CprE 281 HW02

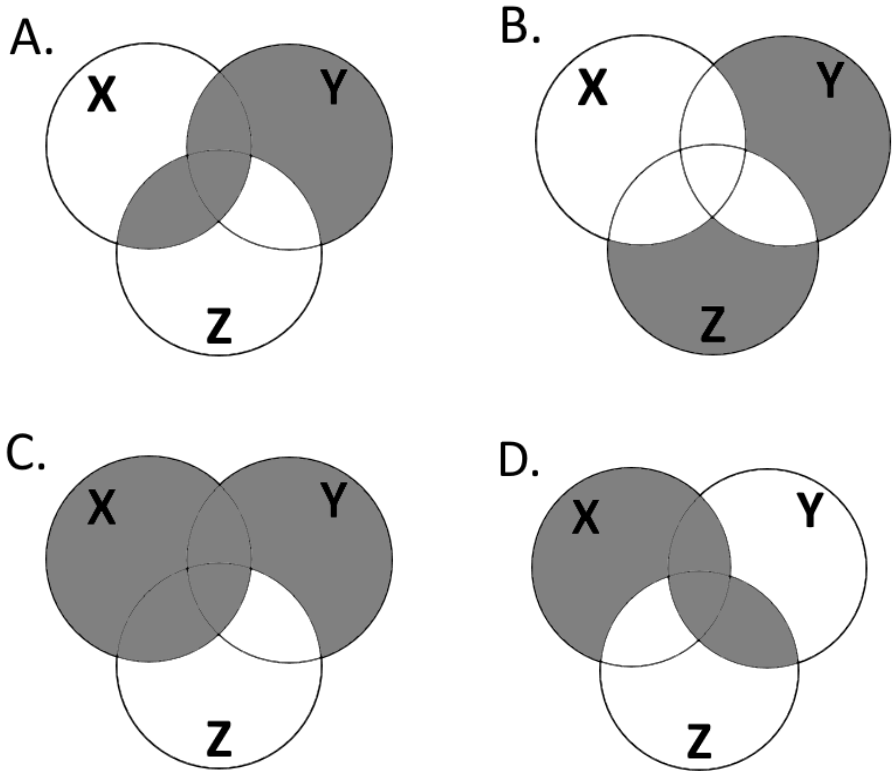
ELECTRICAL AND COMPUTER ENGINEERING
IOWA STATE UNIVERSITY

Boolean algebra, AND/OR/NAND/NOR gates

Assigned Date: Second Week
Finish by Sep. 7, 2022

P1. **(10 points)**: Given the Venn diagrams below:

A. Which of the following can be used to represent the function, $f(X, Y, Z) = Y\bar{Z} + XZ$



B. Write the Boolean expressions for the other Venn Diagrams

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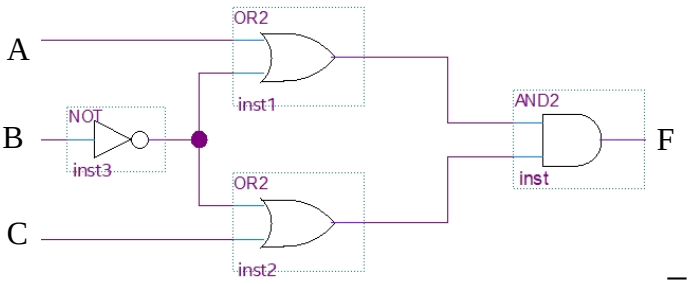
P2. **(15 points):** For the circuit below,

A. Find the boolean expression describing the circuit below

B. Prove that the equation found in part A. matches the simplified equation below



$= \bar{B} + AC$

P3. **(15 points):** Given truth table below:

a	b	c	F
0	0	0	1
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	0
1	0	1	1
1	1	0	0
1	1	1	1

A. Write the boolean expression for F

B. Draw the function using only NAND gates

C. Draw the function using only NOR gates

P4. **(10 points):** Find $\bar{f}$ by first first negating the right-hand side and then applying DeMorgan's theorem to simplify the expression.

A. $f = xz + \bar{w}y + \overline{xx}$

B. $f = (a + b)(a\bar{b} + c)\overline{(a + \bar{b}c)}$

P5. **(10 points)**: Given the following functions, write the canonical Sum-of-Products expressions:

A. $f(x_1, x_2, x_3) = \sum m(0,1,6)$

B. $f(x_1, x_2, x_3) = \sum m(2,4,5,7)$

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P6. **(10 points):** Given the following functions, write the canonical Products-of-Sums expressions:

A. $f(x_1, x_2, x_3) = \prod M(0,6,7)$
B. $f(x_1, x_2, x_3) = \prod M(0,1,4,7)$

P7. **(10 points):** Use Boolean Algebra to prove the following expressions as equivalent. Show each rule of Boolean Algebra used to perform each step:

A. $B + BCD + \bar{B}CD + AB + \bar{A}B + \bar{B}C = B + C$
B. $B\bar{C}(C + A\bar{C}) + (\bar{A} + \bar{C})(\bar{A}B + \bar{A}C) = B\bar{C} + \bar{A}C$

P8. **(20 points)** Consider the logic function $f(A, B, C) = (\bar{A}BC + A\overline{BC} + AB\bar{C} + \overline{AB})$

A. Draw the logic circuit for the function given above.
B. Let the cost of a logic circuit be the total number of gates plus the total number of inputs to all gates in the circuit. What is the cost of the circuit in A?
C. Simplify *f* using Boolean algebra as much as possible.
D. Draw the logic circuit for the simplified version of *f* in C.
E. What is the cost of the circuit in D?