Midterm Notes

Decimal to Anything ⇒ Divide by the desired base. If decimal, multiply.

Anything to Decimal ⇒ $a_i \times b^i + \dots + a_2 \times b^2 + a_1 \times b^1 + a_0 \times b^0 + a_{-1} \times b^{-1} + \dots$

Hexa to Binary and Vice-Versa ⇒ 4 bits

Octal to Binary and Vice-Versa ⇒ 3 bits

Octal to Hexa OR Hexa to Octal ⇒ First convert to binary. Then, convert to what you are looking for.

Decimal to BCD ⇒ Consider each digit separately into 4 bits.

BCD to Decimal ⇒ Break up each section into 4 bits.

Boolean Algebra	(a)	(b)
Postulate 2	$x+0=x$	$x \cdot 1 = x$
Postulate 5	$x + x' = 1$	$xx' = 0$
Theorem 1	$x + x = x$	$xx = x$
Theorem 2	$x + 1 = 1$	$x \cdot 0 = 0$
Theorem 3 (involution)	$(x')' = x$	
Postulate 3 (commutative)	$x+y = y+x$	$xy = yx$
Theorem 4 (associative)	$x+(y+z)=(x+y)+z$	$x(yz)=(xy)z$
Postulate 4 (distributive)	$x(y+z)=xy+xz$	$x+yz=(x+y)(x+z)$
Theorem 5 (de Morgan's Law)	$(x+y)'=x'y'$	$(xy)'=x'+y'$
Theorem 6 (absorption)	$x+xy=x$	$x(x+y)=x$

minterm ⇒ 1 (multiplication) output = Σm(row #'s)

maxterm ⇒ 0 (addition) output = ΠM(row #'s)

Note: The duration of this test is 1:15min.

1. (10 points total)

a) Write the truth table for an AND logic gate (3 pts)

X	Y	F
0	0	0
0	1	0
1	0	0
1	1	1

b) Write the truth table for an XOR logic gate (3pts)

X	Y	F
0	0	0
0	1	1
1	0	1
1	1	0

c) Apply DeMorgan's theorem to the following (4pts) (Hint: Function Complement)

i. $(xy' + z')' = \overline{(x\bar{y} + \bar{z})}$

$= \boxed{(\bar{x} + y)(z)}$

ii. $(A'BC')' = \overline{(\bar{A}B\bar{C})}$

$= \boxed{A + \bar{B} + C}$

2. (10 points total)

a) Convert $(30.625)_{10}$ to binary (base 2) (go out to maximum of 3 bits for the fractional part) (5pts)

	Result	Remainder
$2\sqrt{30}$	15	0
$2\sqrt{15}$	7.5	1
$2\sqrt{7}$	3.5	1
$2\sqrt{3}$	1.5	1
$2\sqrt{1}$	0.5	1

$$2.000 \times 0.625 = 1.250000 \quad (w_1 = 1)$$

$$2.00 \times 0.25 = 0.5000 \quad (w_2 = 0)$$

$$2.0 \times 0.5 = 1.0 \quad (w_3 = 1)$$

$$(11110.101)_2$$

b) Now convert $(30)_{10}$ to hexadecimal (base 16) (5pts)

	Result	Remainder
$16\sqrt{30.000}$	1.875	$16.000 \times 00.875 = 14.000000$
$16\sqrt{1.0000}$	0.0625	$16.0000 \times 00.0625 = 1.0000000$

$$(1E)_{16}$$

3. (15 points total)

a) Convert 01100 to 2's complement (do not add signed bit) (5pts)

$$\begin{array}{r} 11111 \\ -\,01100 \\ \hline 10011 \end{array} \qquad \begin{array}{r} {\scriptstyle 1\,1} \\ 10011 \\ +\quad\;\; 1 \\ \hline 10100 \end{array}$$

$(10100)_{2's}$

b) 00111 – 01100 using 2's complement (hint: convert 01100 to 2's complement and add) (7pts)

$$\begin{array}{r} 11111 \\ -\,01100 \\ \hline 10011 \end{array} \qquad \begin{array}{r} {\scriptstyle 1\,1} \\ 10011 \\ +\quad\;\; 1 \\ \hline (10100)_{2's} \end{array} \qquad \begin{array}{r} {\scriptstyle 1} \\ 00111 \\ +\,10100 \\ \hline 11011 \end{array} \qquad \begin{array}{r} 00100 \\ +\quad\;\; 1 \\ \hline -(00101)_{2's} \end{array}$$

c) Write the answer to part b in decimal (base 10) with a negative or positive sign (3pts)

$(00101)_2$

$(1 \times 2^2) + (1 \times 2^0) =$

$4 + 1$

5

$(-5)_{10}$

4. a) Simplify

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

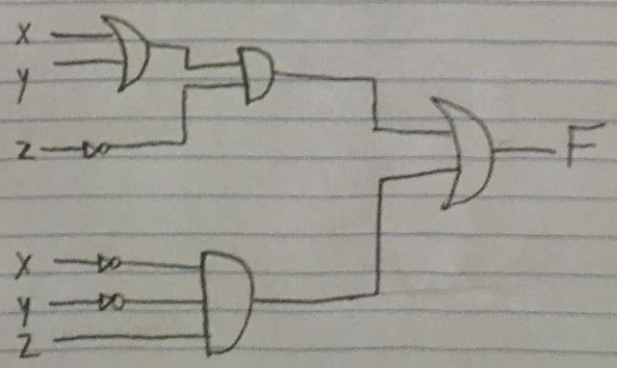
Postulate 4(a)

$F = x'x + x'y' + x'z' + z'x + z'y' + z'z'$

$F = 0 + x'y' + x'z' + z'x + z'y' + 0$ Postulate 5(b)

$F = x'y' + x'z' + z'x + z'y'$

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

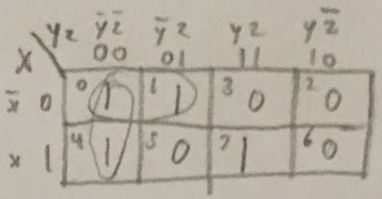


5. (25 points total)

a) Given the Minterm list, write the 1) truth table and 2) Sum of Products form (SOP) 3) Product of Sum (POS) (9 pts)

$F = \sum m(0,1,4,7)$

	X	Y	Z	F
min 0	0	0	0	1
min 1	0	0	1	1
max 2	0	1	0	0
max 3	0	1	1	0
min 4	1	0	0	1
max 5	1	0	1	0
max 6	1	1	0	0
min 7	1	1	1	1



$F = \bar{x}\bar{y} + \bar{y}\bar{z}$

b) Using any method that you choose to write the above truth table in simplified Sum of Products form (5pts)

$$F = (\bar{x}\cdot\bar{y}\cdot\bar{z}) + (\bar{x}\cdot\bar{y}\cdot z) + (x\cdot\bar{y}\cdot\bar{z}) + (x\cdot y\cdot z)$$

$$F = \Sigma m(0,1,4,7)$$

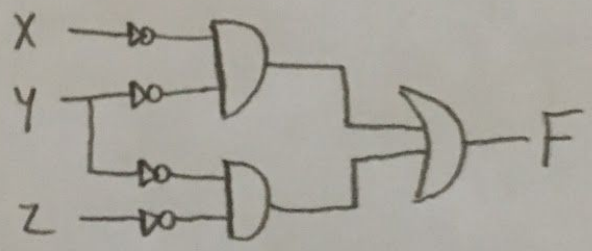
c) Using any method that you choose to write the above truth table in simplified Product of Sums form (5pts)

$$F = (x+\bar{y}+z)(x+\bar{y}+\bar{z})(\bar{x}+y+\bar{z})(\bar{x}+\bar{y}+z)$$

$$F = \pi M(2,3,5,6)$$

d) Draw the circuit described in the expression derived in part (a) of this problem (6pts)

$$F = \bar{x}\bar{y} + \bar{y}\bar{z}$$

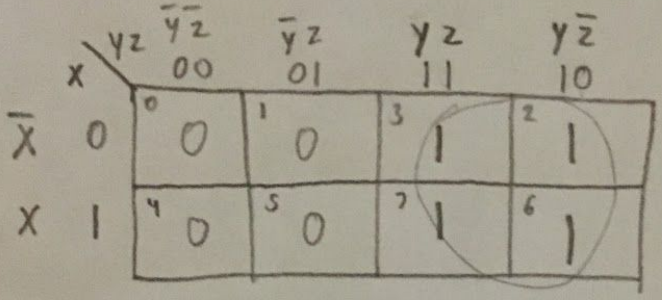


6. (15 points)

Simplify the following expression using a 3 variable K-map

$F = xyz' + x'yz + xyz + x'yz'$

$2^3 = 8$



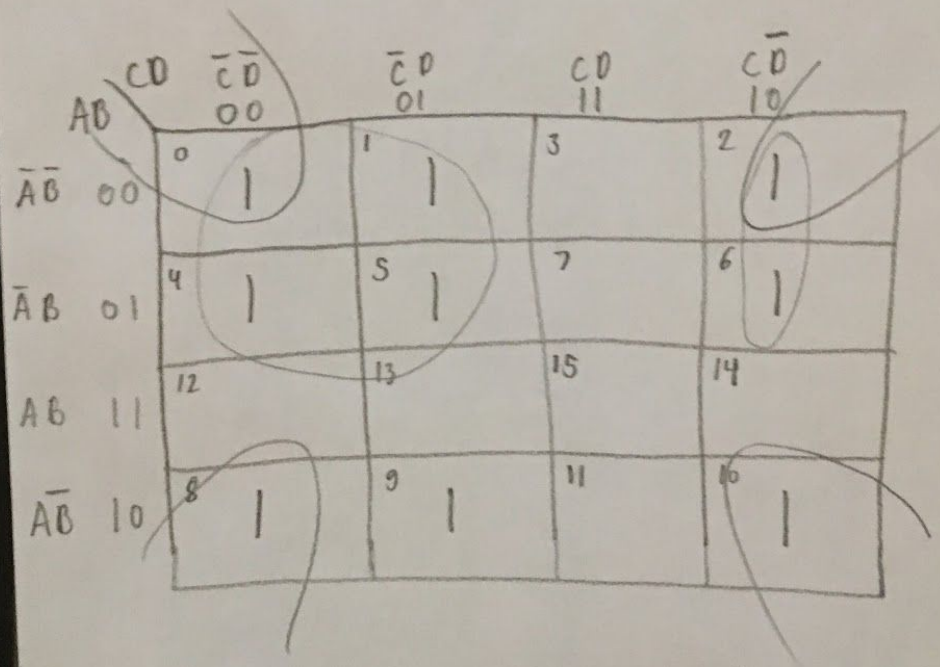
$F = y$

7. (15 points)

Use a 4 variable (A, B, C, D) K-map to minimize the following minterms

$$F = \sum m(0, 1, 2, 4, 5, 6, 8, 9, 10)$$

$2^4 = 16$



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