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CONFIDENTIAL

SET A

UNIVERSITI KUALA LUMPUR
Malaysia France Institute

FINAL EXAMINATION

JANUARY 2014 SESSION

SUBJECT CODE	:	**FAB 20204**
SUBJECT TITLE	:	**PLC AND INDUSTRIAL NETWORKING**
LEVEL	:	**BACHELOR**
TIME / DURATION	:	**(3 HOURS)**
DATE	:	**MAY 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) By referring to **Figure 1**, answer the following questions:

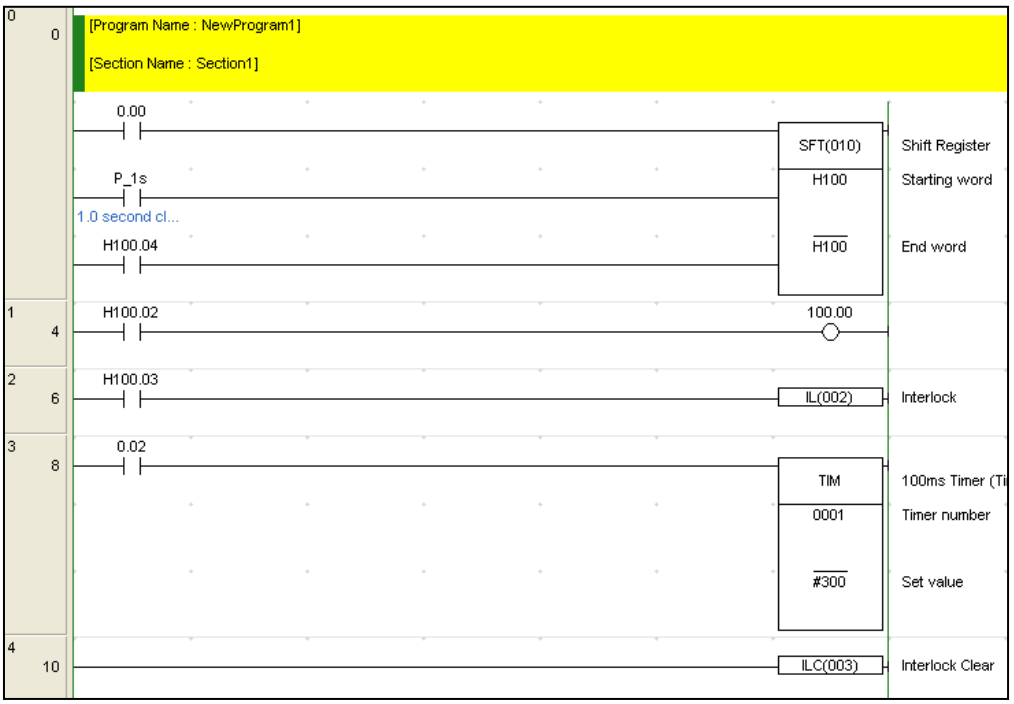

Figure 1: ladder diagram

i. Convert rung 0 until rung 2 into instruction list.

(4 marks)

ii. Determine whether Timer 1 will function if 0.02 is pressed but H100.03 is still off.

(2 marks)

iii. Determine how many pulses (1 sec pulse) needed to turn on 100.00.

(2 marks)

iv. Give **one (1)** example why we need to use Interlock function (IL).

(2 marks)

(b) By referring to **Figure 2** , answer the following question:

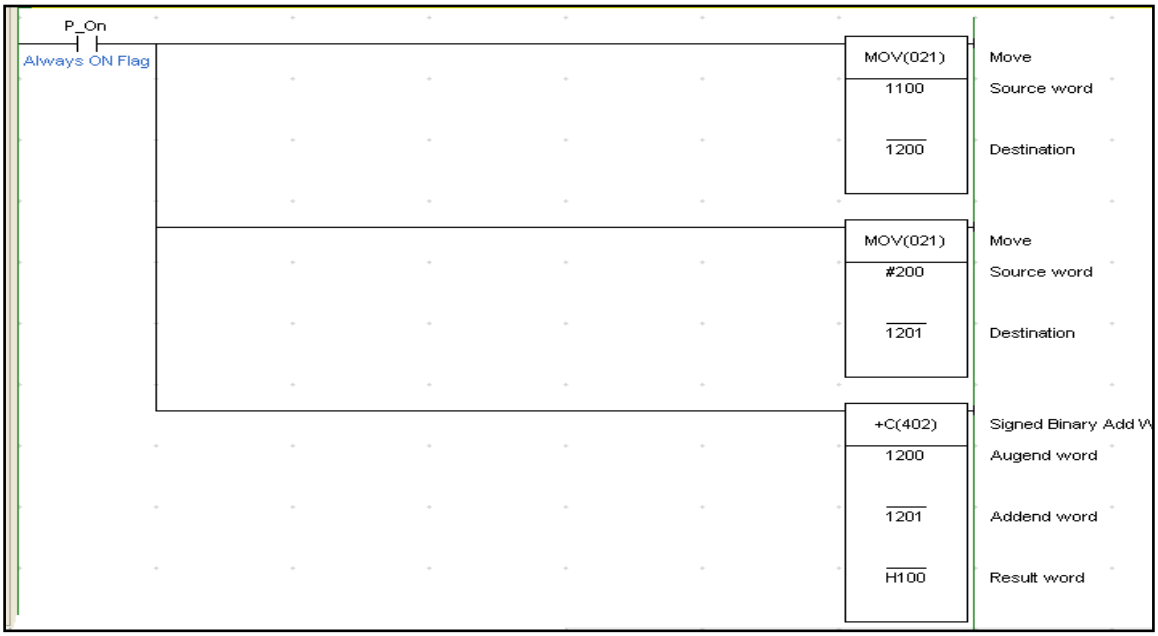

Figure 2: ladder diagram

i. Given data in register 1100 is 0x2F, define the value in H100 after the program run.

(2 marks)

ii. If data in register 1100 is #FF state the value of H101

(2 marks)

iii. Define the function of *Always On* flag

(2 marks)

(c) Name **four (4)** basic components in the PLC structure.

(4 marks)

Question 2

(a) Define OSI model

(3 marks)

(b) State all seven layers of the OSI model

(3.5 marks)

(c) Define the function of any two of the layers in **Question 1(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)

(3.5 marks)

SECTION B (Total: 60 marks)

INSTRUCTION: Answer THREE (3) questions only.

Please use the answer booklet provided.

Question 3

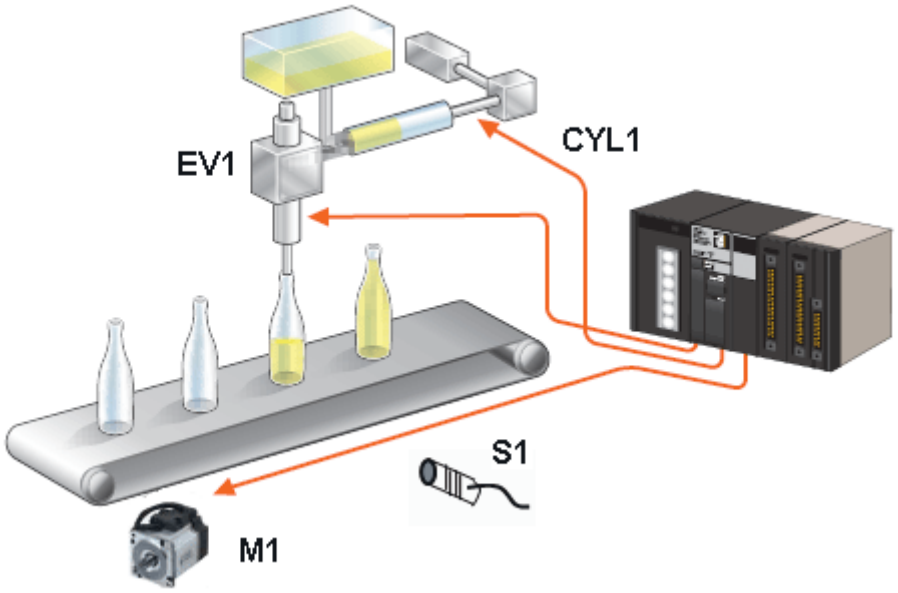

Figure 3: Bottle Filling Station

Figure 3 above shows the illustration of an **Arab-Cola** filling process. The usage of Timer is very important in order to level the water to be filled in the bottle. The Input output list of the system can be referred in **Table 1**.

Table 1: Input and Output list

Index	Tag	Descriptions
1	St	Start Pushbutton Normally Open contact
2	Sp	Stop Pushbutton Normally Close contact
3	S1	Photo Electric sensor 3 wire NPN type
4	RS1	Reed switch sensor to detect cylinder 1 fully extend
5	KM	Contactor to run motor M1
6	EV1	Solenoid valve to allow the flow of water
7	EV2	Solenoid valve to make cylinder CYL1 Extend
8	EV3	Solenoid valve to make cylinder CYL1 Retract

(a) The input and output modules use at the PLC are Module 0 and Module 1 consecutively. Assign the appropriate PLC addresses for the Inputs and Outputs.

(4 marks)

(b) Draw the PLC input wiring

(4 marks)

(c) Draw the PLC output wiring

(4 marks)

(d) Build the ladder diagram base on the explanations given.

i. The system will ON when the Start pushbutton is pressed and only will OFF if the Stop pushbutton is pressed and counter flag is ON.

(1 mark)

ii. When the system ON the conveyor will run and only will stop when the proximity sensor S1 detect the arriving of bottle. The conveyor will run again if the filling process is done (timer is done).

(1.5 marks)

iii. When the sensor S1 detect the arriving of the bottle, the valve EV1 will energize for 5 seconds.

(2 marks)

iv. When the EV1 energize the cylinder CYL1 will extend and when RS1 detected, the CYL1 will retract.

(1.5 marks)

v. When RS1 is on, the counter will count until 1000 and the value of counter will reset if the Stop button is pressed.

(2 marks)

Question 4

(a) By referring ASCII in **Table 2**, answer the following question:

Table 2: ASCII table

ASCII	Hex	ASCII	HEX	ASCII	Hex
0	30	L	4C	g	67
1	31	M	4D	h	68
2	32	N	4E	I	69
3	33	O	4F	j	6A
4	34	P	50	k	6B
5	35	Q	51	l	6C
6	36	R	52	m	6D
7	37	S	53	n	6E
8	38	T	54	o	6F
9	39	U	55	p	70
A	41	V	56	q	71
B	42	W	57	r	72
C	43	X	58	s	73
D	44	Y	59	t	74
E	45	Z	5A	u	75
F	46	a	61	v	76
G	47	b	62	w	77
H	48	c	63	x	78
I	49	d	64	y	79
J	4A	e	65	z	7A
K	4B	f	66		

A sender use internet to send text **PLCINETS** to a receiver. The system is using checksum to detect error from sender and the text is a 16 bits word:

i. Find the sum and the checksum send to sender site.

(3 marks)

ii. Find the sum and checksum to receiver site if no error.

(2 marks)

iii. Find the checksum send to receiver if sender change the data to **PLCiNETS**

(2 marks)

iv. Find the checksum at receiver for answer **question 4 a(iii)**

(2 marks)

v. For the same data PLCiNETS, what would be the receiver checksum if the checksum send to receiver is 0XE333 and determine what receiver would do after checking the checksum received.

(3 marks)

(b) A system is Stop-and-Wait ARQ protocol as to detect errors

i. Draw the flow diagram of Stop-and-Wait ARQ protocol

(4 marks)

ii. From the algorithm in **Figure 4 ,** complete **A** and **B** program.

(4 marks)

```
1  while(true)                          //Repeat forever
2  canSend = true                       //Allow the first frame to go
3  {
4    WaitForEvent();                    // Sleep until an event occurs
5    if(Event(RequestToSend) AND canSend)
6    {
7
8              A
9                                       //Send the data frame
10     canSend = false;                 //Cannot send until ACK arrives
11   }
12           B                          // Sleep until an event occurs
13                                      // An ACK has arrived
14    {
15     ReceiveFrame();                  //Receive the ACK frame
16     canSend = true;
17    }
18 }
```

Figure 4: Stop-and Wait ARQ protocol

Question 5

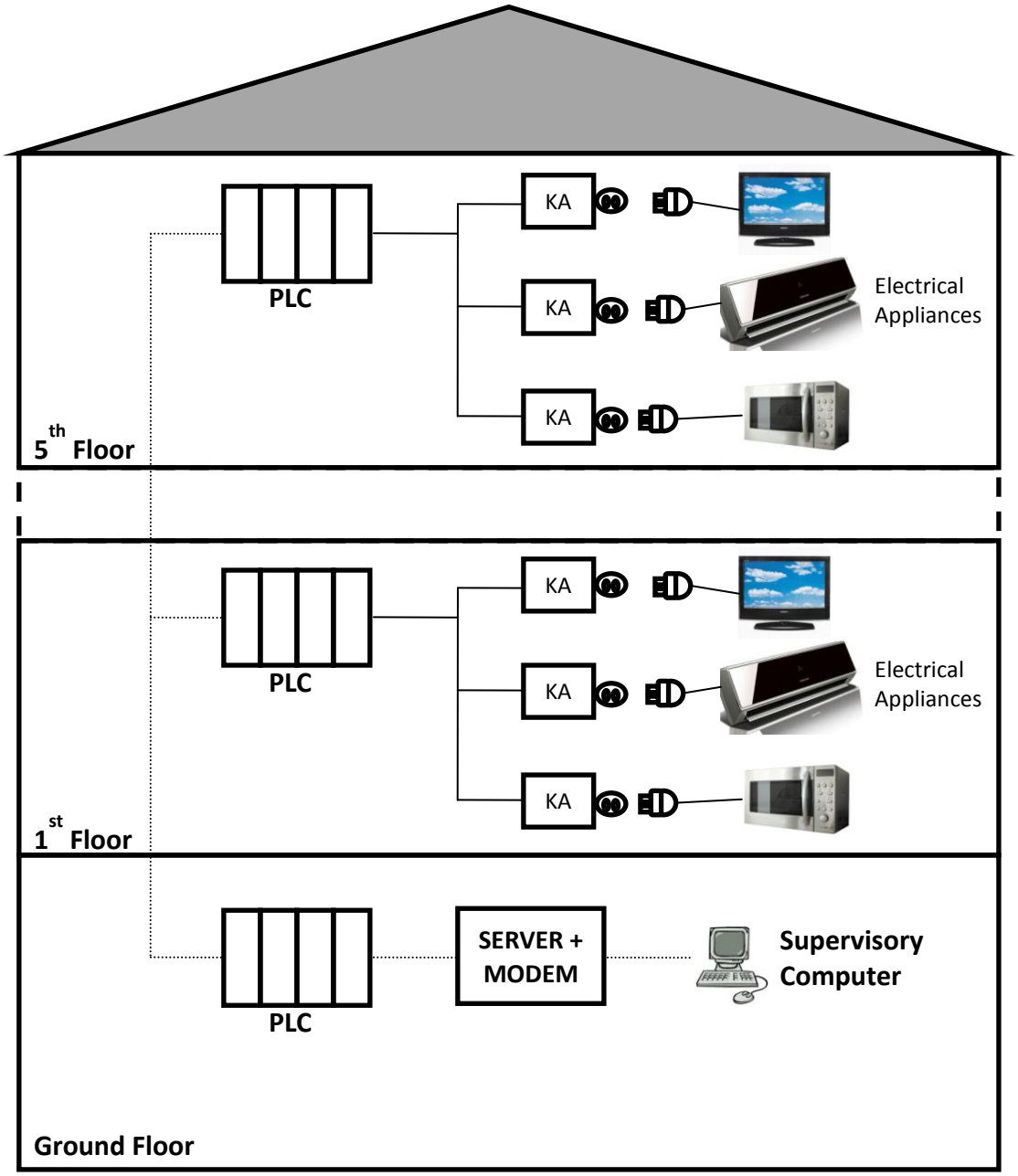

Figure 5: Building with Networking Connection

Figure 5 above show the illustration of a 5th floors building with each floor equipped with one plc each to control the electrical appliances at each floor. A supervisory computer is located at the ground floor in order to monitor the usage of the electrical appliances of the floor.

(a) Propose a suitable industrial networking topology for this building system.

(4 Marks)

(b) List the hardware and software needed to realize this networking configuration (including the connections cable).

(4 Marks)

(c) Assuming that the PLCs at each floor are OMRON - CS1GH cpu44 with 1 digital input module, 1 digital output module, 1 Networking module, 1 cpu module and 1 power supply module is used. Draw the inputs and outputs wiring diagram for PLC at 5^{th} floor.

(4 Marks)

(d) Design a few pages for SCADA system, so that the building manager can monitor the building easily.

(4 Marks)

(e) List the details of variable tags needed for this SCADA.

(4 Marks)

Question 6

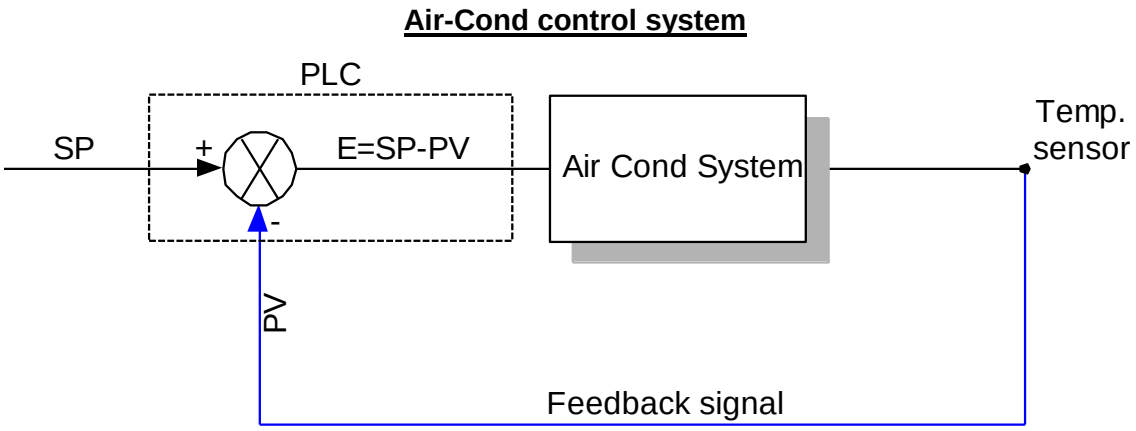

Figure 6: Close-loop block diagram of an air-cond control system

A PLC is used to control an air-cond system in a room.The system consist of a temperature sensor, a PLC and air-cond system (refer to **Figure 6**). The sensor can measure temperature from 0˚C to 100˚C. The motor of a compressor in this system has a maximum speed of 4000 rpm. If the temperature of the room is less than 22˚C, the compressor of the air-cond will be off. If the temperature of the room is between 22˚C and 28˚C, the compressor of the air-cond system will works at 2200 rpm. If the temperature is more than 28˚C, the compressor will work at full speed.

Given is the list of Input/Output of the system:

Table 3: Input and Output table for Parking Gate System

Address	Tag	Description
0.01	Start_sys	N/O start push button for system
0.02	Stop_sys	N/C stop push button
2015	Temp_Sensor	analog temperature sensor
2011	Comp_Motor	Motor of the compressor
1.01	Air_Comp	Contactor for Air-Cond compressor

Answer the following questions by referring to **Figure 4** and **Table 3**:

(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 4**

(8 marks)

Table 4: 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 air-cond 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 temperature using SCADA has an IP address of 172.22.102.240. Based on **Figure 7**, state the address of the I/O Devices in SCADA.

(2 marks)

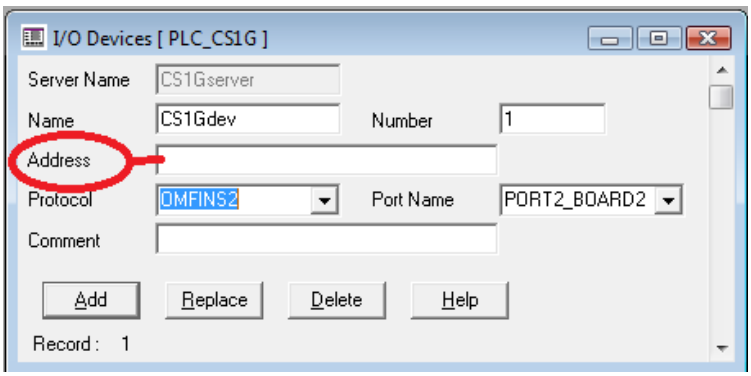

Figure 7: I/O device setup windows

END OF QUESTION