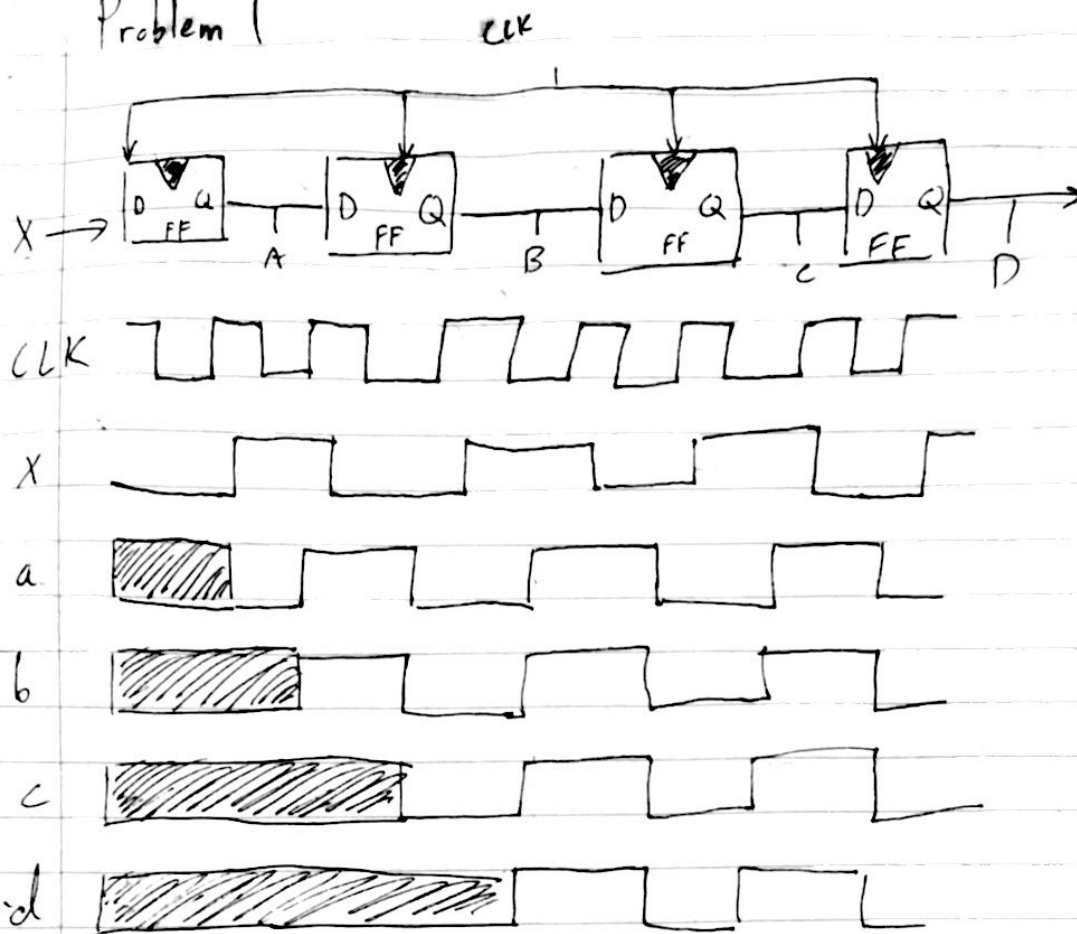
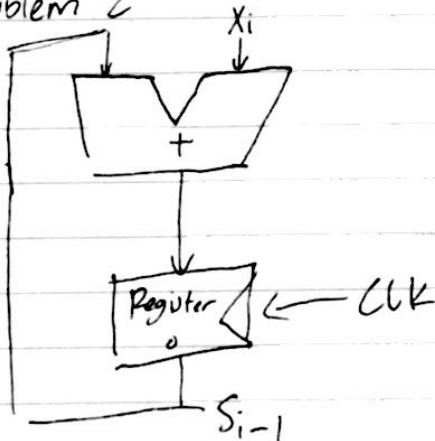


## Problem 1



## Problem 2



Given  
adder delay = 2 ns

register setup = 1 ns  
CLK -  $t_{c-q}$  = 1 ns  
 $f = 400 \text{ MHz}$

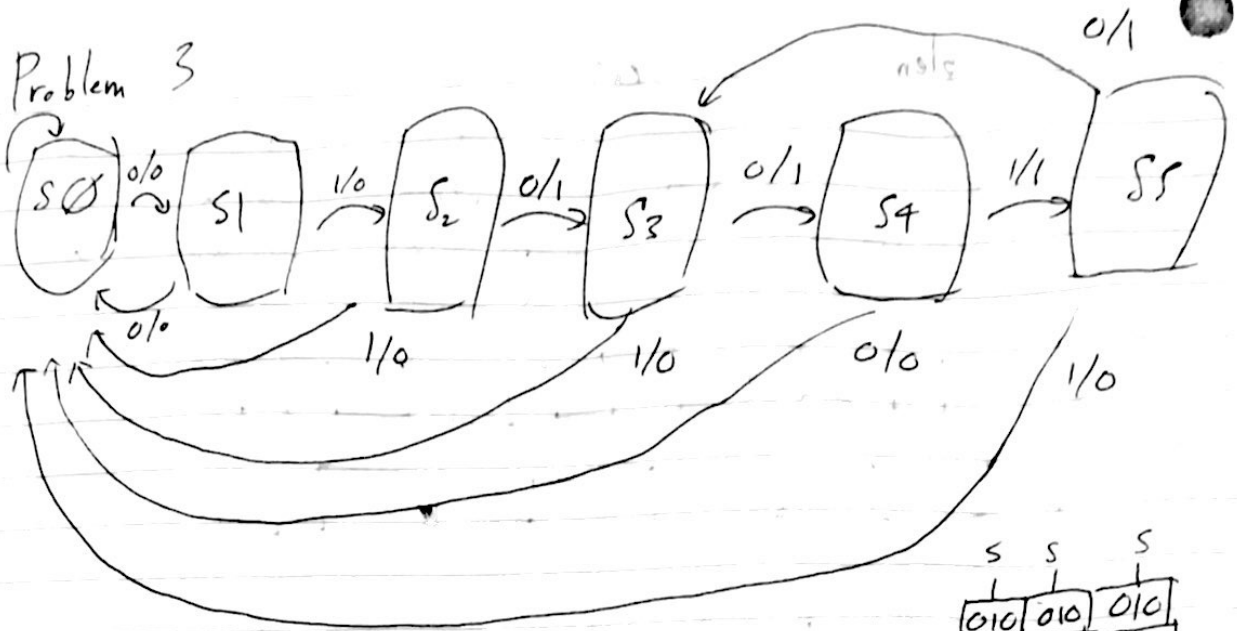
Calculation  
Total Delay = 2 + 1 + 1  
= 4 ns

Period  $T = \frac{1}{f} = \frac{1}{400 \text{ MHz}} = 2.5 \text{ ns}$   
4 > 2.5 Error

If period  
 $T = 4 \text{ ns}$

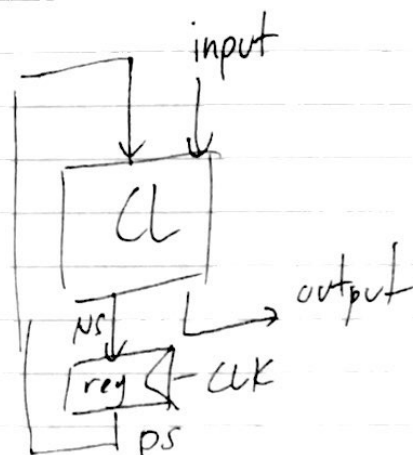
$4 = 4$   
so  $f = \frac{1}{4} = 250 \text{ MHz}$

Problem 3

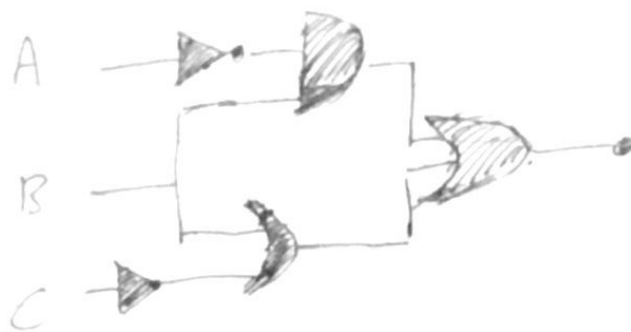


S	S	S
010	010	010
001	111	111

PS	Input	NS	Output
000	0	001	0
000	1	000	0
001	0	000	0
001	1	010	0
010	0	011	1
010	1	000	0
011	0	100	1
011	1	000	0
100	0	000	0
100	1	101	1
101	0	010	1
101	1	000	0



# Problem 4



$$(not\ A\ and\ B) \ or\ (B\ or\ not\ C)$$

$$(\bar{A} \wedge B) \vee (B \vee \bar{C}) \quad 2^3=8$$

A	B	C	Q
1	1	1	1
1	1	0	1
1	0	1	0
1	0	0	1
0	1	1	1
0	1	0	1
0	0	1	0
0	0	0	1

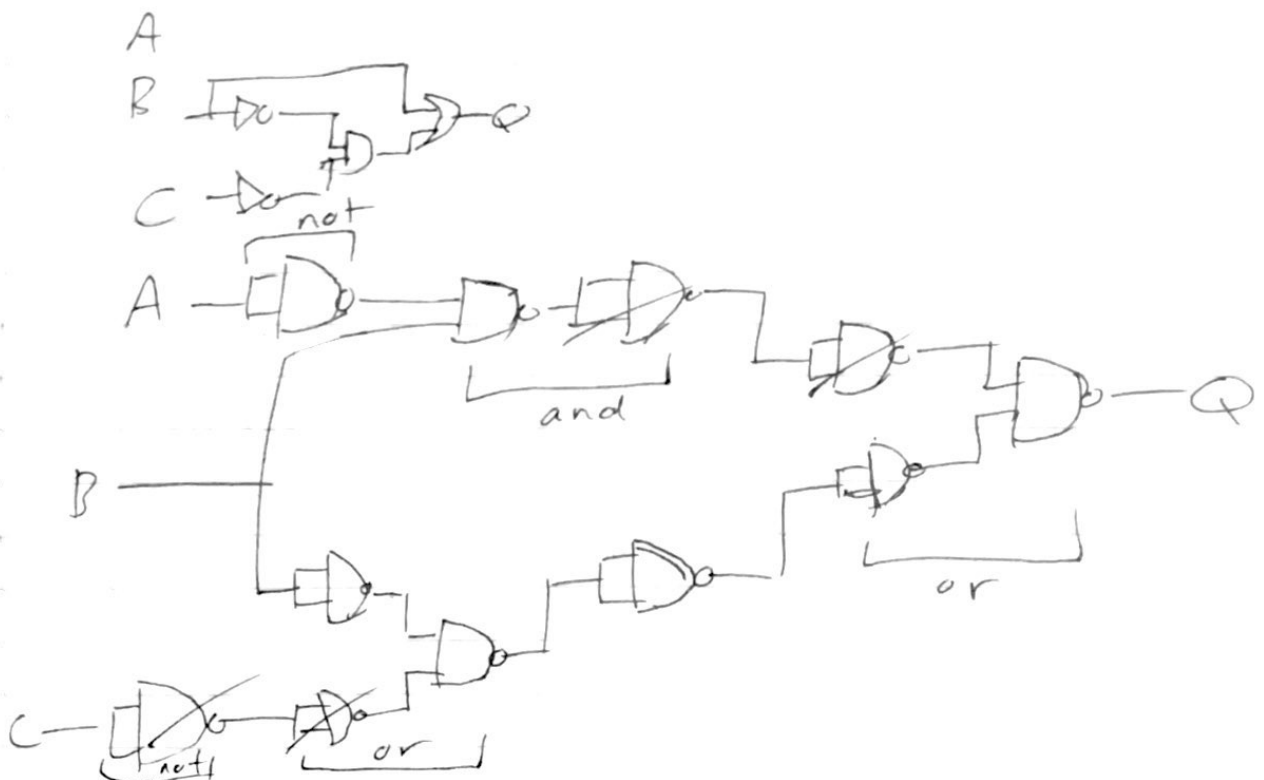
$$Q = abc + ab\bar{c} + a\bar{b}\bar{c} + \bar{a}b\bar{c} + \bar{a}\bar{b}\bar{c}$$

$$Q = ab(c + \bar{c}) + \bar{b}\bar{c}(a + \bar{a}) + \bar{a}\bar{b}(c + \bar{c})$$

$$= ab + \bar{b}\bar{c} + \bar{a}\bar{b}$$

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

$$= b + \bar{b}\bar{c} \quad b \vee (\neg b \wedge \neg c)$$



# Problem 6

## Problem 5

a b c d e

0 0 0 0 0

0 0 0 0 1

0 0 0 1 0

0 0 0 1 1

0 0 1 0 0

0 0 1 0 1

0 0 1 1 0

0 0 1 1 1

0 1 0 0 0

0 1 0 0 1

0 1 0 1 0

0 1 0 1 1

0 1 1 0 0

0 1 1 0 1

0 1 1 1 0

0 1 1 1 1

1 0 0 0 0

1 0 0 0 1

1 0 0 1 0

1 0 0 1 1

1 0 1 0 0

1 0 1 0 1

1 0 1 1 0

1 0 1 1 1

1 1 0 0 0

1 1 0 0 1

1 1 0 1 0

1 1 0 1 1

1 1 1 0 0

1 1 1 0 1

1 1 1 1 0

1 1 1 1 1

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

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

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

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

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

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

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

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

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

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

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

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

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

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

$$(a b c d e)$$

A B C Y

$$0 0 0 1 \quad \bar{a} \bar{b} \bar{c} + \bar{a} b \bar{c} + \bar{a} b c + a b \bar{c} + a b c$$

$$0 0 1 0 \quad \bar{a} \bar{c} (\bar{b} + b) + \bar{a} b c + a b (\bar{c} + c)$$

$$0 1 0 1 \quad \bar{a} \bar{c} + \bar{a} b c + a b$$

$$0 1 1 1 \quad \bar{a} \bar{c} + b(a + \bar{a} c)$$

$$1 0 0 0 \quad \bar{a} \bar{c}$$

$$1 0 1 0$$

$$1 1 0 1$$

$$1 1 1 1$$

$$y = \text{Pr}(\bar{A} \cap \bar{C})$$

A'	B'C'	B'C	BC	BC'
	0	1	3	2
	4	5	7	6

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