



Note: Attempt Four Questions only

Q1

25 Marks

- A- List the advantages of PLCs with brief description.
- B- Show the sketch of the PLC architecture with description of each component.
- C- List the PLC programming devices with brief description on each one.
- D- List six of the PLC input devices with brief description on each one.
- E- Define and mention all you know about the PLC Processor Scan Cycle.

Q2

25 Marks

(A)-

A motorized overhead door is to be operated automatically to preset open and closed positions.

- 1- Write the ladder logic program for the control system.
- 2- Indicate all the input and output field devices in their un-actuated conditions with symbolic addresses.

The sequence of operation requires that:

- When the up button is pushed, the up motor contactor energizes and the door travels upward until the up limit switch is actuated.
- When the down button is pushed, the down motor contactor energizes and the door travels down until the down limit switch is actuated.
- When the stop button is pushed, the motor stops.

The field devices include one of each of the following:

- Reversing motor contactor for the up and down door directions.
- Normally closed down limit switch to sense when the door is fully closed.
- Normally closed up limit switch to sense when the door is fully opened.
- Normally open door up button for the up direction.
- Normally open door down button for the down direction.
- Normally closed door stop button for stopping the door at any time.
- Green door open light to signal when the door is fully open.
- Yellow door closed light to signal when the door is fully closed.

Q2

(B)-

A pump is to be used to fill two storage tanks. The pump is manually started by the operator from a start/stop station. When the first tank is full, the control logic must be able to automatically stop flow to the first tank and direct flow to the second tank through the use of sensors and electric solenoid valves. When the second tank is full, the pump must shut down automatically. Indicator lamps are to be included to signal when each tank is full.

- 1- Draw a sketch for the process.
- 2- Prepare a typical PLC logic program for this control process.
- 3- Indicate all the input and output field devices in their un-actuated conditions with symbolic addresses.

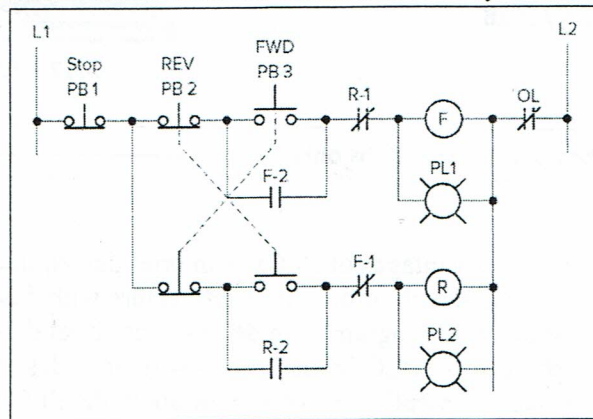
Q2

(C)-

- 1- Write the Ladder logic program that will correctly execute the hardwired control circuit below.
- 2- Indicate all the input and output field devices in their un-actuated conditions with symbolic addresses.

Assume:

- PB1 pushbutton used is an NC type.
- PB2 and PB3 are each wired using one set of NO contacts.
- OL contact is hardwired.



Q3

25 Marks

(A)-

Show the Ladder logic program and the equivalent Function Block Diagram for the following Boolean expressions without any simplification:

$$1) Y = A \cdot B \cdot C + (C + B)$$

$$2) Y = A \cdot \bar{B} \cdot C + B \cdot D \cdot (A + B)$$

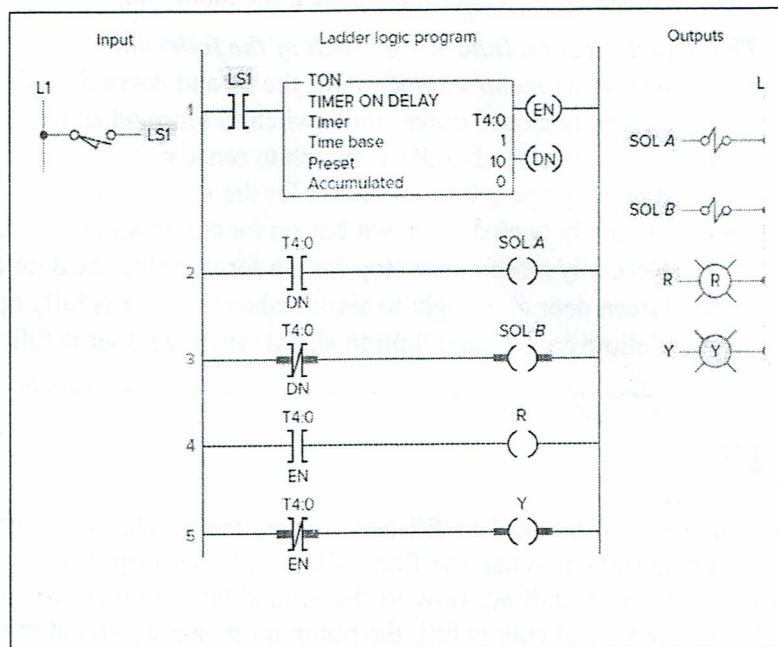
$$3) Y = A \cdot \bar{B} \cdot (C \oplus D) + D$$

$$4) Y = A \oplus B + C \cdot (D \cdot \bar{A} + B \cdot E) + \bar{D} \cdot B$$

(B)-

Study the ladder logic program in Figure and answer the questions that follow:

- a- What type of timer has been programmed?
- b- What is the length of the time-delay period?
- c- What is the value of the accumulated time when power is first applied?
- d- When does the timer start timing?
- e- When does the timer stop timing and reset itself?
- f- When input LS1 is first closed, which rungs are true and which are false?
- g- When input LS1 is first closed, state the status (on or off) of each output.
- h- When the timer's accumulated value equals the preset value, which rungs are true and which are false?
- i- When the timer's accumulated value equals the preset value, state the status (on or off) of each output.
- j- Suppose that rung 1 is true for 5 s and then power is lost. What will the accumulated value of the counter be when power is restored?



Q4**25 Marks****(A)-**

An industrial application uses the on-delay, off-delay, and retentive on-delay instructions in the same program. In this industrial application, there is a machine with a large steel shaft supported by babbitted bearings. This shaft is coupled to a large electric motor. The bearings need lubrication, which is supplied by an oil pump driven by a small electric motor.

The operation of the program is summarized as follows:

- To start the machine, the operator turns SW on.
- Before the motor shaft starts to turn, the bearings are supplied with oil by the pump for 10 seconds.
- The bearings also receive oil when the machine is running.
- When the operator turns SW off to stop the machine, the oil pump continues to supply oil for 15 s.
- A retentive timer is used to track the total running time of the pump. When the total running time is 3 hours, the motor is shut down and a pilot light is turned on to indicate that the filter and oil need to be changed.
- A reset button is provided to reset the process after the filter and oil have been changed.

1- Write the ladder logic program for the control system.

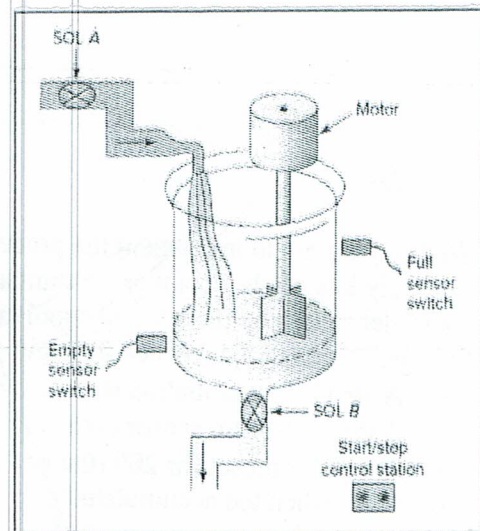
2- Indicate all the input and output field devices in their un-actuated conditions with symbolic addresses.

(B)-

Write a program to implement the process illustrated in Figure.

The sequence of operation requires that:

- Normally open start and normally closed stop push buttons are used to start and stop the process.
- When the start button is pressed, solenoid A energizes to start filling the tank.
- As the tank fills, the empty level sensor switch closes.
- When the tank is full, the full level sensor switch closes.
- Solenoid A is de-energized.
- The agitate motor starts automatically and runs for 3 min to mix the liquid.
- When the agitate motor stops, solenoid B is energized to empty the tank.
- When the tank is completely empty, the empty sensor switch opens to de-energize solenoid B.
- The start button is pressed to repeat the sequence.



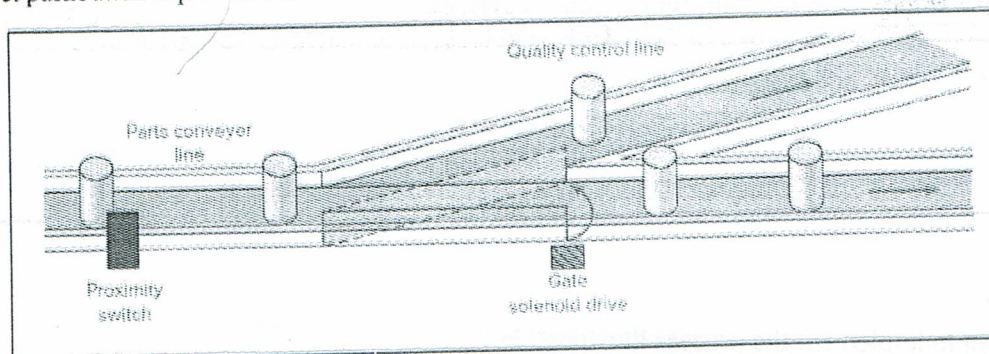
Indicate all the input and output field devices in their un-actuated conditions with symbolic addresses.

(A)-

Write a program to implement the process illustrated in Figure below. An up-counter must be programmed as part of a batch-counting operation to sort parts automatically for quality control. The counter is installed to divert 1 part out of every 2000 for quality control or inspection purposes. Indicate all the input and output field devices in their un-actuated conditions with symbolic addresses.

The sequence of operation requires that:

- A start/stop pushbutton station is used to turn the conveyor motor on and off.
- A proximity sensor counts the parts as they pass by on the conveyor.
- When a count of 2000 is reached, the counter's output activates the gate solenoid, diverting the part to the inspection line.
- The gate solenoid is energized for 3 s, which allows enough time for the part to continue to the quality control line.
- The gate returns to its normal position when the 3-s time period ends.
- The counter resets to 0 and continues to accumulate counts.
- A reset pushbutton is provided to reset the counter manually.



(B)-

Write a program to implement the process illustrated in Figure 8-45. A company that makes electronic assembly kits needs a counter to count and control the number of resistors placed into each kit. The controller must stop the take-up spool at a predetermined amount of resistors (200). A worker on the floor will then cut the resistor strip and place it in the kit. The circuit operates as follows:

- A start/stop pushbutton station is used to turn the spool motor drive on and off manually.
- A through-beam sensor counts the resistors as they pass by.
- A counter preset for 200 (the amount of resistors in each kit) will automatically stop the take-up spool when the accumulated count reaches 200.
- A second counter is provided to count the grand total used.
- Manual reset buttons are provided for each counter.

Indicate all the input and output field devices in their un-actuated conditions with symbolic addresses.

Lecturer: Dr. Basil Mohammed

Head of Dep. : A. Prof. Mohammed Sabri