught cheating or helping someone to cheat can and will be removed from the class for the semester. Cheating can result from expulsion from LIT.
7. If you wish to drop a course, the student is responsible for initiating and completing the drop process. If you stop coming to class and fail to drop the course, you will earn an 'F' in the course.

Disabilities Statement

The Americans with Disabilities Act of 1992 and Section 504 of the Rehabilitation Act of 1973 are federal anti-discrimination statutes that provide comprehensive civil rights for persons with disabilities. Among other things, these statutes require that all students with documented disabilities be guaranteed a learning environment that provides for reasonable accommodations for their disabilities. If you believe you have a disability requiring an accommodation, please contact the Special Populations Coordinator at (409) 880-1737 or visit the office in Student Services, Cecil Beeson Building.

Course Schedule

Week	Topic	Reference
1	Course introduction, policies and PLC's • Lecture • Lab: Allen Bradley PLC's	Handouts SLC 100 & 1000
2	Overview of PLC's. • Lecture • Lab: Activities Manual exercises	Chapter 1
3	PLC Instruction Sets • Lecture • Lab: Place controller in program mode and enter program into memory. Place controller in run mode and run the program.. •	Chapter 1
4	PLC Hardware	Chapter 2

	• Lecture • Lab: Chapter Exercises and Activity Manual exercises • Test 1	
5	Number Systems • Lecture • Lab: Conversions and Radix Function	Chapter 3
6	Codes • Lecture • Lab: Chapter and activity manual Exercises	Chapter 3
7/8	Logic • Lecture • Lab: Activity manual Exercises Boolean Algebra. • Test 2	Chapter 4
9/10	Programming Basics • Lecture • Lab: Activity manual Exercises • Entering basic Programs, editing, and running programs using SLC 100	Chapter 5
11	Fundamental PLC Wiring Diagrams • Lecture • Lab: Activity manual exercises and sequential and combination processes Programming. • Test 3	Chapter 6
12/13	Programming Timers • Lecture • Lab: Activity manual Exercises • Analyze and interpret timer ladder Logic programs • Program control of outputs using Timer control bits	Chapter 7

14/15	Programming Counters • Lecture • Lab: Activity manual Exercises • Analyze and interpret counter ladder Logic programs • Apply counter function and circuitry To control systems	Chapter 8
16	Combination counter and timers applied To control systems • Lecture • Test 4 • Review for Final	Comprehensive

Contact Information

Instructor: Mr. Ron Perry

Office: Building: T1 Room: 111 B

Telephone: (409) 880-1739

E-mail: rrperry@lit.edu

Office Hours: 12:30 pm – 4:30 pm M & W

8:50 am – 10:50 am Friday