10	0 8	9	11	0 10

31/07/2024. (16m)

QB ① * BINARY CODES:

0+0=0
0+1=1
1+0=1
1+1=0

0 001
↓
0001

1) Binary to Gray code converter.

B_3	B_2	B_1	B_0	G_3	G_2	G_1	G_0
0	0	0	0	0	0	0	0
0	0	0	1	0	0	0	1
0	0	1	0	0	0	1	1
0	0	1	1	0	0	1	0
0	1	0	0	0	1	1	0
0	1	0	1	0	1	1	1
0	1	1	0	0	1	0	1
0	1	1	1	0	1	0	0
1	0	0	0	1	1	0	0
1	0	0	1	1	1	0	1
1	0	1	0	1	1	1	1
1	0	1	1	1	1	1	0
1	1	0	0	1	0	1	0
1	1	0	1	1	0	1	1
1	1	1	0	1	0	0	1
1	1	1	1	1	0	0	0

K-map G_0

$B_3B_2 \backslash B_1B_0$	00	01	11	10
00	0	1	0	1
01	0	1	0	1
11	0	1	0	1
10	0	1	0	1

$= \bar{B_1}B_0 + B_1\bar{B_0}$

$\boxed{G_0 = B_1 \oplus B_0}$

G_1

$B_3B_2 \backslash B_1B_0$	00	01	11	10
00	0	0	1	1
01	1	1	0	0
11	1	1	0	0
10	0	0	1	1

$= \bar{B_2}B_1 + B_2\bar{B_1}$

$\boxed{G_1 = B_2 \oplus B_1}$

G_2

$B_3B_2 \backslash B_1B_0$	00	01	11	10
00	0	0	0	0
01	1	1	1	1
11	0	0	0	0
10	1	1	1	1

$\bar{B_3}B_2 + B_3\bar{B_2}$

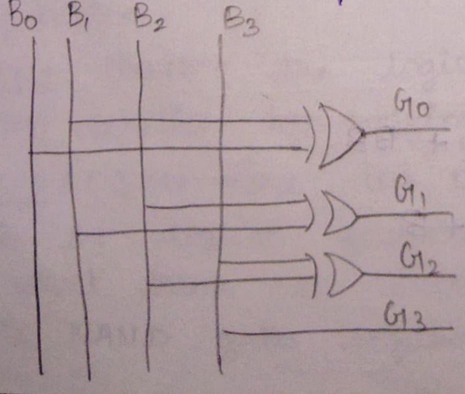
$\boxed{G_2 = B_3 \oplus B_2}$

G_3

$B_3B_2 \backslash B_1B_0$	00	01	11	10
00	0	0	0	0
01	0	0	0	0
11	1	1	1	1
10	1	1	1	1

$= B_3$

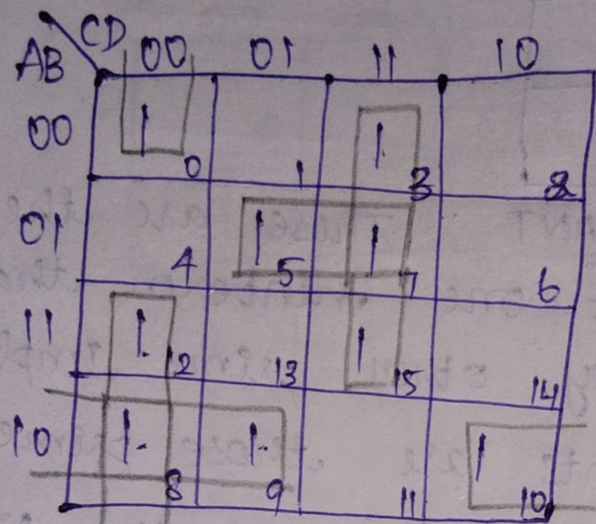
$\boxed{G_3 = B_3}$



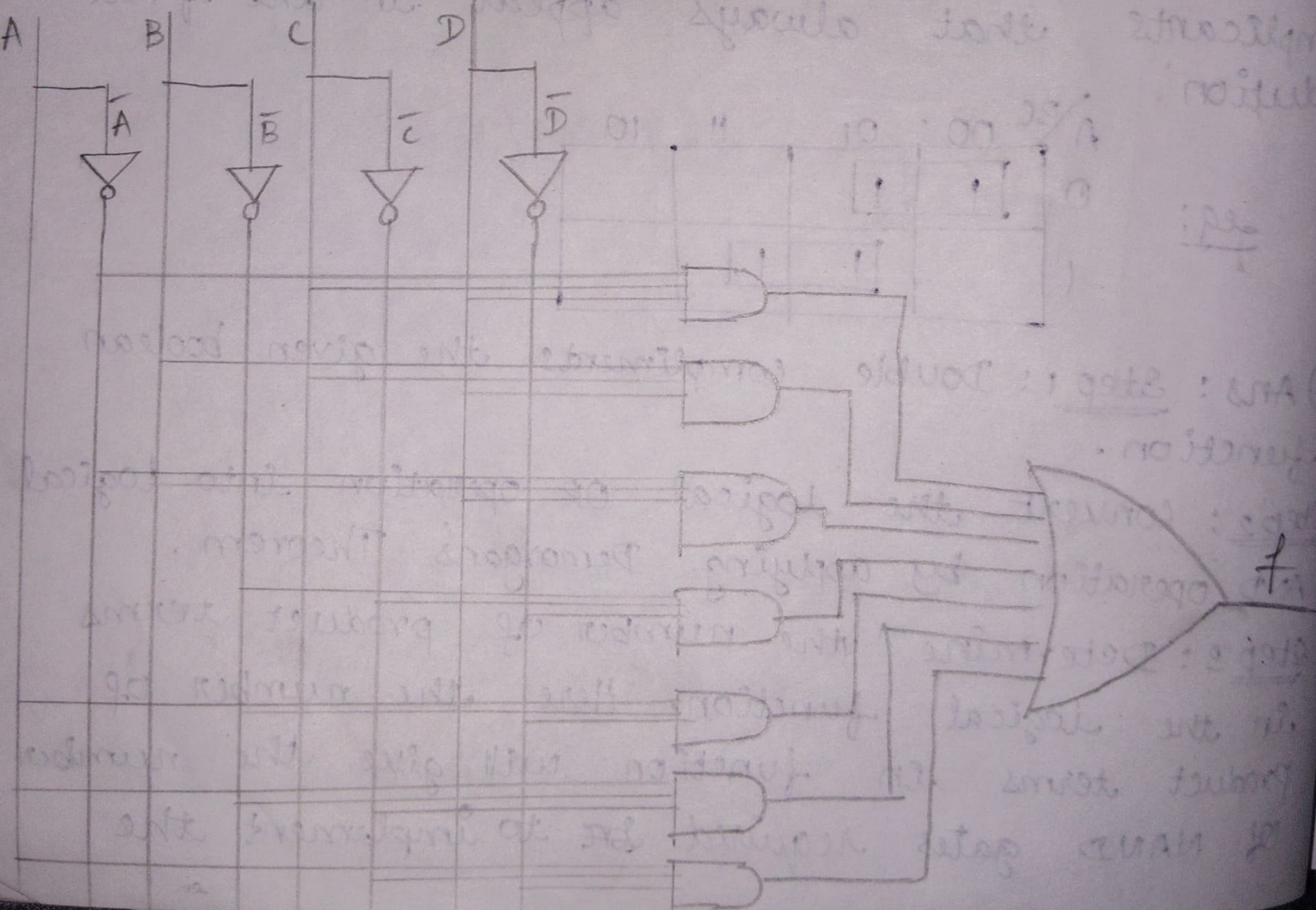
Logic gates.

(2) Q.B (16m)

$f(A,B,C,D) = \Sigma(0,3,5,7,8,9,10,12,15)$



$= \bar{A}CD + BCD + \bar{A}BD +$
$\bar{B}\bar{C}\bar{D} + A\bar{B}\bar{D} +$
$A\bar{B}\bar{C} + A\bar{C}\bar{D}$ //



2) Simply the Boolean expression using k-map

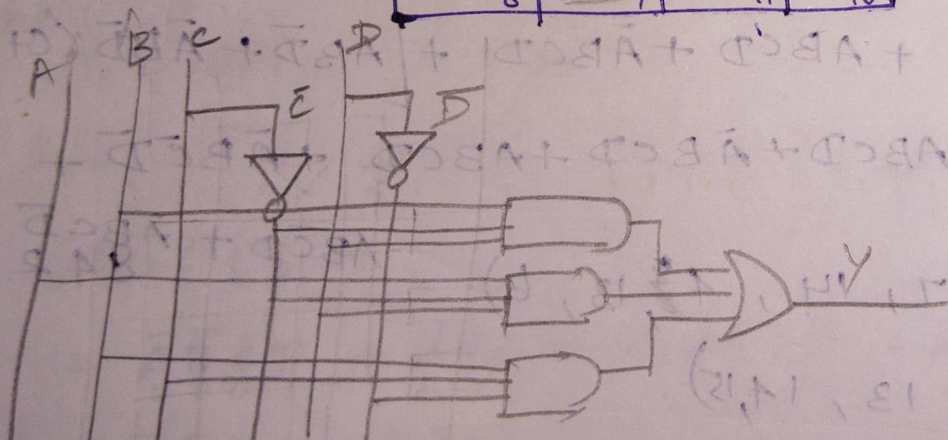
$y = \bar{A}B\bar{C}D + \bar{A}BC\bar{D} + AB\bar{C}D + A\bar{B}\bar{C}D + ABC\bar{D}$

③
QB
(16m)

$f = \Sigma(5, 6, 9, 13, 14)$

AB \ CD	00	01	11	10
00	0	1	3	2
01	4	1 5	7	1 6
11	12	1 13	15	1 14
10	8	1 9	11	10

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



(253.052)8

i) (3m) 4 Q.B

2) Define prime implicant and essential prime implicant.

(6m) ii) Write the procedure for obtaining the logic diagram with NAND gates from a boolean expression

⇒ 1) Ans: A group of squares as rectangles made up of a bunch of adjacent minterms which is allowed by the definition of k-map are called prime implicant, that is all possible groups formed in k-map.

eg:

A \ BC	00	01	11	10
0	1	1		
1		1	1	

ESSENTIAL PRIME IMPLICANT: These are the groups that cover atleast one minterm that cannot be covered by any other prime implicant. Essential prime implicants are those prime implicants that always appear in the final solution

eg:

A \ BC	00	01	11	10
0	1	1		
1		1	1	

ii) Ans: Step 1: Double compliments the given boolean function.

Step 2: Convert the logical OR operation into logical AND operation by applying Demorgan's Theorem.

Step 3: Determine the number of product terms in the logical function. Here the number of product terms in function will give the number of NAND gates required ~~SF~~ to implement the function.

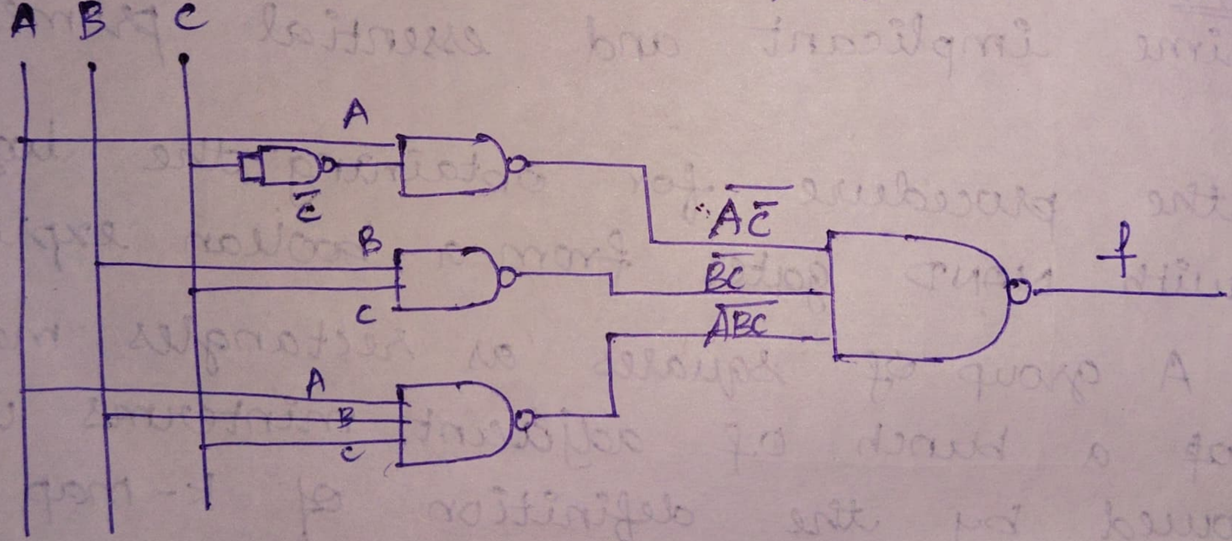
Step 4 : Finally implement the logic circuit diagram by connecting all the NAND gates together according to logic expression.

Example:

$$f = A\bar{C} + BC + ABC$$

$$\bar{\bar{f}} = f = \overline{\overline{A\bar{C} + BC + ABC}}$$

$$= \overline{(\overline{A\bar{C}}) \cdot (\overline{BC}) \cdot (\overline{ABC})}$$



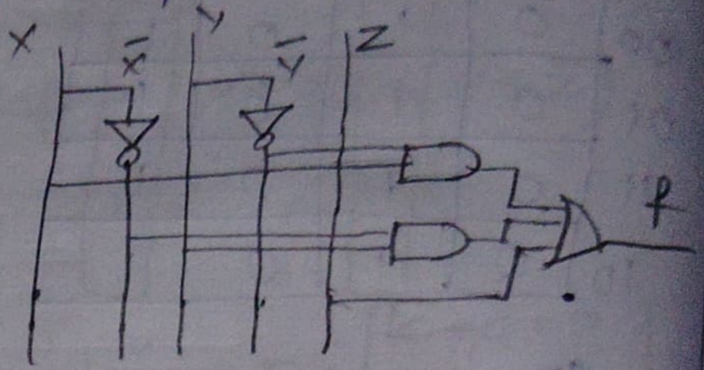
2) construct the switching function $f(x, y, z) = \sum m(1, 2, 3, 4, 5, 7)$ using K-map.

(4m)

(A)

Q.B

$x \backslash yz$	00	01	11	10
0	$_0$	1 $_1$	1 $_3$	1 $_2$
1	1 $_4$	1 $_5$	1 $_7$	$_6$



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

1)

⑤ Q.B (16m)

7) Solve the boolean function using k-map in sop and pos $f(w,x,y,z) = \Sigma(1,3,4,6,9,11,12,14)$

SOP ⇒

WX \ YZ	00	01	11	10
00	0	1 1	1 3	2
01	1 4	5	7	1 6
11	1 12	13	15	1 14
10	8	1 9	1 11	10

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

$f(w,x,y,z) = \Pi(0,2,5,7,8,10,13,15)$

(logic gates)

POS ⇒

WX \ YZ	00	01	11	10
00	0_{0}	$_{1}$	$_{3}$	0_{2}
01	$_{4}$	0_{5}	0_{7}	$_{6}$
11	$_{12}$	0_{13}	0_{15}	$_{14}$
10	0_{8}	$_{9}$	$_{11}$	0_{10}

$= \cancel{XZ} +$

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

(logic gates)

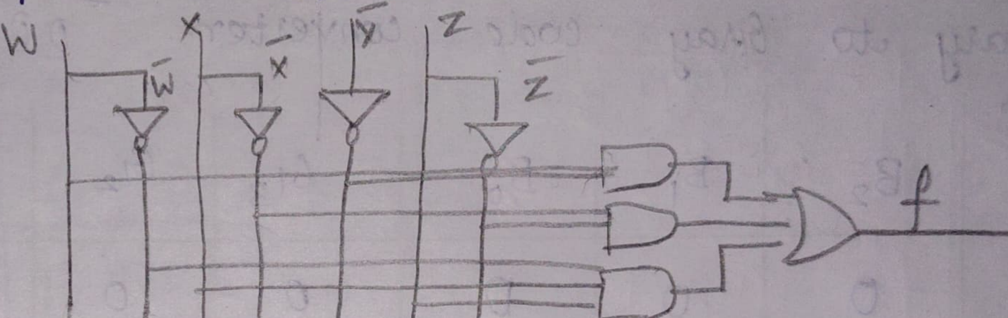
$\boxed{0 + 0 = 0}$

5) Reduce the function using k-map $f(w,x,y,z) = \Sigma_m(0,7,8,9,10,12) + \Sigma_d(2,5,13)$.

(8m) (6) Q.B

WX \ YZ	00	01	11	10
00	1 0	1	3	X 2
01	4	X 5	1 7	6
11	1 12	X 13	15	14
10	1 8	1 9	11	1 10

$= W\bar{Y} + \bar{X}\bar{Z} + \bar{W}XZ$



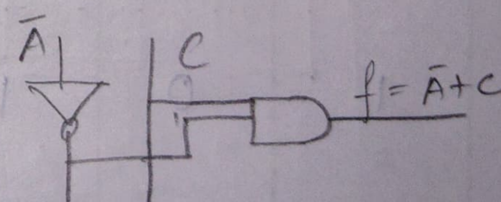
(8m) (6) Q.B

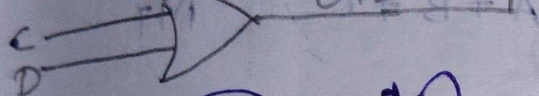
6) Reduce the function using k-Map. $f(a,b,c) = \Sigma_m(0,1,3,7) + \Sigma_d(2,5)$

a \ bc	00	01	11	10
0	1 0	1 1	1 3	X 2
1	4	X 5	1 7	6

$= C + \bar{A}$

$= \bar{A} + C$ //





De - Morgan's Theorem : (8m) (7) Q.B

1) $\overline{A+B} = \bar{A} \cdot \bar{B}$

A	B	$A+B$	$\overline{A+B}$	$\bar{A}$	$\bar{B}$	$\bar{A} \cdot \bar{B}$
0	0	0	1	1	1	1
0	1	1	0	1	0	0
1	0	1	0	0	1	0
1	1	1	0	0	0	0

$$\overline{A+B} = \bar{A}\cdot\bar{B}$$

∴ Hence proved.

2) $\overline{A\cdot B} = \bar{A}+\bar{B}$

A	B	$A\cdot B$	$\overline{A\cdot B}$	$\bar{A}$	$\bar{B}$	$\bar{A}+\bar{B}$
0	0	0	1	1	1	1
0	1	0	1	1	0	1
1	0	0	1	0	1	1
1	1	1	0	0	0	0

$$\overline{A\cdot B} = \bar{A}\cdot\bar{B}$$

∴ Hence proved.

3) Express $x+yz$ as the sum of minterms :

(8m)

(7) Q.B

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

$$f = (xy + x\bar{y})(z+\bar{z}) + xyz + \bar{x}yz$$

$$f = xyz + xy\bar{z} + x\bar{y}z + x\bar{y}\bar{z} + xyz + \bar{x}yz$$

$$f = \Sigma(7, 6, 5, 4, 7, 3)$$

421

$$\boxed{f = \Sigma_m(3, 4, 5, 6, 7).}$$

(8 mark)

1/08/24 (4m) Q.B (8)

1) find the octal equalent of hexa decimal numbers

AB . CD

$\overset{10}{A}\ \overset{11}{B}\ .\ \overset{12}{C}\ \overset{13}{D}$

8	4	2	1
1	0	1	1
1	0	1	0
1	1	0	0
1	1	0	1

$\underbrace{010}\ \underbrace{101}\ \underbrace{011}\ .\ \underbrace{110}\ \underbrace{011}\ \underbrace{010}$

$(253.632)_8$

(2m)

4) Simplify : (4m) Q.B (8)

i) $Y = AB'D + AB'D'$

ii) $Z = (A' + B)(A + B)$

i) $Y = AB'D + AB'D'$

$= AB'(D + D')$

$= AB'$

ii) $Z = (A' + B)(A + B)$

$= A'A + A'B + AB + BB$

$= 0 + A'B + AB + B$

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

$= B + B = B$ //