

ECE275 Final exam Fall 2022

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Student Name:

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1 Instructions

- There are five problems. First four are required. Fifth problem is optional. Complete fifth problem for extra credit.
- Maximum number of marks is 120 (140 with extra-credit). This exam amounts 10% toward the final grade.
- Time allowed is 120 minutes.
- In order to minimize distraction to your fellow students, you may not leave during the last 10 minutes of the examination.
- The examination is closed-book. One 8×11 in two-sided cheatsheet is allowed.
- Non-programmable calculators are permitted.
- Please use a pen or heavy pencil to ensure legibility. Colored pens/pencils are recommended for K-map grouping.
- Please show your work; where appropriate, marks will be awarded for proper and well-reasoned explanations.

Problem 1. A sequential circuit has two inputs and two outputs. The inputs (X_1 and X_0) represent a 2-bit binary number, N . If the present value of N is greater than the previous value, then Z_1 is 1. If the present value of N is less than the previous value, then Z_2 is 1. **Otherwise**, Z_1 and Z_2 are 0. When the first pair of inputs is received, there is no previous value of N , so we cannot determine whether the present N is greater than or less than the previous value; therefore, the “otherwise” category applies.

Find a Mealy state table for the circuit (minimum number of states, including starting state, is five) (30 marks).

(Hint: The header for Mealy State table will look something like this:)

Present State	Next State				Outputs (Z_1Z_2)			
	Inputs $X_1X_0 = 00$	01	10	11	$X_1X_0 = 00$	01	10	11
S_0	S_1	S_2	S_3	S_4	00	00	00	00

Problem 2. *Reduce the following state table to minimum number of states (30 marks)*

PS	NS		Output	
	X = 0	1	0	1
<i>a</i>	<i>b</i>	<i>c</i>	1	0
<i>b</i>	<i>e</i>	<i>d</i>	1	0
<i>c</i>	<i>g</i>	<i>d</i>	1	1
<i>d</i>	<i>e</i>	<i>b</i>	1	0
<i>e</i>	<i>f</i>	<i>g</i>	1	0
<i>f</i>	<i>h</i>	<i>b</i>	1	1
<i>g</i>	<i>h</i>	<i>i</i>	0	1
<i>h</i>	<i>g</i>	<i>i</i>	0	1
<i>i</i>	<i>a</i>	<i>a</i>	0	1

Problem 3. 1. Use the guideline method (Highest priority and Medium priority only) to determine a suitable **state assignment** for the state table (20 marks).

2. Realize the table using J-K flip-flops (30 marks).

Present State	Next State		Output (Z)
	X = 0	1	
A	A	B	1
B	C	E	0
C	F	G	1
D	C	A	0
E	B	G	1
F	F	B	1
G	C	F	0

Problem 4. A 4:2 priority encoder takes 4 inputs y_0, y_1, y_2, y_3 and has three outputs, w_1, w_0 and IST . Find boolean expressions for w_1 and w_0 using K-maps for the priority encoder. The priority encoder truth table is given for reference (“*” indicates all possible input combinations and “d” indicates don’t care output). (10 marks)

Inputs				Outputs		
y_0	y_1	y_2	y_3	w_1	w_0	IST
0	0	0	0	d	d	0
1	*	*	*	0	0	1
0	1	*	*	0	1	1
0	0	1	*	1	0	1
0	0	0	1	1	1	1

Problem 5. (Optional for extra credit) The following diagram shows the pattern of 0's and 1's stored in a ROM with eight words and four bits per word. What will be the values of F_1, F_2, F_3 , and F_4 if $A = B = 0$ and $C = 1$? Also give the minterm expansions for F_1 and F_2 (20 marks).

