

SAULT COLLEGE OF APPLIED ARTS & TECHNOLOGY
SAULT STE MARIE, ON

COURSE OUTLINE

Course Title: PLC CONTROL SYSTEMS

Code No.: ELR 223 Semester: FOUR

Program: ELECTRICAL TECHNOLOGY

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Approved: K. DeRosario April 2/98
Dean Date

Total Credits:

Prerequisite(s):

Length of Course:

Total Credit Hours:

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COURSE NAME
PLC CONTROL SYSTEMS

COURSE NUMBER
ELR 223

I. COURSE DESCRIPTION:

The student will develop an understanding of PLC in general, understand the hardware and software associated with Allen Bradley 5 family PLCs. PLC programming techniques using RS logic 5 software will be used to design, document and commission basic to intermediate PLC lab assignments. The student will learn how to interface a PLC to control a Robot as the final Lab Assignment. Basic control theory associated with PLCs will be introduced to assist with lab assignment implementation.

II. LEARNING OUTCOMES AND ELEMENTS OF THE PERFORMANCE:

(Generic Skills Learning Outcomes placement on the course outline will be determined and communicated at a later date.)

Upon successful completion of the theory portion of this course the student will understand the following:

- 1. The importance that the PLC play in today's automated industrial network and the future role of PLCs through the understanding of hardware and software relationship in developing programs to provide control.**

Potential Elements of the Performance:

- State the major advantages of a typical logic controller (PLC) over conventional hardware relay systems
- Identify the four major components of a typical PLC and describe the function of each
- Define the term discrete
- Define the term analog
- Identify different types of programming devices
- Describe the I/O section of a PLC
- Define the term interposing relay
- Define the term optical isolation
- Describe how basic AC and DC input and output modules work

- Describe the proper wiring connections for input devices and their corresponding modules
- Explain why a hard-wire emergency-stop function is desirable
- Describe the function of the PLC's processor
- Identify the two distinct types of memory
- Explain the term on-line programming
- Understand decimal, binary, hexadecimal, binary coded decimal (BCD) numbering systems
- Identify a hard-wiring diagram
- Understand the Examine ON, OFF, timers, counters move, limits test, sequencers and Internal Storage instructions
- Describe basic programming techniques
- Describe the Force On and Off features and hazards that could be associated with both.

Upon successful completion of lab portion of this course the student will demonstrate the ability to:

2. Develop and demonstrate basic programming techniques for AB 5 PLCs using RS Logic software

Potential Elements of the Performance:

- the ability to program basic PLC functions offline
- the ability to program PLCs to control
- the ability to hard-wire PLCs to field equipment and I/O cards
- the ability to add documentation to a PLC program
- the ability to emulate programs using emulation software on a PC

3. Demonstrate the ability to write basic PLC programs to control various electrical equipment in the lab and run the programs in a PLC in the lab

Potential Elements of the Performance:

- the ability to download a program to a PLC attached to a PC
- the ability to download a program to a PLC from a remote PC over Ethernet through a gateway server to Data Highway then to a particular PLC in the Lab
- the ability to online edit programs
- the ability to upload a program to a PC from a PLC
- the ability to program basic PLC functions online
- the ability to program PLCs to control Motors, traffic lights, and robot
- the ability to down load a program to a local PLC and run a program
- the ability to down load a program to a remotely located PLC from room B1050 to room B1040 over the Ethernet network to a gateway server to the AB data Highway to a particular PLC and run a program

4. Demonstrate the ability to connect PLCs to control various electrical equipment in the lab and run the programs in a PLC in the lab

Potential Elements of the Performance:

- the ability to hard-wire PLCs to field equipment and I/O cards
- the ability to wire PLCs to control Motors, traffic lights, and robot

III. TOPICS:

- 1) Overview of PLC terminology and principles.
- 2) Overview of industrial controls and automation hardware/software.
- 3) Overview of RS Logic 5 software.
- 4) Overview of PLC/PC networking.
- 5) Basic PLC programming.
- 6) PLC Hardware

IV. REQUIRED RESOURCES/TEXTS/MATERIALS:

Required resources will be supplied by the instructor.

V. EVALUATION PROCESS/GRADING SYSTEM

The final grade for the course will be determined as follows:

THEORY Tests 20%

PROJECTS Demonstration 40%

PROJECTS Assignment, Questions and Write-ups 40%

The grading system used will be as follows:

A+ 90 to 100%

A 80 to 89%

B 70 to 79%

C 55 to 69%

R < 55% in theory and/or project component (repeat course)

VI. SPECIAL NOTES:

- In order to maintain a passing grade the student must obtain a minimum 55% average in all sections, the theory , project demonstration and project write-ups portions of the course
- Students must demonstrate all projects that are assigned for demonstration to pass this course. There is no exceptions!!!
- If a student misses a test he/she must have a valid reason (i.e. medical or family emergency). In addition, the school must be notified before the scheduled test sitting. The student should contact the instructor involved. If the instructor cannot be reached leave a message with the Dean's office or the College switchboard. If this procedure is not followed the student will receive a mark of zero on the test with no rewrite option.
- Special Needs
If you are a student with special needs (e.g. physical limitations, visual impairments, hearing impairments, learning disabilities), you are encouraged to discuss required accommodations with the instructor and/or contact the Special Needs Office, Room E1204, Ext. 493, 717, 491 so that support services can be arranged for you.
- Retention of Course Outlines
It is the responsibility of the student to retain all course outlines for possible future use in acquiring advanced standing at other post-secondary institutions.
- Disclaimer for Meeting the Needs of the Learners
- Substitute Course Information is available at the Registrar's Office.

VII. PRIOR LEARNING ASSESSMENT

Students who wish to apply for advanced credit in the course should consult the instructor. Credit for prior learning will be given upon successful completion of the following:

ELR 223

TABLE OF CONTENTS

LAB # 1 INTRODUCTION TO RS LOGIC 5

1. Familiarization to B1050 Lab Environment and Equipment.
2. Familiarization with RS LOGIC 5.

LAB # 2 START-STOP LIGHT EMULATION & ONLINE

1. Familiarization with programming PLC-5 with RS logic 5
2. Development PLC-5 Programs offline and online
3. Connect through hardwiring PLC-5 hardware I/O

LAB # 3 THREE (3) MOTORS

1. Familiarization with programming PLC-5 with RS logic 5 **basic instructions**
2. Development PLC-5 Programs offline and online
3. Connect through hardwiring PLC-5 hardware I/O

LAB # 4 FORWARD & REVERSING A MOTOR

1. Familiarization with programming PLC-5 with RS logic 5 **basic instructions**
2. Development PLC-5 Programs offline and online
3. Connect through hardwiring PLC-5 hardware I/O

LAB # 5 TIME STARTING OF SIX (6) MOTORS

1. Familiarization with programming PLC-5 with RS logic 5 **timer & counter instructions**
2. Development PLC-5 Programs offline and online
3. Connect through hardwiring PLC-5 hardware I/O

LAB # 6 TRAFFIC LIGHTS WITH DELAYED REDS USING TIMERS

1. Familiarization with programming PLC5 with RS logic 5 **Advance timer instructions**
2. Development PLC-5 Programs offline and online
3. Connect through hardwiring PLC-5 hardware I/O

LAB # 7 TIME STARTING OF SIX (6) MOTORS USING LIMIT TEST AND A TIMER

1. Familiarization with programming PLC-5 with RS logic 5 **limit test instructions**
2. Development PLC-5 Programs offline and online
3. Connect through hardwiring PLC-5 hardware I/O

LAB # 8 TRAFFIC LIGHTS WITH DELAYED REDS USING A TIMERS AND LIMIT TEST

1. Familiarization with programming PLC-5 with RS logic 5 **limit test & timer instructions**
2. Development PLC-5 Programs offline and online
3. Connect through hardwiring PLC-5 hardware I/O

LAB # 9 TIME STARTING OF SIX (6) MOTORS USING SEQUENCERS

1. Familiarization with programming PLC-5 with RS logic 5 **sequencer instructions**
2. Development PLC-5 Programs offline and online
3. Connect through hardwiring PLC-5 hardware I/O

LAB # 10 TRAFFIC LIGHTS WITH DELAYED REDS, FLASHING GREEN LIGHTS USING A TIMERS AND SEQUENCERS

1. Familiarization with programming PLC-5 with RS logic 5 **advance sequencer instructions**
2. Development PLC-5 Programs offline and online
3. Connect through hardwiring PLC-5 hardware I/O

LAB # 11 A TANK FILLING PROCESS THROUGH LEVEL LIMIT SWITCH CONTROL USING INPUT AND OUTPUT SEQUENCERS

1. Familiarization with programming PLC-5 with RS logic 5 **sequencer input & output instructions**
2. Development PLC-5 Programs offline and online
3. Connect through hardwiring PLC-5 hardware I/O

LAB # 12 HERCULES ROBOT USING INPUT AND OUTPUT SEQUENCERS

1. Familiarization with programming PLC-5 with RS logic 5 **advance sequencer input & output instructions**
2. Development PLC-5 Programs offline and online
3. Connect through hardwiring PLC-5 hardware I/O

LAB REQUIREMENTS AND MARKS

Read pages 1 to 21 in lab 1 only; you can try up to labs 1-3, they are optional.

Read pages 22 to 62 and do all lab 1 labs associated with these pages.

Do lab 1-4 to lab 1-10 and demonstrate all labs to the instructor and have the instructor sign your sheet that each lab was completed successfully. The sheet will be given to you by the instructor during the first lab period.

Note: the sheet discussed above must be turned in with the lab write ups during the last lab class of the semester with all labs signed on the sheet and demonstrated to the instructor.

If the sheet is not with the lab write ups. The write ups will not be accepted for marking until the student re-demonstrates selected labs which the instructor will select as proof that the student has successfully completed the practical parts of the labs. The student will have to make arrangements with the instructor for a time to demonstrate his/her practical skill. If the student is successful in the practical demonstration his/her labs will be evacuated as if the student had turned in their signed sheet.

**YOU ARE RESPONSIBLE FOR YOUR SHEET
NO EXCUSES WILL BE ACCEPTED**

General Lab Requirement for Write Ups

Lab 1 -4 to lab 1-10 and Lab 2 require no write ups, the student only has to demonstrate these labs to the instructor and have them signed complete on their sheet.

Lab 3 through and including Lab 12 require write ups as outline below

- 1) Labs shall have a ladder logic diagram print out including documentation for both the Emulation portion and actual PLC Running portion of the lab**
- 2) Labs shall have a hardwire schematic diagram**
- 3) Labs shall have an Autocad wiring diagram of the complete lab including all associated equipment, Racks. Lights , switches, and wires.**
- 4) Labs shall have an I/O listing**
- 5) Labs shall have a brief description of operation and function in the student own words, typed in a word processor.**
- 6) All labs assignments must be turned in on hard copy and on computer disk before or no later than the last lab class of the semester. The disk will contain all programs, drawing in Autocad and word processor work.**
- 7) Labs that require tables shall be done in a spread sheet or in a word processor the can produce a table.**
- 8) Each lab may have specific requirement so read each lab carefully.**
- 9) If the student is not clear on any of the requirements, it is his/her's responsibility to ask the instructor for clarification.**

Marks;	demonstration	write ups
Lab 1	2 marks	0 marks
Lab 2	2 marks	0 marks
Lab 3	5 marks	6 marks
Lab 4	6 marks	4 marks
Lab 5	10 marks	10 marks
Lab 6	7 marks	5 marks
Lab 7	7 marks	10 marks
Lab 8	7 marks	10 marks
Lab 9	12 marks	10 marks
Lab 10	12 marks	10 marks
Lab 11	15 marks	10 marks
Lab 12	15 marks	25 marks
Total	100 marks	100 marks

Theory Test	Test 1	15 marks
	Test 2	35 marks
Total		50 marks

Total course marks = 250 mark to represent 100%

You must pass all sections of the course, theory, the demonstration part of the course and the write up portion of the course to obtain a passing grade in this course. If the student passes all sections the final mark will be an average of the three (3) sections. That is the theory mark, and demonstration marks will be averaged with the write up marks to arrive at a final student average for this course. If the student fails any one section of this course he/she will receive an **R grade** (failing grade).

Eg.	100 mark	demonstration
	100 marks	write-ups
	50 marks	theory
Total	250 marks	

Average $\frac{250}{250} \times 100 = 100\%$

Methods of Evaluation

Demonstration of Labs , Lab write-ups represent and tests , will constitute a total of 100% of your ELR 223 course mark.

The distribution of marks are as stated in the previous pages.

NOTES:

- ▶ Attendance is compulsory and will be taken each and every lab class!
- ▶ Two percent per lab class will be deducted for each schedule lab class missed by a student from his final grade up to a maximum of 30%.
- ▶ Every student will be allowed to miss only one lab class without a doctors slip without any marks being deducted for that missed lab class.
- ▶ Students missing more than 1 lab class must have a doctors slip or the 2% per missed lab class will be deducted from his/her's final lab mark.
- ▶ Example the second miss lab class will result in the student having 2% deducted from his/her's final lab grade, e.g. Final mark of 100 % - 2% = 98% or 65% - 2%= 63%
- ▶ Students missing any lab classes will still be responsible to have the particular lab completed, not simply copied from other student. You must indicate to the instructor when you plan to do the lab, you will be responsible for making arrangements to complete the lab with the instructor.
- ▶ All drawings or diagrams must be done in Autocad.
- ▶ All labs will contain a the material that was stated in previous pages
- ▶ All labs must be turned in, in a binder, in order, the second last week of the course up to Friday 12 noon)for marking. The labs turned in after this time will be deducted 2% per day late. No labs will be excepted for marking after the last lab class of the semester. No labs turned in will result in the student obtaining an R (fail) grade
- ▶ All labs must be signed by the instructor at the completion of each and every lab shop portion during the schedule lab class. Therefore when you have completed the lab steps and demonstrated the lab to the instructor, he/she will signing the lab and you may proceed with the next lab assignment. Auto Cad drawings, and all other lab requirements must be met before the labs can be handed in for marking.
- ▶ The student must demonstrate all lab projects assigned to the instructor to his/her satisfaction before the student can have the lab project signed by the instructor as being complete.
- ▶ The instructor may alter or give particular instructions, or additional instructions on a per lab bases

REMEMBER:

ALL Projects (1 to 12) must be demonstrated to the instructor and have the instructor sign your sheet that each project was completed successfully. The sheet will be given to you by the instructor during the first lab period.

Note: the sheet discussed above must be turned in with the project write ups during the last lab class of the semester with all labs signed on the sheet and demonstrated to the instructor.

If the sheet is not with the lab write ups. The write ups will not be accepted for marking until the student re-demonstrates selected project which the instructor will select as proof that the student has successfully completed the practical parts of the labs. The student will have to make arrangements with the instructor for a time to demonstrate his/her practical skill. If the student is successful in the practical demonstration his/her labs will be evacuated as if the student had turned in their signed sheet.

YOU ARE RESPONSIBLE TO DEMONSTRATE ALL LAB PROJECTS TO THE INSTRUCTOR

YOU ARE RESPONSIBLE FOR YOUR SHEET

YOU ARE RESPONSIBLE TO HAND IN COMPLETED LAB WRITE UPS TO THE INSTRUCTOR BY THE ASSIGNED DEAD LINE.

NO EXCUSES WILL BE ACCEPTED