ECE275 Midterm 1 Spring 2025

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Student Name: Student Email:

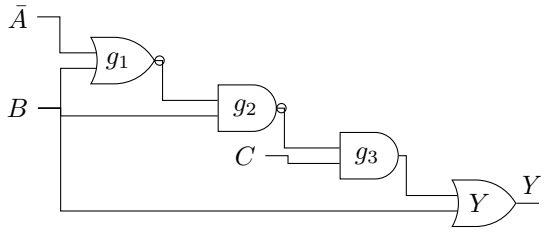
1 Instructions

- 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 50, 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. *Use the following 4-variable K-map for F (A, B, C, D), and find a minimal SOP expression for F (5 marks)*

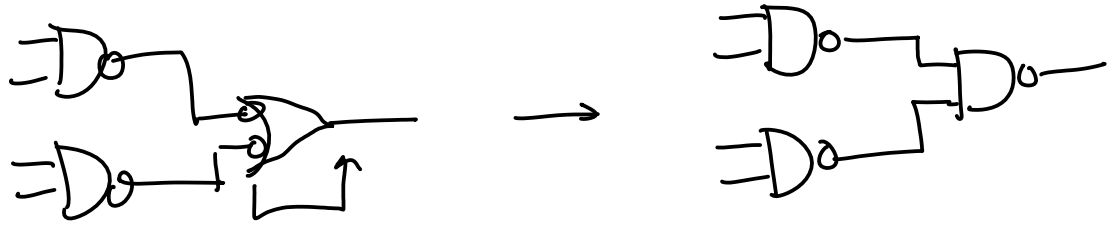
CD \ AB	00	01	11	10
00	0	0	0	1
01	1	1	1	1
11	0	0	0	1
10	0	0	0	1

Problem 2. *Use Boolean algebra to find a simplified SOP expression for Y (5 marks)*



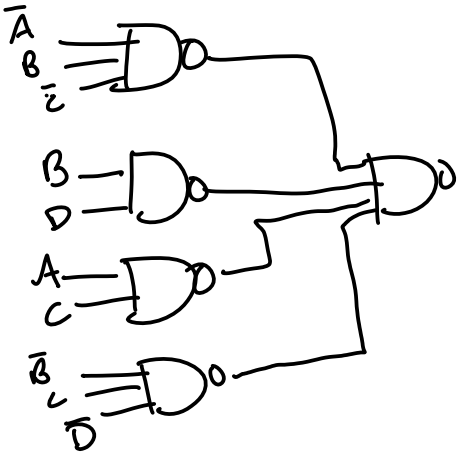
Problem 3. *Draw the ANSI diagram for the following function, using only NAND gates. Repeat using only NOR gates:* $F = \bar{A}B\bar{C} + B\bar{D} + A\bar{C} + \bar{B}C\bar{D}$. *(15 marks)*

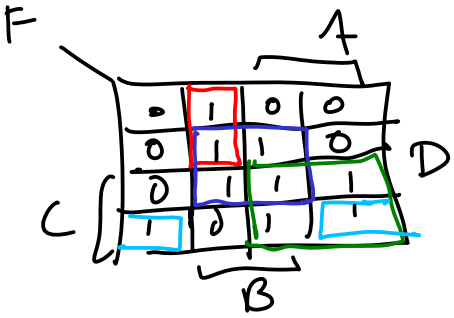
SOP

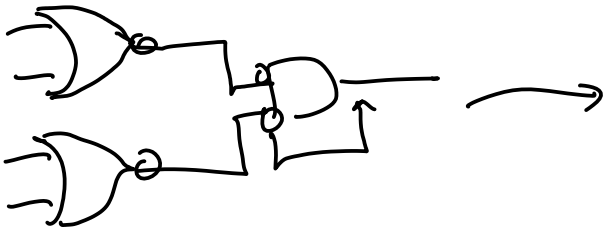


Sum of Products

NAND - NAND

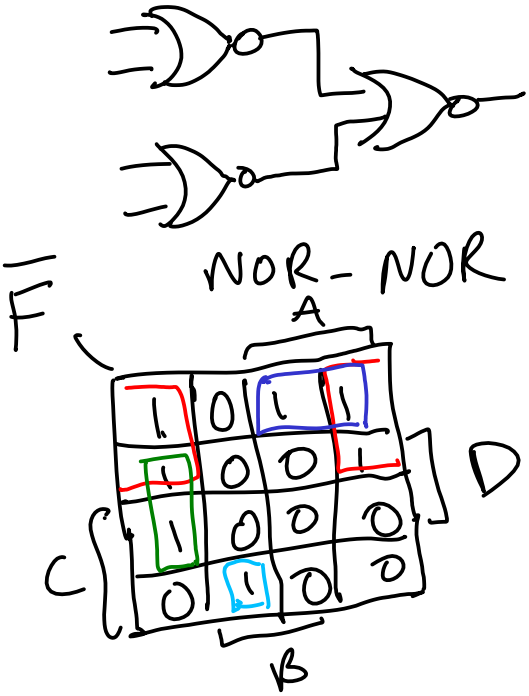






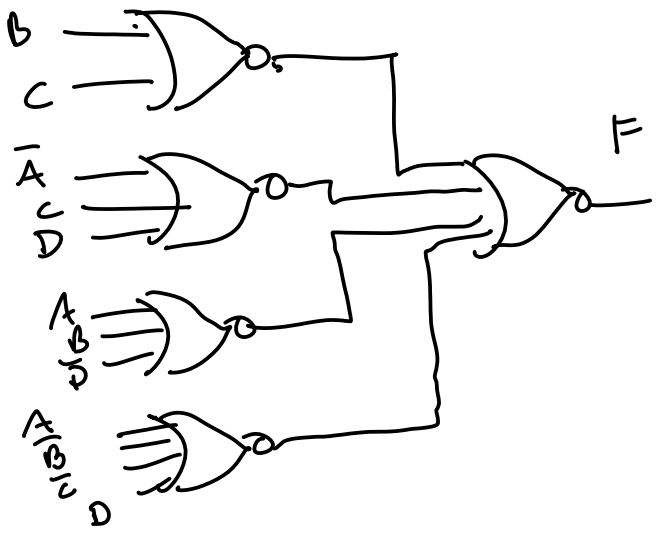
Product of Sums

NOR - NOR



$$\bar{F} = \bar{B}\bar{C} + A\bar{C}\bar{D} + \bar{A}\bar{B}D + \bar{A}BC\bar{D}$$

$$F = (B+C)\cdot(\bar{A}+C+D)\cdot(A+B+\bar{D}) \cdot (A+\bar{B}+\bar{C}+D)$$

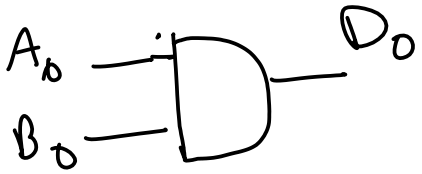

B
C
$\bar{A}$
C
D
A
B
D
A
$\bar{B}$
C
D
F

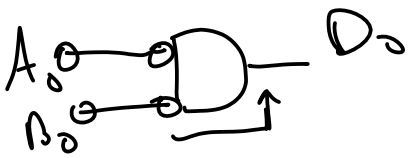
Problem 4. *Consider a circuit to multiply two two-bit unsigned numbers. Denote the two bits of first number as A_1A_0 (forming the number N_A) and the two bits of second number as B_1B_0 (forming the number N_B). The circuit will find the product $N_A * N_B$. The result will be a 4-bit number $D_3D_2D_1D_0$.*

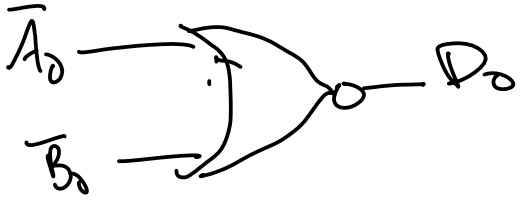
1. *Start with filling out the following truth table (5 example rows are provided) (10 marks).*
2. *Use K-maps to find minimal Product of sum form for D_0 (10 marks).*
3. *Draw an ANSI network for D_0 using NOR gates only (5 marks).*

A_1	A_0	B_1	B_0	D_3	D_2	D_1	D_0
0	0	0	0	0	0	0	0
0	0	0	1	0	0	0	0
0	0	1	0	0	0	0	0
0	0	1	1	0	0	0	0
0	1	0	0				
0	1	0	1				
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	1	1	0				
1	1	1	1	1	0	0	1

$D_0 = A_0 B_0$







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