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CONFIDENTIAL

SET A

UNIVERSITI KUALA LUMPUR
Malaysia France Institute

FINAL EXAMINATION

SEPTEMBER 2013 SESSION

SUBJECT CODE	:	**FAB 20204**
SUBJECT TITLE	:	**PLC AND INDUSTRIAL NETWORKING**
LEVEL	:	**BACHELOR**
TIME / DURATION	:	**(3 HOURS)**
DATE	:	**JANUARY 2014**

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) question only.**
6. **Answer all questions in English.**

THERE ARE 11 PAGES OF QUESTIONS, EXCLUDING THIS PAGE.

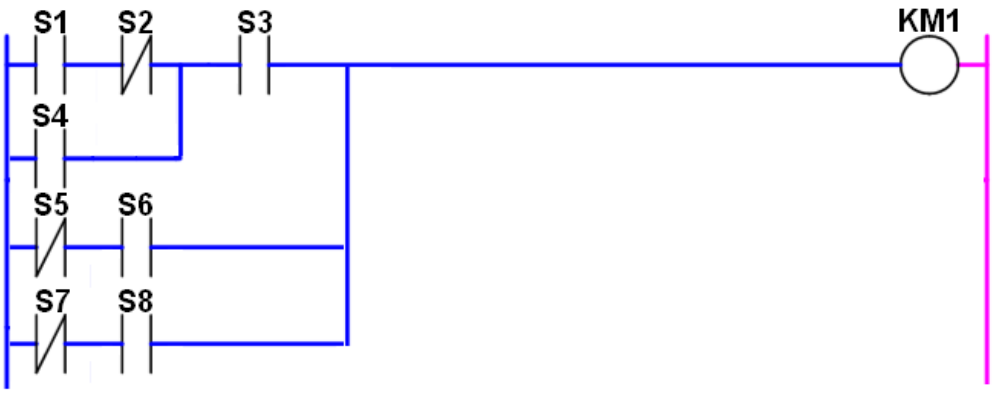
SECTION A (Total: 40 marks)

INSTRUCTION: Answer all questions.

Please use the answer booklet provided.

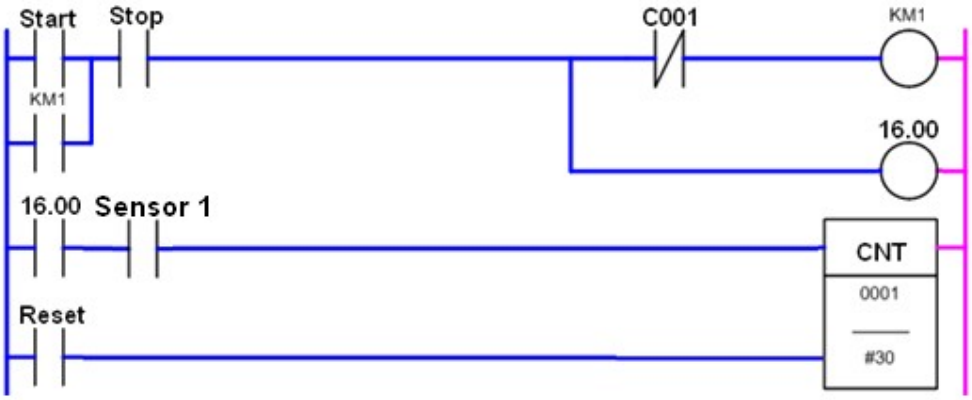
Question 1

(a) Convert the following ladder diagram to instruction list.



(5 marks)

(b) Interpret the following ladder diagram in no more than 50 words.



(5 marks)

(c) Draw a ladder program based on the following requirement. “An indicator light H_1 will be on automatically when pushbutton S1 (NO) is pressed or after the counter finish counting 5 boxes. The indicator light will be off when a switch S2 (NO) is pressed. The objects are detected by sensor S3 (NO). The counter will automatically reset after finish counting.”

(10 marks)

Question 2

(a) Define OSI model

(3 marks)

(b) State all the seven layers of the OSI model.

(4 marks)

(c) Define the function of any two of the layers in **question 2(b)**

(4 marks)

(d) Give **three (3)** causes of signal impairment in signals transmission

(3 marks)

(e) If a signal at the beginning of a cable with -0.3dB/km has a power of 2mW, calculate the power of the signal at 5km

(3 marks)

(f) Draw a signal element versus data element of one data element per two signal elements (r=1/2)

(3 marks)

SECTION B (Total: 60 marks)

INSTRUCTION: Answer THREE (3) questions only.

Please use the answer booklet provided.

Question 3

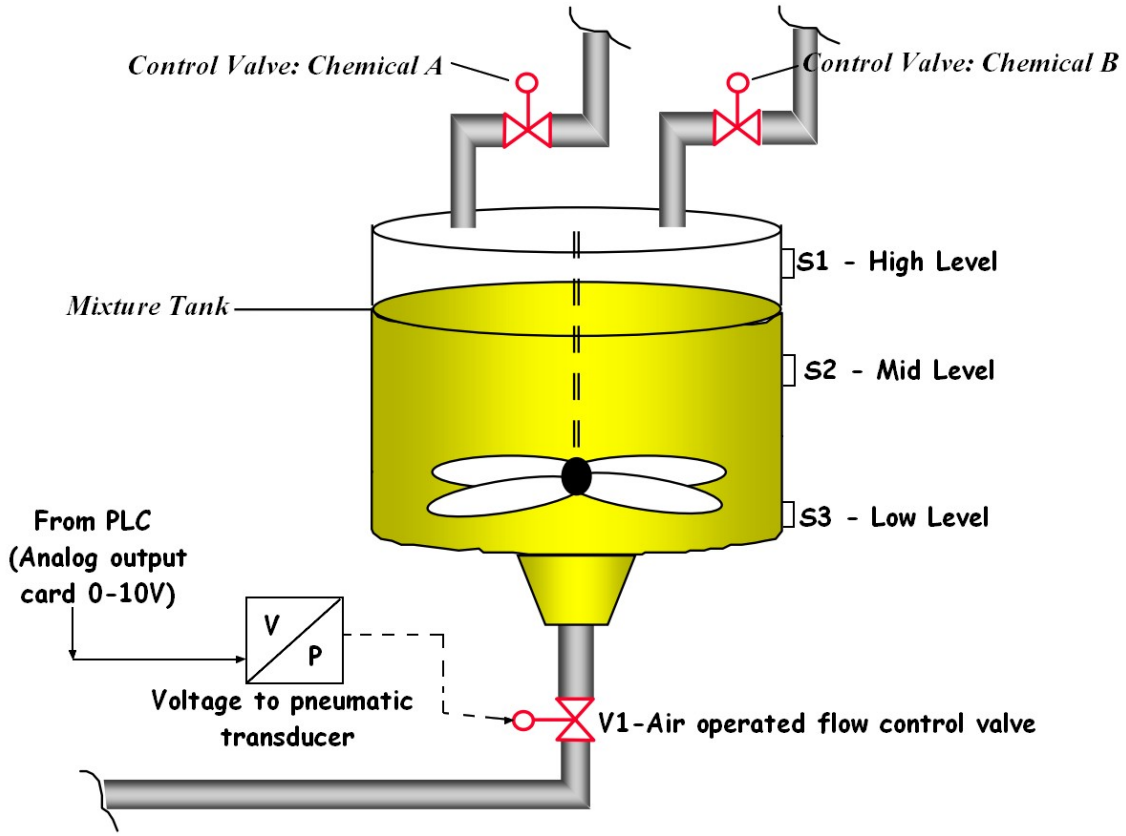


Figure 1: Typical process control application

System description:

Figure 1 above, shows the description of a liquids mixture of two chemicals product. Control valve A and B will control the equal quantity of chemical A and chemical B. The sensors are used to detect different level of the Mixture tank. We want to control the speed of discharge base on the level of the reservoir. If all the sensors (S1, S2, and S3) are ON, the flow control valve will be opened 95%. If the sensor 2 (S2) and sensor 3 (S3) are ON, the flow control valve will be opened 50%. If sensor 3 (S3) is ON, the flow control valve will be opened 25%. The opening and closing of flow control valve is controlled with a PLC OMRON CS1.

Sensor 1, sensor 2 and sensor 3 are magnetic level switch (i.e discrete sensors). The PLC analog output module is used to control the percentage of opening of the flow control valve. The voltage to pneumatic transducer will convert the signal received from the analog output (−10 - +10V) to a proportional pneumatic signal (0-15psi). If it receives −10V, then the flow control valve will be fully closed. If it receives +10V, then the flow control valve will be fully opened. If it receives 5V, then the flow control valve will be half opened.

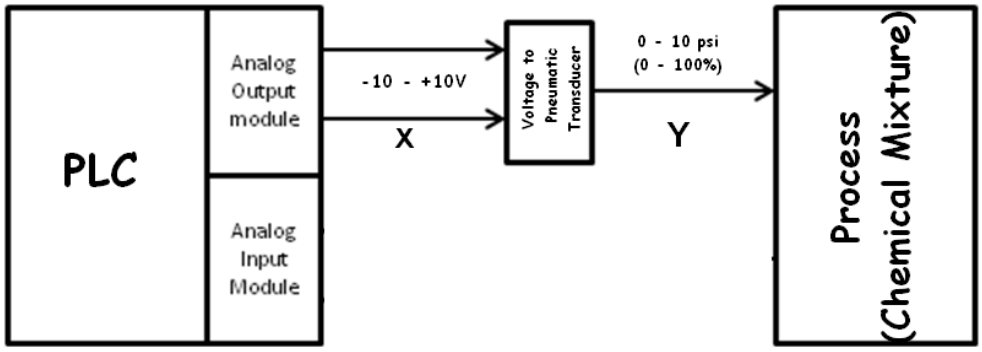


Figure 2: Data conversion of sensor and transducer

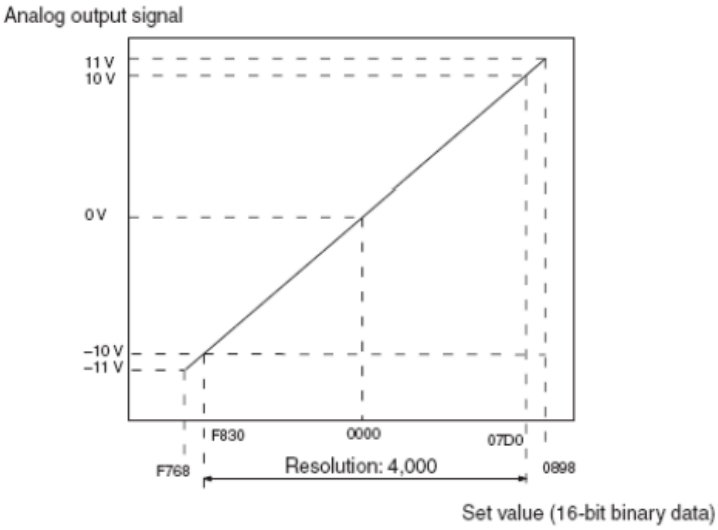


Figure 3: Analog output scaling graph for MAD 44 CSIG.

a) Based on **Figure 2**, find the conversion equation X and Y (Draw the respective graph conversion and show all your calculation).

(6 marks)

b) Complete the **Table 1** below based on the equations obtained in Question 3 (a) and Question 3 (b).

(3 marks)

Table 1: Conversion Table

% opening of the valve	Analog output signal range	Digital Data	
(0-100%)	-10 – 10V	Decimal	Hexadecimal
0			
25			
50			
95			
100			

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

i. Master control relay.

(2 marks)

ii. If sensor 1, sensor 2 and sensor 3 are ON (Mixture tank at high level), the flow control valve will be opened 95%.

(3 marks)

iii. If sensor 2 and sensor 3 are On (reservoir at medium level), the flow control valve will be opened 50%.

(3 marks)

iv. If sensor 3 is On (reservoir at low level), the flow control valve will be opened 25%.

(3 marks)

Question 4

Analyze the logical layout of the industrial network located in an automotive manufacturing plant in Rawang as in the following Figure 4:

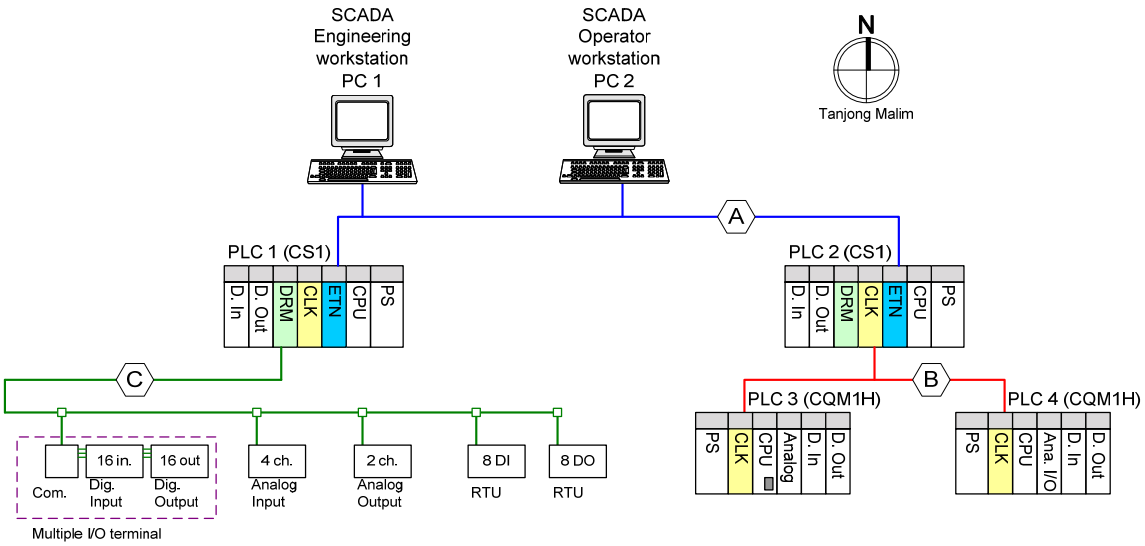


Figure 4

a) Networking parameters: Provide all the required settings and parameters (hardware and software) for each device.

i. Type of industrial network.

ii. Type of transmission media & and its connector

iii. IP address (use class C IP address, it's preferable to use 192.168.197.xx as your IP address), Subnet mask, Network number, Unit number and Node number

	IP Add.	*Subnet*	*Network*	*Unit*	*Node*
PC1					
PC2					
PLC1 (ETN 21)					
PLC2 (ETN 21)					

iv. Routing table for PLC 1 only

Routing Table PLC 1							
Local				*Relay*			
No.	*Local Net.*	*Unit*		*No.*	*End Net.*	*Relay Net.*	*Relay Node*

[10 marks]

b) Network B: Provide all the required settings and parameters (hardware and software) for each device.

i. Type of industrial network.

ii. Type of transmission media & and its connector

iii. Network number, Unit number, and Data link Setup (Size 2 words)

	Network	*Unit*	*Data Link Send Area*	*Data Link Receive*
PLC2 (CLK21)				
PLC3 (CLK21)				
PLC4 (CLK 21				

iv. Routing table for PLC 2 only

Routing Table PLC 2							
Local				*Relay*			
No.	*Local Net.*	*Unit*		*No.*	*End Net.*	*Relay Net.*	*Relay Node*

[10 marks]

Question 5

Parking gate system

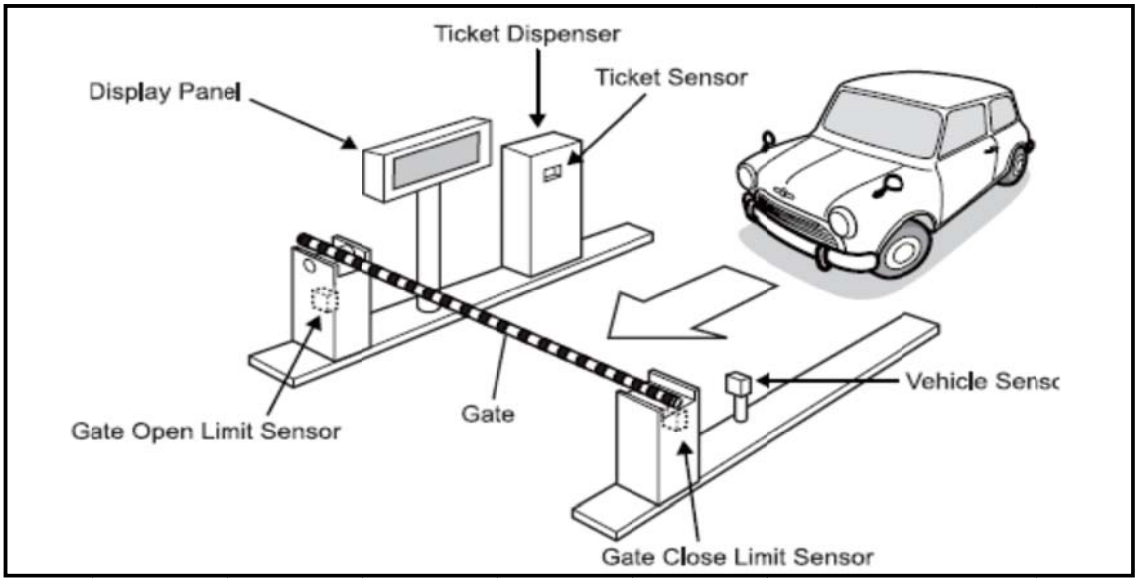


Figure 5: Parking gate system overview

When a car approaches a gate, a ticket is issued. The gate is opened when the ticket is taken. When the car passes the gate, the gate is closed, and the system returns to the initial state. A display panel is used to display status messages. Transitions between actions are initiated by inputs from the sensors.

Given is the Input/Output table of the system:

Table 2: Input and Output table for Parking Gate System

Address	Tag	Description
0.01	Vec_Sen	Vehicle Sensor (Photo electric Sensor)
0.02	Tic_Sen	Ticket Sensor (Limit Switch)
0.04	G_Open	Gate open limit sensor (Limit Switch)
0.05	G_Close	Gate close limit sensor (Limit Switch)
1.01	Tic_Dispen	Ticket Dispenser (Relay)
1.02	Gate Up	Gate Up (Contactor)
1.03	Gate Down	Gate Down (Contactor)
D200	Disp_Panel	Display Panel

Answer the following questions by referring to **Figure 5** and **Table 2**:

(a) Design the Ladder Diagram of the system.

(10 marks)

(b) The system will be monitored using SCADA runtime system. Prepare the table of SCADA variable tags for SCADA setup purposes. The table should be in a format as in **Table 3**

(8 marks)

Table 3: SCADA process data table

PLC	SCADA TAGS	RANGES/DISPLAYED VALUE					
ADDRESS	VARIABLE TAG NAME	RAW ZERO	RAW FULL	ENG ZERO	ENG FULL	ENG UNITS	FORMAT

(c) The PLC used to control the parking gate system is OMRON PLC CS1G-H CPU 44. The PLC is connected in a LAN where the IP address of the PLC is 172.22.102.11. The PC which is used to monitor the system using SCADA has an IP address of 172.22.102.240. Based on **Figure 6**, what is the address value?

(2 marks)

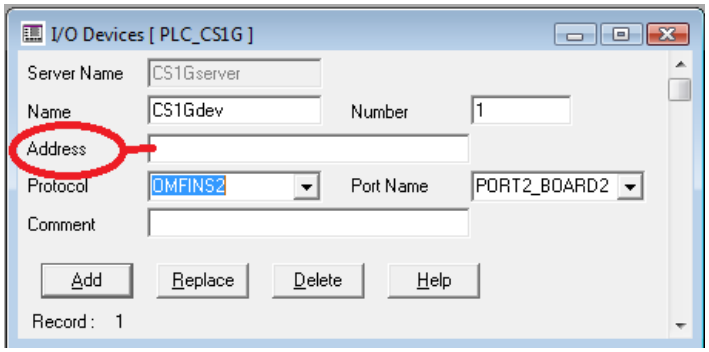


Figure 6: I/O device setup windows

Question 6

Based on the **Figure 7**, the system has four programmable logic controllers (PLC). The model of PLC is CSIG-H CPU44. Each PLC is attached for each station. The communication module of the PLC is controller link. Answer the following questions:

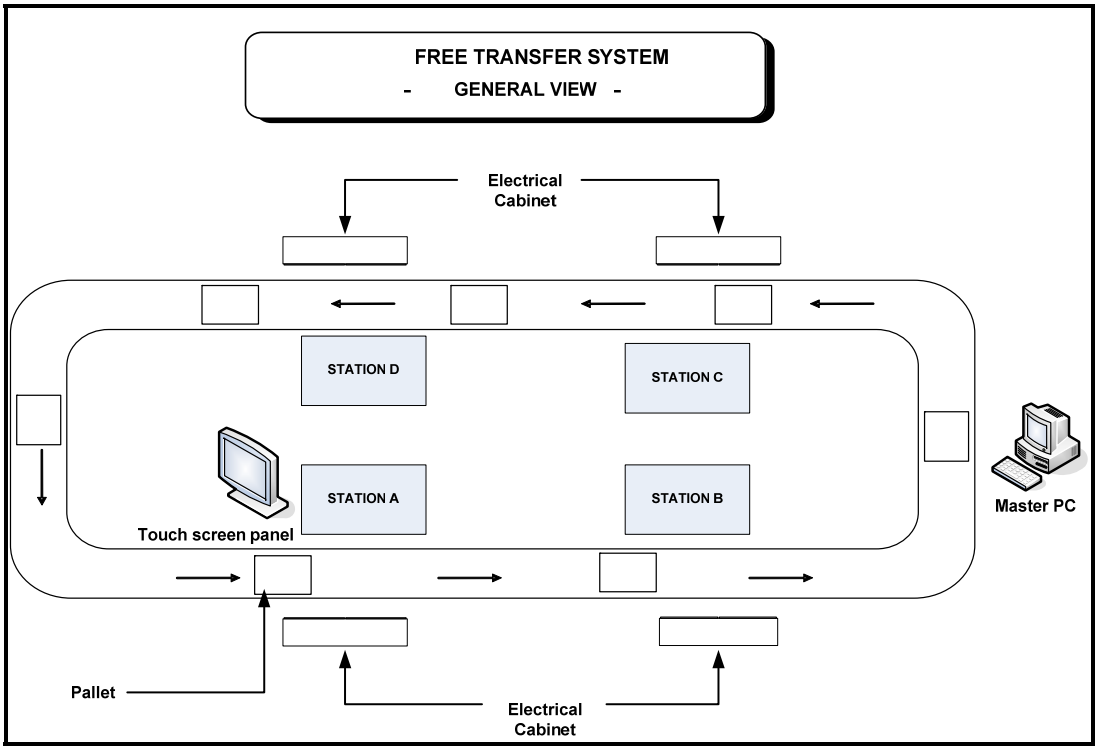


Figure 7: Free transfer system with data link control

(a) Define data link control

(2 marks)

(b) Develop the data link table based on the **Figure 8**.

Node	Link Addr.	Size	Offset	Src Addr.	Link Addr.	Size	Offset	Src Addr.
01	00018	10	-----	Send	D00100	10	-----	Send
02	00028	10	0	00028	D00110	10	0	D00110
03	00038	10	0	00038	D00120	10	0	D00120
04	00048	10	0	00048	D00130	10	0	D00130

Figure 8: Controller link table configuration

(4 marks)

(c) Consider node 01 is for Station A and so on. The PLC system is 16 bits. Show the internal bit(s) and internal word(s) used. Develop a ladder diagram based on the following statement:

i. One input address (0.01) from station A is controlling two outputs address (1.03 and 1.04) in station B and one output address (1.12) in station D (activate in 10 seconds)

(3 marks)

ii. One input address (0.02) from station D is controlling three outputs in different station. One output address (1.05) in station C (activate in 2 seconds).Then it will activate output address (1.07) in station B (activate in 4 seconds). Lastly it will activate output address (1.09) in station A (activate in 6 seconds).

(7 marks)

iii. One input address (0.04) from station B is transferring data for speed value of 3 phase AC motor at station A. The value is **#3AF = 1000 rpm.** Use suitable internal word based on the question 2(c). At station A use analog input address **CIO 2015.**

(4 marks)

END OF QUESTION