Name

First **Last**

Student ID #

Section

University of California Los Angeles

Computer Science Department

CSM51A Midterm 2

Fall Quarter 2017

20th November 2017

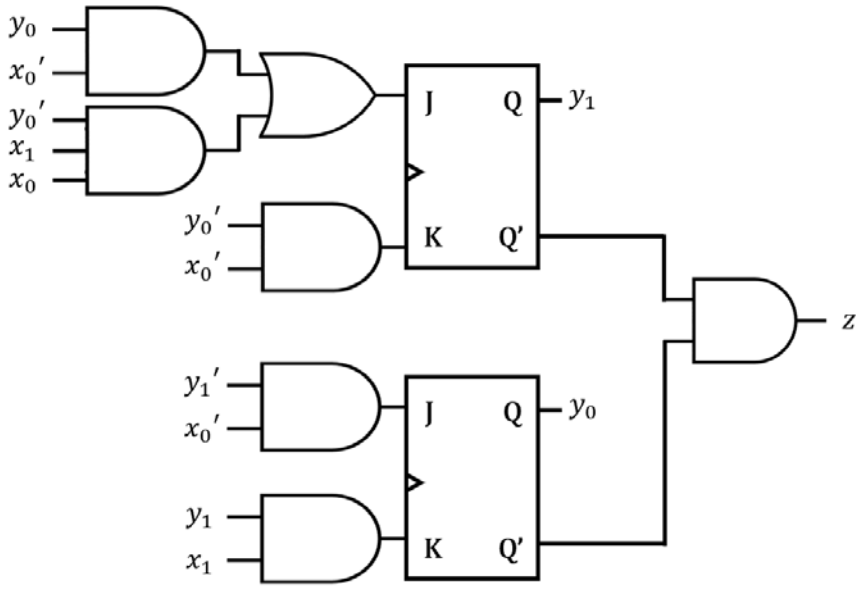
This is a closed book exam. Absolutely nothing is permitted except pen, pencil and eraser to write your solutions. Any academic dishonesty will be prosecuted to the full extent permissible by university regulations.

Time allowed 100 minutes

Problem (Possible points)	Points
1 (20)	
2 (20)	
3 (20)	
4 (20)	
5 (20)	
Total (100)	

Problem 1 (20 points)

Obtain a high-level description (state transition table) of the network shown in the figure below. The system has two inputs (x_1 and x_0) and a single output z.



Problem 1 (Extra sheet)

Problem 2 (20 points)

Using 1 T flip-flop, 1 SR flip-flop, and at most 8 JK flip-flops, design a system as described below. Use any gates to implement your combinational logic.

Input: $x(t) \in \{0,1\}$
Output: $z(t) \in \{0,1\}$
Function: $z(t) = \begin{cases} 1 & \text{, if } x(\text{t-11, t-8})=1110,\ x(\text{t-7, t-4})=10\text{-}0 \text{ or } 0\text{-}01,\ x(\text{t-3, t})=1\text{-}00 \\ 0 & \text{, otherwise} \end{cases}$

For example, for the given input sequence x(t-11, t) = 111010001100, the output z(t) = 1. For the input sequence x(t-11, t) = 111000101000, the output z(t) = 0.

Problem 2 (Extra sheet)

Problem 3 (20 points)

Design a system that generates a pattern of either “UCLA” or “USC” based on an input signal.

As soon as the input bit turns 1, the pattern generator starts to output “UCLA.”
If the input bit turns 0 (*0 is less than 1*), the pattern generator starts to output “USC.”

Some examples:

1. If the input sequence of x(t-13, t) = 11110000001111, the output sequence of $\boldsymbol{z}$(t-13, t) = UCLAUSCUSCUCLA.
2. If the input sequence of x(t-9, t) = 1111001111, the output sequence of $\boldsymbol{z}$(t-9, t) = UCLAUSUCLA.

Use the least number of bits for character encoding, and the minimal number of flip-flops and 4:1 multiplexers.

Problem 3 (Extra sheet)

Problem 4 (20 points)

Design a pattern recognizer for 00-01 using only flip-flops as defined below and NOR gates.

- Input: $x(t) \in \{0,1\}$
- Output: $z(t) \in \{0,1\}$
- Function: $z(t) = \begin{cases} 1 & \text{, if } x(\text{t-4, t}) = \text{00-01} \\ 0 & \text{, otherwise} \end{cases}$

A	B	C	Q_{next}
0	0	0	0
0	0	1	1
0	1	0	Q
0	1	1	Q'
1	0	0	0
1	0	1	1
1	1	0	Q'
1	1	1	Q

Problem 4 (Extra sheet)

Problem 5 (20 points)

Design a system that detects the pattern of consecutive 0s followed by consecutive 1s in the most recent five bits from the input stream. In other words, the input pattern must have 0 in the start, 1 in the end, and change from 0 to 1 only once.

For example, if the input sequence x(t-10, t) = 01001000100, the output z(t) should be 0 because x(t-4, t) = 00100 does not have 1 in the end. The past output z(t-1) is also 0 because x(t-5, t-1) = 00010 does not have 1 in the end.

However, if the input sequence x(t-10, t) = 01111100001, the output z(t) should be 1 because x(t-4, t) = 00001 consists of four consecutive 0s and consecutive 1s – the last bit 1. You may assume that flip-flops are initialized to 0, so the output z(t-10, t) = 01111000001.

- Use only flip-flops and 8:1 multiplexers. No other gates are allowed.

Problem 5 (Extra sheet)