



INTERNATIONAL UNIVERSITY OF SARAJEVO

## HOMEWORK HW3

### EE436 – Programmable Logic Controllers

Date: 18/03/2019, Due date: 25/03/2019

1. Identify the type of counter you would choose for each of the following situations:
  - a. Count the total number of parts made during each shift.
  - b. Keep track of the current number of parts in a stage of a process as they enter and exit.
  - c. There are 10 parts in a full hopper. As parts leave, keep track of the number of parts remaining in the hopper.
2. A buffer can hold up to 10 parts. Parts enter the buffer on a conveyor controller by output conveyor. As parts arrive they trigger an input sensor enter. When a part is removed from the buffer they trigger the exit sensor. Write a program to stop the conveyor when the buffer is full, and restart it when there are fewer than 10 parts in the buffer. As normally, the system should also include a start and stop button.
3. The process of controlling heating of liquid in the tank using heater is shown in figure below.

- To detect high and low level of liquid in the tank, two level switches are used. They give output in digital form, that is, when corresponding levels are detected, they give output high, otherwise remain low. Low Level Switch is mounted at the bottom of the tank and Level High switch is mounted to detect maximum liquid level close to top of the tank.
- To control the level of liquid, Single Acting Piston valve is used. It has two states: either fully open or fully closed.
- To heat the liquid, heater is used. Heater is installed inside the tank and temperature sensor such as RTD or Thermocouple may be used to detect the temperature of liquid in the tank.

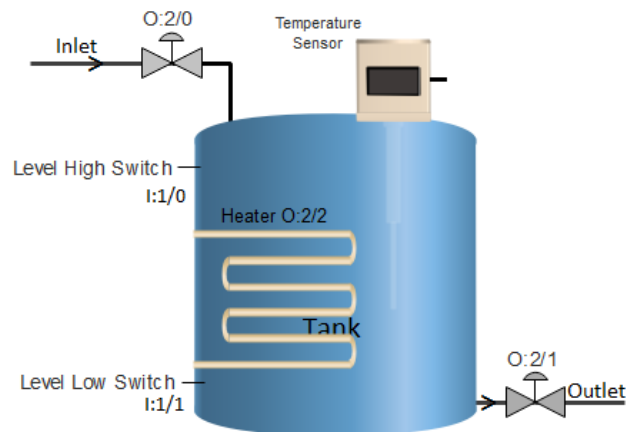


Figure 1: **Diagram: heating of liquid in the tank**

Design a PLC program that will fill the tank with water, heat it to a temperature of 70 deg C, maintain the temperature between 60-75 deg C, and allow the water to be let out (at this temperature) on the outlet valve that is activated by a push-button. If the button is not pressed, and temperature is above 65 deg C, the tank is refilled. If the button is pressed and level is low, the tank must be refilled and water heated.

4. Design a PLC program that will correctly execute the industrial control process in figure 2. The sequence of operation is as follows:

- Product in position (limit switch LS1 contacts close).
- The start button is pressed and the conveyor motor starts to move the product forward toward position A (limit switch LS1 contacts open when the actuating arm returns to its normal position).

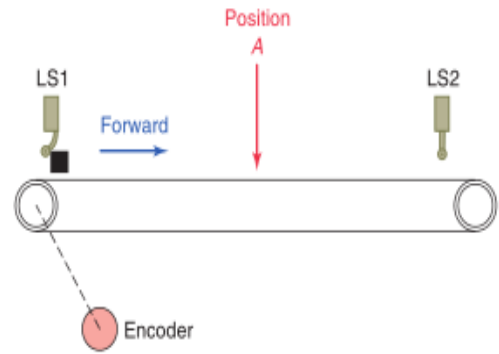


Figure 2: **Diagram of conveyor belt**

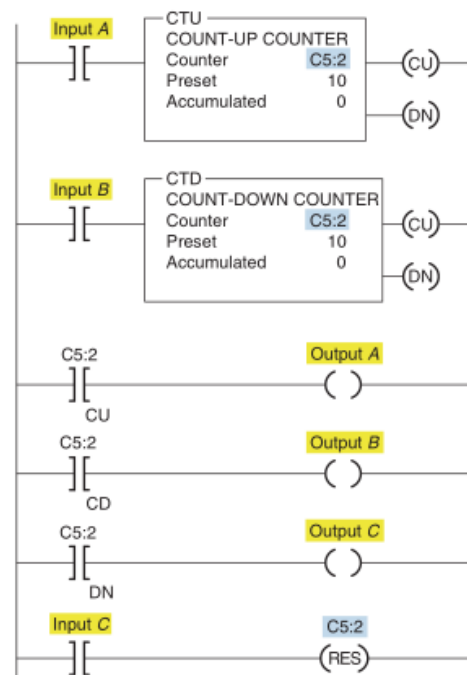
- The conveyor moves the product forward to position A and stops (position detected by 8 off-to-on output pulses from the encoder, which are counted by an up-counter).
- A time delay of 10 s occurs, after which the conveyor starts to move the product to limit switch LS2 and stops (LS2 contacts close when the actuating arm is hit by the product).

5. Answer the following questions with reference to the up/down-counter program shown in figure 3. Assume that the following sequence of events occurs:

- Input C is momentarily closed.
- 20 on/off transitions of input A occur.
- 5 on/off transitions of input B occur.

As a result:

- What is the accumulated count of counter CTU?
- What is the accumulated count of counter CTD?
- What is the state of output A?
- What is the state of output B?
- What is the state of output C?



6. Write a program to operate a light according to the following sequence:

- A momentary pushbutton is pressed to start the sequence.
- The light is switched on and remains on for 2 s.
- The light is then switched off and remains off for 2 s.
- A counter is incremented by 1 after this sequence.
- The sequence then repeats for a total of 4 counts.
- After the fourth count, the sequence will stop and the counter will be reset to zero.