



ASSIGNMENT 8

[Design a MOD-N UP/DOWN SYNCHRONOUS COUNTER]

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ROLL NO.: 002010501074

Objective:- To implement a synchronous modulo UP/Down counter, where n is the addition of last two digits of class roll no.

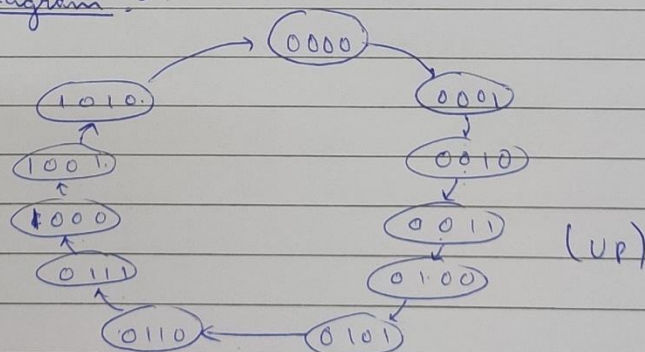
For me, $n = 7 + 4 \Rightarrow \boxed{n = 11} \rightarrow \text{MOD-11}$.

No. of FlipFlops required $\Rightarrow \log(n)$ (ceiling)
 $= \log(11) > 3$
 So, [No. of FFs = 4.]

Excitation table for T-FF

Q_n	Q_{n+1}	T
0	0	0
0	1	1
1	0	1
1	1	0

State Diagram :-



Teacher's Signature & Date :

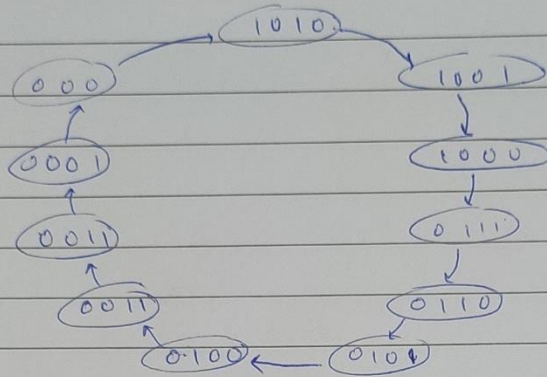
Circuit Excitation Table :- (UP)

M	<u>Present State</u>				<u>Next State</u>				<u>T-FF</u>			
	q_D	q_C	q_B	q_A	q_D^*	q_C^*	q_B^*	q_A^*	T_D	T_C	T_B	T_A
0	0	0	0	0	0	0	0	1	0	0	0	1
0	0	0	0	1	0	0	1	0	0	0	1	1
0	0	0	1	0	0	0	1	1	0	0	0	1
0	0	0	1	1	0	1	0	0	0	1	1	1
0	0	1	0	0	0	1	0	1	0	0	0	1
0	0	1	0	1	0	1	1	0	0	0	1	1
0	0	1	1	0	0	1	1	1	0	0	0	1
0	0	1	1	1	1	0	0	0	1	1	1	1
0	1	0	0	0	1	0	0	1	0	0	0	1
0	1	0	0	1	1	0	1	0	0	0	1	1
0	1	0	1	0	0	0	0	0	1	0	1	0
0	1	0	1	1	x	x	x	x	x	x	x	x
0	1	1	0	0	x	x	x	x	x	x	x	x
0	1	1	0	1	x	x	x	x	x	x	x	x
0	1	1	1	0	x	x	x	x	x	x	x	x
0	1	1	1	1	x	x	x	x	x	x	x	x

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Circuit excitation Table :- (DOWN)

M	Present state				Next state				T-FF			
	q_D	q_C	q_B	q_A	q_D^*	q_C^*	q_B^*	q_A^*	T_D	T_C	T_B	T_A
1	0	0	0	0	1	0	1	0	1	0	1	0
1	0	0	0	1	0	0	0	0	0	0	0	1
1	0	0	1	0	0	0	0	1	0	0	1	1
1	0	0	1	1	0	0	1	0	0	0	0	1
1	0	1	0	0	0	0	1	1	0	1	1	1
1	0	1	0	1	0	1	0	0	0	0	0	1
1	0	1	1	0	0	1	0	1	0	0	1	1
1	0	1	1	1	0	1	1	0	0	0	0	1
1	1	0	0	0	0	1	1	1	1	1	1	1
1	1	0	0	1	1	0	0	0	0	0	0	1
1	1	0	1	0	1	0	0	1	0	0	1	1
1	1	0	1	1	x	x	x	x	x	x	x	x
1	1	1	0	0	x	x	x	x	x	x	x	x
1	1	1	0	1	x	x	x	x	x	x	x	x
1	1	1	1	0	x	x	x	x	x	x	x	x
1	1	1	1	1	x	x	x	x	x	x	x	x

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(UP)

$q_D q_C$ \ $q_B q_A$	00	01	11	10
00	0	0	0	0
01	0	0	1	0
11	x	x	1	x
10	0	0	x	1

$$T_D = q_D q_B + q_C q_B q_A$$

$q_D q_C$ \ $q_B q_A$	00	01	11	10
00	0	0	1	0
01	0	0	1	0
11	x	x	x	x
10	0	0	x	0

$$T_C = q_B q_A$$

$q_D q_C$ \ $q_B q_A$	00	01	11	10
00	0	1	1	0
01	0	1	1	0
11	x	x	x	x
10	0	1	x	1

$$T_B = q_A + q_D q_B$$

$q_D q_C$ \ $q_B q_A$	00	01	11	10
00	1	1	1	1
01	1	1	1	1
11	x	x	x	x
10	1	1	x	0

$$T_A = \bar{q}_D + \bar{q}_B$$

(DOWN)

$q_D q_C$ \ $q_B q_A$	00	01	11	10
00	1	0	0	0
01	0	0	0	0
11	x	x	x	x
10	1	0	x	0

$$T_D = \bar{q}_C \bar{q}_B \bar{q}_A$$

$q_D q_C$ \ $q_B q_A$	00	01	11	10
00	0	0	0	0
01	1	0	0	0
11	x	x	x	x
10	1	0	x	0

$$T_C = q_C \bar{q}_B \bar{q}_A + q_D \bar{q}_B \bar{q}_A$$

$q_D q_C$ \ $q_B q_A$	00	01	11	10
00	1	0	0	1
01	1	0	0	1
11	x	x	x	x
10	1	0	x	1

$$T_B = \bar{q}_B \bar{q}_A + q_B \bar{q}_A = \bar{q}_A$$

$q_D q_C$ \ $q_B q_A$	00	01	11	10
00	0	1	1	1
01	1	1	1	1
11	x	x	x	x
10	1	1	x	1

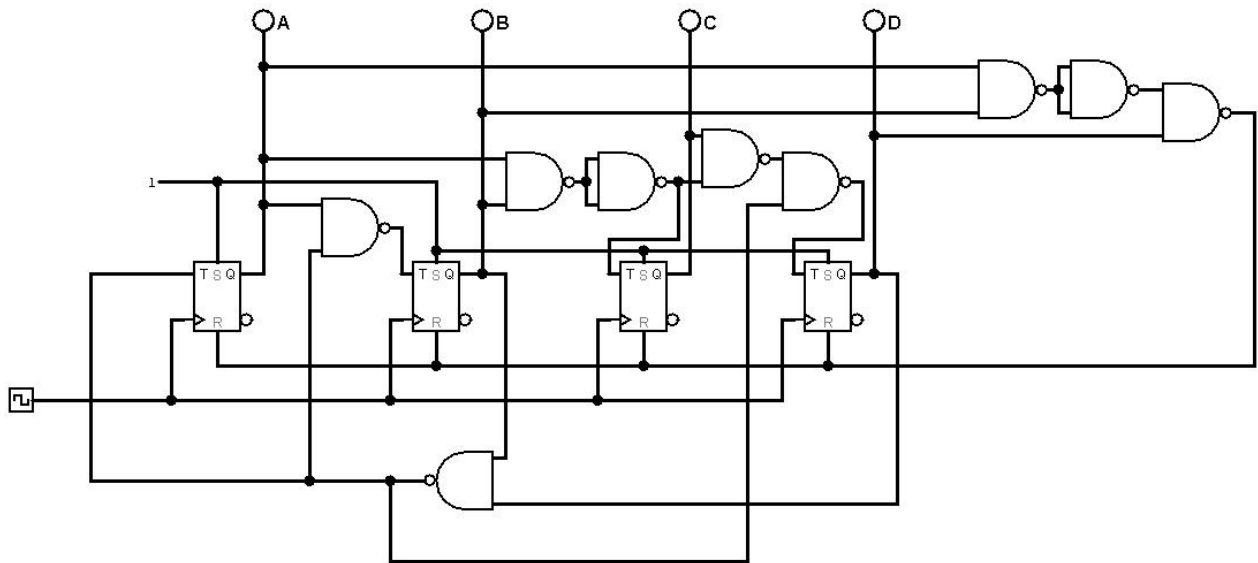
$$T_A = q_A + q_B + q_C + q_D$$

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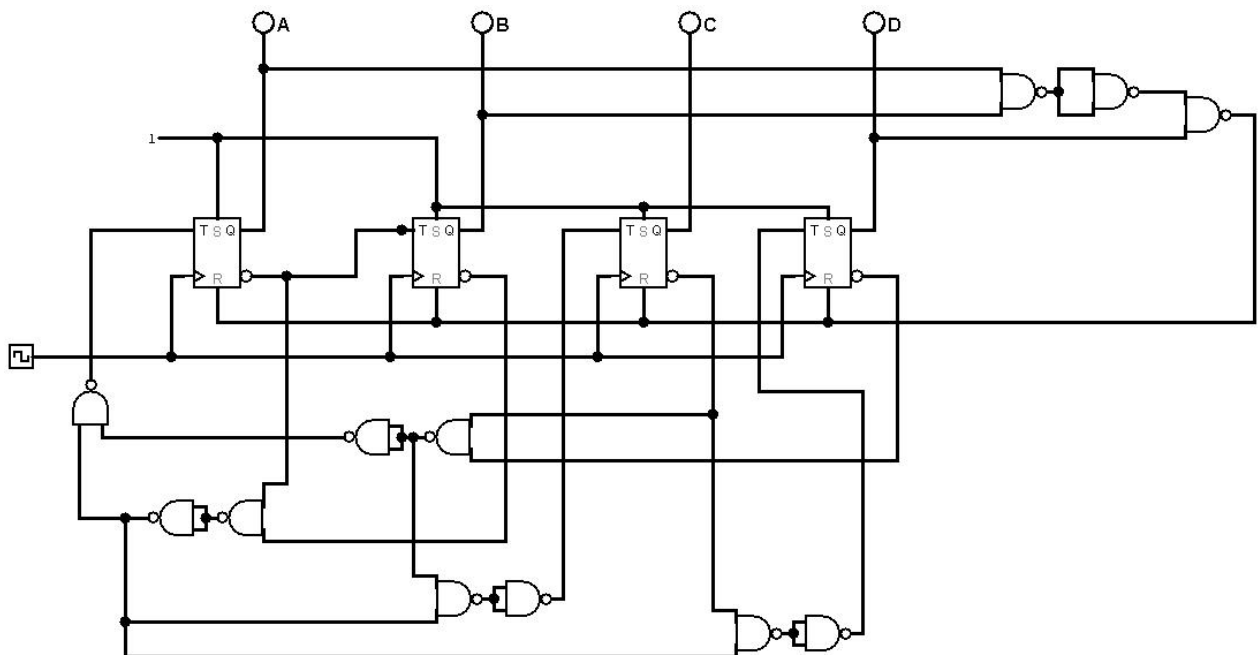
Onward

CIRCUIT DIAGRAM:

UP COUNTER:



DOWN COUNTER:



T - FF:

