Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2014/2015

COURSE NAME	:	INDUSTRIAL ELECTRONICS
COURSE CODE	:	DAE 32003
PROGRAMME	:	3 DAE
EXAMINATION DATE	:	JUNE 2015/JULY 2015
DURATION	:	2 ½ HOURS
INSTRUCTIONS	:	ANSWER **FOUR (4)** QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF **SEVENTEEN (17)** PAGES

Q1 (a) Explain briefly the following devices:

(i) Relay
(ii) Timer
(iii) Solenoid

(6 marks)

(b) Refer to **Figure Q1 (b)**.

(i) Name the circuit A and B.

(2 marks)

(ii) Define the function of each circuit, A and B.

(4 marks)

(iii) Explain the circuit operation during de-energize and energize state.

(6 marks)

(c) Based on **Figure Q1(c)**:

(i) Write a truth table for the circuit function, and determine the logic function it represents.

(3 marks)

(ii) Modify the circuit in **Figure Q1(c)** so that it will represent an OR logic function. (Hint: Add one more +V power supply and re-arrange the contact's connection of the bottom relay)

(4 marks)

Q2 (a) Figure **Q2 (a) (i)** shows the control circuit for a packaging machine. The control circuit is used to detect and count the number of products being carried out on an assembly line. When it counts five products, the circuit energizes a solenoid. The solenoid is energized for a period of two seconds and is then shut off, causing it to retract.

(i) Fill in A, B and C from the ladder diagrams in **Figure Q2 (a)(ii)** with the proper elements and addresses.

(3 marks)

(ii) Based on Q2 (a) (i), write the mnemonic code for the system.

(4 marks)

(b) **Figure Q2(b)** shows the mnemonic code for a car park system. Draw the ladder diagram for that particular mnemonic code.

(12 marks)

(c) **Figure Q2(c)** shows the ladder diagram for two lamps control. Briefly explain the condition of Lamp 1 and Lamp 2 when;

(i) Condition 1: Only button D is pushed.
(ii) Condition 2: Only button A and B are pushed.
(iii) Condition 3: All buttons are pushed.

(6 marks)

Q3 (a) **Figure Q3(a)(i)** and **Table Q3** shows three cylinders system controlled by a main single start button (PB) and three conditional sensors; A, B and C. The process sequence is shown as below.

- All cylinders are in retract position during initial position except for cylinder B that in extend position.(Refer **Figure Q3(a)(i)** diagram)
- Start button is pressed.
- Cylinder B retracts.
- Sensor B detects full retraction for Cylinder B.
- After 3 seconds, cylinder A extends.
- Sensor A detects maximum extension for cylinder A.
- After 4 seconds, cylinder C extends.
- All system RESET/OFF when sensor C detected maximum extension for cylinder C.

Based on the process sequence above:

(i) Draw a pneumatic diagram for cylinder B only (During De-Energized and Energized state).

(10 marks)

(ii) Based on the ladder diagram in **Figure Q3(a)(ii)**, what is the elements that need to be place at A,B,C,D and E in order for the system to function properly.

(10 marks)

(b) **Figure Q3(b)** shows an example of a ladder diagram using timer.

(i) State the type of timing function used in the diagram.

(2 marks)

(ii) If the ladder in **Figure Q3(b)** is modified where A is placed with 0.00 input normally close (NC) contact, what type of timing function will it be?

(3 marks)

Q4 (a) **Figure Q4(a)(i)** shows the game buzzer control system and **Table Q4(a)** shows the IO assignment. The requirement are as follows:

- After the host had finished with the question, the 3 players will press the switch in front of them to fight to be first to answer the question.
- The buzzer will sound for 10 seconds after any one of the player has touched the switch.
- The light indicator in front of each player will light up and only reset by host switch.

From ladder diagram in **Figure Q4(a)(ii)**, fill in the box from A to E with appropriate elements and addresses.

(13 marks)

(b) **Figure Q4(b)(i)** and **Table Q4(b)** shows the PLC used to start and stop the motors of a segmented conveyor belt. This allows only conveyor segment carrying an object to move. The position of an object is detected by a proximity sensor located next to each conveyor segment. As long as the object is within the detecting range of the proximity sensor in each conveyor segment, that particular motor will work. If the object moves beyond the range, a timer is activated for 2 seconds and the motor of that conveyor segment will stops.
The operation is as follows:

- Motor 3 will always on.
- Motor 2 turns on when sensor 3 detects the object.
- Motor 2 is on until Motor 1 is turned on and the object is out of detection range of sensor 2.
- Motor 1 turns on when sensor 2 detect the object.
- Motor 1 is on until object is out of detection range of sensor 1.

From ladder diagram in **Figure Q4(b)(ii)**, fill in the box from A to E with appropriate elements and addresses.

(12 marks)

Q5 (a) Draw the basic operational amplifier (op-amp) with the five-terminal connections. Give the characteristics of an ideal op-amp.

(5 marks)

(b) The circuit in **Figure Q5(b)** is a non-inverting linear combination circuit. Show that the output voltage V_o is given by:

$$V_o = \frac{(R_3 + R_4)}{R_3(R_1 + R_2)}(R_2V_1 + R_1V_2)$$

(8 marks)

(c) Given a differentiator circuit with ramp input voltage, V_{IN} shown in **Figure Q5(c)**. The values of the resistors and capacitors are stated as:
$R_F = 2\ k\Omega$, $R_1 = 10\ k\Omega$, $C = 0.010\ \mu F$.

(i) Sketch and clearly label the values of the output signal, V_{OUT}.

(9 marks)

(ii) Calculate the frequency where the circuit will stop acting as a differentiator.

(3 marks)

Q6 (a) **Figure Q6(a)** shows one type of solenoid valve. State the type of the valve.

(3 marks)

(b) What does the symbols in **Figure Q6(b)** represent?

(10 marks)

(c) A conveyor system works as follows :
A start button is used to turn on a conveyor belt A that brings bottles to a filling station. Sensor S1 placed at the centre of conveyor A will stop the conveyor belt A upon detecting the bottle. Here a valve will open for 2 seconds for filling liquid into the bottle. After that the conveyor will move again until the bottle is sensed by sensor S2 at the end of the conveyor. Conveyor A will stop again and a solenoid is energized for 3 seconds for a piston to push the bottle onto conveyor belt B. The process is repeated for other bottles until a stop switch is pressed.

(i) List out the input and output devices for this system.

(4 marks)

(ii) Draw a motion diagram for this problem.

(8 marks)

- END OF QUESTION -

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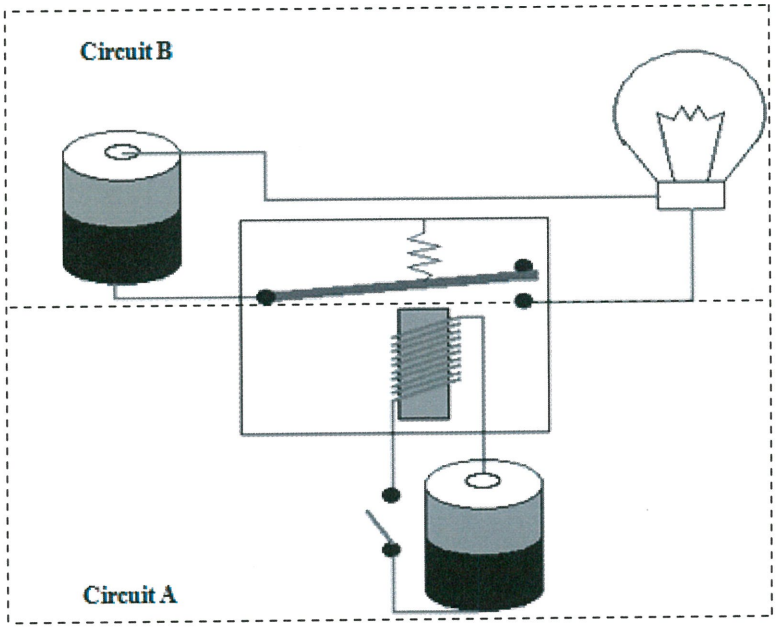

FIGURE Q1(b)

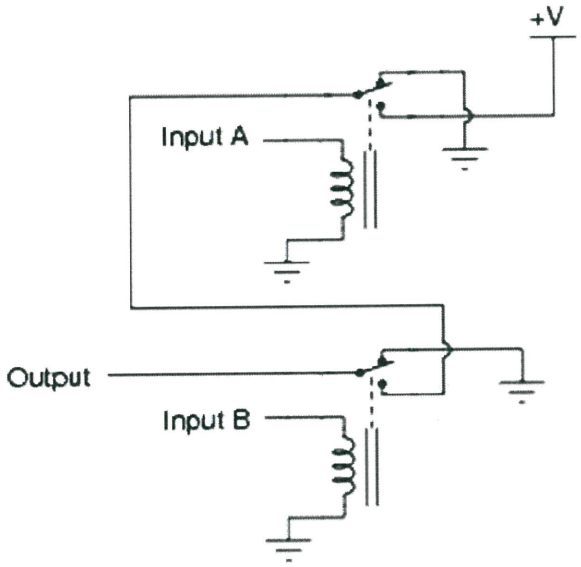

FIGURE Q1 (c)

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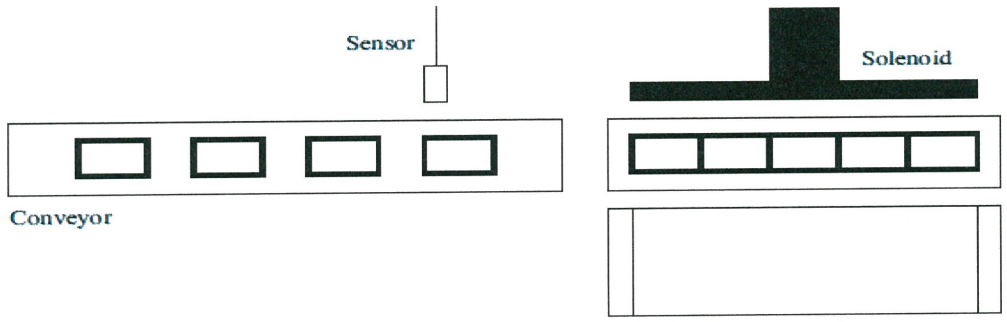

Input	Device
00000	Sensor

Output	Device
01000	Conveyor
01001	Solenoid

Others	
CNT 047	Product counter
TIM 000	Solenoid energizer timer

FIGURE Q2(a)(i)

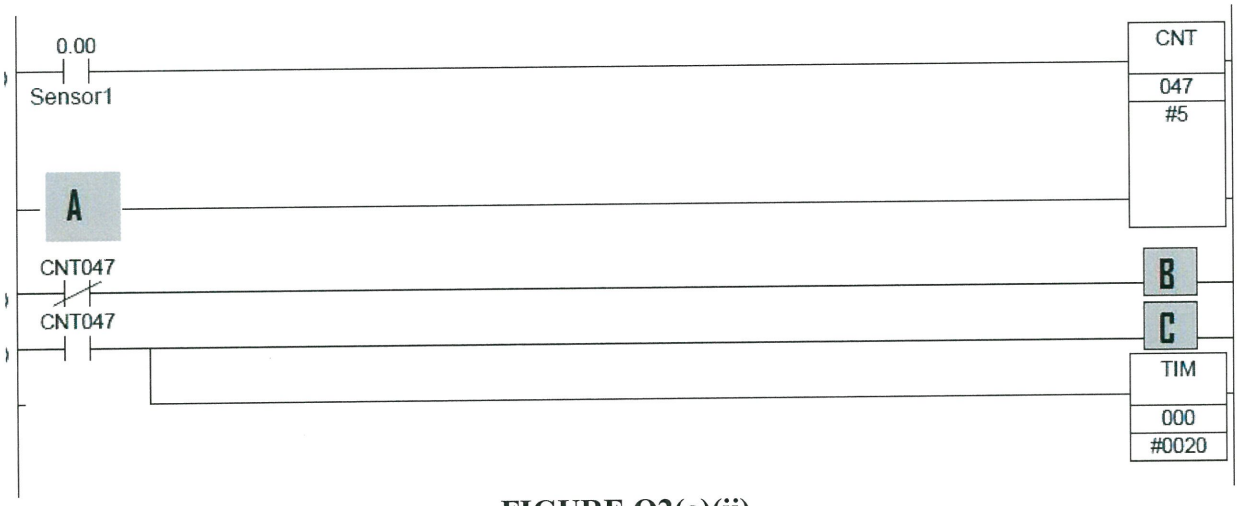

FIGURE Q2(a)(ii)

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Address	Instruction	Data
0000	LD	0.00
0001	DIFU(13)	HR1.01
0002	LD	0.01
0003	DIFD(14)	HR1.02
0004	LD	HR1.01
0005	ADD(50)	HR0
		#1
		HR0
0006	LD	HR1.02
0007	SUB(51)	HR0
		#1
		HR0
0008	LD	P_On
0009	CMP(20)	#50
		HR0
0010	AND	P_EQ
0011	OUT	100.00
0012	END	

FIGURE Q2(b)

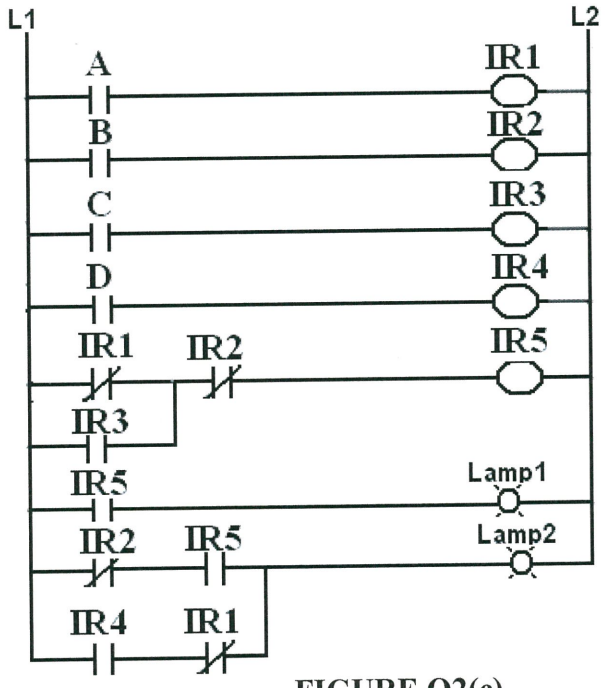

FIGURE Q2(c)

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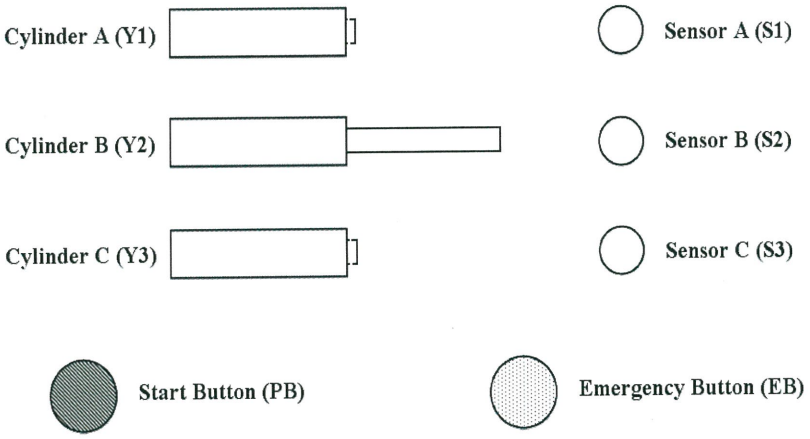

FIGURE Q3(a)(i)

TABLE Q3

Item	Symbols	Description	Initial State
Cylinder A	Y1	Single Acting (3/2 Way Valve)	NC
Cylinder B	Y2	Single Acting (3/2 Way Valve)	NO
Cylinder C	Y3	Single Acting (3/2 Way Valve)	NC
Start Button	PB	Single Pole Spring Return	NO
Sensor A	S1	Limit Switch w/o latching	NO
Sensor B	S2	Limit Switch w/o latching	NO
Sensor C	S3	Limit Switch w/o latching	NO

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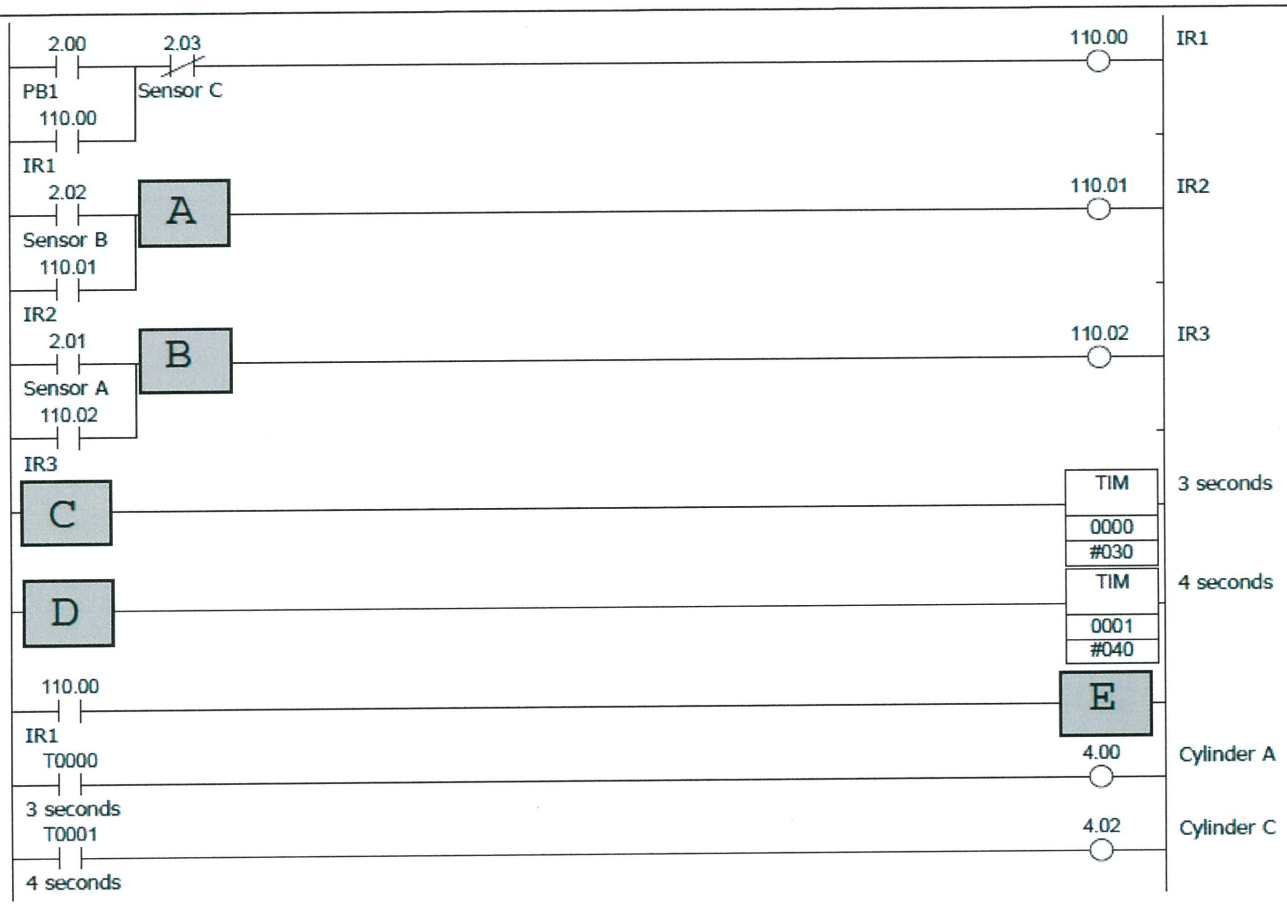

FIGURE Q3(a)(ii)

FIGURE Q3(b)

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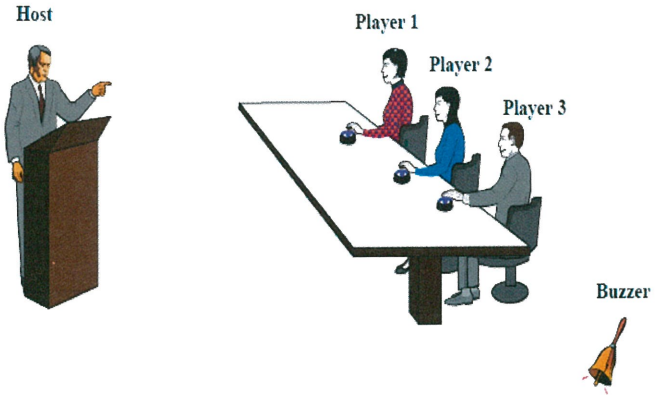

FIGURE Q4(a)(i)

TABLE Q4(a)

Input	Device
00000	PB1
00001	PB2
00002	PB3
00003	RST (reset)

Output	Device
01000	Buzzer
01001	Player 1 light
01002	Player 2 light
01003	Player 3 light

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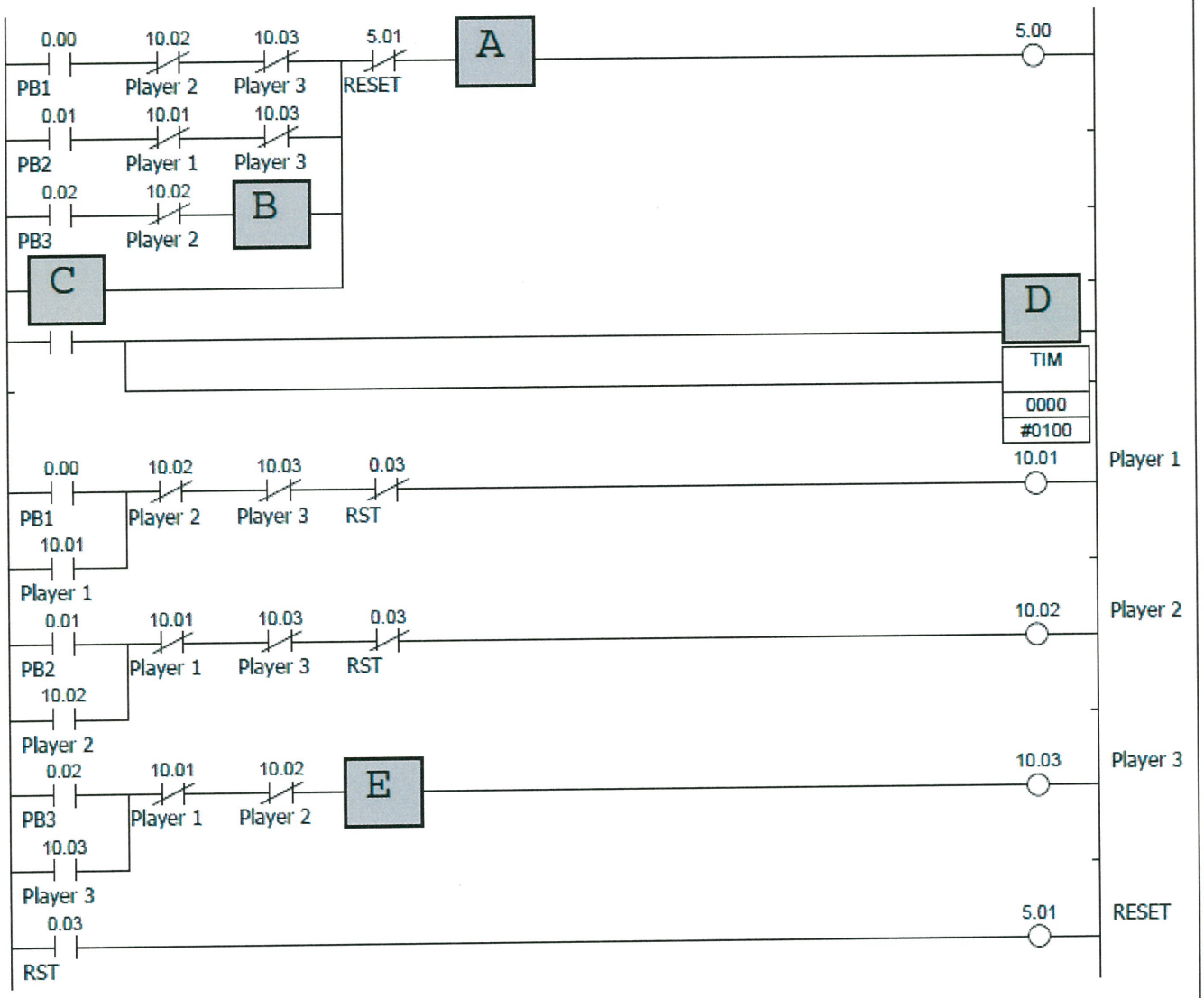

FIGURE Q4(a)(ii)

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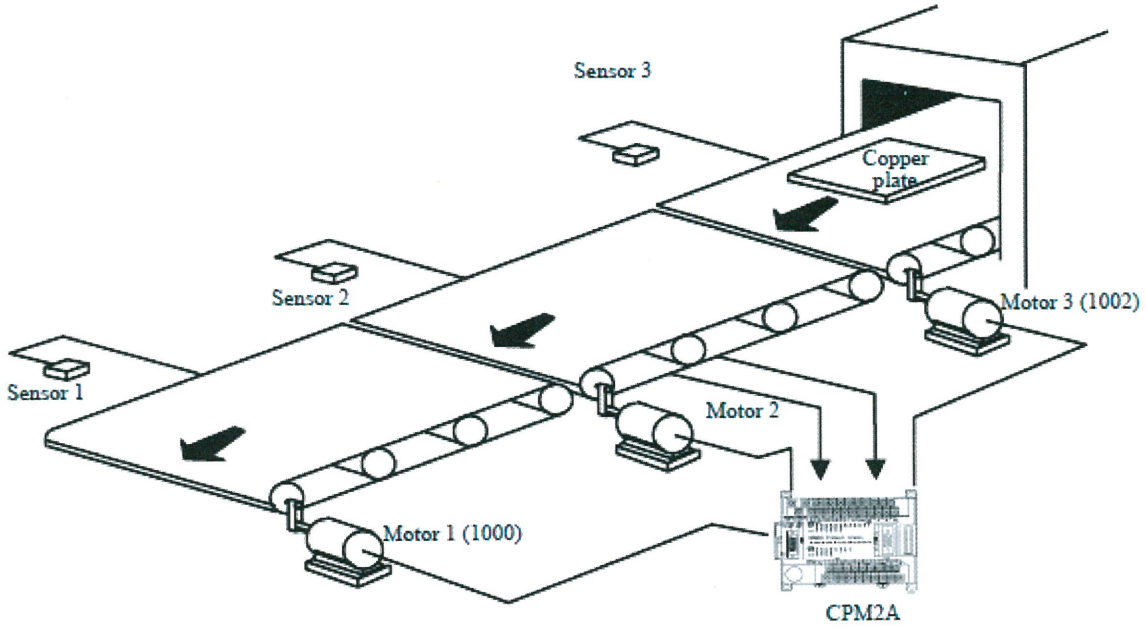

FIGURE Q4(b)(i)

TABLE Q4(b)

Input	Devices
00000	Sensor 1
00001	Sensor 2
00002	Sensor 3

Output	Devices
01000	Motor 1
01001	Motor 2
01002	Motor 3

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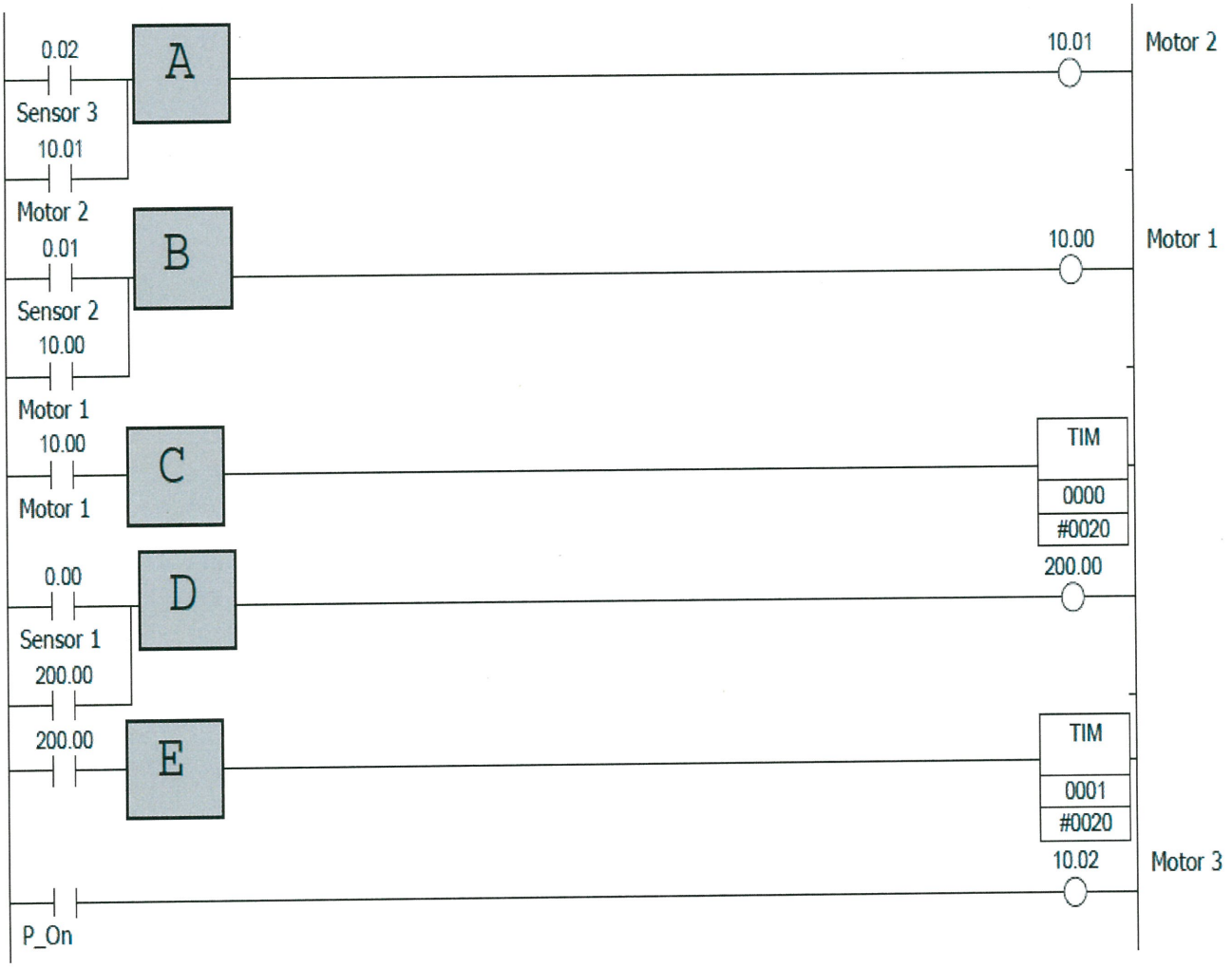

FIGURE Q4(b)(ii)

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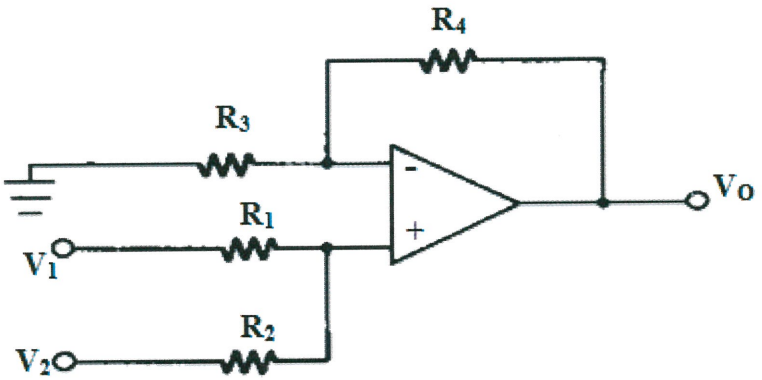

FIGURE Q5(b)

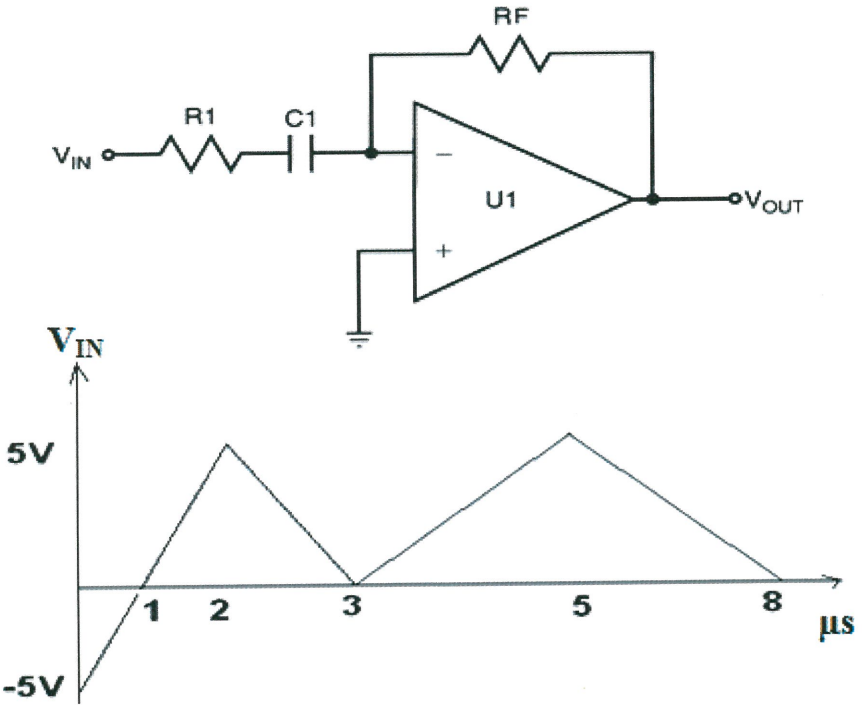

FIGURE Q5(c)

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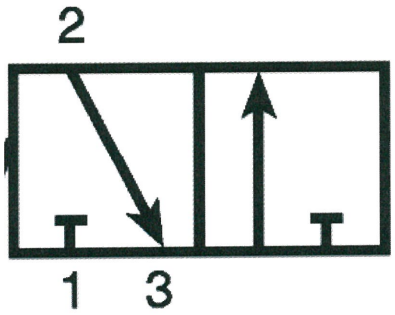
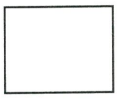
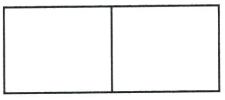
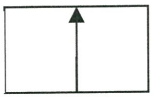
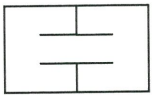


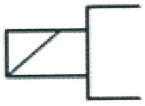
FIGURE Q6 (a)

i) 

ii) 

iii) 

iv) 

v) 

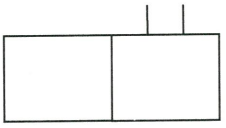
vi) 

FIGURE Q 6(b)