

ECE275 Midterm 1 Fall 2022

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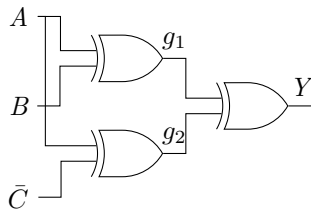
1 Instructions

- Time allowed is 50 minutes. (This sample exam might be lengthier than the actual exam.)
- 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 8x11in 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.
- Please answer questions in the spaces provided; if space is insufficient, please use the back of the pages.
- 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 230_{10} to octal representation (5 marks).
2. What is the value of $19D_{16}$ in base 10 (5 marks).
3. A 6-bit two's complement number is 100011_2 . Convert it to (signed) decimal (5 marks).
4. Represent -23_{10} in two's complement binary notation (5 marks).

Problem 2. *Consider the circuit below*



By algebraic manipulation, prove or disprove that $Y = \bar{B}\bar{C} + BC$ (10 marks).

Problem 3. Use the following 5-variable K-map for $F(A, B, C, D, E)$, and find a minimal SOP expression for F (15 marks)

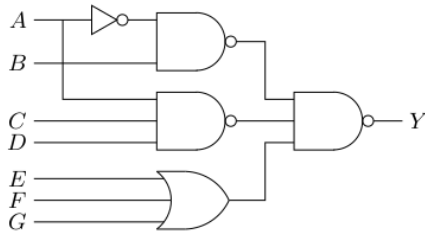
DE \ BC	BC			
	00	01	11	10
00	1			1
01	1	1		1
11		1		
10		1	1	

$A=0$

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

$A=1$

Problem 4. Use bubble-pushing and/or algebra to find an SOP expression for Y in the circuit below. If you use bubble-pushing, draw an equivalent circuit beside the given circuit (5 marks).



Problem 5. Consider the function Y given below.

$$Y(A, B, C, D) = \sum m(0, 3, 5, 7, 8, 14) + d(2, 12, 15)$$

1. Draw a K-maps to derive a minimum SOP and POS expressions for Y . Indicate all essential prime implicants for Y or \bar{Y} in your K-maps (20 marks).
2. Sketch a two-level NOR-NOR circuit for Y . Assume that A , B , C , and D are available in true and complimentary forms (5 marks).
3. Write Y in Product of sums (POS) canonical form (5 marks).

Problem 6. Design a minimal SOP circuit to add two two-bit unsigned numbers. Denote the two bits of first number as A_1A_0 and the two bits of second number as B_1B_0 . The result will be a 2-bit sum S_1S_0 and a carry C . Start with filling out the following truth table (3 example rows are provided) and then use any technique to find expressions for S_1 , S_0 and a single carry bit C_1 .

A_1	A_0	B_1	B_0	C_1	S_1	S_0
0	0	0	0			
0	0	0	1			
0	0	1	0			
0	0	1	1			
0	1	0	0			
0	1	0	1	0	1	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	0
1	1	1	0			
1	1	1	1	1	1	0