

Q1

a) $A = 10010111$
 $B = 01110110$

$$\begin{array}{r} 10010111 \\ 01110110 \\ \hline 000100001101 \\ 01100110 + 6 \\ \hline 000101110011 \end{array}$$

b) $n = 9$

$A_2 = 01001$
 ↑
 sign bit

$B = 13$

$B_2 = 01101$
 ↑
 sign bit

$A - B$
 2's complement of B
 10010
 $\underline{10011} \leftarrow -B$

01001
 $\underline{10011}$
 $11100 = 00100 - 4$
 ↑
 sign -ve

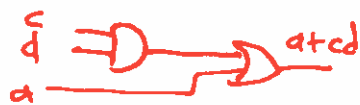
Q2 a) $\overline{A}\overline{B}\overline{C} + \overline{A}cD + A\overline{B}C\overline{D} + A\overline{B}\overline{C}$
 $\overline{B}\overline{C}(\overline{A} + A) + \overline{A}cD + A\overline{B}C\overline{D}$
 $\overline{B}\overline{C} + \overline{A}cD + A\overline{B}C\overline{D}$
 $\overline{B}(\overline{C} + A\overline{C}\overline{D}) + \overline{A}cD$
 $\overline{B}(\overline{C} + A\overline{D}) + \overline{A}cD$
 $\overline{B}\overline{C} + A\overline{B}\overline{D} + \overline{A}cD$

Q2 b



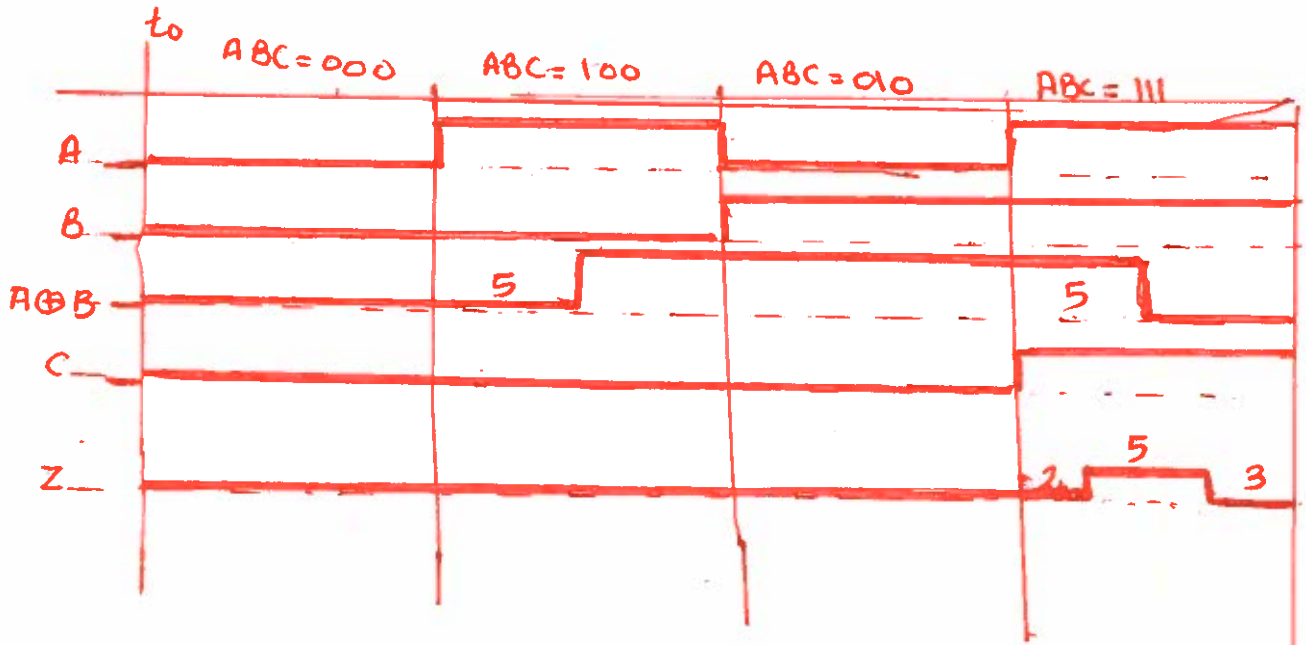
Delay $D = 15 + 20 + 15 = 50\text{ns}$
 Frequency $f = \frac{1}{D} = \frac{10^9}{50} = 20\text{MHz}$

Q2 c) $F = (\overline{a}\overline{b} \oplus \overline{c}\overline{d}) + a$
 $= \overline{a}\overline{b} \cdot \overline{c}\overline{d} + a\overline{b}\overline{c}\overline{d}$
 $= (\overline{a} + \overline{b})\overline{c}\overline{d} + a\overline{b}\overline{c}\overline{d}$
 $= \overline{a}\overline{c}\overline{d} + \overline{b}\overline{c}\overline{d} + \overline{a}\overline{b}\overline{c}\overline{d} + a\overline{b}\overline{c}\overline{d}$
 $= \overline{a}\overline{c}\overline{d} + \overline{b}\overline{c}\overline{d} + a$
 $= \overline{c}\overline{d} + \overline{b}\overline{c}\overline{d} + a$
 $= a + \overline{c}\overline{d}$



Delay $= 12 + 15 = 27\text{ns}$
 Frequency $= \frac{1}{27\text{ns}} = \frac{10^9}{27} \approx 37\text{MHz}$

Q3



Critical Path 7ms. Timing Period selected 10ms

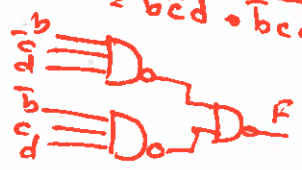
Q4

	ab	00	01	11	10
cd	00	X	4	12	8 X
	01	1	5	13	9
	11	3	7	15	11
	10	2	6	14	10 X

$\text{PI1 } \text{ITM}(4,6,12,14) + d(0,2,8,9) = d \text{ EPI}$
 $\text{PI2 } \text{ITM}(0,9) + d(0,8) = (b+c) \text{ EPI}$
 $\text{PI3 } \text{ITM}(6,7,15) + d(14) = (\bar{b} + \bar{c})$

$F(a,b,c,d) = d(b+c)(\bar{b} + \bar{c}) \dots \text{Equ 1}$

b) From K-map $\text{PI1} = \sum m(5,13) = b\bar{c}d \text{ EPI}$
 $\text{PI2} = \sum m(3,11) = \bar{b}cd \text{ EPI}$
 $F = b\bar{c}d + \bar{b}cd$
 $F = \overline{\overline{b\bar{c}d + \bar{b}cd}}$
 $= \overline{\overline{b\bar{c}d} \cdot \overline{\bar{b}cd}}$



c) Equ. 1 $= d(b+c)(\bar{b} + \bar{c})$
 $F = \overline{\overline{d(b+c)(\bar{b} + \bar{c})}}$
 $F = \overline{\overline{d} + (\bar{b} + \bar{c}) + (\bar{b} + \bar{c})}$

