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SET A

UNIVERSITI KUALA LUMPUR
Malaysia France Institute

FINAL EXAMINATION
SEPTEMBER 2013 SESSION

SUBJECT CODE	:	**FAB 20103**
SUBJECT TITLE	:	**PROGRAMMABLE LOGIC CONTROLLER**
LEVEL	:	**BACHELOR**
TIME / DURATION	:	**(3 HOURS)**
DATE	:	

INSTRUCTIONS TO CANDIDATES

1. **Please read the instructions given in the question paper CAREFULLY.**
2. **This question paper is printed on both sides of the paper.**
3. **Please write your answers on the answer booklet provided.**
4. **Answer should be written in blue or black ink except for sketching, graphic and illustration.**
5. **This question paper consists of TWO (2) sections. Section A and B. Answer ALL questions in Section A. For Section B, answer THREE (3) questions only.**
6. **Answer all questions in English.**

THERE ARE 14 PAGES OF QUESTIONS, EXCLUDING THIS PAGE.

SECTION A (Total: 40 marks)

INSTRUCTION: Answer ALL questions.

Please use the answer booklet provided.

QUESTION 1

a) Answer the following questions:

i. Give three (3) advantages of using PLC over relay based control system.

(3 marks)

ii. State three (3) programming languages that internationally recognized other than ladder diagram.

(3 marks)

iii. State three (3) types of discrete sensor.

(3 marks)

iv. Explain the term ‘scan time’ used in PLC environment.

(4 marks)

b) Answer the following questions:

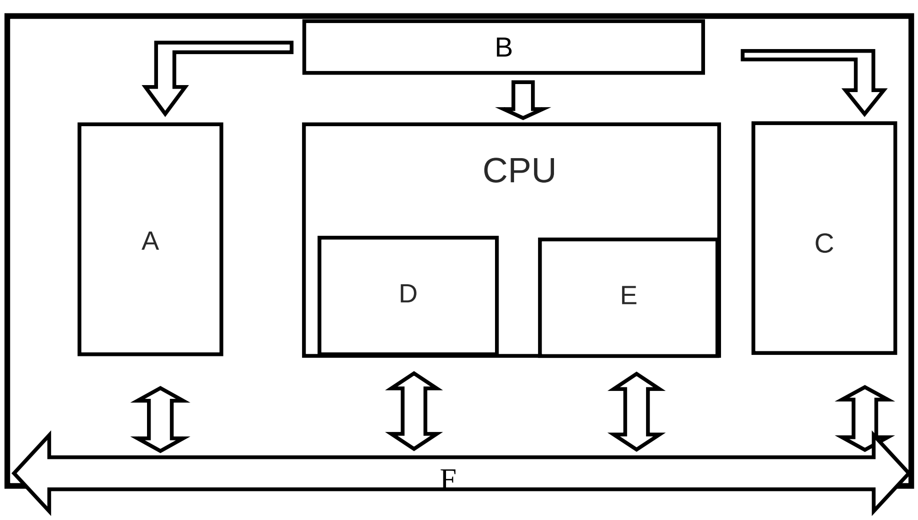

Figure 1: PLC Basic structure

i) State A, B, C, D, E and F and explain briefly the function of each component.

(6 marks)

ii) Convert the following ladder diagram in **Figure 2** to its equivalent Instruction List (IL) language.

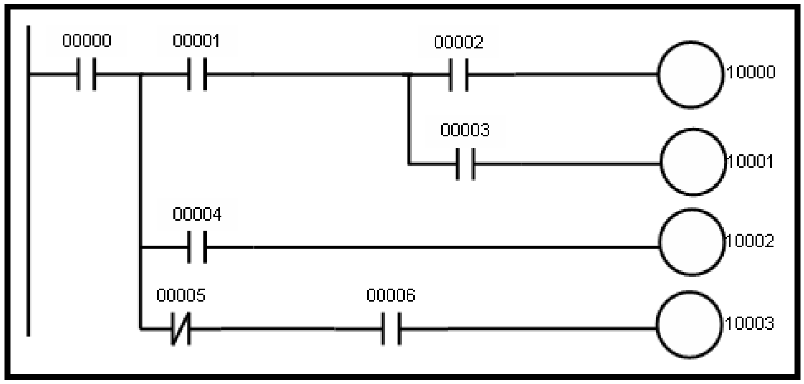

Figure 2: Ladder Diagram

(4 marks)

QUESTION 2

(a) Based on ladder diagram in **Figure 3**, explain what will happen to the output 100.00:

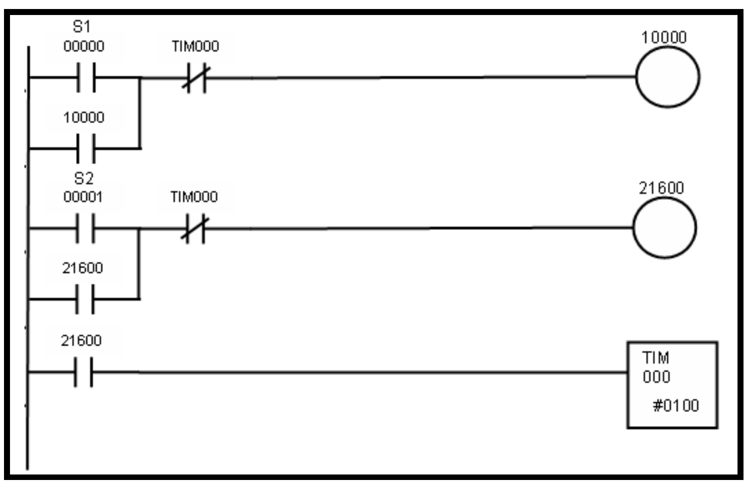

Figure 3: Ladder Diagram

i. If pushbutton S1 is pressed
ii. If pushbutton S2 is pressed
iii. If pushbutton S1 is pressed follow by S2

(3 marks)

(b) Refer to the ladder diagram in **Figure 4**, explain what will happen to counter (CNT 002) and output 100.01 if toggle switch S3 is switched ON.

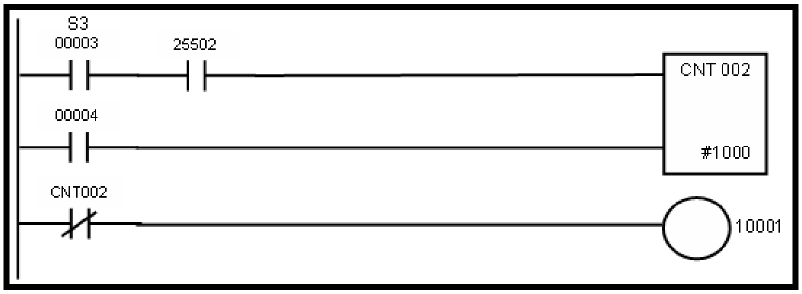

Figure 4: Ladder Diagram

(Note: SR25502 is 1-second clock pulse bit).

(3 marks)

(c) Refer to **Figure 5** and answer the following questions:

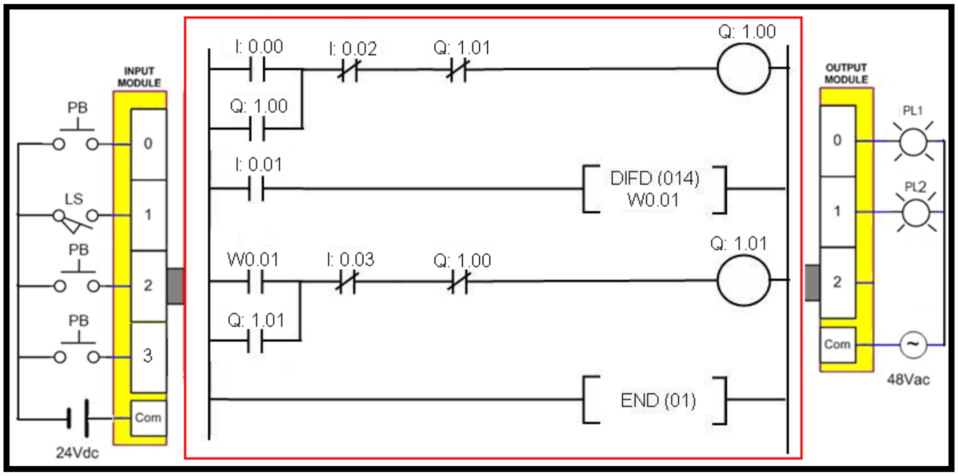

Figure 5: Input / Output wiring and Ladder Diagram

i. Explain how output Q:1.00 (PL1) can be TRUE

ii. Explain how output Q:1.01 (PL2) can be TRUE

iii. Complete the following timing diagram:

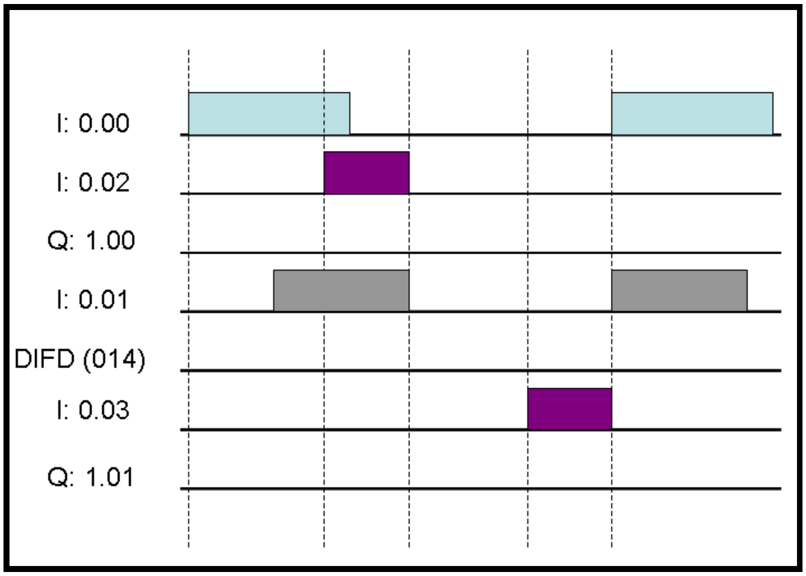

Figure 6: Timing Diagram

(6 marks)

(d) Referring to **Figure 8**, a double acting cylinder is used to break off the welding scale from the welding seam, as shown on **Figure 7**. When a 'START' pushbutton is pressed, the continuous cycle starts. Once the 'STOP' pushbutton is pressed, the cylinder should stops at retracted position.

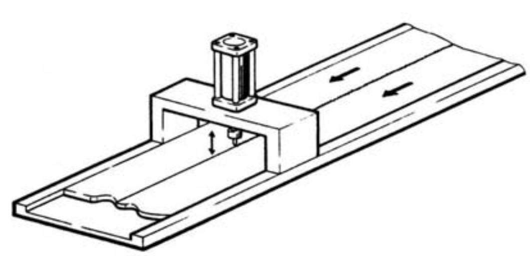

Figure 7: Welding Seam

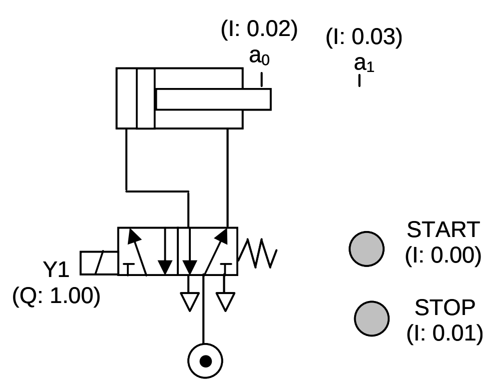

Figure 8: Double Acting Cylinder

You are required to prepare:

(i) Input list table

(ii) Output list table

(iii) PLC typical I/O connection

(iv) Ladder logic diagram for this process.

Note: All switches are of normally opened type.

(8 marks)

SECTION B (Total: 60 marks)

INSTRUCTION: Answer only THREE (3) questions.
Please use the answer booklet provided.

QUESTION 3

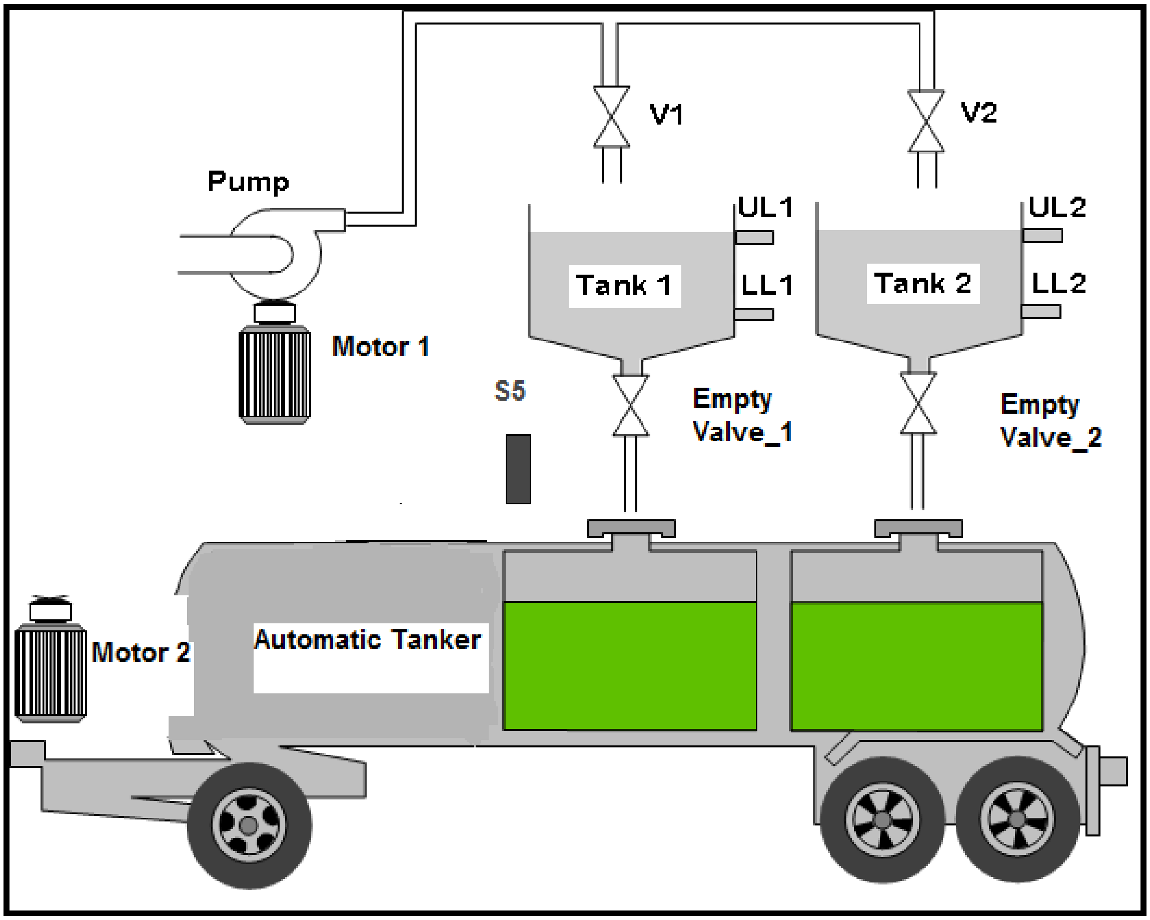

Figure 9: Filling tank system

System Operations **(**Refer to **Figure 9** and **Table 1):**

- A pump is intended to fill two tanks. Two valves allow the liquid to be directed to one or other of the tanks.
- Filling is started each time the lower level (LL1 and LL2) in a tank is reached and is continued until the upper level (UL1 and UL2) is reached.
- The filling process will be done by V1 and V2. The estimate time for each valve is set to 30 seconds. The pump is stop after 30 seconds.
- Emptying is started each time the upper level (UL1 and UL2) in a tank is reached and is continued until the lower level (LL1 and LL2) is reached.

- The emptying process will be done by empty valve_1 and empty valve_2. The estimate time for each valve is set to 45 seconds.
- After time done for both empty valves, the automatic tanker will move and come back to filling system. The duration for automatic tanker to move forward and reverse is about 25 seconds for each direction. The photoelectric sensor S5 is to detect the present of tanker.
- Once the six cycles complete, the system is stop until the operator press the reset push button.

Remarks:

- All valves are of the single action type.
- After first cycle, the system will start automatically by using shift register.
- The empty process for automatic tanker is not taken into account

Table 1: PLC inputs and outputs list for filling tank system

Name	Data Type	Address / Value	Rack Location	Usage	Comment
V_2	BOOL	1.05	Main Rack : Slot 01	Out	Filling valve for tank 2
V_1	BOOL	1.04	Main Rack : Slot 01	Out	Filling valve for tank 1
UL_2	BOOL	0.07	Main Rack : Slot 00	In	Upper level sensor for tank 2, normally open contact
UL_1	BOOL	0.06	Main Rack : Slot 00	In	Upper level sensor for tank 1, normally open contact
Stp	BOOL	0.01	Main Rack : Slot 00	In	Stop push button normally close
St	BOOL	0.00	Main Rack : Slot 00	In	Start push button normally open
S_5	BOOL	0.03	Main Rack : Slot 00	In	Photoelectirc sensor to detect present of tanker, normally open contact
Rst	BOOL	0.09	Main Rack : Slot 00	In	Reset push button normally open
LL_2	BOOL	0.05	Main Rack : Slot 00	In	Low level sensor for tank 2, normally open contact
LL_1	BOOL	0.04	Main Rack : Slot 00	In	Low level sensor for tank 1, normally open contact
KM_3	BOOL	1.03	Main Rack : Slot 01	Out	Power contactor for Motor 2 reverse direction
KM_2	BOOL	1.01	Main Rack : Slot 01	Out	Power contactor for Motor 2 forward direction
KM_1	BOOL	1.00	Main Rack : Slot 01	Out	Power contactor for Motor 1 for pump activation
F_2	BOOL	0.08	Main Rack : Slot 00	In	Thermal overload relay for Motor 2 normally close contact
F_1	BOOL	0.02	Main Rack : Slot 00	In	Thermal overload relay for Motor 1 normally close contact
EV_2	BOOL	1.07	Main Rack : Slot 01	Out	Empty valve for tank 2
EV_1	BOOL	1.06	Main Rack : Slot 01	Out	Empty valve for tank 1

a) Design a ladder diagram for the following statements:

i. Rung 0: Master control relay is ON and internal bits for shift register activation.

(3.5 marks)

ii. Rung 1: Shift register instruction block

(3 marks)

iii. Rung 2: Sequence control

(4 marks)

iv. Rung 3: Pump activation and filling process for 30 seconds.

(2 marks)

v. Rung 4: Emptying process for 45 seconds.

(2 marks)

vi. Rung 5: Automatic tanker moving to the left for 25 seconds.

(2 marks)

vii. Rung 6: Automatic tanker moving to the right for 25 seconds and automatic restart for next cycle.

(2 marks)

viii. Rung 7: Counting six cycles.

(1.5 marks)

QUESTION 4

Answer the following questions by referring to **Figure 10** and **Table 2**

Table 2: Input and output list for the system

Address	Tag	Description	Type
000.00	Start	Start push button N/O	Input
000.01	Stop	Stop push button N/C	Input
000.02	S1	Proximity sensor N/O	Input
100.00	KM1	Contactor for Conveyor 1	Output
100.01	valve 1	Cylinder CYL.A 3/2 single acting valve	Output

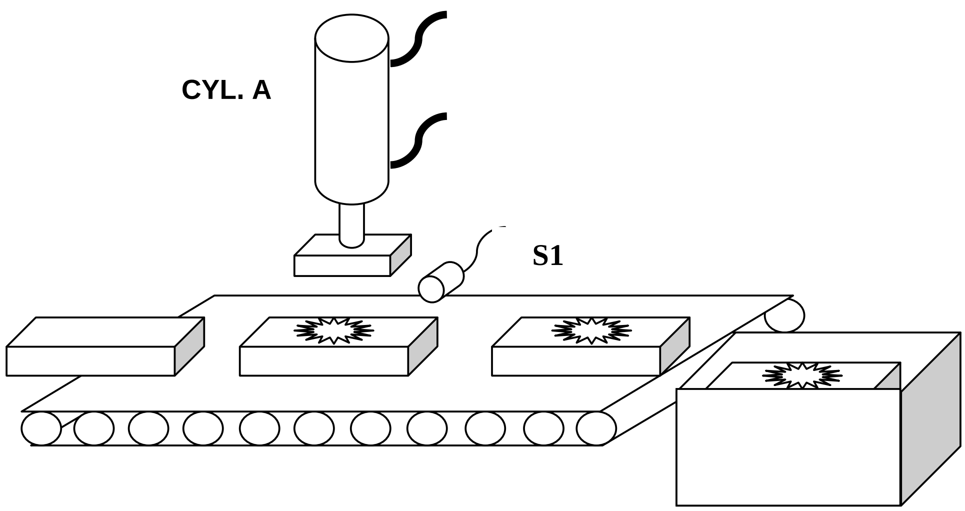

Figure 10: Stamping and Packaging Conveyor

Description of the system:

When a start push button St is pressed, the conveyor will run. Stop button will stop the process. When a product to be stamped reach a proximity sensor, S1, the conveyor will stop immediately and a cylinder, CYL A, consist of a stamp will be extended as to stamp a logo on the surface of the product. The cylinder will remain extended for 3 seconds. After that the conveyor will run again and the finished product will be moved to a box. The whole process will be repeated until the 10^{th} product is stamped and moved to the box. The operation can be stopped when complete 10^{th} product.

i. Draw ladder diagram for the above operation. Use of counter is advisable.

(8 marks)

ii. Modify the program using Arithmetic Instructions (MOVE, COMPARE, ADD, SUB or any that relevant) to replace counter instruction.

(8 marks)

iii. There are 12 boxes. In a box, there are 24 balls bearing for motorcycle.
Sensor S1 will detect the box and sensor S2 will detect the ball bearing. Design a ladder diagram to calculate the total number of bearings. The result of the calculation should be stored in D100. Use arithmetic instruction.

(4 marks)

QUESTION 5

Figure 11 shows a system to sort incomplete product from good product. The product consists of a metal sphere and its holder made from fibre glass. This system consists of a conveyor, a proximity sensor, three pilot lamps (L1, L2, and L3), two bins and a double acting pneumatic cylinder, Cylinder A.

When a start push button, St is pressed, the conveyor will on. Operator of the system will place the product at Drop Zone. The product will then be transfer to Inspection Post to check either the product is completed or not. If the product is detected as good, it will be transfer directly to good product bin. If not, the lamp L1, L2 and L3 will be on when the part travel from transition post no.1 to reject post. At reject post, Cylinder A will extend as to push reject part to reject bin. Encoder En will serve as a shift data (clock pulse) to the shift register function. The system will stop when a stop push button, Sp is pressed.

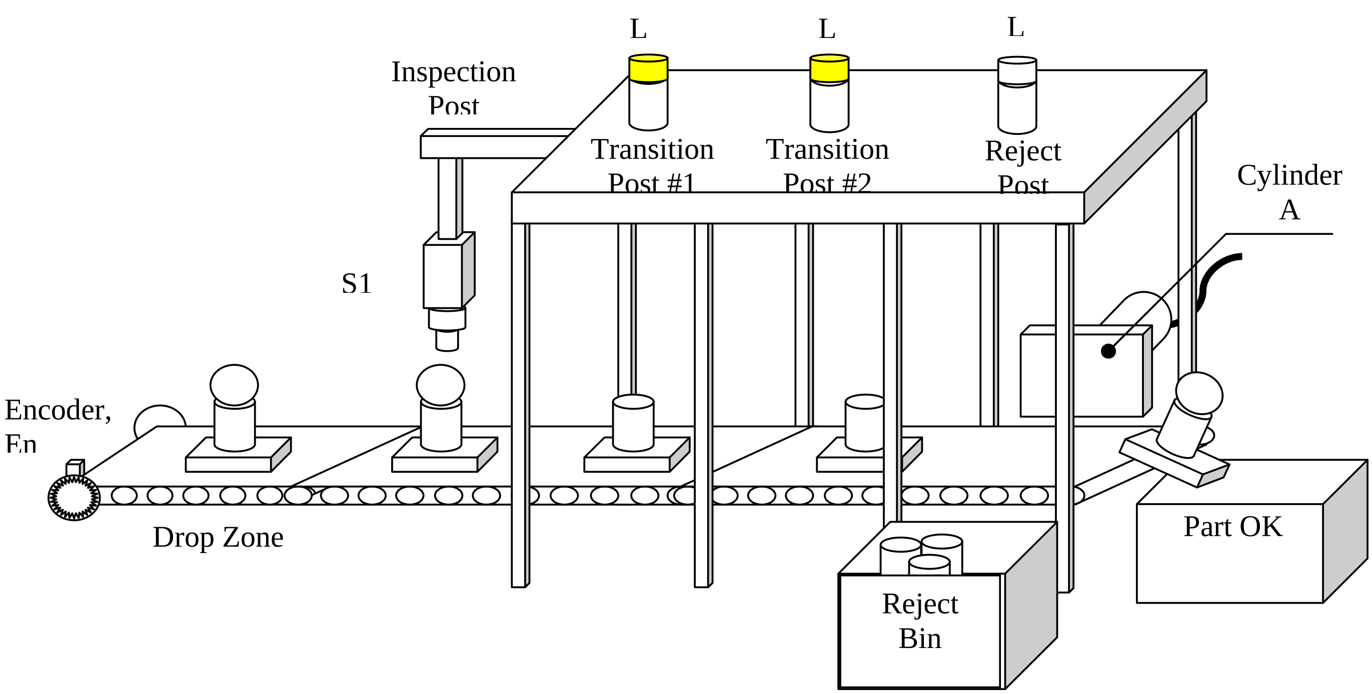

Figure 11: A Part Sorting system

(a) Construct the I/O table of the system

(5 marks)

(b) Draw the I/O wiring for the PLC. The PLC used in the system is CS1G-H CPU44, NPN type.

(5 marks)

(c) Construct the ladder diagram of the system

(10 marks)

QUESTION 6

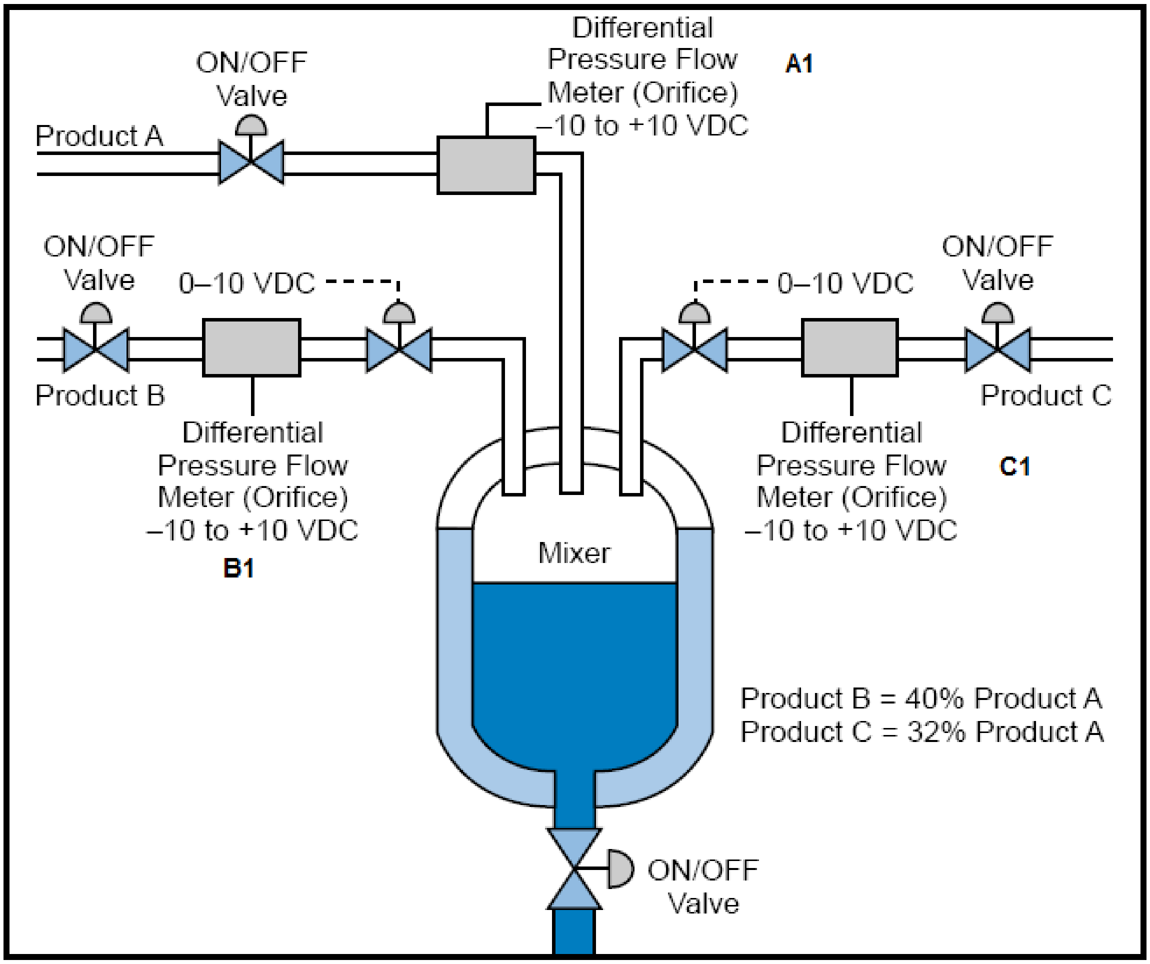

Figure 12: Chemical mixer system

System description:

- Range for differential flow meter at section A1, B1 and C1 are from 0 kg/m^3s to 80 kg/m^3s.
- The flow control valve for section A1, B1 and C1 are from 0% to 100% opening valve.

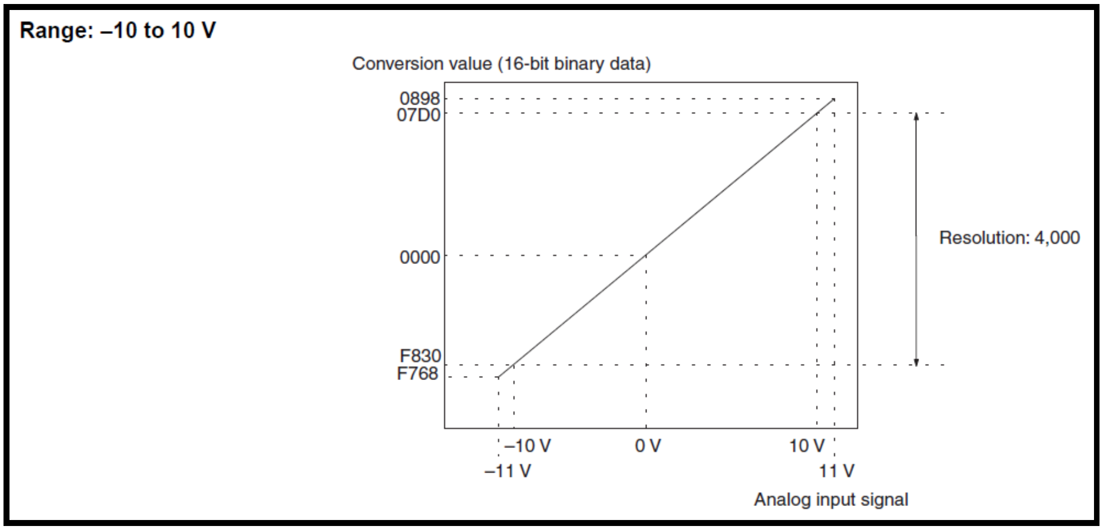

Figure 13: Analog input scaling graph for MAD 44 CSIG.

a) Based on **Figure 12** and **Figure 13**, find the equation for differential pressure flow meter at section A1, B1, and C1.

(3 marks)

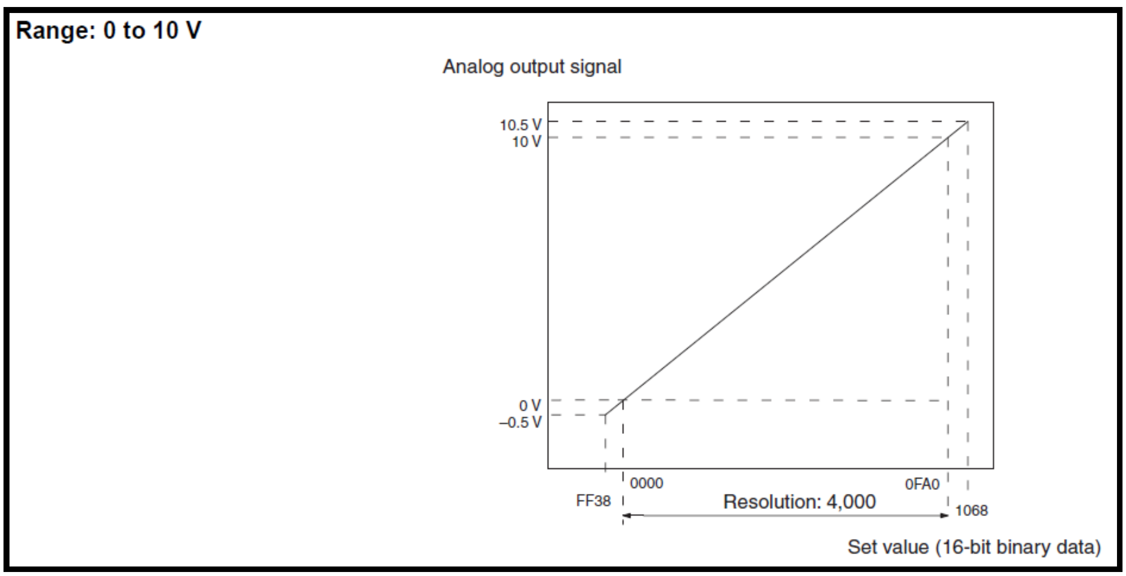

Figure 14: Analog output scaling graph for MAD 44 CS1G

b) Based on **Figure 12** and **Figure14**, find the equation for flow control valve at section B1 and C1.

(3 marks)

c) Design a ladder diagram based on the following statement:

i. Master control relay

(2 marks)

ii. If the differential pressure flow meter at section A1 (2015) send signal -8VDC, the solenoid valve at section A1 will energise for 15 seconds.

(3 marks)

iii. If the differential pressure flow meter at section B1 (2016) send signal -3VDC, the flow control valve at section B1 (2011) will open at 15%.

(3 marks)

iv. If the differential pressure flow meter at section C1 (2017) send signal -7VDC, the flow control valve at section C1 (2012) will open at 32%.

(3 marks)

v. If one of the differential pressure flow meter at section A1 or B1 or C1 send signal at 9 VDC the buzzer will energise for 30 seconds and red indicator light will blinking every 1 seconds.

(3 marks)

END OF QUESTION