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Digital Design

First Semester 2020-21

Tutorial : 08

Sequential Circuit Design

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1 . Design a Modulo 5 Counter

State table

C B A	C+1 B+1 A+1	J _C K _C	J _B K _B	J _A K _A
0 0 0	0 0 1	0 ×	0 ×	1 ×
0 0 1	0 1 0	0 ×	1 ×	× 1
0 1 0	0 1 1	0 ×	× 0	1 ×
0 1 1	1 0 0	1 ×	× 1	× 1
1 0 0	0 0 0	× 1	0 ×	0 ×

Q(t)	Q(t+1)	J	K	
0	0	0	X	(0 0) (0 1)
0	1	1	X	(1 0) (1 1)
1	0	X	1	(1 1) (0 1)
1	1	X	0	(1 0) (0 0)

Excitation Table

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1 . Design a Modulo 5 Counter

for JA

	B	A		
	00	01	11	10
0	1	X	X	1
1	0	X	X	X

$J_A = \bar{C}$

For KA

	B	A		
	00	01	11	10
0	X	1	1	X
1	X	X	X	X

$K_A = 1$

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1 . Design a Modulo 5 Counter

for J_B

	B	A	01	11	10
0	0	1	X	X	X
1	0	X	X	X	X

$$J_B = A$$

for K_B

	B	A	01	11	10
0	X	X	1	0	0
1	X	X	X	X	X

$$K_B = A$$

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1 . Design a Modulo 5 Counter

for J_c

c	B	A	00	01	11	10
0			0	0	1	0
1			X	X	X	X

$$J_c = A \oplus B$$

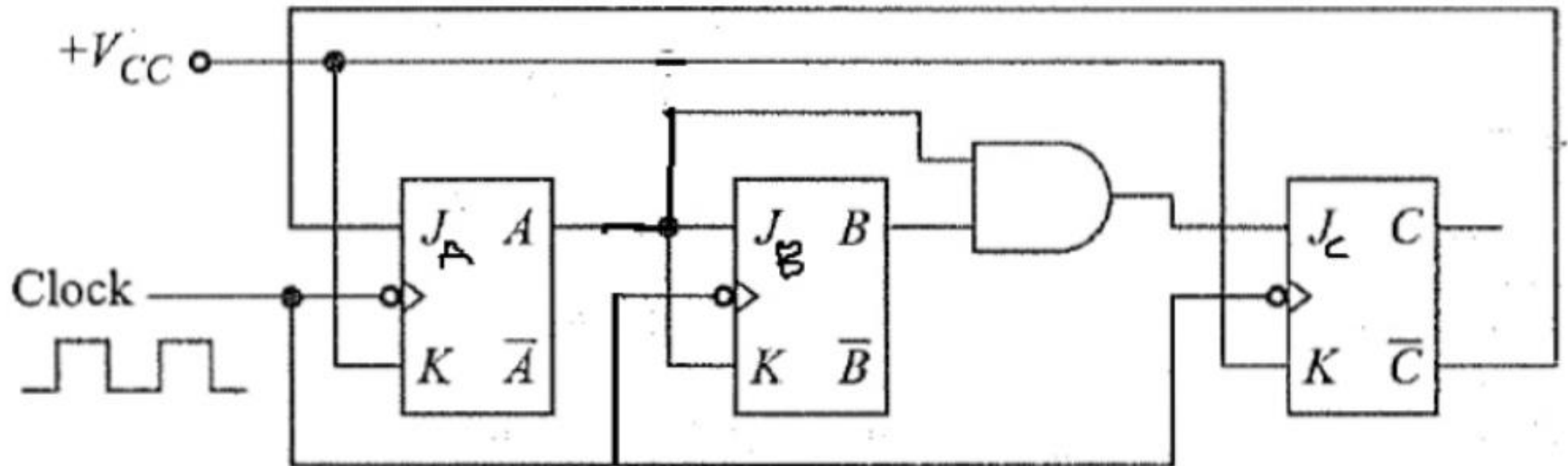
for K_c

c	B	A	00	01	11	10
0			X	X	X	X
1			1	X	X	X

$$K_c = 1$$

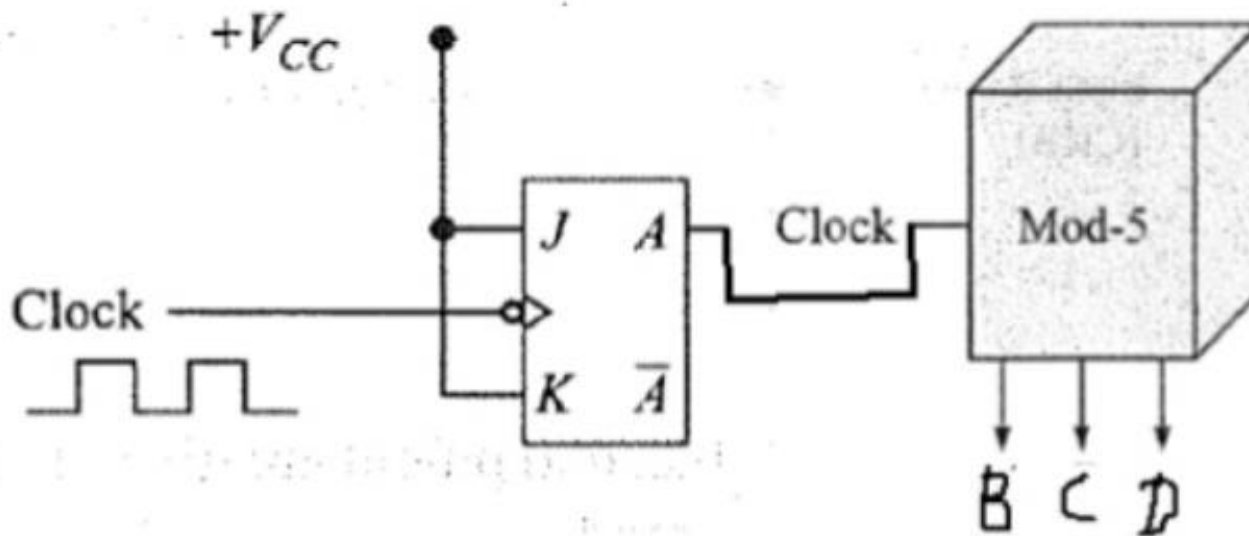
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1 . Design a Modulo 5 Counter



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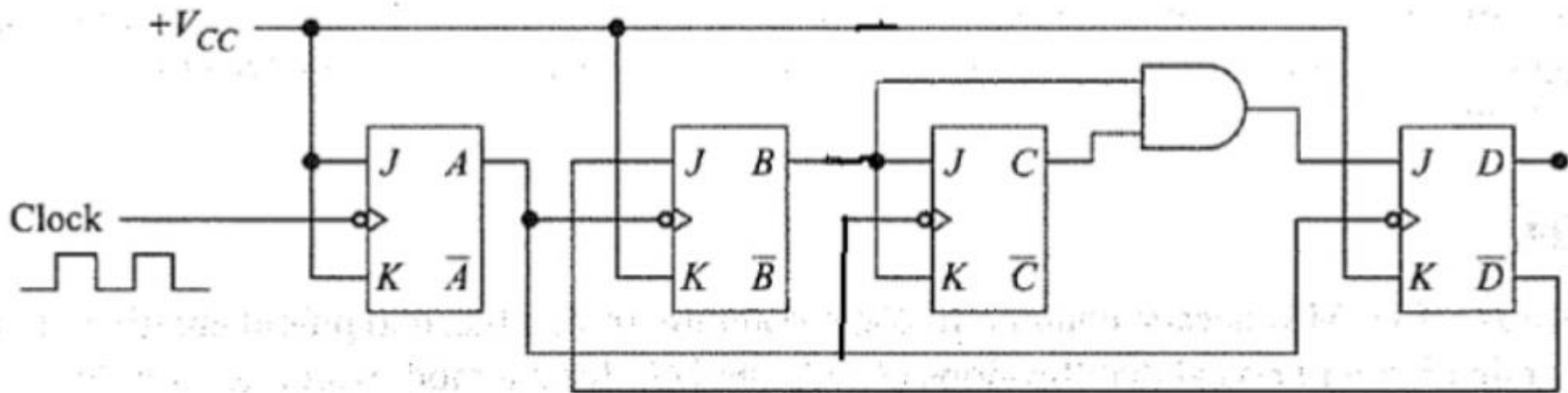
2. Design a Modulo 10 Counter



0000
0001
0010
0011
0100
0101
0110
0111
1000
1001

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2 . Design a Modulo 10 Counter



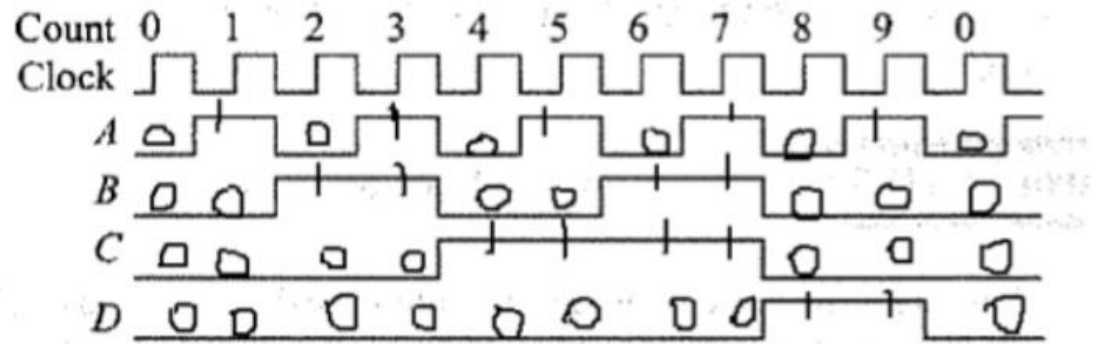
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2. Design a Modulo 10 Counter

Truth Table:

D	C	B	A	Count
0	0	0	0	0
0	0	0	1	1
0	0	1	0	2
0	0	1	1	3
0	1	0	0	4
0	1	0	1	5
0	1	1	0	6
0	1	1	1	7
1	0	0	0	8
1	0	0	1	9

Timing Waveforms:



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3.

Problem: Design self-correcting MOD-6 counter in which all the unused states leads to state CBA=000

State Table:

C_n	B_n	A_n	C_{n+1}	B_{n+1}	A_{n+1}	J_C	K_C	J_B	K_B	J_A	K_A
0	0	0	0	0	1	0	x	0	x	1	x
0	0	1	0	1	0	0	x	1	x	x	1
0	1	0	0	1	1	0	x	x	0	1	x
0	1	1	1	0	0	1	x	x	1	x	1
1	0	0	1	0	1	x	0	0	x	1	x
1	0	1	0	0	0	x	1	0	x	x	1
1	1	0	0	0	0	x	1	x	1	0	x
1	1	1	0	0	0	x	1	x	1	x	1

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3.

Problem: Design self-correcting MOD-6 counter in which all the unused states leads to state CBA=000

	$B_n A_n$			
C_n	00	01	11	10
0	0	0	1	0
1	x	x	x	x

$J_C = B_n A_n$

	$B_n A_n$			
C_n	00	01	11	10
0	x	x	x	x
1	0	1	1	1

$K_C = A_n + B_n$

	$B_n A_n$			
C_n	00	01	11	10
0	0	1	x	x
1	0	0	x	x

$J_B = \bar{C}_n A_n$

	$B_n A_n$			
C_n	00	01	11	10
0	x	x	1	0
1	x	x	1	1

$K_B = A_n + C_n$

	$B_n A_n$			
C_n	00	01	11	10
0	1	x	x	1
1	1	x	x	0

$J_A = \bar{C}_n + \bar{B}_n$

	$B_n A_n$			
C_n	00	01	11	10
0	x	1	1	x
1	x	1	1	x

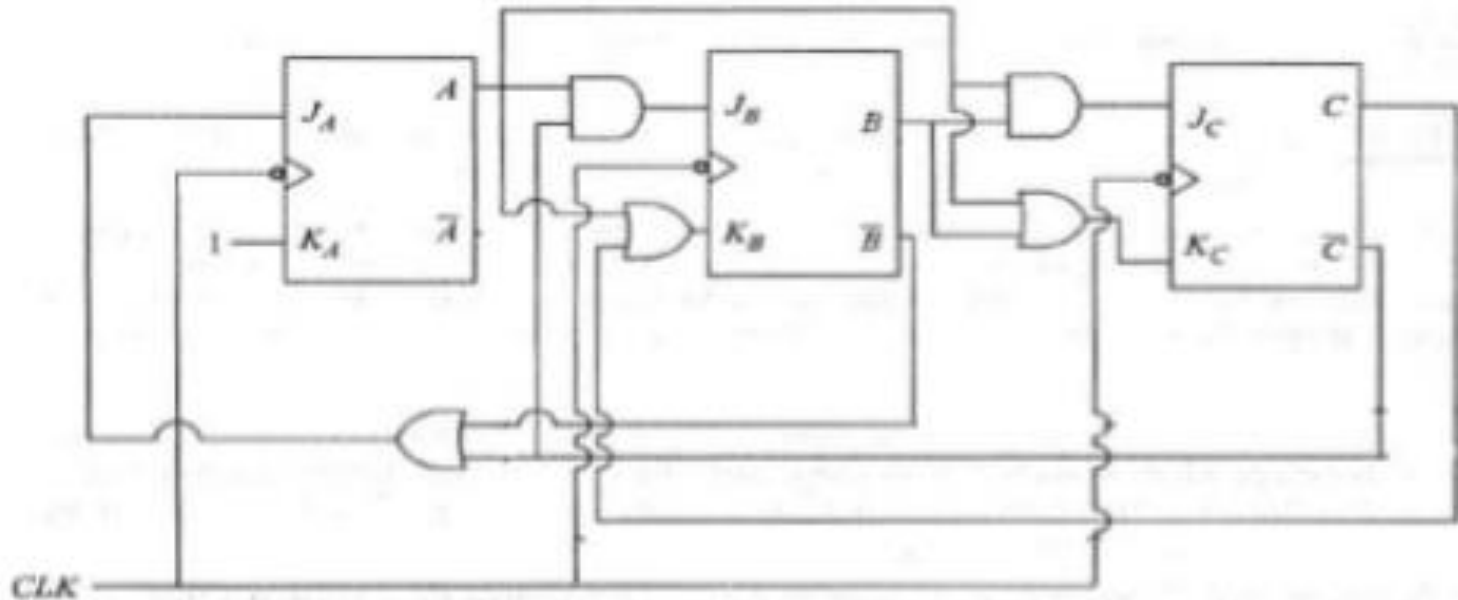
$K_A = 1$

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3.

Problem: Design self-correcting MOD-6 counter in which all the unused states leads to state CBA=000

Mod-6 self-correcting circuit:



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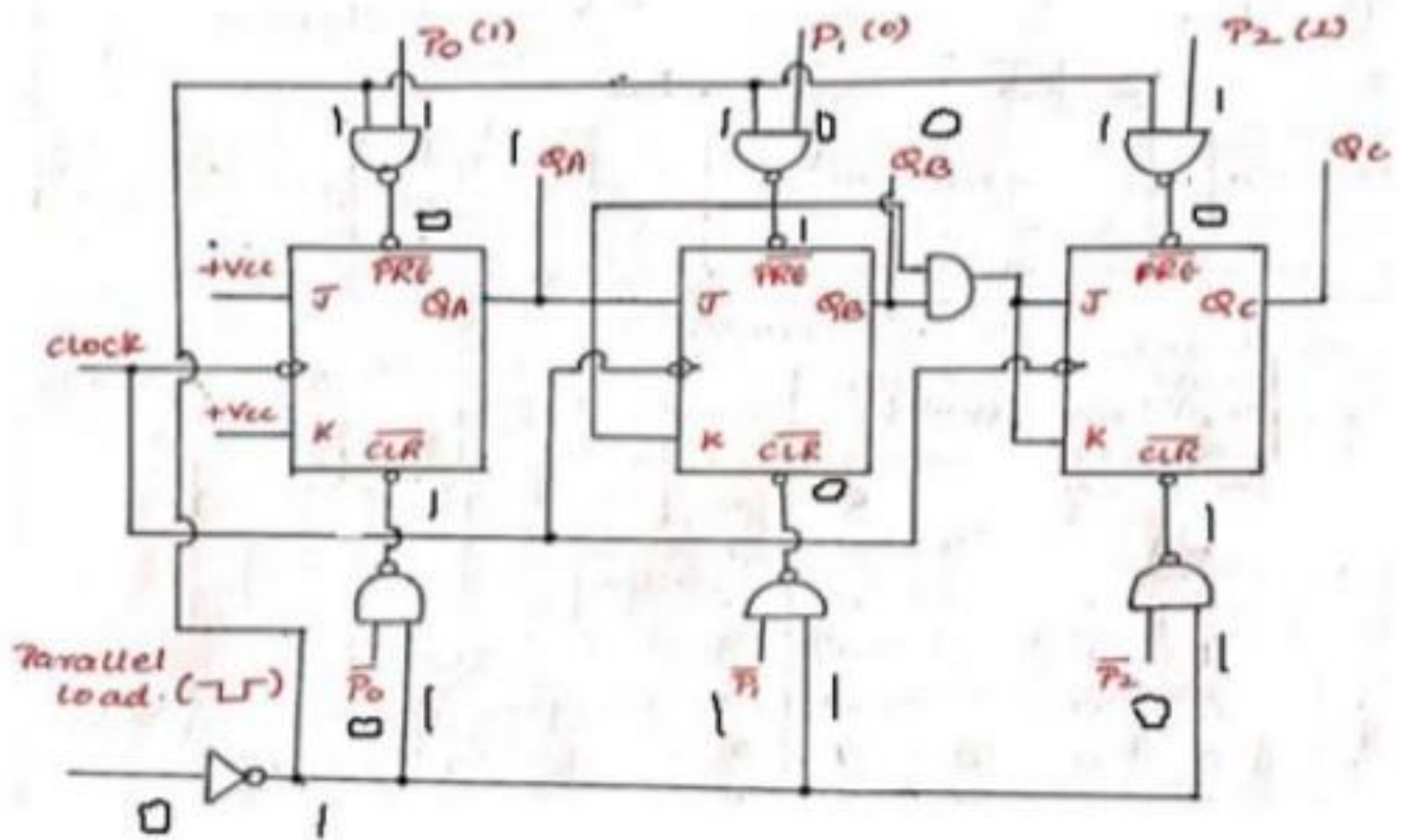
4 . Presettable Counter:

In Presettable counter, user can set initial state of the counter, after initial state, counter can be made to count either UP or Down.

MOD-8 Presettable counter with initial state = 101 (5):

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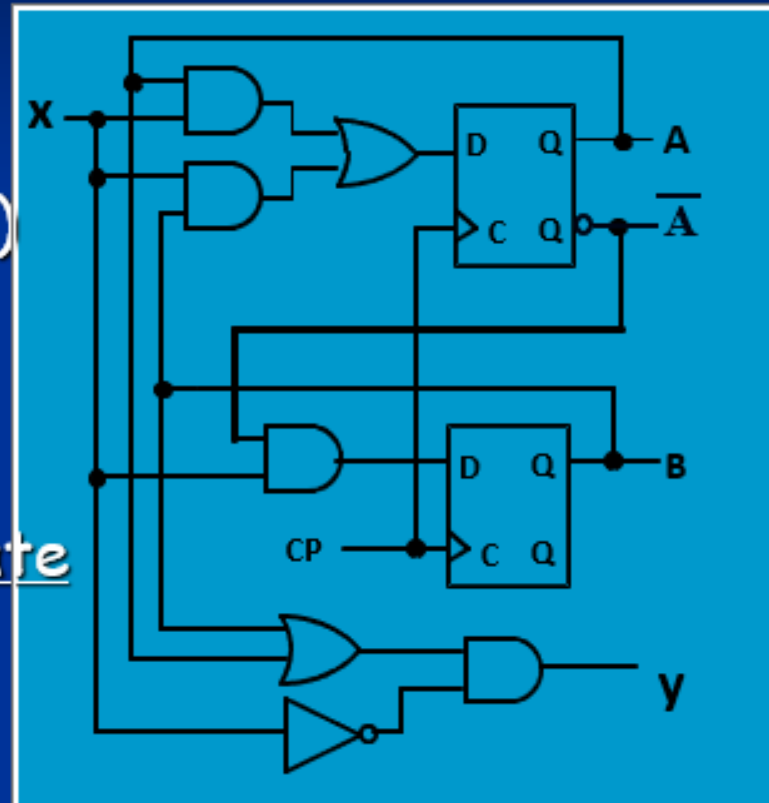
4 .



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5.

- Input: $x(t)$
- Output: $y(t)$
- State: $(A(t), B(t))$
- What is the Output Function?
- What is the Next State Function?



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5.

■ Boolean equations for the functions:

- $A(t+1) = A(t)x(t) + B(t)x(t)$
- $B(t+1) = A'(t)x(t)$
- $y(t) = x'(t)(B(t) + A(t))$

