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Subject: Digital Logic Design

Assignment No: 03

Problem # 2.2

f) $a'bc + abc' + abc + a'bc'$

Solution:

Rearrange the terms:

$$(a'bc + a'bc') + (abc' + abc)$$

Taking Common:

$$a'b(c + c') + ab(c' + c)$$

$\because c + c' = 1$

Thus $a'b(1) + ab(1)$.

$= a'b + ab$

$= b(a' + a) \quad \because a' + a = 1$

$= b(1) = b$ Ans.

Problem # 2.3

d) $xy + x(wz + wz')$.

first simply the Parenthesis.

$wz + wz'$

$w(z + z')$

$z + z' = 1$

So now the expression is $xy + xw$.

$= x(y+w)$ Ans.

Problem 2.4

c). $A'B(D'+C'D)+B(A+A'CD)$

Solution:

Expand the terms.

$A'BD' + A'BC'D + BA + BA'CD$

Notice that $A'BC'D + BA'CD$ has a common factor of $A'B$.

$A'B(D'+C'D) + BA + BA'CD$

$A'B(D'+C')+B(A+A'CD)$

as $A+A'CD = A+CD$.

$A'B(D'+C')+B(A+CD)$

Further simplification:

$A'BD'+ABC' + BA+BCD$.

$ABC' + A'BD' + BCD+BA$

Since $A'BC'+A'BD'= (A'B[C'+D'])$ we get

$A'B(C'+D') + BCD + BA$.

$A'B(C'+D') + B(CD+A)$

$\therefore C'+D' = 1$ $\quad A + CD = A$.

$A'B(1) + B(A)$.

$A'B + BA$

$B(A'+A)$ $\quad \therefore A'+A = 1$

B Ans

Problem # 2.9

b) $(a+c)(a+b')(a'+b+c')$

Solution:

Taking whole complement.

$$[(a+c)(a+b')(a'+b+c')]'$$

Apply De Morgan's Theorem:

$$(ABC)' = A'+B'+C'$$

Applying this on expression.

$$[(a+c)(a+b')(a'+b+c')]'$$

$$(a+c)' + (a+b')' + (a'+b+c')'$$

Applying De-morgan's Theorem on Each term.

- $(a+c)' = a'c'$
- $(a'+b+c')' = a''b'c = ab'c$
- $(a+b')' = a'+b$

$$a'c' + (a'+b) + ab'c \quad \text{Ans.}$$

Problem #2.12

Bitwise operation

a) AND (A & B).

A = 10110001

B = 10101100

Thus A & B = (10100000)

A	B	A & B
1	1	1
0	0	0
1	1	1
1	0	0
0	1	0
0	1	0
0	0	0
1	0	0

b) OR

A	B	A‖B
1	1	1
0	0	0
1	1	1
1	0	1
0	1	1
0	1	1
0	0	0
1	0	1

c) XOR

A	B	$A \oplus B$
1	1	0
0	0	0
1	1	0
1	0	1
0	1	1
0	1	1
0	0	0
1	0	1

d) NOT A

A	~A
1	0
0	1
1	0
1	0
0	1
0	1
0	1
1	0

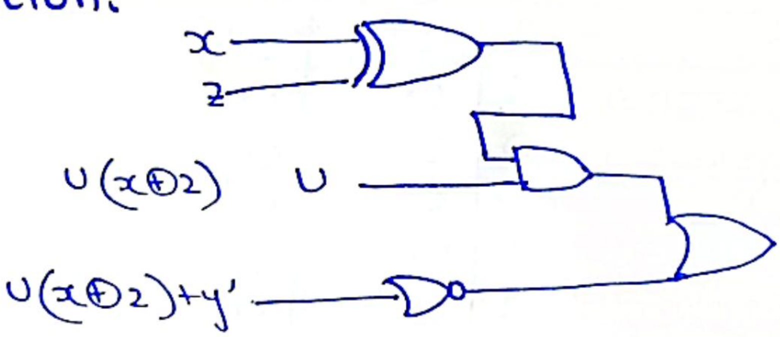
e) NOT B

B	~B
1	0
0	1
1	0
0	1
1	0
1	0
0	1
0	1

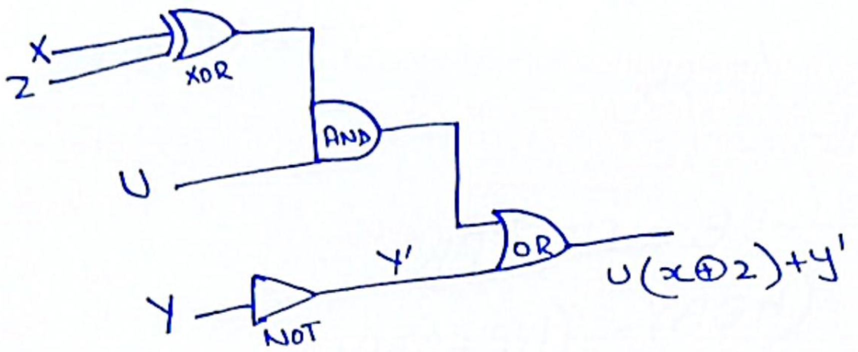
Problem 2.13

d) $y = u(x \oplus z) + y'$

Solution:



Complete diagram:



Problem # 2.19

$F(A,B,C,D) = B'D + A'D + BD$

Solution:

A	B	C	D	B'D	A'D	BD	F
0	0	0	0	0	0	0	0
0	0	0	1	1	1	0	1
0	0	1	0	0	0	0	0
0	0	1	1	1	1	0	1
0	1	0	0	0	0	0	0
0	1	0	1	0	1	1	1
0	1	1	0	0	0	0	0
0	1	1	1	0	1	1	1
1	0	0	0	0	0	0	0
1	0	0	1	1	0	0	1
1	0	1	0	0	0	0	0
1	0	1	1	1	0	0	1
1	1	0	0	0	0	0	0
1	1	0	1	0	1	1	1
1	1	1	0	0	0	0	0
1	1	1	1	0	1	1	1

Sum of minterms

$F(A,B,C,D) = \Sigma_m(1,3,5,7,9,11,13,15)$.

Product of maxterms

$F(A,B,C,D) = \Pi M(0,2,4,6,8,10,12,14)$.

Problem # 2.24

Dual of exclusive OR is equal to its complement. X—OR

Complement

$$A \oplus B = A'B + AB'$$

$$(A \oplus B)' = (A'B + AB')'$$

$$= [(A')' + B'] \cdot [A' + (B')']$$

$$= A + B' \cdot (A' + B)$$

Using distribution.

$$AA' + AB + B'A' + B'B$$

$$(A \oplus B)' = AB + A'B'$$

dual : $= (A + B') \cdot (\bar{A} + B)$

$$= A\bar{A} + AB + B'A' + B'A$$

$$= AB + A'B'$$

Compare:

$$(A \oplus B)' = AB + A'B'$$

Dual of $(A \oplus B) = AB + A'B'$

Dual of $A \oplus B = (A' + B) \cdot (A + B')$.