UNIVERSITY OF COLOMBO, SRI LANKA

FACULTY OF SCIENCE

LEVEL IV EXAMINATION IN SCIENCE - 2023 SEMESTER I

PH4019 – INDUSTRIAL AUTOMATION

(Three Hours)

This paper consists of five (04) questions in three (05) pages.

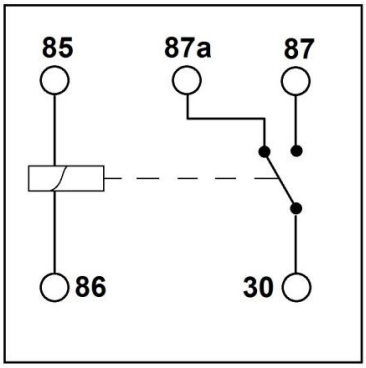
Answer All Questions

1. Answer the following Questions.

I. What does PLC stand for in electrical terms?

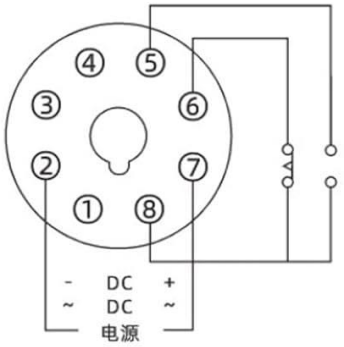
II. What are the main components of a PLC system?

III. Write the terminals of the following 5-pin relay diagram.



IV. What are the two types of timers?

V. For the relay timer diagram below, identify the NO/ NC/ Power (+)/ Power (-) pins.



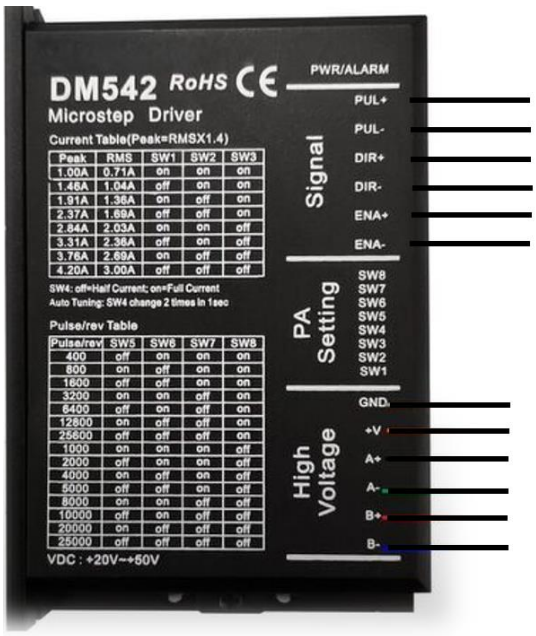
VI. Mention two types of PLCs according to the output voltage.

VII. Name some of the most widely used PLC brands worldwide.

VIII. List three types of switches.

IX. List down five inputs and five outputs commonly used in industrial automation projects.

X. Name all the pins of the DM 542 motor driver provided below.



2. Design a PLC program and prepare an I/O connection diagram and ladder logic program that will correctly execute the packaging process illustrated in the figure below. The operational sequence can be summarized as follows:

I. The purpose of this process is to deposit 50 pieces of the product in each container.

II. The process is set in operation by pressing a start pushbutton.

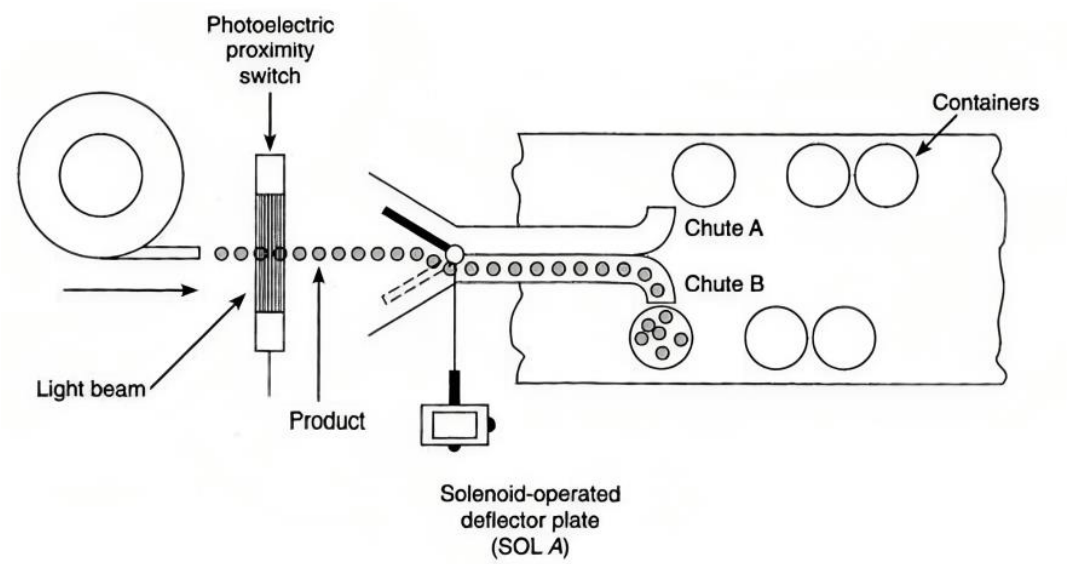
III. As the product passes through the light beam, it is detected by the photoelectric proximity switch and counted by the PLC counter.

IV. When the count reaches 50, the solenoid-operated deflector plate (SOL A) energizes to channel the product from chute A to chute B.

V. The counter is reset automatically for the next count of 50.

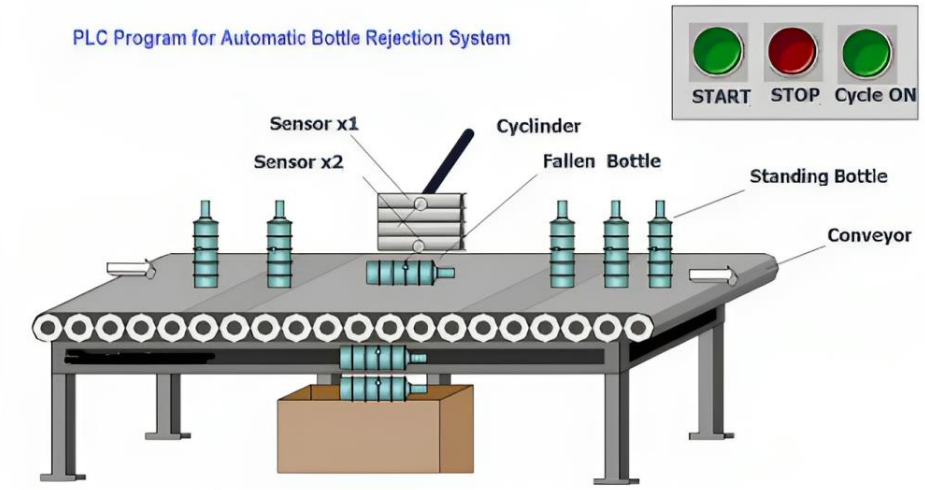
VI. When the second count of 50 is reached, the solenoid-operated deflector plate deenergizes to channel the product back into chute A, and so on.

VII. Provisions must be made for stopping the process at any time and manually resetting the accumulated value of the counter to any number.



3.

A. A belt conveyor is used for transferring the bottles from one station to another station. But before bottles reach the soda filling station it is necessary to make all bottles are in a standing position for further processing. A fallen bottle on the conveyor may create problems in the next process. Identify the inputs and outputs of the system. Consider the indicator lights as outputs. Then, implement the ladder diagram.



B. Design a PLC program that will correctly execute the conveyor motor control process illustrated in the figure below. Enter the program into the PLC and prove its operation. The operational sequence can be summarized as follows:

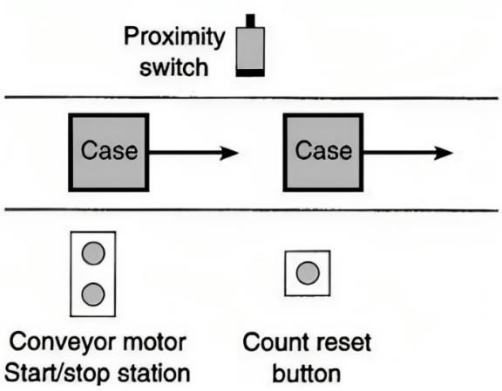
I. The start button is pressed to start the conveyor motor.

II. Cases move past the proximity switch and increment the counter's accumulated value.

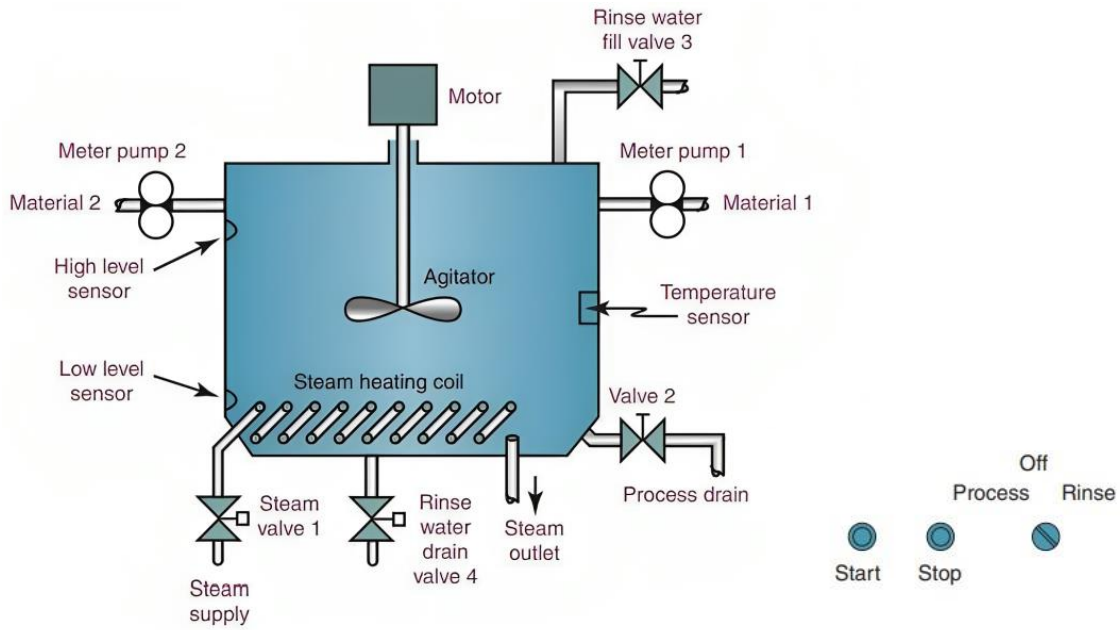
III. After a count of 50, the conveyor motor stops automatically, and the counter's accumulated value is reset to zero.

IV. The conveyor motor can be stopped and started manually at any time without loss of the accumulated count.

V. The accumulated count of the counter can be reset manually at any time using the counter reset button.



4. Prepare the ladder program for the given process.



Operation

- The mixing volumes of two liquid ingredients i.e., material 1 and material 2 are 50 and 60 liters respectively, and the maximum soak temperature is 50 degrees Celcius.
- The system has start and stop pushbuttons and a two-position (center position off) normally open selector switch to select the rinse and process modes.
- Indicator lights display the following conditions: fill cycle, drain cycle, water fill valve open, water drain valve open, process drain valve open, steam valve open, and overtemperature warning.
- The two-process metering pumps pass 2 liters of liquid per minute. The tank has low and high-level liquid sensors, and a temperature sensor and transmitter. A mixer, driven by a motor, is used to agitate the process.
- When the process selector switch is moved to the process position, process rungs are selected.
- The process is started with the start push button, which sets the system start bit (Flag). Each pump rotates through the correct number of minutes to put the desired volume of liquid into the tank.
- The mixer is on whenever the liquid is over the low-level liquid sensor. When all liquids are loaded, the steam valve is opened and the process is heated to the temperature set point.
- When the set point is reached the heater is turned off and the process liquid is drained through the process drain valve.
- When the low-level liquid sensor is not active the system start bit (Flag) is turned off.
- After the process liquid is drained, the system waits for the selector to be placed in the rinse position and the start switch to again be pressed.
- The tank fills with water and the mixer is on whenever the water is over the low-level liquid sensor.
- When the water reaches the high-level liquid sensor, the water is drained through the water drain valve.
- When the rinse cycle is completed, the system returns to the stopped condition.

THE END