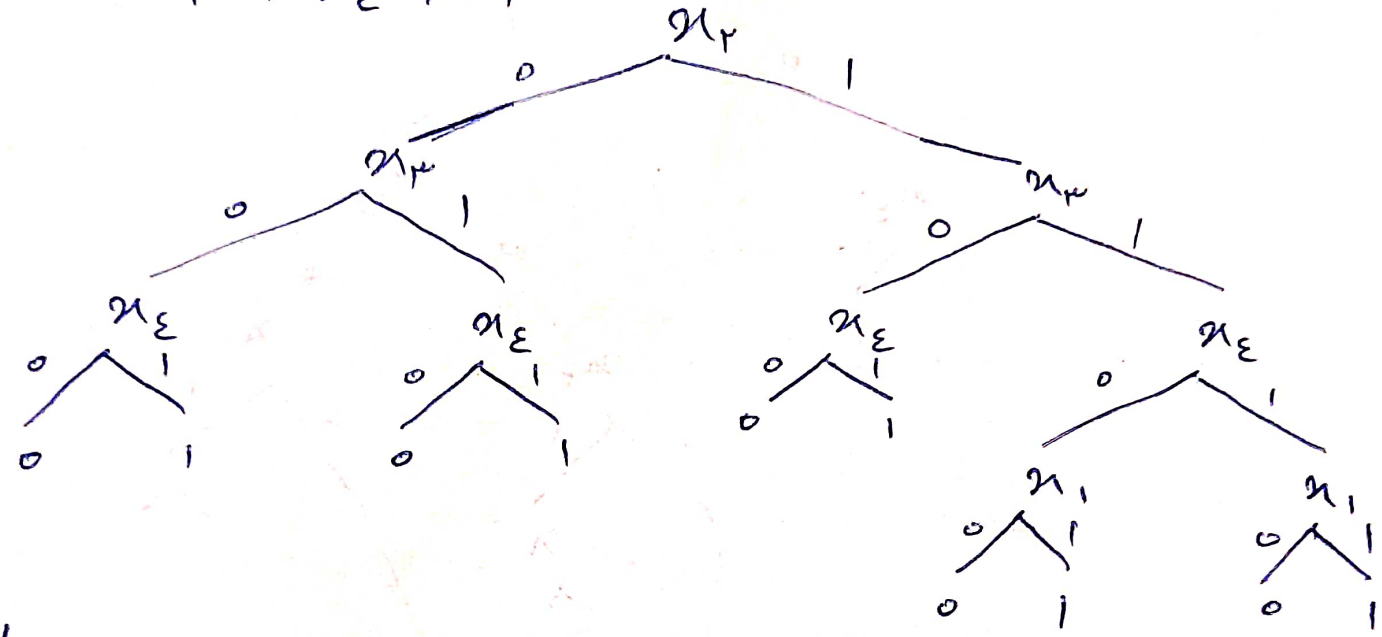
سوال نیاز:

$$F = x_1 x_2 x_3 + x_3 \overline{x_2} x_2 x_1 + x_3 \overline{x_2} x_1 + x_3 \overline{x_2} \overline{x_1} = x_1 x_2 x_3 + x_3 \overline{x_2} x_2 + x_3 \overline{x_2} = x_1 x_2 x_3 + x_3 \overline{x_2}$$

if $x_2 \to x_3 \to x_4 \to x_1$

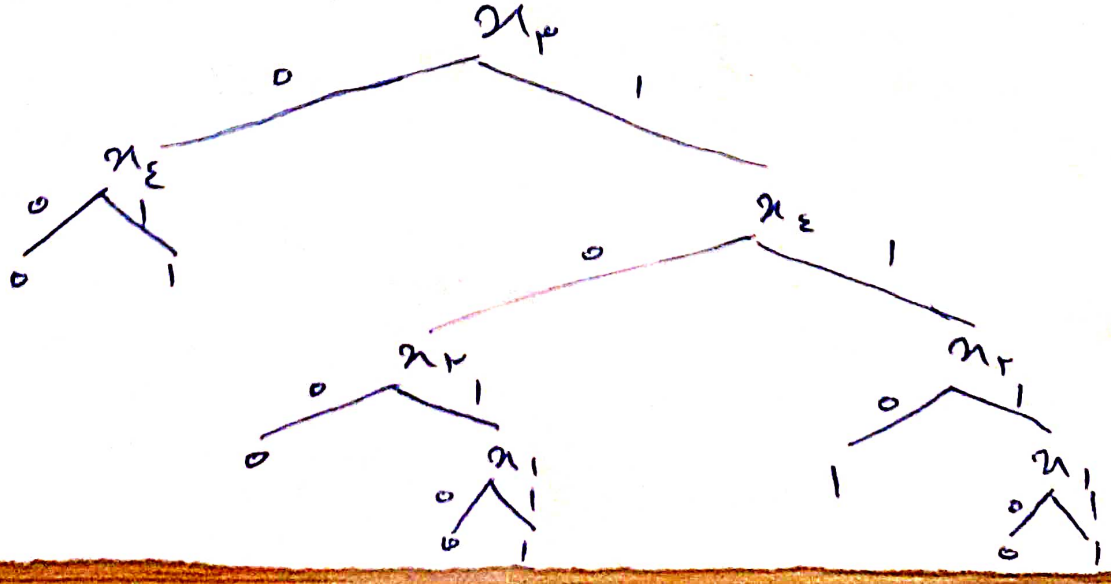


$$cost = 4 + 4 + 4 + 5 + 5 + 4 = 28$$

if $x_1 \to x_2 \to x_3 \to x_4$ (graph of question)

$$cost = 4 + 5 + 4 + 4 + 5 + 4 = 28$$

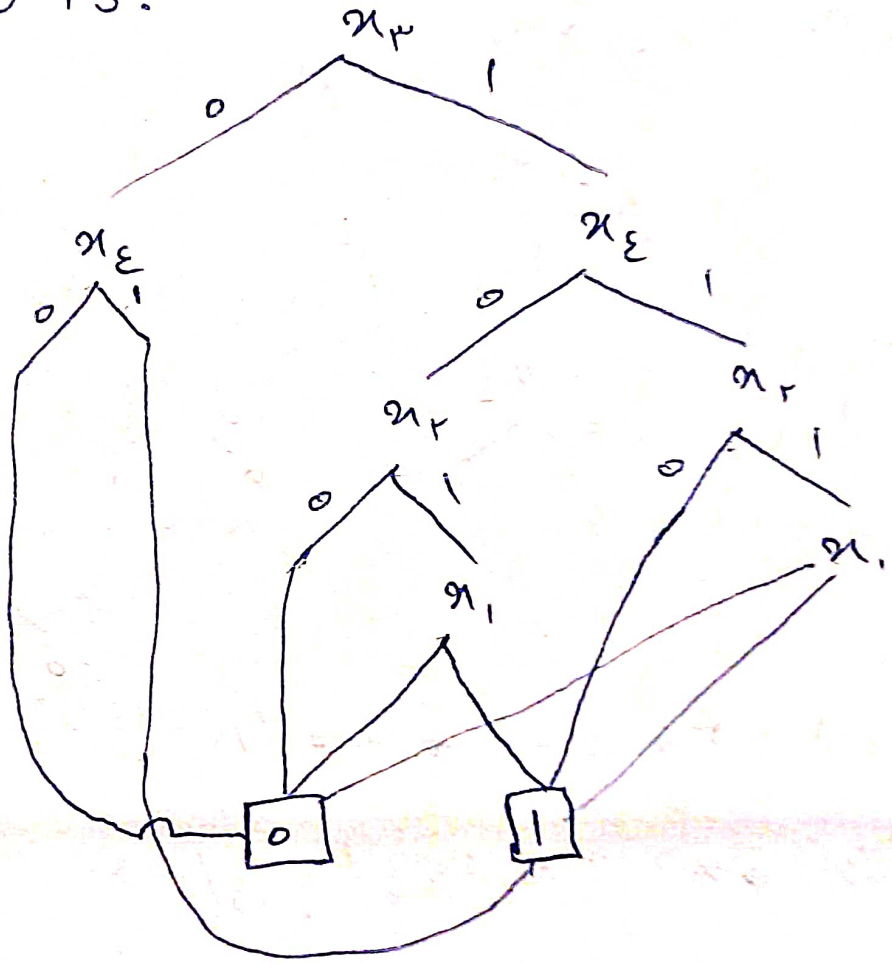
if $x_4 \to x_3 \to x_2 \to x_1$



$cost = 3 + 5 + 6 + 5 + 5 = 24$

So the best BDD order is $x_3 \to x_4 \to x_2 \to x_1$

The ROBDD is:



سوال دو قسمت i)

state 1) $X=0 , S_1=0 , S_0=0 \rightarrow G=0$

$\rightsquigarrow F=(B_0+\bar{Z})(\bar{B}_0+Z) \rightarrow \begin{cases} B_0=1 \rightarrow Z=1 \\ B_0=0 \rightarrow Z=0 \end{cases}$

state 2) $X=0 , S_1=0 , S_0=1 \rightarrow G=0$

$\rightsquigarrow F=(B_1+\bar{Z})(\bar{B}_1+Z) \rightarrow \begin{cases} B_1=1 \rightarrow Z=1 \\ B_1=0 \rightarrow Z=0 \end{cases}$

state 3) $X=0 , S_1=1 , S_0=0 \rightarrow G=0$

$\rightsquigarrow F=(\bar{B}_1+\bar{Z})(B_1+Z) \rightarrow \begin{cases} B_1=1 \rightarrow Z=0 \\ B_1=0 \rightarrow Z=1 \end{cases}$

state 4) $X=0 , S_1=1 , S_0=1 \rightarrow G=0$

$\rightsquigarrow F=(B_2+\bar{Z})(\bar{B}_2+Z) \rightarrow \begin{cases} B_2=1 \rightarrow Z=1 \\ B_2=0 \rightarrow Z=0 \end{cases}$

state 5) $X=1 , S_1=0 , S_0=0 \rightarrow G=1$

$\rightsquigarrow F=Z(B_0+\bar{Z})(\bar{B}_0+Z) \rightarrow Z=1 \rightarrow B_0=1$

state 6) $X=1 , S_1=0 , S_0=1 \rightarrow G=0$

$\rightsquigarrow F=\bar{Z}(B_1+\bar{Z})(\bar{B}_1+Z) \rightarrow Z=0 \rightarrow B_1=0$

state 7) $X=1 , S_1=1 , S_0=0 \rightarrow G=1$

$\rightsquigarrow F=Z(\bar{B}_1+\bar{Z})(B_1+Z) \rightarrow Z=1 \rightarrow B_1=0$

state 8) $X=1, S_1=1, S_0=1 \rightarrow G=1$

$\rightsquigarrow F=z(B_1+\bar{z})(\bar{B}_1+z) \rightarrow z=1 \rightarrow B_1=1$

we have no conflict $\rightarrow B_0=1, B_1=0, B_2=1$

state 1) $X=0, S_1=0, S_0=0 \rightarrow G=0$ تمت تلك

$\rightsquigarrow F=(B_0+\bar{z})(\bar{B}_0+z) \rightarrow \begin{cases} B_0=1 \rightarrow z=1 \\ B_0=0 \rightarrow z=0 \end{cases}$

state 2) $X=0, S_1=0, S_0=1 \rightarrow G=0$

$\rightsquigarrow F=(B_1+\bar{z})(\bar{B}_1+z) \rightarrow \begin{cases} B_1=1 \rightarrow z=1 \\ B_1=0 \rightarrow z=0 \end{cases}$

state 3) $X=0, S_1=1, S_0=0 \rightarrow G=0$

$\rightsquigarrow F=(\bar{B}_1+\bar{z})(B_1+z) \rightarrow \begin{cases} B_1=1 \rightarrow z=0 \\ B_1=0 \rightarrow z=1 \end{cases}$

state 4) $X=0, S_1=1, S_0=1 \rightarrow G=0$

$\rightsquigarrow F=(B_2+\bar{z})(\bar{B}_2+z) \rightarrow \begin{cases} B_2=1 \rightarrow z=1 \\ B_2=0 \rightarrow z=0 \end{cases}$

state 5) $X=1, S_1=0, S_0=0 \rightarrow G=0$

$\rightsquigarrow F=\bar{z}(B_0+\bar{z})(\bar{B}_0+z) \rightarrow z=0 \rightarrow B_0=0$

state 6) $X=1, S_1=0, S_0=1 \rightarrow G=0$

$\rightsquigarrow F=\bar{z}(B_1+\bar{z})(\bar{B}_1+z) \rightarrow z=0 \rightarrow B_1=0$

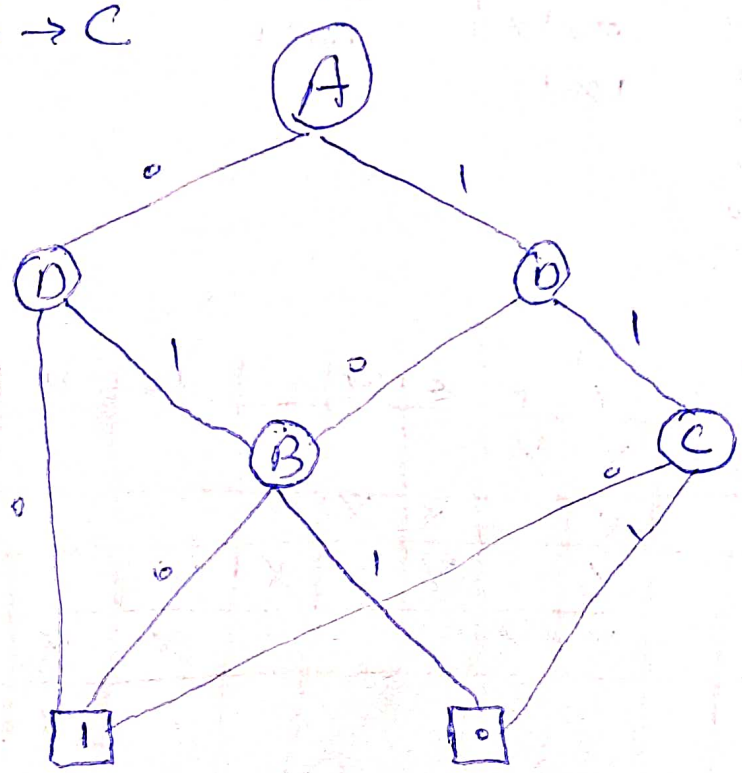
State 2) $X = 1, S_1 = 1, S_0 = 0 \rightarrow G = 0$

$\rightsquigarrow F = \bar{Z}(\bar{B}_1 + \bar{Z})(B_1 + Z) \rightarrow Z = 0 \rightarrow B_1 = 1$ Conflict!

سوال سے قسم الف،

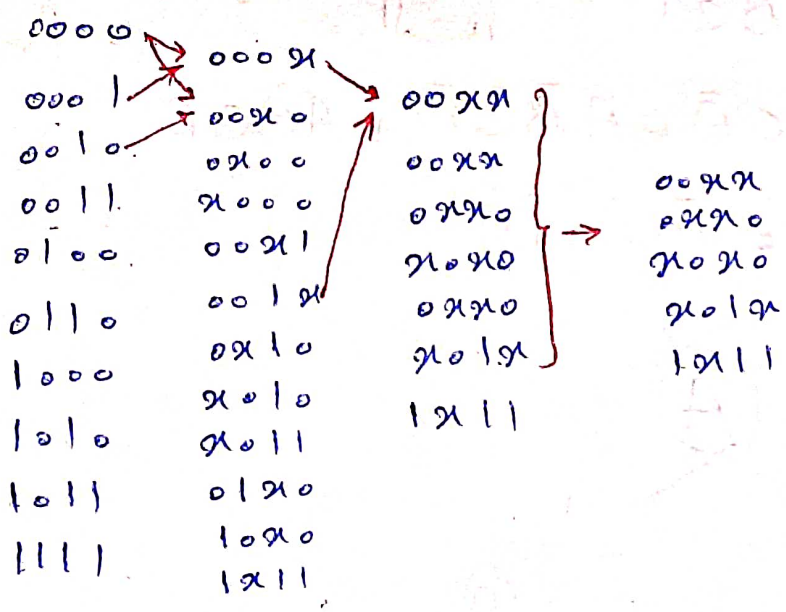
$$f = \bar{A}\bar{B}\bar{C}\bar{D} + \bar{A}\bar{B}\bar{C}D + \bar{A}\bar{B}C\bar{D}$$
$$+ \bar{A}\bar{B}CD + \bar{A}B\bar{C}\bar{D} + \bar{A}BC\bar{D} + A\bar{B}\bar{C}\bar{D} + A\bar{B}C\bar{D}$$
$$= \bar{A}\bar{B} + \bar{A}\bar{D} + \bar{B}\bar{D} + ACD = \bar{A}(\bar{B} + \bar{D})$$

if $A \to D \to B \to C$



$$cst = 4 + 4 + 4 + 3 = 15$$

سوال سه، قسمت ب)



	0	1	2	3	4	5	6	7	8	9
00xx	X	X	X	X						
0xx0	X		X		X	X				
x0x0	X		X				X	X		
x01x			X	X				X	X	
1x11									X	X

$$PI = \{00xx, 1x11, x0x0, 0xx0\}$$

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

$$cost = 2 + 3 + 2 + 2 + 4 = 13$$

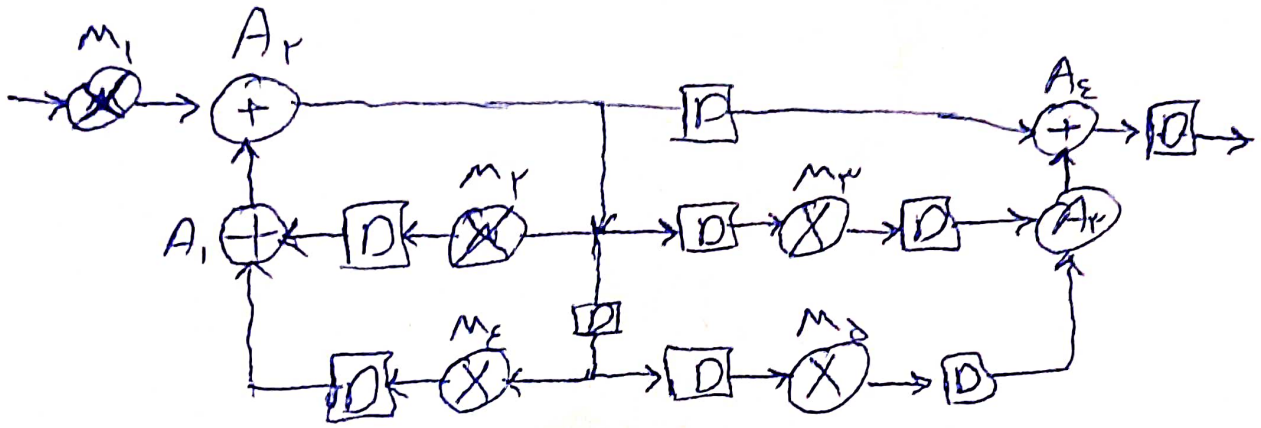
سوال چهار، قسمت الف،

critical Path = 1 multiPlier + 5 adder

= ۲ns + ۵ × 1ns = ۷ns

maximum clock frequency = $\frac{1}{۷ \times ۱۰^{-۹}}$ = ۱۴۲,۸۶ MHz

قسمت ب،



با توجه به تابان مدار سمت راست آن را نکشیم.

Critical Path = 1 multiPlier + 2 adder = ۲ns + ۲ × 1ns = ۴ns

maximum clock frequency = $\frac{1}{۴ \times ۱۰^{-۹}}$ = ۲۵۰ MHz