

Government of Karnataka
Department of Technical Education
Board of Technical Examinations, Bengaluru

Course Title: Programmable Logic Controller Lab		Course Code: 15MC55P
Mode (L:T:P) : 0:2:4	Credits :3	Core/ Elective: Core
Type of course: Tutorials and Practical's		Total Contact Hours: 78
CIE- 25 Marks		SEE- 50 Marks

Prerequisites: Knowledge of BEEE, PLC Programming, Digital Electronics, Fluid Pneumatics.

Course Objectives: understand ladder programming, interface and develop PLC program for broadly defined engineering applications.

Course Outcomes: At the end of the course, students should be able to

1. Develop and execute ladder programs for given Engineering applications.
2. Interface PLC with hardware for given Engineering applications.

Course Outcome		Cognitive Level	Linked with PO	Teaching Hours
CO1	Develop and execute ladder programs for given applications	A	2,3,4	60
CO2	Interface PLC with hardware for given applications	A	2,3,4	18
		Total sessions		78

Legend: R; Remember, U: Understand A: Application

Mapping of Course Outcomes with Program Outcomes

Course	Programme Outcomes									
	1	2	3	4	5	6	7	8	9	10
Programmable Logic Controller Lab	-	3	3	3	-	-	-	-	-	-

Contents

1. Develop a PLC ladder diagram to construct an alarm system which operates as follows
 - . If one input is ON nothing happens
 - . If any two inputs are ON, a red light goes ON
 - . If any three inputs are ON, an alarm sirens sound
 - . If all are ON, the fire department is notified.
 2. Develop a PLC program using ladder diagram for start-stop jog.
 3. Develop a PLC program using ladder diagram for Forward-reverse-stop with mutual interlocks
 4. Develop PLC ladder diagram to realize the following logic gates.
AND, OR, NOT, NAND, NOR, EX-OR.
 5. Develop the following Boolean expressions in to ladder diagram and realize
 - I) $[(P + \overline{Q} + R).(U + V). \overline{W}.X] + (S + T).Y = Z.$
 - II) $\overline{B}.(\overline{C}.\overline{(\overline{D} + E + \overline{C})} + \overline{F}.C) = A.$
 6. In certain process control application a fan is to run only when all of the following conditions are met
 - . Input **A** is OFF
 - . Input **B** is ON or i/p **C** is ON, or both **B** & **C** are ON
 - . Inputs **D** & **E** both are ON
 - . One or more of inputs **F**, **G**, or **H** is ON
- Develop Gate logic, equivalent Boolean expression & realize the same using PLC ladder diagram
7. Develop a PLC ladder diagram to realize the following Timer operation. Write timing diagrams.
 - i) One shot operation
 - ii) Limited ON time
 8. There are 3 mixing devices on a processing line **A**, **B**, **C**. After the process begin mixer-**A** is to start after 7 seconds elapse, next mixer-**B** is to start 3.6 second after **A**. Mixer-**C** is to start 5

seconds after B. All then remain ON until a master enable switch is turned off. Develop PLC ladder diagram, timing diagram and realize the same.

9. An indicating light is to go ON when a count reaches 23. The light is then go off when a count of 31 is reached. Develop, construct, and test PLC circuits for this process.

10. In certain process control application when the count reaches 25, a paint spray is to run for 40 seconds. Develop, construct, and test PLC circuits for this process.

11. Develop a Ladder diagram for the forward and reverse movement of a piston in pneumatic cylinder. The Ladder diagram should consist of 2 input Push button switches I1 and I2. The output O1 and O2 of PLC are connected to Forward and retract Coil of the Pneumatic Cylinder.

12. In bottling plant of cool drinks the bottles are kept on the conveyor. Some bottles are capless, so these bottles are to be removed from the conveyor. I1 and I2 are two toggle switches connected to input unit of PLC. I1 is used to operate (ON) the conveyor and I2 is used to stop (OFF) the conveyor at any time. O1 is the output used to operate the conveyor. S2 is the Proximity Switch which predicts that metal cap is not present on the bottle top. Use I3 switch to operate the conveyor after the removal of capless bottle from the conveyor. Develop the Ladder diagram to achieve the above Industrial Scenario.

13. There are 4 cars parking spaces. Car is to be detected and allowed to enter into the parking space if space is available. I1 is the proximity switch at the gate for detecting the presence of Car. I2, I3, I4, I5 are proximity switches which are installed at suitable places in 4 parking spaces. When the car is parked in a parking place, presence of Car is indicated by corresponding output O2, O3, O4, O5 (by glowing the Output). If space is vacant the corresponding light will not glow and the car owner will have to go in that parking place. Develop the Ladder diagram to achieve the above Scenario.

14. Develop and Interface a PLC program for the following real time applications

- i) Traffic light controlling
- ii) Water level controlling

References

1. "Programmable Logic Controllers Principles & Applications" by John W. Webb – Ronald A. Reis, 5th Edition, Published by PHI Publication.
2. Exploring Programmable Logic-Controllers with Applications by Pradeep Kumar Srivastava, BPB PUBLICATIONS.

Contents linked with CO and PO

Sl No	Contents	CO	PO
1	Develop a PLC ladder diagram to construct an alarm system which operates as follows . If one input is ON nothing happens . If any two inputs are ON, a red light goes ON . If any three inputs are ON, an alarm sirens sound . If all are ON, the fire department is notified	1	2,3,4
2	Develop a PLC program using ladder diagram for start-stop jog.	1	2,3,4
3	Develop a PLC program using ladder diagram for Forward-reverse-stop with mutual interlocks	1	2,3,4
4	Develop PLC ladder diagram to realize the following logic gates. AND, OR, NOT, NAND, NOR, EX-OR.	1	2,3,4
5	Develop the following Boolean expressions in to ladder diagram and realize I) $[(P + \overline{Q} + R).(U + V).\overline{W}.X] + (S + T).Y = Z.$ II) $\overline{B}.(C.(\overline{D} + E + \overline{C}) + \overline{F}.C) = A.$	1	2,3,4
6	In certain process control application a fan is to run only when all of the following conditions are met . Input A is OFF . Input B is ON or i/p C is ON, or both B & C are ON . Inputs D & E both are ON . One or more of inputs F, G, or H is ON Develop Gate logic, equivalent Boolean expression & realize the same using PLC ladder diagram.	1	2,3,4
7	Develop a PLC ladder diagram to realize the following Timer operation. Write timing diagrams. i) One shot operation ii) Limited ON time	1	2,3,4
8	There are 3 mixing devices on a processing line A,B,C. After the process begin mixer-A is to start after 7 seconds elapse, next mixer-B is to start 3.6 second after A. Mixer-C is to start 5 seconds after B. All then remain ON until a master enable switch is turned off. Develop PLC ladder diagram, timing diagram and realize the same.	1	2,3,4
9	An indicating light is to go ON when a count reaches 23. The light is then go off when a count of 31 is reached. Develop, construct, and test PLC circuits for this process.	1	2,3,4
10	In certain process control application when the count reaches 25, a paint spray is to run for 40 seconds. Develop, construct, and test PLC circuits for this process.	1	2,3,4
11	Develop a Ladder diagram for the forward and reverse moment of a	1	2,3,4

	piston in pneumatic cylinder. The Ladder diagram should consist of 2 input Push button switches I1 and I2 .The output O1 and O2 of PLC are connected to Forward and retract Coil of the Pneumatic Cylinder.		
12	In bottling plant of cool drinks the bottles are kept on the conveyor. Some bottles are capless ,so these bottles are to be removed from the conveyor. I1 and I2 are two toggle switches connected to input unit of PLC. I1 is used to operate (ON) the conveyor and I2 is used to stop (OFF) the conveyor at any time. O1 is the output used to operate the conveyor. S2 is the Proximity Switch which predicts that metal cap is not present on the bottle top. Use I3 switch to operate the conveyor after the removal of capless bottle from the conveyor. Develop the Ladder diagram to achieve the above Industrial Scenario.	1	2,3,4
13	There are 4 cars parking spaces .Car is to detected and allowed to enter into the parking space if space is available. I1 is the proximity switch at the gate for detecting the presence of Car. I2, I3, I4, I5 are proximity switches which are installed at suitable places in 4 parking spaces. When the car is parked in a parking place , presence of Car is indicated by corresponding output O2,O3,O4,O5 (by glowing the Output) .If space is vacant the corresponding light will not glow and the car owner will have to go in that parking place. Develop the Ladder diagram to achieve the above Scenario.	1	2,3,4
14	Develop and Interface a PLC program for the following real time applications i) Traffic light controlling ii) Water level controlling	2	2,3,4

Scheme of valuation for SEE

S I. No.	Performance	Max. Marks
1	Writing two Ladder diagrams.	10.
2	Entering two programs in computer system	10.
3	Simulation\Execution	10.
4	Result	10
5	Viva - Voce	10
	Total	50

Student Activity

Activity No.	Description of Student Activity
1	Prepare the hand written report on various sensors, actuators, transducers used in industrial automation.
2	Students can make models of Programmable Logic Controller applications beyond the curriculum.

Note:

1. Group of max four students should do any one of the above activity or any other similar activity related to the course COs and get it approved from concerned Teacher and HOD.
2. No group should have activity repeated or similar
3. Teacher should ensure activities by different groups must cover all Cos.
4. Teacher should assess every student by using suitable **Rubrics** approved by HOD

Sample Rubrics

Dimension	Exemplary	Accomplished	Developing	Beginning	Roll No. of the Student				
	5/4	3	2	1	1	2	3	4	5
Organization	Information presented in logical, interesting sequence	Information in logical sequence	Difficult to follow presentation-- student jumps around	Cannot understand presentation-- no sequence of information	Ex: 2				
Subject Knowledge	Demonstrates full knowledge by answering all class questions with explanations and elaborations	At ease with expected answers to questions but does not elaborate	Uncomfortable with information and is able to answer only rudimentary questions	Does not have a grasp of the information. Cannot answer questions about subject	3				
Graphics	Explain and reinforce screen text and presentation	Relate to text and presentation	Occasionally uses graphics that rarely support text and presentation	Uses superfluous graphics or no graphics	4				
Oral Presentation	Maintains eye contact and pronounces all terms precisely. All audience members can hear	Maintains eye contact most of the time and pronounces most words correctly. Most audience members can hear presentation	Occasionally uses eye contact, mostly reading presentation, and incorrectly pronounces terms. Audience members have difficulty hearing	Reads with no eye contact and incorrectly pronounces terms. Speaks too quietly	5				
Total Score=(2+3+4+5)=14/4=3.5=4									

Course Assessment Pattern

Particulars			Max Marks	Evidence	Course outcomes
Direct Assessment	CIE	Two tests (Average of Two tests)	10	Blue books	1 &2
		Practical record	10	Practical record	1 &2
		Student Activity	05	Student Activity Sheets	1 &2
	SEE	End of the course	50	Answer scripts at BTE	1 &2
Indirect Assessment	Student Feedback on course	Middle of the course		Feedback forms	1 &2
		End of the course		Feedback forms	1 &2

*CIE – Continuous Internal Evaluation

*SEE – Semester End Examination

Note:

1. I.A. test shall be conducted as per SEE scheme of valuation. However obtained marks shall be reduced to 10 marks. Average marks of two tests shall be rounded off to the next higher digit.
2. Rubrics to be devised appropriately by the concerned faculty to assess Student activities.

List of Equipments

1. PLC Trainer Kits with interfacing facility
2. Interfacing modules.
 - 2.1 Traffic light controller
 - 2.2 Water level controller