Summer 5-15-2020

MET 415-450: Automatic Control Systems

Majd Awad

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New Jersey Institute of Technology
Department of Engineering Technology
MET 415 Automatic Control Systems

COURSE NUMBER  MET 415
COURSE NAME   Automatic Control Systems
COURSE STRUCTURE  2-2-3 (lecture hr/wk - lab hr/wk – course credits)
COURSE COORDINATOR/INSTRUCTOR  Dr. A. Sengupta / Majd Awad

COURSE DESCRIPTION  Introduction to programmable logic controllers (PLC) as a tool for industrial controls of machines and process. Includes selections of hardware and software, ladder logic programming, wiring methods, maintenance and trouble shooting of.

PREREQUISITE(S)  MET senior standing

COREQUISITE(S)  None

REQUIRED, ELECTIVE OR SELECTED ELECTIVE  Required

REQUIRED MATERIALS  


COURSE LEARNING OUTCOMES(CLO)  By the end of the course students should be able to:
1. Develop simple PLC programs using basic PLC functions.
2. Develop PLC Ladder Diagrams.
3. Design and develop a PLC automated process.
4. Prepare and present a technical report.

CLASS TOPICS  PLC Memory, CPU, Interfaces, PLC Boolean Algebra, PLC Logic PLC Programming Procedures, Input and Output Ports, PLC Timer and Counter Functions, PLC Arithmetic, Conversion and
New Jersey Institute of Technology  
Department of Engineering Technology  
MET 415 Automatic Control Systems

Comparison Functions, PLC Shift Register and Sequencer Functions, Creating Ladder Diagrams from Process-Control, Program Control Instructions, Analog PLC Instructions, PID Controller, Selecting PLC’s, PLC Installation, Automation and selection of components, LAB Research Presentation:

Automation Project: Each group will design and develop an automated process, using PLCs, which will provide robotic and/or processes functions and PLC functions. A Project Report will be developed and presented to the class.

Research Presentation Each group will investigate a computer driven automated processes using PLC, determine its functions and specifications. Results will be presented to the class via PowerPoint.

**STUDENT OUTCOMES**  
The Course Learning Outcomes support the achievement of the following MET Student Outcomes and TAC of ABET Criterion 9 requirements:

**Student Outcome a** - an ability to select and apply the knowledge, techniques, skills, and modern tools of the discipline to broadly-defined engineering technology activities  
**Related CLO – 1, 2**

**Student outcome 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;  
**Related CLO – 1, 2**

**Student outcome c** - an ability to conduct standard tests and measurements; to conduct, analyze, and interpret experiments; and to apply experimental results to improve processes;  
**Related CLO – 4**

**Student Outcome d** - an ability to design systems, components, or processes for broadly-defined engineering technology problems appropriate to program educational objectives.  
**Related CLO – 3**

**Student Outcome e** - an ability to function effectively as a member or leader on a technical team.  
**Related CLO – 3, 4**
Student outcome f - an ability to identify, analyze, and solve broadly-defined engineering technology problems
Related CLO – 1, 2

Student Outcome g - an ability to communicate effectively regarding broadly-defined engineering technology activities
Related CLO – 4

Student Outcome m - technical expertise having added technical depth in mechanical design, solid mechanics, and electro-mechanical devices and controls.
Related CLO - 1-4

<table>
<thead>
<tr>
<th>Grading Policy</th>
<th>Homework 15 %</th>
<th>PLC Exercises 20 %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Note: Grading Policy</td>
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<tr>
<td>may be modified by</td>
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<tr>
<td>Instructor for each</td>
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<tr>
<td>Section in the Course)</td>
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<tr>
<td>PLC Project 25 %</td>
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<tr>
<td>Two Quizzes 20 %</td>
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<tr>
<td>Final Exam 20 %</td>
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Note: There are two quizzes during the semester. There will be no makeup quizzes.

ACADEMIC INTEGRITY
NJIT has a zero-tolerance policy regarding cheating of any kind and student behavior that is disruptive to a learning environment. Any incidents will be immediately reported to the Dean of Students. In the cases the Honor Code violations are detected, the punishments range from a minimum of failure in the course plus disciplinary probation up to expulsion from NJIT with notations on students' permanent record. Avoid situations where honorable behavior could be misinterpreted. For more information on the honor code, go to http://www.njit.edu/academics/honorcode.php
New Jersey Institute of Technology
Department of Engineering Technology
MET 415 Automatic Control Systems

**Student Behavior**
- No eating or drinking is allowed at the lectures, recitations, workshops, and laboratories.
- Cellular phones must be turned off during the class hours – if you are expecting an emergency call, leave it on vibrate.
- No headphones can be worn in class, unless allowed by the professor.
- Unless the professor allows the use during lecture, laptops should be closed during lecture.
- During laboratory, if you are finished earlier, you must show the professor your work before you leave class.
- Class time should be participative. You should try to be part of a discussion.

**Modification to Course**
The Course Outline may be modified at the discretion of the instructor or in the event of extenuating circumstances. Students will be notified in class of any changes to the Course outline.

**Prepared by**
Majd Awad

**Course Coordinated by**
Dr. A. Sengupta

**Class Hours**
Tuesday 5:45 PM – 9:50 PM
Instructor
Scheduled
Webex Meeting

**Office Hours (GITC 2113)**
By appointment: mga3@njit.edu

**Homework, PLC Exercises, & Project - Important**

Homework
1. Homework is due at the beginning of the class period, one week after it is assigned.
2. Late homework will be penalized one problem grade per week. Assignments more than one week late will not be accepted.
3. Homework will not be accepted after graded homework has been returned or reviewed.
4. Homework must be submitted in sets, arranged in order as in course outline. Sets must be stapled together in the upper left hand corner.
PLC Lab Exercises

1. Lab exercises must be demonstrated during the lab, and write up due at the beginning of the class period, one week after it is assigned.
2. Late Lab exercises will be penalized minus 25% each week. Assignments more than one week late will not be accepted.
3. PLC exercises must be submitted in sets, arranged in order as in course outline. Sets must be stapled together in the upper left hand corner.

Automation Final Project

1. The final project is due on the date indicated. No late projects will be accepted.
2. The Project should be submitted in the format provided by the professor.

SYNCHRONOUS ONLINE INFORMATION

The instructor will discuss these requirements on the first day of the course and/or post on their Learning Management System (LMS). Please become familiar

- Webex: http://ist.njit.edu/webex
- Online Proctoring: https://ist.njit.edu/online-proctoring/

GRADING LEGEND

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<tr>
<th>GRADE</th>
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<tr>
<td>A</td>
<td>90 to 100</td>
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<td>B+</td>
<td>85 to 89</td>
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<tr>
<td>B</td>
<td>80 to 84</td>
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<td>C+</td>
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<td>C</td>
<td>70 to 74</td>
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<td>D</td>
<td>60 to 69</td>
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<td>F</td>
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</tr>
</tbody>
</table>
# New Jersey Institute of Technology
## Department of Engineering Technology
### MET 415 Automatic Control Systems

## MET 415 - Course Outline

<table>
<thead>
<tr>
<th>WEEK</th>
<th>DATE</th>
<th>TOPICS</th>
<th>SECTIONS</th>
<th>ASSIGNMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5/19</td>
<td>Introduction to Electronics &amp; PLCs</td>
<td>1.1-1.3</td>
<td>PLC Exercise 1</td>
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<tr>
<td></td>
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<td>Fundamentals of Ladder Logic Programming</td>
<td>5.6, 5.8-5.10</td>
<td>Ch. 1 Review Questions: 1, 3, 10</td>
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<td>Ch. 5 Review Questions: 7</td>
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<td>Lab Manual vii-xii</td>
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<td>2</td>
<td>5/26</td>
<td>Application Development Part 1</td>
<td>5.1-5.5</td>
<td>PLC Exercise 2</td>
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<td>PLC Addressing</td>
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<td>Ch 5 Problems: 1</td>
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<td>Lab Manual:1-2 through 1-5</td>
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<tr>
<td>3</td>
<td>6/2</td>
<td>Application Development Part 2</td>
<td>Chapter 7</td>
<td>PLC Exercise 3</td>
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<td>PLC Timers</td>
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<td>Lab Manual: 7-12</td>
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<td>App Development Hmwk Part 1 (due week 6)</td>
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<td>4</td>
<td>6/9</td>
<td>Quiz No. 1</td>
<td>Class Handouts</td>
<td>PLC Exercise 4</td>
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<td>PLC Motor Control</td>
<td>6.1-6.3</td>
<td>Lab Manual: 6-15</td>
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<td>Class Project Assigned</td>
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<tr>
<td>5</td>
<td>6/16</td>
<td>PLC Counters</td>
<td>Chapter 8.1-8.4</td>
<td>Lab Manual: 8-3</td>
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<td>PLC Pneumatic Cylinder Control</td>
<td>Class Handouts</td>
<td>PLC Exercise 5</td>
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<td>6</td>
<td>6/23</td>
<td>Event Sequencing</td>
<td>6.10-6.11</td>
<td>PLC Exercise 6</td>
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<td>Lab Manual: 7-26</td>
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| 7    | 6/30 | Overview of Number Systems. | Chapter 3 6.4-6.6 | PLC Exercise 6  
Industrial Sensors. |  
Human Machine Interfaces. | PLC Exercise 7  
Ch. 3 Review Questions: 1-7  
Lab Manual: 7-17 |
| 8    | 7/7  | Quiz No. 2 | 9.1-9.3  
Installation & Wiring Automation Safety.  
PLC Stop Functions. | Lab Manual 8-32  
Ch. 13 Review Questions 1,2,7  
App Development Hmwk Part 2 due Week 11 |
| 9    | 7/14 | Sub-Routine & Jump. | 9.6  
Analog Sensors  
Stepper & Servo Motors. | PLC Exercise 8  
PLC Exercise 9  
Lab Manual 6-11(a) |
|      |      | Math Instructions | 11.1-11.6 | PLC Exercise 10  
Lab Manual 11-4 |
| 11   | 7/28 | Class Presentations | | Class Project Due |
| TBD  |      | FINAL EXAM | | |