ECE275 Final exam Fall 2022

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Student Name: Student Email:

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 $X=0$	NS 1	Output 0	Output 1
a	b	c	1	0
b	e	d	1	0
c	g	d	1	1
d	e	b	1	0
e	f	g	1	0
f	h	b	1	1
g	h	i	0	1
h	g	i	0	1
i	a	a	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* $X = 0$	*1*	*Output (Z)*
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).*