United International University (UIU)
Dept. of Computer Science and Engineering (CSE)
CSE 1325/CSE 225, Digital Logic Design
BSCSE Final Examination, Summer 2022
Marks: 40 Time: 2 hours

Any examinee found adopting unfair means will be expelled from the trimester / program as per UIU disciplinary rules.

Answer any three questions from Q1 to Q4

1. Design a synchronous counter to count the following arbitrary sequence using JK flip flops and basic gates. [1.5+2.5+2+2]
Sequence : $1 \rightarrow 0 \rightarrow 3 \rightarrow 6 \rightarrow 2 \rightarrow 5 \rightarrow 7 \rightarrow 1 \rightarrow \cdots$. Here, the next sequence of the missing number 4 is 6.
    a. Draw the state Diagram
    b. Find the state table with JK flip flop inputs
    c. Minimize the functions of flip flop inputs
    d. Draw the circuit diagram using block Diagram of JK flip flops and basic gates

2. Design a synchronous sequential circuit to recognize 0010 subsequences including overlaps in an input sequence $x = 0000010010011$, which gives output $y = 0000001001000$,
Design the circuit using T flip flop and basic gates. [2+2+2+2]
    a. Draw the state Diagram by assigning state using gray code
    b. Draw the state table with output and T flip flop inputs
    c. Minimize the functions of output and flip flop inputs
    d. Draw the circuit diagram using block Diagram of T flip flops and basic gates

3. A sequential circuit has one D flip-flop with state Q, two inputs X and Y.
Derive the state table and state diagram of the sequential circuit with D as the input to the flip-flop. [8]

$$D = X \oplus Y \oplus Q$$

4. Design a 4 bit universal shift register which can do the following operations based on the two control INPUTS X and Y as given below. You can use any kind of flip-flops and other necessary gates as required. Draw a neat logic diagram of your solution. [8]

X	Y	Operation
0	0	Left Shift
0	1	Parallel Load
1	0	No Change
1	1	Right Shift

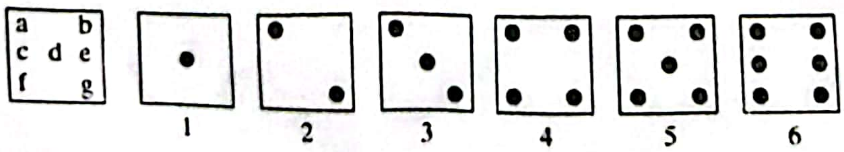
Answer any two questions from Q5 to Q7

5. Consider an application of magnetic positional control for ship navigation. There are six possible events here: North (NO-000), North-East (NE-001), East (EA-011), South (SO-110), South-West (SW-010), West (WE-101). Here, the first two letters are the input and the three bits are the output. For example, in NO-000, NO is the input and 000 is the output. To maintain priority during the occurrence of multiple events at the same time, the priority sequence followed is
NO > NE > SW > WE > EA >SO. Design an 6 *X* 3 encoder that can encode the events based on given priority.You have to answer the followings: [2+3+3]

   a. Derive the truth table of the priority encoder including the valid bit.
   b. Derive the Boolean expressions for all the outputs.
   c. Draw the logic diagram using basic gates.

6. Answer all the following questions below. [6+2]

   a. An electronic game uses an array of seven LEDs (light-emitting diodes) to display the results of a random roll of a die. Use a 3:8 active low line decoder and OR gates to map the 3-bit combinations on inputs X2, X1, and X0 for values 1 through 6 to the outputs a through g. Input combinations 000 and 111 are don't-cares.



b. Design a 16:1 multiplexer with 2:1 multiplexers. You can use any number of 2:1 multiplexers. You need to use the block diagram of the 2:1 multiplexer.

7. Answer all the following questions below. [5+3]

a. Implement the following Boolean function using a 4:1 MUX and necessary basic gates.

$$F(A, B, C, D) = \sum m(0, 1, 3, 4, 6, 7, 10, 12, 13, 14, 15)$$

b. Draw the diagram of a parallel adder to perform addition of the numbers $(9)_{10}$ and $(2)_{10}$. First, you need to determine the size of the required parallel adder. After that, you need to draw the diagram and show the process to add the two numbers that are given.

TABLE 1-3 Excitation Table for Four Flip-Flops

SR flip-flop

$Q(t)$	$Q(t+1)$	S	R
0	0	0	×
0	1	1	0
1	0	0	1
1	1	×	0

D flip-flop

$Q(t)$	$Q(t+1)$	D
0	0	0
0	1	1
1	0	0
1	1	1

JK flip-flop

$Q(t)$	$Q(t+1)$	J	K
0	0	0	×
0	1	1	×
1	0	×	1
1	1	×	0

T flip-flop

$Q(t)$	$Q(t+1)$	T
0	0	0
0	1	1
1	0	1
1	1	0