B.Sc. Engg. SWE 2nd Semester 04 May 2023

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION SUMMER SEMESTER, 2021-2022

DURATION: 3 HOURS FULL MARKS: 150

CSE 4205: Digital Logic Design

Programmable calculators are not allowed. Do not write anything on the question paper.

Answer **all 6 (six)** questions. Figures in the right margin indicate full marks of questions whereas corresponding CO and PO are written within parentheses.

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1. The block diagram in Figure 1 represents how a BCD code (ABCD) is displayed in a 7-Segment Display. The truth table in Figure 2 contains 4-bit input of BCD to 7-bit output of a 7-Segment Display.

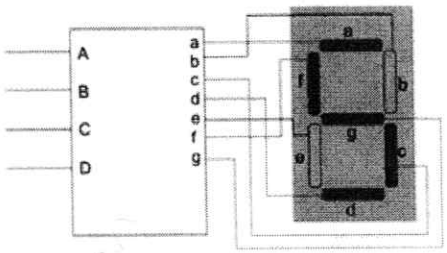

Figure 1: Block Diagram for Question 1.

Decimal Digit	Input lines				Output lines							Display pattern
	A	B	C	D	a	b	c	d	e	f	g	
0	0	0	0	0	1	1	1	1	1	1	0	0
1	0	0	0	1	0	1	1	0	0	0	0	1
2	0	0	1	0	1	1	0	1	1	0	1	2
3	0	0	1	1	1	1	1	1	0	0	1	3
4	0	1	0	0	0	1	1	0	0	1	1	4
5	0	1	0	1	1	0	1	1	0	1	1	5
6	0	1	1	0	1	0	1	1	1	1	1	6
7	0	1	1	1	1	1	1	0	0	0	0	7
8	1	0	0	0	1	1	1	1	1	1	1	8
9	1	0	0	1	1	1	1	1	0	1	1	9

Figure 2: Truth Table for Question 1.

a) Design the combinational logic circuit (follow the design process) whose input is a 4 bit number (A,B,C,D) and output is a 7-bit display line (a,b,c,d,e,f,g) following the above truth table. 20 (CO3) (PO1)

b) Use an appropriate decoder and necessary number of OR gates to implement the combinational logic circuit presented in Question 1. a). 10 (CO2) (PO1)

2. a) A binary Ripple Adder is a digital circuit used to perform addition of two binary numbers. It is called a Ripple Adder because the carry bit ripples through the circuit from LSB to MSB as each bit is added. 5+10 (CO3) (PO1)

   i. Is there any design issue regarding efficiency, power consumption, correctness, scalability etc. with this type of circuit for addition purpose? Explain those issues.

   ii. Design a different type of binary adder circuit which can overcome these issues.

   b) Analyze the following logic diagram in Figure 3. 10 (CO1) (PO1)

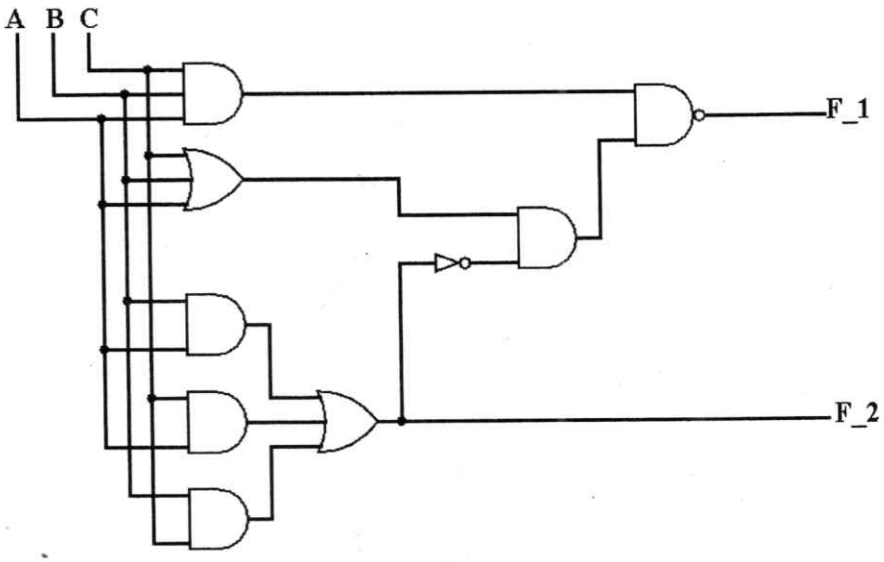

Figure 3: Logic Diagram for Question 4. b).

3. Your teacher has asked you to develop a boolean function on the training board with 5 input switches named A,B,C,D, and E. There will be only 1 output. The output LED will turn on for the following conditions: 15 + 8 + 7 (CO3) (PO1)

   - if all switches are turned off.
   - if only switch A or only switch C or only switch E is turned on.
   - if only switches A and E, or only switches C and E are turned on.
   - if only switches A, B, and E, or only switches A, C, and E are turned on.
   - if only switches A, B, C, and E are turned on.

   Answer the following questions based on this scenario.

   a) Find the simplified boolean expression by using Quine-McCluskey Tabular Method.

   b) Find the simplified boolean expression by using K-Map Method.

   c) Use a 8:1 MUX to implement the boolean function.

4. a) Write down the logic diagram, characteristic table, characteristic equation, and excitation table of RS, D, JK, and T flip flop. 3 × 4 (CO2) (PO1)

b) Construct a 5× 32 decoder with four 3 × 8 decoder and one 2 × 4 decoder. Use labelled block diagram for this construction. 8 (CO2) (PO1)

5. a) Explain 'Race Around' condition in JK flip flop. Describe the possible solution to avoid this condition. 10 (CO2) (PO1)

b) Analyze the sequential circuit in Figure 4 following the analysis procedure. 15 (CO3) (PO1)

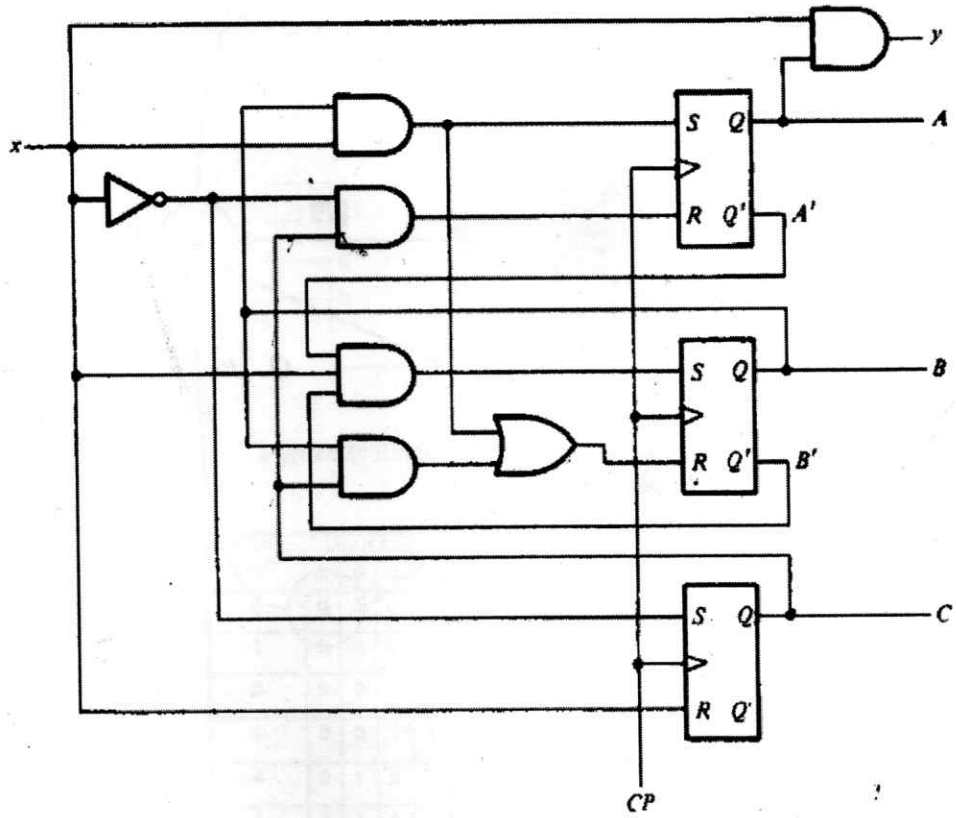

Figure 4: Logic Diagram for Question 5. b).

6. A sequential circuit has 1 input and 1 output. The state diagram of that circuit is shown in Figure 5. 20 (CO3) (PO1)

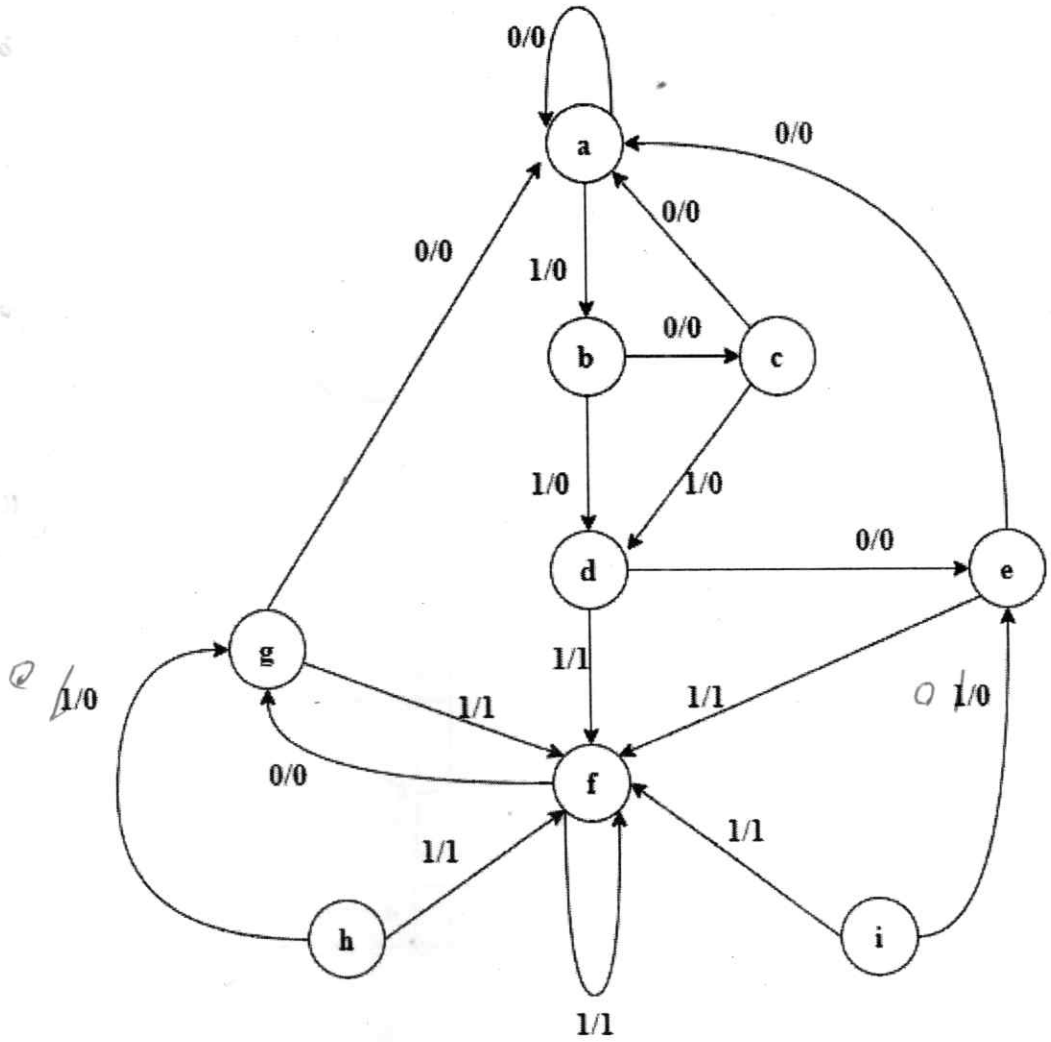

Figure 5: State Diagram for Question 6.

Design the sequential circuit following the design procedure.