**United** International **University (UIU)**

## Department of Computer Science and Engineering

**CSE 1325: DIGITAL LOGIC DESIGN, Final Summer 2024**

Total Marks: **50,** Duration: 2 hours

**Answer ALL Questions**

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

**1.** You have created a new flip-flop X which has the following excitation table:

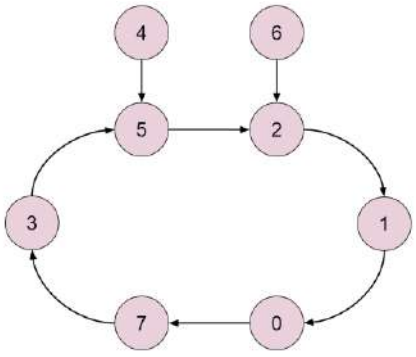
| Q(t) | Q(t+1) | X |
|---|---|---|
| 0 | 0 | 1 |
| 0 | 1 | 0 |
| 1 | 0 | 1 |
| 1 | 1 | 0 |

Design a clocked sequential circuit that recognizes the 4-bit input sequence 0000, including overlap of one bit using X Flip-Flops. For such a circuit, complete the following steps:

[2]

A. Draw the state diagram while assigning the states as gray code. [1]
B. What changes would be made in the state diagram if the sequence was non-overlapping. (You can draw only the modified part) [3]
C. Draw the state table with output and input function for X flip-flop (considering overlapping sequence). [2]
D. Minimize the functions of output and flip-flop inputs. [2]
E. Suppose an input bit stream "00000000" is given. Write down the output stream considering:
   i. Overlapping sequence
   ii. Non-overlapping sequence

**2.** You want to design an arbitrary synchronous counter circuit using D flip-flops that counts according to the sequence given in the figure.




A. Draw the state table with flip-flop inputs. [4]
B. Show the minimized functions of the flip-flop inputs using k-map. [3]
C. Draw the logic diagram. [3]

**3.** Design a 3-bit Universal Shift Register with the functions given in the function table below. Here two control bits F and R determine the mode of operation. Use D Flip Flops for your design. [10]

| F | R | Operation |
|---|---|---|
| 0 | 0 | Parallel Load |
| 0 | 1 | Shift Left |
| 1 | 0 | Toggle |
| 1 | 1 | Clear Register to 0 |

**4** Okabe has 5 mobile phones, and each of his 5 friends can call him on one of these phones to leave a message. Since he can only check one message at a time, he needs to prioritize which message to check first if multiple phones ring simultaneously. His friends and their message codes are Kurisu (K-4), Mayuri (M-2), Luka (L-6), Faris (F-7), and Hashida (H-3). The first letter represents the friend (input), and the number represents the message code. For example, in "M-2", 'M' is the input, and "2" or "010" is the message code. The priority sequence Okabe uses to decide which message to check first is: M>K>H>L>F.

You have to answer the followings: [3]

A. Derive the truth table of the priority encoder including the valid bit. [3]

B. Derive the Optimal Boolean expressions for all the outputs. [2]

C. Draw the logic diagram using basic gates. [2]

D. If the inputs (M, K, H, L, F) are (0, 1, 1, 0, 1) whose message code will he read first? What is the message code?

**5** A. Implement the following functions using a single decoder: [5]

F1= $A'B'C'D + AB'CD + AB'C'D + A'BCD$

F2= $(A + B + C + D)(A + B + C' + D)(A' + B' + C' + D)(A' + B' + C' + D')$

B. Implement the function F(A, B, C, D) = $\prod_M(1,5,6,9,10,11,13)$ using a 4x1 MUX. [5]

**Excitation Tables for D Flip-Flop**

| Q(t) | Q(t+1) | D | Operation |
|---|---|---|---|
| 0 | 0 | 0 | Reset |
| 0 | 1 | 1 | Set |
| 1 | 0 | 0 | Reset |
| 1 | 1 | 1 | Set |