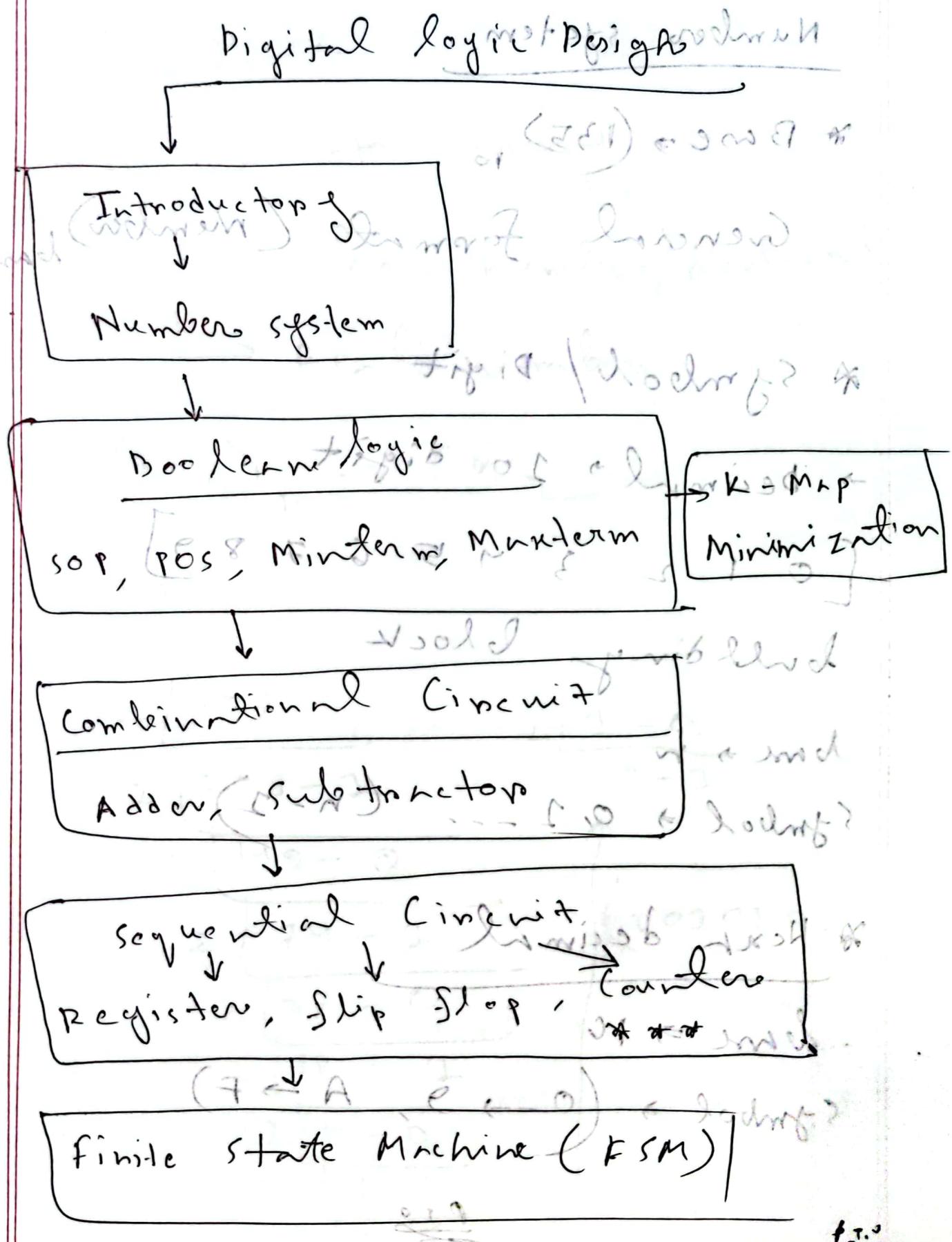


UNIVERSITY

Name	Sadman		
Class	School/College		
Roll No	DLD	Section	011221592
Subject	Year		



Number system

* Base $\rightarrow (135)_{10}$

General form $\rightarrow \underline{\text{Digit}}_1 \text{ (Number)} \underline{\text{base}}$

* symbol / Digit

\rightarrow decimal \rightarrow 10 digit \rightarrow 0, 1, 2, 3, 4, 5, 6, 7, 8, 9

[0, 1, 2, 3, 4, 5, 6, 7, 8, 9] \rightarrow 10 digits

building block

forwards limitation

base $\rightarrow n$

symbol $\rightarrow 0, 1, \dots, n-1$ \rightarrow n symbols

* Hexadecimal \rightarrow 16 digits

base $\rightarrow 16$ \rightarrow 16 digits

symbol $\rightarrow (0 \rightarrow 9, A \rightarrow F)$

(0 to 9) forward 10 to 15 (A to F)

Pr

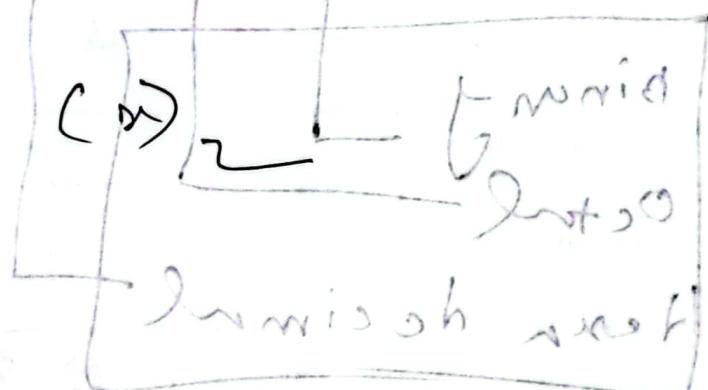
Conversions

* Decimal to Binary

↳ whole number / Natural number

↳ remain number

$$\Rightarrow (597)_{10} \rightarrow$$



$$x = 9.$$

$$\begin{array}{r} 2 \\ | \\ 597 \end{array} \xrightarrow{\text{Int to 0}} \begin{array}{r} 2 \\ | \\ 298-1 \end{array}$$

$$\begin{array}{r} 2 \\ | \\ 149-0 \end{array} \xrightarrow{\text{Int to 0}} \begin{array}{r} 2 \\ | \\ 74-1 \end{array} \xrightarrow{\text{Int to 0}} \begin{array}{r} 2 \\ | \\ 37-0 \end{array} \xrightarrow{\text{Int to 0}} \begin{array}{r} 2 \\ | \\ 18-1 \end{array} \xrightarrow{\text{Int to 0}} \begin{array}{r} 2 \\ | \\ 9-0 \end{array} \xrightarrow{\text{Int to 0}} \begin{array}{r} 2 \\ | \\ 4-1 \end{array} \xrightarrow{\text{Int to 0}} \begin{array}{r} 2 \\ | \\ 2-0 \end{array}$$

$$\begin{array}{r} 2 \\ | \\ 149-0 \end{array} \xrightarrow{\text{Int to 0}} \begin{array}{r} 2 \\ | \\ 74-1 \end{array} \xrightarrow{\text{Int to 0}} \begin{array}{r} 2 \\ | \\ 37-0 \end{array} \xrightarrow{\text{Int to 0}} \begin{array}{r} 2 \\ | \\ 18-1 \end{array} \xrightarrow{\text{Int to 0}} \begin{array}{r} 2 \\ | \\ 9-0 \end{array} \xrightarrow{\text{Int to 0}} \begin{array}{r} 2 \\ | \\ 4-1 \end{array} \xrightarrow{\text{Int to 0}} \begin{array}{r} 2 \\ | \\ 2-0 \end{array}$$

normal ans. 1

$2^8 \quad 2^7 \quad 2^6 \quad 2^5 \quad 2^4 \quad 2^3 \quad 2^2 \quad 2^1$
 256 128 64 32 16 8 4 2 1

Binary Number System



Base 10
 {Base 8 + Base 16}

Binary, Octal, Hex
 {Base 2 + Base 8 + Base 16}

Decimal

{Base 10 + Base 16 + Base 2}

$2^0 \quad 2^1 \quad 2^2 \quad 2^3 \quad 2^4 \quad 2^5 \quad 2^6 \quad 2^7 \quad 2^8$
 1 2 4 8 16 32 64 128 256

119

5/2/81
h.s.

49.023 - Linnemann

O.	023	
H.S.H.	x 2 mid	dec
00.	00060	0
5	* 5200	5
50	090200	5
	* 2	
E	0. 18900	E
N	0050	N
S	0005	8
D	5005	0
A	0101	01

GW

18.10.22

PLD

Hexadecimal to Binary

Dec	Bin	Hex
0	0000	0
1	0001	1
2	0010	2
3	0011	3
4	0100	4
8	1000	8
9	1001	9
10	1010	A

22 - 2022 - B (FFFF) ⚡

22 - 2200 - C

8243 → 821F018 + D + 8~~0~~ + F

24 - 2220 - E (ECON)

25 - 2222 - F

(252F) ⚡

B2F8 → ~~4A98~~ 45816

$(2592)_{10} \rightarrow (A2F)_{16}$

16 | 2592
16 | 161 - 15 (F)
16 | 10 - 2
0 - 10 (A)

$$* \quad (7777)_{8} = 5005 - 55$$

$$= 0055 - 55$$

$$7 \times 8^3 + 7 \times 8^2 + 7 \times 8^1 + 7 \times 8^0$$

$$= (4095)_{10} - 0555 - 55$$

$$7 - 5005 - 55$$

$$* \quad (7526)_8$$

$$= 21821 - 8750$$

$$* \quad (222000117)_{8}$$

$$\begin{array}{r} \text{---} \\ (725)_{10} \quad 01 \quad (77A)_{8} \quad (525)_{10} \\ \text{---} \end{array}$$

$$(A)$$

$$\begin{array}{r} 21 - 101 \\ \text{---} \\ 11 - 01 \\ \text{---} \\ 01 - 0 \\ \text{---} \end{array}$$

~~870~~

~~Hex~~ \leftrightarrow Octal

$$(5.23.AE)_{16} \begin{matrix} 5 \\ 2 \\ 3 \\ A \\ E \end{matrix} \quad (5.23.AE)_{16}$$

$$\begin{array}{r} 0 - 38 \\ \downarrow \\ 0 - 22 \\ \downarrow \\ 513. \begin{matrix} A \\ F \end{matrix} \end{array} \quad (5.23.AE)_{16}$$

$$5 \times 16^0 + 2 \times 16^1 + 3 \times 16^{-1} + \frac{A}{16} \times 16^{-2}$$

$$50.80001$$

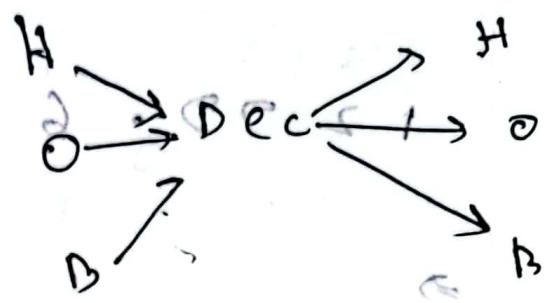
$$+ \frac{14}{16} \times 16^{-2}$$

~~1279.67 2688~~

$$\begin{array}{r} 2688 \\ \hline 2 \end{array}$$

$$884 \cdot N$$

$$PT.$$



12.985
 6
 8
 12.985
 6
 8

~~12.985~~
~~6~~
~~216 - 3~~
~~36 - 0~~
~~6 - 0~~
~~1 - 0~~
~~3.812~~
~~0 - 1~~

$$\begin{array}{r}
 31 \times \frac{A}{31} + 31 \times 8 + 31 \times 18 + 31 \times 62 \\
 20003.04
 \end{array}$$

$$31 \times 17$$

~~0.698~~
~~0.6~~
~~4.288~~
~~2~~
~~0.59~~

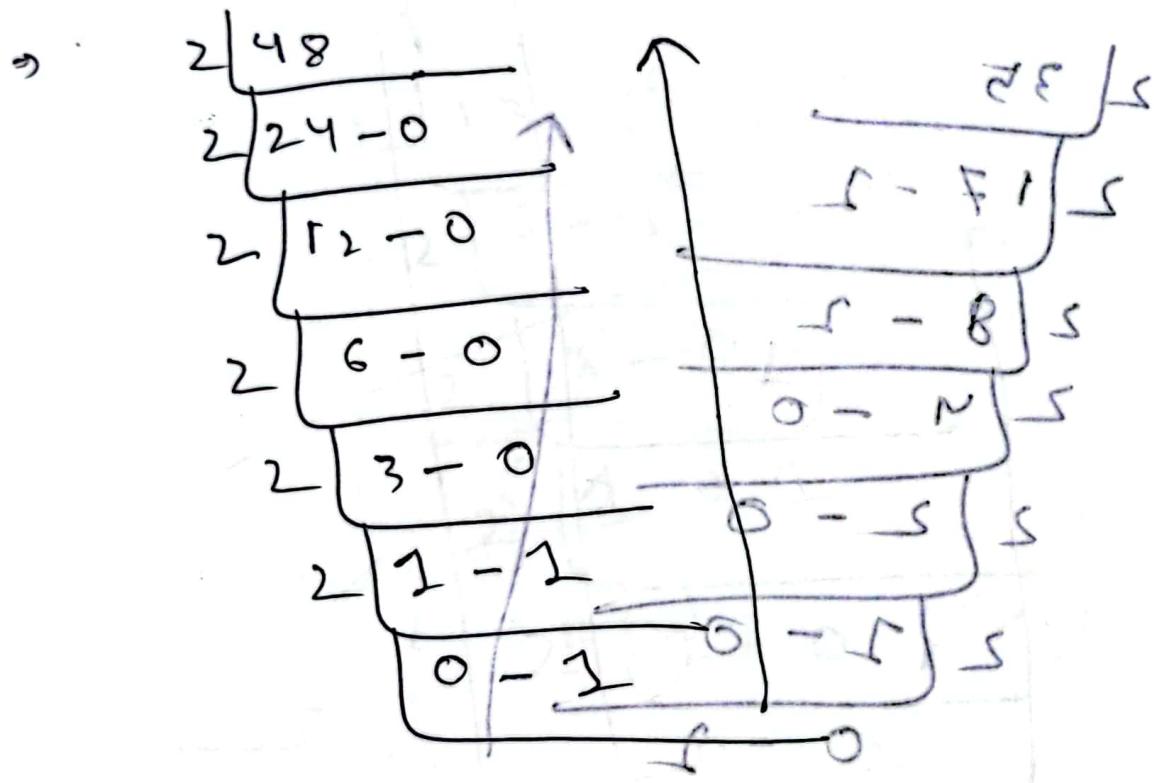
*

$8 (\text{EN})$

~~48 (10)~~

$^0 8 \times E + ^5 8 \times N \in$

$$(48)_{10} - (43)_8 = 0, (\text{EN}) \in$$



$$(48)_{10} \rightarrow (1240000)_5 = 0, (\text{EN})$$

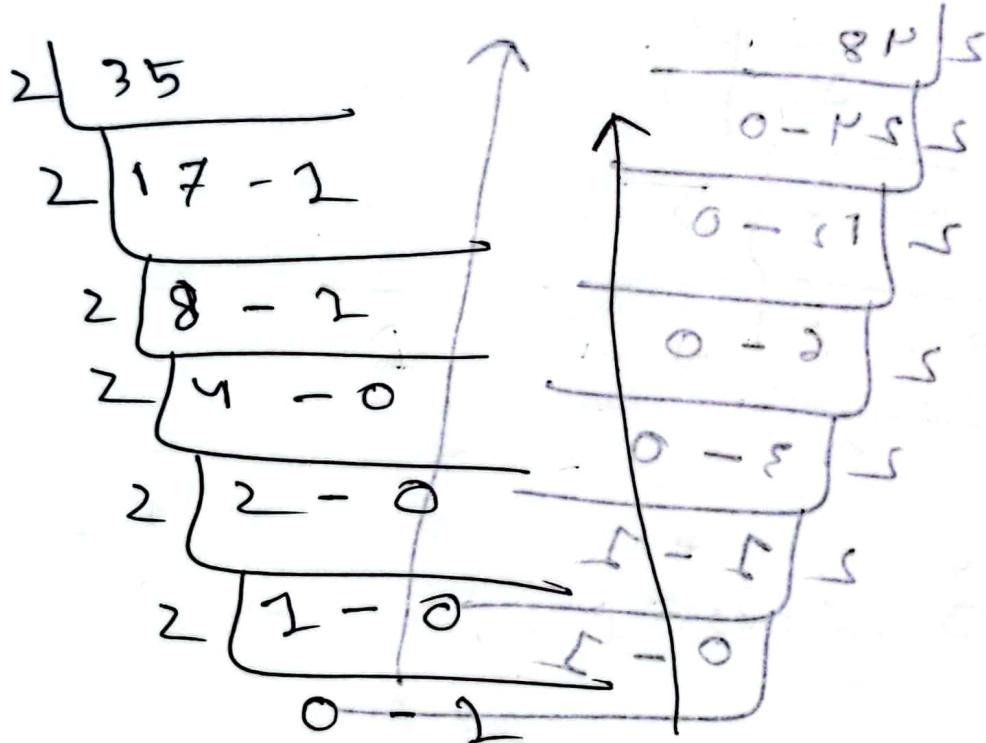
$$\begin{array}{r} 0000055 \\ 5500045 \\ \hline (5055000) \end{array}$$

(43)₈

$$\Rightarrow 4 \times 8^2 + 3 \times 8^0$$

$\Rightarrow (35)_{10}$

~~(81)~~ \rightarrow (81)



$(35)_{10} = 1000111_2 \leftarrow (81)$

$$\begin{array}{r} 110000 \\ - 100011 \\ \hline \end{array}$$

$$\rightarrow \overbrace{\underline{(00011101)}}^{(00011101)}$$

$$\begin{array}{r} 48 \\ - 35 \\ \hline (13)_{10} \end{array}$$

~~$$\begin{array}{r} 81 \\ - 28 \\ \hline (13)_{10} \end{array}$$~~

$$\begin{array}{r} 13 \\ 2 \overline{)13} \\ 2 \overline{)6\cancel{1} - 1} \\ 2 \overline{)3 - 2} \\ 2 \overline{)1 - 1} \\ \hline 0 & 1 & 2 \\ (13)_{10} = (2301)_2 \end{array}$$

~~GW~~
~~27.10.22~~

DLD

* 13 ଏହି ପାଇଁ କିମ୍ବା କିମ୍ବା (B7F4)

* 13 ଏହି BCD 1 ଏବଂ ର୍ଯ୍ୟ ଆବଶ୍ୟକ

3 ଏବଂ ଏଣ୍ଟ ଅଲାନ୍ତ 0005 0010

$$\begin{array}{r} 1001 \xrightarrow{\text{0 } 0} 19 \\ 0100 \xrightarrow{\text{0 } 1} 8 \\ \hline 1201 \xrightarrow{\text{1 } 3} 13 \\ 0110 \xrightarrow{\text{1 } 0} 6 \\ \hline 0001 \xrightarrow{\text{0 } 1} 1 \\ \hline \end{array}$$

1 0000 0001

* Invalid code ଏଣ୍ଟ 8 ଏବଂ
ପାଇଁ କିମ୍ବା 200.

27.10

* Carrying Biases are same

1000 1000 1000 1000 1000 1000 1000 1000

0100 1000 1000 1000 1000 1000 1000 1000

0011 0100

$$\begin{array}{r} 0111 \\ \underline{-} 1100 \\ 1111 \\ \underline{-} 1000 \\ 1011 \\ \underline{-} 0100 \\ 0111 \\ \underline{-} 0100 \\ 0111 \end{array}$$

~~1000 1000~~

1000 1000 1000 1
68 68 68 bilanT *

1000 1000 1000 1000 1000 1000 1000 1000

1000

1000

Boolean Algebra

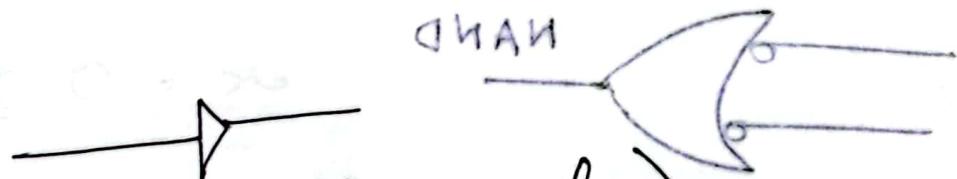
True (1)

False (0)

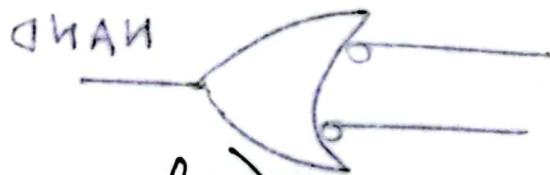
And \Rightarrow ~~कार्यकारी~~ circuit { AND }

Or \Rightarrow ~~समानांतर~~

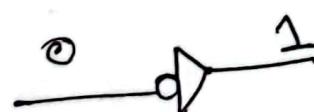
Not \Rightarrow Short



(Buffer gate)

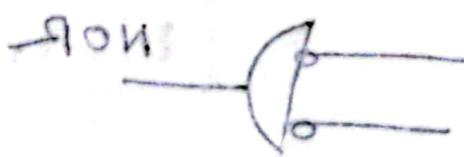


AND



{ Active low }

NOT



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

NOT

L.T.I

C.V
29.10.27

CT Practice

DLD

AND \Rightarrow AND gate with AND

OR \Rightarrow

(+) sum

NOT \Rightarrow

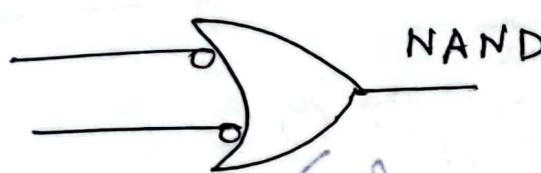
(0) sum

{NAND \Rightarrow } + NOR \Rightarrow Universal gates b/w A



NAND

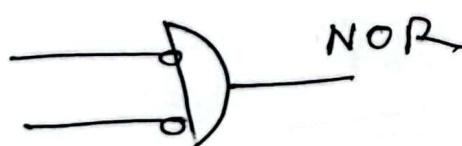
\sim INVERTER \Leftarrow OR



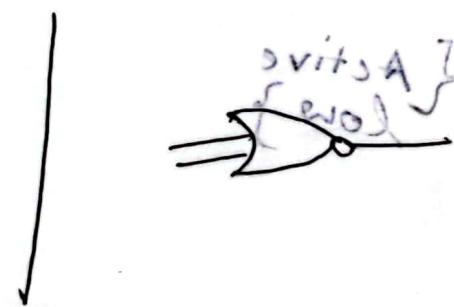
$x = \overline{A} \cdot \overline{B}$ (Step notation)



* NOR



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

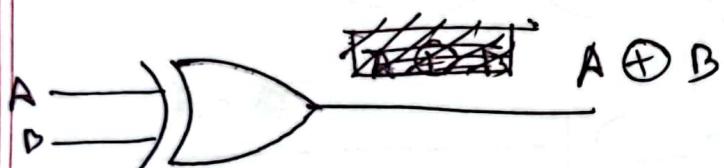


Q.T.P.

I.T.

• XOR gate / Odd 1 bektor :-

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



XOR

$$x \oplus x = 0$$

$$x \oplus \bar{x} = 1$$

$$x \oplus 1 = \bar{x}$$

$$x \oplus 0 = x$$

प्र० अंग०

→ फलात् लेखा नहीं करके $\frac{(F+x)(G+x)}{2}$

$$(F+x) \cdot (G+x) = FG + Fx + Gx + x^2$$

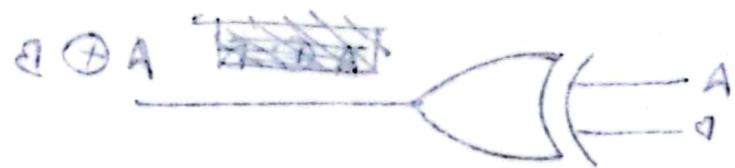
or direct int. id

P.T.O.

174

record (Module-2 & addition)

$$\downarrow \\ \text{remainder} \\ \overline{A} + \overline{A} = 0 \oplus A$$



X-NOR

* ~~कॉस्टि~~ नो घटना 0 नियम Output
0 काम करा.

$$0 = x \oplus x$$

$$\overline{x} = x \oplus x$$

$$x = 0 \oplus x$$

~~मुख्य नियम~~

* ~~मुख्य नियम~~ $x \cdot (y + z) = \cancel{x \cdot y} + \cancel{x \cdot z}$

$$\Rightarrow x + yz = (x+y) \cdot (x+z)$$

Distributive

P.T.O

Parenthesis > Not > And > Or

(C) ~~$(A + B) \cap \overline{D} + E + F$~~ ~~2F82.0P~~

$\rightarrow A \cdot B + (\overline{C} \cdot \overline{D}) \cdot (\overline{E} \cdot \overline{F}) \rightarrow \overline{A \cdot B} + \overline{C \cdot \overline{D}} \cdot \overline{E} \cdot \overline{F}$

$\rightarrow \overline{A \cdot B} + C + D \cdot \overline{E} \cdot \overline{F}$

~~$\rightarrow \overline{(A + B) \cap \overline{D}}$~~

$\rightarrow \boxed{(A + B) \cap \overline{D}} \cdot \boxed{\overline{E} \cdot \overline{F}}$

$\rightarrow \left\{ \overline{A + B} + C + D \right\} \overline{E} \cdot \overline{F} \quad \overline{E} \cdot \overline{F} = 1$

$\Rightarrow \left\{ \overline{A} \cdot \overline{B} + C + D \right\} \overline{E} \cdot \overline{F}$

$\rightarrow \overline{(\text{Orr})} \leftarrow \text{Orr}$

$F(O, 0) \leftarrow (2F82.0)$

$2F82.0$

$\begin{array}{r} 2F82 \\ - 5x \\ \hline 2F3 \end{array} \cdot 5$

$\begin{array}{r} 2F3 \\ - 5x \\ \hline 2F \end{array} \cdot 0$

$\begin{array}{r} 2F \\ - 5x \\ \hline 2 \end{array} \cdot 5$

$\begin{array}{r} 2 \\ - 5x \\ \hline 0 \end{array} \cdot 5$

~~infa~~

~~F11011.0111011~~

0 < a < 1 Practice

* $(46.6875)_{10} \rightarrow (x)_{(2+A)} \quad \textcircled{3}$

$$\begin{array}{r} 2 | 46 \\ 2 | 23 - 0 \\ 2 | 11 - 1 \\ 2 | 5 - 1 \\ 2 | 2 - 1 \\ 2 | 1 - 0 \\ \hline & 0 - 1 \end{array} \quad \begin{array}{l} (1 \cdot 1), (1 \cdot 1) + 1 \cdot A \\ \cancel{(1 \cdot 1)} \\ (1 \cdot 1) + 1 \cdot A \\ \cancel{(1 \cdot 1)} (1 + A) \\ (1 \cdot 1) + \cancel{1 \cdot A} \\ 1 \cdot 1 \{ 1 + 1 + \cancel{1 \cdot A} \} \\ 1 \cdot 1 \{ 1 + 1 + \cancel{1 \cdot A} \} \end{array}$$

$(46)_{10} \rightarrow (101110)_2$

$$\begin{array}{r} 0. | 6875 \\ \times 2 \\ \hline \end{array}$$

$$(0.6875) \rightarrow (1011)_2$$

$$\begin{array}{r} 1. | 375 \\ \times 2 \\ \hline \end{array}$$

Ans:

$$\cancel{\dots}$$

$$(101110.1011)_2$$

$$\begin{array}{r} 0. | 75 \\ \times 2 \\ \hline \end{array}$$

$$\begin{array}{r} 2. | 5 \\ \times 2 \\ \hline \end{array}$$

$$\begin{array}{r} 1. | 0 \\ \hline \end{array}$$

1000	1000	1000	1000	1000
0001	1000	1001	1001	0111
0010	1001	0000	0000	0101
0011	1000	0000	0000	
0110	0001	1001	1100	
0110	0001	1001	1100	
0100	0111	1010	0010	
0100	0111	1010	0010	
0100	0000	0000	0000	0010
0100	1000	0000	0000	0010
4	8	0	2	

$$*(A85)_{16} \rightarrow (x)_{10}$$

~~01000000~~ 8
F - EN55 8

$$\rightarrow A \times 16^2 + 8 \times 16^1 + 5 \times 16^0$$

8

$$\rightarrow (2693)_{10}$$

R - 01 8
~~A8~~ - 5 8

$$*(2591)_{10} \rightarrow (x)_{16}$$

(FPN 8)

$$\begin{array}{r} 16 | 2591 \\ 16 | 161 - 15 - F \\ 16 | 10 - 2 \\ \hline 2 - 10 \rightarrow A \end{array}$$

8

(H055) 8

$$\begin{array}{r} 16 | 650 \\ 16 | 40 - 10 \\ 16 | 2 - 8 \\ \hline 8 - 2 \end{array}$$

$$* \overline{8} (9999)_{10} *$$

$$\begin{array}{r} 8 \overline{)2249 - 7} \\ 8 \overline{)156} \xrightarrow{\text{A}} 8 + 81 \times A \\ 8 \overline{)19 - 4} \\ 8 \overline{)2 - 3} \xrightarrow{\text{A}} \\ \end{array}$$

$\xrightarrow{\text{A}} 0_1 (1025)$

$$(23427)_8$$

$$\begin{array}{r} 10000 \xrightarrow{\text{A}} 0_1 \\ 7 - 21 = 101 \xrightarrow{\text{A}} 0_1 \\ 290000 \xrightarrow{\text{A}} 0_1 \\ 200 \xrightarrow{\text{A}} 0_1 \\ 3 \quad 2 \xrightarrow{\text{A}} 0_1 - 5 \\ \end{array}$$

$$\Rightarrow (3204)_8$$

$$\begin{array}{r} 020 \xrightarrow{\text{A}} 0_1 \\ 01 - 02 \xrightarrow{\text{A}} 0_1 \\ 8 - 5 \xrightarrow{\text{A}} 0_1 \\ 5 - 8 \xrightarrow{\text{A}} 0_1 \end{array}$$

$$(346)_7 = (501)_{10}$$

$$\Rightarrow 3 \times 7^2 + 4 \times 7^1 + 6 \times 7^0 = 5x^2 + 0.x + 1 \cdot x^0$$

$$\Rightarrow 181 = 5x^2 + 1$$

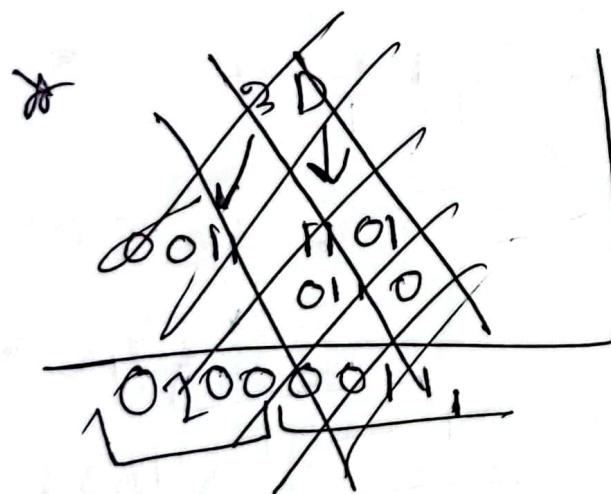
$$\Rightarrow 5x^2 = 181 - 1$$

$$\Rightarrow 5x^2 = 180$$

$$\Rightarrow x^2 = 36$$

$$\Rightarrow x = 6$$

A



$$\begin{aligned} & 3D \\ & \Rightarrow 3 \times 16^1 + D \times 16^0 \\ & = 3 \times 16^1 + 13 \times 16^0 \end{aligned}$$

$$\begin{aligned} & = 61 \\ & \downarrow \\ & 0110 \quad 0001 \end{aligned}$$

A

~~GW~~
~~10.11.22~~

~~DLP~~

$$\cancel{D \cancel{A}} + (A + B) + (\bar{A} + S)(\bar{A} \bar{B} C + A)$$

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

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

$$= (A + B C) + (\bar{A} \bar{B} C) \quad [B \cdot \bar{B} = 0]$$

$$= A (\bar{B} C + 0 + \cancel{1}) + \bar{A}$$

$$= A \bar{B} C + \cancel{A} + \frac{3}{3} + \bar{A}$$

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

$$A \bar{A} + \cancel{S} + \cancel{S} + A \bar{A} + A$$

$$(A + \bar{A})(S + \bar{S})$$

$$A \bar{A} + \cancel{S}$$

P.T.O

$$(5+x)(5+x) = 25 + x$$

↑

$$*(A(B + \bar{A}C)D + (CD)A) + \bar{A}C$$

$$\Rightarrow \bar{A}B\bar{D}(A + \bar{A}C + \bar{A}\bar{B} + CD) + \bar{A}C$$

$$(2) \bar{A}A \{ 1 + \bar{B}C + \bar{B}\bar{C}D \} + \bar{C} \{ 1 + A\bar{D} \}$$

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

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

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

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

$$\Rightarrow A + BD + \bar{C}$$

$$\bar{C} + C \cdot ABD$$

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

$$\Rightarrow \bar{C} + ABD$$

$$x + jz = (x+j)(x+z)$$

P.T.O.

$$A(B+A)B' C + A B^2 C' \text{ is a}$$

$$\Rightarrow A B + A B' C \left[C + C' = 1 \right]$$

$$= A \quad (\text{both terms})$$

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

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

$$= A A' \quad \text{not between signs}$$

$$= 0$$

both terms are zero left in T only

first sign

P.T.O

Q.E.D

* Redundancy of Complement

(extra) term $A \bar{A}$ will be
with zero

(i) $(\bar{A} + A)$ 3rd variable $(\bar{A} + A)(A + A) \rightarrow$

(ii) $(\bar{A} + A)(\bar{B} + B)$ Variable 2 will repeat \bar{B}^n ,

(iii) One variable will be in
complemented form. $\bar{A} A$

(iv) True the terms complimented
variable exist.

P.T.O

U.I

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

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

$$\Rightarrow (A\bar{B}+B\bar{B}+AC+BC) (A+C)$$

$$\Rightarrow (\bar{A}\bar{B}+AC+BC) (A+C)$$

$$\Rightarrow AA\bar{B} + AA\bar{B}C + ABC + A\bar{B}C + ACC + BCC$$

$$= \bar{A}\bar{B} + AC + ABC + A\bar{B}C + ACTBC$$

$$\Rightarrow \cancel{\bar{A}\bar{B}(1+C)} + AC + ABC$$

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

$$\Rightarrow \bar{A}\bar{B}(1+C) + AC + BC (A+1)$$

$$\Rightarrow \bar{A}\bar{B} + AC + BC$$

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

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

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

$$(A+B)$$

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

refl dual

$$P = AB + BC + AC$$

$$(A+B) \cdot (B+C) \cdot (A+C)$$

$$\Rightarrow (AB + AC + BC + BC + AC) (A+C)$$

$$\Rightarrow (B+AC) (A+C) = AB + AC + BC + AC$$

$$\Rightarrow AB + AB + AC = P + BC + AC$$

$$\therefore (P, Q, R) = (\bar{P} + \bar{Q}) (\bar{Q} + \bar{R}) (\bar{R} + \bar{P})$$

$$\Rightarrow (\bar{P} \cdot \bar{Q}) + (\bar{Q} \cdot \bar{R}) + (\bar{R} \cdot \bar{P})$$

\rightarrow (Contradiction = 0)

P.T.B

C.V
5/15/22

DLD

x_1	x_2	x_3	Land & Water
0	0	0	$\rightarrow \min \rightarrow M = \overline{x_1} \overline{x_2} \overline{x_3}$
0	0	1	$A + \overline{A} + A = 9$
0	($\overline{0} + A$)	($\overline{0} + 1$)	$\rightarrow \max \rightarrow M = \overline{x_1} + \overline{x_2} + \overline{x_3}$
0	1	1	$\rightarrow \max \rightarrow M = \overline{x_1} + \overline{x_2} + \overline{x_3}$
1	0	0	$\rightarrow \max \rightarrow M = \overline{x_1} + \overline{x_2} + \overline{x_3}$
1	0	1	$\rightarrow \max \rightarrow M = \overline{x_1} + \overline{x_2} + \overline{x_3}$
1	1	0	$\rightarrow \max \rightarrow M = \overline{x_1} + \overline{x_2} + \overline{x_3}$
($\overline{1} + \overline{1}$)	($\overline{1} + \overline{0}$)	($\overline{0} + \overline{1}$)	($1, 0, 0$)
2	1	1	

$m = \pi^2 \sin(\frac{\pi}{3})$

Minterm \longleftrightarrow minterm

* ~~एक वर्षा तर्म का संगत~~

Variable Present ~~(expres)~~ वर्षा,

→ original

→ complemented form

(मिन्टर्म) बुलार्ड रूप में

* Variable का product एकाएँ

नहीं

$$1 + 1 + 1$$

$$1 - x \\ 0 - \bar{x}$$

* ~~किसी भी~~ रूप (n)

Minterm

०.५७

* ० र १

* ० $\rightarrow x$, १ $\rightarrow \bar{x}$

* M (अ. रूप)

* Min term \leftrightarrow Max term

→ ~~Min term~~ \leftrightarrow Complement ~~Max term~~

, Min term \leftrightarrow (De-Morgan)

↓ \neg chain

↓ \neg chain

Sum of Product

(Min term)

$$\textcircled{P} + \textcircled{P} + \textcircled{P}$$

$$x = 1 \quad *$$

$$\bar{x} = 0$$

(n) Pairs $\overbrace{\text{etc}}^{\text{etc}}$ *

~~Pq.~~

Min term

True or *

$x = 1, \bar{x} = 0$ *

(PQTS 25) M *

from slide truth table

* Truth table \rightarrow SOP

$$\Rightarrow F(x_1, x_2, x_3) \rightarrow$$

$$\rightarrow m_1 + m_4 + m_5 + m_6$$

209
Outputs = 1
SOP form
 $(x_1 + x_3)(x_2 + x_3)(x_4 + x_5 + x_6)$

$$\rightarrow \{x_2 x_3 + x_1 \bar{x}_3\} + M_4 + M_5 + M_6 \rightarrow (\text{minimal SOP})$$

$$\{x_1, x_2\} \cdot \{x_4 + x_5 + x_6\}$$

$$\text{row } 8 \rightarrow \{x_1, x_2\} \cdot \{m_1, m_4, m_5, m_6\}$$

$$P = 5$$

P.T.O.

~~shift left shift right~~

pos

90? ← shift right →

~~n = 0 to 999~~

is it a product of sum

→ 88820

$$\rightarrow \begin{pmatrix} ++ \\ ++ \end{pmatrix} (n^m + \dots + n^m) \begin{pmatrix} ++ \\ ++ \end{pmatrix}$$

$$F(x_1, x_2, x_3) = \underbrace{x_1 + x_2 + x_3}_{\text{minim}}$$

$$(90) \rightarrow M_0 \rightarrow M_1 \rightarrow M_2 \rightarrow M_3 \rightarrow M_4 \quad \begin{matrix} 1 \\ 2 \\ 2 \\ 1 \\ 2 \end{matrix}$$

$$\rightarrow (x_1 + x_2 + x_3) \cdot (x_1 + x_2 + x_3) \cdot (x_1 + x_2 + x_3)$$

$$\cdot (x_1 + x_2 + x_3)$$

$$(91) \rightarrow (x_1 + x_3)^m + x_2^m \quad \begin{matrix} x_1 \\ x_2 \\ x_3 \end{matrix}$$

$$(92) \rightarrow (x_1 + x_3) \cdot (x_2 + x_3)$$

$$L = 4$$

~~IT.0~~

Product

$$f(x_1, x_2, x_3) = \overline{x_1} \cdot \overline{x_2} \cdot x_3 + x_1 \cdot \overline{x_2} \cdot \overline{x_3} + x_1 \cdot x_2 \cdot \overline{x_3}$$

$$f(x_1, x_2, x_3) = \overline{x_1} \cdot \overline{x_2} \cdot x_3 + x_1 \cdot \overline{x_2} \cdot \overline{x_3} + x_1 \cdot x_2 \cdot \overline{x_3}$$

$$\text{product} \rightarrow \overline{x_1} \cdot \overline{x_2} \cdot x_3 + \overline{x_1} \cdot \overline{x_2} \cdot \overline{x_3} + x_1 \cdot \overline{x_2} \cdot \overline{x_3} \quad [A = A + A]$$

$$= \overline{x_1} \cdot \overline{x_2} \cdot \overline{x_3} + M(0, 2, 3, 7)$$

$$F(x_1, x_2, x_3) = \sum m(0, 2, 3, 7)$$

minimal pos gate expression

and draw the circuit

$$f(x_1, x_2, x_3) = \overline{x_1} \cdot \overline{x_2} \cdot x_3 + M(0, 2, 3, 5, 6, 7)$$

PTV

$$f(x_1, x_2, x_3) = \sum_m f_{2,3,4,6,7}$$

$$\rightarrow \boxed{x_1 x_2} x_3 + \boxed{x_1 x_2} x_3 + x_1 \overline{x_2} \overline{x_3}$$

$$(x_1 x_2 x_3 + x_1 \cdot \cancel{x_2} \cdot \overline{x_3} + x_1 x_2 \overline{x_3}) \\ [A+A=\underline{A}] + (x_1 x_2 \overline{x_3})$$

$$\rightarrow \cancel{x_1 x_2 x_3} + x_1 x_2 + x_1 x_2 \quad \text{extra}$$

$$\rightarrow \cancel{x_1 x_2 x_3} + x_1 x_2 + x_1 x_2$$

erinnerns an 209 Lösungen

+ dieses enth. etwas zu

$$(x_1 x_2 x_3) M \Pi \cancel{(x_1 x_2 x_3)}$$

P.T.O.

UJY

* Minimized \rightarrow Standard SOP

SOP
SOP

209

$$\Rightarrow A\bar{B}C + \bar{A}\bar{B} + AB\bar{C}D$$

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

$$\Rightarrow A\bar{B}\bar{C}D + A\bar{B}C\bar{D} + \bar{A}\bar{B}[CD + C\bar{D} +$$

$$\bar{C}D + \bar{C}\bar{D}]$$

$$(\bar{A} + J + \bar{J} + \bar{A}A)(\bar{A}d + j + \bar{a} + A)$$

\downarrow \downarrow \downarrow \downarrow

$$(\bar{A} + J + \bar{J} + A)(a + j + \bar{a} + A)$$

$$(\bar{a}m(A\bar{J} + \bar{J}^0)) \quad \begin{matrix} 3 \\ \bar{a} + J \end{matrix}, \begin{matrix} 2 \\ \bar{a} + J \end{matrix}, \begin{matrix} 0 \\ a + J \end{matrix}, \begin{matrix} 1 \\ a + J \end{matrix}$$

$$(a + J + \bar{a} + A)$$

P.T.O.

9.22 Minimizing \rightarrow standard \times
POS $\xrightarrow{9.22}$ POS

$$q\bar{J}AA + \bar{B}\bar{A} + \bar{J}\bar{B}A.$$

$$\rightarrow (A + \bar{B} + \bar{C} + \bar{P}) (\bar{B}\bar{A} + \bar{C}\bar{P}) A.$$

$$\rightarrow (\bar{A} + \bar{D}) \bar{B}\bar{A} + \bar{A} (\bar{A} + \bar{B} + \bar{C} + \bar{P}).$$

$$\rightarrow (A + \bar{B} + \bar{C} + \bar{P}) (\bar{A}\bar{B} + \bar{B} + \bar{C} + \bar{D})$$

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

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

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

Ans

$$* \overline{A} \overline{B} \overline{C} + \overline{A} B \overline{C} + \overline{A} \overline{B} C + A \overline{B} C +$$

A B C

N.D.E.S.O.A (Y)

$$\rightarrow H \sum m_i \left(\cancel{A_1} + 21x_2 + 23x_3 + A_5, 7 \right)$$

$\cancel{A_1} + D + E + F + G$

$$\rightarrow T T M_0 \left(1, 5, 8, 9, 8, 6, 2 \right) \text{ o } (N)$$

$$\begin{array}{r} 5 5 8 5 8 . 0 \\ \times 8 \\ \hline 4 4 0 0 0 0 \end{array} \quad \begin{array}{r} 2 0 0 0 0 0 \\ \cancel{A} + \cancel{B} + C \\ \hline 2 5 1 2 \end{array} \quad \begin{array}{r} 2 0 0 0 0 0 \\ \cancel{A} + \cancel{B} + C \\ \hline 2 5 1 2 \end{array}$$

$$\begin{array}{r} 2 0 0 0 0 0 \\ \times 8 \\ \hline 1 6 0 0 0 0 \\ \times 8 \\ \hline 1 2 8 0 0 0 0 \\ \times 8 \\ \hline 1 0 2 4 0 0 0 0 \\ \times 8 \\ \hline 8 1 9 2 0 0 0 0 \end{array}$$

$$\begin{array}{r} 2 0 0 0 0 0 \\ \times 8 \\ \hline 1 6 0 0 0 0 \\ \times 8 \\ \hline 1 2 8 0 0 0 0 \\ \times 8 \\ \hline 1 0 2 4 0 0 0 0 \\ \times 8 \\ \hline 8 1 9 2 0 0 0 0 \end{array}$$

~~5.11.22~~

MID

DLD

A + ~~DATA~~ SUMMER 2020 AT A *

2

J A A

(R) A02 E. D4

$$= A \times 16^3 + 0 \times 16^2 + 2 \times 16^1 + E \times 16^0 + \\ D \times 16^{-1} + 4 \times 16^{-2}$$

$$= (41006.82813)_{10} \text{ IN TT} *$$

8 | 42006

8 | 5125 - 6

8 | 640 - 5

8 | 80 - 0

8 | 10 - 0

8 | 10 - 0

2 - 2

(120056. ~~0523~~)₈
6500

$$\begin{array}{r} 0.82813 \\ \times 8 \\ \hline 6.62504 \\ \times 8 \\ \hline 5.00032 \\ \times 8 \\ \hline 0.00256 \\ \times 8 \\ \hline 0.02048 \end{array}$$

(N)

$$\begin{array}{r} 246 \\ \downarrow \\ 0010 \\ \downarrow \\ 0110 \\ \downarrow \\ 0111 \end{array}$$
$$\begin{array}{r} 756 \\ \downarrow \\ 0110 \\ \downarrow \\ 0101 \\ \downarrow \\ 0111 \end{array}$$
$$\begin{array}{r} 1002 \\ \downarrow \\ 0001 \\ \downarrow \\ 0010 \\ \downarrow \\ 0000 \end{array}$$
$$\begin{array}{r} (G^k + F) + (F + G^k) \\ \downarrow \\ (G^k + F) + (G^k + F) \\ \downarrow \\ 0000 \end{array}$$

$$\begin{array}{r} 0010 \\ 0111 \\ \hline 0100 \end{array}$$
$$\begin{array}{r} 0100 \\ 0101 \\ \hline 0101 \end{array}$$
$$\begin{array}{r} 0110 \\ 0110 \\ \hline 0110 \end{array}$$

$$\begin{array}{r} 2001 \\ 2001 \\ \hline 4000 \end{array}$$
$$\begin{array}{r} 1001 \\ 1010 \\ \hline 0110 \end{array}$$
$$\begin{array}{r} 1000 \\ 0110 \\ \hline 0110 \end{array}$$

$$\begin{array}{r} 2010 \\ 0110 \\ \hline 0000 \end{array}$$
$$\begin{array}{r} 0000 \\ 0010 \\ \hline 0010 \end{array}$$

$$\begin{array}{r} 0001 \\ 0000 \\ \hline 1 \end{array}$$
$$\begin{array}{r} 0000 \\ 0 \\ \hline 0 \end{array}$$
$$\begin{array}{r} 0000 \\ 0 \\ \hline 0 \end{array}$$
$$\begin{array}{r} 0010 \\ 2 \\ \hline \end{array}$$

Σ

(4)

$$\begin{aligned}
 & \cancel{\overline{xy}} + \cancel{000} \\
 & \rightarrow (\cancel{x'y'z'} + z) + z \cancel{x'y} + \cancel{z} \\
 & \rightarrow (\cancel{x'y'z'}) + z (\cancel{1 + w}) + x'y \\
 & \Rightarrow (\cancel{x'y'z'}) + (\cancel{z} + \cancel{x'y}) \\
 & \rightarrow (\cancel{1 + x'y'}) + (\cancel{z} + \cancel{x'y}) \\
 & \Rightarrow \cancel{\overline{xy} + \cancel{000} + \cancel{000} + \cancel{000}} \\
 & \Rightarrow (\cancel{\overline{z} + \cancel{x'y}}) + z + x'y \\
 & \Rightarrow \cancel{x'y} (\cancel{\overline{z} + z}) + z \\
 & \Rightarrow \cancel{x'y} + z \\
 & \quad \text{A} \\
 & \begin{array}{r} 0100 \\ - 0110 \\ \hline 0010 \end{array} \quad \begin{array}{r} 0000 \\ - 0110 \\ \hline 0000 \end{array} \quad \begin{array}{r} 0000 \\ - 0110 \\ \hline 0000 \end{array} \quad \begin{array}{r} 1000 \\ - 0110 \\ \hline 1000 \end{array} \\
 & \quad \text{A}
 \end{aligned}$$

(N) Compliment ~~not input A~~ ~~not output B~~

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

$$\Rightarrow (A' \cdot B \cdot C) + (A + B' \cdot C') + (A' \cdot B' + C')$$

suppose not winning ↓

turns Eben (an 3, 5, 6; 9, 11, 13, 15)

1	2	3
4	5	6
7	8	9

your turn		
short white		
white		short white
white		white

8

white

21

N

w

w

471

W

8-11.22

DLD

* Boolean Algebra } minimization (d)

CT

* SOP | POS } minimization (d)

$(\bar{A} + \bar{B} \cdot \bar{C}) \overline{F(\bar{M} + \bar{P}(\bar{A} + \bar{B})) + (\bar{I} \cdot \bar{A} \cdot \bar{B})}$

↳ minimization technique

↳ most minimized circuit

↳ Karnaugh Map

↳ Truth table

↳ Karnaugh version

Truth table

row

3 var

4

n

K-map

cell

8

16

2^n

P.J.

Binary bit sum \rightarrow gray code

Dec	Bin	Gray
0	0000	0000
1	0001	0001
2	0010	0011
3	0011	0110
4	0100	1100
5	0101	1101
6	0110	1110
7	0111	1111
8	1000	0000
9	1001	0001
10	1010	0011
11	1011	0110
12	1100	1100
13	1101	1101
14	1110	1110
15	1111	1111

at 22 C + P - new bid Grand

A B C

0 0 0

0 0 1

0 2 0

0 2 1

AD

00

$\bar{A} \bar{B}$

01

$\bar{A} B$

02

AB

11

$A \bar{B}$

10

000	010	110	200
0	1	2	4
001	011	111	201
2	3	7	5

P J.^o

~~DATA + DATA + DATA~~

		$\bar{A}\bar{B}$	$\bar{A}B$	$A\bar{B}$	AB	
		00	01	10	11	
		CD	0000	0200	2200	2000
$\bar{C}\bar{D}$	00	00	0	4	12	8
$\bar{C}\bar{D}$	02	0002	0101	1101	2001	5
$\bar{C}\bar{D}$	12	0011	0111	1111	2011	10
$\bar{C}\bar{D}$	20	0010	0110	1110	2010	11
		2	6	14	10	5

PT. 0

$$* \overline{A}\overline{B} CD + \overline{A} B \overline{C}\overline{D} + A B \overline{C} D + \cancel{A B C D} + \cancel{A B C D}$$

	$\overline{A}\overline{B}$	$\overline{A}\overline{B}$	$\overline{A}\overline{B}$	$\overline{A}\overline{B}$	$\overline{A}\overline{B}$
$\overline{C}D$	00	01	11	11	20
$\overline{C}D$	00	01	11	11	20
$\overline{C}D$	01	01	11	11	20
$\overline{C}D$	11	11	11	11	20
$\overline{C}D$	00	01	11	11	20
$\overline{C}D$	01	01	11	11	20
$\overline{C}D$	11	11	11	11	20
$\overline{C}D$	00	01	11	11	20

P.T.O. 0.79

Map the following: SOP

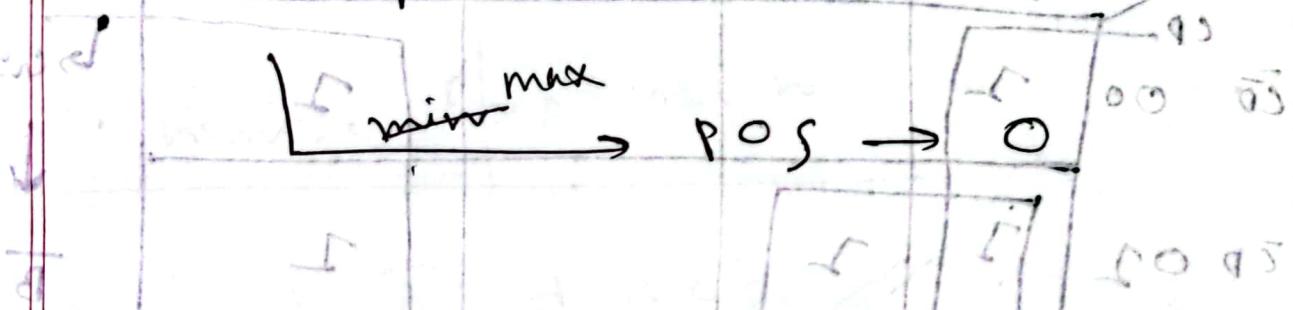
expression over K-map

$$B' \bar{C} \bar{D} + A \bar{B} \bar{C} + A \bar{B} C + A B \bar{C} D +$$

X map

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

at K-map $\xrightarrow{\text{min}}$ SOP $\rightarrow \bar{A} \bar{B} C D$



1 Q-4 Grouping

$$\hookrightarrow 2^0 = 1$$

$$\hookrightarrow 2^2 = 2$$

$$2^4 = 4$$

$$2^3 = 8$$

$$2^4 = 16$$

$$1100$$

$$0101$$

$$1110$$

$$0011$$

$$1000$$

$$0001$$

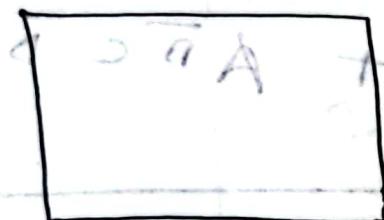
Ans

IT-9

Target : ~~state of test group~~

q = 2 Create ~~target~~ states

* A adjacent cell



* Overlapping

→ partition

→ full X

		$\bar{A}B$	$\bar{A}\bar{B}$	$A\bar{B}$	AB	
		00	01	10	11	
		CD 00	CD 01	CD 10	CD 11	
CD	00	1	0	0	1	
CD	01	1	1	0	1	
CD	11	1	1	1	1	
CD	10	1	0	1	1	
		P = 1/2		P = 1/2		
$\bar{A}D$		$Q_0 = 1/2$		$Q_1 = 1/2$		
		P_{T-1}		P_T		
		$C_0 = 3$		$C_1 = 3$		
		$A \subset D$				

PT-1

$$\begin{array}{c}
 AB \\
 \hline
 \overline{CD} \rightarrow 00
 \end{array}
 \quad
 \begin{array}{l}
 (0+0) 0 2 (0+2) 1 (\overline{A}+\overline{A}) \bar{0} = \\
 1 (\overline{0}+0) (\overline{0}+2) 1 (\overline{\overline{A}}\bar{A}+\overline{A}\bar{A}) \bar{0} = \\
 (\overline{0}+0) \cdot (\overline{0}\overline{\overline{A}} + \overline{0}\overline{A}) \bar{0} = \\
 0 \overline{0}\overline{A} + 0 \overline{0}\overline{A} + \overline{0}\overline{A} \bar{A} + \overline{0}\overline{A} \bar{A} \bar{A} = \\
 \overline{0}\overline{A} + \overline{0}\overline{A} \bar{A} + \\
 \overline{0}\overline{A} \\
 0 \bar{0}
 \end{array}$$

Minimize Expression

$$\Rightarrow \overline{B} + \overline{A}D + A\overline{C}\overline{D}$$

$$\Rightarrow \overline{B} + \overline{A}D + A\overline{C}\overline{D}(B + \overline{B})$$

$$\Rightarrow \overline{B} + \overline{A}D + ABC\overline{D} + A\overline{B}\overline{C}\overline{D}$$

$$\Rightarrow \overline{B} + \overline{A}D(B + \overline{B})(C + \overline{C}) + ABC\overline{D} + A\overline{B}\overline{C}\overline{D}$$

$$\Rightarrow \overline{B} + (\overline{A}B\overline{D} + \overline{A}\overline{B}D)(C + \overline{C}) + ABC\overline{D} + A\overline{B}\overline{C}\overline{D}$$

$$\Rightarrow \overline{B} + (\overline{A}BCD + \overline{A}\overline{B}\overline{C}D + AB\overline{C}\overline{D} + A\overline{B}\overline{C}\overline{D})$$

P.T.O.

$$\Rightarrow \overline{B} (A + \overline{A}) (C + \overline{C}) (D + \overline{D})$$

$$\Rightarrow (\overline{B}A + \overline{B}\overline{A}) (C + \overline{C}) (D + \overline{D})$$

$$\Rightarrow (A\overline{B}C + \overline{A}\overline{B}\overline{C}) (D + \overline{D})$$

$$\Rightarrow \underline{A\overline{B}C D} + \underline{\overline{A}\overline{B}\overline{C}\overline{D}} + \overline{A}BCD + \overline{A}\overline{B}\overline{C}D$$

$$+ ABC\overline{D} + A\overline{B}C\overline{D}$$

\overline{AB}
00

\overline{AB}
01

AB
11

$A\overline{B}$
10

$\overline{CD}00$	1		
$\overline{CD}01$	1	$\overline{A} + A\overline{B} + \overline{B}$	
$CD11$	1	$(\overline{A} + A)\overline{B}A + A\overline{B} + \overline{B}$	
$CD10$	0	$\overline{B}A + \overline{A}BA + (\overline{A} + A)(\overline{B}A + BA)$	
$\overline{CD}11$	0	$\overline{B}A + \overline{A}BA + A\overline{B}\overline{A} + A\overline{B}A$	

~~11-11-22~~

~~Lesson 10 A~~

DLD

Fall 2020

100

~~2~~
~~(a)~~

$$(x+y+z') \cdot (x+y'+z') \cdot (x'+y'+z)$$

~~(b)~~

$$\cancel{x}y' + \cancel{x}y'z' + xy + y'z$$

$$\cancel{= x}y' + \cancel{y}z' + \cancel{xy}(z+z') + \cancel{y'z} \cancel{(x+x')}$$

$$= y' + yz' + xy + y'z + x'y'z$$

$$= y' + yz + y'z$$

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

$$= y + y'z$$

~~✓~~

Fall - 2022

3
(k) $A + B (C + \overline{A} + C)$

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

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

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

$$\Rightarrow A + B \bar{A} + BC$$

$$\Rightarrow (A + B)(A + \bar{A}) + BC$$

$$(A + A)$$

$$\Rightarrow A + B + BC$$

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

$$\Rightarrow A + B (1 + C)$$

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

$$\Rightarrow A + B$$

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

P.T.O

GV
32.11.22

P2D

K-MAP \rightarrow POS 201 625 minimized

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

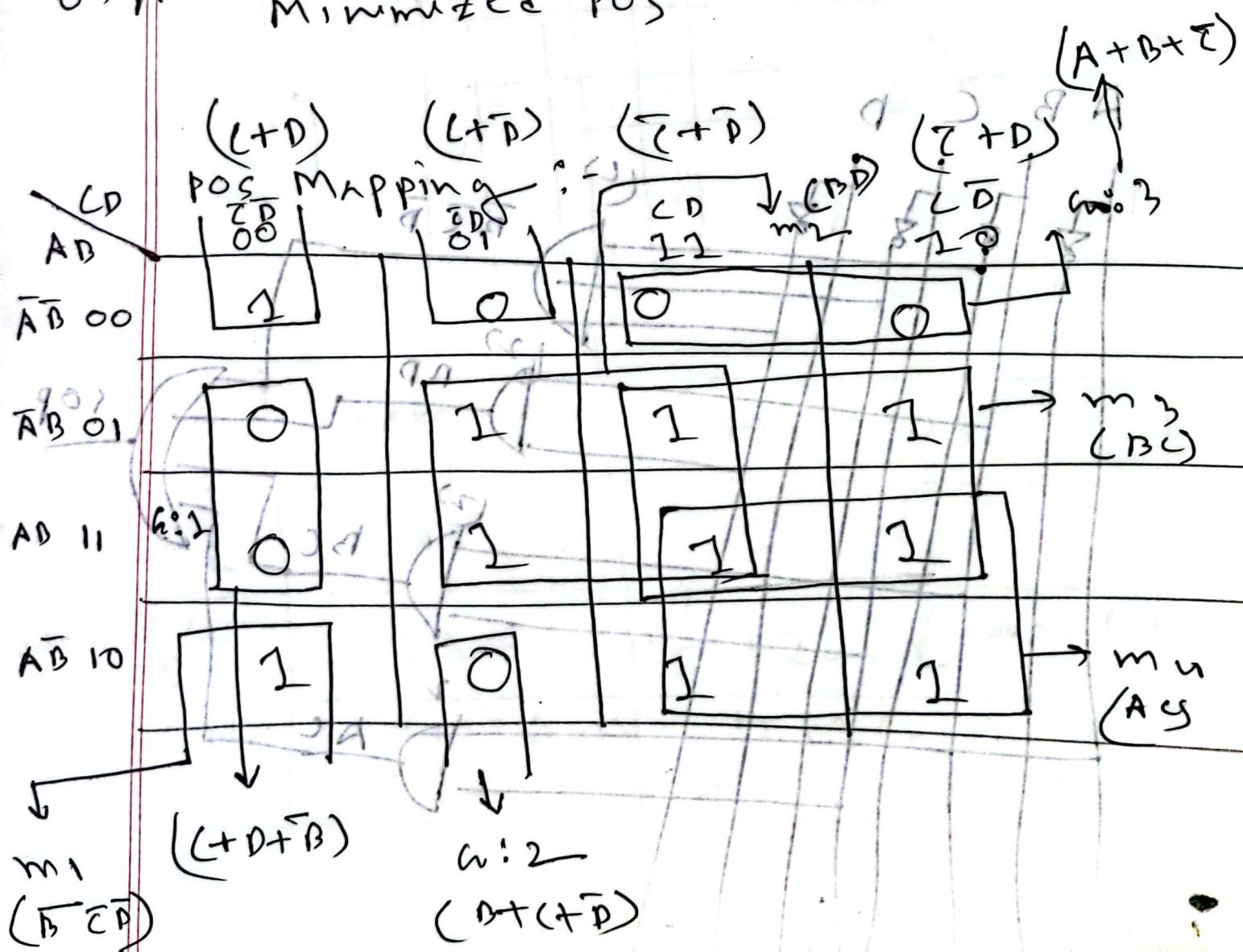
\rightarrow Optimize / Minimize K-MAP
Minimized POS

Maxterm
 $2 \rightarrow \bar{A}$
 $0 \rightarrow A$

Minimized POS

minimized

$\bar{A} + \bar{B} + AB + \bar{A}\bar{B}$ TSOP



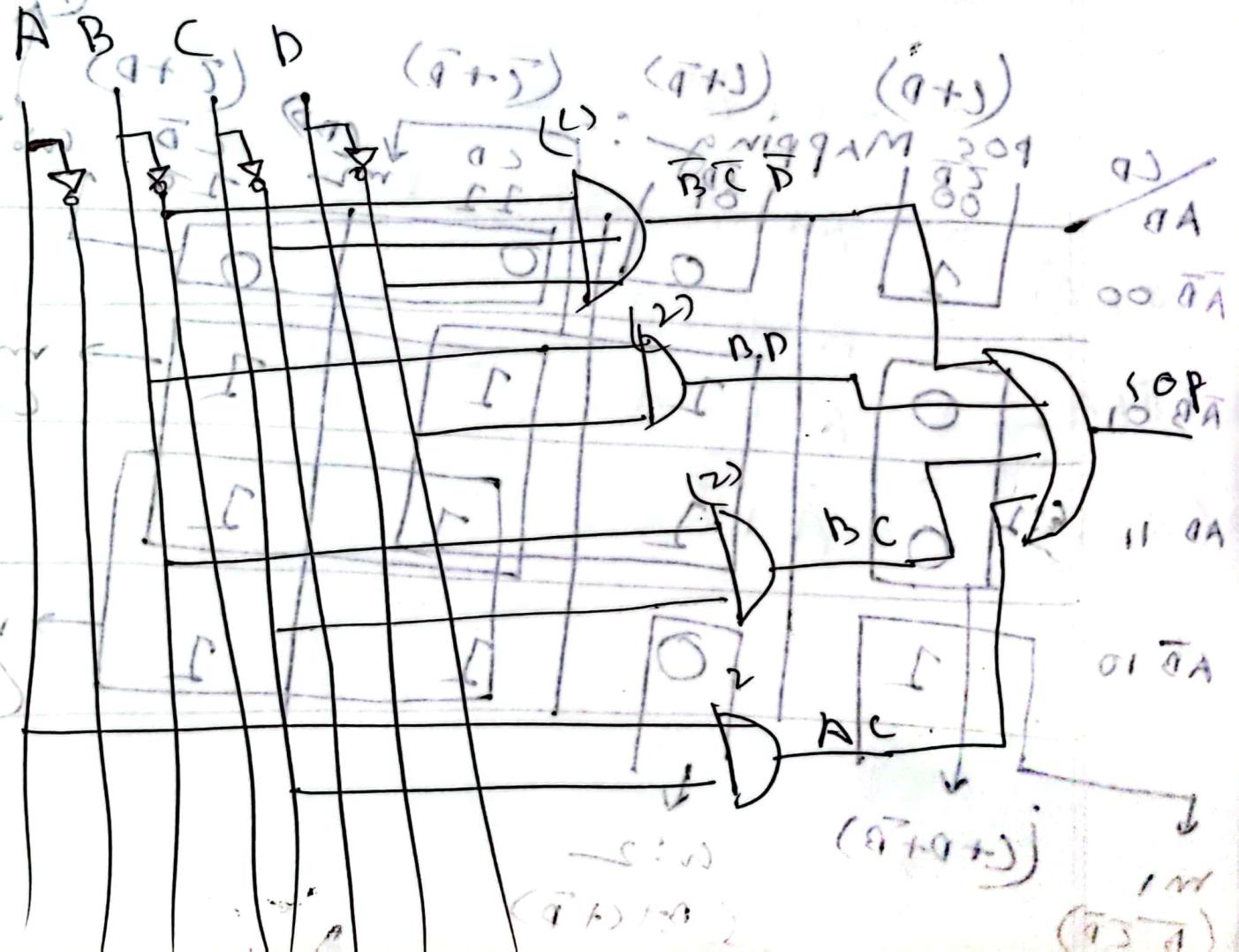
Minimized POS: $Z_{01} \leftarrow A + M + Y$

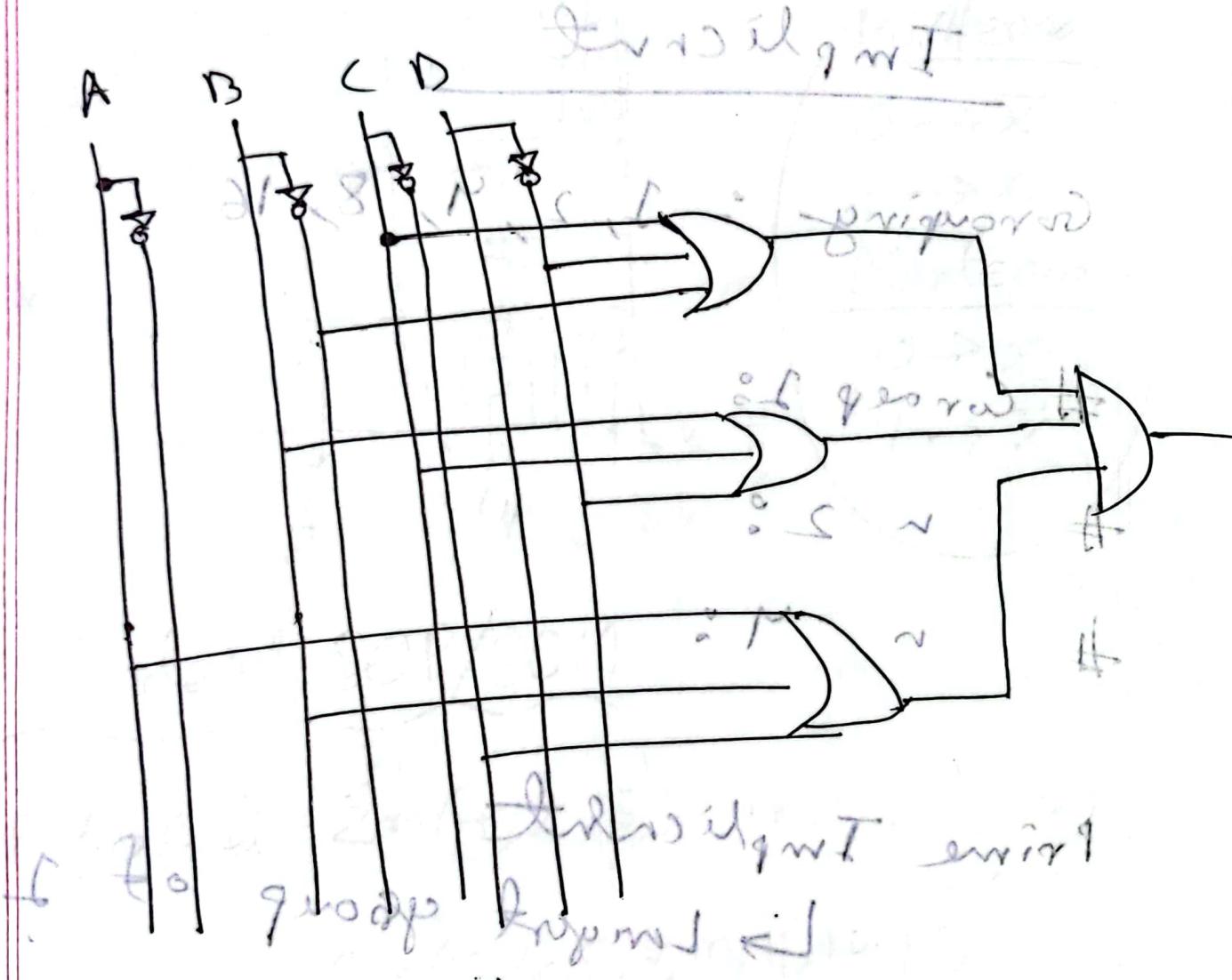
~~Minimized POS: $Z_{01} \leftarrow (C + D + \bar{B}) (Z_{01} + (A + \bar{M})) (A + B + \bar{C})$~~

Minimized SOP: -

$Z_{01} \leftarrow \bar{B} \bar{C} \bar{D} + BD + BC + AC$

$(\bar{A} + A)$





Cost criterion	Min Freq SOP	Min POS
(literal)	9	9
(without negation)	13	15 12 (term+literal)
GN	$13 + 3 \text{ (not)}$ $\Rightarrow 16$	$12 + 3 \text{ (not)}$ $\Rightarrow 17$ (term+literal+not)

Implicant

Grouping → 1, 2, 4, 8, 16

Group 2°

n 2°

n 4°

Prime Implicant

→ Largest group of 2

→ cover enough possible
group

(multiple rows)

→ 51

P.I.

(top) S + S'

and don't care

S' S

(top) S + S'

S' S

and

don't care

and

don't care

Minterm

$\Rightarrow 0$

	$\bar{C}D$	$C\bar{D}$	CD	$C\bar{D}$
$\bar{A}B$	00	01	11	10
$A\bar{B}$	00			10
$\bar{A}B$	01	11	11	10
AB	11	11	11	10
$A\bar{B}$	10			10

Minterm

$$0 \rightarrow \bar{x}$$

$$1 \rightarrow x$$

Maxterm

$$0 \rightarrow x$$

$$1 \rightarrow \bar{x}$$

standard SOP/SOM

$$F(A, B, C, D) = \sum m(4, 2, 5, 7, 14, 15, 11, 10)$$

$$= \sum m(2, 4, 5, 7, 10, 11, 14, 15)$$

$$\left. \begin{array}{l} \overline{AB}\overline{CD} + \overline{A}\overline{B}\overline{C}\overline{D} + \overline{A}\overline{B}\overline{C}D + \overline{ABC}\overline{D} + A\overline{B}\overline{C}\overline{D} \\ + AB\overline{CD} + A\overline{B}CD + A\overline{B}\overline{C}\overline{D} \end{array} \right\}$$

$$\left. \begin{array}{l} (\overline{A}+\overline{B}+\overline{C}+\overline{D}) (\overline{A}+\overline{B}+\overline{C}+D) (\overline{A}+\overline{B}+C+\overline{D}) \\ (\overline{A}+\overline{B}+C+D) (\overline{A}+B+\overline{C}+\overline{D}) (A+\overline{B}+\overline{C}+\overline{D}) \end{array} \right\} \text{minimized}$$

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

$$\Rightarrow (+)(+)(++)$$

Masterom

	$C+D$	$C+\bar{D}$	$\bar{C}+\bar{D}$	$\bar{C}+D$	10	00
AB	00	01	11	10		
$A+B$	00					
$A+\bar{B}$	01	(4)	(5)	(6)	(7)	
$\bar{A}+\bar{B}$	11					
$\bar{A}+B$	10	(9)	(10)			

POS/POM

4

3

Most biabot

$$F(A, B, C, D) = \prod M(3, 4, 5, 7, 6, 14, 9, 11)$$

$$(2, 8) = \prod M(3, 4, 5, 6, 7, 9, 11, 14)$$

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

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

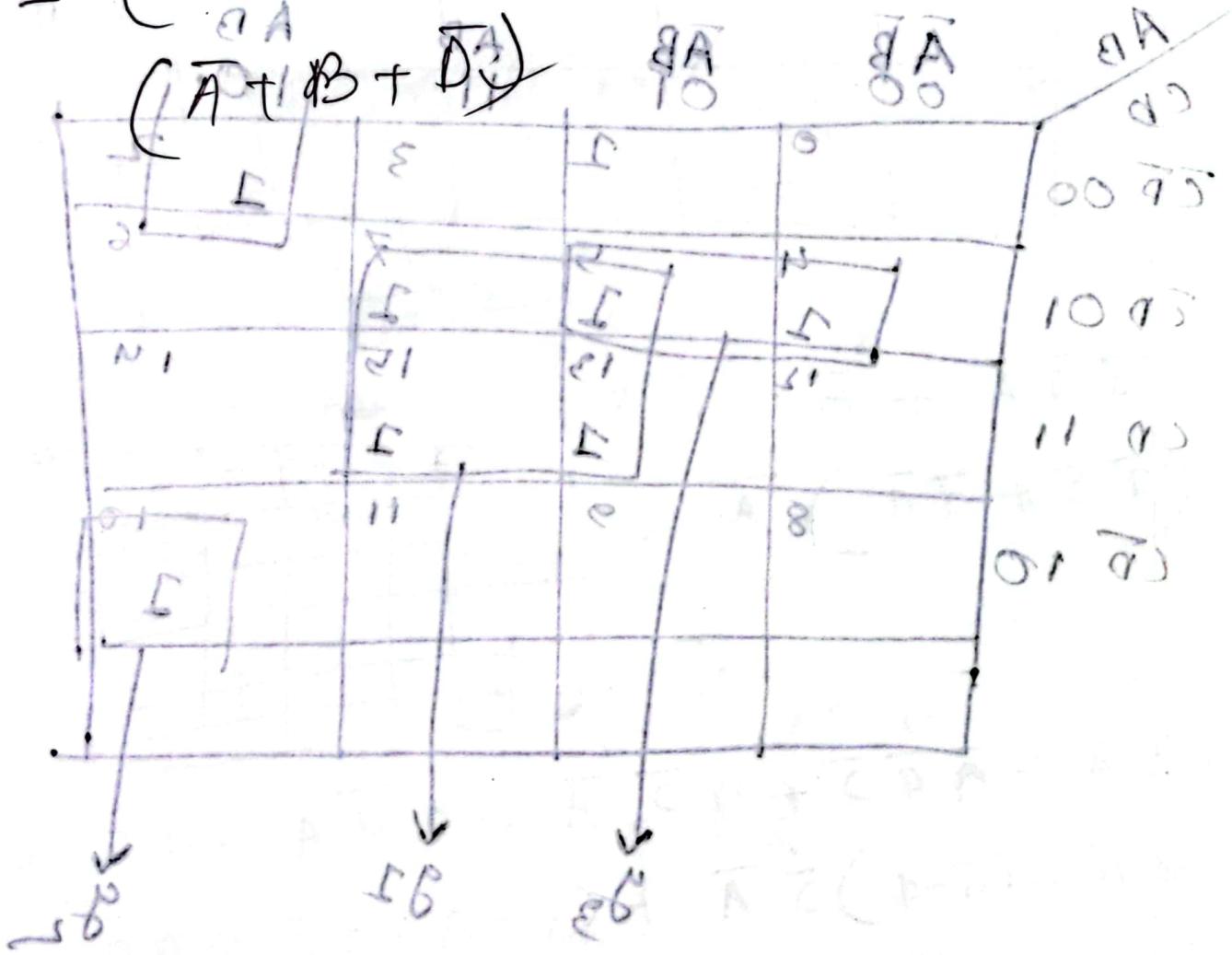
$$= (A+\bar{B})(\bar{B}+\bar{C}+D)(\bar{C}+\bar{D}+B) (A+\bar{B}+\bar{D})$$

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

(B' + C + A'D)

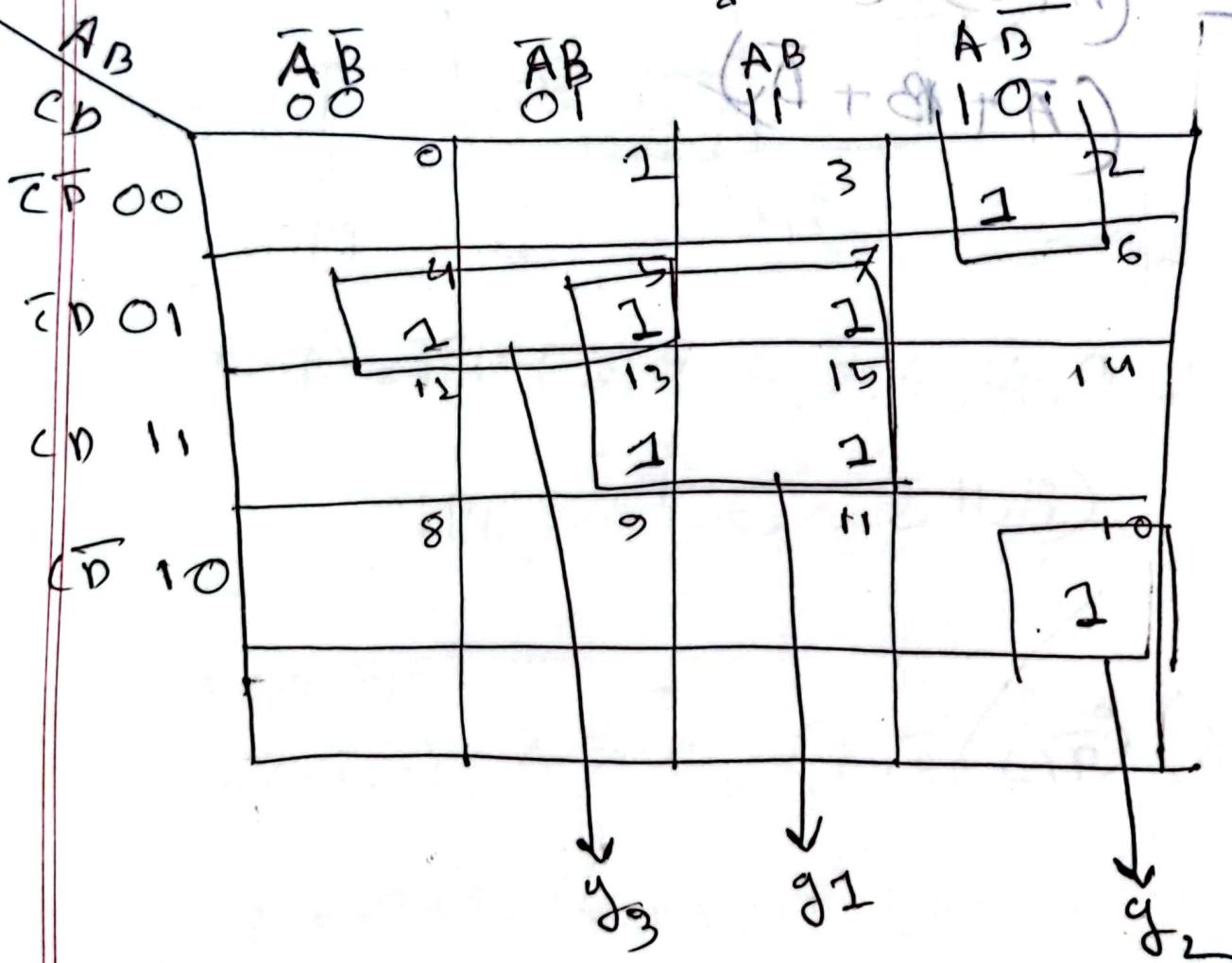
$$+ (0, 1, 0, 1, 1, 0, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1)$$

$$= \frac{(1, 0, 1, 0, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1)}{(A + \bar{B}) (\bar{B} + \bar{C} + D) (B + \bar{C} + \bar{D})}$$



$$D(A' + \bar{B}' \bar{A} + \bar{A} \bar{B}) = (0, 1, 1)$$

$$\begin{aligned}
 & \cancel{5} \cdot (\bar{A} + B + A) (A + \bar{B} + \bar{A}) (\bar{A} + A) = \\
 & F(A, B, C, D) = \sum_m (2, 4, 5, 7, 10, 13, 15) + \\
 & (\bar{A} + \bar{B} + \bar{D}) (\sum_a (0, 1, 6, 8, 11)) (\bar{C} + A)
 \end{aligned}$$



$$F(A, B, C, D) = \cancel{AB}BD + A\bar{B}\bar{D} + \bar{A}\bar{C}D$$

$\bar{A}B$	$\bar{A}\bar{B}$	$\bar{A}B$	$\bar{A}\bar{B}$	$\bar{A}B$	$\bar{A}\bar{B}$
CD	$\bar{C}\bar{D}$	00	01	11	10
$\bar{C}\bar{D}$	00	1	2	3	2
$\bar{C}\bar{D}$	01	4	5	7	6
CD	11	8	9	15	14
$\bar{C}\bar{D}$	10	1	2	11	10

(1)

$\bar{A}B$	$\bar{A}\bar{B}$	$\bar{A}B$	$\bar{A}\bar{B}$
$\bar{C}\bar{D}$	$\bar{C}D$	$\bar{C}\bar{D}$	$C\bar{D}$
$\bar{C}D$	$\bar{C}\bar{D}$	00	01
$\bar{C}\bar{D}$	$C\bar{D}$	11	10
$C\bar{D}$	$C\bar{D}$	00	01
$C\bar{D}$	$\bar{C}\bar{D}$	11	10

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

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

$$\begin{aligned} &= BD + \bar{B}\bar{D} + \bar{A}\bar{C} + \bar{A}\bar{B}\bar{D} \\ &= BD + \bar{B}\bar{D}(1 + \bar{A}) + \bar{A}\bar{C} \\ &= BD + \bar{B}\bar{D} + \bar{A}\bar{C} \end{aligned}$$

~~SOM~~

$$\begin{aligned} f(x_1, x_2, x_3) &= \sum m(2, 3, 4, 6, 7) \\ &= \overline{x_1} \overline{x_2} \overline{x_3} + \overline{x_1} x_2 \overline{x_3} + x_1 \overline{x_2} \overline{x_3} + \\ &\quad \cancel{x_1} \cancel{x_2} \cancel{x_3} + \cancel{x_1} \cancel{x_2} x_3 \\ &\quad + x_2 \overline{x_3} (\cancel{x_1} + x_1) + \overline{x_1} x_2 \overline{x_3} + x_1 \overline{x_2} \overline{x_3} \\ &= \cancel{x_2} \overline{x_3} + x_2 \overline{x_3} (\cancel{x_1} + x_1) + x_1 \overline{x_2} \overline{x_3} \\ &\Rightarrow x_2 \overline{x_3} + \cancel{x_2} \overline{x_3} + x_1 \overline{x_2} \overline{x_3} \\ &\Rightarrow x_2 (\overline{x_3} + x_3) + x_1 \overline{x_2} \overline{x_3} \\ &\Rightarrow x_2 + x_1 \overline{x_2} \overline{x_3} \\ &\Rightarrow 1 + (\overline{x_2}) \overline{x_3} + (\overline{x_1} + x_1) \overline{x_2} \overline{x_3} \\ &\Rightarrow \overline{x_1} \overline{x_2} + \overline{x_2} \overline{x_3} + \overline{x_1} \overline{x_2} \overline{x_3} \end{aligned}$$

$$b \cancel{dx_1} = x_2 \overline{x_3} (\overline{x_1} + b x_1) + x_2 x_3 \cancel{(x_1 + x_1)}$$

$$\cancel{b \cancel{dx_1}} + x_1 \overline{x_2} \overline{x_3}$$

$$+ (\cancel{b x_2}) \overline{x_3} + x_2 + x_3 + x_1 \cancel{\overline{x_2} \overline{x_3}}$$

$$= \overline{b} \cancel{x_2} (\overline{x_3} + x_3) + x_1 \overline{x_2} \overline{x_3}$$

$$= \overline{b} \cancel{dx_2} x_2 + x_1 \overline{x_2} \overline{x_3} + b \cancel{x_3}$$

$$b \cancel{dx_1} + b \cancel{dx_2} + (\cancel{b} + \cancel{d}) b$$

$$f(\cancel{x_1}, \cancel{x_2}, \cancel{x_3}, \cancel{b}, \cancel{c}, \cancel{d})$$

$$= \sum m(3, 7, 9, 12, 13, 14, 15)$$

$$= \cancel{a} \overline{b} \cancel{c} \overline{d} + \cancel{b} \overline{a} \overline{c} \overline{d} + \cancel{a} \overline{b} \overline{c} d +$$

$$+ \cancel{b} \overline{a} \overline{b} \overline{c} \overline{d} + \cancel{a} \overline{b} \overline{c} d + \cancel{a} \overline{b} c \overline{d} + \cancel{a} b \overline{c} \overline{d}$$

$$= \cancel{b} \cancel{a} \cancel{b} c \overline{d} + \cancel{a} c \overline{d} (\overline{r} + r) + \cancel{b} \overline{a} \overline{c} d + \cancel{a} \overline{c} \overline{d}$$

$$= \cancel{b} \cancel{a} \cancel{b} c \overline{d} + \cancel{a} c \overline{d} + \cancel{a} \overline{b} \overline{c} d + \cancel{a} b \overline{c} \overline{d} +$$

$$= \cancel{a} \overline{b} c \overline{d} + b \overline{c} \overline{d} + \cancel{a} \overline{b} \overline{c} d + \cancel{a} b \overline{c} (\overline{c} + \overline{c}) +$$

$$+ \cancel{a} b \overline{c} \overline{d}$$

LII

$$\begin{aligned}
 & (\alpha = \overline{a}) \overline{b} \times \overline{c} \delta + \cancel{\alpha c \delta + \cancel{\alpha b \delta}} + \cancel{\alpha b \delta} \\
 & \quad \cancel{\overline{c} \times \cancel{\overline{c}}, \cancel{c} + \cancel{\alpha b \delta}} \\
 & = \cancel{\overline{b} \overline{c} \delta} + \cancel{\alpha c \delta} + \cancel{\alpha \overline{c} \delta} (\cancel{b} + \cancel{b}) + \\
 & \quad \cancel{\cancel{\alpha} \cancel{c}, \cancel{c} + (\cancel{\alpha} + \cancel{\alpha})} \cancel{\cancel{\alpha} \cancel{b} \delta} \\
 & = \cancel{\overline{b} \overline{c} \delta} + \cancel{\alpha c \delta} + \cancel{\alpha \overline{c} \delta} + \cancel{\alpha b \delta} \\
 & = \cancel{c \delta} (\cancel{\overline{b} \overline{b} + \cancel{b}}) + \cancel{r \overline{c} \delta} + \cancel{\alpha b \delta} \\
 & = \cancel{c \delta} ((\cancel{b} + \cancel{b}) (\cancel{b} + \cancel{b})) + \cancel{r \overline{c} \delta} + \cancel{\alpha b \delta} \\
 & \quad + \cancel{b \overline{c} \delta} + \cancel{b \overline{c} \delta} + \cancel{r \overline{c} \delta} + \cancel{r \overline{c} \delta} \\
 & = \cancel{c \delta} (\cancel{b} + \cancel{b}) + \cancel{r \overline{c} \delta} + \cancel{r \overline{c} \delta} \\
 & \Rightarrow \cancel{\cancel{b} \cancel{c} \delta} + \cancel{r \overline{c} \delta} + \cancel{r \overline{c} \delta} + \cancel{\alpha b \delta} \\
 & \Rightarrow \cancel{\cancel{b} \cancel{c} \delta} + \cancel{(\cancel{r} + \cancel{r}) \cancel{b} \delta} + \cancel{r \overline{c} \delta} \\
 & = \cancel{c \delta} (\cancel{r} + \cancel{r}) + \cancel{b \overline{c} \delta} + \cancel{b \overline{c} \delta} \\
 & \Rightarrow \cancel{\cancel{b} \cancel{c} \delta} + \cancel{b \overline{c} \delta} \\
 & \Rightarrow \cancel{(\cancel{r} + \cancel{r}) \cancel{b} \delta} + \cancel{b \overline{c} \delta} + \cancel{b \overline{c} \delta} + \cancel{b \overline{c} \delta} \\
 & \quad \cancel{\cancel{b} \cancel{c} \delta}
 \end{aligned}$$

9 15 22

AB	CD	EF	GH	IJ	KL	MN	OP
00	00	01	01	11	10	10	10
S	(t+x)	(t+x)	(t+x)	1	1	1	1
CD	00	01	01	2	2	2	2
EF	00	01	01	2	2	2	2
GH	00	01	01	2	2	2	2
IJ	00	01	01	2	2	2	2
KL	00	01	01	2	2	2	2
MN	00	01	01	2	2	2	2
OP	00	01	01	2	2	2	2

~~AB~~ = ~~0~~ · ~~AB~~ *
~~CD~~ = ~~00~~ · ~~CD~~ *
~~EF~~ = ~~00~~ · ~~EF~~ *
~~GH~~ = ~~00~~ · ~~GH~~ *
~~IJ~~ = ~~01~~ · ~~IJ~~ *
~~KL~~ = ~~01~~ · ~~KL~~ *
~~MN~~ = ~~01~~ · ~~MN~~ *
~~OP~~ = ~~01~~ · ~~OP~~ *

$x = G \cdot E + x \rightarrow C_2 = \bar{E} \cdot x$
 $x = (G+x) \cdot x \rightarrow G = \bar{x} + x$
 $= CD + \bar{A}BC + A\bar{B}C$

(S+x)	(S+x)	(t+x)	x	x	x	x	x
(S+x)	(S+x)	(t+x)	x	x	x	x	x
(S+x)	(S+x)	(t+x)	x	x	x	x	x
(S+x)	(S+x)	(t+x)	x	x	x	x	x
(S+x)	(S+x)	(t+x)	x	x	x	x	x
(S+x)	(S+x)	(t+x)	x	x	x	x	x
(S+x)	(S+x)	(t+x)	x	x	x	x	x
(S+x)	(S+x)	(t+x)	x	x	x	x	x
(S+x)	(S+x)	(t+x)	x	x	x	x	x
(S+x)	(S+x)	(t+x)	x	x	x	x	x

$x = \bar{F} \cdot x + G \cdot x$
 $x = (\bar{F}+x) \cdot (G+x)$
 $\bar{F} \cdot x = \frac{1}{G+x}$
 $\bar{G} \cdot x = \frac{1}{G+x}$
 $G \cdot x = \bar{G} \cdot x + x$
 $G \cdot x = (t+\bar{x}) \cdot x$
 $\bar{x} + G \cdot x = \bar{x} \cdot \bar{x} + G \cdot t + G \cdot x - x$

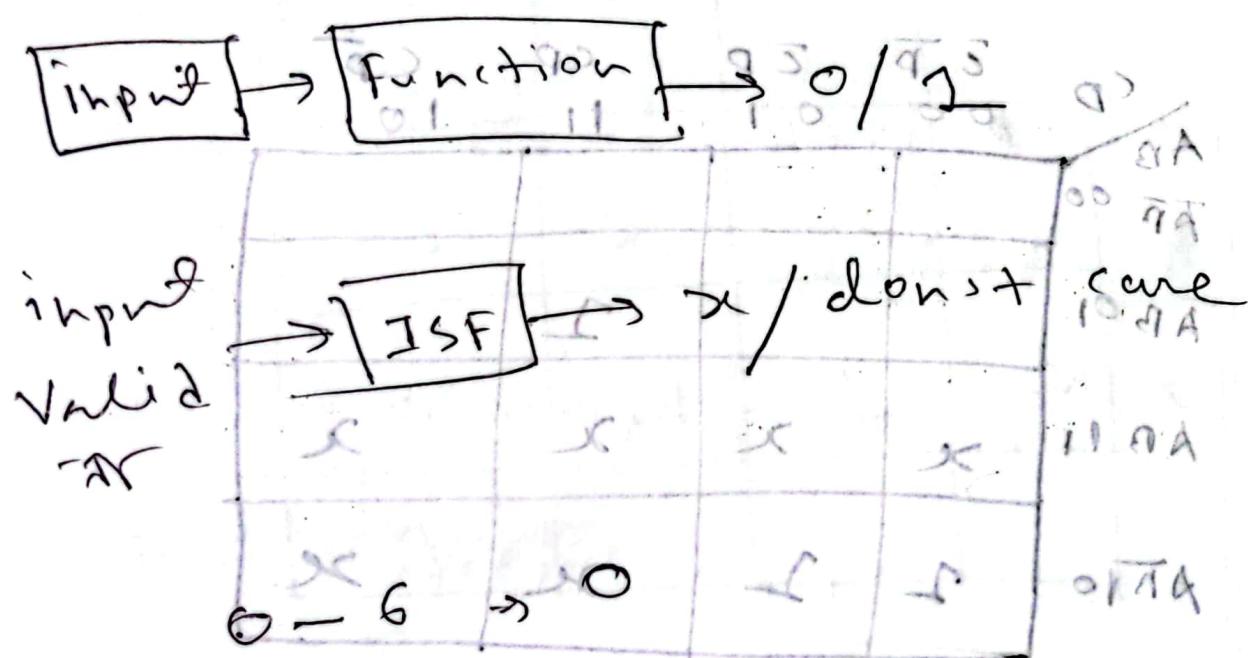
$$\begin{aligned}
 * & x \cdot 0 = 0 \\
 * & x + 1 = 1 \\
 * & x \cdot 1 = x \\
 * & x + 0 = x \\
 * & x \cdot x = x \\
 * & x + x = x \\
 * & x - \bar{x} = 0 \\
 * & x + \bar{x} = 1 \\
 * & \bar{\bar{x}} = x
 \end{aligned}$$

$$\begin{aligned}
 * & x \cdot j = j \cdot x \\
 * & x + j = j + x \\
 * & x \cdot (j \cdot z) = (x \cdot j) \cdot z \\
 * & x \cdot (j + z) = (x \cdot j) + z \\
 * & x \cdot (j + z) = x \cdot j + x \cdot z \\
 * & x + (j \cdot z) = (\bar{x} \cdot j) \cdot (x + z)
 \end{aligned}$$

$$\begin{aligned}
 * & x \cdot j + x \cdot \bar{j} = x \\
 * & (x + j) \cdot (x + \bar{j}) = x \\
 * & \overline{x \cdot j} = \overline{x} + \bar{j} \\
 * & \overline{x + j} = \overline{x} \cdot \bar{j} \\
 * & x + \overline{x} \cdot j = x + j \\
 * & x \cdot (\overline{x} + j) = x \cdot j \\
 * & x + j + j \cdot z + \overline{x} \cdot z = x \cdot j + \overline{x} \cdot z
 \end{aligned}$$

~~GW~~
14.11.22

Incompletely Specified Function DLD



$7-9 \rightarrow 1$
 $201 \leftarrow 0, L = (don't care)$
 $20-25 \downarrow \rightarrow 002$

Total state count is 6 million \Rightarrow

PTT

~~Sum of minterms~~

CD	$\bar{C}\bar{P}$	$\bar{C}P$	$C\bar{P}$	CP	$\bar{C}\bar{P}$	$\bar{C}P$	$C\bar{P}$	CP
$A\bar{B}$	00	01	11	10	00	01	11	10
$\bar{A}\bar{B}$	00							
$\bar{A}B$	01							
AB	11	x	x	x	x	x	x	x
$A\bar{B}$	10	2	2	0x	2	2	2	2

* Minimize $\Rightarrow x = 2, 0 \leftarrow P = F$
 \downarrow pos
SOP

* Unnecessmly $x = 2$ extra \bar{x} ,

~~6-2
15.77.2~~

Design Problem (Ans)

~~Ans~~

~~Ans~~

A	B	C	D	F	G
0	0	0	0	0	1
0	0	0	1	0	1
0	0	1	0	1	1
0	0	1	1	1	0
0	1	0	0	0	1
0	1	0	1	1	1
0	1	1	0	0	0
0	1	1	1	1	0
1	0	0	0	0	0
1	0	0	1	0	0
1	0	1	0	0	x
1	0	1	1	1	x
1	1	0	0	0	x
1	1	0	1	1	x
1	1	1	0	0	x
1	1	1	1	0	x

* Prime numbers (0 - 15), Q.A.J7

$(2, 3, 5, 7, 11, 13)$ positions of stars

$\frac{1}{1}, \frac{1}{1}, \frac{1}{1}, \frac{1}{1}, \frac{1}{1}, \frac{1}{1}$

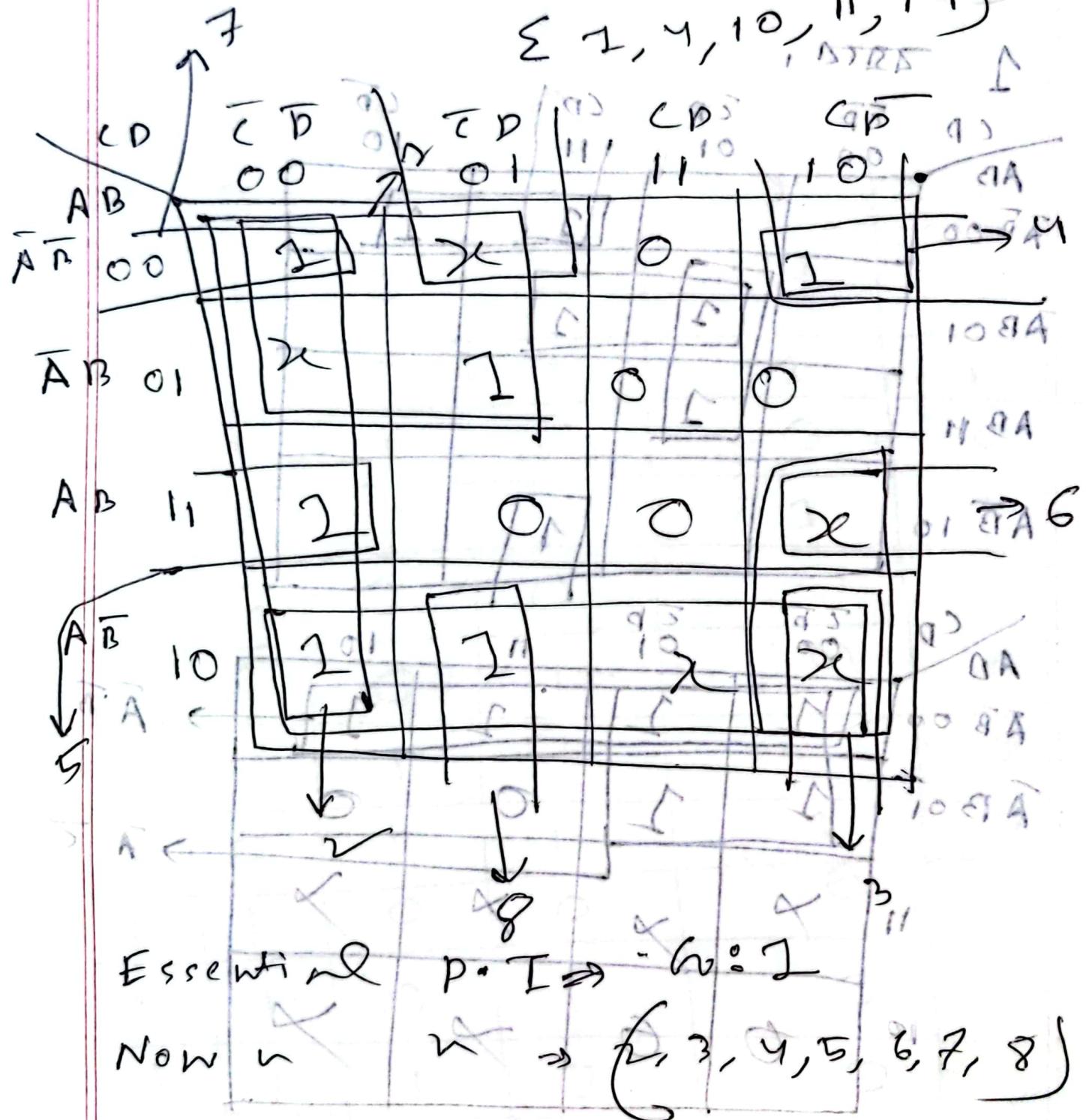
$\frac{1}{1}, \frac{1}{1}, \frac{1}{1}, \frac{1}{1}, \frac{1}{1}, \frac{1}{1}$

	CD	$\bar{C}D$	CD	$\bar{C}D$	CD	$\bar{C}D$
AD	00	01	11	10	00	01
$\bar{A}\bar{B}00$	1	1	1	1	1	1
$\bar{A}B01$	1	1	1	1	1	1
AB11	1	1	1	1	1	1
$A\bar{B}10$	X	0	1	1	1	1
$A\bar{B}00$	1	1	1	1	1	1
$\bar{A}B01$	1	1	0	0	0	0
AB11	X	X	X	X	X	X
$\bar{A}B10$	0	0	X	X	X	X

$F(A, B, C, D) \Rightarrow$ reduce minterms

$\Sigma m(0, 2, 5, 8, 9, 12) +$

$\Sigma m(2, 4, 10, 11, 14)$



K-MRP

→ Assignment →

→ Optimize →

Type : 1 → minimize / optimize /

→ Formulation {Simplify} + Find Δ

Type : 2 → P.T → ESS · P.T
→ (optimize)

Selection rule :-

$$\rightarrow f(A, B, C, D) = C_{01} 1 + C_{03} 3 + 5 + 7$$

(Overlap score
 $1 \leq 3$)

Non-ess. group star अनिवार्य select
दूरी तक एवं समान्तर 2 cover 25%
अपे overlap दरम 25%.

P.T.

Assignment

BLD

GW
15. 11. 22

AB $\bar{A}\bar{B}$

$\bar{A}B$

AB

$A\bar{B}$

CD 00

1 1

1

1

CD 01

1 1

0

0

CD 11

x x

x

x

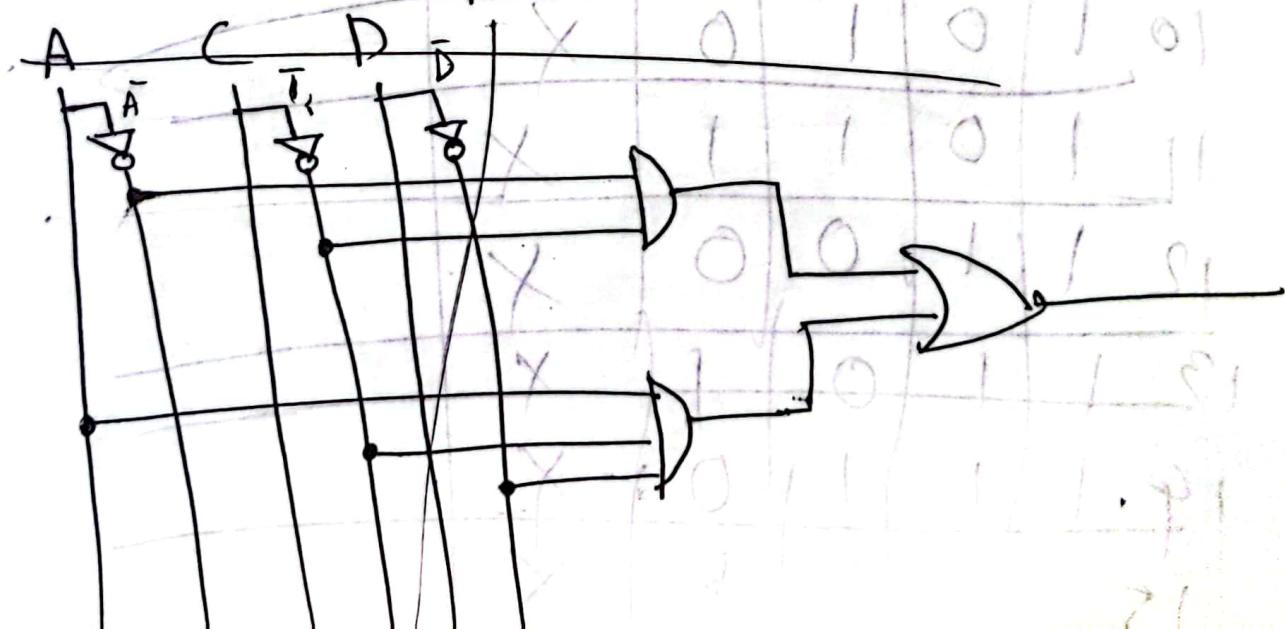
CD 10

0 0

x 1

x

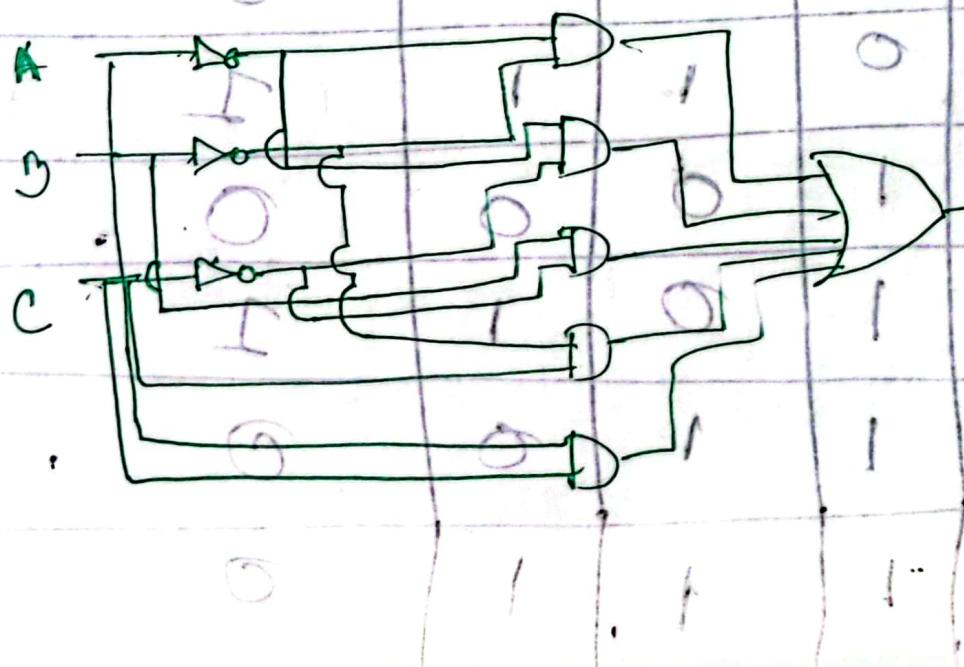
$$F(A, B, C, D) = \cancel{ABC\bar{D}} + \cancel{A\bar{B}CD} + \cancel{A\bar{B}C\bar{D}} + \cancel{A\bar{B}CD} \\ = \bar{A}C + \bar{D}A \rightarrow \bar{A}C + AD$$



	A	B	C	D	f ₁	
0	0	0	0	0	1	
1	0	0	0	0	1	AA
2	0	0	1	0	1	AA
3	0	0	1	1	1	00
4	0	1	0	0	1	10 05
5	0	1	0	1	1	10
6	0	1	1	0	0	11 05
7	0	1	1	1	0	01 05
8	1	0	0	0	0	
9	1	0	0	1	0	(0,0,0,A) +
10	1	0	1	0	X	A
11	1	0	1	1	X	
12	1	1	0	0	X	
13	1	1	0	1	X	
14	1	1	1	0	X	
15	1	1	1	1	X	

	$\bar{C}P$	$C\bar{P}$	$\bar{C}P$	$2.CP$	$C\bar{B}$	G
AB	00	01	11	11	10	A
$\bar{A}B$	00	11	11	11	10	B
AB	11	X X	X 1 X			5
$A\bar{B}$	10		X X			
	Y	3				

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



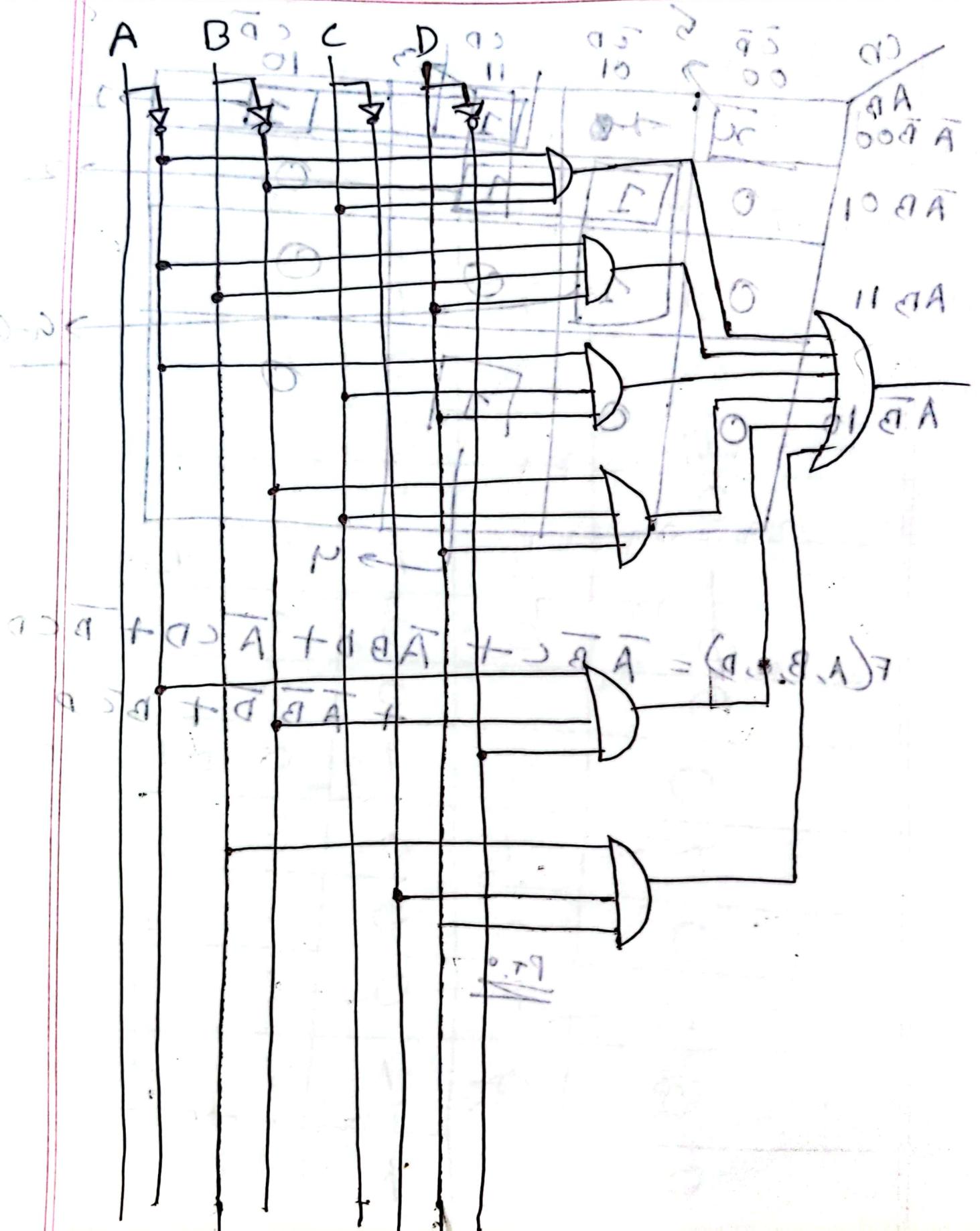
3	A	B	C	D	Output
0	0	0	0	0	X
1	0	0	0	1	X
2	0	0	1	0	1
3	0	0	1	1	X
4	0	1	0	0	0
5	0	1	0	1	1
6	0	1	1	0	0
7	0	1	1	1	1
8	1	0	0	0	0
9	1	0	0	1	0
10	1	0	1	0	0
11	1	0	1	1	1
12	1	1	0	0	0
13	1	1	0	1	1
14	1	1	1	0	0
15	1	1	1	1	0

CD	$\bar{C}\bar{D}$	00	01	10	11	$C\bar{D}$	$\bar{C}D$	A
$\bar{A}B00$		0	1	0	1	0	1	2
$\bar{A}B01$		0	1	1	0	0	0	2
$AB11$		0	1	0	0	0	0	
$A\bar{B}10$		0	0	1	1	0	0	$G-6$
								4

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

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

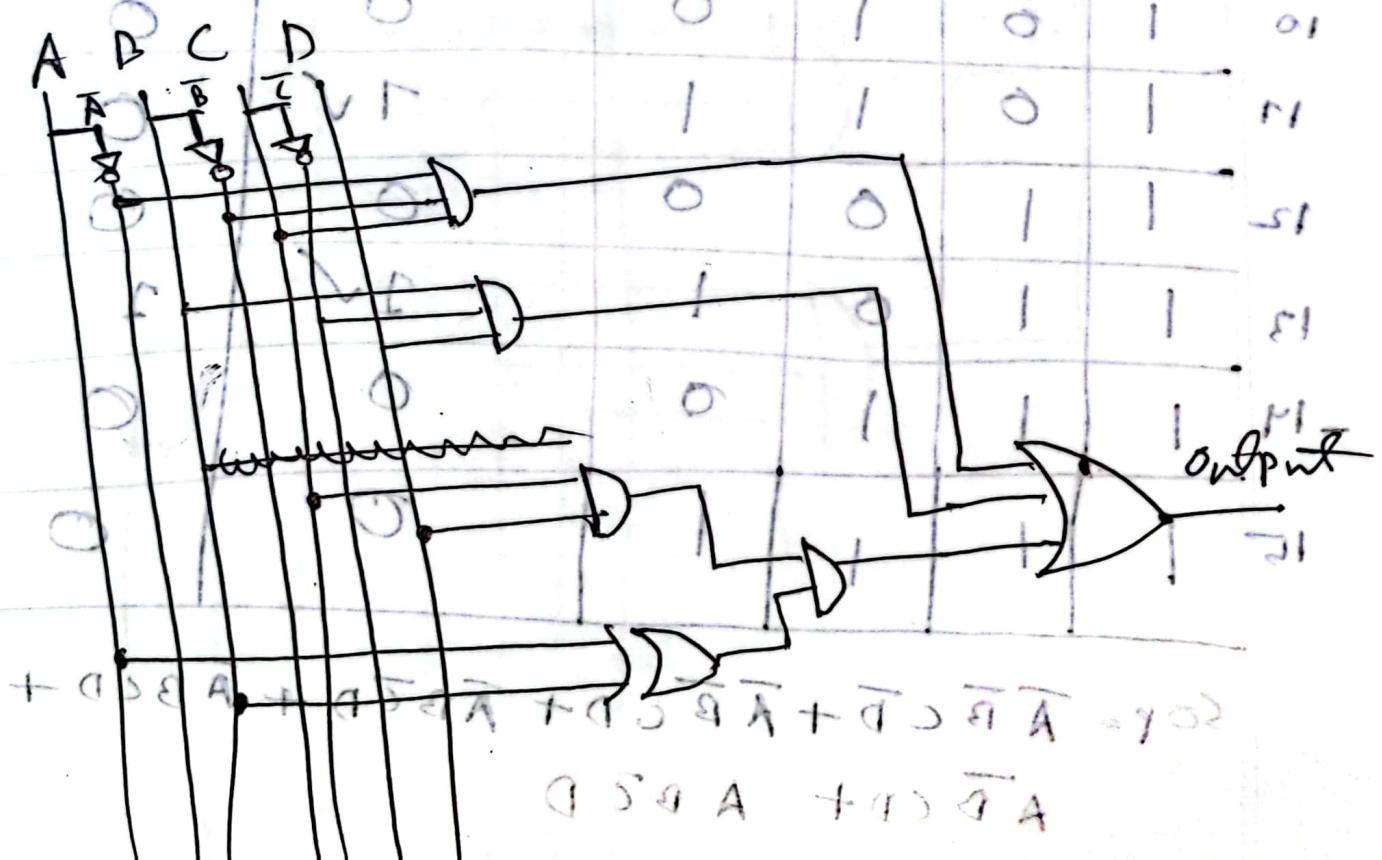
P.T.O.



	A	B	C	D	Output	Output fil
0	0	0	0	0	0	1
1	0	0	0	1	0	1
2	0	0	1	0	1	1
3	0	0	1	1	1	1
4	0	1	0	0	0	0
5	0	1	0	1	1	1
6	0	1	1	0	0	0
7	0	1	1	1	1	0
8	1	0	0	0	0	0
9	1	0	0	1	1	0
10	1	0	1	0	0	0
11	1	0	1	1	1	0
12	1	1	0	0	0	0
13	1	1	0	1	1	1
14	1	1	1	0	0	0
15	1	1	1	1	0	0

$$SOP = \overline{A}\overline{B}C\overline{D} + \overline{A}\overline{B}CD + \overline{AB}\overline{C}D + \overline{ABC}D + \\ A\overline{B}CD + AB\overline{C}D$$

$$\begin{aligned}
 &= \overline{A} \overline{B} C (D + \overline{D}) + \overline{A} B \overline{C} D + \\
 &\quad \cancel{\overline{A} B C D + A \overline{B} C D + A B \overline{C} D} \\
 &= \overline{A} \overline{B} C + \cancel{\overline{A} B \overline{C} D + A \overline{B} C D +} \\
 &\quad \cancel{\overline{A} B C D + A \overline{B} C D} \\
 &= \overline{A} \overline{B} C + \cancel{B \overline{C} D} (A + \overline{A}) + \cancel{\overline{A} B C D + A \overline{B} C D} \\
 &= \overline{A} \overline{B} C + \cancel{B \overline{C} D} + \cancel{\overline{A} B C D} + A \overline{B} C D \\
 &= \overline{A} \overline{B} C + B \overline{C} D + C D (\overline{A} B + A \overline{B}) \\
 &= \overline{A} \overline{B} C + B \overline{C} D + C D (A \oplus B)
 \end{aligned}$$



~~from 3 truth table~~

$$0+1 = 1$$

$$1+1 = 2$$

$$2+1 = 3$$

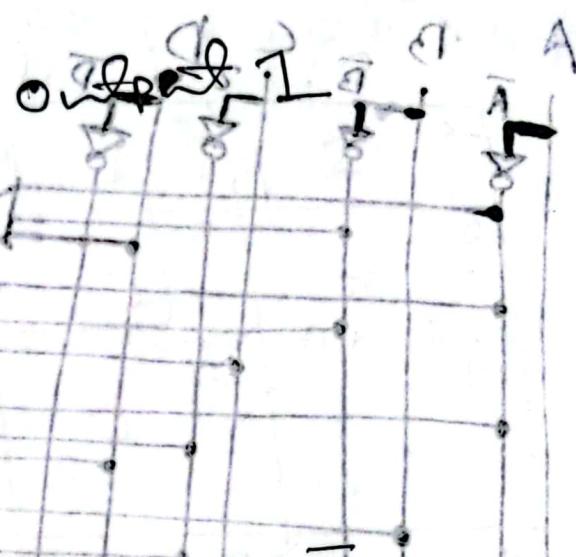
$$3+2 = 5$$

$$5+3 = 8$$

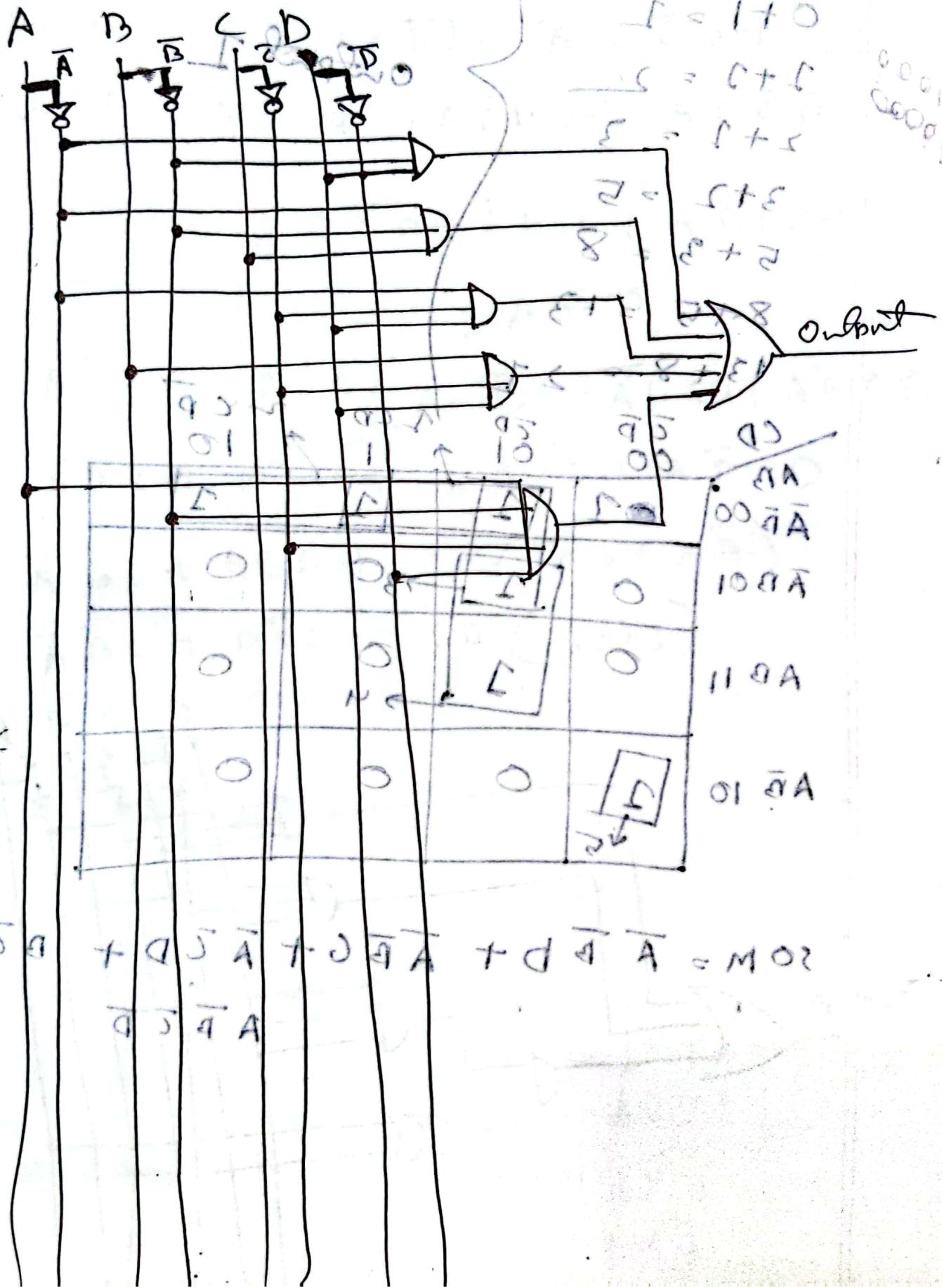
$$8+5 = 13$$

$$13+8 = 21$$

CD	$\bar{C}D$	$\bar{C}\bar{D}$	$C\bar{D}$	CD
$\bar{A}B$	00	01	11	10
00	1	1	1	1
01	0	1	0	0
11	0	1	0	0
10	1	0	0	0



$$SOM = \bar{A}\bar{B}D + \bar{A}\bar{B}G + \bar{A}\bar{C}D + B\bar{C}D + A\bar{B}\bar{C}\bar{D}$$



1

2

5	$\bar{C}D$	$\bar{C}P$	$\bar{C}D$	C_P	C_D	$\bar{C}P$	$\bar{C}P$
$\bar{A}\bar{B}$	00	00	01	11	10	10	10
$\bar{A}B$	01	01	10	11	11	11	11
$A\bar{B}$	11	10	11	11	11	11	11
AB	10	10	11	11	11	11	11

Quorum 15: w
Signature 14: w

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

$\bar{C}D$

$\bar{C}P$

$\bar{C}P$

$\bar{C}D$

$\bar{A}\bar{B}$	x	x					4
$\bar{A}B$	1	1	1	1	x		2
$A\bar{B}$		1	1	1			2
AB	x		x	x	x		6

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

P.I.:

EPI \rightarrow $a: 2 g, w: 6$

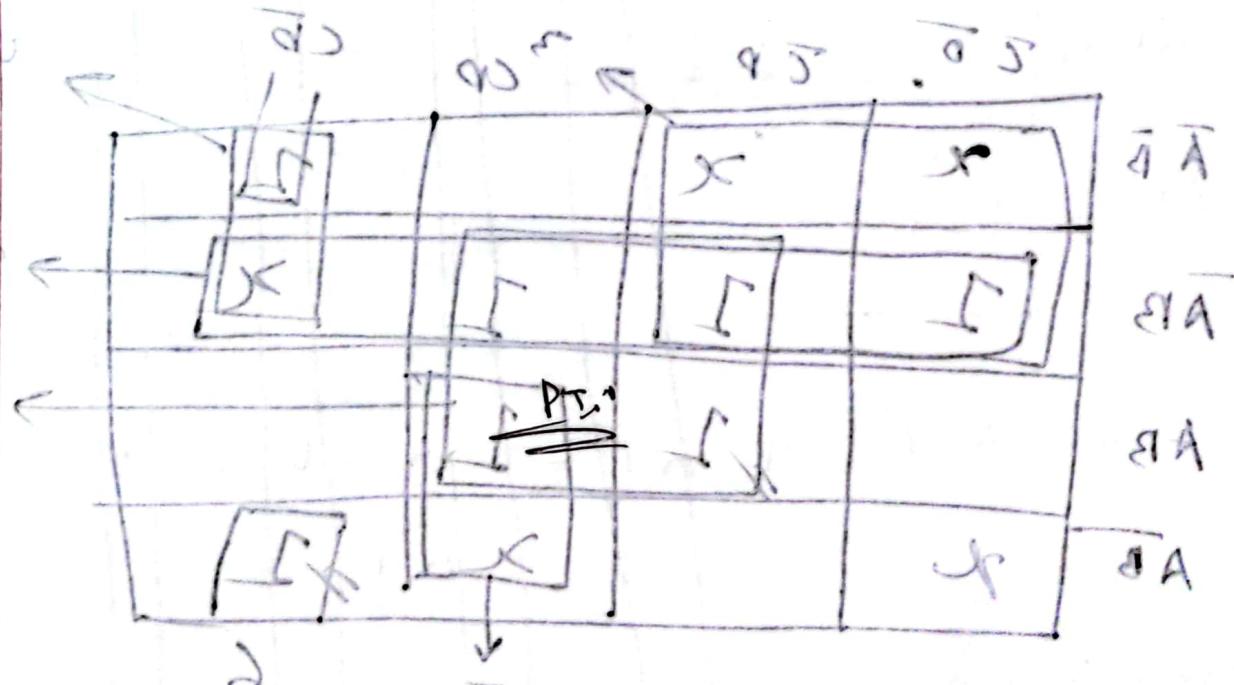
$$\Rightarrow \bar{A}B + \bar{B}\bar{C}\bar{D}$$

selection rule

Overlapping ~~BD~~ / ~~BC~~ group

$$\Rightarrow w: 2, w: 3, u: 4, h: 6$$

$$\Rightarrow AB + \bar{A}\bar{C} + \bar{A}\bar{C}\bar{D} + \bar{B}\bar{C}\bar{D}$$



$$\bar{A}B + A'C + A'C'D + B'C'D$$

271

6

	$\bar{C}P$	$\bar{C}P$	CP	CP
$\bar{A}\bar{B}00$	x	x	1	10
$\bar{A}\bar{B}01$	0	0	0	0
$\bar{A}\bar{B}11$	1	1	x	x
$A\bar{B}10$	1	0	1	1

$\Sigma m = \Sigma m_0 + \Sigma m_1 + \Sigma m_2 + \Sigma m_3$

$$SOP = \overline{AB} + A\bar{B} + A\bar{C} + \overline{B}\overline{C}P$$

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

A

PT.

$$\cancel{AB'C(D+\bar{D}) + AB'D(C+\bar{C}) + A'B'C(D+\bar{D})}$$

$$(2+5)(4+7) + \cancel{A'B'D(C+\bar{C})}$$

$$\cancel{AB'CD + ABCD' + AB'CD + AB'C'D +} \\ \cancel{A'B'CD + A'BCD'} + \cancel{A'BD + A'B'C'D}$$

$$\sum \bar{D} \quad \sum D \quad CD \quad CP$$

$\bar{A}\bar{B}$			2	
$\bar{A}B$		1	1	1
AB		1		1
$A\bar{B}$	1	1	1	1

Minimize SOP = $\bar{A}B\bar{D} + \bar{A}B\bar{C} + A\bar{B}D + A\bar{B}C$

2

$$(P + \overline{Q} + R) \cdot (\overline{P} + \overline{Q} + \overline{R}) \cdot ((\overline{Q} + S))$$

$$(\overline{P} + Q) \cdot (P + \overline{Q} + R) \cdot (Q + \overline{Q} + S) =$$

$$M \cdot r_{SOP} = \overline{P} \overline{Q} \overline{R} + P \overline{Q} R + Q S$$

cost criterion	Min SOP	Min POS
L	8	8
(without Not gate)	11	11
C _{DN}	13	17

In this two expression for the C_{DN} Min SOP < Min POS. So I will prefer the Min SOP.

10

11

$$(a) F(A, B, C, D)$$

$$= \overline{AB} + \overline{(A+B)} \overline{((C+D) + (D) + A' + C)}$$

$$= (AB + A'B') (C'D' + CD) A + \overline{AA} =$$

$$= \overline{ABC'D'} + ABCD + A'BCD' + A'B'C'D + A'BCD + A' + C'$$

$$+ (A'B'C'D' + ABCD + A' (1 + B'C'D)) +$$

$$+ A'B'C'D + C'$$

$$= 1 (ABD' + 1) + ABCD + A' + A'B'C'D$$

$$= 1 + ABCD + A' + A'B'C'D + \overline{AA} =$$

$$= 1 + ABCD + A' (1 + B'C'D) \overline{AA} =$$

$$= 1 + ABCD + A' (1 + A) \overline{AA} + \overline{AA} =$$

$$= 1 + ABCD + A' + \overline{AA} \quad (\text{Absorption})$$

$$= BD + \overline{A} + \overline{C} + A' (A + (AA + A)) \overline{AA} =$$

$$= (A + A') + A' + \overline{A} + \overline{C} =$$

$$\cancel{\frac{8}{(3r+4)_n + (2r+4)_n}} \times (21)_r = (645)_{10}$$

$$= \{(3r+4) + (2r+4)\}_{10} \times 21_{10} = 645$$

$$\Rightarrow 10r^2 + 21r + 8 = 645$$

Solving with equation law,

$$(x_1, x_2) = \left(7, -\frac{1}{10} \right)$$

$$-\frac{1}{10} \text{ (not allowed)}$$

$$\text{So, } r = 7$$

$$\cancel{(0.500000)} = 0.1(28N)$$

MIDFall - 2020DLD3

$$(a) \text{ BCD Number } (15)_10 = \{ (15)_2 + (15)_2 \} = \\ 0110 \quad 1000 \quad 0110 \quad \begin{array}{r} 8 \\ 8 \\ \hline 4 \end{array} \quad \begin{array}{r} 8 \\ 4 \\ \hline 2 \end{array} \quad 1$$

$$\Rightarrow (486)_{10} = \{ (4+8+6) + (4+8+6) \} =$$

$$2 \overline{)986_2} = 8 + 4 + 4 + 01 \\ 2 \overline{)243_2} \\ 2 \overline{)122_2} \quad 1, 4 + 4 + 01 \\ 2 \overline{)60_2} \quad 1, 4 + 4 + 01$$

and now

$$2 \overline{)30_2} \quad 01 \\ 2 \overline{)15_2} \quad 01 \\ 2 \overline{)7_2} \quad 01 \\ (2 \overline{)3_2} \quad 01 \\ 2 \overline{)1_2} \quad 01 \\ 2 \overline{)1_2} \quad 01$$

$(486)_{10} = (111100110)_2$

P.T.O

$$(6) \quad (396)_{10} = 0011 \quad 1001 \quad 0110$$

~~$(654)_{10} = 0110 \quad 0101 \quad 0100$~~

$$(1050)_{10} = 0001 \quad 0000 \quad 0101 \quad 0000$$

~~Step 4 numbers~~ $\therefore M = 1000$

$$\begin{array}{r} 0011 & 1001 & 0110 \\ 0110 & 0101 & 0100 \\ \hline 1000 & 1110 & 1010 \\ & \underline{0} & \underline{0110} \\ \hline 1000 & 1111 & 0000 \\ & \underline{0110} & - \end{array} \quad I : 292$$

$$\begin{array}{r} 1010 \\ 0101 \\ 0110 \\ \hline \end{array} \quad 0000$$

$$\begin{array}{r} 0001 \quad 0000 \quad 0101 \quad 0000 \\ (1 \quad 0 \quad 5 \quad 0)_{10} \end{array}$$

A

P.J.

~~WEEK 8~~
~~QUESTION~~
Ans to the ques no: 2

$$(a) x'j'z + x'jz + xjz' \\ = (x+j+z') (xj+z) (x'+j'+z)$$

$$(b) xj' + xj'z' + xj + j'z \\ = x(j+j') + xj'z' + j'z \\ = \cancel{x} + xj'z' + j'z \\ = \cancel{x} + j'z \quad (\text{Absorption}) \\ \rightarrow (x+x \cdot j' - x)$$

~~3~~

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

$$(b) (jz' + j'z) - (j' + x'z)$$

$$\rightarrow jj'z + jx'z + j'j'z + x'j'z$$

$$\rightarrow x'jz + j'z + xj'z$$

$$\rightarrow x'jz + j'z (1+x')$$

$$\rightarrow x'jz + j'z$$

Ans

~~4~~ ~~5~~

soon up to MA

A'	B	C	D	E	F
0	0	0	0	$\frac{1}{5}x + \frac{1}{5}t_1x + \frac{1}{5}t_2x + \frac{1}{5}t_3x$	(a)
0	0	0	1	0	0
0	0	1	0	$\frac{1}{5}t_1x$	$\frac{1}{5}t_1x + x$
0	0	1	1	?	1
0	1	0	0	0	0
0	1	$\frac{1}{5}t_1x + \frac{1}{5}t_2x + \frac{1}{5}t_3x + \frac{1}{5}t_4x$	$\frac{1}{5}t_1x + \frac{1}{5}t_2x + \frac{1}{5}t_3x + \frac{1}{5}t_4x$	(b)	
0	1	$\frac{1}{5}t_1x + \frac{1}{5}t_2x + \frac{1}{5}t_3x + \frac{1}{5}t_4x$	1	$\frac{1}{5}t_1x + \frac{1}{5}t_2x + \frac{1}{5}t_3x + \frac{1}{5}t_4x$	
0	1	$\frac{1}{5}t_1x + \frac{1}{5}t_2x + \frac{1}{5}t_3x + \frac{1}{5}t_4x$	$\frac{1}{5}t_1x + \frac{1}{5}t_2x + \frac{1}{5}t_3x + \frac{1}{5}t_4x$	(b)	
1	0	0	0	0	$\frac{1}{5}t_1x + \frac{1}{5}t_2x + \frac{1}{5}t_3x + \frac{1}{5}t_4x$
1	0	0	1	$\frac{1}{5}t_1x + \frac{1}{5}t_2x + \frac{1}{5}t_3x + \frac{1}{5}t_4x$	
1	0	0	0	$\frac{1}{5}t_1x + \frac{1}{5}t_2x + \frac{1}{5}t_3x + \frac{1}{5}t_4x$	0
1	0	$\frac{1}{5}t_1x + \frac{1}{5}t_2x + \frac{1}{5}t_3x + \frac{1}{5}t_4x$	2	$\frac{1}{5}t_1x + \frac{1}{5}t_2x + \frac{1}{5}t_3x + \frac{1}{5}t_4x$	0
1	1	0	0	2	1
1	1	0	1	2	1
1	1	0	0	$\frac{1}{5}t_1x + \frac{1}{5}t_2x + \frac{1}{5}t_3x + \frac{1}{5}t_4x$	(a)
1	1	$\frac{1}{5}t_1x + \frac{1}{5}t_2x + \frac{1}{5}t_3x + \frac{1}{5}t_4x$	$\frac{1}{5}t_1x + \frac{1}{5}t_2x + \frac{1}{5}t_3x + \frac{1}{5}t_4x$	(a)	

$$\frac{1}{5}t_1x + \frac{1}{5}t_2x + \frac{1}{5}t_3x + \frac{1}{5}t_4x$$

$$\frac{1}{5}t_1x + \frac{1}{5}t_2x + \frac{1}{5}t_3x + \frac{1}{5}t_4x$$

$$(\frac{1}{5}t_1 + \frac{1}{5}t_2)(\frac{1}{5}t_3 + \frac{1}{5}t_4)x$$

$$\frac{1}{5}t_1 + \frac{1}{5}t_2$$

↓

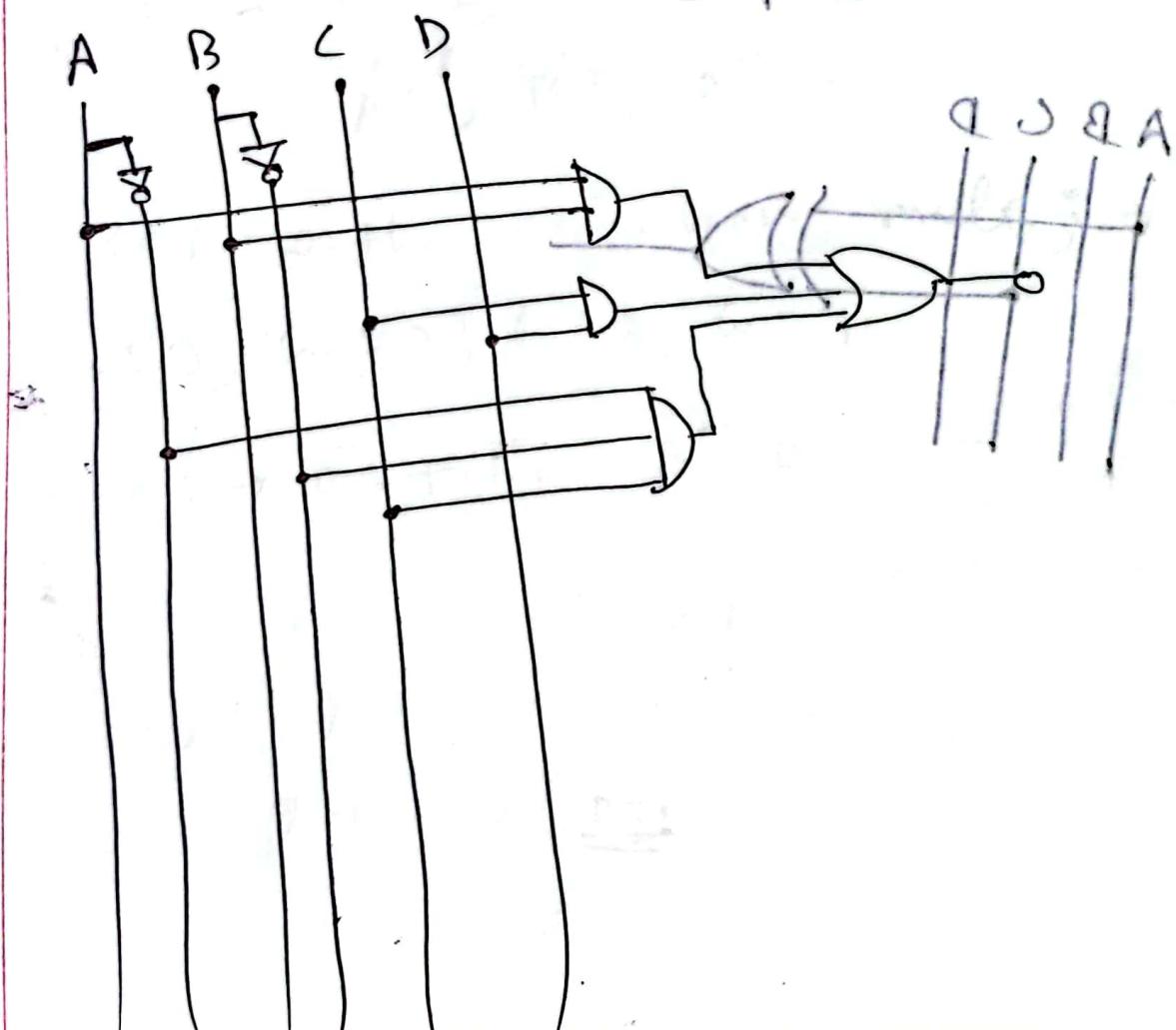
11

$\bar{A}B$	$C\bar{D}$	$\bar{C}\bar{D}$	$\bar{C}D$	CD	$C\bar{D}$
00	01	01	11	11	10
$\bar{A}B$	00	0	1	1	0
$\bar{A}B$	01	0	1	1	0
$\bar{A}B$	11	1	1	1	1
$A\bar{B}$	10	1	1	1	0

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

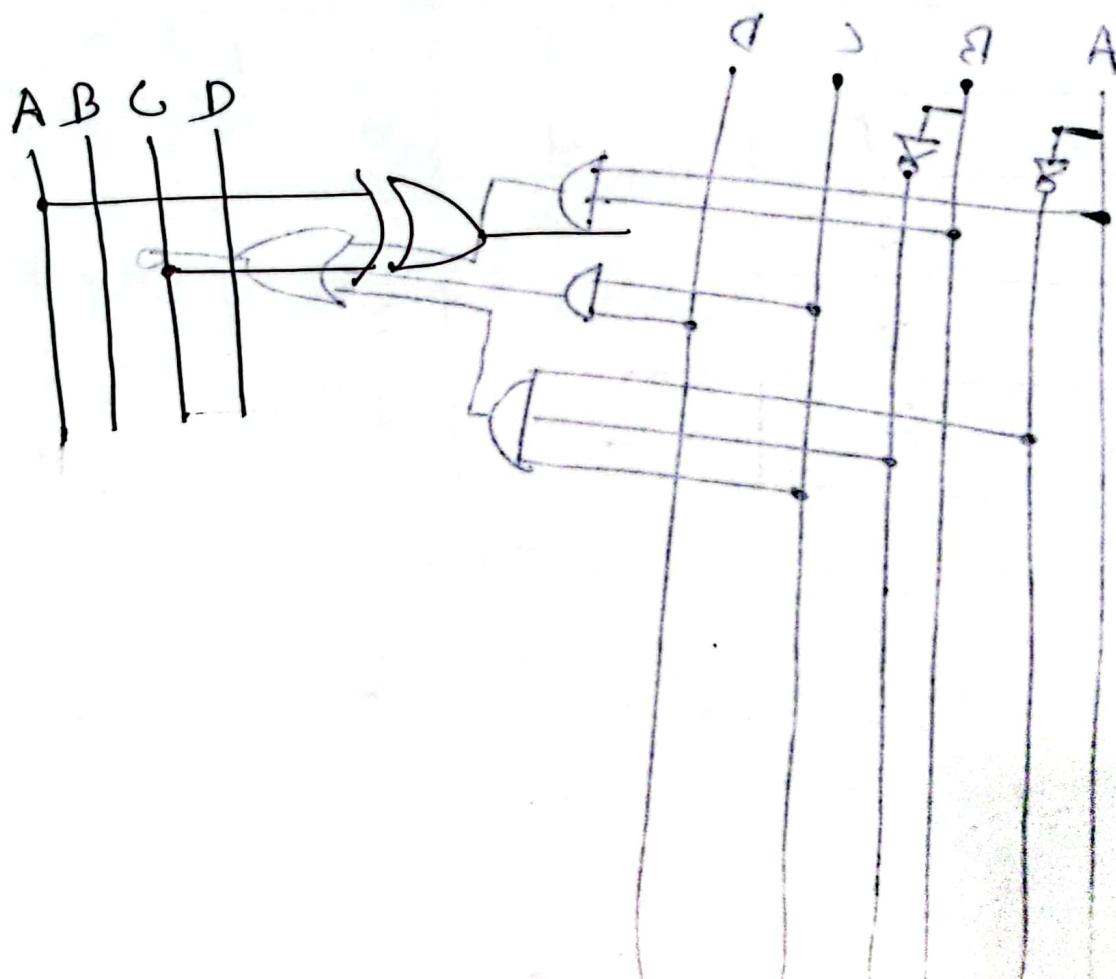
$$C \oplus A =$$



5

$\bar{C} \bar{B}$	$\bar{C} D$	$C D$	$\bar{C} \bar{D}$	$C \bar{D}$	A
$\bar{A} B$	00	01	11	10	$\bar{B} A$
$\bar{A} B$	01		11	11	$\bar{B} A$
$A B$	11	10	11	11	$B A$
$A \bar{B}$	10	11	11		$\bar{B} A$

$$F(A, B, C, D) = \overline{\bar{A}AC} + \bar{A}\bar{C} + BA = (0, 0, 0, 1) \\ = A \oplus C$$



0.505 min

	$\bar{C}\bar{D}$	$\bar{C}D$	CD	$C\bar{D}$	
$A\bar{B} 00$	00	1	1	1	$\rightarrow 3$
$\bar{A}B 01$	1	1	1	1	$\rightarrow 2$
$AB 11$	1	1	1	1	$\rightarrow 1$
$A\bar{B} 10$	1	1	1	1	$\rightarrow 0$

P.T.
 $F(A, B, C, D) \Rightarrow AC + \bar{B}C + \bar{B}D + B\bar{C}\bar{D} + ABD$

$+ \bar{A}BCD + \bar{ABC} + \bar{ACD}$

EPI :- $w_1 = 1, w_2 = 2, w_3 = 3, w_4 = 4$
 $AC, \bar{B}D, B\bar{C}\bar{D}$

"SOP with selection rule; \Rightarrow

$w_1 = 1, w_2 = 2, w_3 = 3, w_4 = 4$

$\Rightarrow AC + \bar{B}C + \bar{B}D + B\bar{C}\bar{D}$

•

P.T.O

Spring 2020

$$\begin{aligned} F(P, Q, R, S) &= (P + \overline{Q} + \overline{R}) (\overline{P} + \overline{Q} + \overline{R}) \\ &= P \cdot \overline{Q} \cdot \overline{R} + P \overline{Q} R + Q \overline{S} \\ &= \overline{P} Q \overline{R} (S + \overline{S}) + P Q R (S + \overline{S}) + \\ &\quad \overline{Q} \overline{S} (P + \overline{P}) (R + \overline{R}) \\ &= \overline{P} Q \overline{R} S + \overline{P} Q \overline{R} \overline{S} + P Q R S + P Q R \overline{S} \\ &\quad + Q \overline{S} P R + Q \overline{S} \overline{P} R + Q S P R + \\ &\quad Q S \overline{P} \overline{R} \end{aligned}$$

↙ (dhr waifsls) which - 90%

P : w, E : w, S : w, F : w

$$\overline{A} \overline{B} C D + \overline{A} \overline{B} + \overline{C} \overline{D} + \overline{A} C$$

~~PT. 2~~

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$$= \overline{P} \overline{Q} \overline{R} S + \overline{P} Q \overline{R} \overline{S} + P Q R S + P Q R \overline{S} +$$

$$P Q R S + \overline{P} Q R S + P Q \overline{R} S + \overline{P} Q \overline{R} S$$

~~$P Q S + \overline{P} Q S + Q S + \overline{Q} S + Q T + \overline{Q} T$~~

	$\overline{R} \overline{S}$	$\overline{R} S$	$R \overline{S}$	$R S$
$\overline{P} \overline{Q}$	$\overline{P} \overline{Q} \overline{R} \overline{S}$	$\overline{P} \overline{Q} R \overline{S}$	$\overline{P} Q \overline{R} \overline{S}$	$P Q R \overline{S}$
$\overline{P} Q$	1	1	1	1
$P \overline{Q}$	$\overline{P} \overline{Q} \overline{R} S$	$\overline{P} \overline{Q} R \overline{S}$	$\overline{P} Q \overline{R} S$	$P Q R \overline{S}$
$P \overline{Q}$	1	1	1	1

$$\text{Min SOP} \Rightarrow \overline{P} Q + Q S + Q R$$

$$\text{Min POS} \Rightarrow (P + \overline{Q}) (\overline{Q} + \overline{S}) + (\overline{Q} + \overline{R})$$

	Min SOP	Min POS
L	6	6
Without not gate	9	9
GW	10	13

Min SOP \leftarrow N < Min POS \leftarrow N
 \hookrightarrow T will prefer this one.

$$\cancel{2909} + \cancel{2909} + 2\cancel{509} + 2\cancel{509} =$$

$$4x^3 + 0x^2 + 2x^1 + 2x^0 - 2909$$

$$= 8j^3 + 7j^2 + 8j^0$$

$$\rightarrow 4x^3 + 2x^1 - 2 = 8j^3 + 7j^2 + 8j^0$$

$$\rightarrow 4x^3 + 2x^1 - 2 = 8j^3 + 7j^2 + 8j^0$$

$$\rightarrow \cancel{4x^3} \cancel{+ 2x^1} \cancel{- 2} = \cancel{8j^3} \cancel{+ 7j^2} \cancel{+ 8j^0}$$

$$27j^2 - 20 + 20 + 0.8 \leftarrow 902 \text{ nm}$$

$$x = \frac{(9+0)}{(-0.59)} \times \frac{(2+0)}{(0.87)(10+1)} \leftarrow 209 \text{ nm}$$

j^2	j^1	j^0
2	0	1
0	0	0
1	0	0

transit
zone

$\text{nm } 209 \text{ nm} \rightarrow \text{nm } 902 \text{ nm}$
 and int with this T.

$$\begin{aligned}
 & \text{LHS} \\
 (a) \quad f(A, B, C) &= AB + BC' + CA' \\
 &= AB(C+C') + BC'(A+A') + CA'(B+B') \\
 &= ABC + ABC' + A'BC' + A'BC + A'B'C \\
 &\cancel{= ABC + ABC' + A'BC' + A'B'C} + A'B'C + A'B'C \\
 &\cancel{= (F+F')Gx + (F+F')G'x} + A'B'C \\
 &= BC(A+A') + (ABC)' + (AB'C)' \\
 &= BC + ABC' + AB'C' \\
 &= AB'C + A'BC' + A'BC + A'B'C \\
 &\boxed{= AB(C+C') + A'BC' + A'B'C} \\
 &= \cancel{AB} + \cancel{A'BC'} + \cancel{AB'C} \\
 &= \cancel{AB} + \cancel{A'BC'} + \cancel{AB'C}
 \end{aligned}$$

$$\begin{aligned}
 F(A, B, C) &= \{m(7, 6, 2, 5) + m(5, 6, 1) \\
 &\quad + m(4, 5, 1) + m(3, 2, 1)\} \\
 &= (F+Gx)(F+G'x)(F+Hx) \\
 &\quad (F+H'x)(F+Ix)(F+I'x) \\
 &= (E_1 + E_2 + E_3 + E_4 + E_5 + E_6) MTT
 \end{aligned}$$

b

$$F(x, j, z) = x' + x(j + j')(z + z')$$

$$(x' + (xj + (jA - A)))(z + z')$$

$$\rightarrow x' + xj + xz' + xj'z' + xj'z$$

$$\rightarrow x' + xj + xz' + xj'z'$$

$$= x'(j + j')(z + z') + xj(z + z') +$$

$$= x'jz + x'j'z + x'jz' + x'j'z' +$$

$$= x'jz + xjz' + xjz + xj'z' + xj'z$$

$$\rightarrow x'jz + x'j'z + x'jz' + x'j'z' +$$

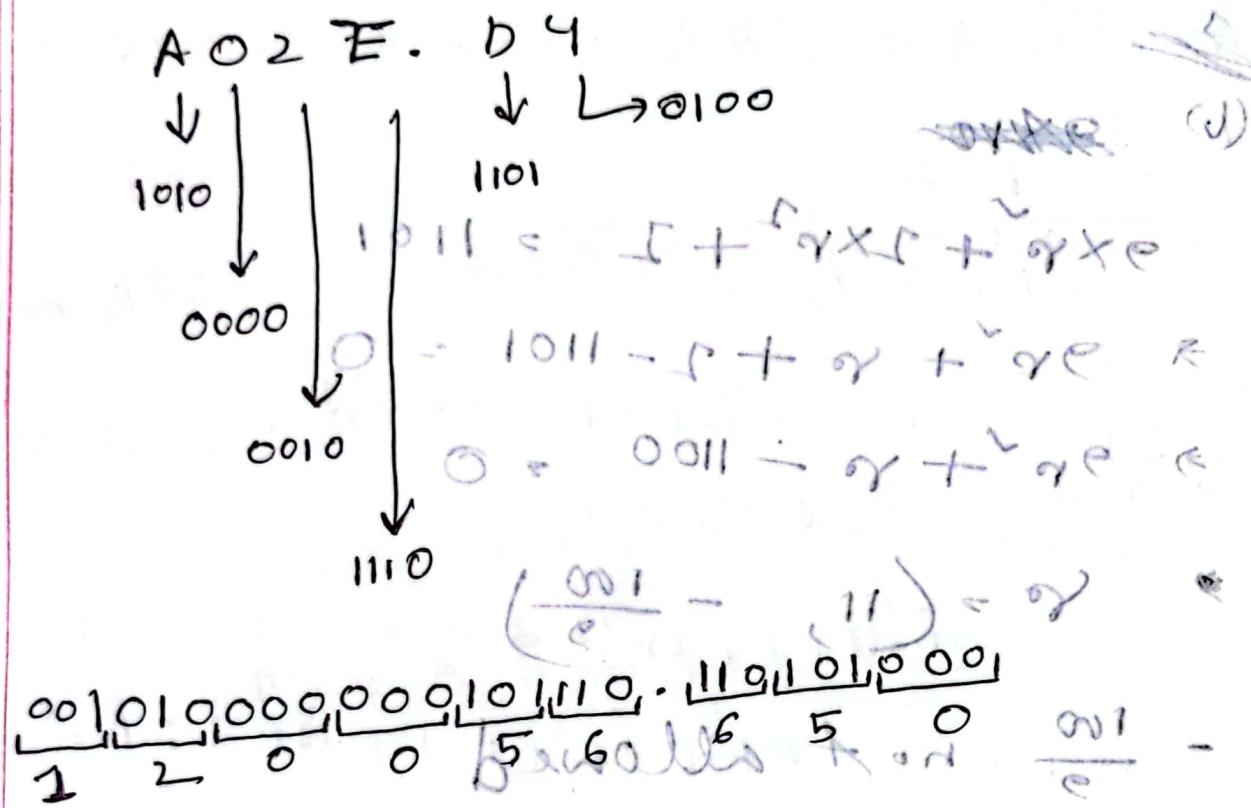
$$= x'jz + xjz' + xjz + xj'z' + xj'z$$

$$= (x + j + z)(x + j' + z)(x + j + z)$$

$$= (x + j + z)(x' + j' + z)(x' + j + z)$$

$$= \text{ITM}(4, 5, 3, 2, 2, 3)$$

Summers 2020



$$(A \otimes 2^E \cdot D^4)_{16} \rightarrow (120056 \cdot 650)_{10} = 8$$

$$\begin{aligned}
 & (\overline{B+A} + \overline{C}) \overline{D} + A \overline{D} \\
 & \cancel{(\overline{B} \cdot \overline{A} + \overline{C}) \overline{D}} + A \overline{D} \\
 & \quad \overline{B} \overline{A} + \overline{D} \overline{A} + A \overline{D} \\
 & \overline{B} \overline{A} + (\overline{A} + A) \overline{B} + (\overline{B} + \overline{C})(\overline{A} + A) A \\
 & \overline{B} \overline{A} + \overline{B} A + \overline{B} \overline{A} + \overline{B} A + \overline{B} \overline{A} + \overline{B} A \\
 & \overline{B} \overline{A} +
 \end{aligned}$$

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~~Fall 2021~~

~~2~~

(b)

$$9x^2 + 2x^2 + 1 = 1101$$

$$\Rightarrow 9x^2 + x + 2 - 1101 = 0$$

$$\Rightarrow 9x^2 + x - 1100 = 0$$

$$\Rightarrow x = \left(\frac{1}{2}, -\frac{100}{9} \right)$$

$\frac{100}{9}$ not allowed

$$y = \underline{\overline{I}} \underline{(A + B + C)} = (PD \cdot FSOA)$$

~~2~~

$$(c) A + B \left(C + \overline{A + C} \right)$$

$$\Rightarrow A + B \left(C + \overline{A} \cdot \overline{C} \right)$$

$$\Rightarrow A + BC + \overline{A}B\overline{C}$$

$$\Rightarrow A(A + \overline{B})(C + \overline{C}) + BC(A + \overline{A}) + \overline{A}B\overline{C}$$

$$\Rightarrow ABC + AB\overline{C} + A\overline{B}C + A\overline{B}\overline{C} + AB(C + \overline{A}B) + \overline{A}B\overline{C}$$

PT.

$$\Rightarrow ABC + AB\bar{C} + A\bar{B}C + A\bar{B}\bar{C} + \cancel{\bar{A}BC}$$

$$\Rightarrow ABC + B\bar{C}(A + \cancel{\bar{A}}) + A\bar{B}C + \cancel{A\bar{B}C} + \cancel{A\bar{B}C}$$

$$\Rightarrow ABC + B\bar{C} + A\bar{B}C + A\bar{B}\bar{C} + \cancel{A\bar{B}C}$$

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

$$\Rightarrow B\bar{C} + B\bar{C} + A\frac{1}{B}(C + M) + A\bar{B}(\bar{C} + h)$$

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

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

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

$$\Rightarrow B + A\bar{B} (\cancel{(C + \bar{C})}) \quad \text{Ans}$$

$$\Rightarrow B + A\bar{B} \quad (\cancel{\# \text{Ans}})$$

$$(1 \times 1 \times 0) \text{ MTT} = 209$$

$$(1 \times 1 \times M)(1 \times N \times M)(1 \times h \times M)$$

$$(1 \times N \times M) \quad \underline{\text{PT.}}$$

$$28 \quad \cancel{B\bar{A} + \bar{A}A} + \bar{C}A + \bar{C}A + \bar{C}A =$$

(b)

$$G_0(L, M, N)$$

$$\Rightarrow (L + MN)(N + LN) + A) \bar{C}A + \bar{C}A =$$

$$\Rightarrow ML + LN + MN + MNLN + MNLN + \bar{C}A =$$

$$\Rightarrow ML + LN + MN + \bar{C}A + (A + A) \bar{C}A =$$

$$\Rightarrow ML(N + N') + LN(M + M') + MN(L + L') + MNL$$

$$\Rightarrow \cancel{ML} + \cancel{MN'L} + \cancel{MNL} + \cancel{M'NL} + \cancel{MNL} + \cancel{MN'L}$$

$$\Rightarrow MNL + MN'L + M'NL + MN'L + MN'L$$

$$\text{sop} \Rightarrow \sum m(7, 3, 5, 6) \bar{C}A + q$$

$$\Rightarrow \sum m(3, 5, 6, 7) \bar{C}A + q$$

$$POS = \pi m(0, 2, 2, 4)$$

$$\Rightarrow (M' + N' + L') (M + N + L') (M + N' + L')$$

$$(M' + N' + L)$$

	$\bar{A}\bar{B}$	$\bar{A}B$	AB	$A\bar{B}$	8
$\bar{E}P$	0	0	1	1	2
$\bar{C}P$	0	1	1	1	2
\bar{D}	0	1	1	0	3. $\bar{B}\bar{C}$
$\bar{C}P$	1	0	1	0	4

$\therefore PI \Rightarrow \bar{C}D + \bar{C}\bar{A}B A\bar{B} (\bar{A}C\bar{P}) \bar{B} \bar{C} \bar{P} \bar{A}\bar{B}\bar{D}$,
 $\bar{B}\bar{C}D, A\bar{B}\bar{P} F + Gx$.

E.P.I $\Rightarrow G: 2$

3

(b) $(\overline{x} \cdot \overline{y} + \overline{z}) + z + xy + wz$

$$\Rightarrow (\overline{x} \cdot \overline{y} \cdot \overline{z}) + z + xy$$

$$\Rightarrow x \cdot y \cdot \overline{z} + z + xy$$

$$\Rightarrow xy(\overline{z} + 1) + z = xy + z \in I \cdot F$$

$$\Rightarrow xy + z$$

∴ $\omega \in I \cdot F$

Sum-2022

Sum-2022

$$\cancel{x\bar{y} + \bar{x}y} = (\bar{x} + \bar{y})(x + y) \text{ for } x, y \in S$$

$$\Rightarrow x\bar{y}(z + \bar{z}) + \bar{x}y(z + \bar{z})$$

$$\Rightarrow (\cancel{x\bar{y}z} + \cancel{x\bar{y}\bar{z}} + \cancel{\bar{x}yz} + \cancel{\bar{x}y\bar{z}}) \text{ for } z \in S$$

$$\Rightarrow x\bar{y}(z + \bar{z}) + \bar{x}y(z + \bar{z})$$

$$\Rightarrow x\bar{y} + \bar{x}y$$

$$F_{exw} + F_{ew} + F_{ew}$$

$$F_{ew} + F_{ew} + F_{ew} \xrightarrow{\text{Dual}}$$

$$AB \oplus A\bar{B}C + AC$$

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

Few

01050

$$\begin{aligned} & \cancel{wx + \bar{w}\bar{y}z + \bar{w}xz + \bar{x}\bar{y}\bar{z}} + \\ & \cancel{wx - \bar{y}z} \\ & (\bar{x} + \bar{y})\bar{w}x + (\bar{x} + \bar{y})\bar{w}x \in \\ \rightarrow & wx(\bar{y} + \bar{z})(\bar{z} + \bar{z}) + \bar{w}\bar{y}z(x + \bar{x}) + \\ & (\bar{w}xz(y + \bar{z}) + \bar{x}\bar{y}\bar{z}(w + \bar{w})) + \\ & \cancel{wx\bar{y}\bar{z} + \bar{w}x} \\ = & \cancel{wx\bar{y}z} + \bar{w}x\bar{y}z + \bar{w}x\bar{y}\bar{z} \\ & + \bar{w}y\bar{z}x + \bar{w}\bar{y}z\bar{x} + \bar{w}xz\bar{y} + \bar{w}x\bar{z}\bar{y} \\ & + \bar{x}\bar{y}\bar{z}w + \bar{w}\bar{x}\bar{y}\bar{z} + \cancel{wx\bar{y}z} \\ = & \cancel{wx\bar{y}z} \end{aligned}$$

$$(xy + z) \cdot (y + xz) \cdot (x + \bar{z}) = ?$$

~~$$(xy + z)$$~~

$$\Rightarrow xy\cancel{y} + xxz + z\cancel{y} + xz^2$$

$$\Rightarrow x\cancel{y} + xz + z\cancel{y} + xz$$

$$\Rightarrow x\cancel{y}(z + x) + xz(y + \bar{y}) + z\cancel{y}(x + \bar{x}) + xz(y + \bar{y})$$

~~$$x\cancel{y}z + x\cancel{y}\bar{z} + \cancel{x}\bar{y}z + x\cancel{y}z + \cancel{x}\bar{y}z$$~~

~~$$\cancel{x}\bar{y}z + \cancel{x}\bar{y}z + x\bar{y}z$$~~

~~$$\Rightarrow x\bar{y}z + x\bar{y}z' + x\bar{y}'z + \cancel{x}\bar{y}z' + x\bar{y}z$$~~

$$\Rightarrow x\bar{y}z + x\bar{y}z' + x\bar{y}'z + \bar{x}\bar{y}z'$$

$$\Rightarrow (\bar{x} + \bar{y} + \bar{z}) \cdot (\bar{x} + \bar{y} + z) \cdot (\bar{x} + y + \bar{z}).$$

$$\underline{(x + \bar{y} + z)}$$

6 6

* $\sqrt{(224)}_{\text{r}} = \sqrt{(13)}_{\text{r}}$

\checkmark							
\checkmark							
\checkmark							
\checkmark							
\checkmark							

$\Rightarrow (224)_{\text{r}} = (13)_{\text{r}}$

$\Rightarrow 2 \times r^5 + 2 \times r^3 + 9 \times r^0 = (r^2 + 3)^5$

$\Rightarrow 2r^5 + 2r^3 + 9 = (r+3)^5$

$\Rightarrow 2r^5 + 2r^3 + 9 = r^5 + 6r^4 + 12r^3 + 8r^2 + 9$ *

$\Rightarrow 2r^5 + 2r^3 + 9 - (r^5 + 6r^4 + 12r^3 + 8r^2 + 9) = 0$

$\Rightarrow r^5 - 4r^4 - 9r^3 - 8r^2 = 0$

$\Rightarrow r^2(r^3 - 4r^2 - 9r - 8) = 0$

~~$r^2(r+1)(r-4)(r+8)$~~

$r = 5$

~~A~~

$\frac{1}{2}$ $\frac{1}{2}$

	$C+D$	$C\bar{D}$	$\bar{C}D$	$\bar{C}\bar{D}$	
$A+B$	1	0	0	1	
$A+\bar{B}$	0	1	1	0	
$\bar{A}+\bar{B}$	0	0	1	1	
$\bar{A}+B$	1	0	0	1	

* $B D + \bar{B} \bar{D}$ = $P + Q + R$

$$\Rightarrow (\cancel{B} + \cancel{\bar{B}}) (\cancel{D} + \cancel{\bar{D}}) = P + Q + R$$

$$= Z = P - R$$

$$\Rightarrow (\cancel{B} + \cancel{D}) (\cancel{B} + \cancel{D}) = (Z - R) = 0$$

$Z = R$

~~2~~

$$\overline{w}x \left(\frac{\overline{c}\overline{d}}{z} + \frac{\overline{a}\overline{b}}{z} \right) + x \left(\overline{w} + \frac{\overline{w}\overline{y}\overline{z}}{z} \right)$$

$$+ \overline{w}\overline{c}\overline{d}\overline{A} + \overline{A}\overline{c}\overline{d} + \overline{a}\overline{b}\overline{c}\overline{d} + \overline{A}\overline{b}\overline{c}\overline{d} + \overline{A}\overline{B}\overline{C}\overline{D}$$

$$\rightarrow \cancel{\left(\overline{w}\overline{c}\overline{d}\overline{A} + \overline{A}\overline{c}\overline{d} + \overline{a}\overline{b}\overline{c}\overline{d} + \overline{A}\overline{B}\overline{C}\overline{D} \right)} + x \left(\overline{w} + \frac{\overline{w}\overline{y}\overline{z}}{z} \right)$$

$$\rightarrow x \left(\cancel{\overline{w}\overline{c}\overline{d}\overline{A}} + \overline{w}\overline{w}\overline{x}\overline{y}\overline{z} + \overline{w}\overline{w}\overline{x}\overline{y}\overline{z} \right)$$

$$\rightarrow x \left(0 + 0 + 0 \right)$$

$$\rightarrow x \left(\overline{w}\overline{z} + \overline{w}\overline{y}\overline{z} \right) + x \left(\overline{w} + \overline{w}\overline{y}\overline{z} \right)$$

$$\rightarrow (x+x) \left(\cancel{\overline{w}\overline{z}} + \cancel{\overline{w}\overline{y}\overline{z}} \right)$$

$$\left(\overline{w}\overline{z}0 + \overline{w}\overline{w}\overline{z}\overline{y}\overline{z} + \overline{w}\overline{y}\overline{z}0 + \overline{w}\overline{z}\overline{y}\overline{z}0 \right)$$

$$\rightarrow (x+x) (0+0+0+0)$$

$$= 0$$

$$ADD + \overline{ABC}C + A\overline{B}D + \overline{BC}D$$

$$(S6\overline{w}+w)x + (\overline{S}\overline{C} + S)w\overline{w}$$

$$\Rightarrow ABCD + AB\overline{C}D + \overline{ABC}D + \overline{ABC}\overline{D} +$$

$$(S6\overline{w}+w)x + (\overline{S}\overline{E}w\overline{C} + \overline{S}\overline{E}w\overline{C}\overline{D}) + \overline{A}\overline{B}CD + A\overline{B}CD + \overline{ABC}D + \overline{ABC}\overline{D}$$

$$+ \overline{S}\overline{E}x\overline{w}w + \overline{S}\overline{E}x\overline{w} + \overline{E}x\overline{w} + \overline{E}x\overline{w})x +$$

$$(\overline{E}\overline{B} \overline{UDF} \overline{CD} + \overline{CD})$$

$$\overline{AB}$$

$$1$$

$$AB$$

$$1$$

$$1$$

$$AB$$

$$1$$

$$1$$

$$A\overline{B}$$

$$1$$

$$1$$

$$+ \overline{S}\overline{E}\overline{F}\overline{D}\overline{w} + w\overline{F}\overline{D}$$

$$(S6\overline{w} + \overline{S}\overline{E}w + w\overline{E}\overline{G})$$

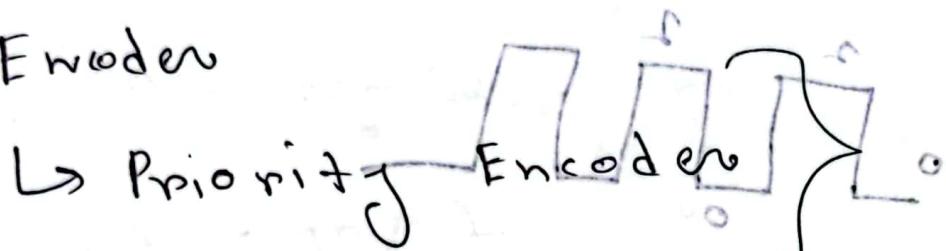
$$(0+0+0+0) (x+x) = 0$$

Final system

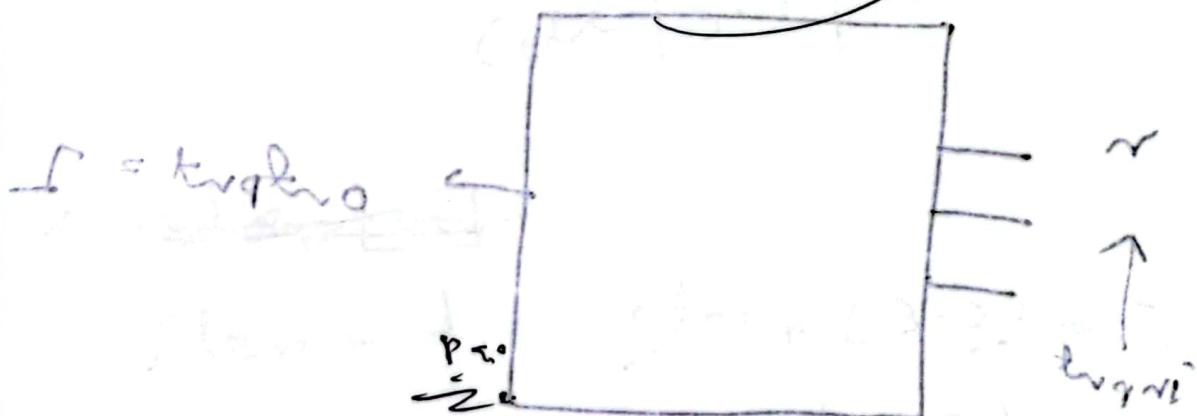
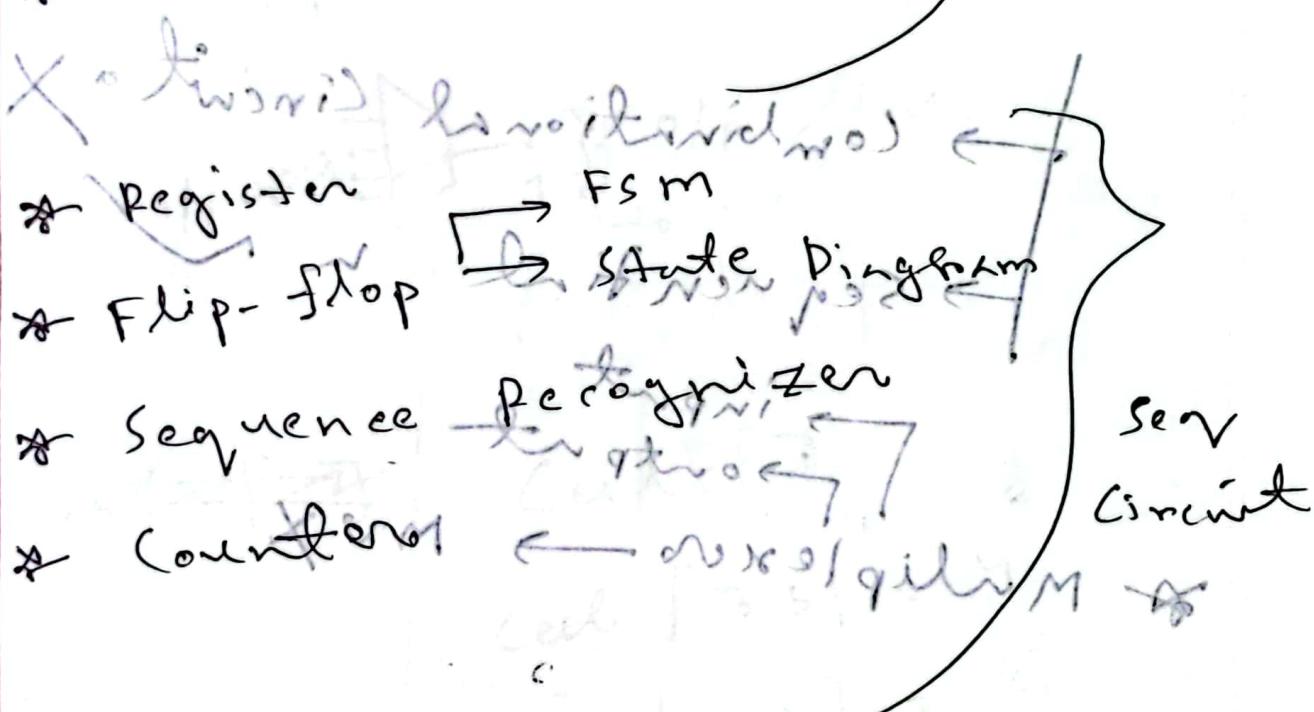
DLD

* Multiplexer (input signals)

* Encoder



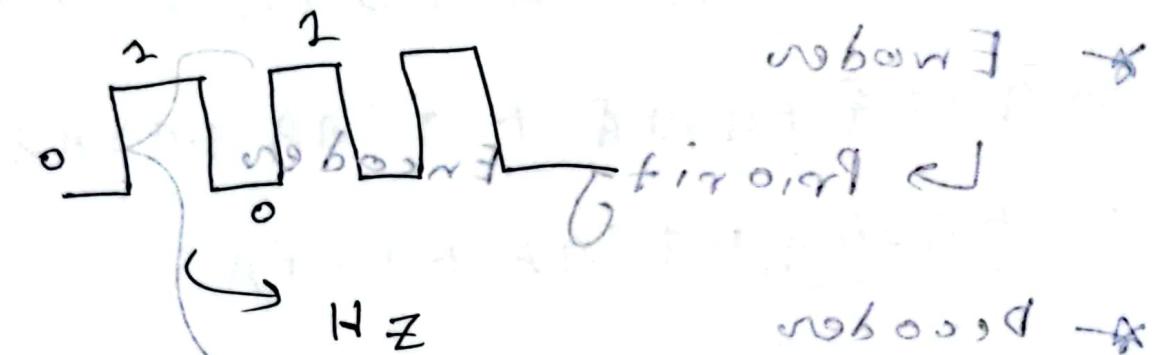
* Decoder



Wavelength & Optics

2.89

* Clock Signal ~~and~~ digital *

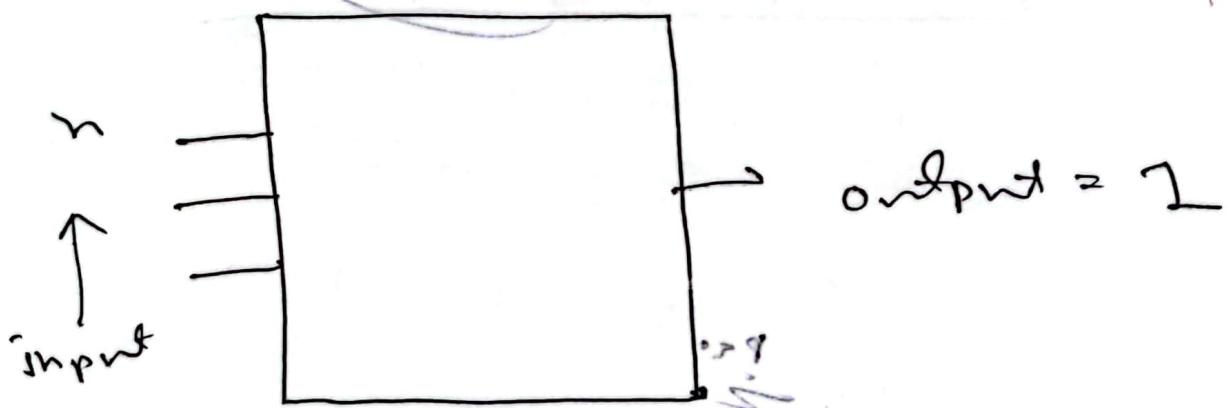


→ Combinational Circuit ~~X~~

→ Sequential ~~X~~ ^{memory} ~~not required~~

→ ^{initial} ~~input~~ ^{state} ~~output~~

→ Multiplexor → Mux ~~(Mux)~~



* n - to 1 multiplexer

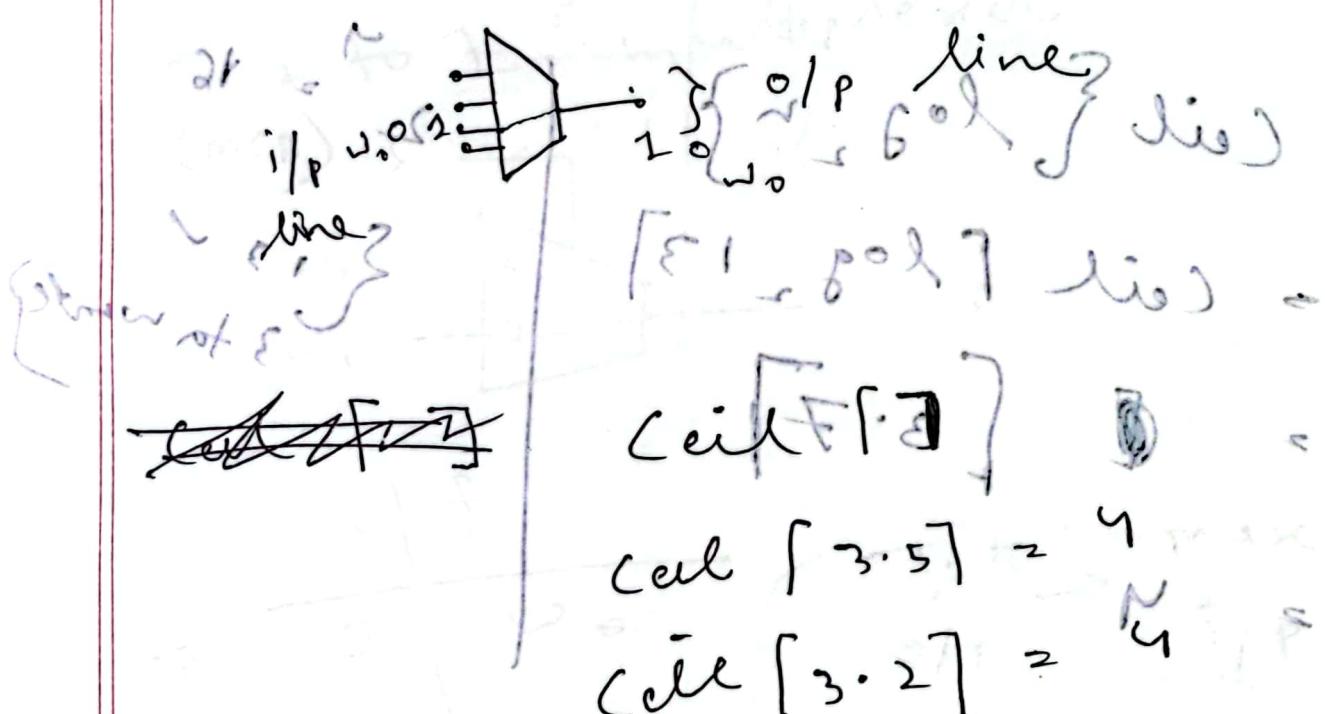
1 to

* $2^2 - \text{to} - 2$ [e.m] error *

* 2^n (n) \in to $- [2 \cdot e]$ error

* 2^3 (8) \in to $- [5 \cdot e]$ error

* 2^{10} (10) \in to $- 2$



* ~~ceil[3.2]~~

$$\text{floor } L \lfloor 3.2 \rfloor = 3$$

$$\text{floor } L \lfloor 3.2 \rfloor = 3$$

∴

* round $\lceil 3.9 \rceil$ of - → *

round $\lceil 3.5 \rceil$ of $3.5(4)$ *

round $\lceil 3.2 \rceil$ of $3(8) \leftarrow$
 $\lceil -0.1 \rceil \rightarrow \infty$

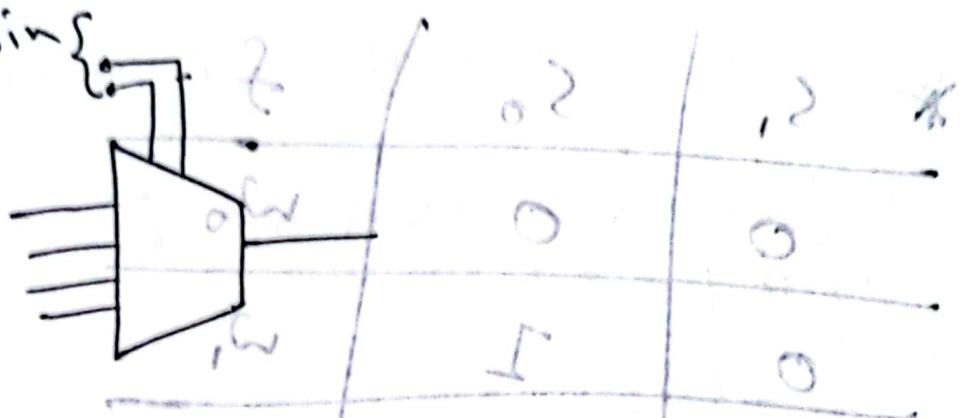
$$\begin{aligned} & \text{ceil} \left\{ \log_2 \frac{9}{10} \right\} \leftarrow \left\{ \begin{array}{l} 1 \\ 0 \\ 2 \\ 0 \\ 1 \\ 1 \end{array} \right\}^{\text{ceil}} = 16 \\ & \Rightarrow \text{ceil} \lceil \log_2 13 \rceil \\ & = \text{ceil} \left\{ \lceil 3.7 \rceil \text{ i.e.} \right\} \leftarrow \cancel{\left\{ \begin{array}{l} 1 \\ 3 \\ 7 \\ 7 \end{array} \right\}}^{\text{ceil}} \leftarrow \cancel{\lceil 3 \rceil \text{ towards}} \\ & = \text{ceil} \left\{ \lceil 3.8 \rceil \text{ i.e.} \right\} \\ & = \lceil 3.8 \rceil \text{ i.e.} \end{aligned}$$

$$S = \lfloor c \cdot e \rfloor \text{ root } L \downarrow \text{root}$$

$$S = \lfloor c \cdot e \rfloor \text{ root } L$$

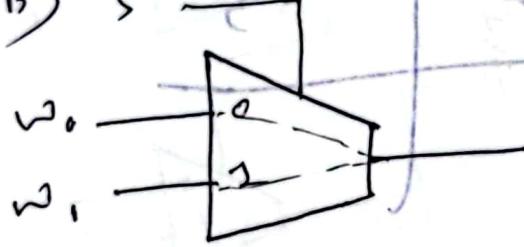
↑
↓

Select pins {



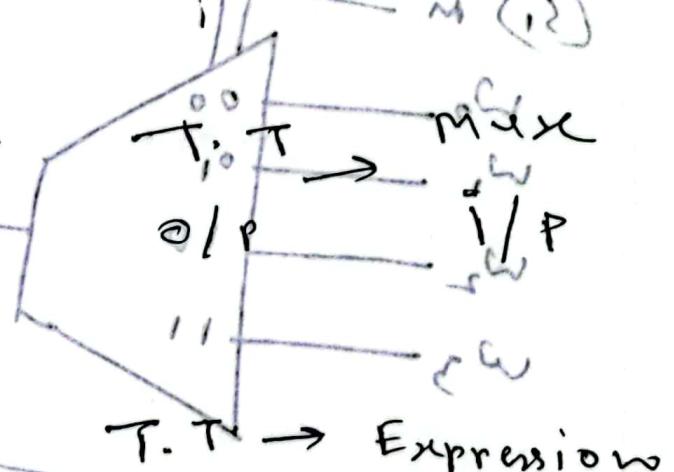
* w_2 to 1 \rightarrow m \rightarrow Multiplexor

(msb)



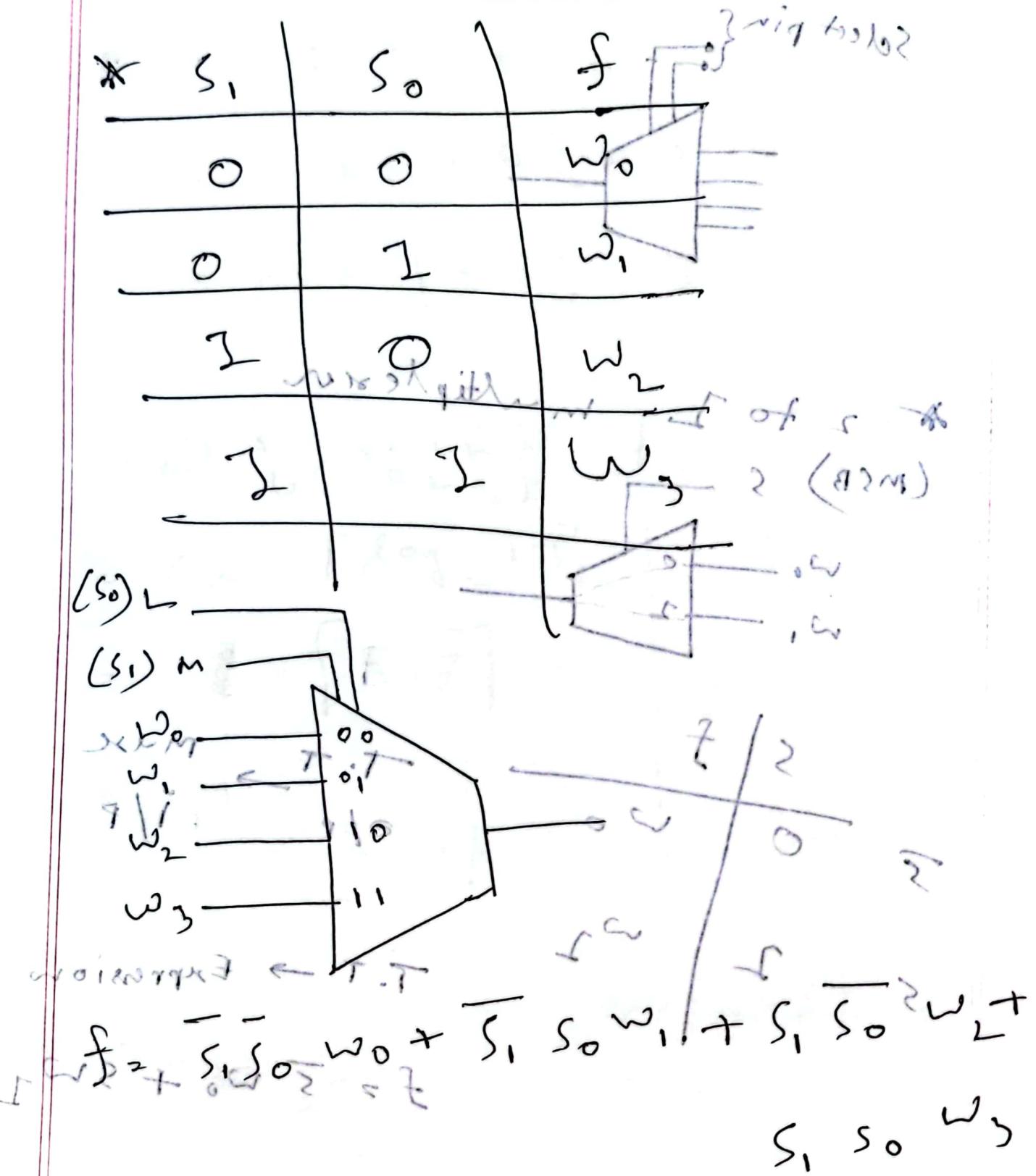
s f

3 0 w_0
2 1 w_1
 $w_0 \bar{w}_1 + \bar{w}_0 w_1$



$$f = \bar{s} \bar{w}_0 \bar{w}_1 + s w_1$$

P.T. ✓



~~... kq.~~

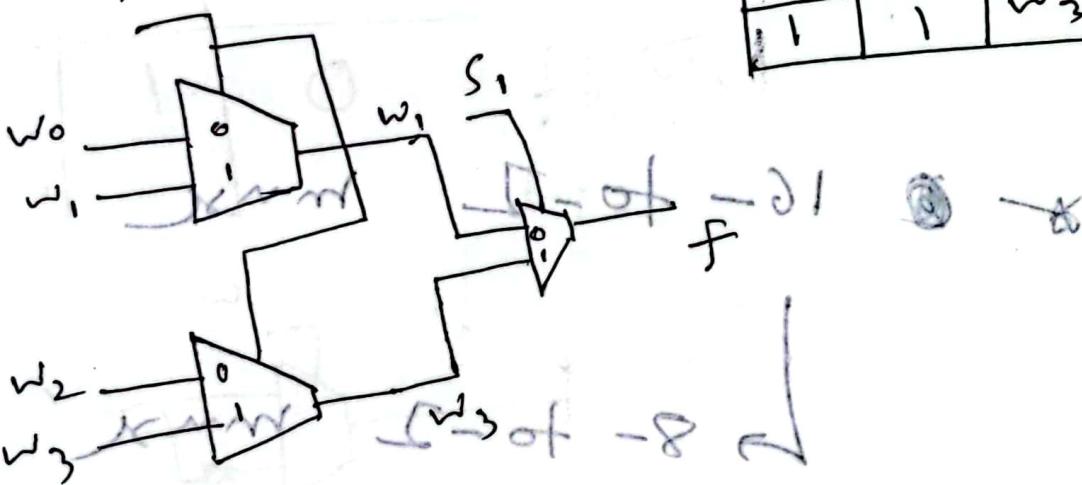
~~constant~~

4- To learn w₀ - w₃ by using

$w_0 + w_1 = 1$ otherwise

learn F or S ←

S₀



s_1	s_0	f
0	0	w_0
0	1	w_1
1	0	w_2
1	1	w_3

} w_1
} w_3

learn F - or - S ←

learn F - or - S ←

17.0

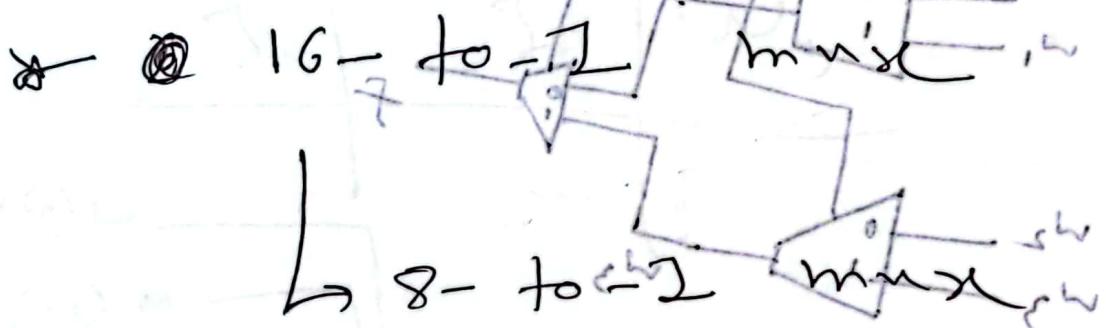
3

~~Ques~~ 8-to-1 mux - of - P

7	02	12
04	0	0
16	1	0
32	0	1
64	13	1

→ 8-to-1 mux

→ 2-to-2 mux



→ 4-to-1 mux

→ 2-to-1 mux

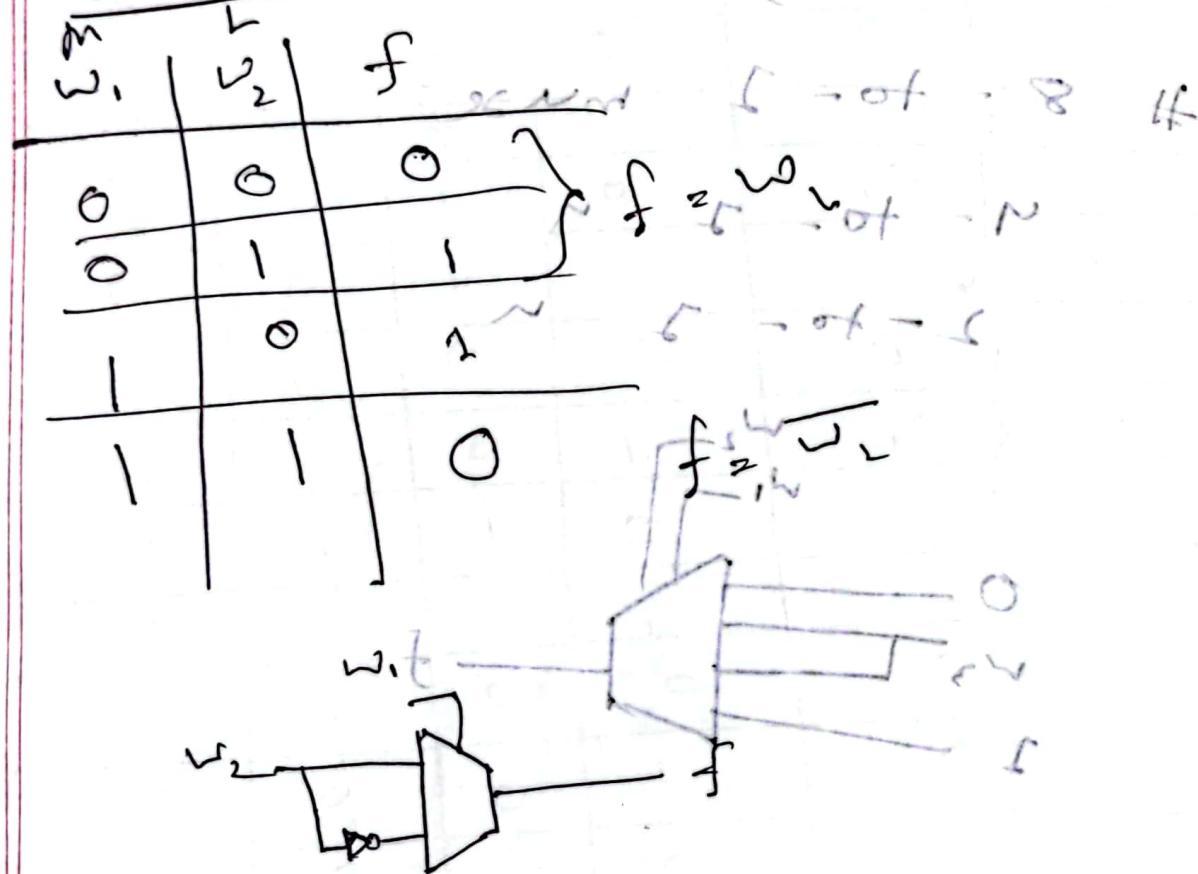
ans

✓

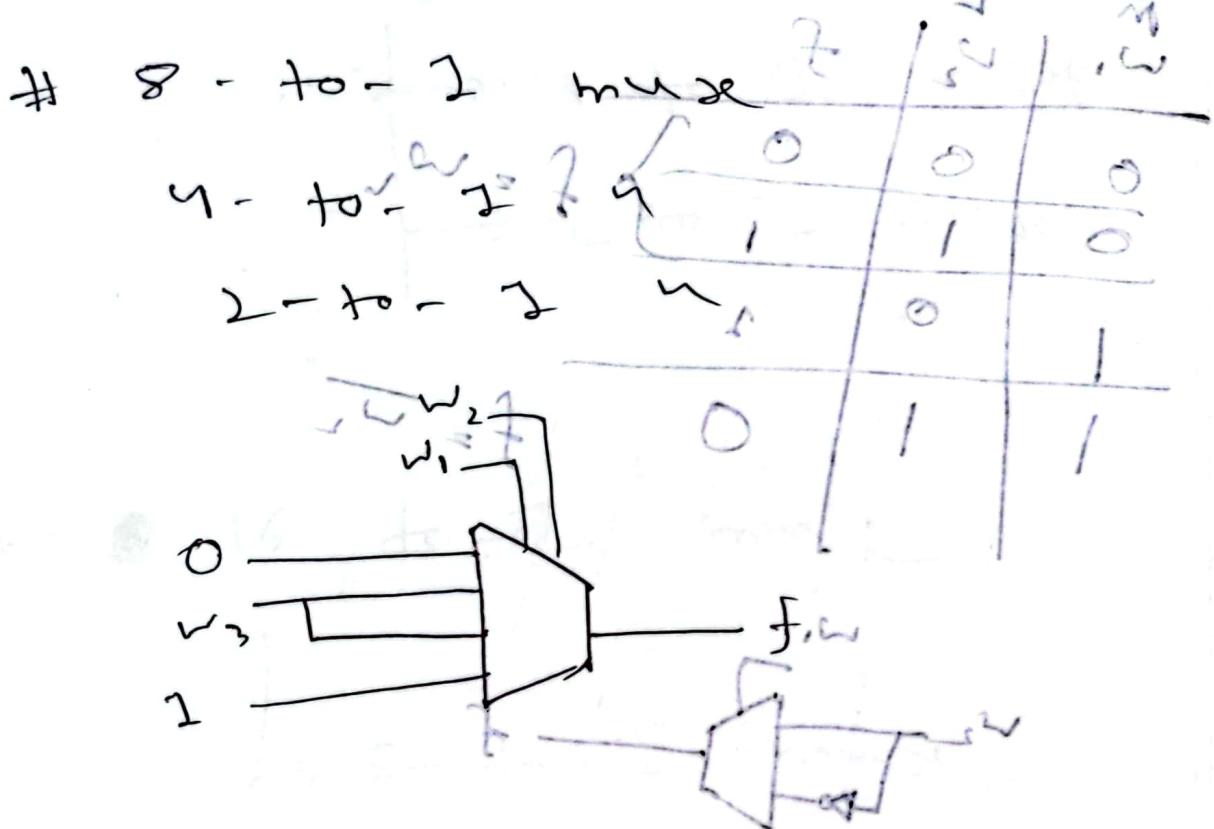
Ques

DLD

(XOR gate) $f = (x_1 \oplus x_2)$ is

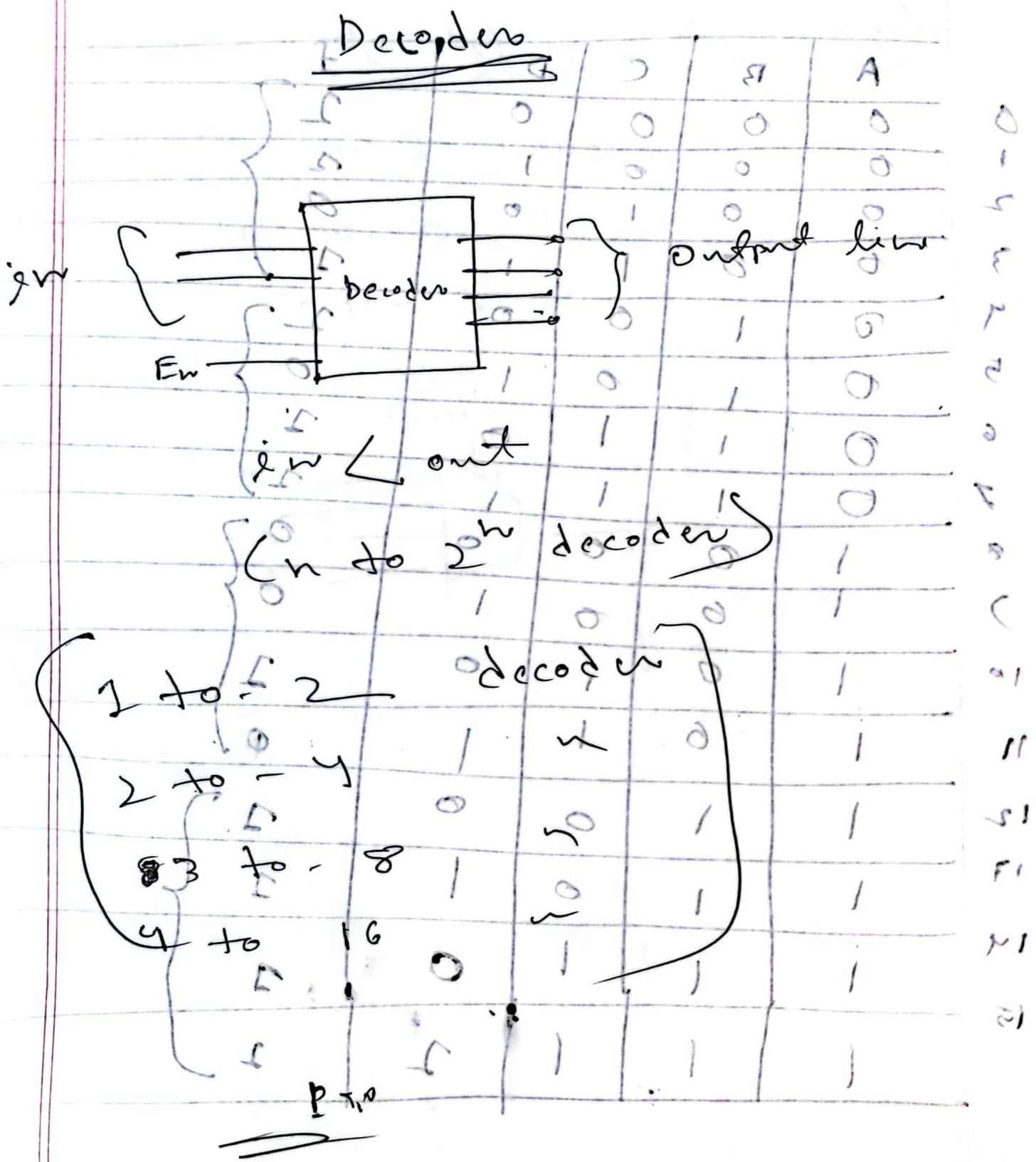


* $f(w_1, w_2, w_3) = \sum_m (3, 5, 6, 7)$

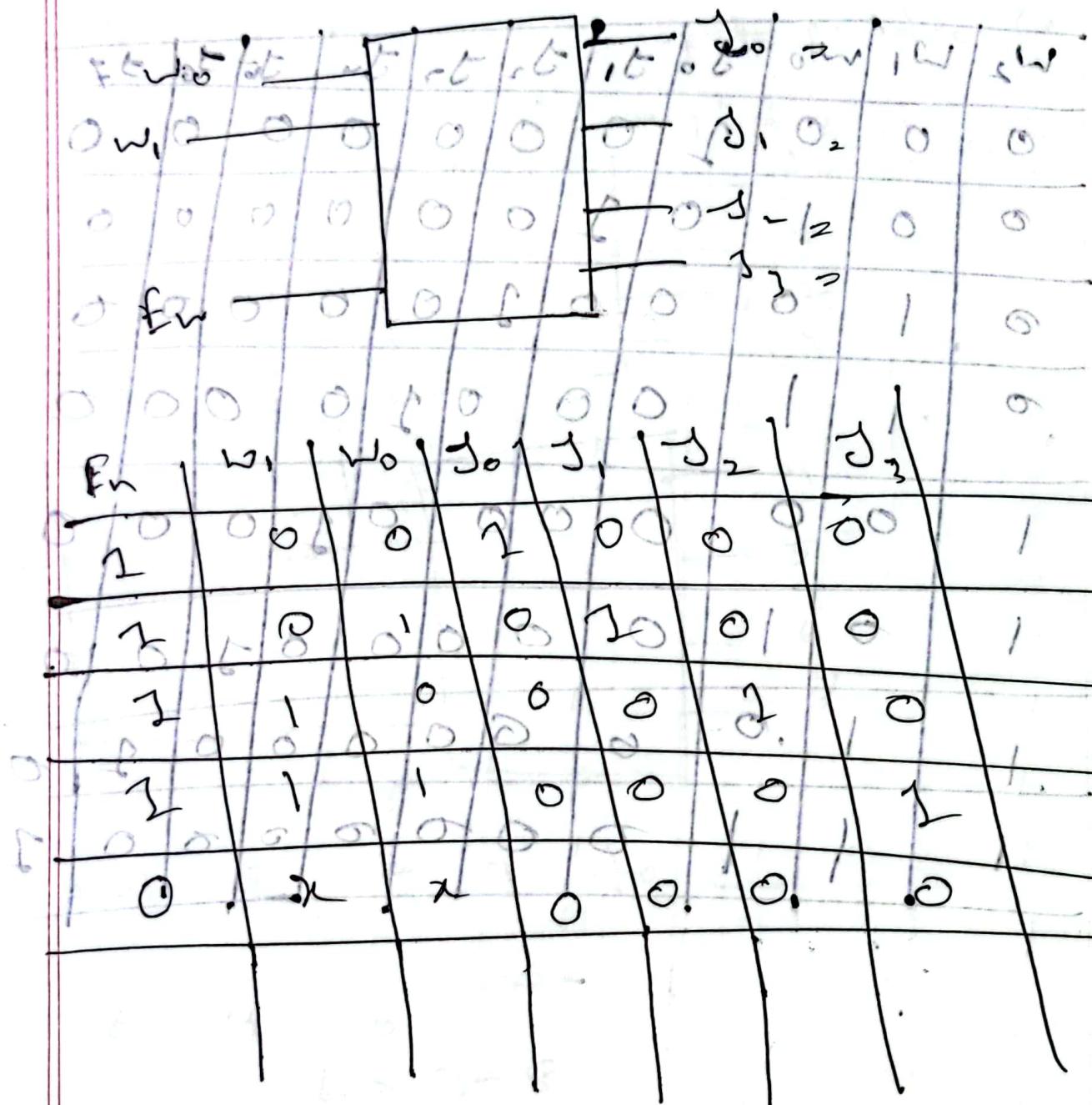


$$\sum_{w=0}^{15}$$

	A	B	C	D	E
0	0	0	0	0	2
1	0	0	0	1	2
2	0	0	1	0	0
3	0	0	1	1	1
4	0	1	0	0	2
5	0	1	0	1	0
6	0	1	1	0	2
7	0	1	1	1	1
8	1	0	0	0	0
9	1	0	0	1	0
10	1	0	0	0	2
11	1	0	1	1	0
12	1	1	0	0	1
13	1	1	0	1	8
14	1	1	1	0	0
15	1	1	1	2	2



~~(3 to 8 Decoder)~~



$w \cdot w \rightarrow 3 \text{ to } 8 \text{ Decoder (N.L)}$
with basic gate

(MSB)

E_{in}

(MSB \leftarrow LSB)

input

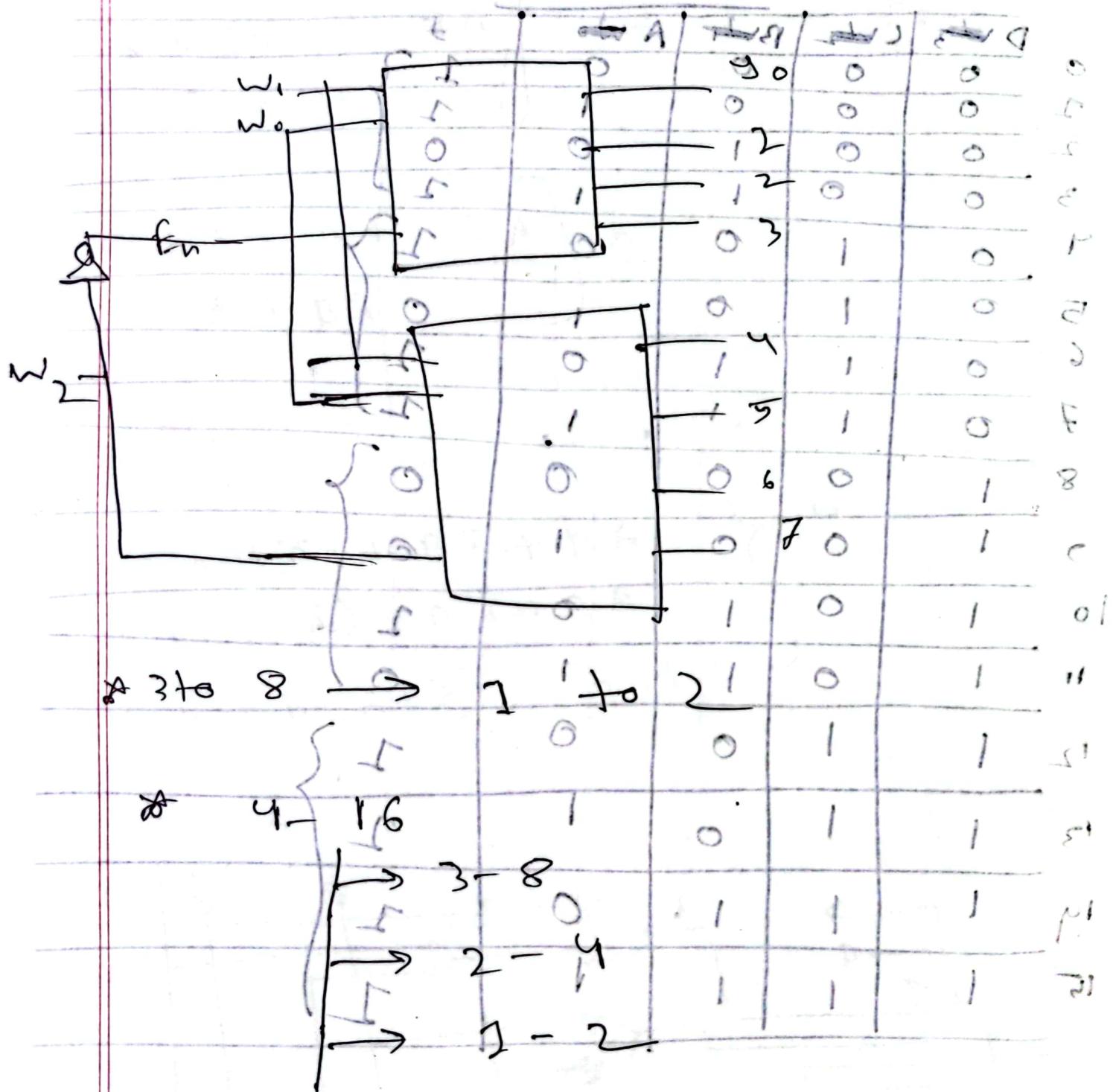
w_2	w_1	w_0	j_0	j_1	j_2	j_3	j_4	j_5	j_6	j_7
0	0	0	1	0	0	0	0	0	0	0
0	0	1	0	1	0	0	0	0	0	0
0	1	0	0	0	1	0	0	0	0	0
0	1	1	0	0	0	1	0	0	0	0
1	0	0	0	0	0	0	1	0	0	0
1	0	1	0	0	0	0	0	1	0	0
1	1	0	0	0	0	0	0	0	1	0
1	1	1	0	0	0	0	0	0	0	1

(ex. 1) when 8 bits = width
steps and which

9.14

2020 and 2017

3 to 8 dec \rightarrow 12 bit binary dec (contd)



final Ans solve

DLD

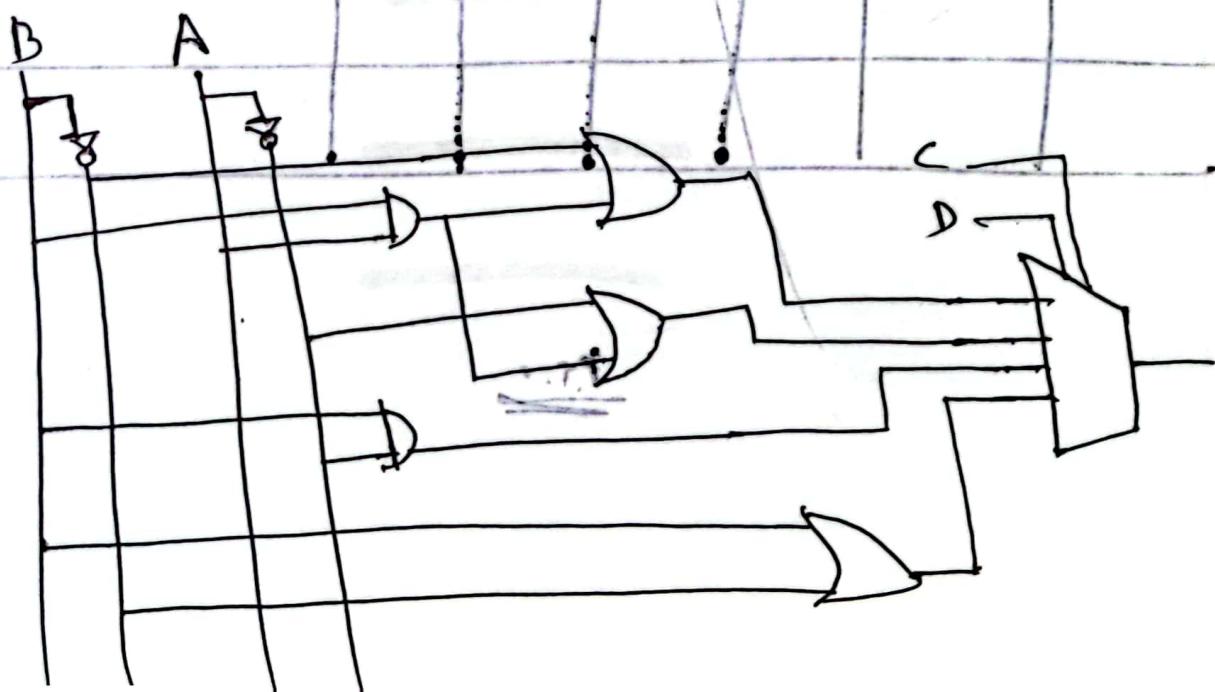
(*) 16 Multiplexer 16 of 8

D	C	B	A	F
0	0	0	0	1
1	0	0	1	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	1
5	0	1	0	0
6	0	1	1	1
7	0	1	1	1
8	1	0	0	0
9	1	0	0	0
10	1	0	1	1
11	1	0	1	0
12	1	1	0	1
13	1	1	0	1
14	1	1	1	1
15	1	1	1	1

$$\begin{aligned} & \overline{B}\overline{A} + \overline{B}A + BA \\ &= \overline{B}(A + \overline{A}) + BA \\ &= \overline{B} + BA \end{aligned}$$

$$\begin{aligned} & \overline{B}\overline{A} + B\overline{A} + BA \\ &= \overline{A} + BA \\ & BA \end{aligned}$$

$$\begin{aligned} & \overline{B}\overline{A} + \overline{B}A + B\overline{A} + BA \\ &= \overline{B}(A + \overline{A}) + B\overline{A} + BA \\ &= \overline{B} + B(A + \overline{A}) = \overline{B} + B \end{aligned}$$



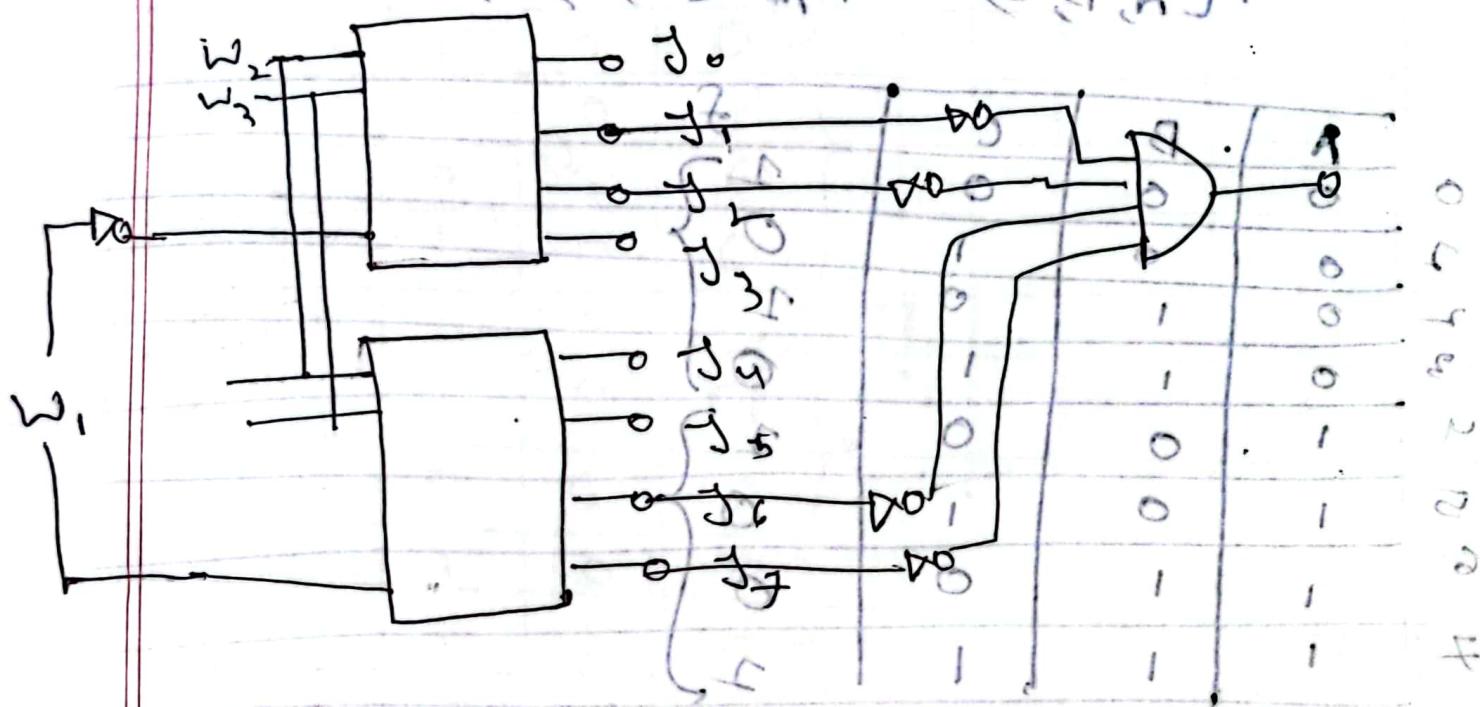
~~GW~~

~~DKD~~

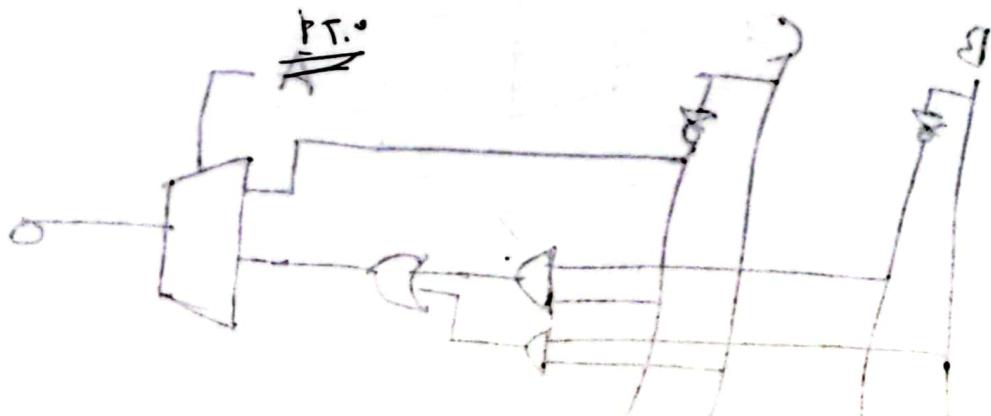
$$f(w_1, w_2, w_3) \rightarrow \text{Sum } (0, 1, 3, 4, 6, 7)$$

$$f(w_1, w_2, w_3) = \text{Sum } (1, 2, 6, 7)$$

$$(0, 1, 3, 4) \text{ mT} = (0, 1, A)7$$

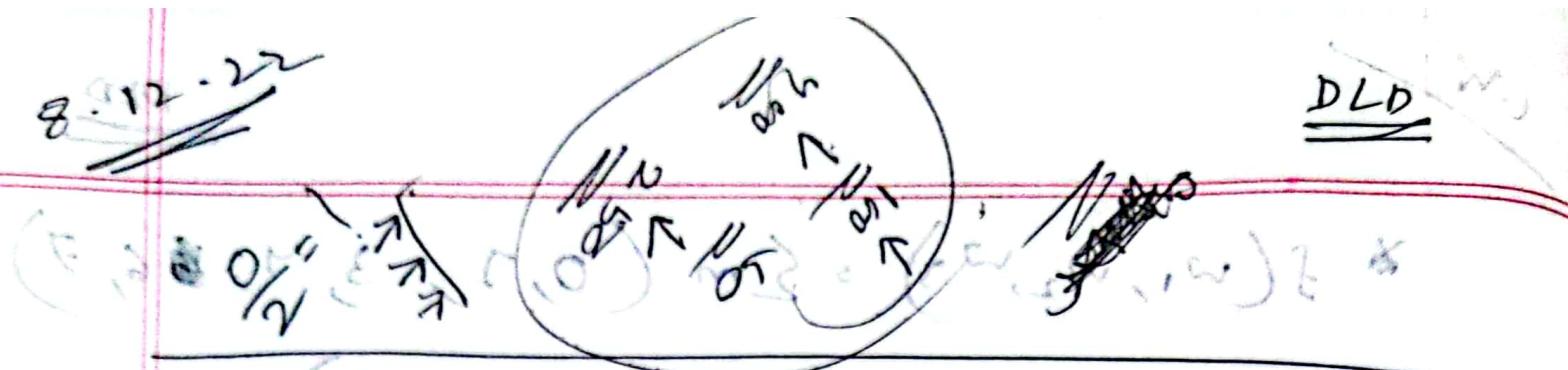


$$\begin{array}{c|cc}
& \overline{j_0 + j_1} & \overline{j_2 + j_3} \\
\hline
w_1 & 0 & 1 \\
w_2 & 1 & 0 \\
& 0 & 0 \\
& 1 & 1 \\
& 0 & 1 \\
& 1 & 0 \\
& 0 & 0 \\
& 1 & 1
\end{array}$$



8.9.12 - 22

DLD



$$\text{Minterms} = (0^C, w, e)$$

$$* F(A, B, C) = \prod_{m=1}^4 (1, 3, 5, 6)$$

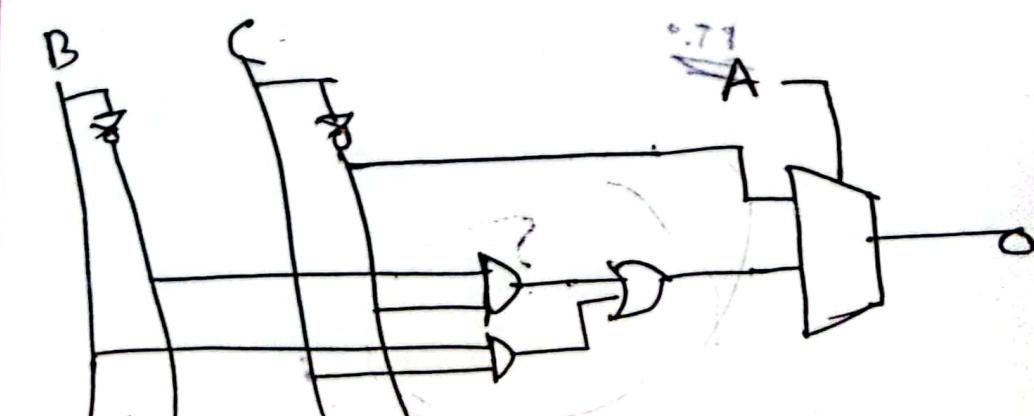
A	B	C	F	W
0	0	0	1	
1	0	0	0	
2	0	1	1	
3	0	1	0	
4	1	0	1	
5	1	0	0	
6	1	1	0	
7	1	1	1	

$$\overline{B}\overline{C} + \overline{B}\overline{C}$$

$$\Rightarrow \overline{C}(B + \overline{B})$$

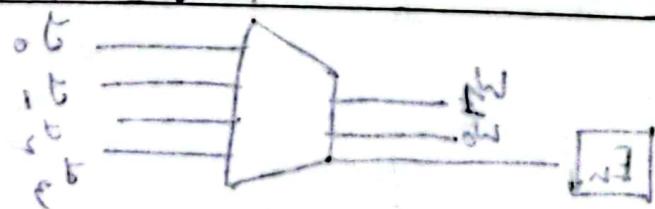
$$\Rightarrow \overline{C} \times 2$$

$$\overline{B}\overline{C} + BC$$

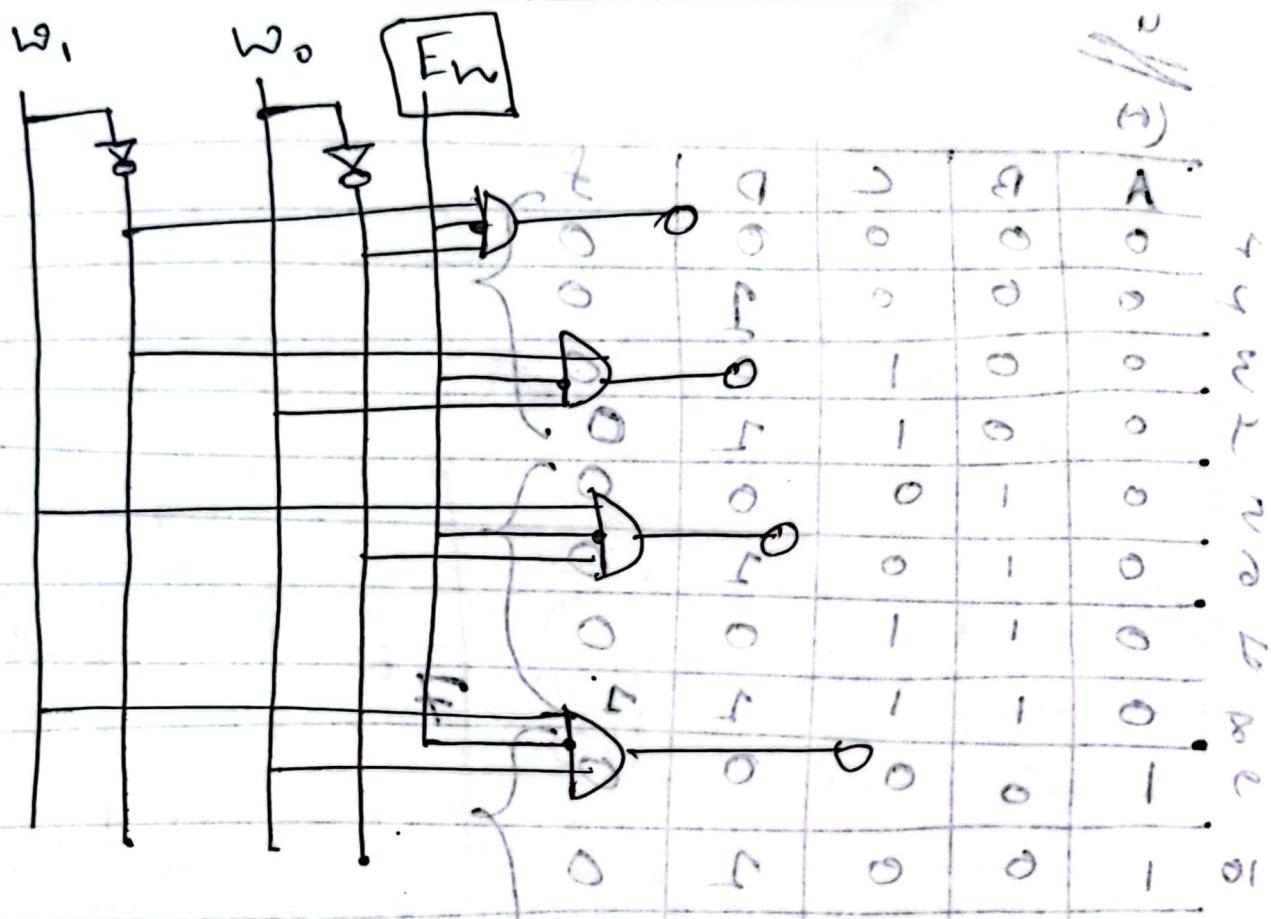


26-03-29

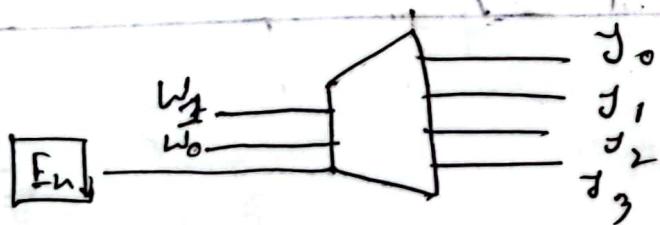
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	1	1	1	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0



Decoder



w ₁	w ₀	y ₀	y ₁	y ₂	y ₃	0	1	0	1	1
0	0	1	0	0	0	0	1	0	1	1
0	1	0	1	0	0	0	0	1	1	1
1	0	0	0	1	0	0	0	1	1	1
1	1	0	0	0	1	0	0	1	1	1



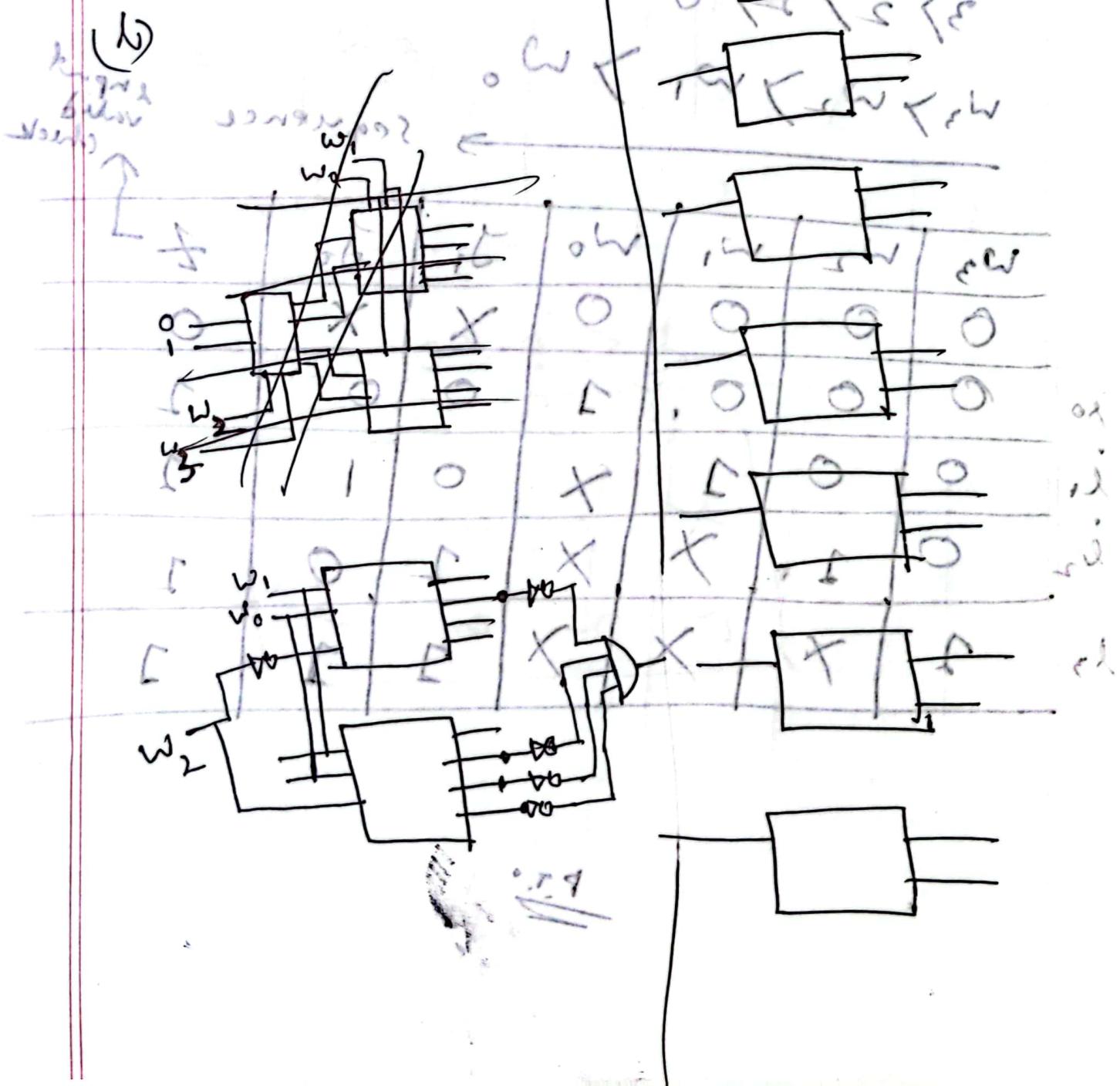
~~(t_{end} , T)~~
~~(w , ω)~~

constant stirring

batchwise

~~down~~ [stirring] ~~down~~ ~~up~~

(b)



GW
12.2.22

DLD

Priority Encoder

Preference

Descending
T-T

Circuit

$w_3 > w_2 > w_1 > w_0$

$w_3 > w_2 > w_1 > w_0$

Priority
 w_3

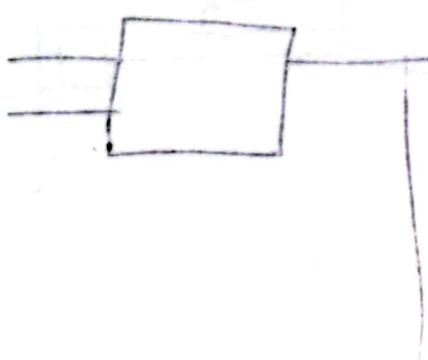
(d)
input
valid
check

Sequence

	w_3	w_2	w_1	w_0	j_1	j_0	Z
i_0	0	0	0	0	X	X	0
i_1	0	0	0	1	0	0	1
i_2	0	0	1	X	0	1	X
i_3	1	X	X	X	1	0	1



P.T.O



$$i_0 = \overline{\omega_3} \cdot \overline{\omega_2} \cdot \overline{\omega_1} \text{ i.e. } 0$$

$$j_0 = \overline{\omega_1} \cdot \overline{\omega_2} \cdot \overline{\omega_3}$$

$$i_1 = \overline{\omega_3} \cdot \overline{\omega_2} \cdot \omega_1$$

$$j_0 = i_1 + i_3$$

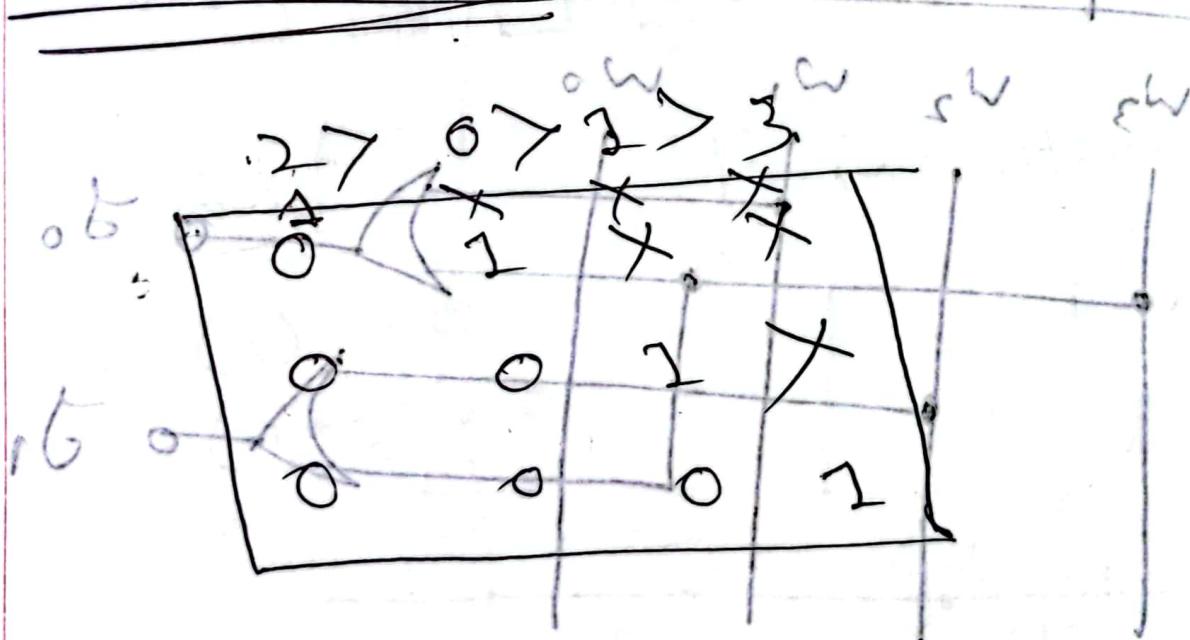
$$i_2 = \overline{\omega_3} \cdot \omega_2$$

$$j_0 = i_0 + i_1 + i_2 + i_3$$

$$i_3 = \omega_3$$

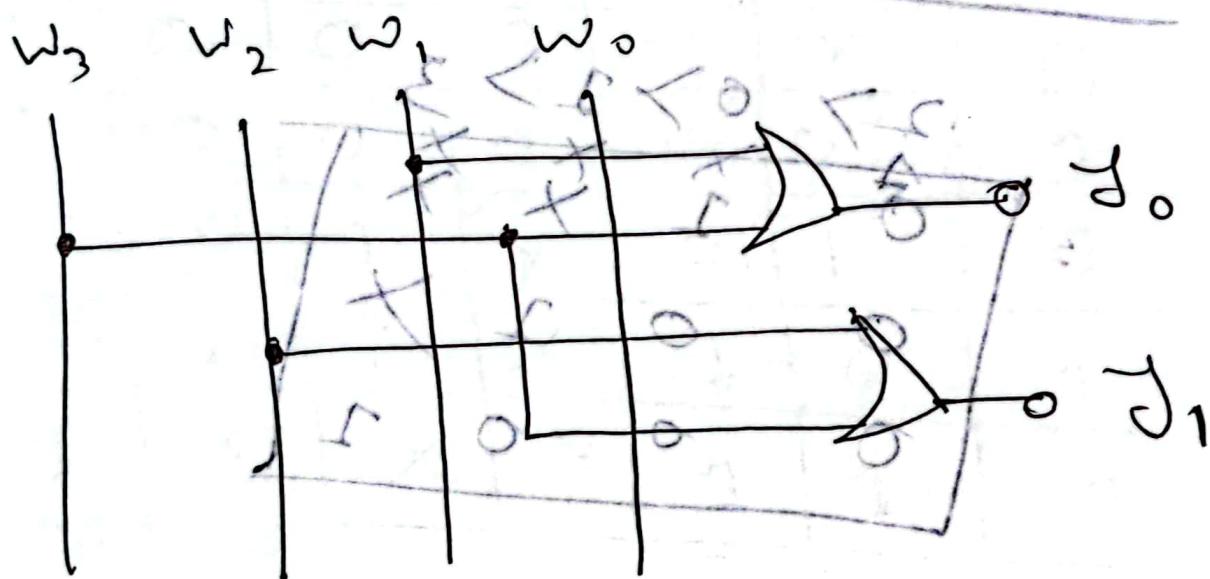
$$j_0 = i_0 + i_1 + i_2 + i_3$$

precedence:



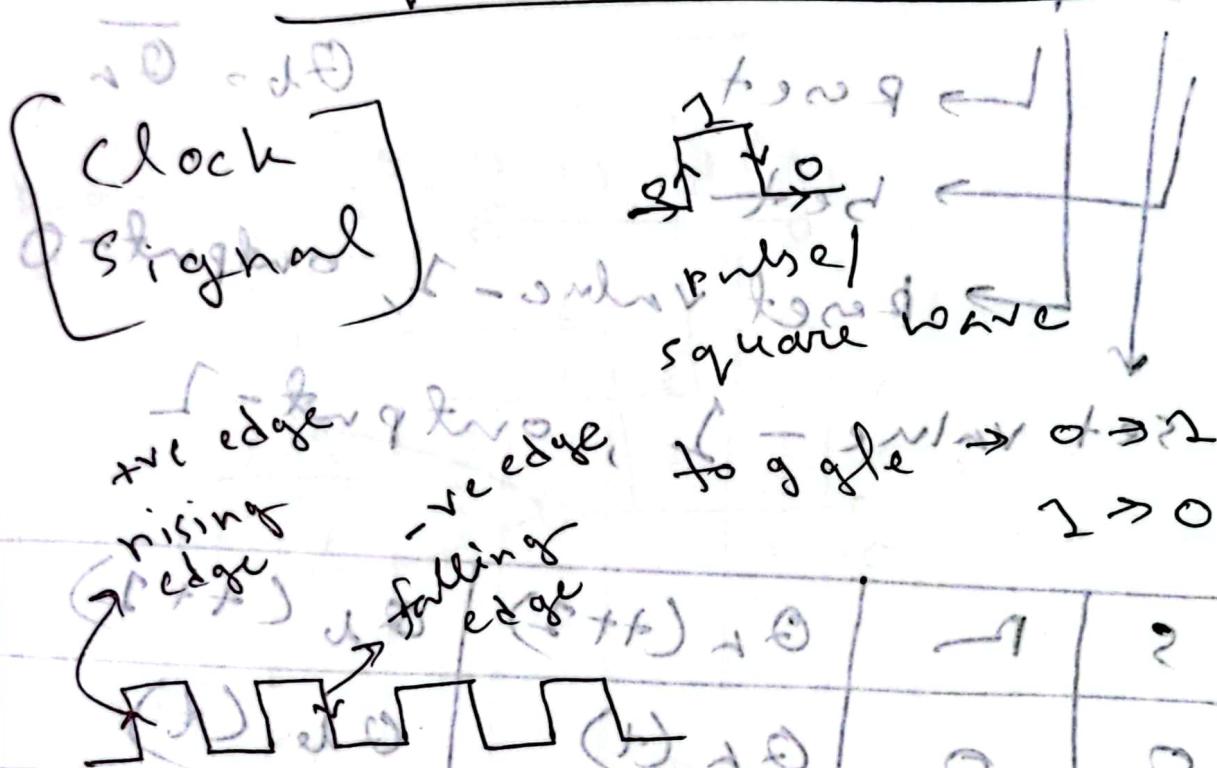
4.1

	w_3	w_2	w_1	w_0	j_1	j_0	z
i_0	0	0	0	0	X	X	0
i_1	X	0	X	1	0	0	1
i_2	X	0	1	0	0	1	2
i_3	1	0	0	0	1	0	2



P.T.O.

Segmented Circuit



Latches

$$Q(t) = 0$$

$$Q(t+1) = 0$$

[Value stored \Rightarrow]

Silence

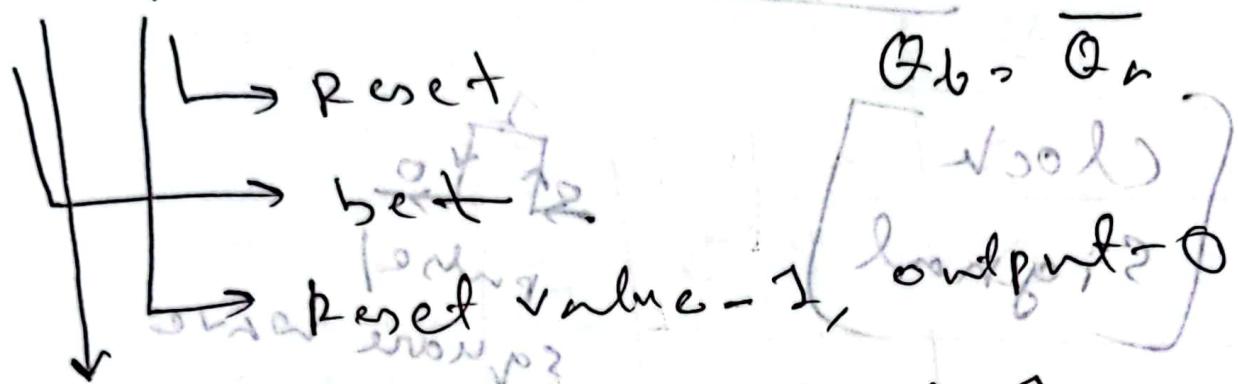
$$t = 0$$

$$t+1 = 0$$

$$t+2 = 0$$

Step

S-R Latch \Rightarrow Latch



Set value - 1, output 0
0 < 1

S	R	$Q_L(t+1)$	$Q_H(t+1)$
0	0	$Q_L(t)$	$Q_H(t)$
0	1	0	1
1	0	1	0
1	1	X	0

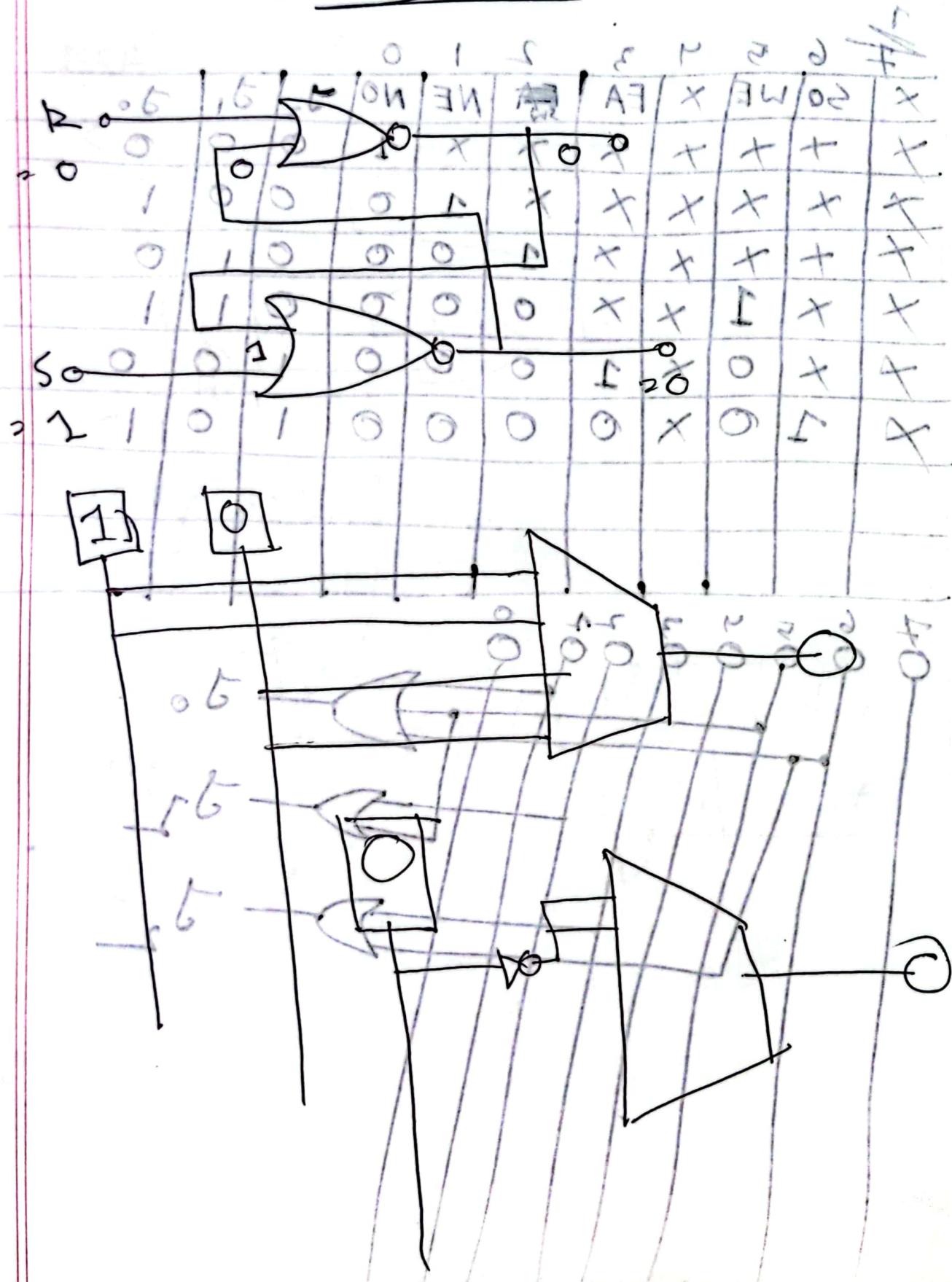
→ Invalid

Input t+1 t
S = 0 0 0
R = 0 1 0

P.T.O.

~~verbundene Gitter~~

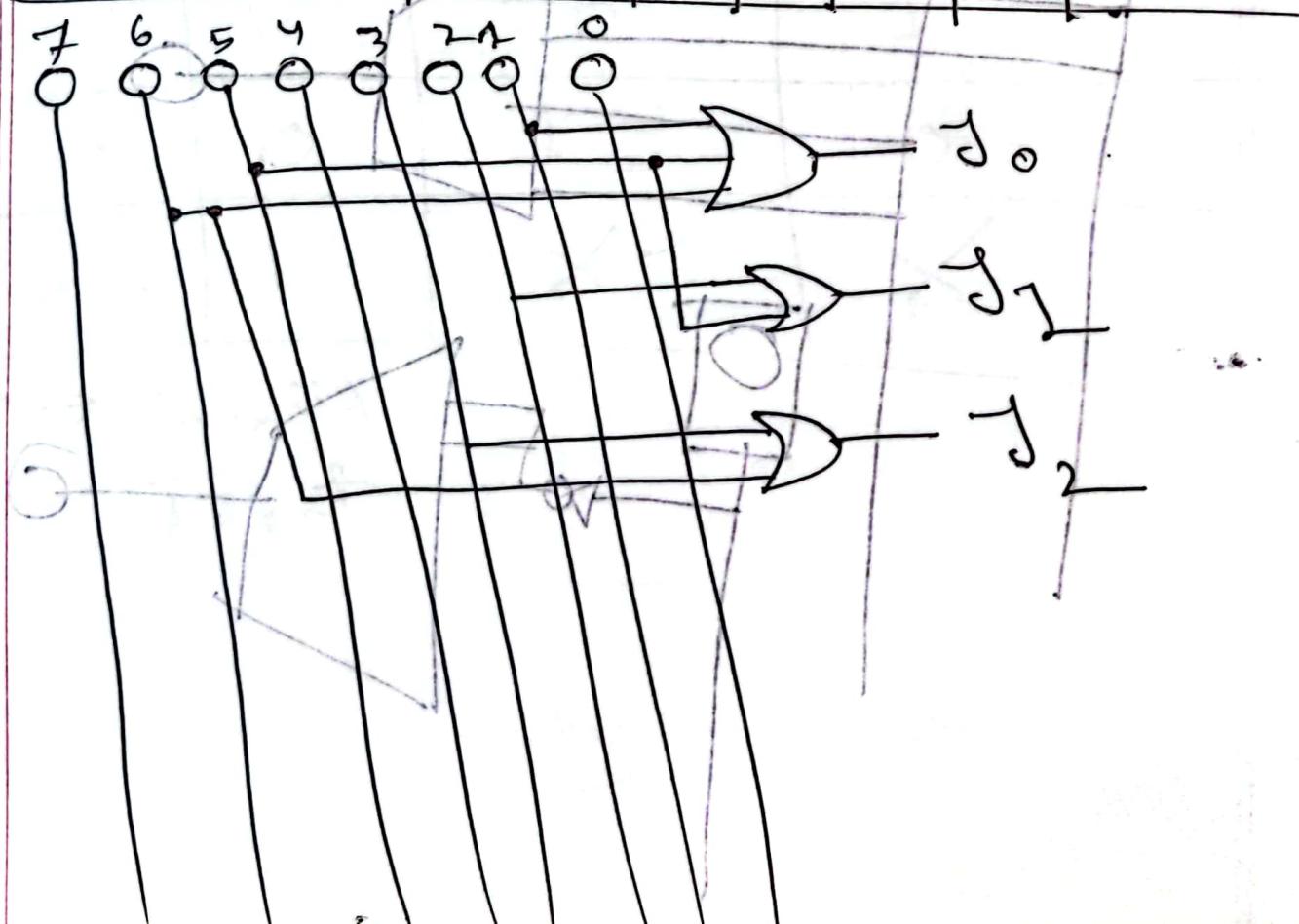
~~NOR-Gitter~~



~~Fig~~ Priority encoder

~~Final~~ soln

	7	6	5	4	3	2	1	0	J_0	J_1	J_2
X	S0	WE	X	EA	EN	NE	NO	J_2	0	0	0
X	+ + +	X	X	X	X	X	1	0	0	0	0
X	X X X X	X	X	X	X	1	0	0	0	1	
X	+ + X X	X	X	X	1	0	0	0	1	0	
X	X 1 X X	X	0	0	0	0	0	1	1		
X	X 0 X 1	0	1	0	0	0	0	1	0	0	0
X	1 0 X 0	0	0	0	0	0	1	0	1	0	0

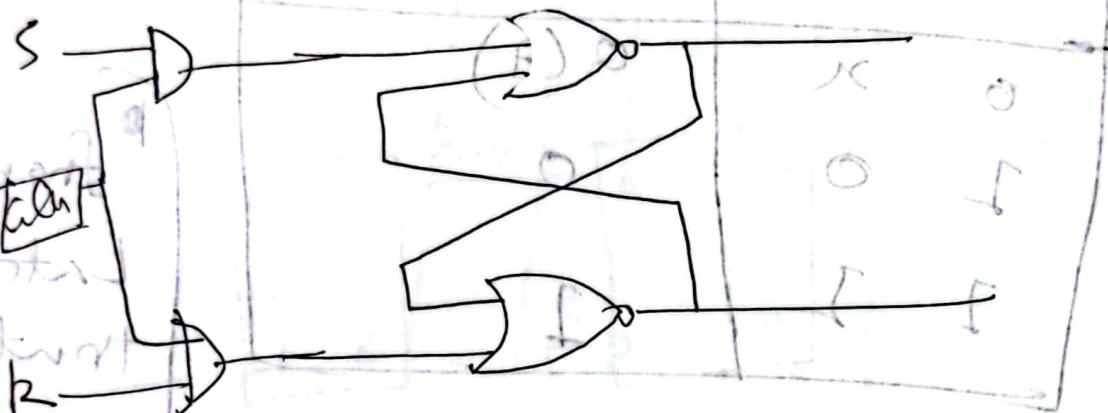


~~6.12~~
~~12.22~~

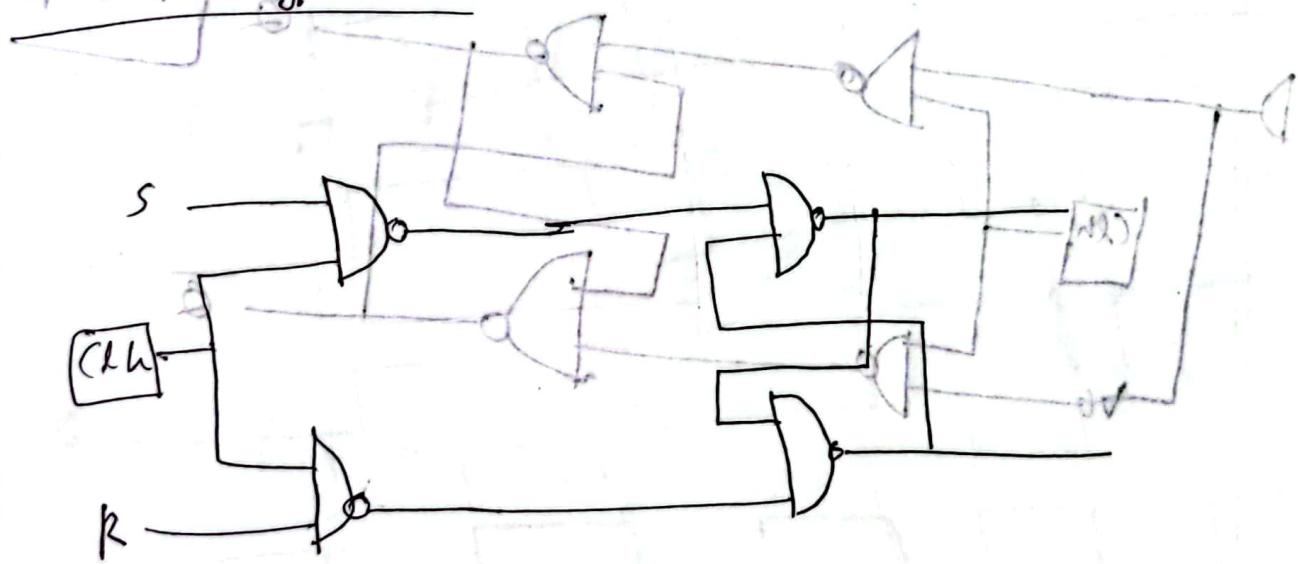
DLD

Waited SR - latch

NOR gate: $\Rightarrow (C+A) \oplus B$



NAND gate: \Rightarrow



79

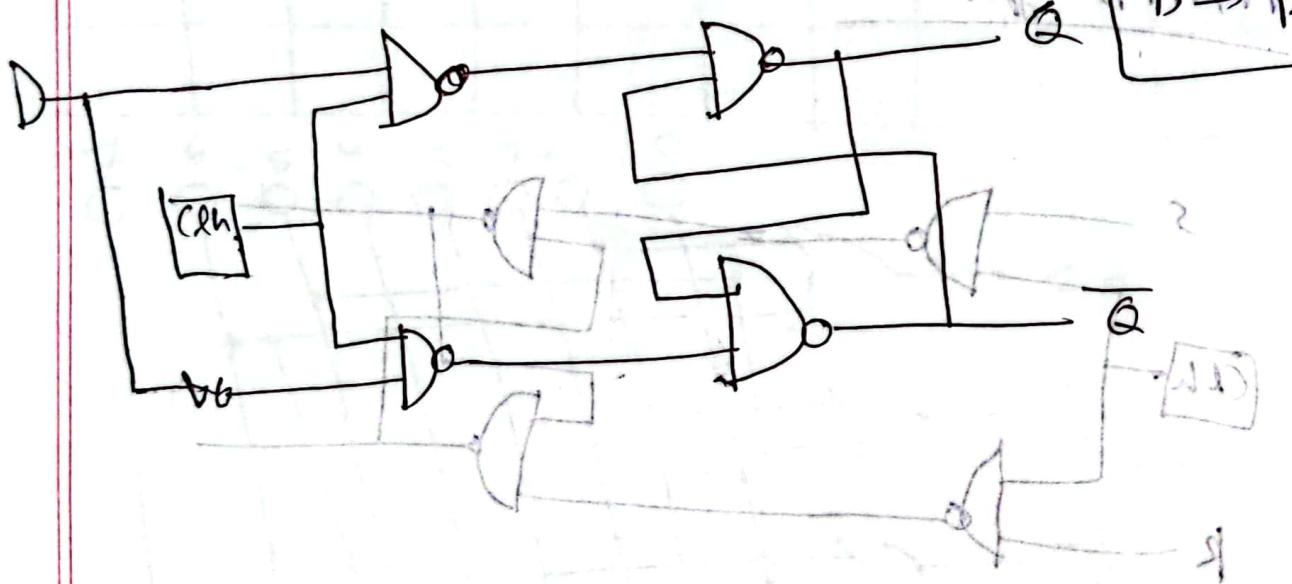
Asynchronous-D-Latch

Clk	D	$Q(t+2)$
0	x	$Q(t)$
1	0	0
1	1	1

from SR
latches
truth table

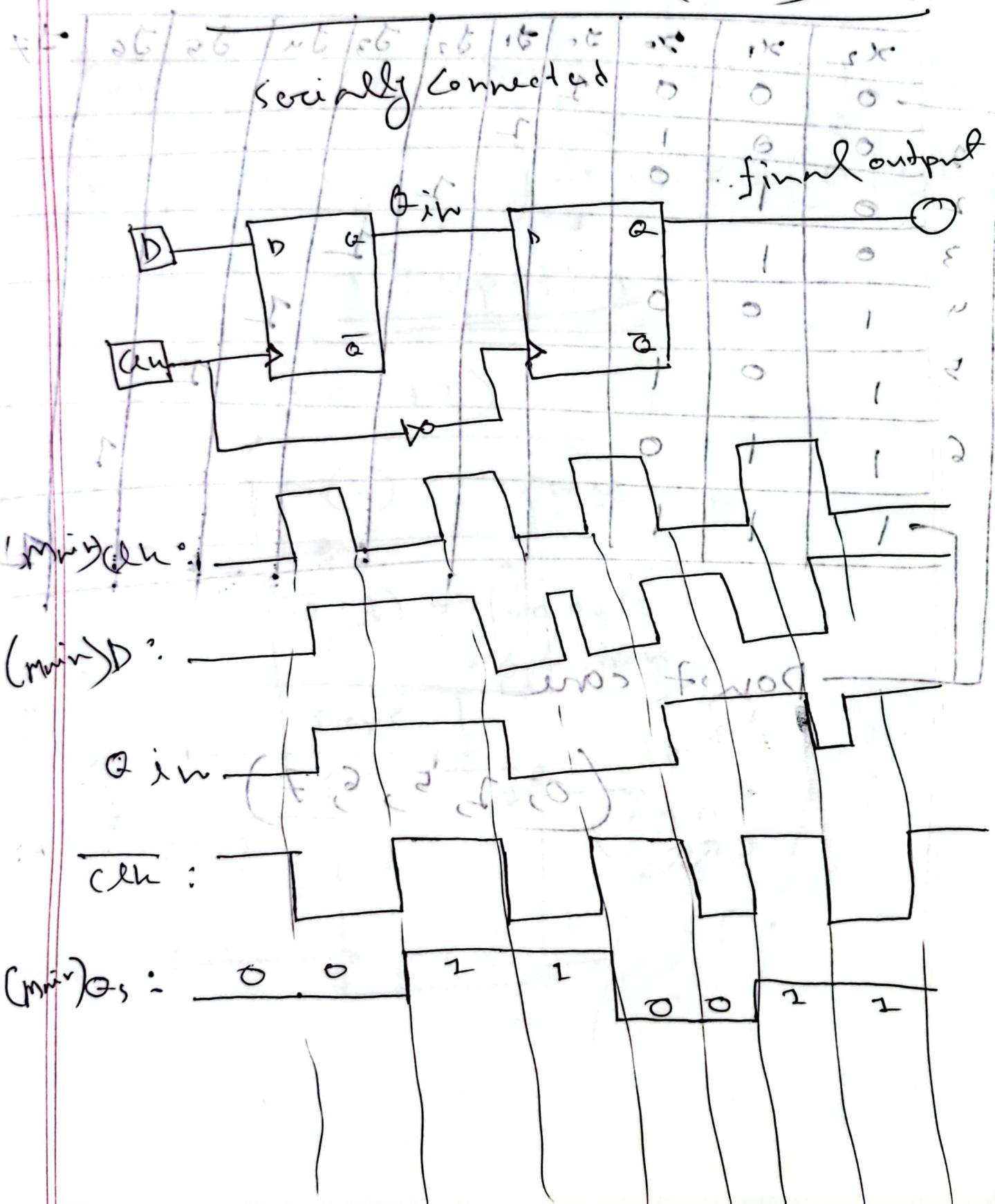
$$D \rightarrow S$$

$$\overline{D} \rightarrow R$$



P.S. o

Masters - Slave - (D-FF)



6

(17) = minterm

x_2	x_1	x_0	j_0	j_1	j_2	j_3	j_4	j_5	j_6	j_7
0	0	0	1							
2	0	0		2						
2	0	1	0			1				
3	0	1	1			1				0
4	1	0	0					3		
5	1	0	1	7		2	5	1		
6	1	1	0						1	
7	1	1	1							1

Don't care

: Krivay

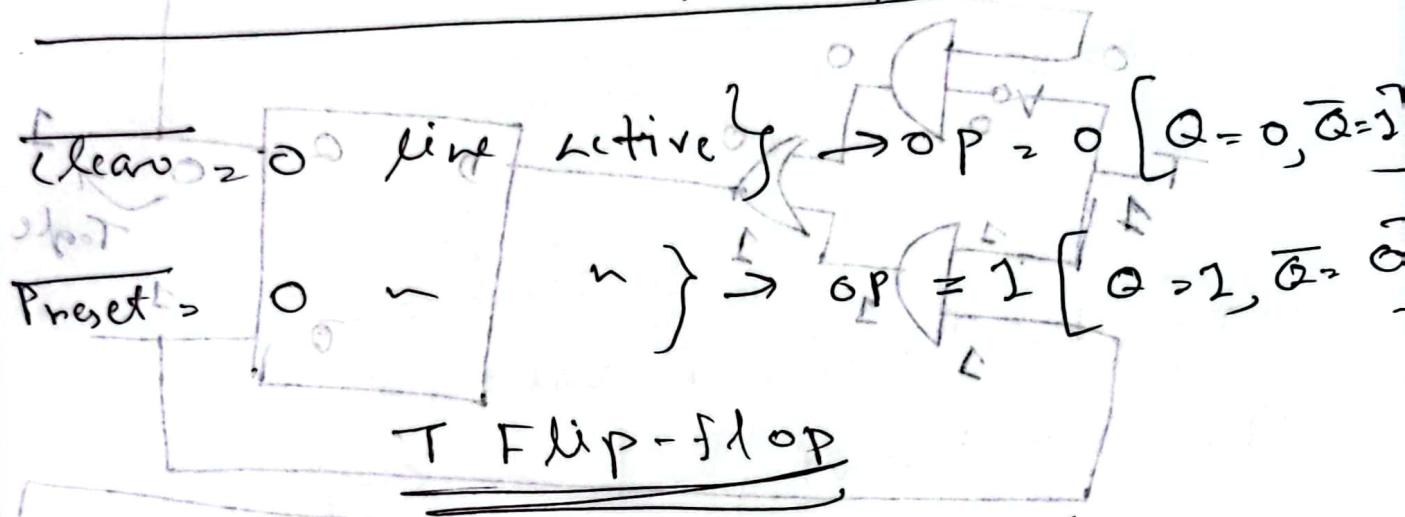
(0, 2, 5, 6, 7)

= 10

: 10

: 10 (Krivay)

~~Q1 Q2 Q3~~
Master - Slave \rightarrow Flip-flop

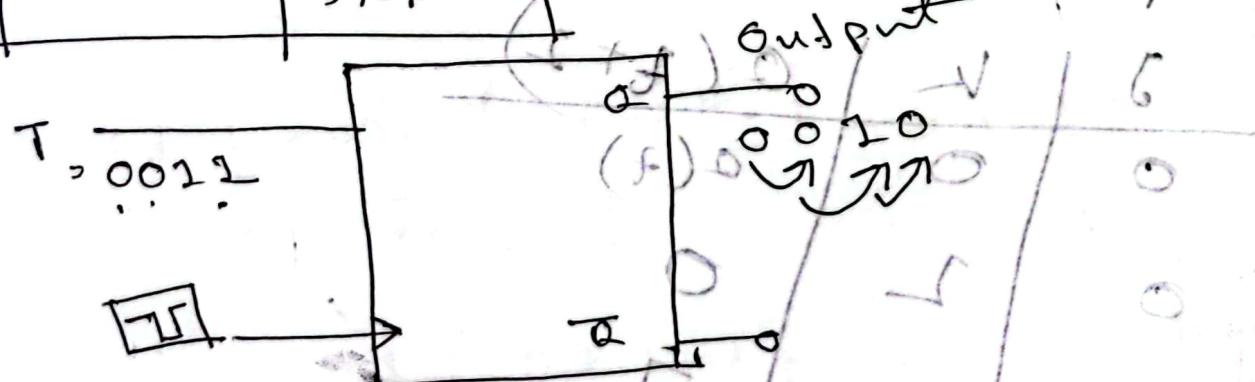


$$\text{Q}(t+1) = \overline{\text{Q}}(t) + \text{D}_T + \text{D}_{\overline{T}} = 1$$

$$\text{Q}(t) \rightarrow \text{Storage} \Rightarrow \text{D}_T$$

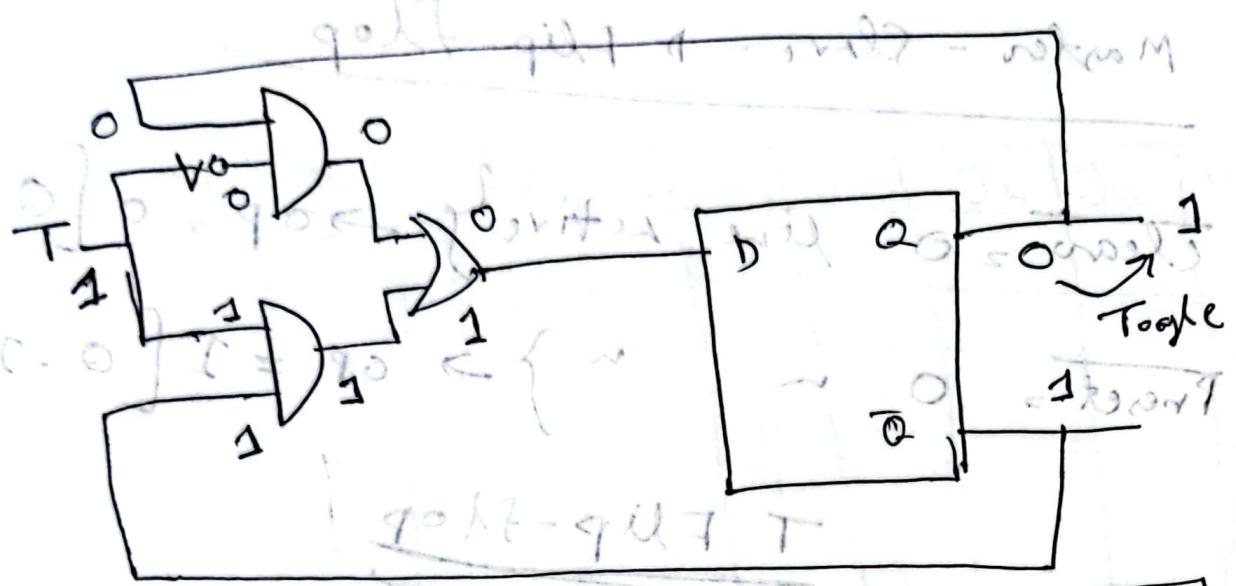
$$\overline{\text{Q}}(t) \rightarrow \begin{cases} \text{to gate operations} \\ \text{NET} \end{cases}$$

Store



(+) →

5.79



$$D = \overline{T}Q + T\bar{Q}$$

$$_2 \quad T \oplus Q \text{ start?} \leftarrow (t)$$

$X - \oplus R$

$X \oplus 0 = \bar{x}$

$X \oplus 1 = \bar{x}$

T

J

0

0

1

1

$\overline{T} = u$

K

$Q(t+1)$

$Q(t)$

1

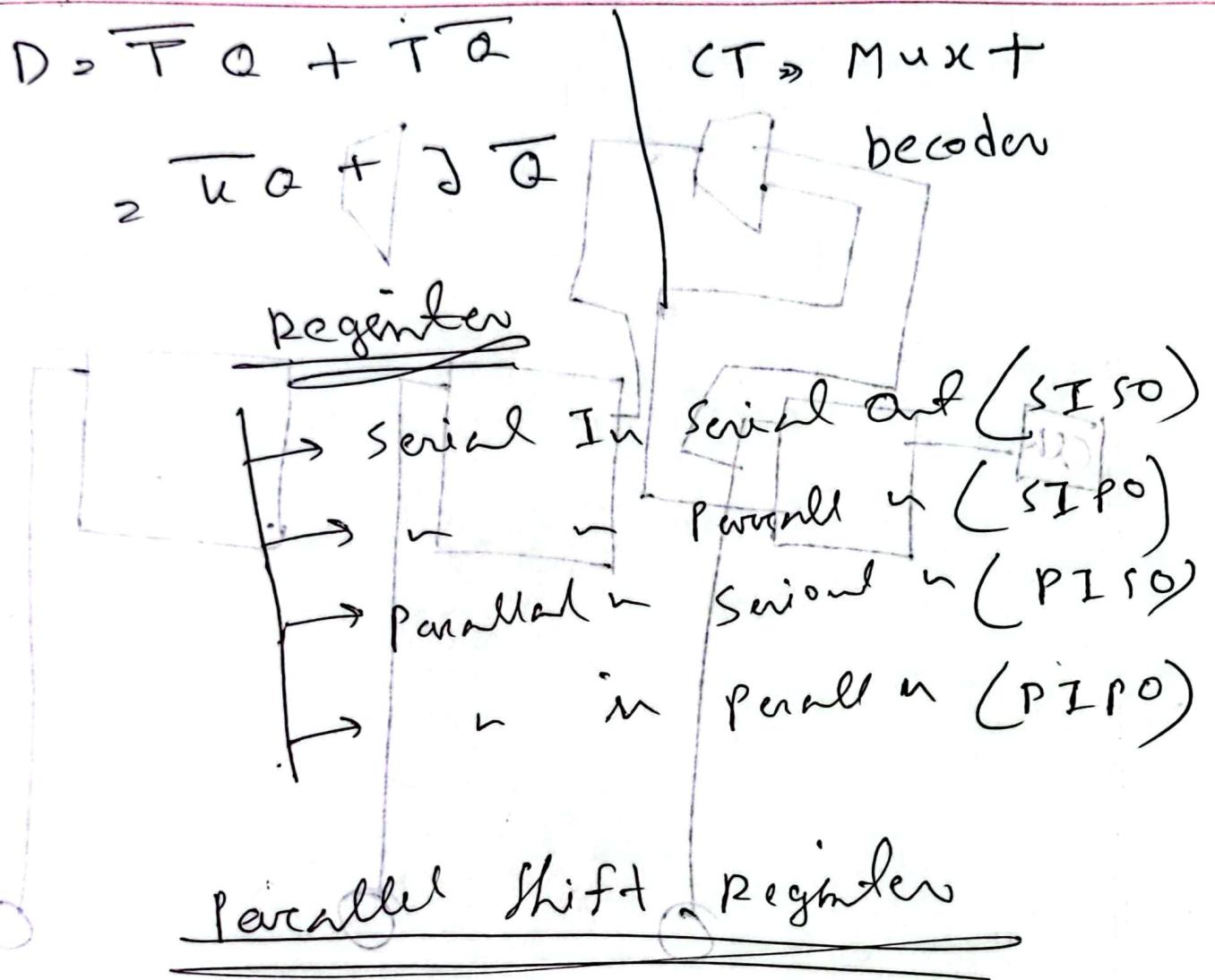
0

1

0

$\bar{Q}(t)$

P.T.O

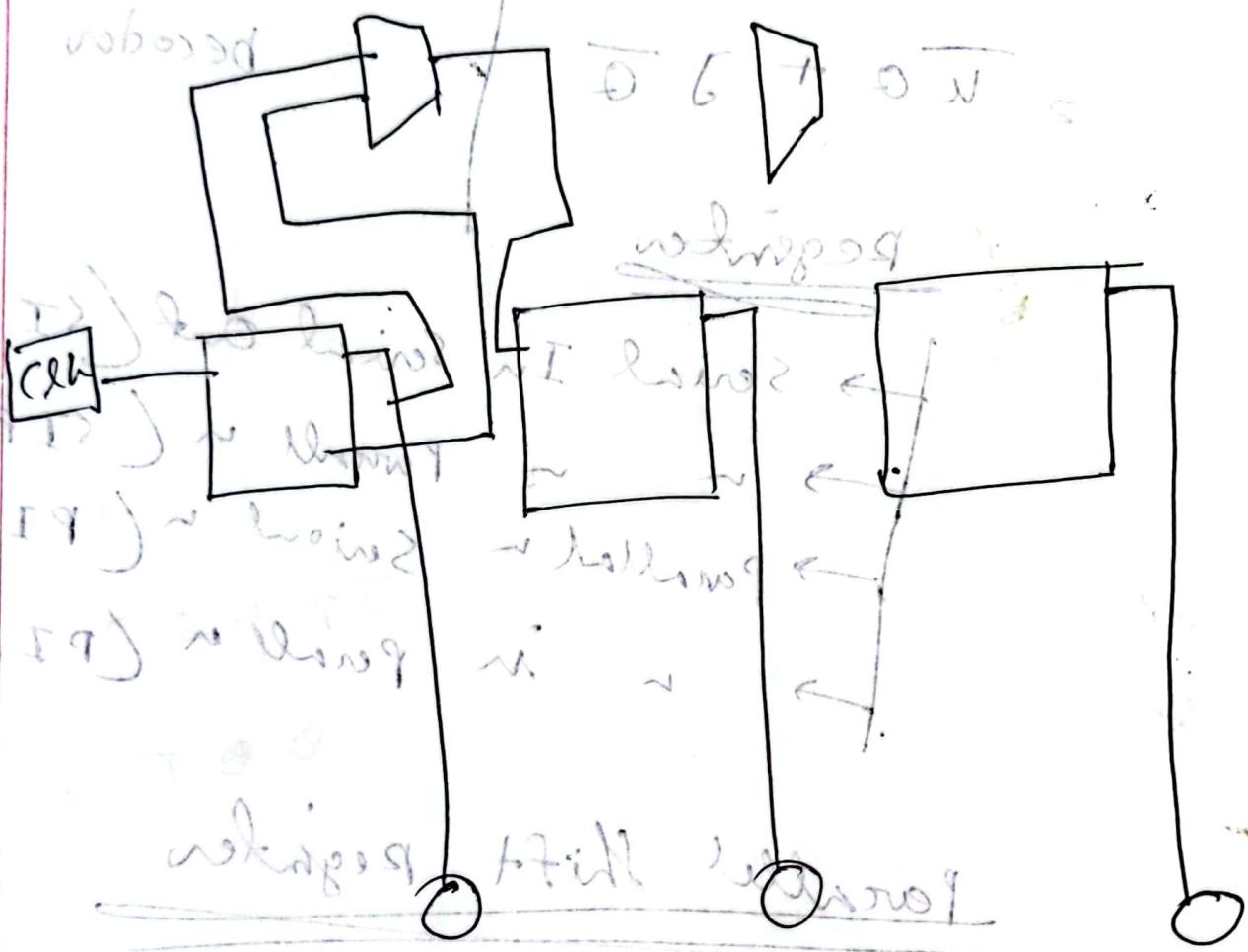


shift [Right/Left] → Input: Serial In
 Load [Output = Input] → n: 4 Bit
 { 4 Bit FF }
 { 4 n Bit load }
 { Parallel load }

from 0 to 75

$\overline{0T} + \overline{0T} = 0$

robosc



root : $\text{left} \leftarrow [\text{float} \mid \text{left}]$ $\text{right} \leftarrow [\text{float} \mid \text{right}]$

$\text{float} \leftarrow [\text{left} + \text{right}]$ $\text{left} \leftarrow \{ \text{float} \}$
 $\text{right} \leftarrow \{ \text{float} - \text{left} \}$