ECE275 Midterm 1 Fall 2022

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Student Name: Student Email:

1   Instructions

- Time allowed is 50 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.

- The maximum number of marks is 100, as indicated; the midterm examination amounts 10% toward the final grade.

- 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. *Number conversions:*

1. *Use repeated division to convert 77_{10} to octal representation (5 marks).*

2. *What is the value of 7064_8 in base 10 (5 marks).*

3. *An 8-bit two's complement number is 10110011_2. Convert it to (signed) decimal (5 marks).*

4. *Represent -121_{10} in 8-bit two's complement binary notation (5 marks).*

Problem 2. *Use the following 5-variable K-map for F (A, B, C, D, E), and find a minimal SOP expression for F (20 marks)*
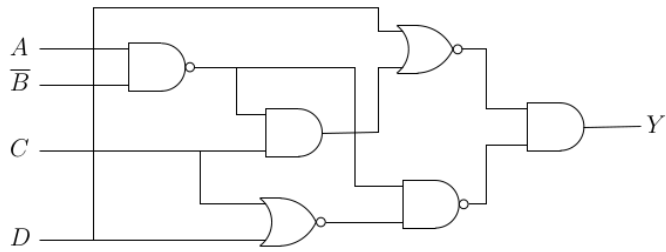
$A=0$

DE\BC	00	01	11	10
00	0	0	0	1
01	d	1	1	0
11	d	1	1	0
10	0	0	0	1

$A=0$

$A=1$

DE\BC	00	01	11	10
00	0	0	0	1
01	0	1	1	1
11	0	0	0	1
10	0	0	0	1

$A=1$

Problem 3. *Use Boolean algebra to find a simplified SOP expression for Y (10 marks)*

Problem 4. *Consider a circuit to subtract two two-bit unsigned numbers. Denote the two bits of first number as $A_1 A_0$ (forming the number N_A) and the two bits of second number as $B_1 B_0$ (forming the number N_B). The circuit will find the difference $N_A - N_B$. The result will be a 2-bit difference $D_1 D_0$. Assume that the circuit never sees an input combination in which N_A is less than N_B. In other words, we always have $N_A \geq N_B$.*

1. *Start with filling out the following truth table (3 example rows are provided) (10 marks).*

2. *Write D_1 using Maxterms notation (5 marks).*

3. *Use K-maps to find minimal Product of sum form for D_0 (20 marks).*

4. *Draw an ANSI network for D_0 using NOR gates only (10 marks).*

A_1	A_0	B_1	B_0	D_1	D_0
0	0	0	0		
0	0	0	1	d	d
0	0	1	0		
0	0	1	1		
0	1	0	0		
0	1	0	1	0	0
0	1	1	0		
0	1	1	1		
1	0	0	0		
1	0	0	1		
1	0	1	0		
1	0	1	1		
1	1	0	0		
1	1	0	1	1	0
1	1	1	0		
1	1	1	1		

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Problem 5. *Write the function* $F(A, B, C, D) = \prod M(0, 4, 5)$ *in Product of sums **canonical** form (5 marks).*