

**UNIVERSITY COLLEGE TATI (UCTATI)****FINAL EXAMINATION QUESTION BOOKLET**

COURSE CODE	: BMT 4043
COURSE	: AUTOMATION ENGINEERING TECHNOLOGY
SEMESTER/SESSION	: 2 – 2023 / 2024
DURATION	: 3 HOURS

**Instructions:**

1. This booklet contains **4** questions. Answer all questions.
2. All answers should be written in answer booklet.
3. Write legibly and draw sketches wherever required.
4. If in doubt, raise your hands and ask the invigilator.

**DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO**

**THIS BOOKLET CONTAINS 5 PRINTED PAGES INCLUDING COVER PAGE**

**QUESTION 1**

- a) SFC stands for Sequence Function Chart. Describe the representation of SFC in PLC programming. (2 marks)
- b) i) Name the three (3) components in SFC. (3 marks)  
ii) Briefly describe each of the components. (5 marks)
- c) Describe the operation of interlock instruction. (4 marks)
- d) Describe the difference of operation between Jump instruction and Conditional Jump instruction. (10 marks)
- e) Subroutine instruction is a short program inside a ladder program that is used by the main program to perform a specific task or function. Describe the three (3) subroutine instructions required to be used for Omron PLC. (6 marks)

**QUESTION 2**

a) There are two types of edge detection instruction in Omron PLC system. Describe the operation of each type of edge detection instruction.

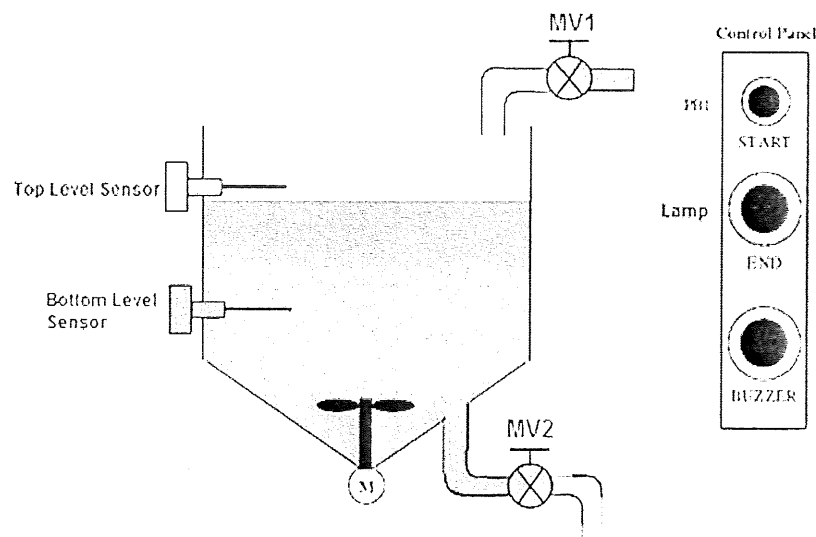
(4 marks)

b) Figure 1 shows an application of water filling and draining system. The operation runs as below:

- As the Start pushbutton (PB1) is pressed momentarily, the water supply valve (MV1) turns on and the water begins to fill the tank.
- After a delay of 5 seconds, the stirring motor (M) starts rotating.
- When the water passes the bottom level sensor and reaches the top-level sensor, MV1 turns off and the stirring motor will stop 10 seconds later.
- After that, the drain valve (MV2) turns on and start draining the water.
- When the water level has dropped below the bottom level sensor, MV2 turns off and the END indicator lamp together with the buzzer then turns on for 10 seconds. Then the operation can be started again.

Produce the ladder diagram program for this application using SET/RSET and appropriate usage of edge detection instructions.

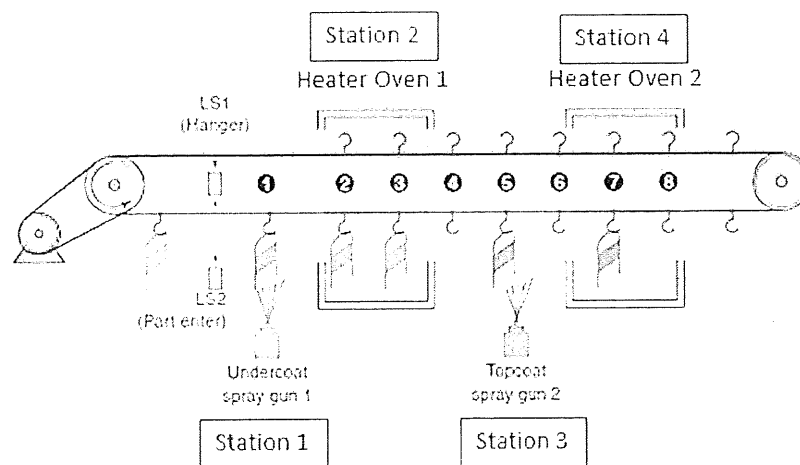
(16 marks)



**Figure 1**

**QUESTION 3**

- a) Identify any three (3) applications that could represent the data in the shift register.  
(3 marks)
- b) State three (3) types of shift registers that can be used in PLC programming.  
(3 marks)
- c) Recognize the range values of the data area that must be used for the following register area:  
 i. Common I/O Register  
 ii. Work Relay Register  
 iii. Holding Relay Register  
 iv. Auxiliary Relay Register  
(4 marks)
- d) Figure 2 shows a spray-painting operation controlled by a shift register instruction. The parts to be painted is to be detected by limit switch LS2 and the activation of limit switch LS1 will generate the shift pulse of the status of part detected. When part is detected, all the four stations will turn on to do the required operation. When there is no part to be sprayed, no operation will be done.  
 Produce the ladder diagram to implement this process.



**Figure 2**

(10 marks)

**QUESTION 4**

- a) Describe the steps/processes in converting an analog signal to binary format when a sensor is connected to a PLC analog input module.  
(5 marks)
- b) A temperature sensor provides a 0 – 10Vdc voltage signal that is proportional to the temperature variable being measured. The temperature measurement ranges between 0 degree and 1000 degrees. The analog input module accepts a 0 – 10Vdc unipolar range and converts it to a range based on a 12 bits ADC. The process application where this signal is being used to detect low and high alarms at 250 degrees and 850 degrees, respectively.
- i. Determine the relationship (the equation of line) between the input variable signal and the counts being measured by the PLC analog module. Your answer must show the sketch of the linear graph.  
(9 marks)
- ii. Calculate the equivalent number of counts for each of the alarm temperatures specified.  
(6 marks)
- c) Identify the difference between process variable and control variable in a PID loop.  
(4 marks)
- d) State the function of a PID module that is used with a PLC system.  
(2 marks)
- e) Manual method and fully automatic method are the tuning methods that can be done when doing a PID controller tuning. Briefly describe these two types of method.  
(4 marks)

----- END OF QUESTION -----

