



UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER I
SESSION 2012/2013**

COURSE NAME : **INDUSTRIAL ELECTRONICS**
COURSE CODE : **DAE 32003**
PROGRAMME : **3 DAE/DAL**
EXAMINATION DATE : **OCTOBER 2012**
DURATION : **2 ½ HOURS**
INSTRUCTIONS : **ANSWER FOUR (4)
QUESTIONS ONLY**

THIS QUESTION PAPER CONSISTS OF EIGHTEEN (18) PAGES

- Q1** (a) There are many types of protection circuits used in systems.
- (i) List four (4) types of protection circuits.
 - (ii) What type of protection circuit is used in Figure Q1(a)?
 - (iii) Based from the answer in Q1(a)(i), which of the protection circuits cannot be used in the AC circuit?
 - (iv) What will happen if there is no diode in Figure Q1 (a) circuit?

(11 marks)

- (b) Figure Q1(b) shows the operation of a relay during energizing state.
- (i) Explain the relay operation during de-energizing and energizing state.
 - (ii) Explain the function of Control Circuit and Power Circuit.
 - (iii) Give two advantages and two disadvantages of using relays.

(14 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 diagram in Figure Q2(a)(ii) with the proper elements and addresses.
 - (ii) Based on Q2(a)(i), write the mnemonic code for the system.

(7 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 (2) lamps control. Explain the condition of Lamp 1 and Lamp 2. Briefly explain:
- (i) Condition 1: All the buttons are pushed.
 - (ii) Condition 2: All the buttons are not pushed.
 - (iii) Condition 3: Push button C fail to function (normally open) and push button B is pushed.

(6 marks)

- Q3 (a)** Figure Q3(a)(i) and Table Q3 shows three (3) cylinders system controlled by a main single start button (PB) and three (3) conditional sensors; A, B and C. The process sequence is shown.

Process Sequence:

- 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 secs, cylinder A extends.
- Sensor A detects maximum extension for cylinder A.
- After 4 secs, cylinder C extends.
- All system RESET/OFF when sensor C detected maximum extension for cylinder C.

Answer the questions:

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

(21 marks)

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

- (i) What type of ladder it is?
- (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 ladder will it be?

(4 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), please 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 stop.

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), please fill in the box from A to E with appropriate elements and addresses.

(12 marks)

- Q5** (a) Consider the summing amplifier in Figure Q5(a).

- (i) Calculate the output voltage of the summing amplifier circuit in which $V_1 = -1.2V$, $V_2 = +0.5V$ and $V_3 = -2.8V$.
- (ii) If V_1 and V_3 remain the same, what is the value of V_2 to give an output voltage of $+0.5V$?

(8 marks)

- (b) Figure Q5(b)(i) show the operational amplifier circuit. Given the value of $R_F = 2.2 \text{ k}\Omega$, $R_1 = 1 \text{ k}\Omega$, $C_1 = 0.001 \text{ }\mu\text{F}$ and V_{IN} is a ramp input that goes from $+5V$ to $-5V$ as shown in Figure Q5(b)(ii).

- (i) Calculate the output signal V_{OUT} .
- (ii) Sketch the input V_{IN} and the output signal V_{OUT} on the same graph.
- (iii) At what frequency will it stop acting as a differentiator? What is the gain at this frequency?

(17 marks)

- Q6 (a)** Figure Q6(a)(i) shows an automatic gear lubrication system with the I/O assignment. When the gear is moved toward S1, the sensor S1 will detect the gear and signal the electromagnetic valve V1 for oil supply on the gear. The valve V1 will open for 1.5 seconds, supplying a predetermined quantity of oil. When the sensor S2 sense that the lubricating tank oil level is low, the oil shortage alarm indicator will be ON.
- (i) From ladder diagram in Figure Q6(a)(ii), please fill in the box from A to C with appropriate elements and addresses.
- (ii) Based on the ladder diagram in Q6(a)(ii), write the mnemonic code for the system.

(8 marks)

- (b)** Figure Q6(b)(i) and Table Q6(b) shows the automatic filling and draining control system and the IO assignment. The process are as follows:

- As PB1 is pressed, MV1 opens and the water begins to fill the tank. At the same time, the stirring motor M starts operations.
- When the water level passes TLB2 and reaches TLB1, the MV1 closes and the stirring motor stops.
- Next, MV2 opens and starts draining the water. When the water level drops below TLB2, MV2 closes.
- When the cycle of operation has repeated four times, the operation END indicator illuminates, and the filling and draining operation will not restart even if PB1 is pressed.

From the ladder diagram in Figure Q6(b)(ii), please fill in the box from A to F with appropriate elements and addresses.

(17 marks)

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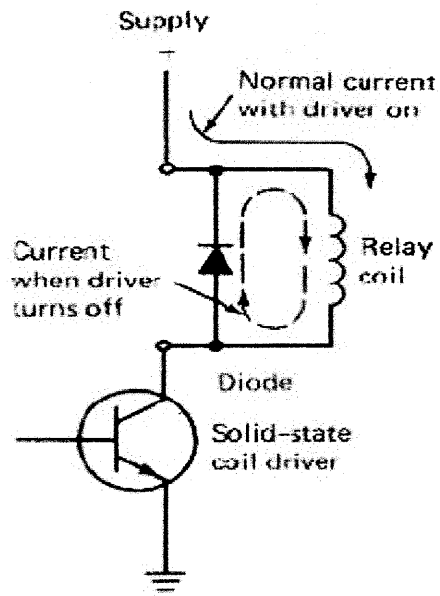


FIGURE Q1(a)

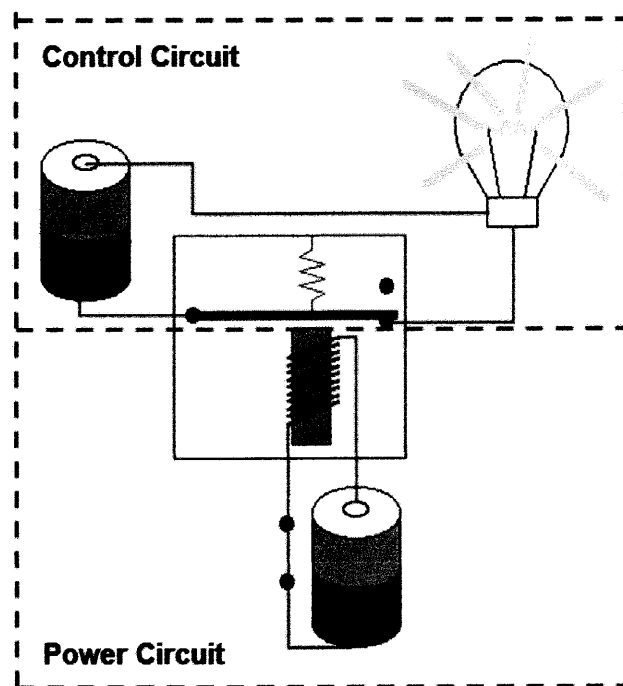
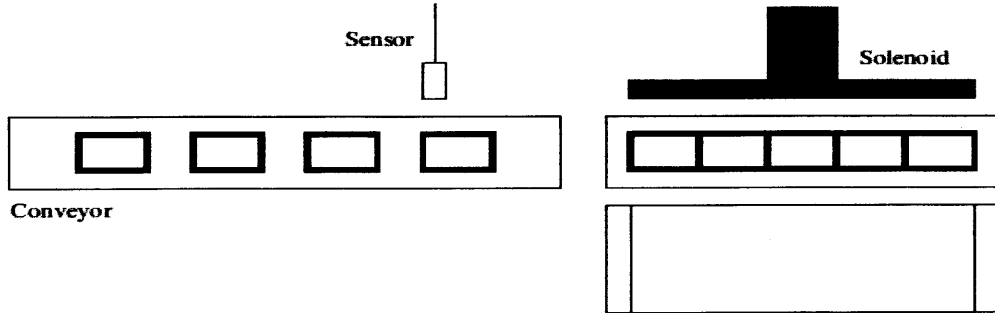


FIGURE Q1(b)

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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)

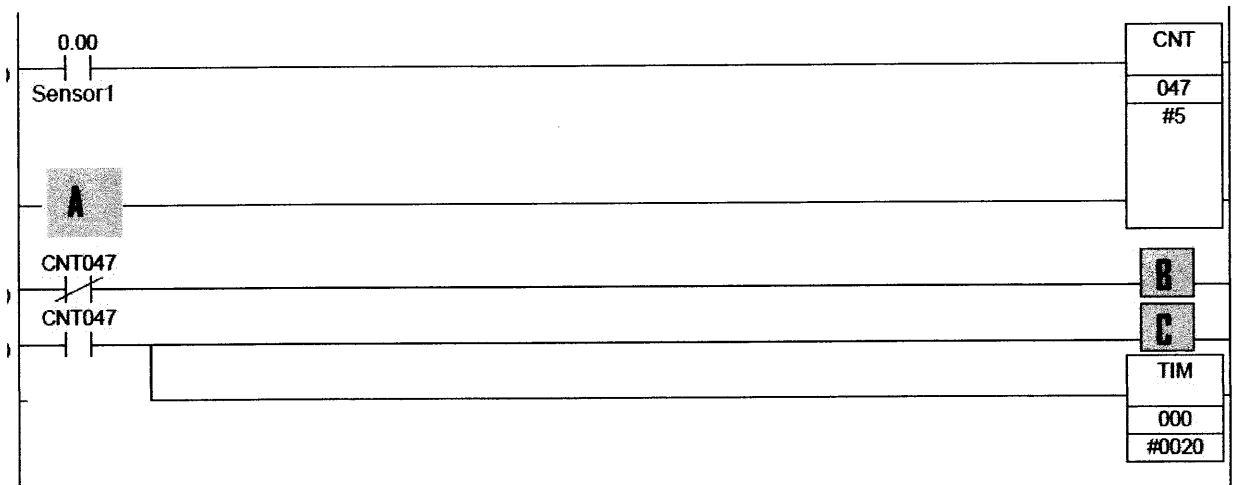


FIGURE Q2(a)(ii)

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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(30)	HR0
		#1
		HR0
0006	LD	HR1.02
0007	SUB(31)	HR0
		#1
		HR0
0008	LD	P On
0009	CMP(20)	#30
		HR0
0010	AND	P EQ
0011	OUT	100.00
0012	END	

FIGURE Q2(b)

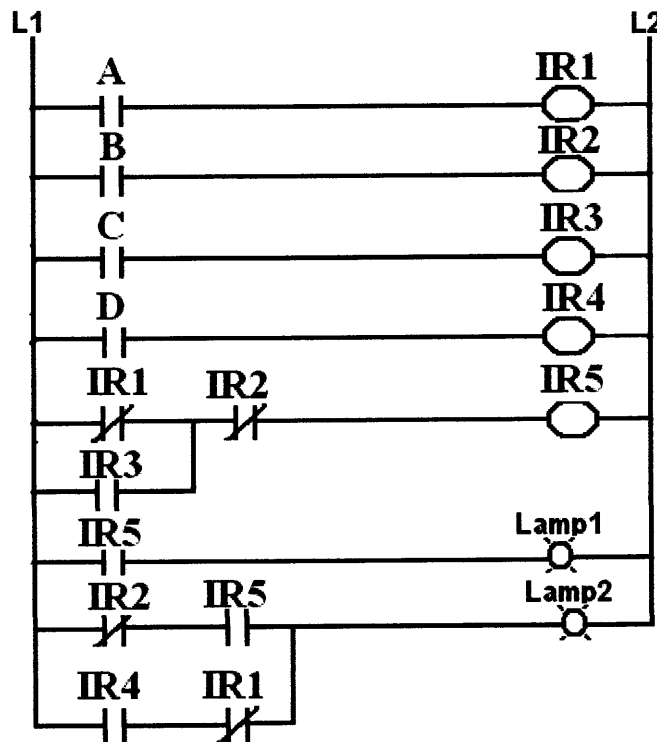


FIGURE Q2(c)

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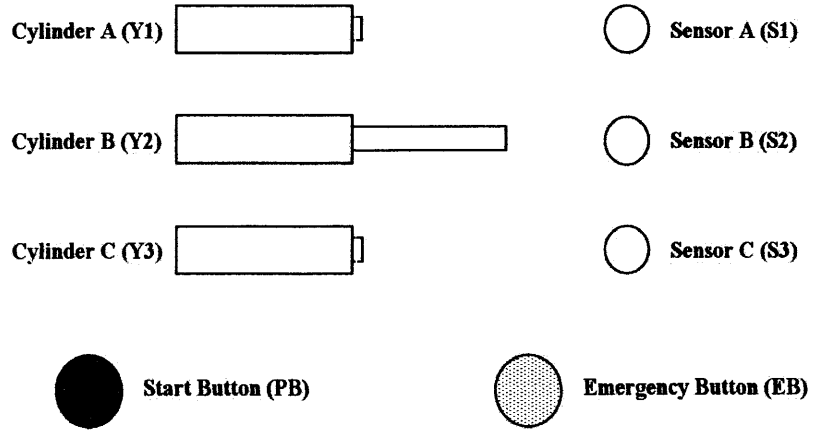


FIGURE Q3(a)(i)

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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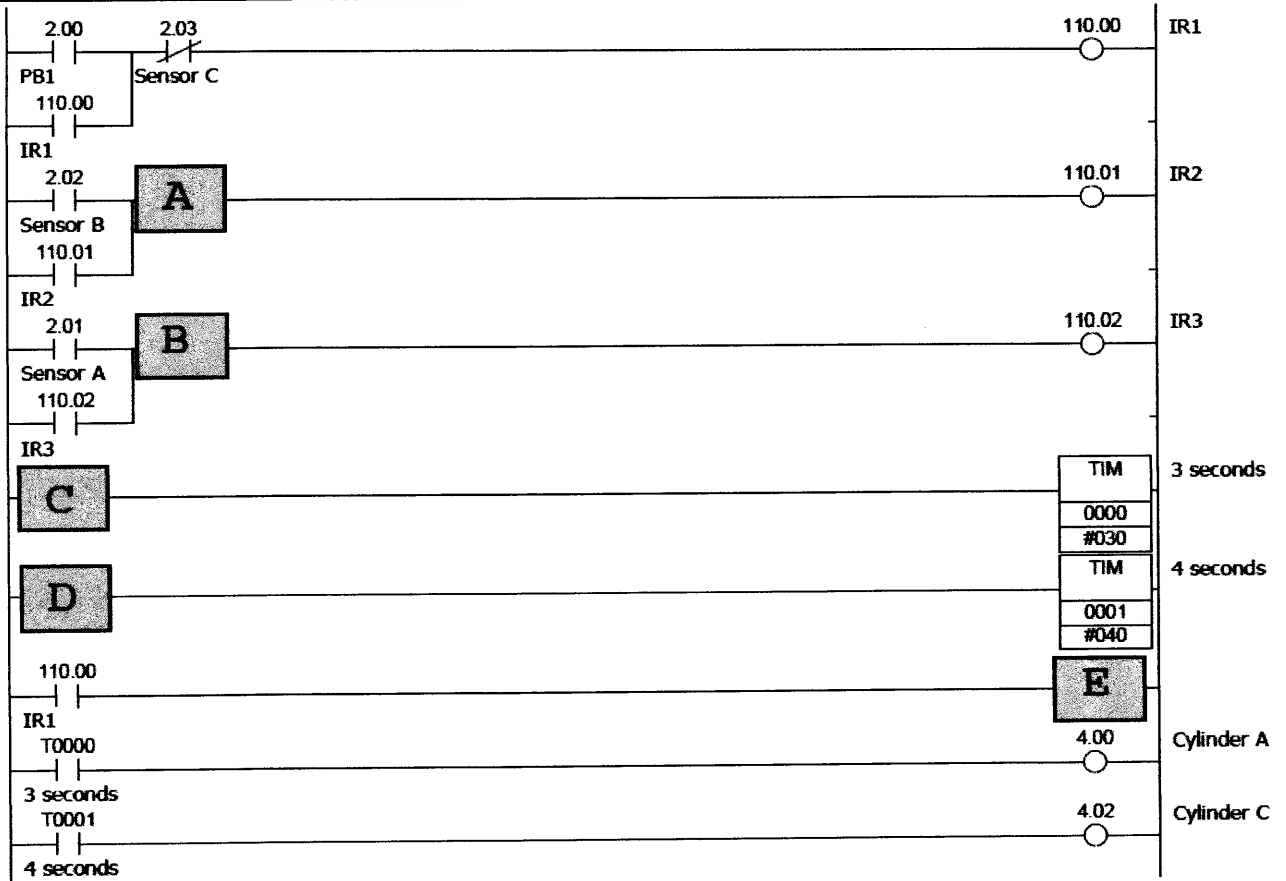


FIGURE Q3(a)(ii)

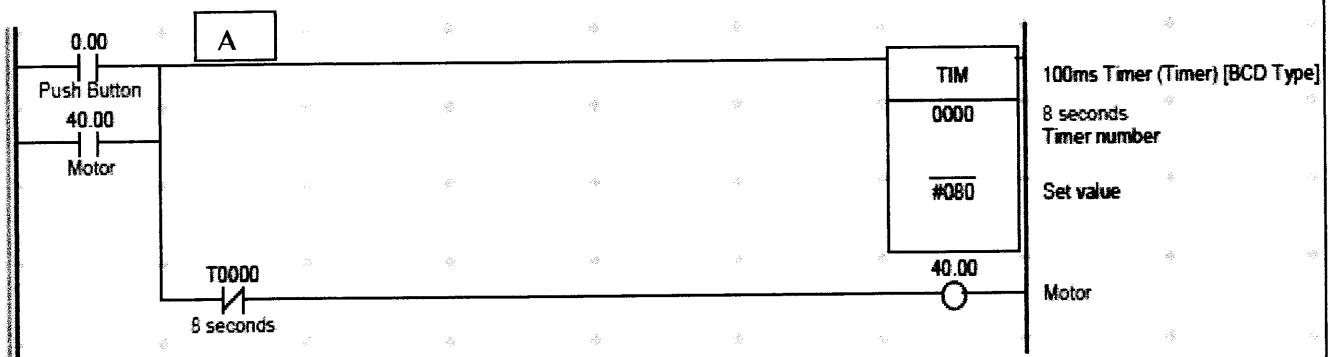


FIGURE Q3(b)

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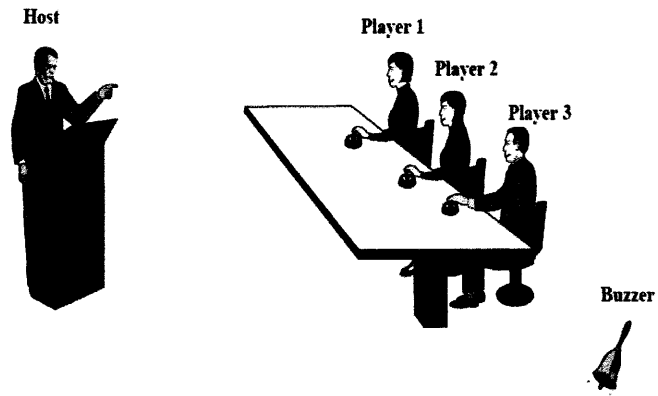


FIGURE Q4(a)(i)

TABLE Q4(a)

Input	Device
0000	PB1
0001	PB2
0002	PB3
0003	RST (reset)

Output	Device
0100	Buzzer
0101	Player 1 light
0102	Player 2 light
0103	Player 3 light

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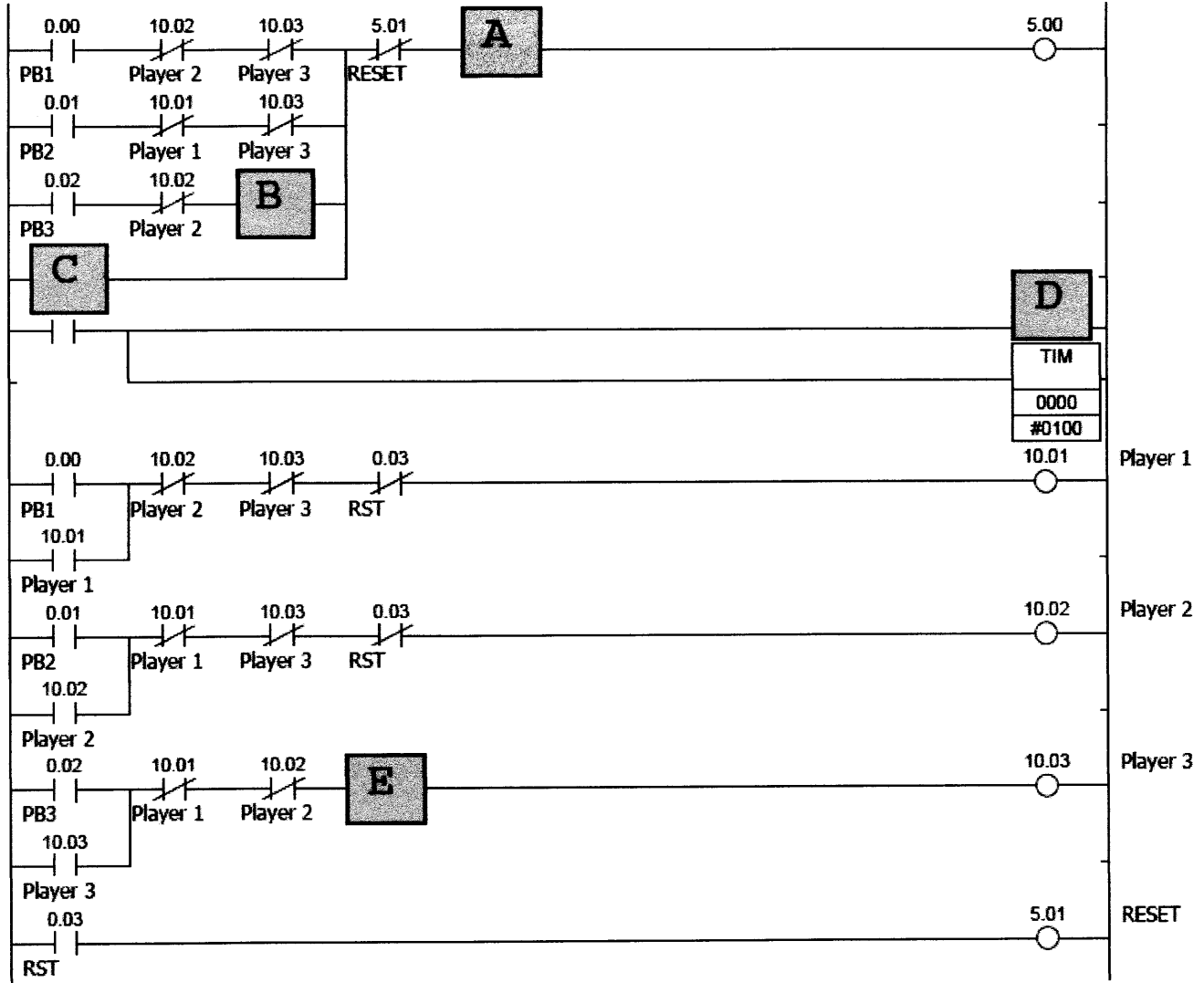


FIGURE Q4(a)(ii)

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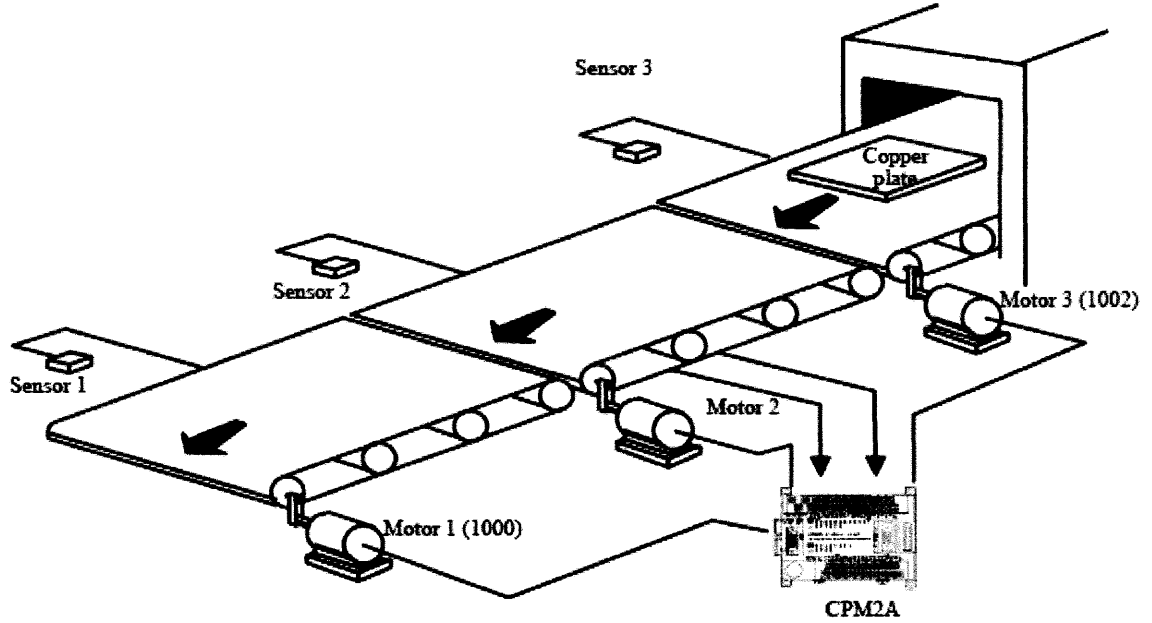


FIGURE Q4(b)(i)

TABLE Q4(b)

Input	Devices
0000	Sensor 1
0001	Sensor 2
0002	Sensor 3

Output	Devices
0100	Motor 1
0101	Motor 2
0102	Motor 3

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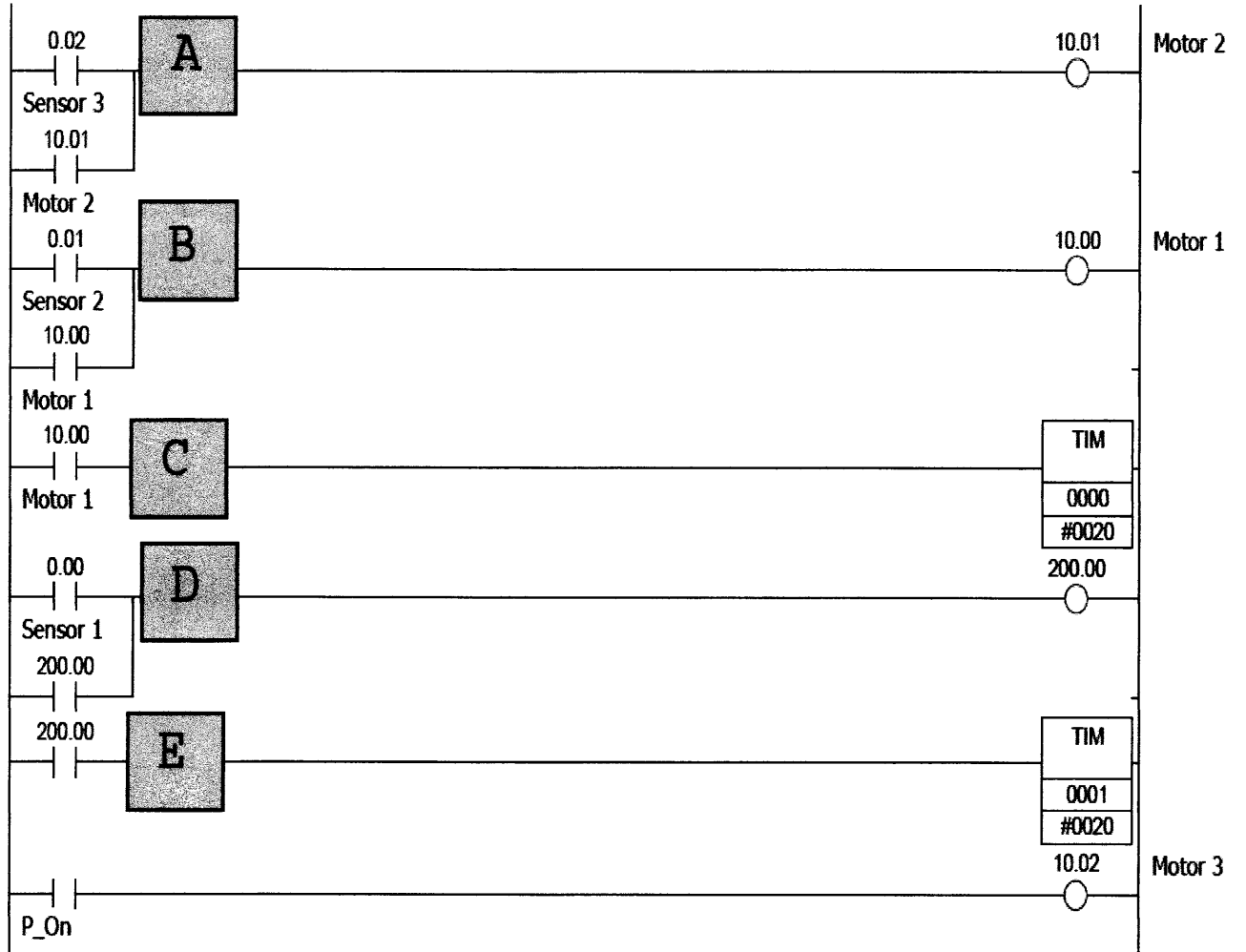


FIGURE Q4(b)(ii)

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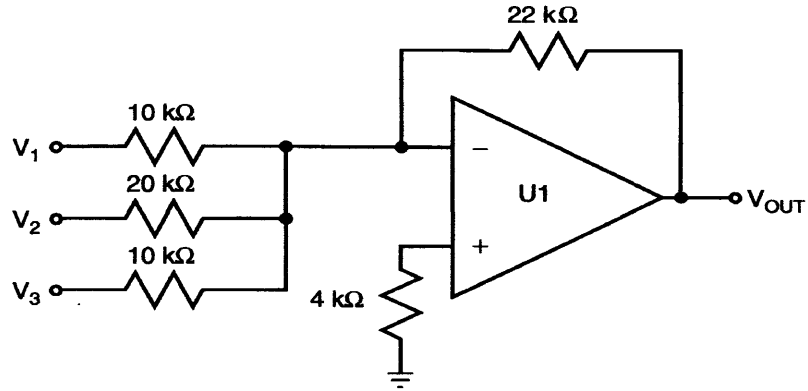


FIGURE Q5(a)

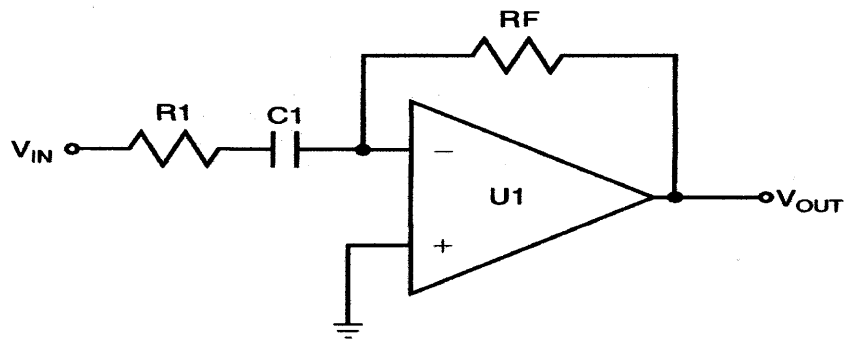


FIGURE Q5(b)(i)

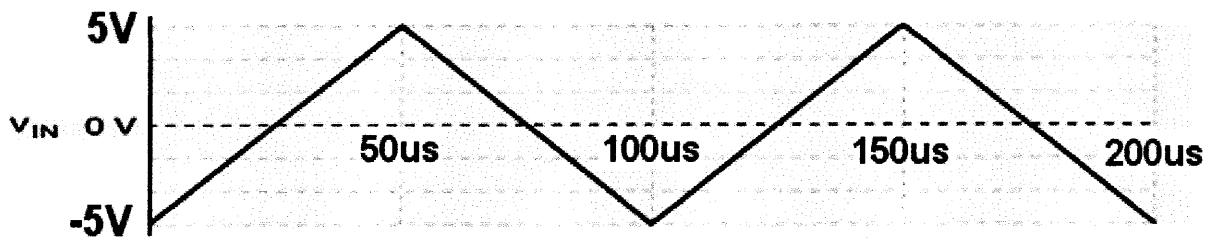
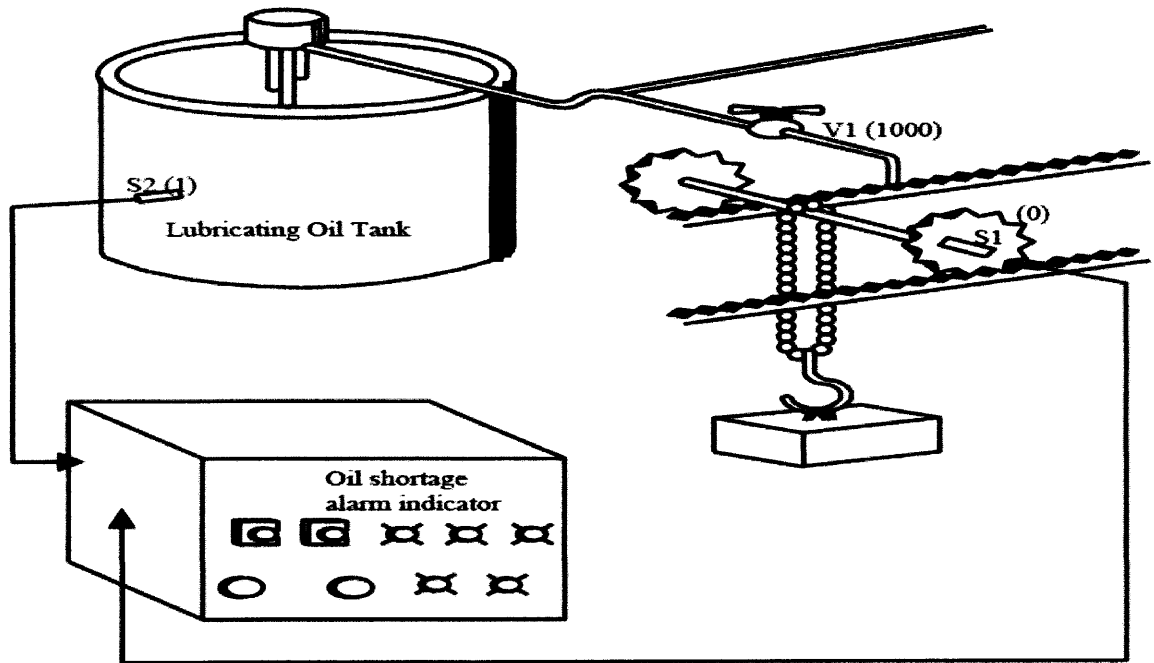


FIGURE Q5(b)(ii)

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I/O Assignment

Input	Devices	Output	Devices
00000	Position detection (S1)	01000	Electromagnetic valve for oil supply (V1)
00001	Lower limit of oil (S2)	01001	Oil shortage alarm indicator

FIGURE Q6(a)(i)

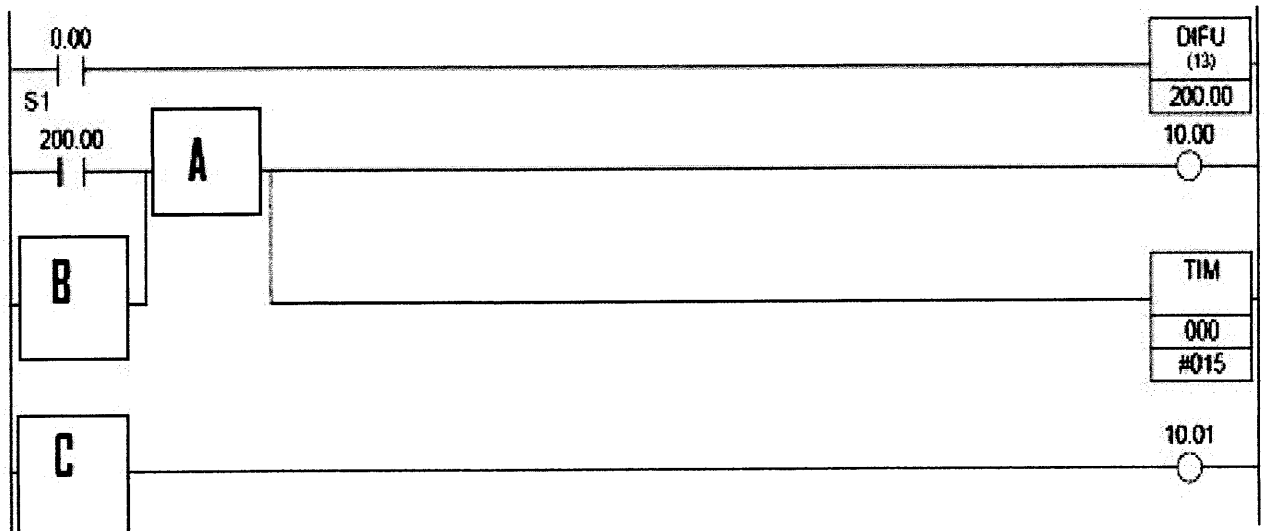
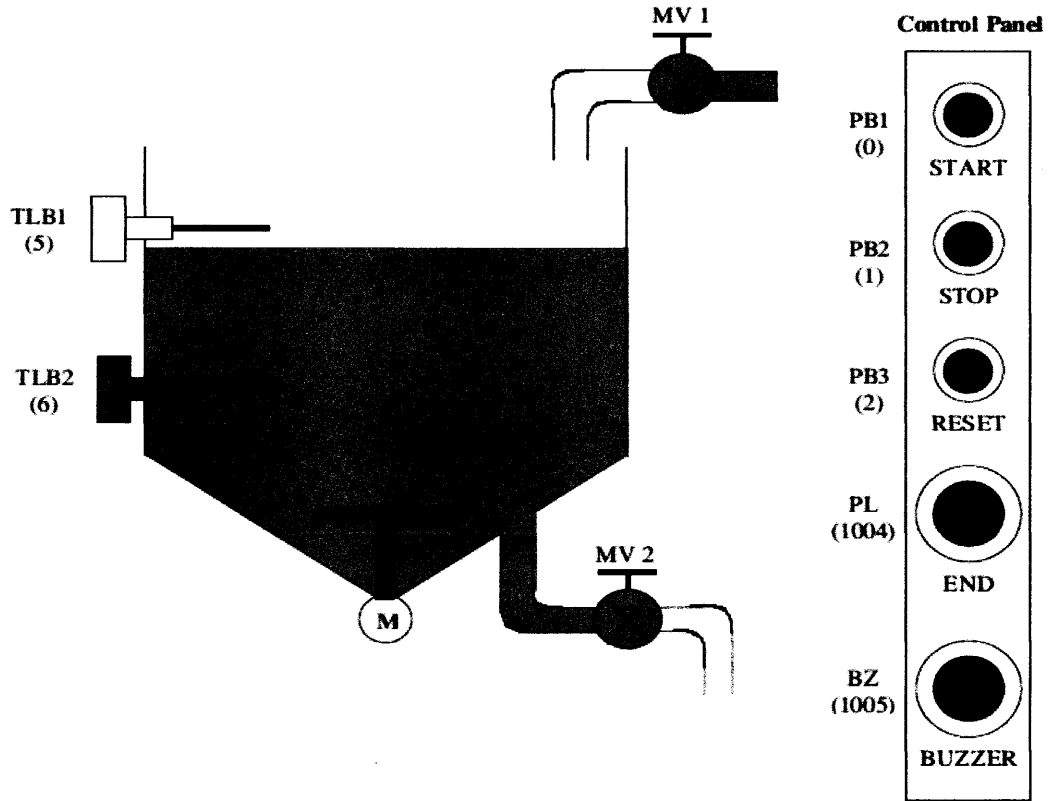


FIGURE Q6(a)(ii)

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I/O Assignments

Input	Device
00000	Start Button (PB1)
00001	Stop Button (PB2)
00002	Reset Button (PB3)
00005	Upper Level Switch (TLB1)
00006	Lower Level Switch (TLB2)

Output	Device
01000	Water Supply Valve (MV1)
01001	Drain Valve (MV2)
01002	Stirring Motor (M)
01004	End Indicator
01005	Buzzer

FIGURE Q6(b)(i)

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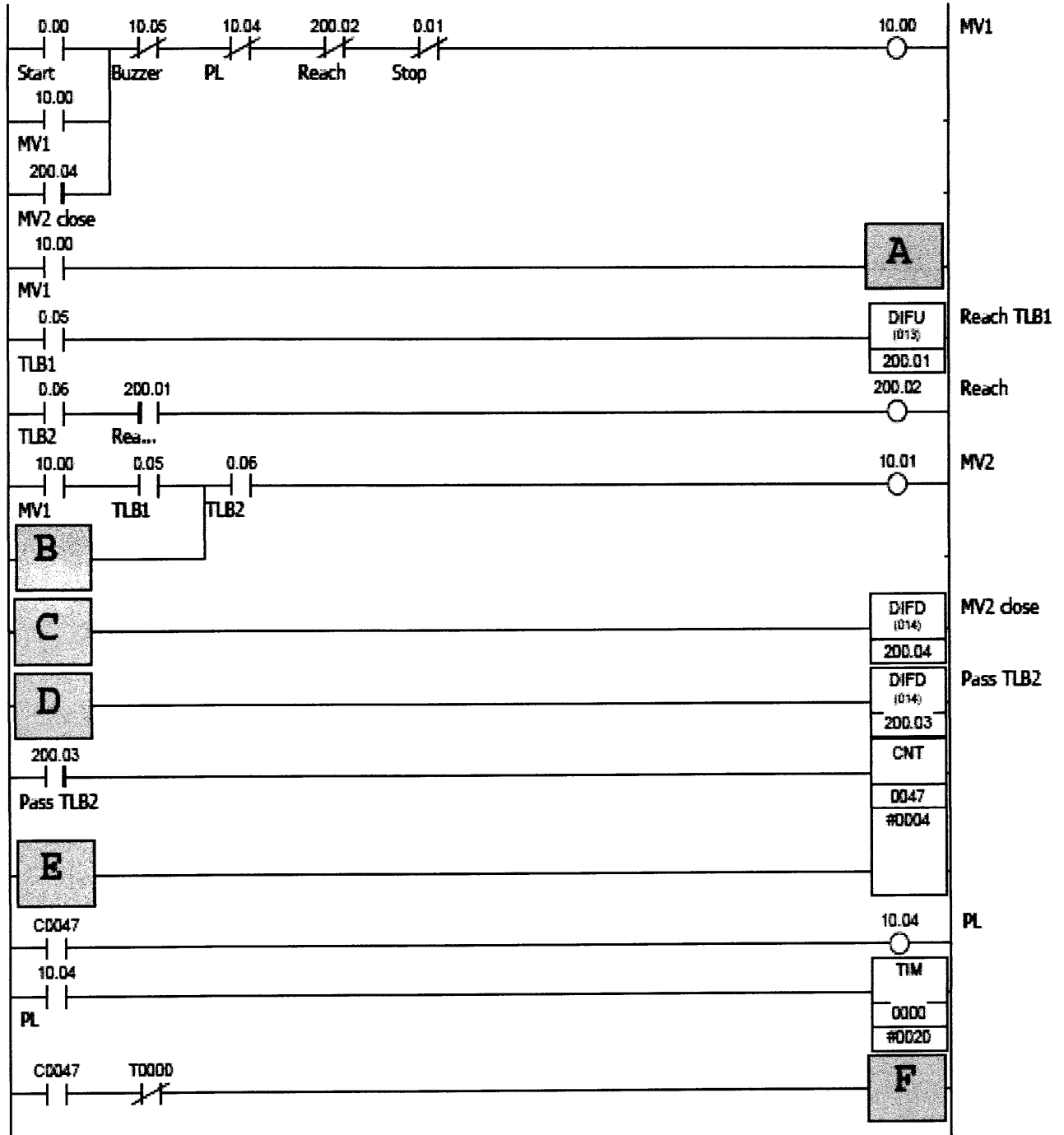


FIGURE Q6(b)(ii)