**Tutorial 1**

1. Construct a truth table for the following:
   a. $xyz + x(yz)' + (xyz)'$ b. $(x + y)(x + z)(x' + z)$

2. Using DeMorgan's Law, write an expression for the complement of $F$ if $F(x,y,z) = x(y' + z)$.

3. Using DeMorgan's Law, write an expression for the complement of $F$ if $F(x,y,z) = xy + x'z + yz'$ in product of sums form.

4. Show that $x = xy + xy'$
   a. Using truth tables b. Using Boolean identities

5. Simplify the following functional expressions using Boolean algebra and its identities. List the identity used at each step.
   a. $F(x,y,z) = x'y + xyz' + xyz$
   b. $F(w,x,y,z) = (xy' + w'z)(wx' + yz')$
   c. $F(x,y,z) = (x + y)'(x' + y')'$

6. The truth table for a Boolean expression is shown below. Write the Boolean expression in sum-of-products form.

| $x$ | $y$ | $z$ | $F$ |
|---|---|---|---|
| 0 | 0 | 0 | 1 |
| 0 | 0 | 1 | 0 |
| 0 | 1 | 0 | 0 |
| 0 | 1 | 1 | 1 |
| 1 | 0 | 0 | 0 |
| 1 | 0 | 1 | 0 |
| 1 | 1 | 0 | 1 |
| 1 | 1 | 1 | 0 |

7. Draw the truth table and rewrite the expression below as the complemented sum of two products:
   $xz' + y'z + x'y$

8. Given the function: $F(xy,z) = xy'z + x'y'z + xyz$
   a. List the truth table for F.
   b. Draw the logic diagram using the original Boolean expression
   c. Simplify the expression using Boolean algebra and identities.
   d. List the truth table for your answer in Part c.
   e. Draw the logic diagram for the simplified expression in Part c.

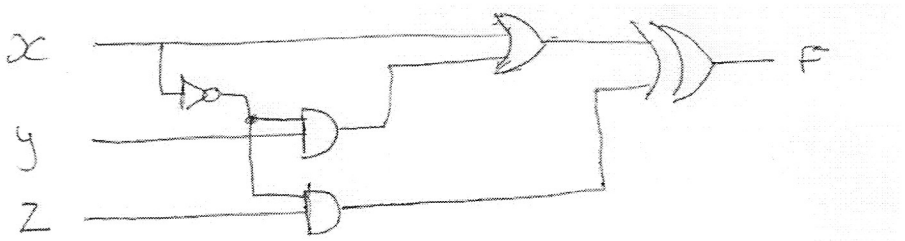
9. Construct the XOR operator using only AND, OR and NOT gates.

10. Construct the XOR operator using only NAND gates

11. Draw the combinational circuit that directly implements the Boolean expression:
    $F(x,y,z) = xz + (xy + z')$

13. Draw the combinational circuit that directly implements the Boolean expression:
    $F(x,y,z) = (xy \ XOR \ (y + z')') + x'z$

14. Find the truth table that describes the following circuit:




15. Draw a half adder using only NAND gates.

16. Tyrone Shoelaces has invested a huge amount of money into the stock market and doesn't trust just anyone to give him buying and selling information. Before he will buy a certain stock, he must get input from three sources. His first source is Pain Webster, a famous stock broker. His second source is Meg A. Cash, a self-made millionaire in the stock market, and his third source is Madame LaZora, world famous psychic. After several months of receiving advice from all three, he has come to the following conclusions:
a. Buy if Pain and Meg both say yes and the psychic says no.
b. Buy if the psychic says yes.
c. Don't buy otherwise.
Construct a truth table and find the minimized Boolean function to implement the logic telling Tyrone when to buy.

17. How many 256 × 8 RAM chips are needed to provide a memory capacity of 4096 bytes?
a. How many bits will each memory address contain?
b. How many address lines must go to each chip?
b. How many lines must be decoded for the chip select inputs? Specify the size of the decoder

18 Describe how each of the following circuits works and indicate typical inputs and outputs. Also provide a carefully labeled "black box" diagram for each.
a) Decoder b) Multiplexer

19. Create the Kmaps and then simplify for the following functions:
a. $F(x,y,z) = x'y'z' + x'yz + x'yz'$
b. $F(x,y,z) = x'y'z' + x'yz' + xy'z' + xyz'$
c. $F(x,y,z) = y'z' + y'z + xyz'$

20. Create the Kmaps and then simplify for the following functions:
a. $F(w,x,y.z) = w'x'y'z' + w'x'yz' + w'xy'z + w'xyz + w'xyz' + wx'y'z' + wx'yz'$
b. $F(w,x,y,z) = w'x'y'z' + w'x'y'z + wx'y'z + wx'yz' + wx'y'z'$
c. $F(w,x,y,z) = y'z + wy' + w'xy + w'x'yz' + wx'yz'$