	Department of Mechanical Power Engineering	Cairo University Faculty of Engineering	

Course Specifications

Program(s) on which this course is given	Bachelor Degree of Mechanical Power Engineering
Department offering the program	Mechanical Power Engineering
Department offering the course	Mechanical Power Engineering
Academic Level	Fourth Year
Date	2023-2024
Semester(based on final exam timing)	Fall Spring √

A- Basic Information

1. Title:	Application of PLC in Automatic Control Systems			**Code:**	MEP 4023 (New 2018 Bylaws)			
2. Units/Credit hours per week:	Lectures	1	Tutorial	2	Practical	**1**	Total	4

B- Professional Information

1. Course description:

Overview:

This is a specialized elective course for students in the last year of Mechanical Power Engineering Program. It is designed to help students understand, effectively, the basics of process control and the applications of industrial PLC systems. It provides students skills and knowledge to PLC components. The objective is to prepare students to implement a PLC system from beginning to the end, including the planning and design of hardware & soft-ware parts. **1st part of the course** covers essential basics of PLC control systems such as Input/Output devices, types of PLC memory and types of various advanced modules used in PLC systems. **2nd part of this course covers** PLC programming and various solution methods for a very large number of practical control problems. The blended lectures, the distributed notes, the practical sheets and reports and many self-study references provide a professional tool for studying and analyzing various aspects related to using industrial applications of PLC for automatic control of various types of mechanical power systems.

2. Learning Outcomes of Course (LOs):

a) Knowledge and Understanding:

Having successfully completed this course, the student should have knowledge and understanding of:
- Basics of process sequential control and practical applications of industrial PLC Systems.
-Major functions and various components and expansion modules of different types of PLC systems.
-Types of PLC discrete or analog inputs/outputs signals and operation of PLC timers and counters.
- Structure of PLC languishes for the Ladder logic, statement list, and function block diagrams.

b) Intellectual Skills:

Having successfully completed this course, the student should have the ability to:
-Select and apply appropriate technical and optimum method in doing engineering design and analysis of automatic control problems.
-Searching for scientific/technical information and adopting PLC automatic control capabilities.
-Analyze & compare various PLC components, performance & tech. specifications of different PLCs
-Apply the concept of Ladder logic simulation, PLC diagnostics and the operation of PLC system.
-Compare between practical measurement devices, transducers and methods for signal conditioning, data acquisition and different output displaying/processing systems of PLC systems.
- Solve practical examples on using PLC systems for automatic control problems.
-Study, describe and compare between different PLC types, models and programming languishes.

c) Professional and Practical Skills:

Having successfully completed this course, the student should have the ability to:
-Identify various types of field devices (sensors, actuators and final control elements) which are essential for the operation of PLC automatic control systems.
-Suggest possible alternative sensors, actuators and final control elements for PLC systems.
-Diagnose all possible operation modes, configuration and diagnostics of PLC systems.
- Design, select, apply and implement various examples of PLC automatic control systems.
- Diagnose failure and automatic control problems of industrial PLC automatic control systems.
- Monitor and evaluate performance of different parts and components of PLC control systems.

d) General and Transferable Skills:

Having successfully completed this course, the student should have the ability to:
-Perform engineering calculations, draw feed-back control circuits, block diagrams, graphical presentation of experimental data, and perform data-regression analysis.
-Transfer knowledge, Work in group, and Communicate in written and oral forms, in English.
- Use IT and evolutionary technological tools and PC applications (Excel, Mat lab, Virtual labs, .etc).
- Prepare and write reports, Manipulate and sort data, Think logically, and continuous self-E-learning.

	- Identify practical problems, compare between different technologies for measurement systems. -Organise and manage time and resources effectively; for short-term and longer-term commitments. ********** Short Learning Outcomes as per NARS 2018 1. Recognize differences between continuous control systems or conventional DCS and the contemporary discrete/digital control systems which are computer-based programmable controllers (PLCs). 2. Comprehend the basics and essentials of discrete control systems using common PLC control systems. 3. Identify major components of industrial PLC systems and describe their control functions and objectives. 4. Identify types of discrete/analog inputs/outputs and describe operation method of timers and counters. 5. Read, understand and write types of basic ladder logic, statement list and Function Block diagrams. 6. Identify operational and technical differences between various types of PLC devices and models. 7. Identify proper technical manual to refer to for PLC installation, programming and implementation**.** 8. Exchange knowledge with engineering community. 9. Work in stressful environment and within constraints. 10. Communicate effectively, Effectively manage tasks and resources, Refer to relevant literature

3. Contents

Topic	Total No. of hrs	*Lecture*	Tutorial & Practical
Introduction- Define a PLC system- Differences between continuous control systems or conventional DCS and the contemporary discrete/digital control systems which are computer-based Programmable Logic controllers (PLCs). Types of PLCs- Identifying major and expansion components, functions and applications of industrial PLC system. Basics of electric components in PLC circuits (Sensors, transducers, keys, Relays, Contactors)- Basics and essentials of discrete control systems using common control systems. Types of Analog and Digital Signals-Pneumatic Logical Elements- Types of Memories: ROM, RAM, EPROM and EEPROM -Identify types and describe operation modes of timers & counters. PLC Programming-Read, understand and write types of basic ladder logic, statement list & Function Block diagrams. Identify operational and technical differences between various types PLC devices & models. Identify proper technical manual to refer to for PLC installation, programming & implementation. Expanding of PLCs-Selection &connection for proper expansion modules & various types of PLC analog inputs/outputs	56 hrs	1hr/week for 14 weeks before The Final Term Exam	3hr/week for 14 weeks before The Final Term Exam
Time for Preparing for the term exam	4	1	3
Total teaching hours in 15 weeks (+1 office hr/wk)	**60**	**15**	**45**

4. Teaching and Learning Methods	Lectures (√)	Practical Training/ Virtual Laboratory (√)	Seminar/Workshop (x)
	Class Activity (√)	Case Study/Reports (√)	Projects (x)
	E-learning (√)	Assignments /Homework (√)	Other: Reports

Also for Teaching and Learning: انظرأيضاً ملف نظام الدراسة الهجين والتعليم الذاتى للمقرر

- Lectures and problem solving in tutorial classes.
- Information collection from text material, class notes and the Internet sites.
- Report and research assignments. Various assignment Sheets (1, 2, 3 up to 9)
- Group discussions in lectures and tutorial classes.
- Hand-outs materials.

5. Student Assessment Methods:

• **Assessment Schedule**	**Week**
-Assessment 0: Sheet-0	Week # 2
-Assessment 1; Sheet-1	Week # 3
-Assessment 2; Sheet-2	Week # 4
-Assessment 3; Sheet-3	Week # 5
-Assessment 4; Sheet-4	Week # 6
-Assessment 5; Sheet-5	Week # 7
Mid-term Exam	Week # 8
-Assessment 6; Sheet-6	Week # 9
-Assessment 7; Sheet-7	Week # 10
-Assessment 8; Sheet-8	Week # 11
-Assessment9; Sheet-9	Week # 12
Review General Report	Week # 13
Final Term Exam to assess gains of all completed topics and the entire course LO's.	End of the Term

- **Weighting of Assessments**

Assignments & class performance	15 pts
Attendance & Written Reports	5 pts
Mid-term Exam	20 pts
Final-term Examination	60 pts
-Total	100 pts

6- List of References (Note that this is a Partial Self-Study and Blended Learning Course):

1- Several Class Notes, Reports, and Self-study Materials prepared by the Course Instructor.
2-"Programmer's Reference, Revision 1.1" Software-i-TRiLOGI Version 6.45, Tri-TRIANLE RESEARCH INTERNATIONAL
3-iTRiLOGI Tutorial – Getting Started.mp4 38.3 MB MPEG-4 Video.
4-"Automating Manufacturing Systems with PLCs" Version 4.2, 2003, Huge Jack, Copyright©1993-2003 (jack@gvsu.edu), http://clay-more.engineer.gvsu.edu/~jackh/books.html
5-"A PLC Primer" ©1999 by Industrial Text & Video Company, www.industrialtext.com
6-"Basics of PLCs, S7-200 PLCs", the STEP series, Siemens Technical Education Program, Siemens AG.
7-"Control_electricity.pdf" digital manual from the "Regulating" industry, Basic Omron FA & CC products.
8-"S7-200_Simulator Software_V3", from Siemens AG.

ملاحظة: يوجد عدد كبير من المادة العلمية والأمثلة المحلولة والأفلام والمراجع للمقررموجودة على موقع معمل التحكم acc-vlab.cu.edu.eg

7. Facilities Required for Teaching and Learning: Data Show, Laptop Computer and access to the net.

Course Coordinator:	**Associate Prof. Mohsen S. Soliman**
Head of Department:	**Prof. Dr. Sayed Kaseb**
Date:	**February 2024**