SET A

1. Reduce the following Boolean expressions to the indicated number of literals (Using theorems & axioms).
   (a) $xyz + x'y + xyz'$ to one literal
   (b) $x'y'z' + y + xy'z'$ to two literals

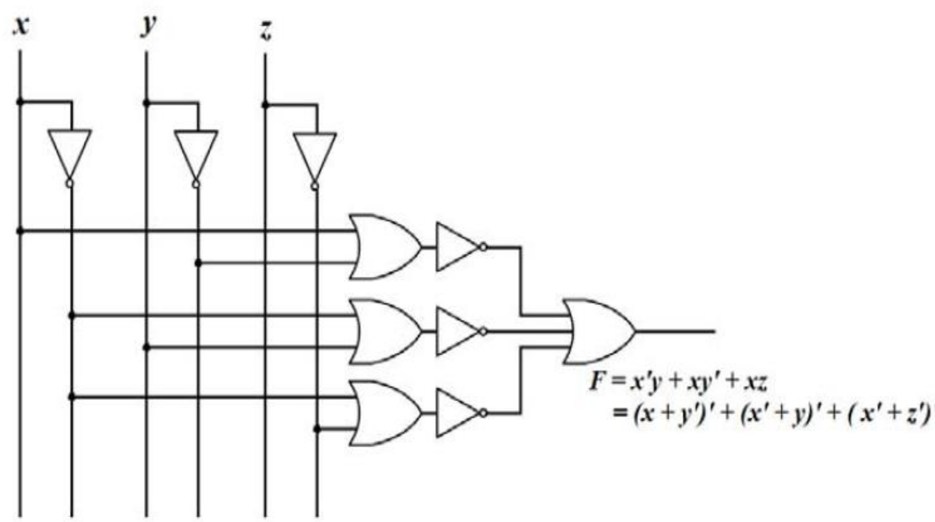
Solution:

$$xyz + x'y + xyz' = xy + x'y = y$$

$$x'y'z' + y + xy'z' = (x' + x)y'z' + y = y + y'z' = (y + y')(y + z') = y + z'$$

2. Implement the Boolean function $F = x'y + xy' + xz$ with OR and inverter gates.

Solution:



3. Show that the dual of the exclusive-OR is equal to its complement.

Solution:

$$x \oplus y = x'y + xy' \quad and\ (x \oplus y)' = (x + y')(x' + y)$$

$$Dual\ of\ x'y + xy' = (x' + y)(x + y') = (x \oplus y)'$$

4. Convert decimal +49 and +29 to binary, using the signed-2's-complement representation and enough digits to accommodate the numbers. Then perform the binary equivalent of (+29) + (-49). Convert the answers back to decimal and verify that they are correct.

Solution:

+49 → 0_110001 (Needs leading zero extension to indicate + value);
+29 → 0_011101 (Leading 0 indicates + value)
-49 → 1_001110 + 0_000001→ 1_001111
-29 → 1_100011 (sign extension indicates negative value)

(+29) + (-49) = 0_011101 + 1_001111 = 1_101100 (1 indicates negative value.)
Magnitude = 0_010011 + 0_000001 = 0_010100 = 20; Result (+29) + (-49) = -20

SET B

1. Reduce the following Boolean expressions to the indicated number of literals (Using theorems & axioms).
   (a) $(x + yz)' + (x + y'z')'$ to one literal
   (b) $(x + y)'(x' + y')$ to two literals

Solution:

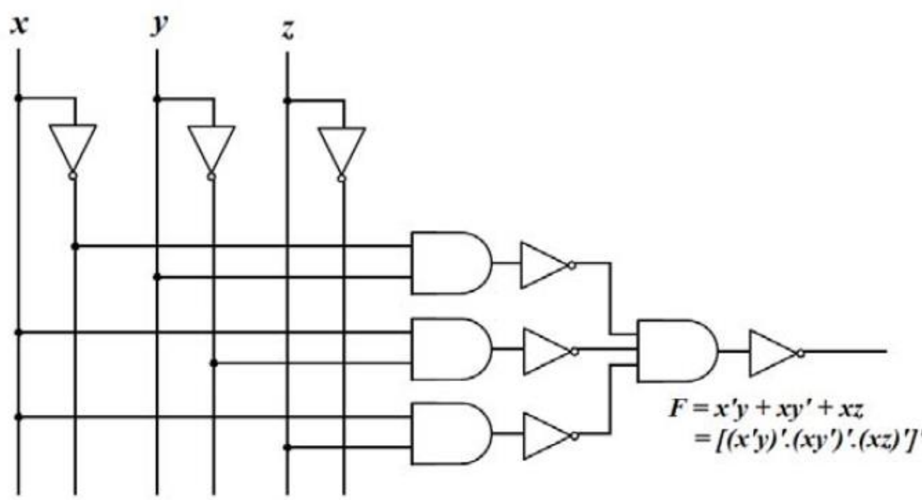
$$(x + yz)' + (x + y'z')' = x'(y' + z') + x'(y + z) = x'y' + x'z' + x'y + x'z$$

$$= x'(y' + y) + x'(z' + z) = x'$$

$$(x + y)'(x' + y') = x'y'(x' + y') = x'y'$$

2. Implement the Boolean function $F = x'y + xy' + xz$ with AND and inverter gates.

Solution:



3. Show that the dual of the exclusive-OR is equal to its complement.

Solution:

$$x \oplus y = x'y + xy' \quad and \; (x \oplus y)' = (x + y')(x' + y)$$

$$Dual\ of\ x'y + xy' = (x' + y)(x + y') = (x \oplus y)'$$

4. Convert decimal +49 and +29 to binary, using the signed-2's-complement representation and enough digits to accommodate the numbers. Then perform the binary equivalent of (-29) + (+49). Convert the answers back to decimal and verify that they are correct.

Solution:

+49 → 0_110001 (Needs leading zero extension to indicate + value);
+29 → 0_011101 (Leading 0 indicates + value)
-49 → 1_001110 + 0_000001→ 1_001111
-29 → 1_100011 (sign extension indicates negative value)

(-29) + (+49) = 1_100011 + 0_110001 = 0_010100 (0 indicates positive value)
(-29) + (+49) = +20

SET C

1. Reduce the following Boolean expressions to the indicated number of literals (Using theorems & axioms).
   (a) $x'yz + xyz' + xyz + x'yz'$ to one literal
   (b) wxy'z' + wy' + wx'y'z' to two literals

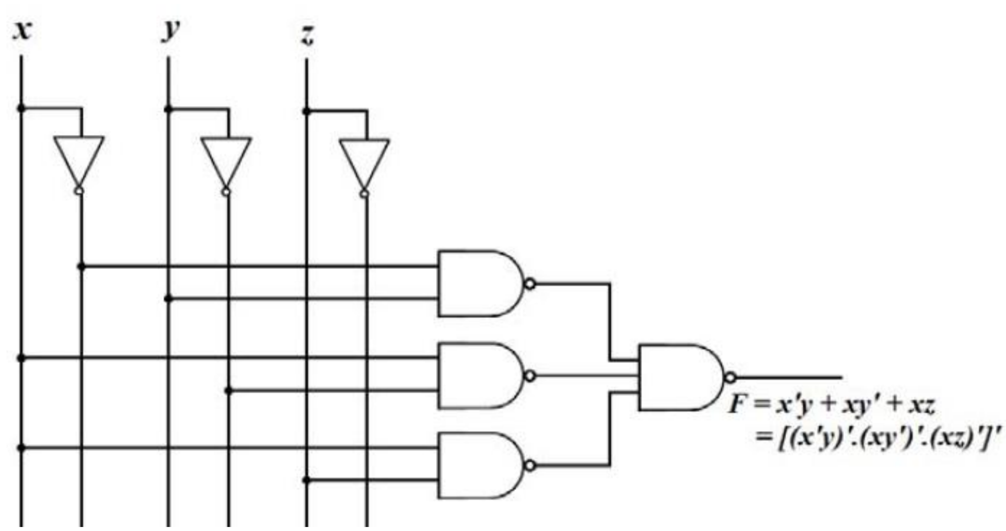
   Solution:

$$x'yz + xyz' + xyz + x'yz' = x'y(z + z') + xy(z + z') = x'y + xy = (x' + x)y = y$$

$$wxy'z' + wy' + wx'y'z' = wy'z'(x + x') + wy' = wy'(z' + 1) = wy'$$

2. Implement the Boolean function $F = x'y + xy' + xz$ with NAND and inverter gates.

   Solution:



3. Show that the dual of the exclusive-OR is equal to its complement.

   Solution:

$$x \oplus y = x'y + xy' \quad and \ (x \oplus y)' = (x + y')(x' + y)$$

$$Dual\ of\ x'y + xy' = (x' + y)(x + y') = (x \oplus y)'$$

4. Convert decimal +49 and +29 to binary, using the signed-2's-complement representation and enough digits to accommodate the numbers. Then perform the binary equivalent of (+29) + (-49). Convert the answers back to decimal and verify that they are correct.

Solution:

+49 → 0_110001 (Needs leading zero extension to indicate + value);
+29 → 0_011101 (Leading 0 indicates + value)
-49 → 1_001110 + 0_000001→ 1_001111
-29 → 1_100011 (sign extension indicates negative value)

(+29) + (-49) = 0_011101 + 1_001111 = 1_101100 (1 indicates negative value.)
Magnitude = 0_010011 + 0_000001 = 0_010100 = 20; Result (+29) + (-49) = -20