

# Midterm 2

ECE 275

Nov 12th, 2021

(1) Your name:

Student ID:

## About the exam

1. There are total 4 problems.
2. Problem 1 and Problem 2 are mandatory. You have the option of doing any one of Problem 3 and Problem 4. If you do both, you will receive the best of the two.

## Problem description

Design a Mealy sequential circuit which investigates an input sequence  $X$  and which will produce an output of  $Z = 1$  for any input sequence ending in 1010 provided that the sequence 001 has never occurred.

*Example:*

$$X = 10101001010$$

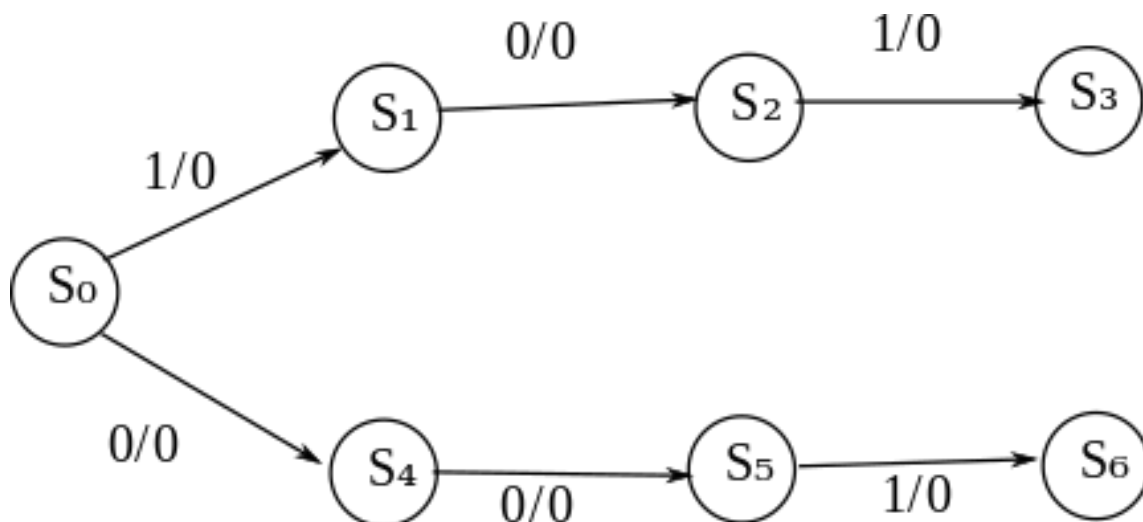
$$Z = 00010100000$$

Notice that the circuit does not reset to the start state when an output of  $Z = 1$  occurs.

Problem 1. Complete the following state diagram. You can also choose to draw state diagram from scratch. Also fill the state transition table. (20 marks)

State	Meaning
S <sub>0</sub>	xxx
S <sub>1</sub>	xx1
S <sub>2</sub>	x10
S <sub>3</sub>	"101"
S <sub>4</sub>	xx0
S <sub>5</sub>	x00
S <sub>6</sub>	"001"

Present State	Next State		Output	
	X=0	X=1	X=0	X=1
S <sub>0</sub>	S <sub>4</sub>	S <sub>1</sub>	0	0
S <sub>1</sub>	S <sub>2</sub>		0	
S <sub>2</sub>		S <sub>3</sub>		0
S <sub>3</sub>				
S <sub>4</sub>	S <sub>5</sub>		0	
S <sub>5</sub>		S <sub>6</sub>		0
S <sub>6</sub>	S <sub>6</sub>	S <sub>6</sub>	0	0



Problem 2. Can the above state table be reduced? Find out the equivalent states. Only specify which states are equivalent to each other. You do not need to write the state table again. (10 marks)

Problem 3. (State assignment).

Using the guideline method find the groups of states that should be grouped together. Draw the state assignment map. Assign a 3-bit state encoding to the states in the reduced state table derived in Problem 2. (20 marks).

Problem 4. The following state-assigned table is given. Find the boolean expressions for inputs  $J_0$  and  $K_0$  to a J-K flip flop that implements the transition from Present state  $y_0$  to Next state  $Y_0$ . Express the inputs  $J_0$  and  $K_0$  in terms of input  $X$  and present state  $y_2$ ,  $y_1$  and  $y_0$  (20 marks).

Present state			Next State						Output	
$y_2$	$y_1$	$y_0$	$X=0$			$X=1$			$X=0$	$X=1$
			$Y_2$	$Y_1$	$Y_0$	$Y_2$	$Y_1$	$Y_0$		
0	0	0	0	1	0	0	0	0	0	0
0	0	1	1	1	1	0	1	1	1	0
0	1	0	0	0	1	1	0	0	0	0
0	1	1	0	1	1	1	1	1	0	0
1	0	0	d	d	d	d	d	d	d	d
1	0	1	1	1	0	1	1	1	1	0
1	1	0	1	0	0	1	0	0	1	0
1	1	1	1	1	1	0	1	1	1	0



