PROBABLE QUESTIONS & ANSWER

Subject - DLD

Semester - 3rd

Branch - CSE

Module - I, II, III

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Probable questions and Answers

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Semester – 3rd
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Module-I, II, III

(SHORT QUESTIONS)

① convert the number $(42.625)_{10} = (\quad)_2$

Ans

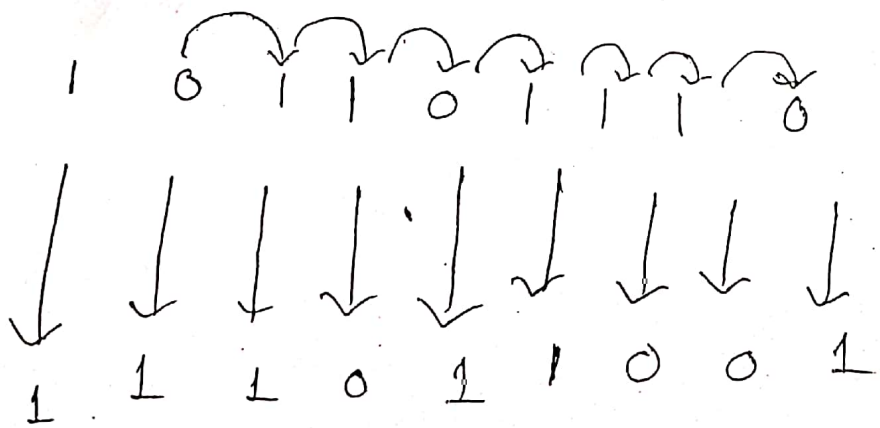
2	42	
2	21	— 0
2	10	— 1
2	5	— 0
2	2	— 1
2	1	— 0
	0	— 1

$0.625 \times 2 = 1.25$
$0.25 \times 2 = 0.50$
$0.50 \times 2 = 1.00$

So, $(42.625)_{10} = (101010.101)_2$

② convert $(10110110)_2$ into Gray code.

Ans



Hence the Gray code =

(11101101)

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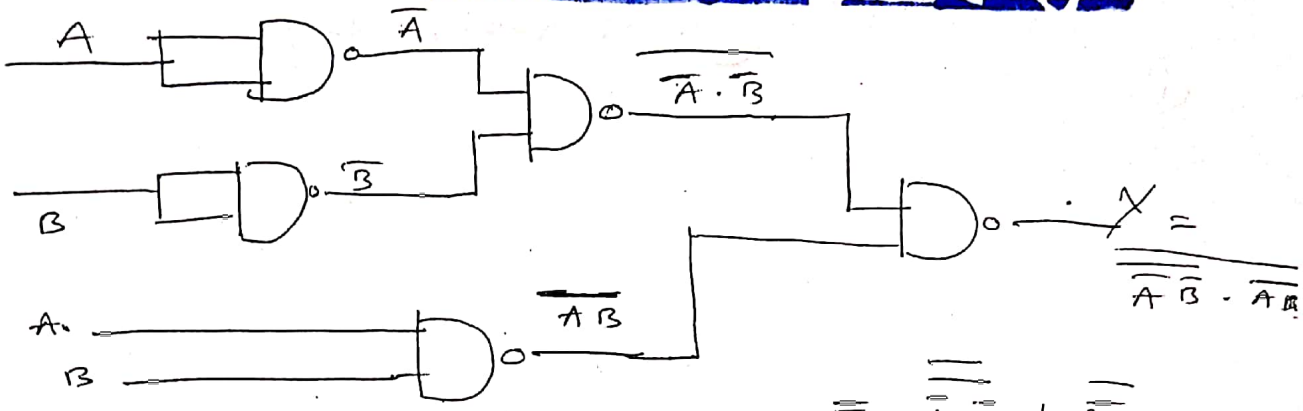
(3) Implement X-NOR GATE using NAND GATE.

Ans:



$= \overline{\overline{A}\,\overline{B}} + \overline{AB}$

$= A\,B + \overline{A}\,\overline{B}$

(4) Determine the base of the number

$$\left(\frac{14}{2}\right)_r = (5)_r$$

Ans:

Hence $\dfrac{(14)_r}{(2)_r} = (5)_r$

$$\Rightarrow \frac{1 \times r^1 + 4 \times r^0}{2 \times r^0} = 5 \times r^0$$

$$\Rightarrow \frac{r+4}{2} = 5$$

$$\Rightarrow r = 10 - 4 = 6$$

$\Rightarrow$ Base = radix = r = 6

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(5) Simplify the Boolean expression

(a) $f = ABC + \bar{A}B + AB\bar{C}$

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

$= AB(C + \bar{C}) + \bar{A}B$

$= AB + \bar{A}B$

$= B(A + \bar{A}) = B$

(b) $\bar{X}YZ + XZ = Z(\bar{X}Y + X)$

$= (\bar{X} + X)\cdot(X + Y)Z$

$= (X + Y)Z$

(6) Subtract $(3049)_{10}$ from $(7158)_{10}$ using

Ans 10's complement i.e

7188 → 10's complement = 7188

− 3049 → 10's complement = +6951

1 4139

End carry neglected

So, Answer is $(+4139)_{10}$

(7) Subtract $(101011)_2$ from $(11101)_2$ using 1's complement method.

Ans Now 1's complement of $(101011) = 010100$

Now 11101

+ 010100

1 010001

carry + 1

01001 0

So $(101011)_2 - (11101)_2$

$= (0\,|\,01010)_2$

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(8) Proof the theorem $x+1 = 1$

Ans Consider L.H.S $= x+1$

$\Rightarrow 1\,(x+1)$

$\Rightarrow (x+\bar{x})\,(x+1)$

$\Rightarrow x + \bar{x} \cdot 1$

$= x + \bar{x}$

$= 1$

$1\,(x+1)$

$(x+\bar{x})\,(x+1)$

$x(x+1) + \bar{x}(x+1)$

$xx + x + \bar{x}x + \bar{x}$

$x + x + \bar{x}$

$x + \bar{x} = 1$

(9) Proof the following theorem

(a) $x + xy = x$ (b) $x(x+y) = x$

Ans (a) L.H.S $= x + xy = x(1+y)$

$= x \times 1 = x$ (R.H.S)

(b) $x(x+y) = (x+0)(x+y)$

$= x + 0 \cdot y = x + 0 = x$ (R.H.S)

(10) State the principle of Duality

Ans (i) Interchanging the 'OR' and AND operations of the expression.

(ii) Interchanging the 0's and 1's elements of the expression.

(iii) Not changing the form of the variables.

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(11) $(24)_b + (17)_b = (40)_b$

$\Rightarrow [4 \times b^0 + 2 \times b^1] + [7 \times b^0 + 1 \times b^1]$

$= [4 \times b^1 + 0 \times b^0]$

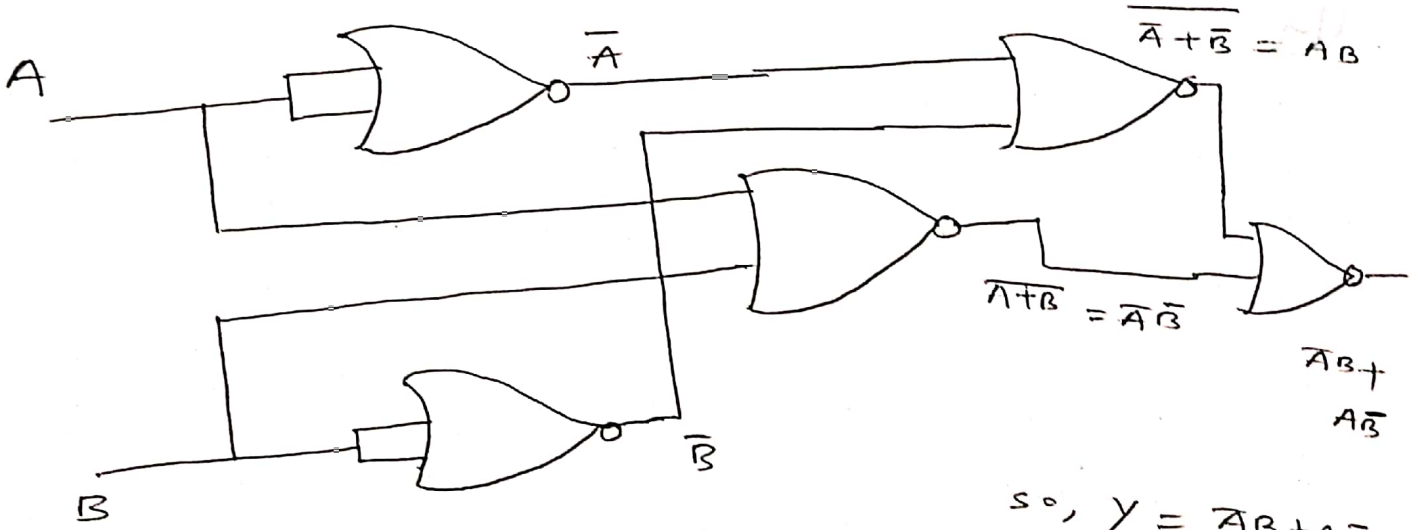
$\Rightarrow 4 + 2b + 7 + b = 4b$

$\Rightarrow 3b + 11 = 4b$

$\Rightarrow \boxed{b = 11}$

So, $b = 11$ (Ans)

(12) Implementation of X-OR gate using NOR gate



So, $Y = A\overline{B} + \overline{A}B$

X-OR gate

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(13)

Synchronous sequential ckt	Asynchronous sequential ckt
→ Their behaviour is determined by the values of the signals at only discrete instants of time.	→ Their behaviour is immediately affected by the input signal changes.
→ When a task is executed synchronously you wait for a task to be completed before moving on to another task.	→ When a task is executed asynchronously you can directly switch to another task before the previous has been completed.

(14)

Figure of merit in logic family

A figure of merit correlated with the energy efficiency of a device. It can be calculated by the product of propagation delay time with power dissipation.

i.e. figure of merit

= propagation delay time

× power dissipation

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(15) Difference between analog and digital System :

Ans -

Key	Digital System	Analog system
(1) Signal type	It uses discrete signals as on/off i.e. binary 1 and 0	It uses continuous signals with varying magnitude.
(2) Wave type	Generally It uses square waves.	Generally It uses sine waves.
(3) Transmission	Digital transmission is easy and can be made noise proof with no loss.	Analog systems are affected badly by noise during transmission.
(4) Bandwidth (BW)	It needs more BW.	It needs less BW.
(5) Memory	Digital data is stored in form of bits.	Analog data is stored in form of waveform signals.
(6) power Requirement	It needs low power	It needs more power.
(7) Cost	These are costly	These are cheap.
(8) Example	CD, DVD computer, digital watch etc.	Audio/video devices i.e. TV, Radio etc.

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(16) Convert $(A21B)_{16} = (?)_{10}$

Ans Given:

$(A21B)_{16} = A \times 16^3 + 2 \times 16^2 + 1 \times 16^1 + B \times 16^0$

$= 10 \times 16^3 + 2 \times 16^2 + 1 \times 16^1 + 11 \times 16^0$ (1)

$= 40960 + 512 + 16 + 11$

$= (41,499)_{10}$ (Ans)

(17) Add the two numbers +(27) and -(33) in 2's complement method.

Ans –

2	27	
2	13	1
2	6	1
2	3	0
2	1	1
	0	1

2	33	
2	16	1
2	8	0
2	4	0
2	2	0
2	1	0
	0	1

$(27)_{10} = (11011)_2$ $\quad$ $(33)_{10} = (100001)_2$

In 8 bit format $(0,0011011)$ $\quad$ $(0,0100001)$

Now-

$+27 = 0,0011011$

$-33 = +\ 1,1011111$

$1,1111010$

Sign bit | Magnitude bits

2's

$0000110 \Rightarrow 1 \times 2^2 + 1 \times 2^1 = 4 + 2 = 6$

∴ Finally it is -6.

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(18) Differentiate between DMUX and Decoder.

Ans - In a MUX, we are providing a single i/p data line, 'n' no. of selection lines and that generate 2^n no. of outputs

- But a decoder does not have any i/p lines. The corresponding selection line of DMUX will be treated as the i/p lines of a decoder.

- DMUX has - 1×2^n (n = no. of select^n line)
  Decoder has - $n \times 2^n$

(19) Define priority Encoder

Ans - It is an encoder that includes the priority function.

- The operation of the priority encoder is such that if two or more i/ps are equal to 1 at the same time, the i/p having the highest priority will take precedance.

- At the time of encoding if more than 1s will be activated then get proper answer which is different from normal encoder.

(20) What is prime implicant & essential implicant?

Ans - prime implicant - It is a product term formed from by combining maximum possible number of adjacent squares in the K-map.

Essential implicant - prime implicants that cover minterms with a single cross in their column are called essential prime implicants.

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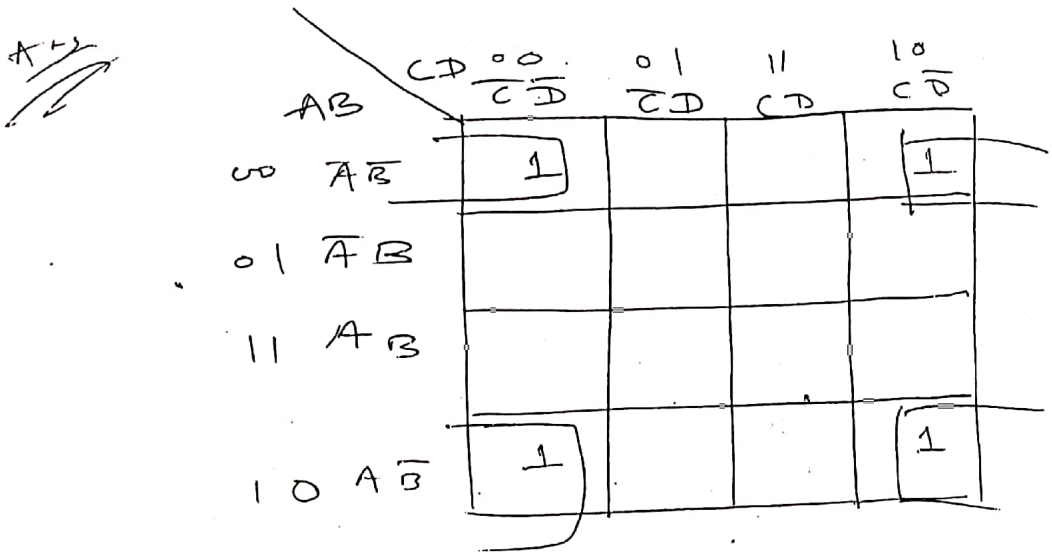
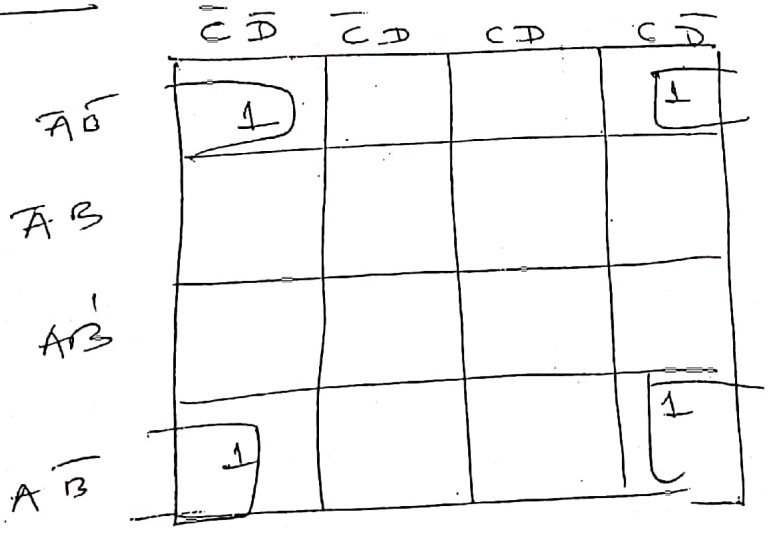
LONG QUESTIONS

(1) Simplify the Boolean expression using four variable K-map.

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



Group 1



$f_1 = B\bar{D}$

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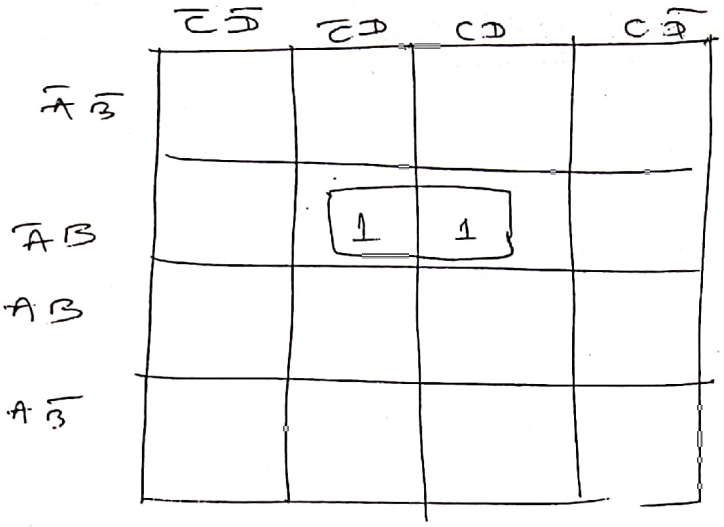
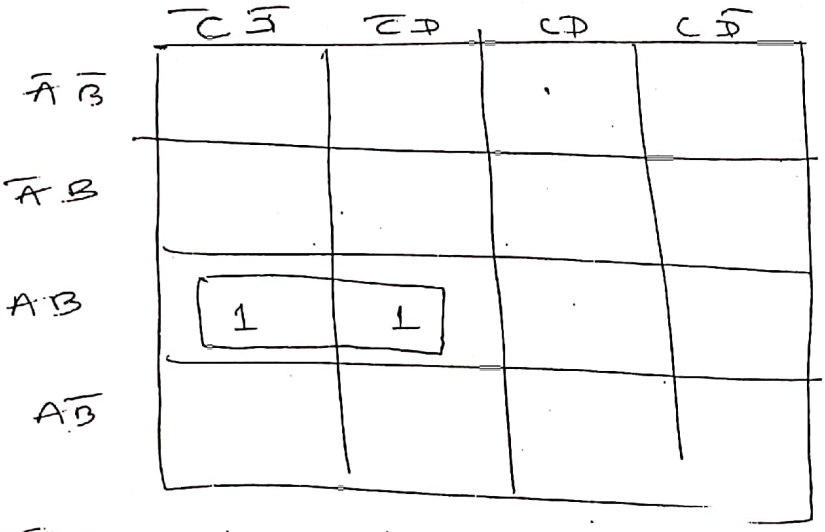
Group-2



$f_2 = \bar{A}BD$

Group-3



$f_3 = AB\bar{C}$

from Group-1, Group-2 and Group-3

$f = f_1 + f_2 + f_3 = \bar{B}\bar{D} + \bar{A}BD + AB\bar{C}$

(2) Simplify the following Boolean expression using four variable K-map.

(a) $f = \bar{W}z + xz + \bar{x}y + W\bar{x}z$

(b) $f = \bar{B}D + \bar{A}B\bar{C} + A\bar{B}C + AB\bar{C}$

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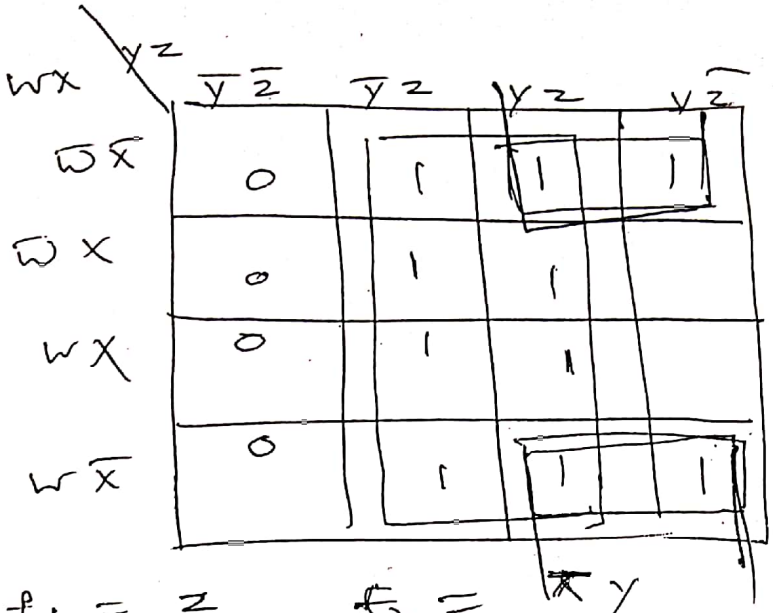
Q5

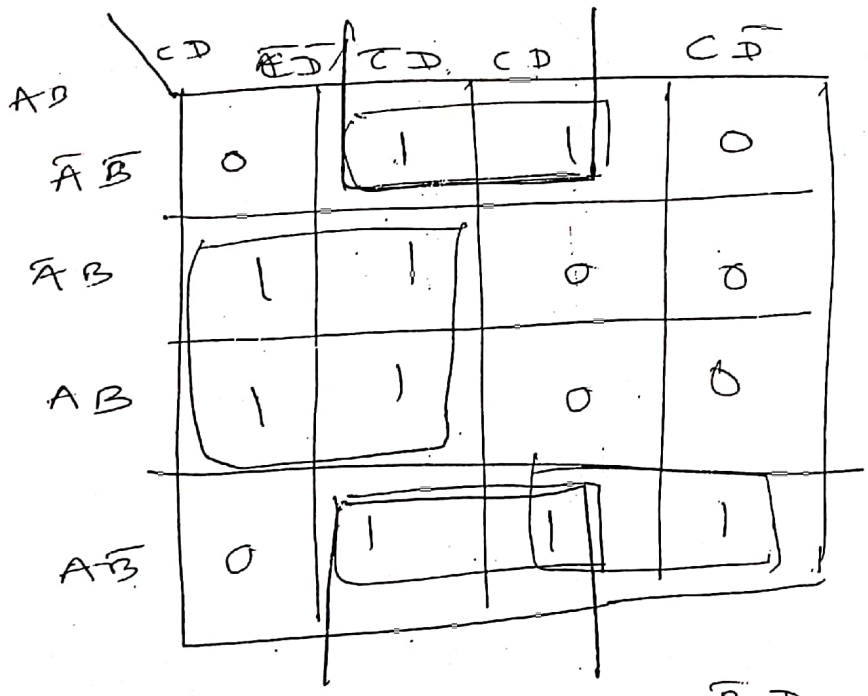
(a)



$f_1 = z$, $f_2 = \bar{x}y$

$\Rightarrow f = f_1 + f_2 = z + \bar{x}y$

(b)



$f_1 = B\bar{C}$ $f_2 = \bar{B}D$, $f_3 = A\bar{B}C$

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

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(3) prove that.

$$(A+BC)(\bar{A}+\bar{D}+\bar{E}) = A(\bar{D}+\bar{E})+\bar{A}BC$$

Ans $(A+BC)(\bar{A}+\bar{D}+\bar{E})$

$= A\bar{D} + A\bar{E} + \bar{A}BC + BC(\bar{D}+\bar{E})$

$= A(\bar{D}+\bar{E}) + \bar{A}BC + BC(\bar{D}+\bar{E})$

$= (\bar{D}+\bar{E})(A+BC) + \bar{A}BC$

$= (\bar{D}+\bar{E})[A+BC(\bar{A}+A)] + \bar{A}BC$

$= (\bar{D}+\bar{E})[\bar{A}+ABC+ABC] + \bar{A}BC$

$= (\bar{D}+\bar{E})[\bar{A}(1+BC) + \bar{A}BC] + \bar{A}BC$

$= (\bar{D}+\bar{E})[\bar{A}+\bar{A}BC] + \bar{A}BC$

$= A(\bar{D}+\bar{E}) + \bar{A}BC(\bar{D}+\bar{E}) + \bar{A}BC$

$= A(\bar{D}+\bar{E}) + \bar{A}BC(1+\bar{D}+\bar{E})$

$= A(\bar{D}+\bar{E}) + \bar{A}BC = R.H.S$

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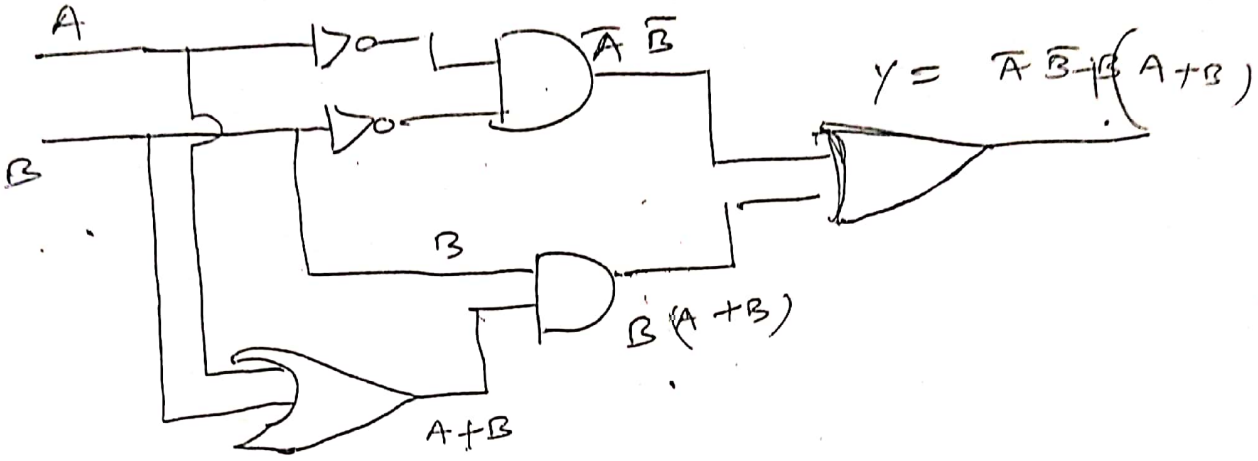
4. Draw the logic diagrams for the following

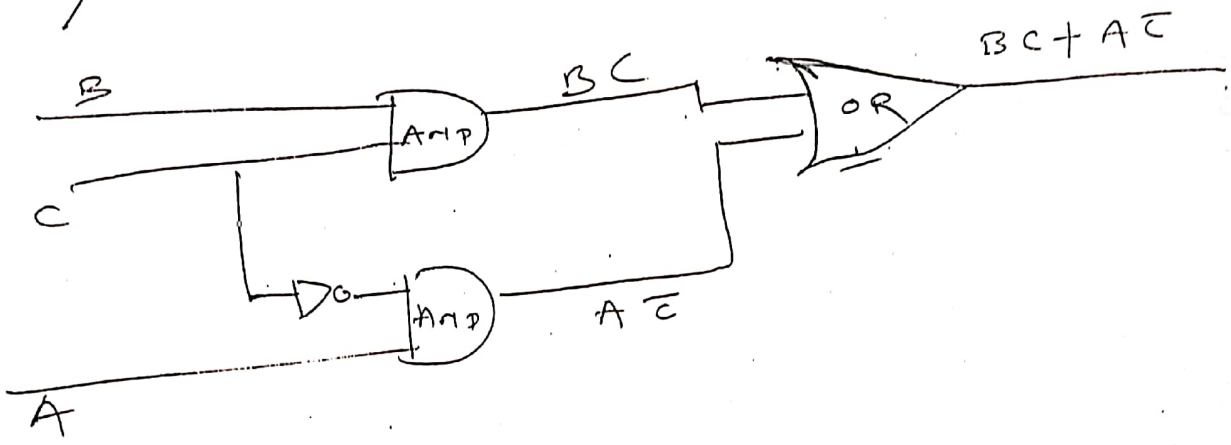
(a) $Y = \bar{A}\bar{B} + B(A+B)$

(b) $Y = BC + A\bar{C}$

Sol^n (a) $Y = \bar{A}\bar{B} + B(A+B)$



(b) $Y = BC + A\bar{C}$



5. What is SOP (sum of product)

Ans → SOP is an expression in which product terms (AND terms) are one sum (OR) together.

→ It can be expressed with one OR and two or more ANDs in which product term is equivalent to Boolean

(ii) Sum term = Boolean addition

→ In SOP form the product (AND) terms are formed first and then these are summed (OR).

Example of SOP expression

(i) $F = A\bar{B} + \bar{C}D + DE$ (normal form)

(ii) ~~ABC~~ $F = ABC + \bar{A}\bar{B}\bar{C} + A\bar{B}\bar{C}$ (standard form)

→ In an SOP expression, a single variable can not extend over more than one variable but more than one variable in a term can have an overbar. e.g ABC (not allow) but $\bar{A}\bar{B}\bar{C}$ allow.

6 (i) convert the following SOP expression to an equivalent POS expression.

$\bar{A}\bar{B}\bar{C} + \bar{A}BC + A\bar{B}C + ABC$

Ans The evaluation is as follows

$000 + 010 + 011 + 101 + 111$

Since there are three variables in the domain of this expression, there are a total of eight (2^3) possible combinations. The SOP expression contains five of these combinations, so the POS must contain the other three which are 001, 100 and 110.

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Remember these are the binary values that make the sum term 0. The equivalent POS expression is :

$$(A+B+\bar{C})(\bar{A}+B+C)(\bar{A}+\bar{B}+C)$$

(7) Simplify the following Boolean expression.

$$\left[\bar{A}\bar{B}(C+BD)+\bar{A}\bar{B}\right]C$$

Ans.

$$(A\bar{B}C+A\bar{B}BD+\bar{A}\bar{B})C$$

$$=(A\bar{B}C+A\cdot 0\cdot D+\bar{A}\bar{B})C$$

$$=(A\bar{B}C+0+\bar{A}\bar{B})C$$

$$=(A\bar{B}C+\bar{A}\bar{B})C$$

$$=(A\bar{B}C+\bar{A}\bar{B})C$$

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

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

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

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(8) Given—

$F = \Sigma(1, 2, 3, 5, 11, 12, 15)$

Implement using 4:1 MUX.

Now, Let A, B, C, D are i/p variables.

Using 4:1 MUX :— Here, A, B → selection lines
C, D → i/p data lines

selection line A	B	C	D	F
0	0	0	0	0
0	0	0	1	1
0	0	1	0	1
0	0	1	1	1
0	1	0	0	0
0	1	0	1	1
0	1	1	0	0
0	1	1	1	0
1	0	0	0	0
1	0	0	1	0
1	0	1	0	0
1	0	1	1	1
1	1	0	0	1
1	1	0	1	0
1	1	1	0	0
1	1	1	1	1

$I_0 = \bar{C}D + C\bar{D} + CD$

$= \bar{C}D + C(\bar{D} + D)$

$= \bar{C}D + C$

$I_1 = \bar{C}D$

$I_2 = CD$

$I_3 = \bar{C}\bar{D} + CD$

$= C \odot D$

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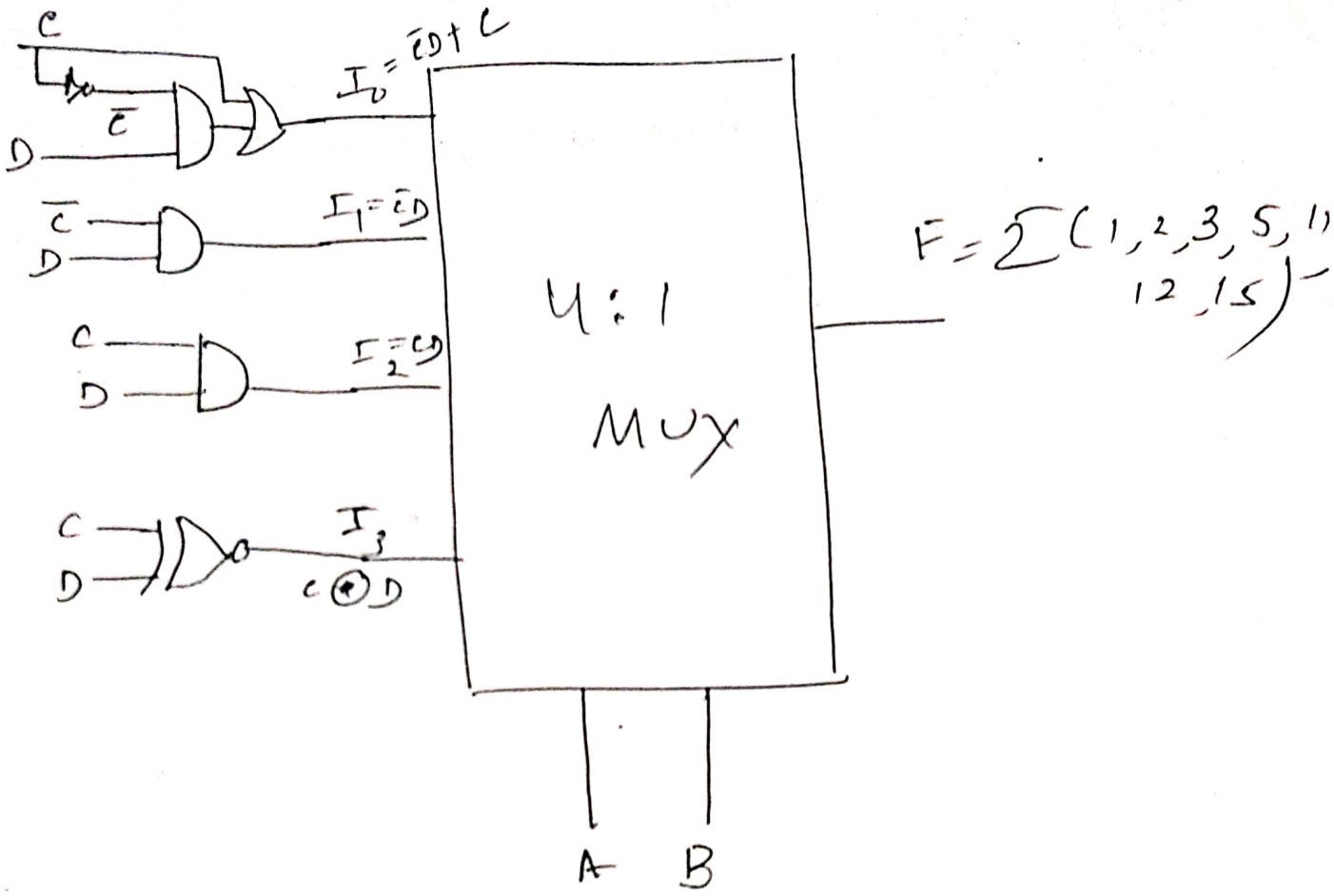

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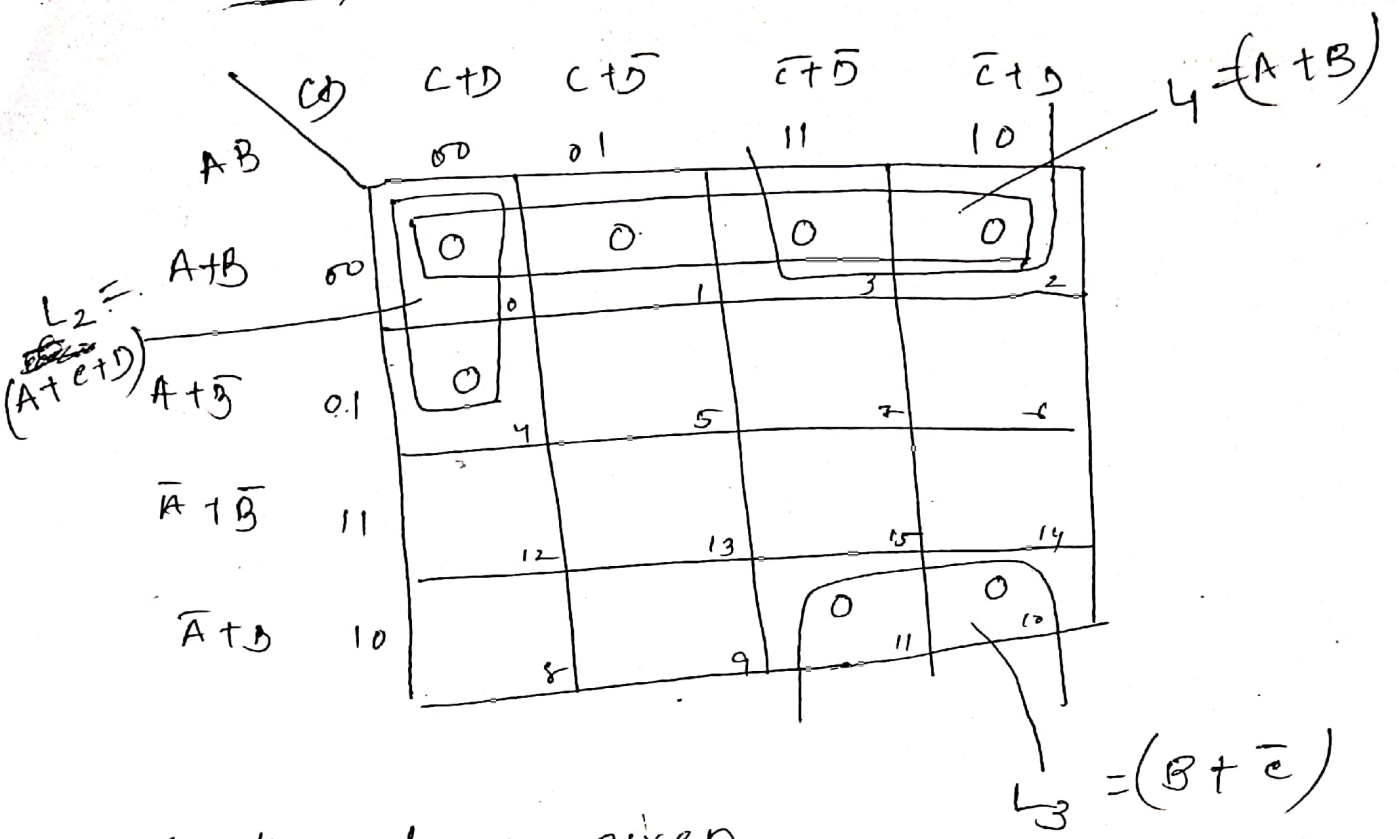
(9) Given $F(A,B,C,D) = \Pi(0,1,2,3,4,10,11)$

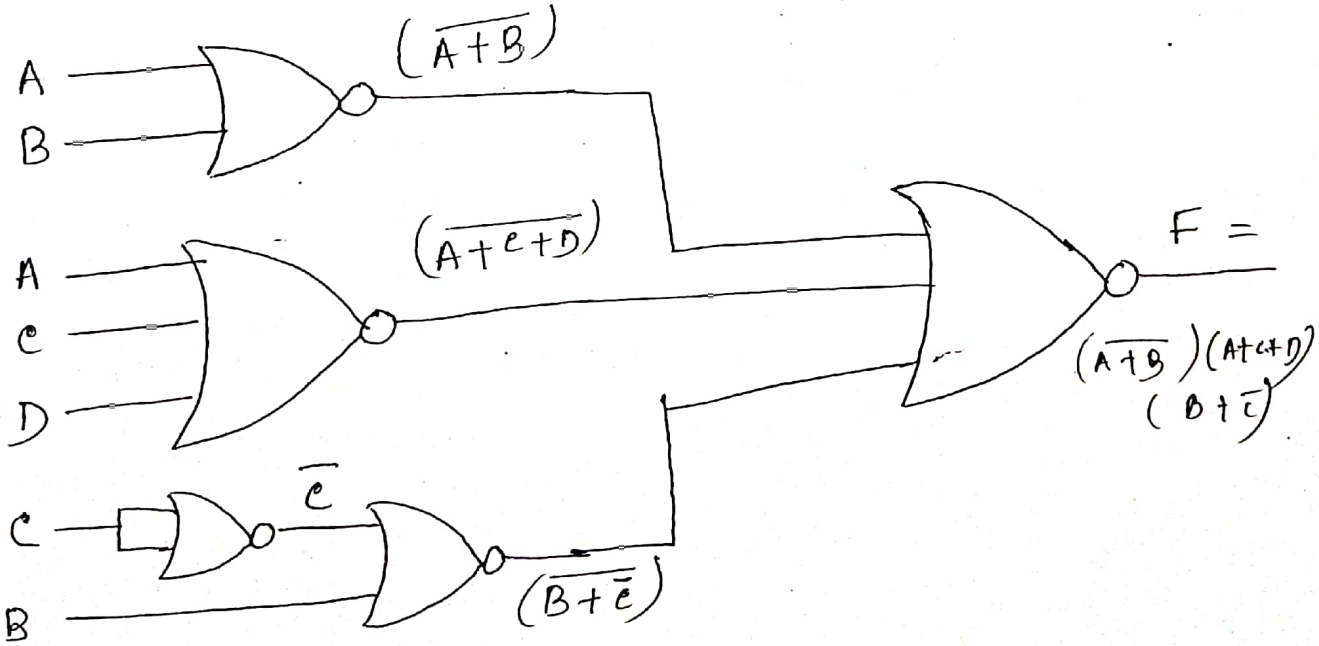
Simplification :—



So the above given expression in POS form is written as.

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

Implement using NOR :—



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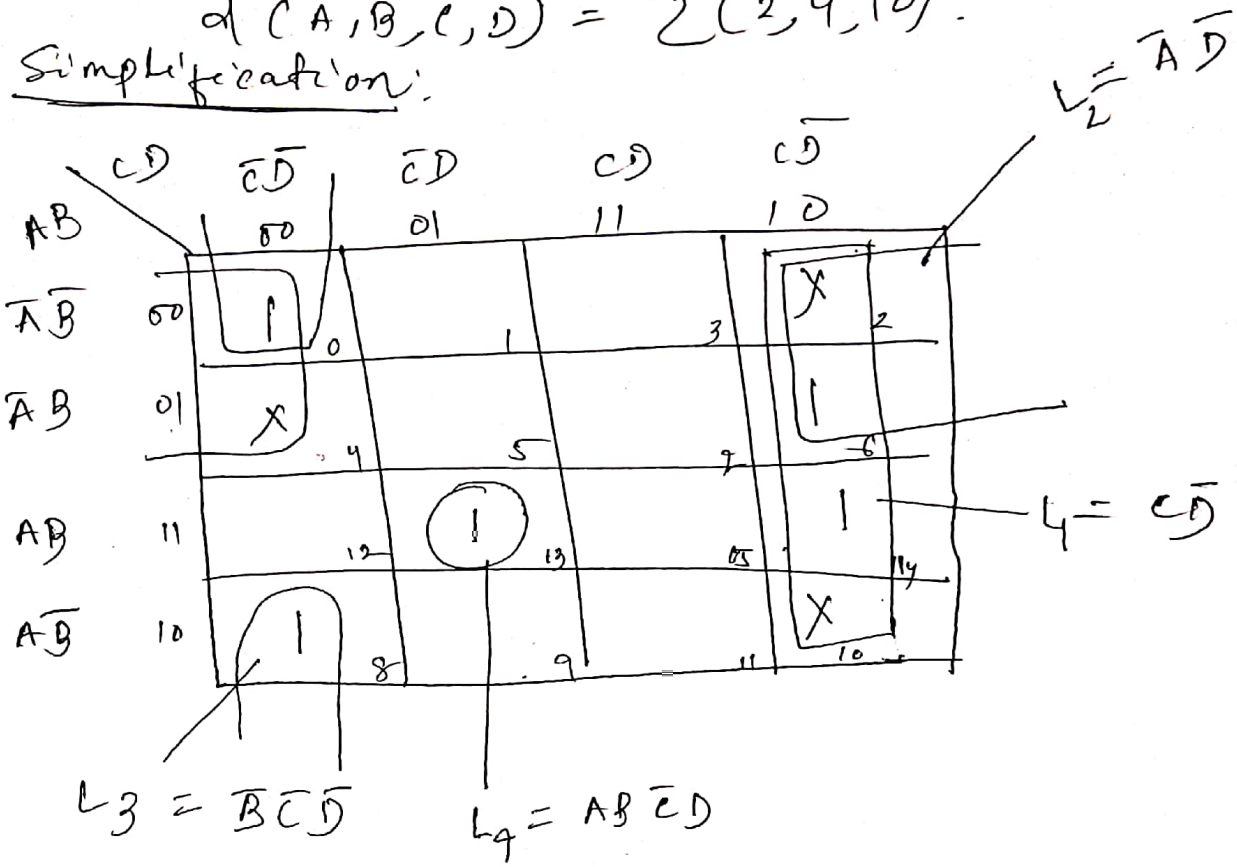
(10) Given

$F = (A, B, C, D) = \sum(0, 6, 8, 13, 14)$

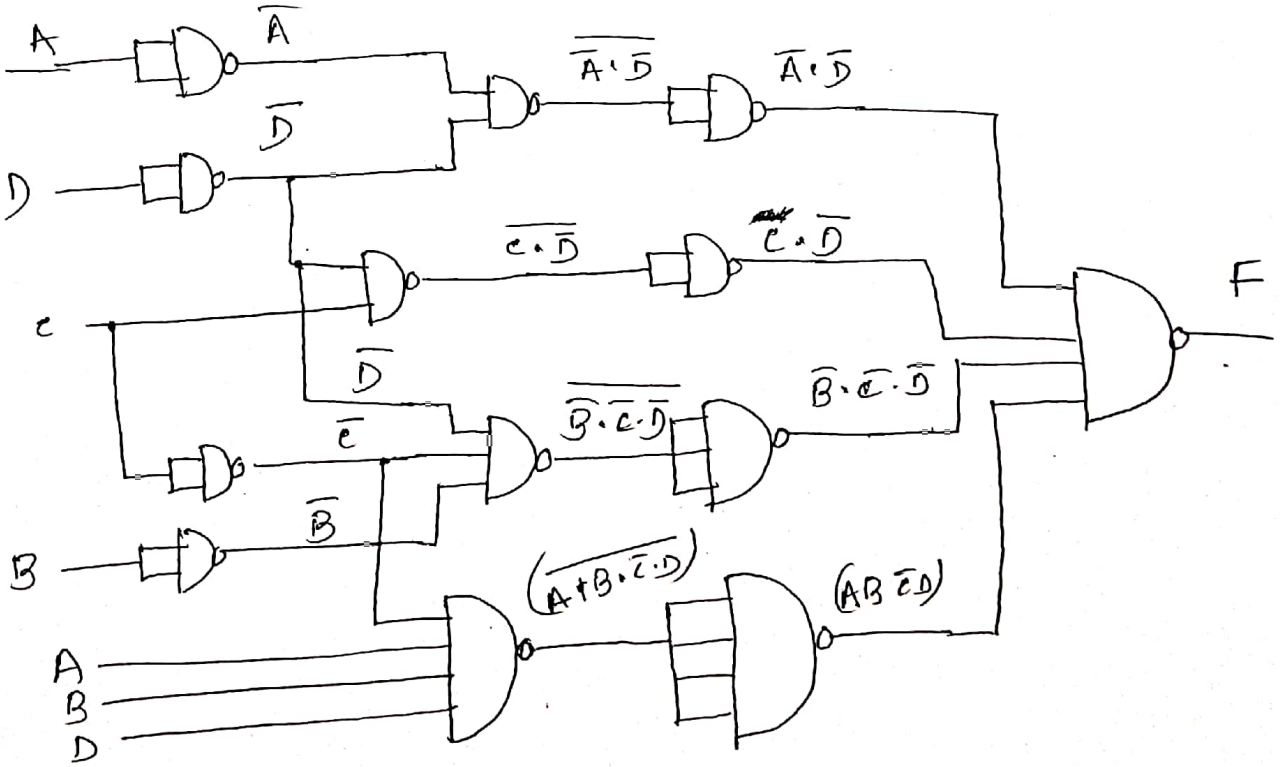
$d(A, B, C, D) = \sum(2, 4, 10)$.

Simplification:



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

Using NAND:



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(11) Given $-46-25$ in 2's complement method.

In binary 8-bit form -

$(46) \rightarrow 0,0101110$

$(25) \rightarrow 0,0011001$

→ As these are two negative numbers, the 2's complement should be find out.

Thus,

$-46 \rightarrow 1,1010010$ (augend)

$-25 \rightarrow 1.1100111$ (addend)

$1\ 1.0111001$

↑ carry bit ↑ sign bit ↓ magnitude bits

→ The carry is discarded and hence the result is 10111001.

→ The true magnitude is 2's complement of 0111001 i.e. 1000111 (−71).

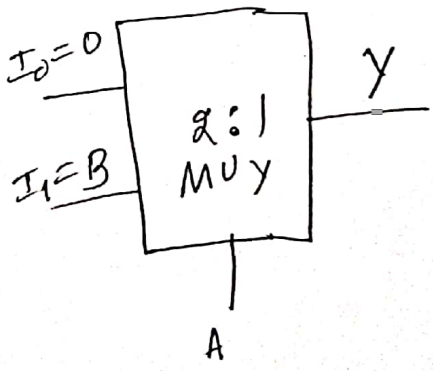
(12) Implement $Y = AB$, using 2:1 MUX.

Let using 2:1 MUX

Ans

Selection Line ← A | B | Y ← data line

A	B	Y	
0	0	0	$I_0 = 0$
0	1	0	
1	0	0	$I_1 = B$
1	1	1	



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13

Error detection

→ Whenever a message is transmitted, it may get scrambled by noise or data may get corrupted. To avoid this, we use error-detecting codes which are additional data added to a given digital message to help us detect if an error occured during transmission of the message. A simple example of error-detecting code is parity check.

Error correction

→ In Error-correcting codes, parity check has a simple way to detect errors along with a sophisticated mechanism to determine the corrupt bit location.

→ To detect and correct the errors, additional bits are added to the data bits at the time of transmission and specially for error correction "Hamming code" is used.

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(14) Error detection and correction code :-

Error detection :- It can be possible by the use of parity bit. This parity bit is a extra bit which is added with the message bit to identify the no. of 1s present in the code word.

→ parity bit is divided in types -
- (a) Even parity
- (b) Odd parity.

→ If no. of 1s present in a code word is even then the corresponding parity bit is 0.

→ If no. of 1s is odd then it's parity bit is 1 which is applicable for even parity condition & vice versa can be assumed for odd parity condition.

→ This code can only detect the error bit but can't able to correct it.

Error correction :- It can be done by hamming code.

→ It has the capacity to detect as well as correct the error. So it is also called self correcting code.

Given: the message is received i.e. 1 1 1 0 1 0 1.

i.e.	D_7	D_6	D_5	P_4	D_3	P_2	P_1
	1	1	1	0	1	0	1

Applying 1st parity relation i.e. $P_1 \oplus D_3 \oplus D_5 \oplus D_7$

$\Rightarrow x_1 = 1 \oplus 1 \oplus 1 \oplus 1 = 0$

Applying 2nd parity relation i.e. $P_2 \oplus D_3 \oplus D_6 \oplus D_7$

$\Rightarrow x_2 = 0 \oplus 1 \oplus 1 \oplus 1 = 1$

Applying 3rd parity relation i.e. $P_4 \oplus D_5 \oplus D_6 \oplus D_7$

$\Rightarrow x_3 = 0 \oplus 1 \oplus 1 \oplus 1 = 1$

→ Thus, the position of error is $x_3 x_2 x_1$ will be 1 1 0 i.e. 6th data bit having error & it should be corrected as 1 0 1 0 1 0 1.

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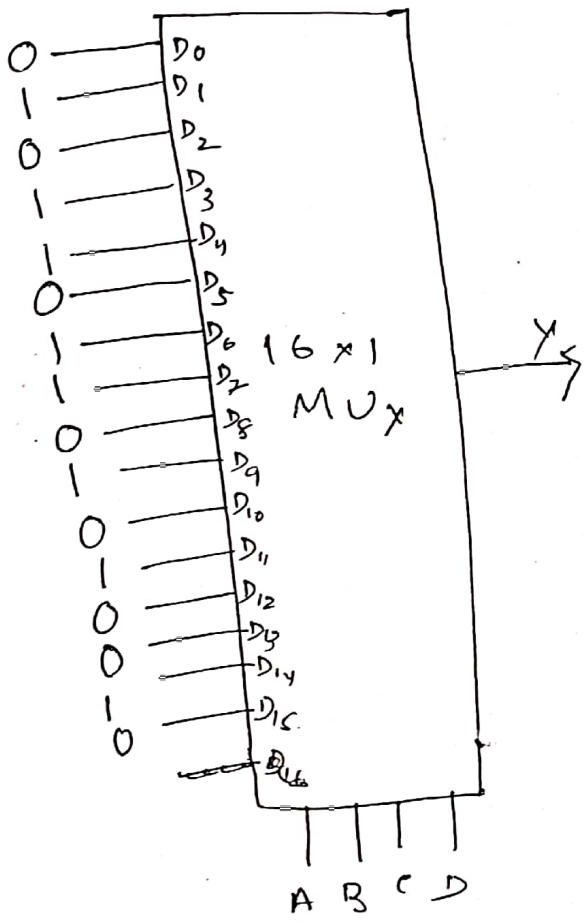
(15) Given the Boolean expression.

$$F(A,B,C,D) = \sum m(1,3,4,6,7,9,11,14)$$

(i) 16×1 MUX.

Selection Lines.

	A	B	C	D	Y (o/p)
0	0	0	0	0	0
1	0	0	0	1	1
2	0	0	1	0	0
3	0	0	1	1	1
4	0	1	0	0	1
5	0	1	0	1	0
6	0	1	1	0	1
7	0	1	1	1	1
8	1	0	0	0	0
9	1	0	0	1	1
10	1	0	1	0	0
11	1	0	1	1	1
12	1	1	0	0	0
13	1	1	0	1	0
14	1	1	1	0	1
15	1	1	1	1	0



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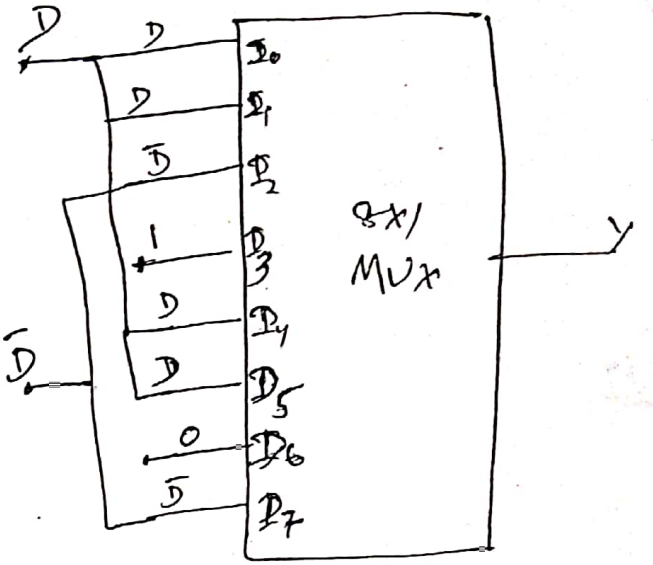
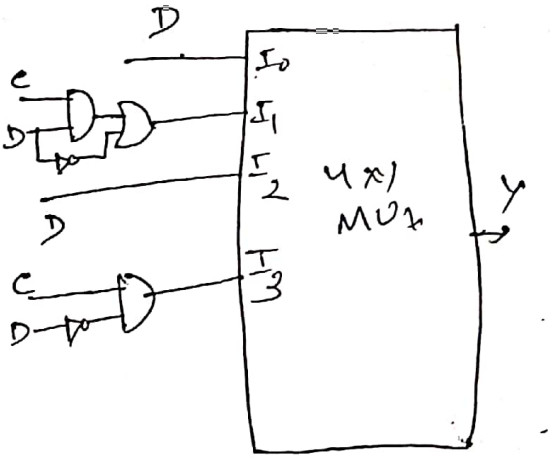
(ii) 8×1 MUX :-

Selection line A	B	C	D	data line	Y	Expression
0	0	0	0		0	D
0	0	0	1		1	
0	0	1	0		0	D
0	0	1	1		1	
0	1	0	0		1	$\bar{D}$
0	1	0	1		0	
0	1	1	0		1	$D+\bar{D}=1$
0	1	1	1		1	
1	0	0	0		0	D
1	0	0	1		1	
1	0	1	0		0	D
1	0	1	1		1	
1	1	0	0		0	0
1	1	0	1		0	
1	1	1	0		1	D
1	1	1	1		0	



(iii) 4×1 MUX :-

Selection line A	B	data line C	D	Y	E
0	0	0	0	0	$\bar{C}D+CD$
0	0	0	1	1	$=D(\bar{C}+C)$
0	0	1	0	0	$=D$
0	0	1	1	1	
0	1	0	0	1	$\bar{C}D+C\bar{D}+CD$
0	1	0	1	0	$=D(\bar{C}+C)+C\bar{D}$
0	1	1	0	1	$=D+C\bar{D}$
0	1	1	1	1	
1	0	0	0	0	$\bar{C}D+CD$
1	0	0	1	1	$=D$
1	0	1	0	0	
1	0	1	1	1	
1	1	0	0	0	CD
1	1	0	1	0	
1	1	1	0	1	
1	1	1	1	0	



(iv) 2×1 MUX

Selection line A	data line B	C	D	Y
0	0	0	0	0
0	0	0	1	1
0	0	1	0	0
0	0	1	1	1
0	1	0	0	0
0	1	0	1	1
0	1	1	0	0
0	1	1	1	1
1	0	0	0	0
1	0	0	1	0
1	0	1	0	1
1	0	1	1	1
1	1	0	0	0
1	1	0	1	0
1	1	1	0	1
1	1	1	1	1

Expression

$I_0 = \bar{B}\bar{C}D+\bar{B}CD+B\bar{C}\bar{D}+B\bar{C}D+BCD$

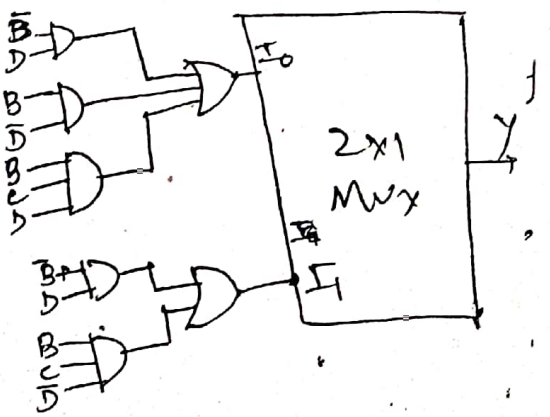
$=\bar{B}D(\bar{C}+C)+B\bar{D}(\bar{C}+C)+BCD$

$=\bar{B}D+B\bar{D}+BCD$

$I_1 = \bar{B}\bar{C}D+\bar{B}CD+BC\bar{D}$

$=\bar{B}D(\bar{C}+C)+BC\bar{D}$

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



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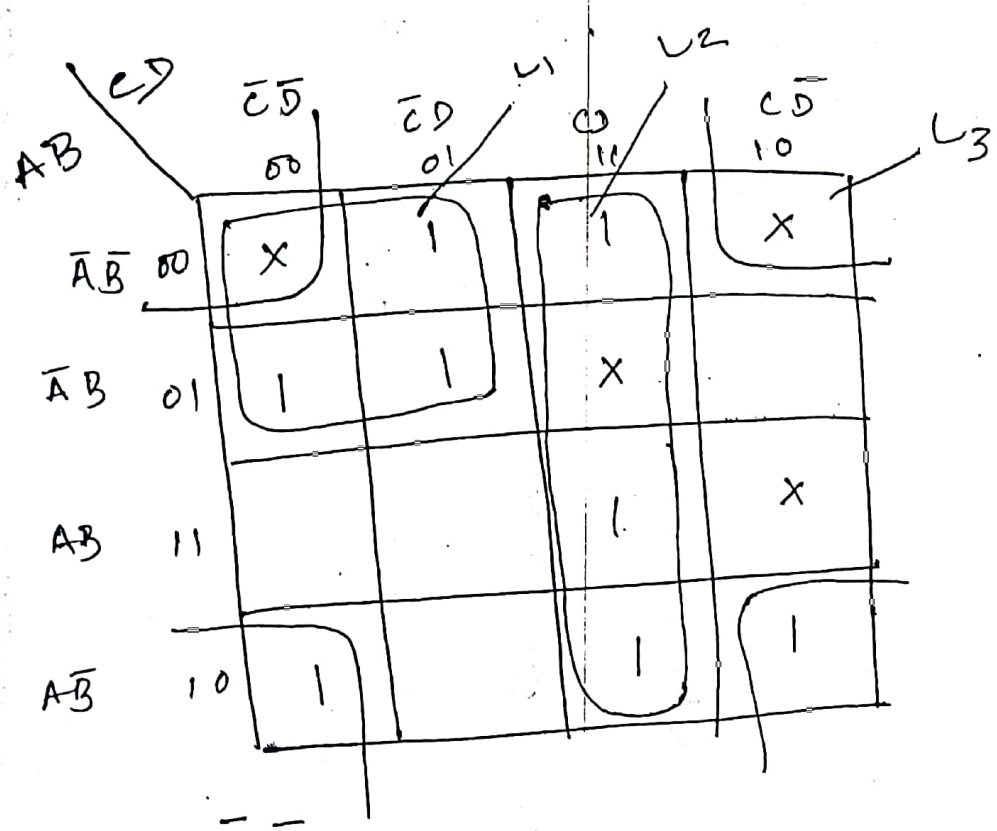
(16) Given

$F(A,B,C,D) = \Sigma m(1,3,4,5,8,10,11,15) + \Sigma d(0,2,7,14)$



$L_1 = \bar{A}\bar{C}$

$L_2 = CD$

$L_3 = \bar{B}\bar{D}$

$F(A,B,C,D) = \bar{A}\bar{C} + CD + \bar{B}\bar{D}$

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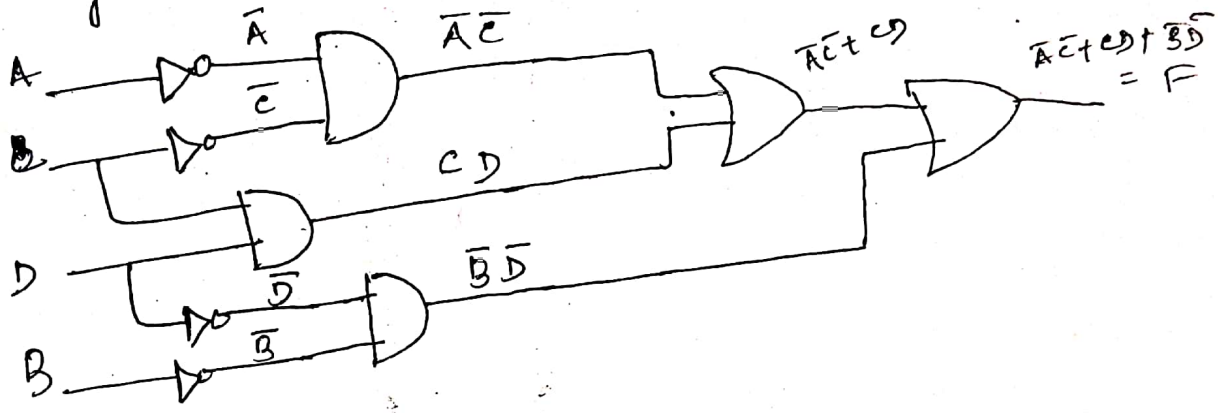
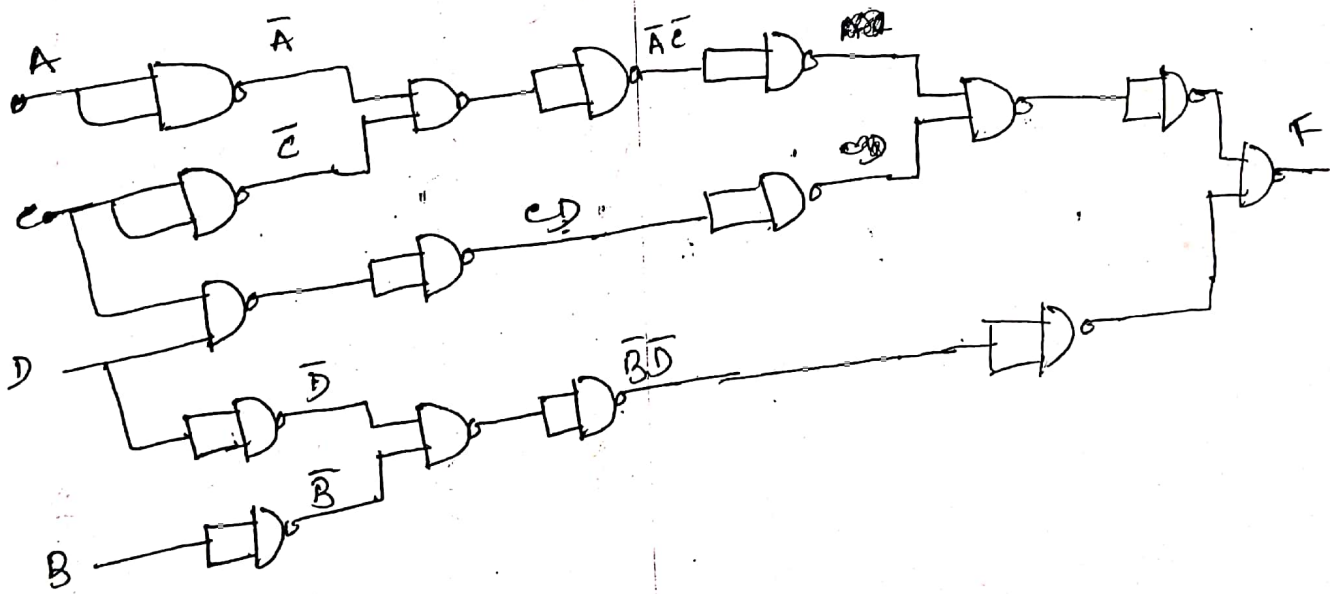
By using universal gate (NAND gate)

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

Using basic gates:-



Using NAND gate:-



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