

Assignment

19EE10039.

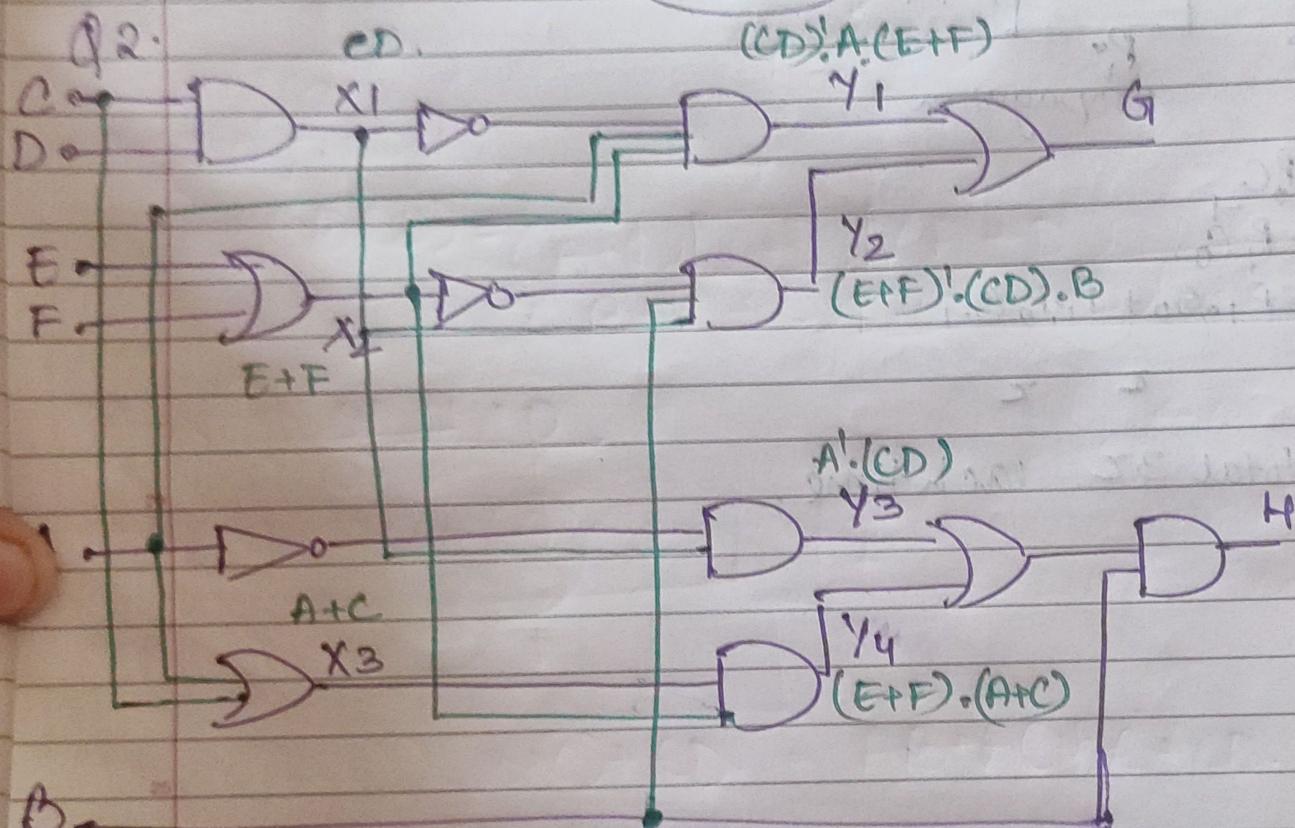
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Q1. $F(ABCD) = \prod M(0, 1, 4, 7) \cdot \sum m(6, 11, 14, 15)$.

AB\CD	00	01	11	10	
00	0	0	1	1	$(A+B+C)(A+C+D)$
01	0	1	0	X	$(B+C)$
11	1	1	X	1	
10	1	1	X	1	

Literal cost
= 8
 $T = 3$
 $N = 2$

$G = 11$
 $GN = 13$



$$G = Y_1 + Y_2 = A(\bar{C}+\bar{D})(E+F) + BCD\bar{E}'F'$$

$$= AC'E + AC'F + AD'E + AD'F + BDE'F' B.$$

Gate i/p cost = 17 + 5 + 4 = 26.

$$H = (Y_3 + Y_4) \cdot B \\ = B (A'CD + A'ET + A'F + CE + CF).$$

$$H = A'B'CD + ABE + ABF + BCE + BCF.$$

$$\text{Gate ip cost} = 16 + 5 + 1 = 22.$$

$$Q3. F_1(A, B, C, D) = \pi M(2, 3, 4, 7, 15) \cdot d(5, 12, 13)$$

$$F_2(A, B, C, D) = \pi M(7, 9, 11, 12, 15) \cdot d(4, 6, 14)$$

AB\CD	SD	01	11	10
SD	1	1	0	0
01	1	X	0	1
11	1	1	1	1
10	1	1	1	1

AB\CD	SD	01	11	10
SD	1	1	1	1
01	1	X	1	1
11	1	1	1	1
10	0	0	0	0

Individual S

$$F_1(A, B, C, D) = (B' + C)(B + D')(A + B + C')$$

$$TC_1^1 = 7 + 3 + 4 = 14.$$

Total Cost

$$F_2(A, B, C, D) = (B' + D)(B' + C')(A' + B + D')$$

$$TC_2^1 = 7 + 3 + 5 = 15 = 14.$$

$$TC = 14 + 15 = 29.$$

Individual

Combined:

$$F_1(A, B, C, D) = (A + B + C')(B' + C' + D')(B' + C + D).$$

$$F_2(A, B, C, D) = (A' + B + D)(B' + C' + D')(B' + C + D).$$

$$\text{combined CC} = (9 + 3) + (3 + 3) + (4 + 2) = 24.$$

$$CC = 24$$

Combined

$$Q_{ABCD} = (A+B)(C+D) + (A+C)(B+D) + (A+B)(C+D)$$

flip 00 01 11 10 Static 0 hazard.

	00	01	11	10
00	0 0	1 1		
01	0 0	1 0		
11	1 0	0 0	0 0	
10	1 0	0 0	0 1	

$$\begin{aligned}
 ABCD: & 0100 \rightarrow 0110 \quad (A+B+D) \\
 & 0101 \rightarrow 1101 \quad (B+C+D) \\
 & 1110 \rightarrow 1111 \quad (A'+B'+C') \\
 & 0001 \rightarrow 1001 \quad (B+C+D')
 \end{aligned}$$

odd 1

minimized hazard free!

$$F(ABCD) = \frac{(A+C)(C+D')(A'+D')}{(B'+C'+D')(A+B+D)(A+B+D')}$$

ABC 00 01 11 10

	00	01	11	10
00	0 0	1 1		
01	0 0	1 0		
11	1 0	0 0	0 0	
10	1 0	0 0	0 1	

$$F_F = (A+C')(B+C) + CD = AB + AC + BC' + CD = 011$$

(i) ABCD 00 01 11 10 Static 1 Hazard.

	00	01	11	10
00	0 0	1 1	1 0	
01	1 1	1 0	1 0	
11	1 1	1 1	1 1	
10	0 0	0 0	1 1	

$$ABCD: 0111 \rightarrow 0101$$

$$0111 \rightarrow 0101$$

$$A'BD \text{ or } \underline{BD}$$

$$F = C + C' = 1$$

$$\begin{aligned}
 & (A+C')(B+C) + (A+B)C'P + B'R \\
 & \text{Static 0} \quad \text{Static 1} \\
 & ABP + AC + BC' + CD + BD \\
 & A(CB + C) + BC' + (C + B'D)D \\
 & (CB + C)(A + D + D') \\
 & \text{Simplification} \\
 & ABC' + BC' + BD \\
 & ABC' + BC' + BD
 \end{aligned}$$

Static 0 Hazard.

ABCD:

$$0000 \rightarrow 0010.$$

$$F = CC' = 0$$

Dynamic Hazard.

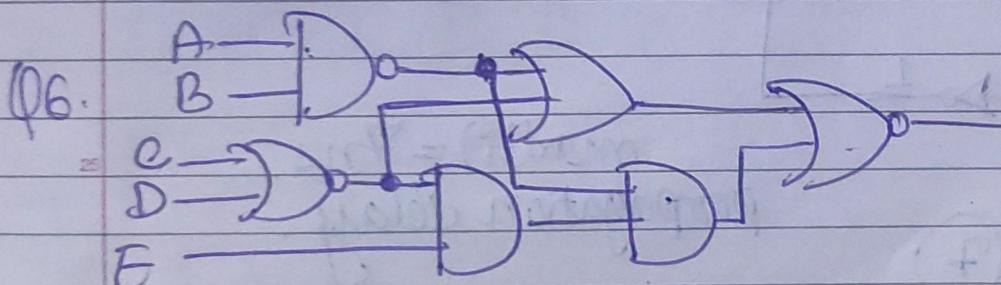
ABCD:

$$\begin{aligned}
 A=1 & \quad F = CC' + C \\
 B=1 & \\
 D=1 & = C
 \end{aligned}$$

$$(ii) F = \sum m(0, 2, 5, 6, 7, 8, 9, 12, 13, 15).$$

AB\CD	00	01	11	10
00	0	0	0	0
01	0	1	1	1
11	1	1	1	0
10	1	1	0	0

$$\begin{aligned}
 & = A'B'D + A'BC + BD + \\
 & AC' + B'C'D' + A'C'D'
 \end{aligned}$$



NAND 20ps
 NOR 25ps.
 AND 30ps
 OR 35ps

$$\begin{aligned}
 (i) \quad t_A &= d_{NAND} + d_{OR} + d_{NOR} = 80 \\
 t_B &= d_{NAND} + d_{OR} + d_{NOR} = 80 \\
 t_C &= 2d_{NOR} + 2d_{NAND} + d_{NOR} = 110 \\
 t_D &= 2d_{NOR} + 2d_{NAND} + d_{NOR} = 110 \\
 t_E &= 2d_{NAND} + d_{NOR} + d_{NOR} = 85.
 \end{aligned}$$

Propagation delay
 $\{m_{max}(t_i)\} = 110$ ps

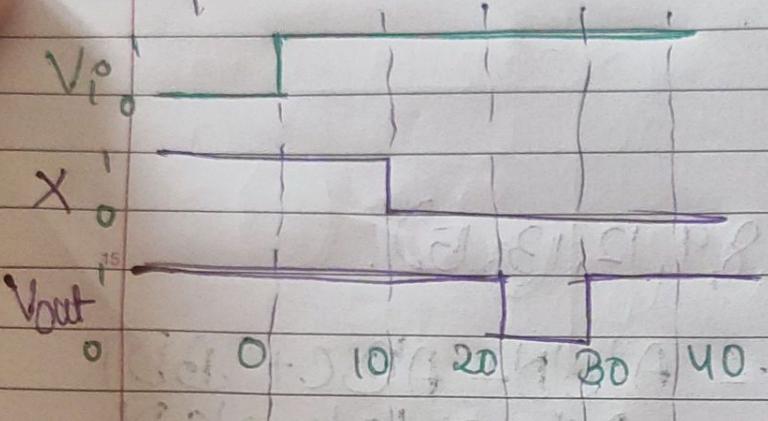
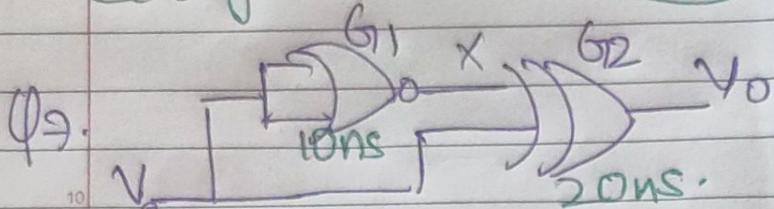
(ii) contamination delay = shortest time for
C/P to change

$$T_A = T_B = d_{NAND} + d_{NAND} + d_{OR} = 75 \text{ ps}$$

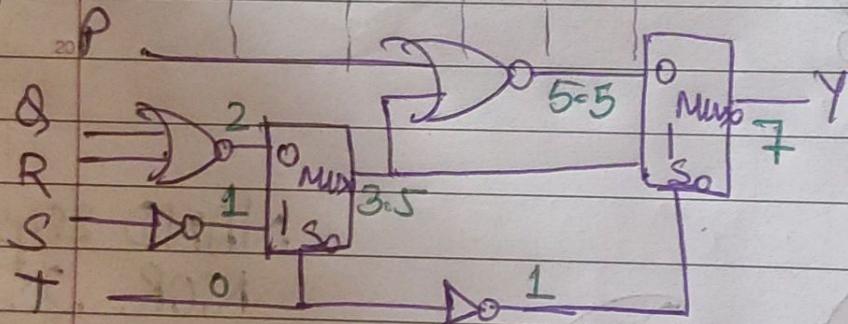
$$T_C = T_D = 2d_{NOR} + d_{OR} = 85 \text{ ps}$$

$$T_E = 85 \text{ ps}$$

contamination(min Ti) = 75 ps



Q8.



NOR 2 ns
gate

Inverter 1ns
MUX 1.5ns.

max.

$$P \rightarrow 2 + 1.5 = 3.5$$

$$Q \rightarrow 2 + 1.5 + 2 + 1.5 = 7$$

$$R \rightarrow$$

$$S \rightarrow 1 + 1.5 + 2 + 1.5 = 6$$

$$T \rightarrow 1.5 + 2 + 1.5 = 5$$

max(t₁) = 7 ns
propagation delay

Q9- ii) $F(ABC) = (A+B')(B+C)(A+C)$

$ABC \backslash C$	01
00	01
01	00
11	—
10	01

Static 0 Hazard
ABC:

$$000 \rightarrow 010$$

add
 $A+C$.

$$F(ABC) = (A+B')(B+C)(A+C)$$

(ii) $F(ABC) = BD + A'B'C + ACD + B'C'D$.

$AB \backslash CD$	00	01	11	10
00	0	0	1	0
01	0	1	1	0
11	0	1	0	0
10	0	0	1	1

Static-1 Hazard.

ABC'D:

$$1011 \rightarrow 0011$$

add

$B'CD$

$$0111 \rightarrow 0011$$

$A'CD$

$$1011 \rightarrow 1010$$

ABC .

$$F = BD + CD + B'C'$$

Q10. $F = \sum m(1, 3, 5, 7, 8, 9, 14, 15)$.

$AB \backslash CD$	00	01	11	10
00	0	1	0	0
01	0	1	1	0
11	0	0	1	1
10	1	1	0	0

$$F = A'D + A'BC + A'BC' + BC'D + BCD$$

