



COLLEGE OF ENGINEERING, SCIENCE & TECHNOLOGY

**SCHOOL OF ELECTRICAL & ELECTRONIC
ENGINEERING.**

TRADE DIPLOMA IN ELECTRICAL ENGINEERING

Course Code: EEE520

Course Name: PROGRAMMABLE LOGIC CONTROL.

FINAL EXAMINATION - SEMESTER 1, 2019.

TIME: 3 HOURS AND 10 MINUTES

ROOM: AS PER TIMETABLE

INSTRUCTIONS TO STUDENTS

1. *You are allowed 10 minutes Extra reading time during which you are NOT to write.*
2. *Begin each answer on a fresh page and use both sides of the sheet.*
3. *Write your candidate-number at the top of each attached sheet.*
4. *Insert all written sheets in their correct sequence and secure with string.*
5. *For all sheets of paper on which rough/draft work has been done, cross it though and you MUST ATTACH to your answer scripts.*
6. *Write clearly the number(s) of the question(s) attempted on the top of each sheet.*
7. **ANSWER ALL QUESTIONS.**
8. *Show all workings where necessary.*
9. *Do not use programmable calculators, especially the ones that does the conversions of number systems.*
10. **CHECK YOUR WORK BEFORE YOU LEAVE THE ROOM!**

SECTION A:

PART 1: MULTIPLE CHOICE

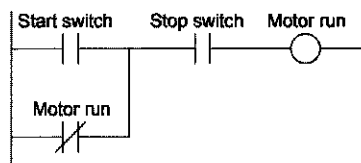
(20 marks)

Instructions:

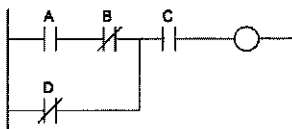
Select the appropriate answers of each question by identifying the suitable alphabet(s).

1. In a PLC, the scan time refers to the amount of time in which...
 - a. the technician enters the program
 - b. timers and counters are indexed by
 - c. one "rung" of ladder logic takes to complete
 - d. the entire program takes to execute
 - e. transmitted data communications must finish

2. Identify the problem in this motor control PLC program:



- a. Coil
 - b. Start contact
 - c. Seal-in contact
 - d. Stop contact
 - e. Power source
3. The Boolean representation of this PLC program is:



- a. $ABC + D$
 - b. $C + (A + B)D$
 - c. $C + D(A + B)$
 - d. $ABC + BD$
 - e. $C(AB + D)$
4. The difference between online and offline PLC programming is . . .
 - a. whether the PLC is running or stopped
 - b. whether the programming PC has internet connectivity
 - c. the type of programming cable used
 - d. where the edited program resides
 - e. the type of programmer used
 5. Name the Omron software that is used to simulate the PLC program in the lab.
 - a. CX-2
 - b. CX-1
 - c. CX-12
 - d. CP1L-1
 - e. CP1M-1
 6. What is the equivalent of $1F3A_{16}$ in binary?
 - a. 0001 1111 0011 1010 (7994 Decimal)
 - b. 0011 0001 1111 1010 (12794 Decimal)
 - c. 1000 1111 1100 0101 (36805 Decimal)
 - d. 0001 0011 1111 1010(5114 Decimal)

- e. 1010 0011 1111 0001 (41969 Decimal)
7. An OR function implemented in ladder logic uses:
- a. Normally-closed contacts in series
 - b. Normally-open contacts in series
 - c. A single normally-closed contact
 - d. Normally-open contacts in parallel
 - e. Normally-closed contacts in parallel
8. One word is equal to _____ bits
- a. 8
 - b. 15
 - c. 16
 - d. 0 to 7
 - e. 9
9. Solenoids, lamps, motors are connected to:
- a. Analog output
 - b. Digital output
 - c. Analog input
 - d. Digital input
 - e. Both input and output
10. Which device has following description?
"When S turns ON, the designated bit will go ON and stay ON until reset, regardless of whether S stays ON or goes OFF. When R turns ON, the designated bit will go OFF."
- a. Counter
 - b. Keep
 - c. Set and reset
 - d. Timer
 - e. Relay

PART 2: Short Answer Questions

(25 marks)

1. Figure 1 shows an electromechanical relay circuit. For the circuit shown in Figure 1,
 - a. Identify the real inputs and outputs by circling each (5 Marks)
 - b. Assign the I/O addresses (8Marks)
 - c. Assign the internal addresses (if required) (5 Marks)
 - d. Draw the I/O connection diagram (7 Marks)

Assume that the PLC used has a modularity of 8 points per module. Each rack has 8 module slots, and the master rack is number 0. Inputs and outputs can have any address as long as the correct module is used. The PLC determines whether an input or output module is connected in a slot. The number system is octal, and internals start at address 1000₈

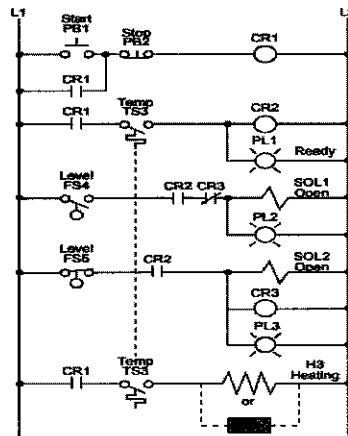


Figure 1: Electromechanical Relay Circuit

Hint: Use this table

Module Type	I/O Address			Description
	Rack	Group	Terminal	
Input				
Spare	0	1	0	Not Used
	.	.	.	
	.	.	.	
	0	1	7	
Output				

Table 1: I/O Address Assignment

SECTION B

(35 Marks)

Instruction:

Answer all questions.

Question 1

(10 Marks)

As a PLC engineer you are required to design the ladder logic for the bottle filling machine based on the specifications given.

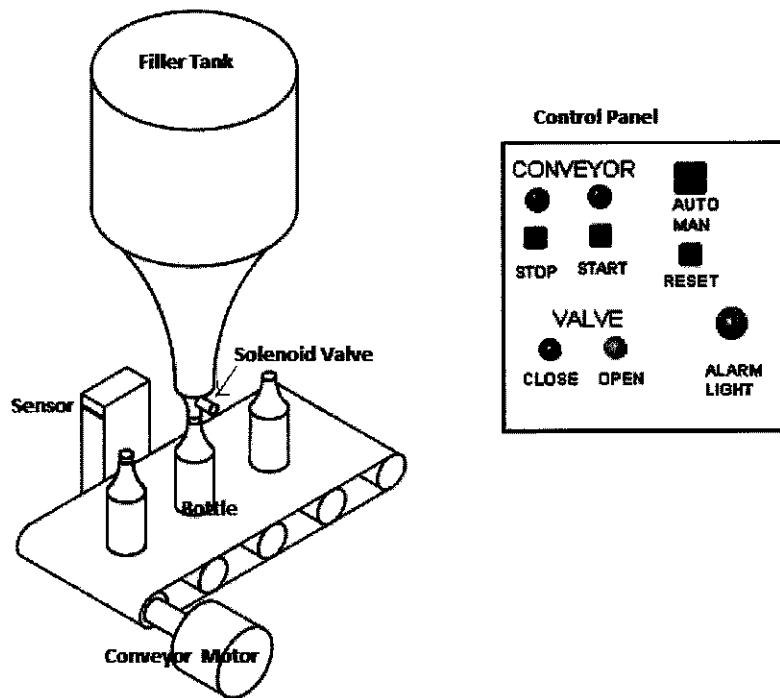


Figure 2: Bottle Filling Machine

OPERATION

This is a part of a juice factory where by juice is filled in the bottles automatically and the process is fully controlled by PLC. The conveyor motor can be started and stopped manually but once the conveyor is started on auto mode the whole process starts on its own. The bottle comes on the conveyor and travels down. As it reaches the sensor, the sensor gets activated and stops the conveyor at once. Then it opens the solenoid valve which fills the bottle for exactly 4seconds. After 4 seconds the valve closes and the conveyor starts again to bring in another bottle. BUT if in case the first bottle did not move and the sensor is still sensing the bottle in another 2 seconds the whole process will stop. Then the reset button has to be pressed to start the process again.

INPUTS

- 0.00 – start button
- 0.01 – stop button
- 0.02 – sensor switch
- 0.03 – reset button

OUTPUTS

- 100.00 – conveyor motor
- 100.01 – solenoid valve
- 100.02 – alarm light
- 100.03 – conveyor running light
- 100.04 - conveyor stopped light
- 100.05 – valve open light
- 100.06 – valve close light

Question 2

(25 marks)

Design a ladder logic that could be used to control the three phase change over switch contactor by PLC as shown in Figure 3. The general purpose of change over contactor system in electrical installation 3 phase to distribution board and standby generator. The function of change over contactor is back up supply in essential load. The circuit change over contactor system is done in automatically. This will be able to support the two uninterruptible power supplies, operating in conjunction with diesel generators sets with one essential load. Use the given below block diagram.

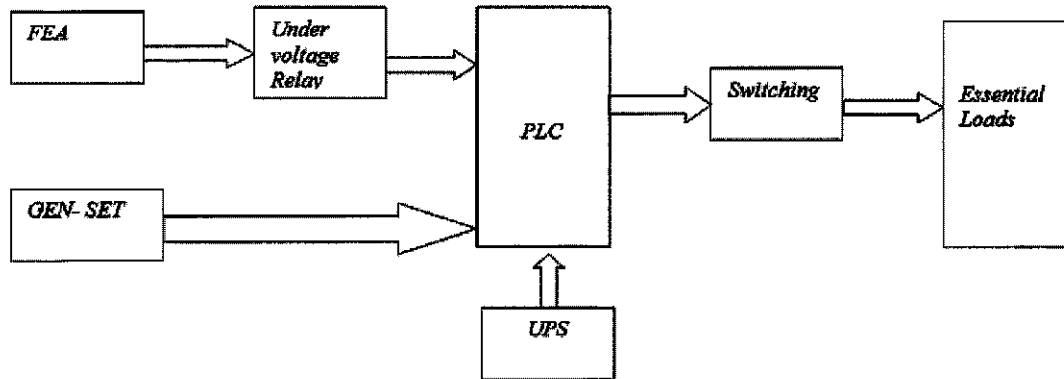


Figure 3: Change over contactor system

SECTION C

(20 Marks)

Instruction:

Answer all questions.

Question 1

(10 marks)

Design a ladder logic circuit to provide control to a water pumping system.

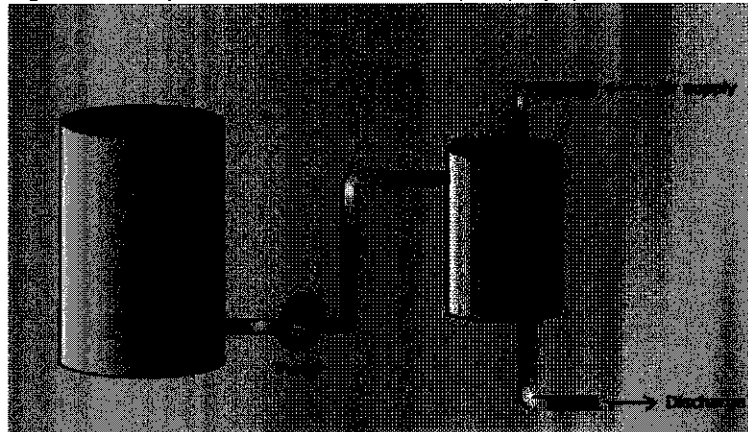


Figure 4: Water pumping system

Figure 4 above shows the pumping system which transfers water from the storage tank to the pressure tank.

- Design a ladder logic circuit which turns on the pump only while the push button is pressed.
- Modify the logic circuit in a. to eliminate the need for the operator to keep pressing the button while the pressure tank fills.
- Modify the logic circuit in b. so that there is no need for the operator to push the stop button again before the pressure tank is completely filled.
- Modify the logic circuit in c. so that the pump turns on automatically when the water level becomes too low in the storage tank.
- The storage tank supplies water to the pressure tank. If the level of water drops below the level of the outlet pipe in the storage tank, the pump becomes damaged because no water is flowing through it. Modify the logic design in d. to solve this problem.

Question 2

(10 Marks)

A lathe machine oil reservoir provides lubrication to the gear box. It is ensured that the lubricant for the gear box is applied before the lathe spindle starts to run which aims to ensure that the oil pump motor starts first and the main motor starts subsequently. Design a ladder logic circuit to make this work.

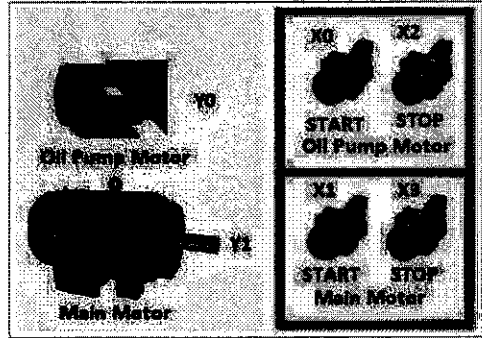


Figure 5: Motor and Controls

END OF EXAM

ATTACH THIS SHEET TO YOUR ANSWER SCRIPT

Section A

Part 1

Multiple Choice

1	a	b	c	d	e
2	a	b	c	d	e
3	a	b	c	d	e
4	a	b	c	d	e
5	a	b	c	d	e
6	a	b	c	d	e
7	a	b	c	d	e
8	a	b	c	d	e
9	a	b	c	d	e
10	a	b	c	d	e

Part 2

1.a.

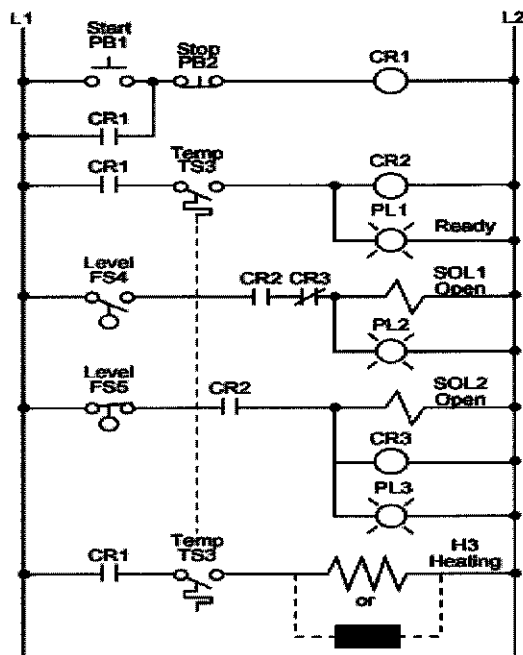


Figure 1: Electromechanical Relay Circuit

ATTACH THIS SHEET TO YOUR ANSWER SCRIPT

1. b.

Hint: Use this table

Module Type	I/O Address			Description
	Rack	Group	Terminal	
Input				
Spare	0	1	0	Not Used
	.	.	.	
	.	.	.	
	0	1	7	
Output				

Table 1: I/O Address Assignment