



## ELE 224 - Introduction to Programmable Logic Controllers

CRN 12467/ Section 01 Tu Th 6 - 9 pm (TI 137, TI 143) – Winter 2013

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**Instructor:** Dale Petty

**Phone:** 734.677.5108 (If no answer, please leave a message on my voice mail.)

**Email:** petty@wccnet.edu

**Websites:** <https://blackboard.wccnet.edu/> <http://courses.wccnet.edu/~petty/>

**Office:** TI 122C

**Office Hours:** My schedule is posted in TI 122 and at:  
<http://www4.wccnet.edu/search/officehours/pdf/officehours.pdf>  
Please make an appointment for other times.

**Prerequisites:** ELE 111 Electrical Fundamentals or permission of instructor

**Materials:** Required:  
*Programmable Logic Controllers*, Frank D. Petruzella, 4<sup>th</sup> edition  
*Coursepack: ELE 224, 3<sup>rd</sup> Edition*, © DPetty 2011

Recommended:  
- USB flash drive  
- Calculator (not a cell phone)  
- Three ring binder

Supplied by Instructor:  
- Manuals for PLC hardware and software  
- Other Rockwell manuals available at <http://literature.rockwellautomation.com>

**Format:** A typical week will include about two hours of lecture and two hours of lab, with the remaining time split between working in teams reviewing homework and doing exercises, quizzes and task checkups. Your instructor will be with you for the lecture period and part of the lab. A lab assistant will be with you for most of your lab time.

Tues 6-8 p.m.	Tues 8-9 p.m.	Thur 6-7 p.m.	Thur 7-9 p.m.
Lecture TI 137	Quiz & Task Checkup TI 143	Team HW review TI 143	Lab TI 143

**Homework  
& Teamwork:**

You should expect to spend at least 8 hours per week outside of class reading, working problems, preparing for lab, discussing with classmates and studying for exams. I recommend that you do a quick overview of the reading assignment before the lecture and a thorough reading following the lecture. Homework problems should be done following the lecture and before the next class so that you arrive prepared to share questions and insights.

**Labs:**

Please follow appropriate safety practices in the lab!

You should prepare for each lab by reading over the lab instructions and doing as much of the lab as you can on paper. Then when you get to the lab, you'll have enough time to complete it.

Labs will be done in teams of two unless arranged otherwise. Please work with your lab partner to share the work equally. Regularly check in with your partner and ask how you can help them learn, and let your partner know what is helpful to you.

When you feel that your lab is complete, verify that you have answered all questions. Please try to discuss any questions you have with your teammates before asking the lab assistant or instructor. Ask your instructor or lab assistant to review the lab with you and sign your lab sheet before you turn it in.

A Saturday morning Open Lab, staffed by our lab assistant Dennis Kilgore, is available for students to finish lab work not completed during class. Make arrangements with your instructor if you wish to make up a lab at a different time.

Put your name on your lab and staple together all of the lab pages when submitting your lab for grading. If requested in the lab, staple your program printout to the back of the lab. Labs will be graded on completeness and correctness. There is a 1 point penalty for labs turned in more than a week after they are assigned.

**Quizzes:**

There will be regular quizzes throughout the semester. You may use a calculator (not a cell phone), and one 8 ½ x 11" crib sheet (both sides). You must do your own work unless otherwise noted. Missed quizzes may not be made up, however the grade for any missed quizzes will be raised to match your final exam grade percentage.

**Task Checkups:**

There will be regular evaluations of your practical skills throughout the semester. These evaluations will be time limited, and crib sheets will not be allowed. If you score less than 100% on a Task Checkup, you may retake it, with a minimum of 1 week between attempts.

**Final Exam:**

A comprehensive final exam will be given at the end of the semester. You may use a calculator (not a cell phone), and one 8 ½ x 11" crib sheet (both sides). You must turn in the crib sheet with the exam.

**Grading:** Your final grade will be based on the total number of points accumulated during the semester as follows:

Teamwork	~ 7 % of your grade
Labs (5 points each)	~ 14 % of your grade
Quizzes	~ 29 % of your grade
Task Checkups	~ 25 % of your grade
Final Exam	~ 25 % of your grade

Letter grades will be assigned according to the following scale.

A	93 - 100 %	C	73 - 76 %
A-	90 - 92 %	C-	70 - 72 %
B+	87 - 89 %	D+	67 - 69 %
B	83 - 86 %	D	63 - 66 %
B-	80 - 82 %	D-	60 - 62 %
C+	77 - 79 %	F	0 - 59 %

W Withdrew from class by submitting a drop form to Student Records  
I An incomplete may be given in the event of extreme circumstances near the end of the semester when only a few assignments remain to be completed

**Please Note:**

- Please keep drink containers covered, and take responsibility for disposing of your trash and repairing any damage done to equipment from spilled drinks.
- Container recycling bins in the classrooms and in the TI building lobby are for all glass, plastic and metal beverage containers.
- Paper recycling bins in the classrooms and hallways are provided for office and notebook paper and grayboard (no napkins, tissues, etc.)
- Trash containers are provided for all your non-recyclables. Please clean off your bench at the end of each class.
- Please remove your personal flash drives and diskettes at the end of each lab.
- Multi-meters and tools are available on request for use in class. Ask your instructor if you need help finding them. At the end of class, please return whatever you have borrowed.
- Comfortable, adjustable seating: please keep shoes and sharp objects off.

**Support:**

Extra help is available from your instructor after class, during office hours or by appointment.

You can contact any of your classmates by email through BlackBoard.

*Learning Support Services* provides tutoring for all enrolled students. Please see the schedule posted outside LA 104 as times may change each semester. If you need an academic accommodation because of a disability, please advise me and make an appointment with Learning Support Services as soon as possible to verify the disability and arrange accommodations. Call (734) 973-3342 or stop by LA 104, Monday – Friday, 8:00am - 5:00pm.

## Course Goals:

1. Troubleshoot PLC controlled systems by applying knowledge of PLC:
  - a. hardware
  - b. electrical prints
  - c. programs
  - d. monitoring software
  - e. troubleshooting procedures
2. Develop and manage PLC programs
3. Perform installation and maintenance tasks on PLCs.

## Major Course Objectives

1. Identify the characteristics of PLC hardware components, including chassis, power supply, CPU, I/O modules.
2. Read PLC electrical prints and relate them to hardware components.
3. Recognize and apply the operating principles of PLCs including memory, data types, data tables, scan cycle, I/O addresses, number systems, program restrictions and CPU modes.
4. Analyze and interpret ladder logic containing *relay-type instructions*, including normally open and normally closed contacts, coils, and *combinational logic*.
5. Analyze and interpret ladder logic programs that include start and stop buttons, latching outputs, and internal relays.
6. Analyze and interpret ladder logic containing *timer instructions*, including on-delay and off-delay timers, retentive timers.
7. Analyze and interpret ladder logic containing *counter instructions*.
8. Analyze and interpret ladder logic containing *data manipulation instructions*, including move, compare, math, and file manipulation.
9. Analyze and interpret ladder logic containing *program control instructions*, including jump, subroutine, and MCR.
10. Analyze and troubleshoot simple event-driven *sequential systems* by analyzing program flow and the turn on and turn off conditions of rungs.
11. Analyze and troubleshoot complete PLC controlled systems utilizing a systematic process, electrical prints, software tools, indicator lights, manuals, and test equipment.
12. Develop ladder logic programs that interface to discrete I/O devices including start and stop buttons, selector switches, pneumatic valves, and motor starters.
13. Develop ladder logic programs that utilize relay-type, timer, counter, and data manipulation instructions.
14. Use PLC software to create, edit, document, print, download, monitor, test, print out and back up ladder logic programs.
15. Identify and demonstrate the proper techniques for PLC installation and maintenance.

# Washtenaw Community College Board of Trustees Policies

## **8085 -- SMOKE-FREE CAMPUS POLICY**

Smoke in the workplace has become an important public health issue. There is considerable evidence that concentrations of smoke are harmful to non-smokers as well as to smokers. The College has an obligation to provide a safe and healthy work and learning environment. Any employee, student, or visitor has a right not to be exposed to the effects of smoke. Washtenaw Community College, therefore, establishes the following non-smoking policy for all College-owned facilities.

### **Policy Statement:**

Effective September 1, 2005, Washtenaw Community College will become a smoke-free campus. Smoking will not be permitted anywhere on the campus; this includes all College facilities, including buildings, sidewalks, parking lots, building entrances, and common areas. The Administration shall fully implement this policy, and all applicable laws, regulations, and local ordinances related to smoking.

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## **4095 -- STUDENT RIGHTS AND RESPONSIBILITIES**

### **Academic Dishonesty**

All forms of academic dishonesty including but not limited to collusion, fabrication, cheating, and plagiarism will call for discipline.

1. Collusion is defined as the unauthorized collaboration with any other person in preparing work offered for individual credit.
2. Fabrication is defined as intentionally falsifying or inventing any information or citation on any academic exercise.
3. Cheating is defined as intentionally using or attempting to use unauthorized materials, information, or study aids in any academic exercise.
4. Plagiarism is defined as the appropriation of any other person's work and the unacknowledged incorporation of that work in one's own work offered for credit.

**ELE 224 Introduction to PLCs – Fall 2012      Course Outline (tentative) – Winter 2013**  
**Instructor: Dale Petty      email: [petty@wccnet.edu](mailto:petty@wccnet.edu)      phone: 734-677-5108**

Week	Date	Topics	Homework: Reading	Homework: Problems	Labs
1	1/15	PLC Overview Hardware Components	Ch 1, Ch 2 ; Electrical Safety (1); Reading a Ladder Diagram (4); Reading a Print (5); Standard Elementary Diagram Symbols (7); Intro to SLC-500 ...PLCs (11)	Blackboard Exploration Lab Prep; Ch 1 Questions (3,7,11,13) Ch 2 Questions (11,14,15,19,21,24,48,53); Internet exercise	Lab 1: PLC System Hardware and Wiring
2	1/22	Memory Organization, Programming Languages, Programming and Monitoring Software PLC addressing	Ch 5.1 - 5.6; 5.8-5.10 Identifying SLC-500 ... Addresses (11); Common Procedures... (15)	Lab Prep; Ch 5 Questions (1- 7,10-16, 23)	Lab 2: Intro to PLC Programming – RSLogix500
3	1/29	Relay Type Instructions Fundamentals of Logic	Ch 5.4 – 5.6; 5.8; Ch 4.1 - 4.7; Solving Ladder Logic (21)	Lab Prep; Ch 5 Problems (6,7,8,9); Ch 4 Questions (3, 4, 5); Ch 4 Problems (1, 2)	Lab 3: Relay Type Instructions
4	2/5	Sensors and Actuators Fundamentals of Programming	Ch 6.1-6.8, 6.11; Solenoid...Valves (29)	Lab Prep; Ch 6 Questions (1, 2, 9, 10, 11, 23, 26)	Lab 4: PLC control of Pneumatic Valves
5	2/12	Programming Considerations Troubleshooting Writing a program from a problem description	Ch 5.6, 5.7, 6.9, 6.10, 8.2, 13.9; Proj: 25723-IN.RSP (32); Ladder Logic Programming... (37); Converting Relay Logic to PLC Ladder Logic (39); Systematic Troubleshooting (41)	Lab Prep; Ch 5 Problems (2-5); Ch 6 Problems (1-3); Ch 13 Problems (5, 9)	Lab 5: Programming Considerations

Week	Date	Topics	Homework: Reading	Homework: Problems	Labs
6	2/19	Writing a program continued File Management	File Management Considerations (42)	Lab Prep File Management Scenarios Exercise (43); Ch 6 Problems 4, 5, 6, 7, 9, 10	Lab 6: File Management
7	2/26	Timer Instructions Move (MOV) Instructions	Ch 7	Lab Prep; Ch 7 Questions (2); Ch 7 Problems (3, 4, 5, 9, 10); Timer Instr. Apps (45) (2, 4, 6, 10, 15)	Lab 7: Timer and Move Instructions
8	3/12	Number Systems Masked Move (MVM) Instruction	Ch 10.1-10.2 Ch 3.1-3.5	Lab Prep; Number Systems Ex 1-9 (53-55) Ch 10 Questions (1, 2, 5, 6); Ch 10 Problems (1,2,8)	XC - Lab 8: Timer and Move Instructions –Advanced
9	3/19	Counter Instructions Compare Instructions	Ch 8, 10.3, 10.4; Proj: 2572-IN.RSP (36); 1061-2.RSP (100-104)	Lab Prep; Ch 8 Problems (1, 3, 4, 8) Ch 10 Problems (4, 5); Counter/Number Comparison Instructions (57 ) (1, 3, 5, 8)	Lab 9: Counter and Compare Instructions
10	3/26	PLC-5 Overview RSLogix5 Software Motor Starters	Ch 3.4, 14.6; Introduction to the PLC-5 (59); Common Procedures: RSLogix5 Software (69)	Lab Prep; Ex: PLC-5 Addressing #1 (65)	Lab 10: PLC-5 Hardware and RSLogix5 Programming

Week	Date	Topics	Homework: Reading	Homework: Problems	Labs
11	4/2	Startup Procedures Forces PLC-5 Troubleshooting Wiring Practices	Ch 6.2, 6.3, 9.5, 13.9, 13.10 PLC-5 Startup Procedures (71); Using Forces (72); Forces.rsp (73) Typical Distribution of Faults... (74); Abbreviated PLC Troubleshooting Chart (75); Troubleshooting Guide (PLC-5 Installation Manual)	Lab Prep; Ch 6 Questions (4-6); Ch 6 Problems (6); Ch 13 Problems (2, 4, 6, 7)	Lab 11: PLC-5 Wiring and Troubleshooting – Motor Control
12	4/9	Sequential Logic Control – Event Driven	Structured Logic (81-93)	Lab Prep	Lab 12: Event Driven Sequential Logic Control
13	4/16	Program Control Instructions COP, FLL and SQO Instructions Math Instructions	Ch 9; Program Control - Car Wash (94) Control_560.rsp (98) Ch 11, (278-280), 10.5; 3.6 2752-IN.RSP (36) 1061-2.RSP (102)	Lab Prep; Ch 9 Problems (1-4); Ch 11 Questions (5-9); Ch 11 Problems (1, 2); Ch 3 Questions (7)	Lab 13: Program Control, Math and Data Manipulation Instructions
14	4/23	Installation RSLogix – search, cross reference, online editing, communications, processor status, troubleshooting Pathfinder demo	Ch 13.1 – 13.8	Ch 13 Questions (1-10); Ch 13 Problems (3,8) Prepare for Final Exam	Lab 14: System Troubleshooting – Pathfinder Simulation
15	4/30	Final Exam Review Complete Task List  <b>Final Exam on Thursday 5/2</b> <b>Last Saturday Open Lab 5/4</b>	Final Exam Review (105)	Prepare for Final Exam	