Practice Exam

There are 4 problems. Problem 1 and 2 are mandatory. Problem 3 and 4 are optional. If you do both 3 and 4, best of 3 and 4 will be taken.

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
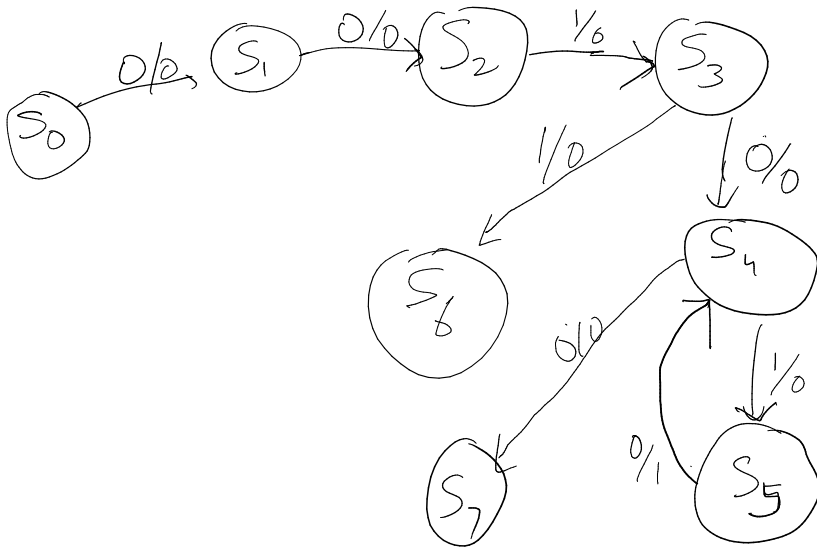that the sequence 001 has occurred at least once.

Example:

    X = 1 0 1 0 0 1 0 1 0 1 0

    Z = 0 0 0 0 0 0 0 0 1 0 1

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)

$A=0$ "001" has not occurred
$A=1$ "001" has occurred

$S_0 = \{A=0, () \text{ empty seq}\}$
$S_1 = \{A=0, "0"\}$
$S_2 = \{A=0, "00"\}$
$S_3 = \{A=1, "001"\}$
$S_4 = \{A=1, "x10"\}$
$S_5 = \{A=1, "101"\}$
$S_6 = \{A=1, "xx1"\}$
$S_7 = \{A=1, "xxx"\}$

Present State	Next State		Output (Z)	
	X = 0	X = 1	X = 0	X = 1
S_0	S_1		0	
S_1	S_2		0	
S_2		S_3		0
S_3	S_4	S_6	0	
S_4	S_7	S_5		0
S_5	S_4		1	
S_6				
S_7				

Problem 2. The above state table can be reduced to only 7 states instead of 8 states. Reduce the states by row-reduction method. You can also use implication table but that will take longer. 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 6 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_2 and K_2 to a J-K flip flop that implments the transition from Present state y_2 to Next state Y_2. Express J_2 and K_2 in terms of input X and present state y_2, y_1 and y_0 (20 marks).

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