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D.E Assignment - 2

(1) Demonstrate by means of truth table, validity of both Distributive laws.

→ (.) over (+) → $A.(B+C) = (A.B)+(A.C)$

A	B	C	B+C	A.B	A.C	(A.B)+(A.C)	A.(B+C)
0	0	0	0	0	0	0	0
0	0	1	1	0	0	0	0
0	1	0	1	0	0	0	0
0	1	1	1	0	0	0	0
1	0	0	0	0	0	0	0
1	0	1	1	0	1	1	1
1	1	1	1	1	1	1	1
1	1	0	1	1	0	1	1

⇒ (+) over (.) → $A+(B.C) = (A+B).(A+C)$

A	B	C	B.C	A+B	A+C	A+(B.C)	(A+B).(A+C)
0	0	0	0	0	0	0	0
0	0	1	0	0	1	0	0
0	1	0	0	1	0	0	0
0	1	1	1	1	1	1	1
1	0	0	0	1	1	1	1
1	0	1	0	1	1	1	1
1	1	0	0	1	1	1	1
1	1	1	1	1	1	1	1

(2) Simplify the Boolean functions to minimum literals:-

(a) $(X+Y)(X+Y') = X.X + X.Y' + Y.X + Y.Y'$
$= X + X.Y' + X.Y + 0$
$= X + X(Y'+Y)$
$= X + X$
$= \underline{X}$

(b) $XYZ + X'Y + XYZ' = Y.(XZ + X' + XZ')$
$= Y.\{X' + X(Z+Z')\}$
$= Y.\{X' + X\}$
$= \underline{Y}$

(c) $XZ + X'YZ = Z.(X + X'Y)$
$= Z.[(X+X').(X+Y)]$
$= Z.(X+Y)$
$= \underline{Z.X + Z.Y}$

(d) $(a+b)'(a'+b')' = a'.b'.(a.b)$
$= a.a'.b.b'$
$= 0.0 = \underline{0}$

(e) $Y(WZ' + WZ) + XY = Y[W.(Z+Z')] + XY$
$= \underline{Y.W + X.Y}$

$= \underline{Y.(W+X)}$

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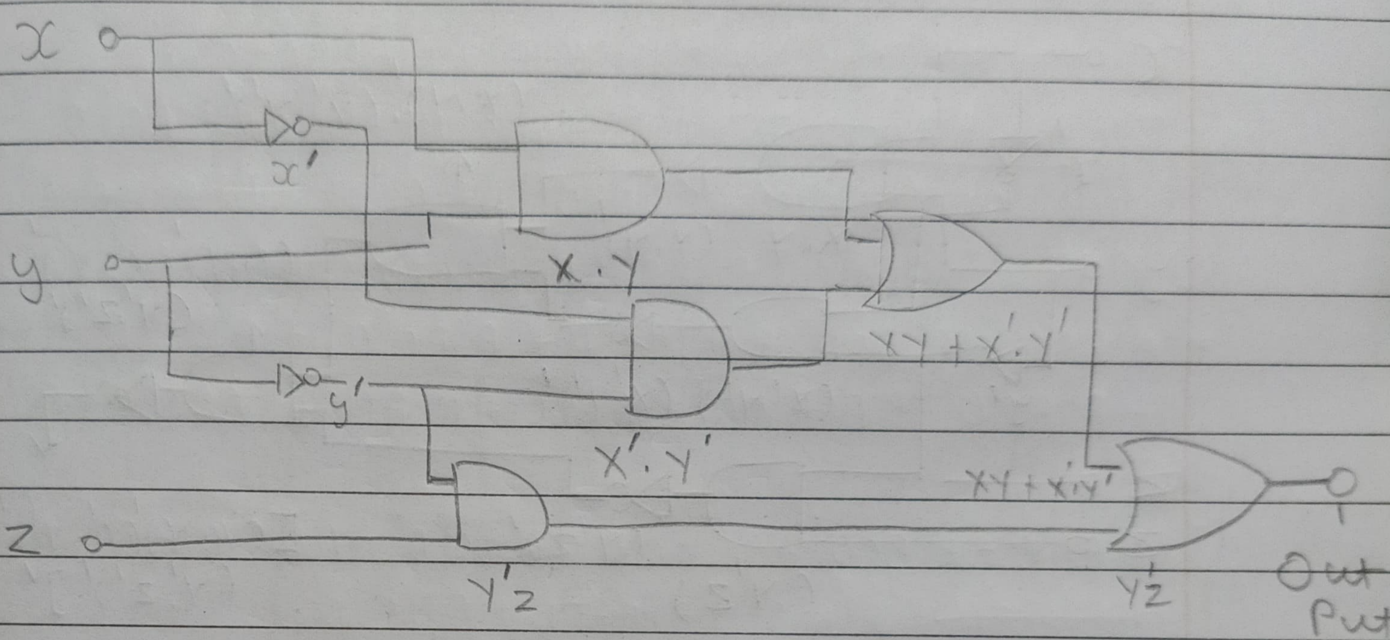
(3) For given:- $F = XY + X'Y' + Y'Z$

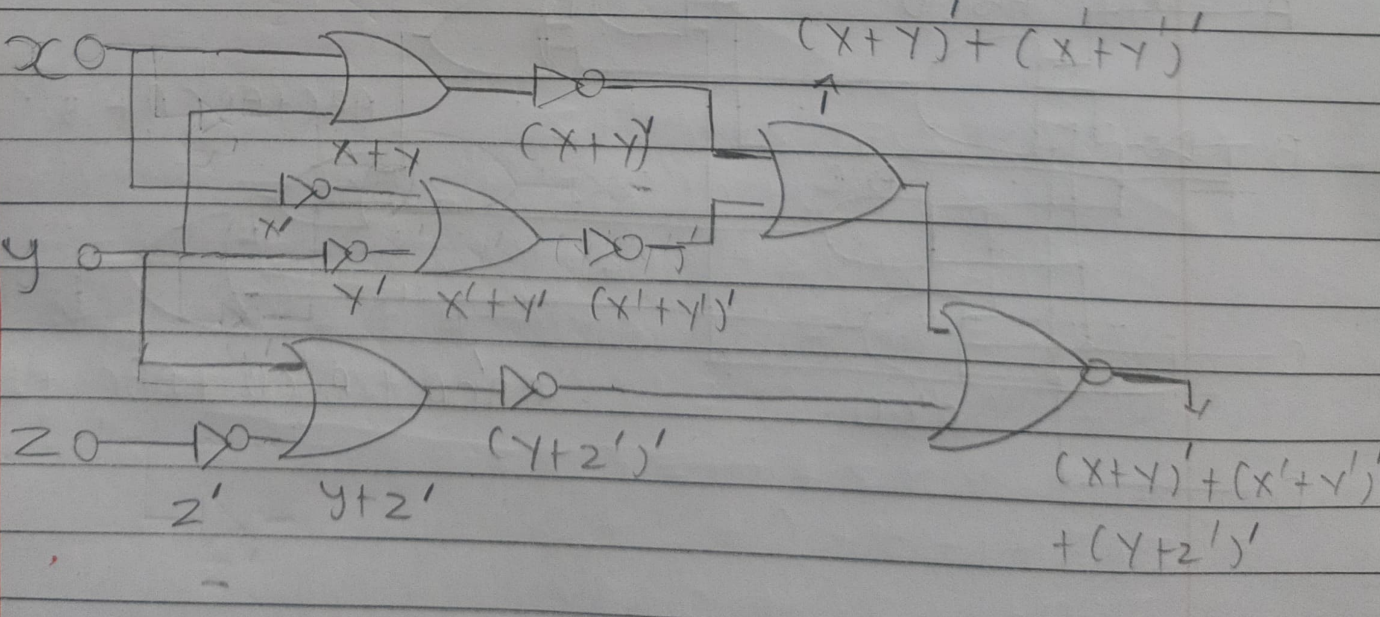
(1) Implement using (3) AND, (2) OR, (2) NOT gates



(2) Implement using 5 (OR) and (6) NOT gates

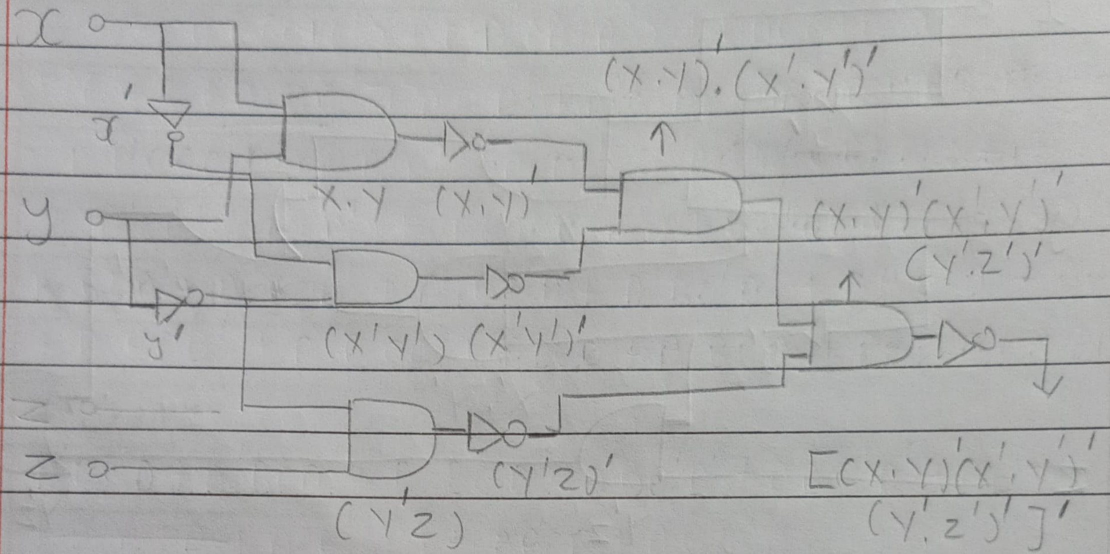
$F = XY + X'Y' + Y'Z$

→ using De morgan's law ⇒ $F = (X'+Y')' + (X+Y)' + (Y+Z')'$



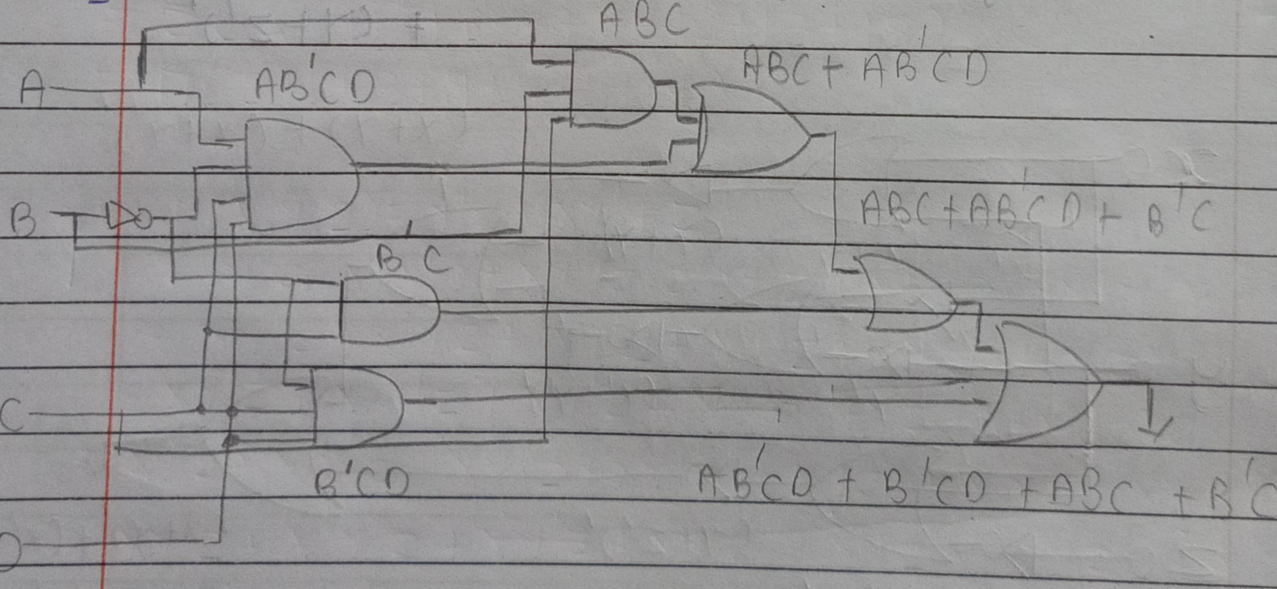
(3) Implement with (5) AND and (8) NOT gates

$$F = XY + X'Y' + Y'Z$$
$$= [(XY)'(X'Y')'(Y'Z)']'$$



Q-4 Draw the circuit for the following functions:-

(a) $F = AB'CD + B'CD + ABC + B'C$



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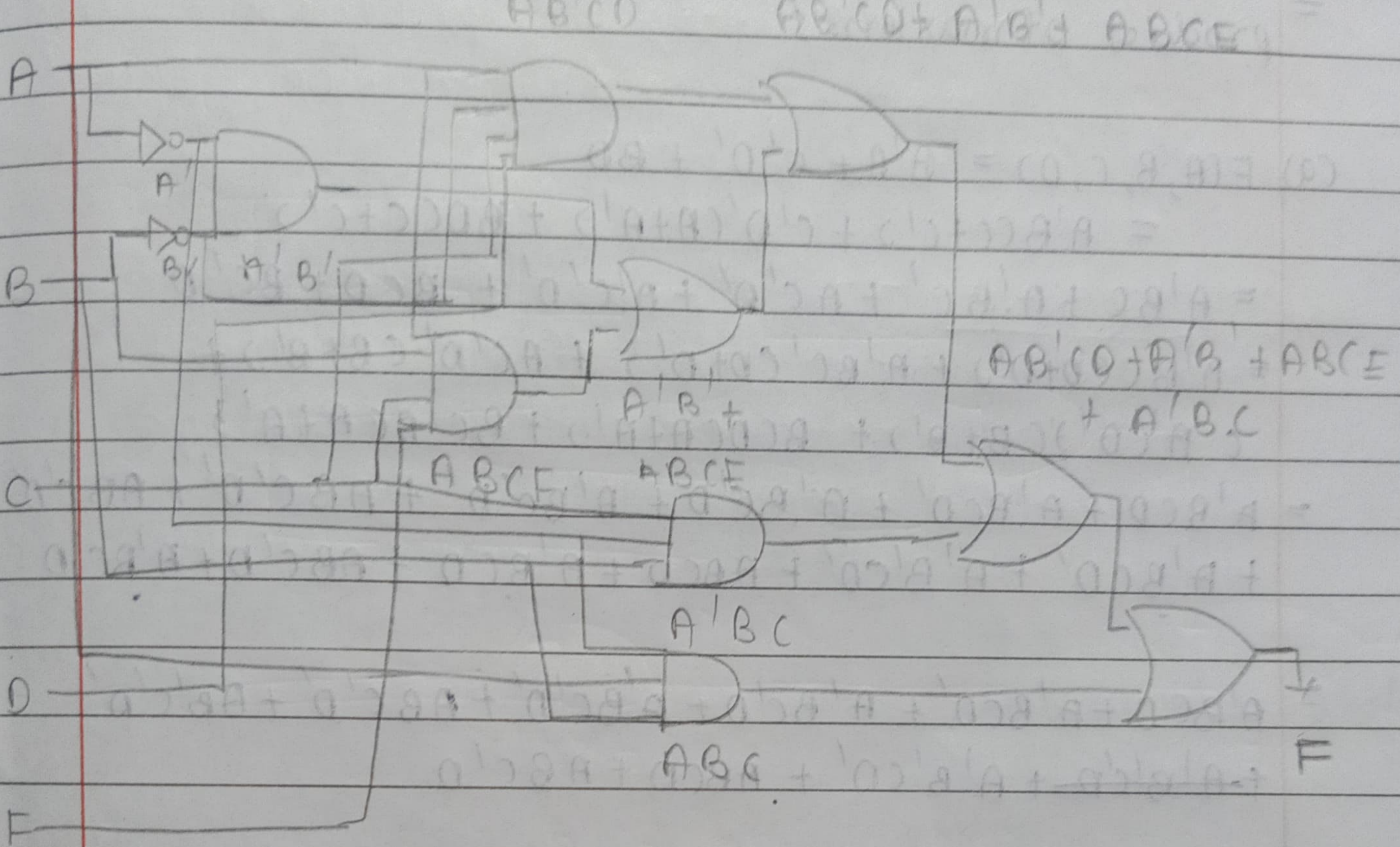
(b) $F = A'B'C + ABCE + AB'CD + A'B' + ABC$



Q-(5) Express the functions in sum of minterms and product of maxterms

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

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

$= A'BC + A'BC' + AC'D' + A'C'D' + BCD + BC'D$

$= A'BC(D+D') + A'BC'(D+D') + AC'D'(B+B') + (A'C'D')(B+B') + BCD(A+A') + BC'D(A+A')$

$= A'BCD + A'BCD' + A'BC'D + A'BC'D' + ABC'D' + AB'C'D' + A'BCD' + A'B'CD' + ABCD + A'BCD + ABC'D + A'BC'D$

$= A'BCD + A'BCD' + A'BC'D + A'BC'D' + ABC'D' + AB'C'D' + \cancel{A'B'C'D} + A'B'CD' + ABCD + ABC'D$

$= \cancel{\Sigma(A'5+}$

$= \Sigma(7+6+5+4+12+8+2+15+13)$

$= \Sigma(2+4+5+6+7+8+12+13+15)$

$= \Pi(0+1+3+9+10+11+14)$

(b) $F(X,Y,Z) = Y'Z + XY' + Z'$

$= Y'Z(X+X') + XY'(Z+Z') + Z'(\cancel{X+X'})(Y+Y')$

$= XY'Z + X'Y'Z + XY'Z + XY'Z' + YZ' + Y'Z'$

$= XY'Z + X'Y'Z + XY'Z + XY'Z' + YZ'(X+X') + Y'Z'(X+X')$

$= XY'Z + X'Y'Z + XY'Z + XY'Z' + XYZ' + X'YZ' + XY'Z' + X'Y'Z'$

$= XY'Z + X'Y'Z + \cancel{XY'Z} + XY'Z' + XYZ' + X'YZ' + X'Y'Z'$

$= \Sigma(5+1+4+6+2+0)$

$= \Sigma(0+1+2+4+5+6)$

$= \Pi(3+7)$

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

$= A'B' + A'C + BB' + BC$

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

$= A'B'C + A'B'C' + A'BC + A'B'C + ABC + A'BC$

$= ABC + A'BC + A'B'C + A'B'C'$

$= \Sigma(7 + 3 + 1 + 0)$

$= \Sigma(0 + 1 + 3 + 7)$

$= \Pi(2 + 4 + 5 + 6)$

(d) $F(W,X,Y,Z) = (Y+Z)(X'+Y')(X'+Z)$

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

$= X'Y + X'YZ + X'Y'Y + YY'Z + X'Z + X'Z + X'Y'Z$
$+ Y'Z$

$= X'Y + X'YZ + X'Z + X'Y'Z + Y'Z$

$= X'Y(Z+Z') + X'YZ + X'Z(Y+Y') + X'Y'Z + Y'Z(X+X')$

$= X'YZ + X'YZ' + X'YZ + X'YZ + X'Y'Z + X'Y'Z + XY'Z + X'Y'$

$= X'YZ + X'YZ' + X'Y'Z + XY'Z$

$= \Sigma(3 + 2 + 1 + 5)$

$= \Sigma(1 + 2 + 3 + 5)$

$= \Pi(0 + 4 + 6 + 7)$

* Define:-

(i) Fanout - Specifies the number of standard loads that output of a gate can drive without impairing its normal operation

(ii) Power Dissipation - It is the supplied power required to operate the gate. It represents the power delivered to gate from supply

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(iii) Propagation Delay - It is the average transition delay time for a signal to propagate from input to output when binary signals change in value

(iv) Noise margin - It is the maximum noise voltage added to input signal of digital circuit that does not cause an undesirable change in circuit output.