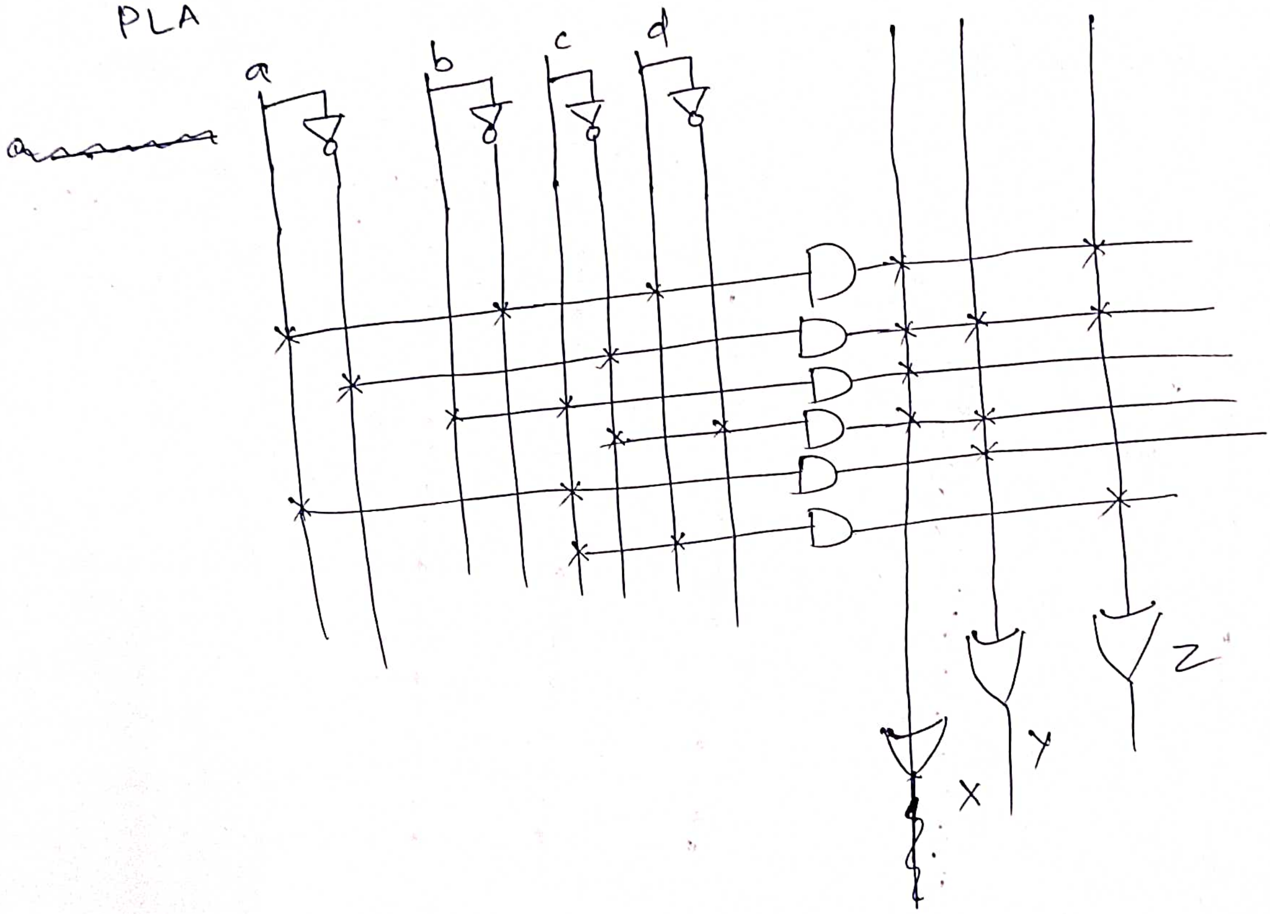
Practice Sheet 5 -

1. $X = \cancel{AB'D} + a\bar{b}d + \bar{a}\bar{c} + bc + \bar{c}\bar{d}$

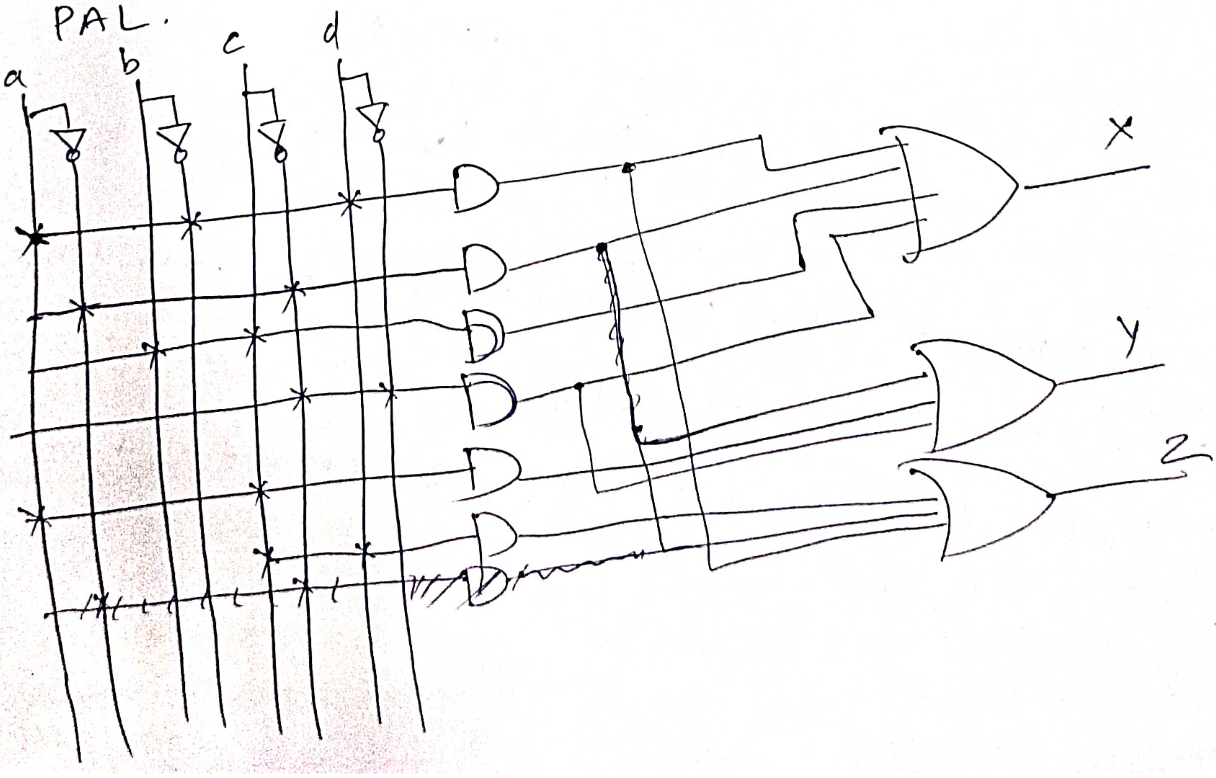
$Y = \bar{a}\bar{c} + ac + \overline{cd}$

$Z = cd + \bar{a}\bar{c} + a\bar{b}d$

PLA



PAL.



(2) Full subtractor

$D : A \oplus B \oplus C$

$B = A.(B \oplus C) + BC$

(15) $F = (v+w+x)(v+x+y)(v+z)$

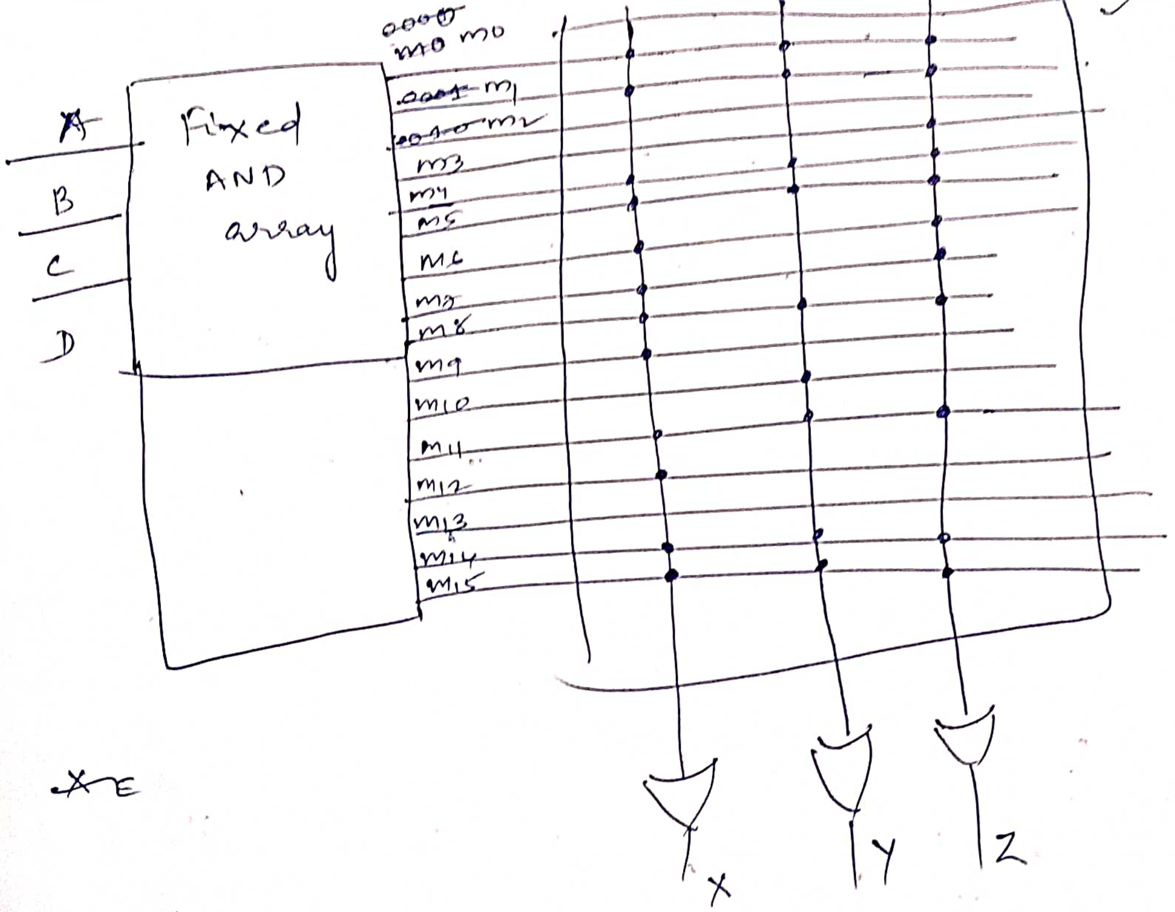
$= [(v+x)+(w.y)].(v+z)]$

$= v + z(x + w'y)$

Q1 PROM

$x = a\bar{b}d + \bar{a}\bar{c} + bc + \bar{a}\bar{d}$

$= 1001, 1001, 0110, 1110, 0111, 1111, 0000, 0001, 0100, 0101, 0100, 0000, 1000, 1100$



~~AE~~

$m_7 +$

$X = m_0 + m_1 + m_4 + m_5 + m_6 + m_8 + m_9 + m_{11} + m_{12} + m_{14} + m_{15}$

$Y = m_0 + m_1 + m_4 + m_5 + m_{10}, m_{11} + m_{14} + m_{15} + m_8 + m_4$

$Z = m_0 + m_1 + m_4 + m_5 + m_8 + m_{11} + m_6 + m_{14} + m_3 + m_7 + m_{15}$

3) $F = a\bar{b}cd\bar{e} + b\bar{c}\bar{d}e + \bar{a}c\bar{d}e + a\bar{c}d\bar{e}$

$F = \bar{b}(f_{b=0}) + b(f_{b=1})$

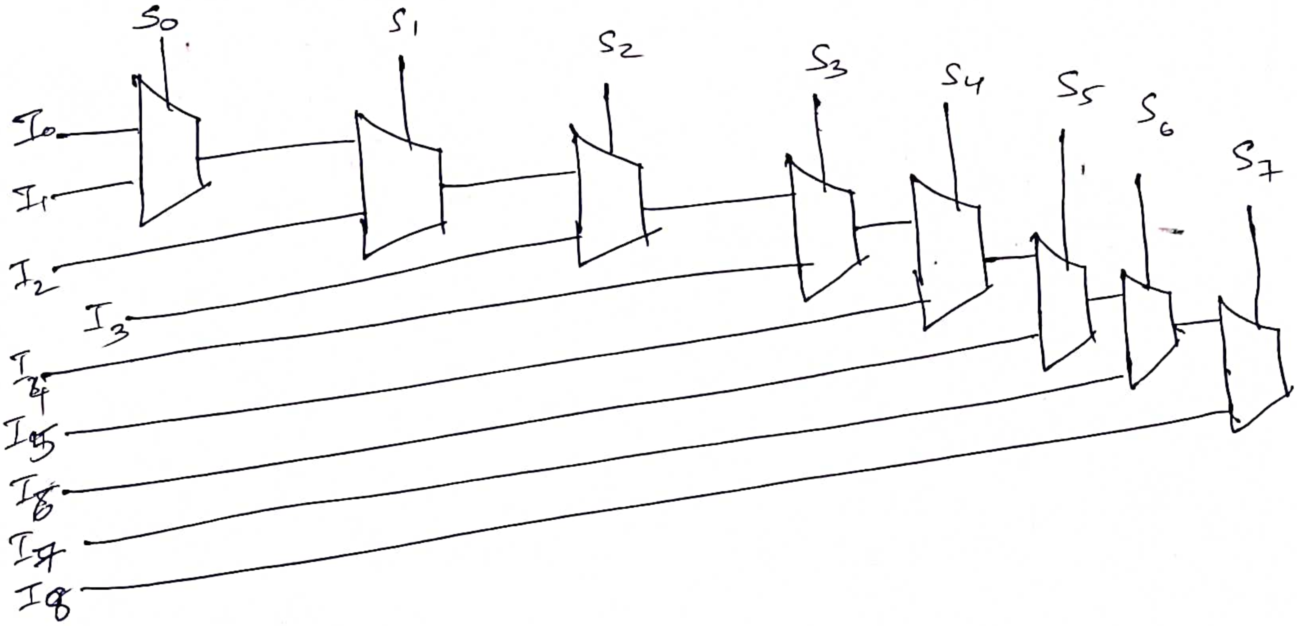
$= \bar{b}(abcd\bar{e} + \bar{a}\bar{b}c\bar{d}e + a\bar{c}d\bar{e})$

$+ b(b\bar{c}\bar{d}e + \bar{a}c\bar{d}e + a\bar{c}d\bar{e})$

$= \bar{a}\bar{b}c\bar{d}e + a\bar{b}\bar{c}d\bar{e} + b\bar{c}\bar{d}e + \bar{a}bc\bar{d}e + ab\bar{c}d\bar{e}$

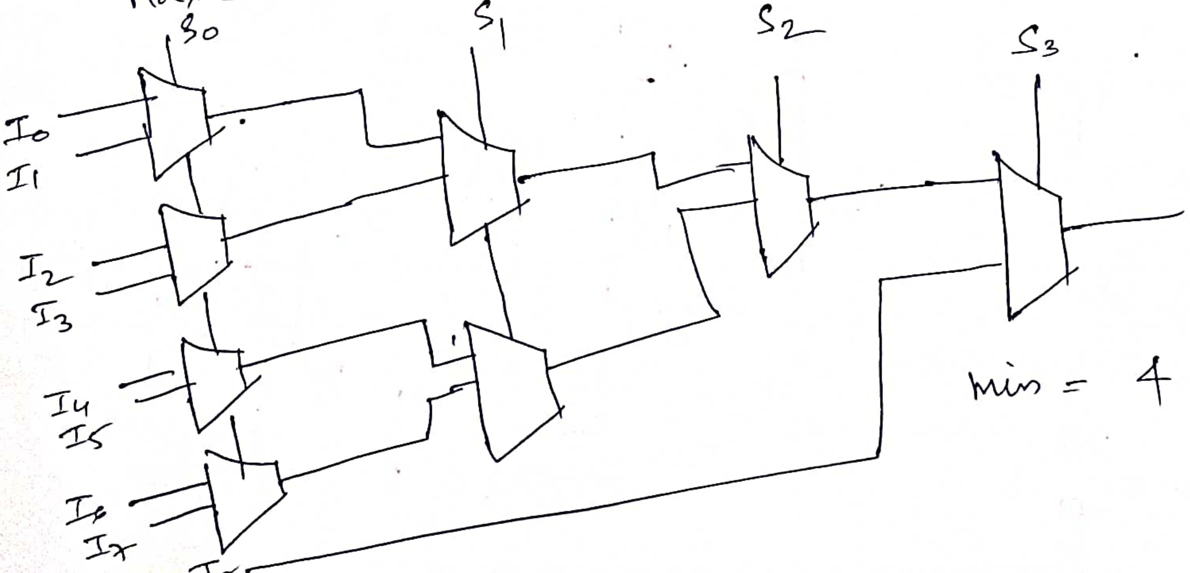
$= \cancel{ad}\, a\bar{c}d\bar{e} + \bar{a}c\bar{d}e + b\bar{c}\bar{d}e$

5) Realise the 9:1 mux using 2:1 mux.



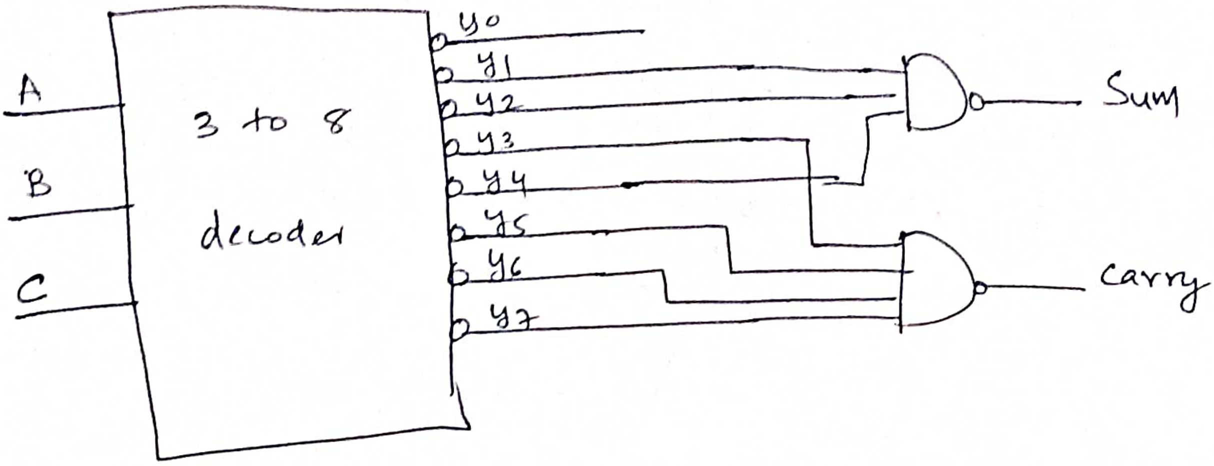
Max = 8

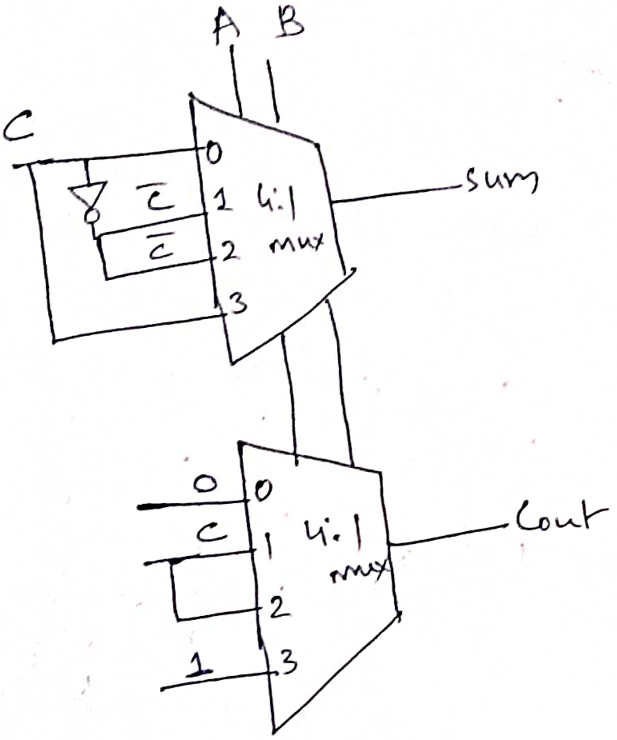
Max = N-1



min = 4.

Q 11



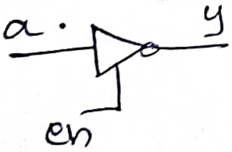


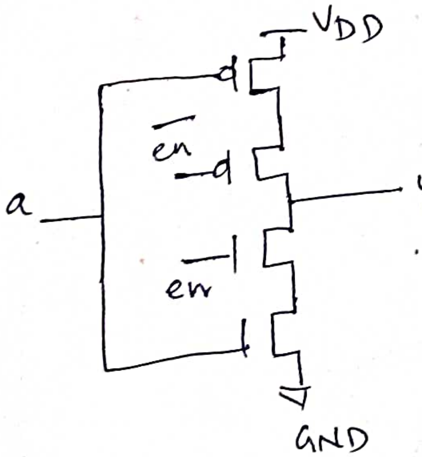
A	B	C	Sum	Cout
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

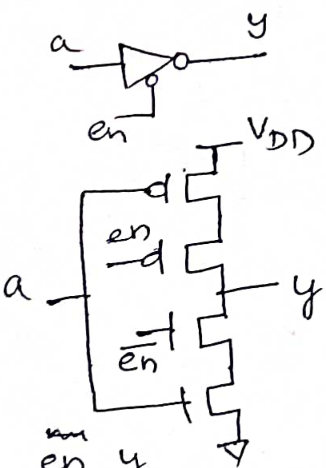
12 Same type as question 11

You can omit Q 13, 14, 15, 16. and 18

17





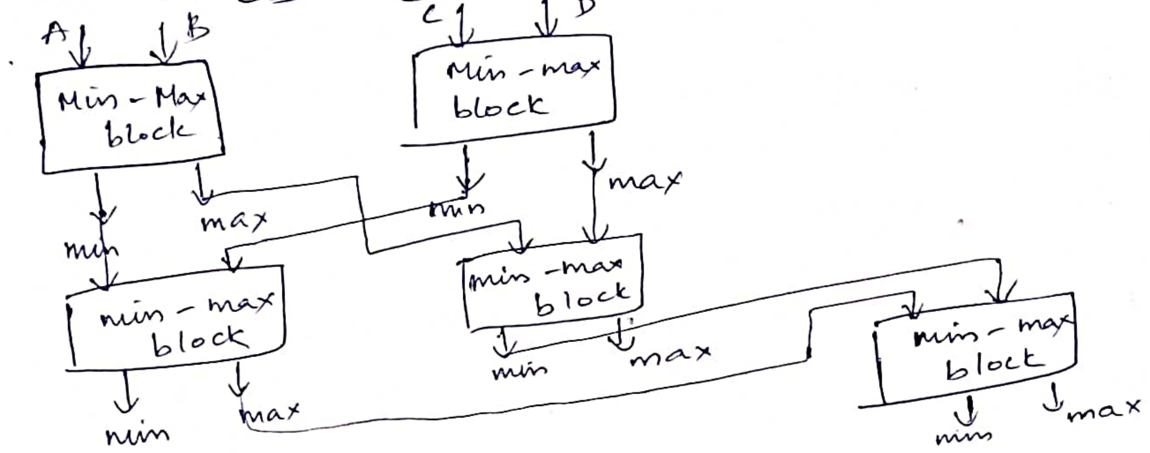


a	en	y
0	0	Z
1	0	Z
0	1	1
1	1	0

a	en	y
0	0	1
1	0	0
0	1	Z
1	1	Z

7) a) ~~Lab~~ Done in lab (Magnitude Comparator)

b)



8) $X = X_4 X_3 X_2 X_1 X_0$

a) X is odd $\therefore X = X_4 X_3 X_2 X_1 1$ (eg $1 - 00001$, $3 - 00011$)

$Y = X - 1$

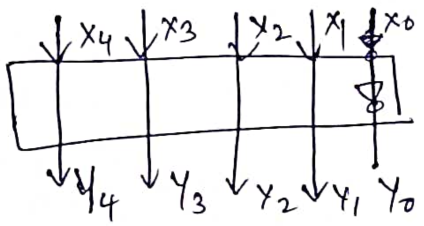
$= X_4 X_3 X_2 X_1 0$

$$\begin{array}{r} X_4\ X_3\ X_2\ X_1\ 1 \\ -\quad\quad\quad\quad\ 1 \\ \hline X_4\ X_3\ X_2\ X_1\ 0 \end{array}$$

X is even

$X = X_4 X_3 X_2 X_1 0$ $\qquad Y_0 = \overline{X_0}$

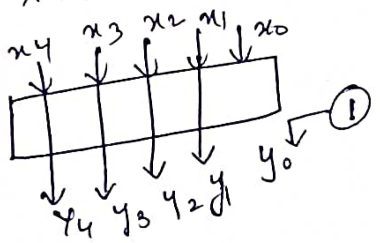
$Y = X + 1 = X_4 X_3 X_2 X_1 1$



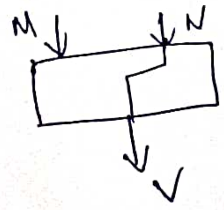
b) X is even.

$X = X_4 X_3 X_2 X_1 0$ $\quad\therefore Y_0 = 1$

$Y = X + 1 = X_4 X_3 X_2 X_1 1.$



c) if $M > N$, $V = N$. else $V = N$.



d) $P = 8 \times \text{int}(M/8)$

$M/8$ = right shift 3 bit positions

$M = M_4 M_3 M_2 M_1 M_0$

A $M/8 = 000.M_4 M_3 \cdot M_2 M_1 M_0$

$\text{int}(M/8) = 000 M_4 M_3$

$P = 8 \times \text{int}(M/8)$

$= 2^3 \times \text{int}(M/8)$

Multiply by 8 = 3 left shifts

$P = M_4 M_3 000$

e) $R = r_4 r_3 r_2 r_1 r_0$

eg

No.		
4	01	00
8	10	00
12	11	00
16	100	00

$R/4 = 00 r_4 r_3 r_2$

If R is divisible by 4 $\quad r_1 r_0 = 00$

$\therefore S = r_4 r_3 r_2 00$

$S = \text{int}(R/4) = 00 r_4 r_3 r_2 = r_1 r_0 r_4 r_3 r_2$

as $r_1 = 0, r_0 = 0$

else

$4 \times \text{int}(R/4) = r_4 r_3 r_2 00$

$= r_4 r_3 r_2 r_1 r_0$

$$R - 4 \times \text{int}(R/4) = \begin{array}{r} r_4 r_3 r_2 r_1 r_0 \\ - r_4 r_3 r_2 0\ 0 \\ \hline 0\ 0\ 0\ r_1 r_0 \end{array}$$

$$\begin{array}{lr} 8 \times (R - 4\,\text{int}(R/4)) = & r_1 r_0 000 \\ +\ \text{int}(R/4) & 00 r_4 r_3 r_2 \\ \hline & r_1 r_0 r_4 r_3 r_2 \end{array}$$

f) $S = (16 \times H) + 9$ — Size of S is not specified.

$\cancel{S}$ $H = h_4\ h_3\ h_2\ h_1\ h_0$ — $16 \times H$ = shift to left by 4 bit positions

$16 \times H = \cancel{h_4 0000}\ h_4\ h_3\ h_2\ h_1\ h_0\ 0\ 0\ 0\ 0$

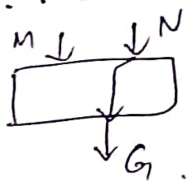
$+9 \quad + \quad 1\ 0\ 0\ 1$

$h_4\ h_2\ h_3\ h_1\ h_0\ 1\ 0\ 0\ 1$

g) if $M = N$, $G = M$ else $G = N$.

if true $G = M = N$.
else $G = N$.

$\therefore G = N$.

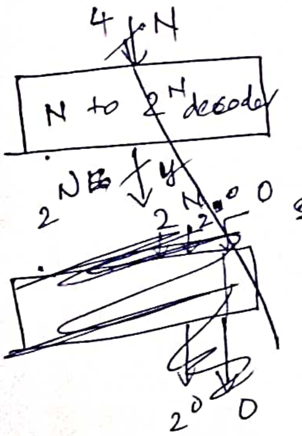


10) a) $Y = 2^N$. — N to 2^N decoder

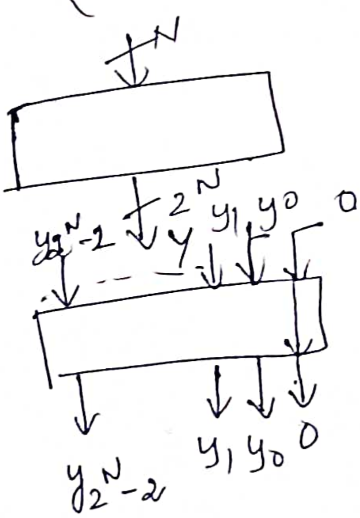
N - 4 bit no. — 4 to 16 decoder circuit.

Y - 16 o/ps.

b) $P = 2^{N+1} = 2^N \times 2^1$

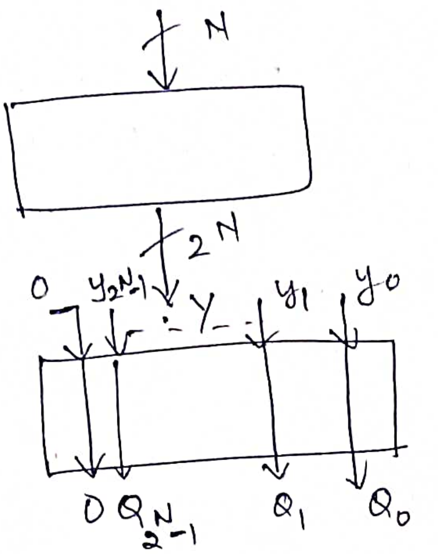


shift by 1 bit position to left



(replace y with P)

$Q = 2^{N-1} = 2^N \div 2$



$R = 2^N - 1$

Suppose $N = 3$, $Y = 2^3 = 8$, $R = Y - 1$

n_2	n_1	n_0	y_7	y_6	y_5	y_4	y_3	y_2	y_1	y_0	r_7	r_6	r_5	r_4	r_3	r_2	r_1	r_0
0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1
0	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	1
1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	1	1
1	0	1	0	0	1	0	0	0	0	0	0	0	0	1	1	1	1	1
1	1	0	0	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1
1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1

$r_7 = 0$

$r_6 = y_7$

$r_5 = y_7 + y_6$

$r_4 = y_7 + y_6 + y_5$

$\vdots$

$r_1 = y_7 + y_6 + y_5 + y_4 + y_3 + y_2$

$r_0 = \overline{y_0}$

14 2 to 4 decoder

$y_0 = \bar{E}\,\bar{I_1}\,\bar{I_0}$

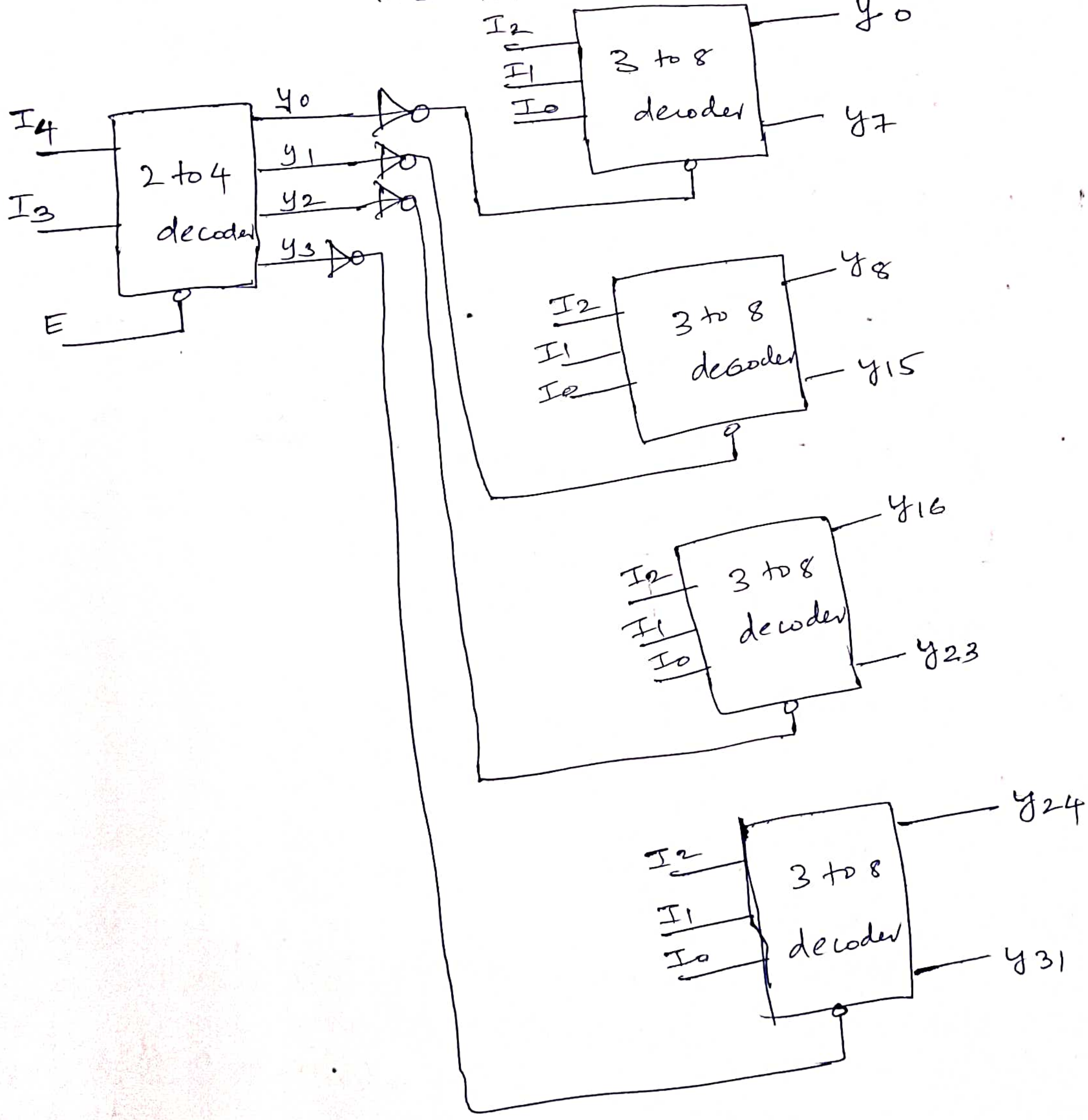
$y_1 = \bar{E}\,\bar{I_1}\,I_0$

$y_2 = \bar{E}\,I_1\,\bar{I_0}$

$y_4 = \bar{E}\,I_1\,I_0$

E	I_1	I_0	y_3	y_2	y_1	y_0
1	x	x	x	x	x	x
0	0	0	0	0	0	1
0	0	1	0	0	1	0
0	1	0	0	1	0	0
0	1	1	1	0	0	0

5 to 32 decoder



20) Encoder circuit.

21) a) 7.

b) 3

22) a) $y = x - 1$.

eg $x_3\, x_2\, x_1\, x_0$ $y_3\, y_2\, y_1\, y_0$

x_3	x_2	x_1	x_0	y_3	y_2	y_1	y_0
0	1	0	0	0	0	1	1
1	0	1	0	1	0	0	1

$y_0 = \overline{x_0}$

$y_1 = \overline{x_1 \oplus x_0}$

b) $y = \lfloor x/4 \rfloor$

$y_0 = x_2$

$y_1 = x_3$

c) $y = x^2 = x \times x$

$$\begin{array}{rrrrr} & & x_2 & x_1 & x_0 \\ & \times & x_2 & x_1 & x_0 \\ \hline & & x_2x_0 & x_1x_0 & x_0x_0 \\ & x_2x_1 & x_1x_1 & x_1x_0 & \times \\ x_2x_2 & x_2x_1 & x_2x_0 & \times & \times \\ \hline & & & 0 & x_0 \end{array}$$

$x_1\; x_0$
$+\; x_1\; x_0$.

If $x_0 = 0$
$0 + 0 = 0$
If 1
$1 + 1 = 0$

$y_0 = x_0$

$y_1 = 0$

d) $y = x \bmod 8$

$y_0 = x_0$

$y_1 = x_1$

Do the rest.

3) $f = a\bar{b}cd\bar{e} + b\bar{c}\bar{d}e + \bar{a}c\bar{d}e + a\bar{c}d\bar{e}$

$\bar{b}(f(b=0)) + b(f(b=1))$

$f = \bar{b}(acd\bar{e} + \bar{a}c\bar{d}e + a\bar{c}d\bar{e}) + b(\bar{c}\bar{d}e + \bar{a}c\bar{d}e + a\bar{c}d\bar{e})$

$= \bar{b}(ad\bar{e} + \bar{a}c\bar{d}e) + b(\bar{d}e(\bar{c} + \bar{a}) + a\bar{c}d\bar{e})$

$= \bar{b}(ad\bar{e} + \bar{a}c\bar{d}e) + b(\bar{c}\bar{d}e + \bar{a}\bar{d}e + a\bar{c}d\bar{e})$