You are expected to solve homework problems individually. If needed, you may seek help from your friends. However, do not copy. Show all steps with your solutions for full credit.

Name: Key **/ 50**

1. (5 points) Express the following function as a sum of minterms and maxterms
   a. $g(x, y, z) = x' + y z + y' z'$
   $=x'(y +y') + y z(x+x') + y'z'(x+x')$
   $=x'y+x'y'+xyz+x'yz+xy'z'+x'y'z'$
   $= (x'y+x'y')(z+z')+xyz+x'yz+xy'z'+x'y'z'$
   $=x'yz+ x'yz'+ x'y'z+ x'y'z'+xyz+x'yz+xy'z'+x'y'z'$
   $= x'y'z'+ x'y'z+ x'yz'++x'yz+ xyz+xy'z'$
   $=m_0+m_1+m_2+m3+m7+m4$
   $=\sum m(0,1,2,3,4,7)$

   b. $f(x, y, z) = (x' + y) (x + z) (y + z)$
   $= (x' + y +zz') (x + yy' + z) (xx' + y + z)$
   $= (x' + y + z) (x' + y + z') (x + y + z) (x + y' + z) (x+ y + z) (x' + y + z)$
   $= (x' + y + z) (x' + y + z') (x + y + z) (x + y' + z)$
   $=M4.M5.M0.M2.$
   $=\Pi M(0,2,4,5)$

2. (5 points) Find the complement of the following expressions:
   a) $(a + c) (a + b') (a'+ b + c')$
   The dual of F is = (ac) (ab')(a'bc')
   Complement each literal F′= a'c' + a'b + ab'c

   b) $x'y' + xy'$
   The dual of F is = $(x '+ y') (x + y')$
   Complement each literal
   $F' = (x+ y) (x'+y)$

3. (5 points) Convert each of the following to the other canonical form:

   (a) $F(x, y, z) = \sum m(1, 3, 5)$
   $= \Pi M(0, 2, 4, 6, 7)$

   (b) $F(A, B, C, D) = \Pi M(3, 5, 8, 11)$
   $= \Sigma m(0, 1, 2, 4, 6, 7, 9, 10, 12, 13, 14, 15)$

4. (6 points) Simplify the following Boolean expressions to a minimum number of literals and draw logic diagram of the circuits that implement the simplified expression.
   a) $(a + b + c')(a' b' + c)$
   = a a' b' + a c + b a' b' + b c + c' a' b' + c' c

=0. b' + a c + 0. a' + b c + c' a' b' + 0
= a c + b c +a' b' c'

b) a′ b c + a b c′ + a b c + a′ b c′
= a' b(c + c') + a b(c + c')
= a' b + a b = (a' + a) b
= b

c) (a′ + c′) (a + b′ + c′)
= a' a + a' b' + a' c' + c' a + c' b' + c' c'
= a' b' + a' c' + a c' + b' c'
= c' + b'(a' + c')
= c' + b' c' + a' b'
= c' + a' b'

5. For the Boolean function

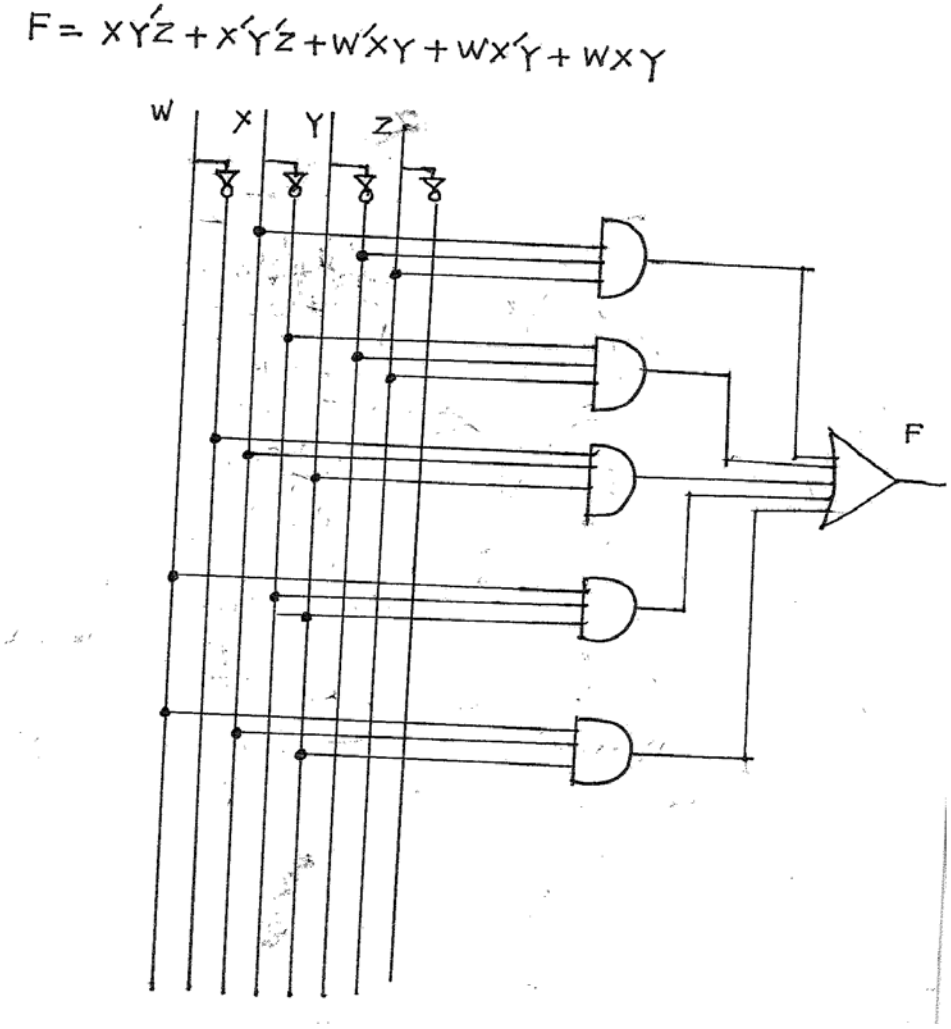
F = XY′Z + X′Y′Z + W′XY + WX′Y+ WXY

a. (5 points) Obtain the truth table of F.

wx y z	*F*
00 0 0	0
00 0 1	1
00 1 0	0
00 1 1	0
01 0 0	0
01 0 1	1
01 1 0	1
01 1 1	1
10 0 0	0
10 0 1	1
10 1 0	1
10 1 1	1
11 0 0	0
11 0 1	1
11 1 0	1
11 1 1	1

$F = xy'z + x'y'z + w'xy + wx'y + wxy$
$F = \Sigma(1, 5, 6, 7, 9, 10\ 11, 13, 14, 15)$

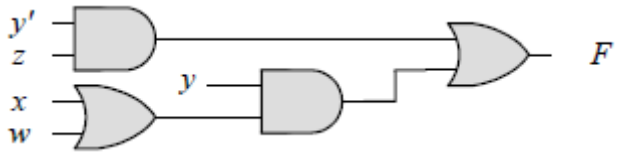
b. (4 points) Draw the logic diagram, using the original Boolean expression.



c. (5 points) Use Boolean algebra to simplify the function to a minimum number of literals.

F = x y' z + x' y' z + w' x y + w x 'y + w x y
= x y' z + x' y' z + w' x y + w x y + w x 'y + w x y
= y' z + x y + w y
= y′ z + y(w + x)

d. (5 points) Draw the logic diagram from the simplified expression, and compare the total number of gates with the diagram of part (b).



Original expression

3 input AND gates----5
Inverter----------3
3 input OR gates------2

Simplified expression

2 input AND gates---- 2
Inverter----------1
2 input OR gates-------2

6. (2+2+2+2+2) For the following truth table

x	y	z	Function f_2
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

a. Show the minterms in numerical form

F2 = ∑m(3,5,6,7)

b. Show an algebraic expression in sum of minterms form

F2 = x′yz + xy′z + xyz′ +xyz

c. Simplify the SOP expression

$$f_2 = x'yz + xy'z + xyz' + xyz$$
$$= x'yz + xy'z + xyz' + xyz + xyz + xyz$$
$$= yz(x' + x) + xz(y' + y) + xy(z' + z)$$
$$= yz + xz + xy$$
$$= xy + yz + zx$$

d. Show the maxterm in numerical form

F2 = ΠM (0, 1, 2, 4)

e. Show the algebraic expression in product of maxterm form and draw the logic diagram of the circuit.

$$F_2(X, Y, Z) = \Pi M(0, 1, 2, 4)$$

$$= M0 \cdot M1 \cdot M2 \cdot M4$$

$$= (X+Y+Z) \cdot (X+Y+Z') (X+Y'+Z) (X'+Y+Z$$