Mechatronics I

The University of Toledo
Engineering Technology, Electrical Engineering Technology, College of Engineering
Mechatronics I-R1 - 41163 - EET 2410 – 001, 002, 003

Name:	William T Evans	**Class Location**:	NE 2390
Email:	william.evans@utoledo.edu	**Class Day/Time**:	2:30-3:50pm T, R
Office Hours:	9:30-12:00 M, W	**Lab Location**:	NE 2390
Office Location:	NE 1607	**Lab Day/Time**:	Lab Section 1 – T, 3:55-5:25 pm
Instructor Phone:	419-530-3349		Lab Section 2 – R 3:55-5:25 pm
Offered:	Fall, Spr, Su	**Credit Hours**:	4

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CATALOG/COURSE DESCRIPTION

A study of programmable controllers emphasizing program development, logic development and troubleshooting. Emphasis on relays, timers, counters, integer math and scan-dependent programming. Factory floor control concepts are stressed.

COURSE STATEMENT

The objective of this course is to familiarize the student with two of the main programmable controllers used in industry. The objective is also to use them to solve automation projects. The student should be able through the lab experiences gain confidence in solving useful automation problems.

Upon completion of this course, the students will be able to have a(n):

1. Introduction to Relay Logic including the history of PLCs
2. Introduction to PLC programming on the PC
3. Allen-Bradley Instruction Set – Memory Circuit Construction
4. Siemens Instruction Set – Memory Circuit Construction
5. Hardware considerations
6. PLC Addressing
7. Timer and Counter applications
8. Math and Numeric Applications including number systems
9. Control Panel Planning, Safety, and Sensor Selection
10. State Diagram and sequential program design
11. Special Instructions, batch programming and use of Specifications
12. Introduction to HMI Concepts
13. Introduce data transfer concepts in PLC networks

STUDENT LEARNING OUTCOMES

ABET

1. an ability to apply knowledge, techniques, skills and modern tools of mathematics, science, engineering, and technology to solve broadly-defined engineering problems appropriate to the discipline;b - an ability to select and

apply a knowledge of mathematics, science, engineering, and technology to engineering technology problems that require the application of principles and applied procedures or methodologies;

2. an ability to design systems, components, or processes meeting specified needs for broadly-defined engineering problems appropriate to the discipline;

Discipline Specific Content (Criteria 5):

D. Include design considerations appropriate to the discipline and degree level such as: industry and engineering standards and codes; public safety and health; and local and global impact of engineering solutions on individuals, organizations and society; and

E. Include topics related to professional responsibilities, ethical responsibilities, respect for diversity, and quality and continuous improvement.

EET Specific Outcomes:

Ec - the ability to analyze, design, and implement control systems, instrumentation systems, communications systems, computer systems, or power systems.

Ed - the ability to apply project management techniques to electrical/electronic(s) systems.

OBOR/TAG Outcomes

1 - Recall the history of control systems and programmable logic controllers (PLCs).
2 - Explain and describe the use of number systems.
3 - Demonstrate the use of ladder logic programming devices.
4 - Employ ladder logic in control circuit design.
5 - Use addressing to control Input/Output (I/O) modules.
6 - Demonstrate the use of relays, contacts, coils, and timers.
7 - Demonstrate counters and sequencers.
8 - Demonstrate fundamental PLC programming (e.g., comparators, block transfers, I/O forcing).
9 - Demonstrate data transfer in PLC networks.

PHILOSOPHY OF TEACHING (TEACHING METHODOLOGY)

This course requires students to participate in lab activities with the goal of making a set of requirements work successfully in a manner similar to an automation project in a factory. Lectures provide examples of how instructions in the PLC can be used to build a program and how to implement the program successfully. There are many correct answers and students are encouraged to implement the program from his or her own ideas. Creativity is encouraged.

Homework is encouraged to build the student's confidence in successful writing of control programs.

Recommendations for success:

- Come to lectures and take notes
- Read the relevant contents in the textbook
- Solve examples in the textbook and do homework
- Review the relevant contents and homework before each test or exam
- Finish each of the lab assignments and demonstrate a successful program

Never hesitate to ask for help from the instructor

PREREQUISITES AND COREQUISITES

EET 2210

REQUIRED INSTRUCTIONAL MATERIALS (TEXTS AND ANCILLARY MATERIALS)

Text is free at site: www.eng.utoledo.edu/~wevans and then "Hybrid Text"

TECHNOLOGY EXPECTATIONS

None – Text is online at above website with assignments

UNIVERSITY POLICIES
Academic Accommodations

The University of Toledo is committed to providing equal opportunity and access to the educational experience through the provision of reasonable accommodations. For students who have an accommodations memo from Student Disability Services, it is essential that you correspond with me as soon as possible to discuss your disability-related accommodation needs for this course. For students not registered with Student Disability Services who would like information regarding eligibility for academic accommodations due to barriers associated with a potential disability, please contact the Student Disability Services Office.)

ACADEMIC POLICIES

1. No eating, drinking, or smoking in classrooms.

2. There are no make-up exams for this course. If you have a problem or conflict and cannot attend an exam, let me know beforehand and we will try to work something out. No credit will be given for a missed exam that we haven't made arrangements about beforehand unless you have a ***really excusable*** emergency. Cell phone use will not be allowed. If you do not have a calculator, buy one and bring it to class.

Cheating is not allowed and will be punished by rules of U of Toledo Student Handbook.

The University of Toledo is committed to providing equal opportunity and access to the educational experience through the provision of reasonable accommodations. For students who have an accommodations memo from Student Disability Services, it is essential that you correspond with me as soon as possible to discuss your disability-related accommodation needs for this course. For students not registered with Student Disability Services who would like information regarding eligibility for academic accommodations due to barriers associated with a potential disability, please contact the Student Disability Services Office.)

COURSE EXPECTATIONS

Students in this course should be familiar with policies that govern the institution's academic process. Please find a total list of undergraduate Academic Polices: http://www.utoledo.edu/policies/academic/undergraduate/

Electronica Policy: No electronic items: cellular telephones, Blackberrys, personal digital assistants, digital music players or similar items that may disrupt the learning environment may be used at any time for any purpose during the classroom or laboratory time. If a cell phone must be kept on due to a potential emergency situation, it must be on a silent setting. If an emergency call must be taken during a class, the student must leave the classroom prior to answering the call and not return until the call is completed. See also Article IV.B Conduct Rules and Regulations of the Student Code of Conduct at the University of Toledo, which states, in part:

"Disruption of operations of the University Community. Disruption is an action or combination of actions by an individual or a group, which unreasonably interferes with, hinders, obstructs, or prevents the right of others to freely participate in its programs, services, or academic settings. This may include, but is not limited to a disruption by the use of pagers, cell phones and/or any other communication devices. "

Readings: Reading for the course is shown on the accompanying handout. Readings are to be completed prior to the lecture portion of the class.

Missed Class Policy: Students are required to be present for class. Should there be an unexpected absence on your part, you must notify me by e-mail or voicemail. The University's Policy for missed classes is available on the Faculty Senate website at: http://www.utoledo.edu/facsenate/missed_class_policy.html

Students are expected to conduct themselves in a manner which is conducive to learning for themselves and others. Disruptive behavior is not acceptable and may affect a student's final grade, or in severe cases result in a student being removed from class.

If there is a conflict or misunderstanding, please see me privately to work out a resolution.

OVERVEW OF COURSE GRADE ASSIGNMENT

Quizzes	**10 %,**	**Projects**	**40 %**
Midterm exam	**25 %,**	**Final Exam**	**25%**

(A >= 90, B >= 80, C > = 70, D > = 60)

COURSE GUIDELINES

Please use your UT student email address (XX@Rockets.Utoledo.edu) for all your communications. All others type of email address will go directly to Junk E-mail folder. Homework assignments are accepted only before or on the assigned day. The final answer alone is not enough to get credit. Solution steps must be shown to get credit.
When not done in person, preferred communication between the instructor and students will take place via email to a student's Rocket email address. While the instructor will not communicate via email on a regular basis throughout the semester, it is advisable that students check their email regularly so as to keep abreast of any special instructions, clarifications on assignments or cancellations that may occur during the term

ACADEMIC SUPPORT SERVICES

In addition to visiting the instructor which is highly encouraged, several offers additional support, are available which could aid you in succeeding in this course:

- Engineering Technology Department Teaching Assistants - NE 1604 & NE 1606

SAFETY AND HEALTH SERVICES FOR UT STUDENTS

For safety and health services, please refer to the following website: (http://www.utoledo.edu/offices/provost/utc/docs/CampusHealthSafetyContacts.pdf);

Lab Assn 2.1 Due	Lab 2.1	Explained in Ch. 2, pg 31-35			5%
Hmwk Ch 2	Ch. 2	Pg 38-41		1-17	
Lab Assn 4.1 Due	Lab 4.1	Ch. 4, Hot Dog Counter		Demo both A-B and Siemens with report – no signature	5%
Hmwk Ch 3_4	Ch. 3	Pg. 39 #1-4	Ch. 4	Pg. 37 #1-4	
Lab Assn 5.1 Due	Lab 5.1	Ch. 5, Coin Changer (35-cent option)		Demo both A-B or Siemens with report – signature required	5%
Hmwk Ch 5	Ch. 5	Pg. 43-47 #1-19			
Lab Assn 7.1 Due	Ch. 7	7.1 Traffic Intersection (7.1F)		Demo both A-B or Siemens with report – signature required	5%
Hmwk Ch 6	Ch. 6	Pg 50-60 #1-24			
Mid-Term	**CH. 1-8**	**95 mins 10 Questions**		**In-class, calculator ok but no notes**	**25%**
Lab Assn 7.2 Due	Ch. 7	7.2 Cash Register (7.2C & E)		Demo both A-B or Siemens with report – signature required	5%
Hmwk Ch 7	Ch. 7	Pg. 44-49 #1-15			
Hmwk Ch 8	Ch. 8	Pg. 56-57 #1-19			
Lab Assn 8.1b Due	Ch. 8	8.1b (subtract)		Demo either A-B or Siemens with report – signature required	2.5%
Hmwk Ch 9	Ch. 9	Pg. 44 #1-13			
Hmwk Ch 10	Ch. 10	Pg. 51-52 #1-11			
Lab Assn 10.1 Due	Ch. 10	10.1 MUX		Demo either A-B or Siemens with report – signature required	2.5%
Lab Assn 10.2 Due	Ch. 10	10.2 Bicycle		Demo either A-B or Siemens with report – signature required	2.5%
Hmwk Ch 11	Ch. 11	Pg 71 #6-8			
Lab Assn 11.1 Due	Ch. 11	11.1(Three Pumps) Option 11.1.3	P1(A/M) P2(A) P3(A/M)	Demo either A-B or Siemens with report – signature required	2.5%
Hmw_Ch12_13	Ch. 12, 13	Ch. 12 – 1,2 Ch. 13 – 6,7			
Lab Assn 13.1 Due	Ch. 13	13.1.1A Simon		Demo either A-B or Siemens with report – signature required	2.5%
Lab Assn 13.2 Due	Ch. 13	13.2b-Whack-a-mole		Demo either A-B or Siemens with report – signature required	2.5%
Lab Assn 13.3	Ch. 13	13.3-Maze		Demo either A-B or Siemens	2.5%

Due				with report – signature required	
Lab Assn 15.1 Due	Ch. 15	15.1- Cash Reg II		Demo either A-B or Siemens with report – signature required	2.5%
Lab Assn 15.2 Due	Ch. 15	15.2- Bottle on Conv		Demo either A-B or Siemens with report – signature required	2.5%
Final 12-10	Tuesday	2:45-4:45		Chs. 1-13, 15, 16	25%

COURSE SCHEDULE

No Class Dates: Per university calendar

Final Exam Date: Per university schedule

Course Schedule (Subject to Change depending on the course progress)

Week No.	*Course Content*	
1	History of the PLC, Use of Relays in Control	Chs. 1, 2
2	Programming the PLC	Chs. 3, 4
3	Combinational Logic in the PLC	Ch. 5
4	Sequential Logic in the PLC	Ch. 6
5	Use of Timers and Counters	Ch. 7
6	Use of Math in the PLC	Ch. 8
7	Midterm Exam	
8	Considerations for construction of a control panel	Ch. 9
9	Safety, Sensors and Analog I/O	Ch. 10
9 cont	ABET Criteria 5-D, E	Ch. 10
10	State Diagrams	Ch. 11
11	Enhanced Instruction Set	Ch. 12
12	Batching Systems	Ch. 13
13	Human Machine Interface/Networks & Protocols	Ch. 15, 16
14	Review	
15	Final Exam	

TAG Student Learning Outcomes, (SLO), by Lecture

1. Recall the history of control systems and programmable logic controllers (PLCs).
2. Explain and describe the use of number systems.
3. Demonstrate the use of ladder logic programming devices.
4. Employ ladder logic in control circuit design.
5. Use addressing to control Input/Output (I/O) modules.
6. Demonstrate the use of relays, contacts, coils, and timers.
7. Demonstrate counters and sequencers.
8. Demonstrate fundamental PLC programming (e.g., comparators, block transfers, I/O forcing).
9. Demonstrate data transfer in PLC networks.

SLO Number	Chapters and Topics	Number of Lectures
1	Chapter 1: Introduction	1.0
1	Total	1.0
2	Chapter 8: Math Functions	1.0
2	Total	1.0
3	Chapter 3: PLCs and Processing I/O	0.5
	Chapter 4: Programming the Application	0.5
3	Total	1.0
4	Chapter 5: Control Task Basics	1.0
	Chapter 6: Basic Memory Circuits	2.0
	Chapter 7: Timers, Counters and T/C Applications	1.0
	Chapter 8: Math Functions	1.0
	Chapter 11: Use of State Diagram	1.0
	Chapter 12: Handling Data	1.0
	Chapter 13: Indexing – Batching Applications	1.0
4	Total	8.0
5	Chapter 4: Programming the Application	0.5
	Chapter 10: Sensors, Safety and Analog	0.5
5	Total	1
6	Ladder Basics	1
6	Total	1
7	Chapter 7: Timers, Counters and T/C Applications	1.0
	Chapter 11: Use of State Diagram	1.0
7	Total	2.0
8	Chapter 8: Math Functions	1.0
8	Total	1.0
9	Chapter 16: Networks and Protocol	1.0
9	Total	1.0