



Philadelphia University - Faculty of Engineering
MSc. – Mechatronics Engineering Department
First Semester 2014/2015

Course Syllabus	
Course Title:	Advanced PLC (640742).
Text Book:	Programmable Logic Controllers: An Emphasis on Design and Application Second Edition, by Kelvin T. Erickson, 2011
Class Time:	Tuesday 15:00-18:00
Instructor:	Dr. Mohammed Bani Younis
email	mbaniyounis@philadelphia.edu.jo
website	http://www.philadelphia.edu.jo/academics/mbaniyounis/
Prerequisites	BS degree in Mechatronics or related fields
Office Hours:	Sun. Tue. Thurs. : 13:00-15:00

Course Description

This course is designed to provide an in depth understanding of the PLC Networking, Analog systems, advanced instruction set features, communications, diagnostics, modem and internet connections, remote I/O, Ethernet, motion control. Formal methods are introduced during this course to encourage the students to design a control algorithm. Formal methods are also important to verify and validate the control algorithm before implementing it. Distributed control and automation (DCS) according to IEC 61499.

Learning outcomes / competencies

On completing the course, students will be able to have the following skills:

- Knowledge and understanding
 - A1. Understand formal methods and their use in designing a PLC programs.
 - A2. Understanding new technologies related to PLCs, such as motion control, Ethernet and Internet Communication, and DCS.
- Intellectual skills
 - B1. Able to formulate strategies for solutions to advanced engineering problems based on the formal methods taught.
 - B2. Able to choose appropriate tools and PLC algorithms to implement a control system.
- Professional and practical skills
 - C1. Able to apply advanced PLC methods in engineering problems.
 - C2. Enable the students to create and formalize complex problems through the use of formal methods.
- General and transferrable skills
 - D1. To get hand-on experience in PLCs to build control algorithms.
 - D2. Communicate solutions adequately

week	Topics
1	Introduction to Programmable Controllers Definition, PLC History, Operation Principles, Ladder Diagrams, PLC advantages Processors and Power Supply Processors, Process Scan, System Power Supply, Error Checking, Programming Devices Memory Systems and I/O Interaction Memory Overview, Structure, and Organization, Configuration, and I/O Interaction (Reference 1: chapters 1,4, 5)
2	Discrete Input / Output System I/O Racks, PLC I/O Instructions, Discrete I/O Types Analog Input / Output System Analog I/O Instructions, I/O Data Representation and Handling (Reference 1: chapters 6,7)
3	PLC Programming Types of PLC Languages, Ladder Diagram Format Ladder Relay Programming Timers and Counters Flow Control Instructions (Reference 1: chapters 9)
4	The process for control designing (Reference 2: chapters 2)
5	Basic formal interpretations (Reference 2: chapters 2)
6	Realization of control, Textual and Graphic standard-programming-language (Reference 2: chapters 2)
7	Signal Interpreted Petri Net (SIPN) (Reference 2: chapters 3)
8	Analysis of SIPN, Verification and Validation (V&V) (Reference 2: chapters 3)
9	V&V of SIPN (Reference 2: chapters 4)
10	Conversion from SIPN to standard-programming-language (Reference 2: chapters 4)
11	Software quality (Reference 2: chapters 5)
12	Distributed Control (Reference 3)
13	Motion Control (Reference 4)
14	PLC communications (Reference 5)
15-16	Modem and Internet Connections, Remote I/O, Ethernet (Reference 5)

Teaching Method:

Lectures, tutorials, problem solving, modeling, and self-studies.

Grade Distribution	
Mid Examination	30 %
Assignments, study cases	30 %
Final Exam	40 %

References:

1. Programmable Controllers: Theory and Implementation, 2nd edition, By Bryan and Bryan. Industrial Text Company Publications
2. Design and formal analysis of Petri net based logic control algorithms by Georg Frey, 2002.
3. Modelling Control Systems Using IEC 61499. Applying Function Blocks to Distributed Systems (IEE Control Engineering, R. W. Lewis, Robert Lewis, R. W. Burns
4. PLCopen Motion Control Part1, Technical Specification, PLCopen - Technical Committee 2 – Task Force, Function blocks for motion control, Version 1.1, 2005.
5. Practical Data Communications for Instrumentation and Control Search, by Park, John; Mackay, Steve; Wright, Edwin, 2010