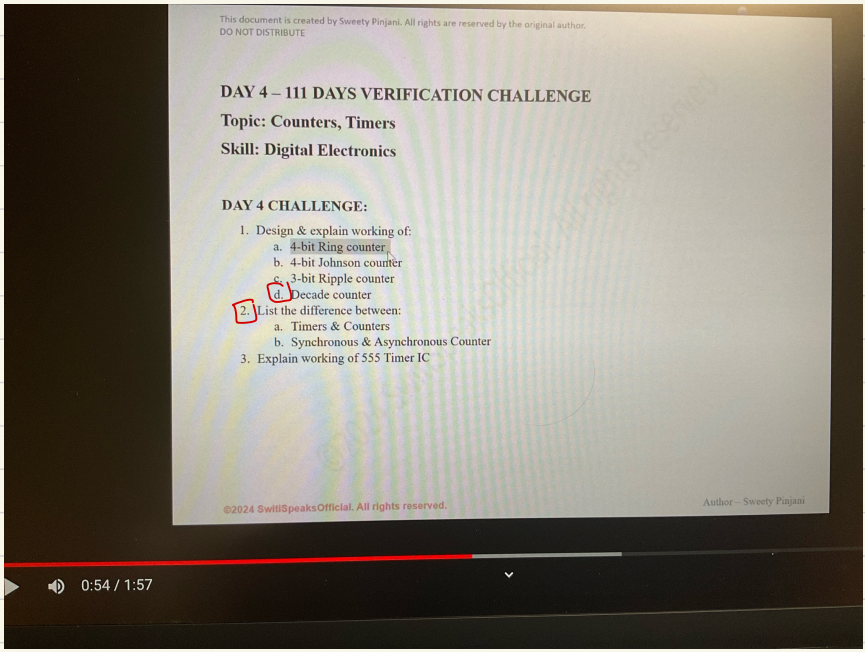
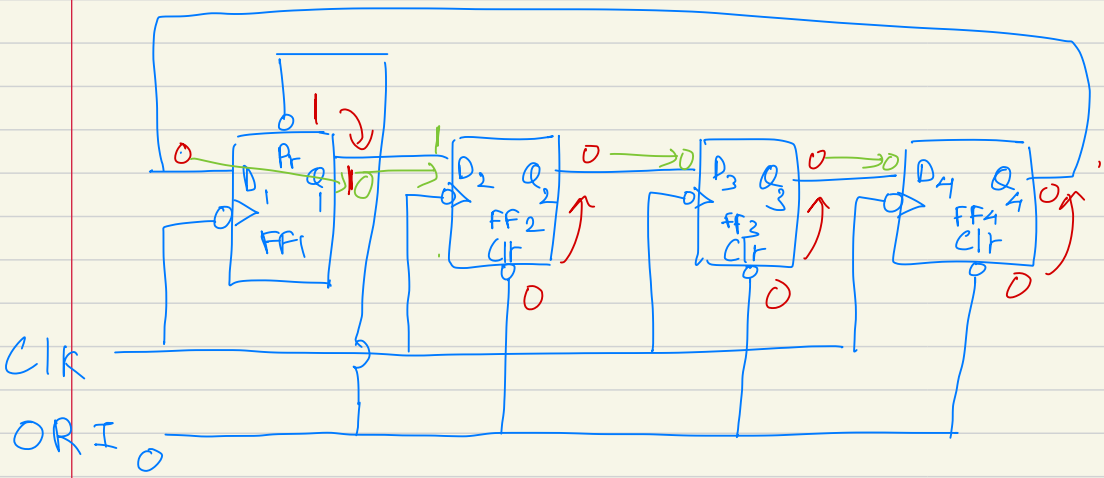
Day 4 — Counters 5 Sept



1) Ring Counter (4 bit ring counter)

no. of States = no. of flip flops for a ring counter.
the same value is looped around & is fed back



Questions :→ Why have we given Preset to FF1 & rest we are giving CLR (ORI) → override Input.

→ What are ring counters.

→ Why are ring Counters used.

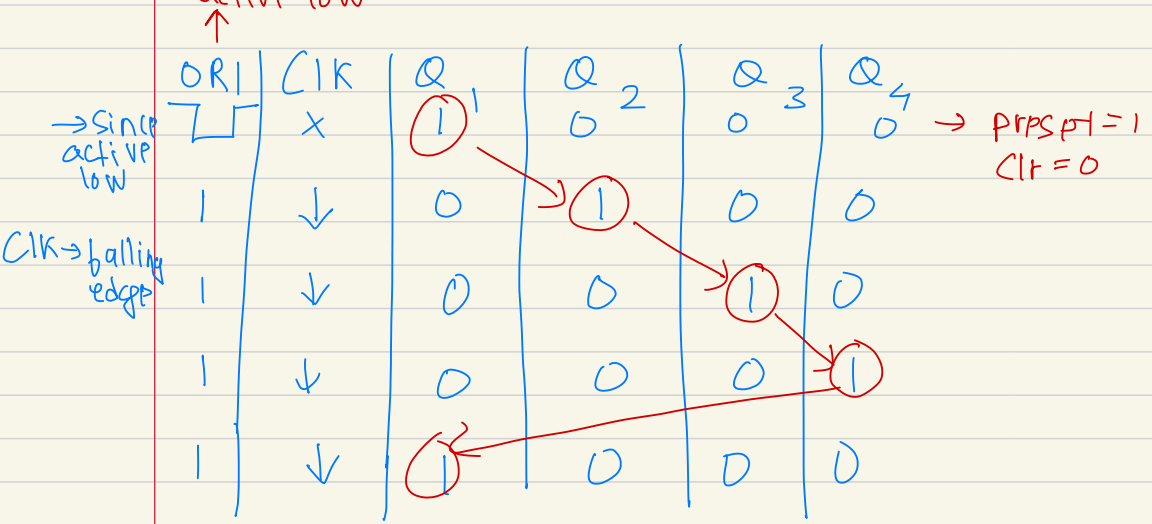
→ How does ring counter work?

ORI → These are preset & clear.

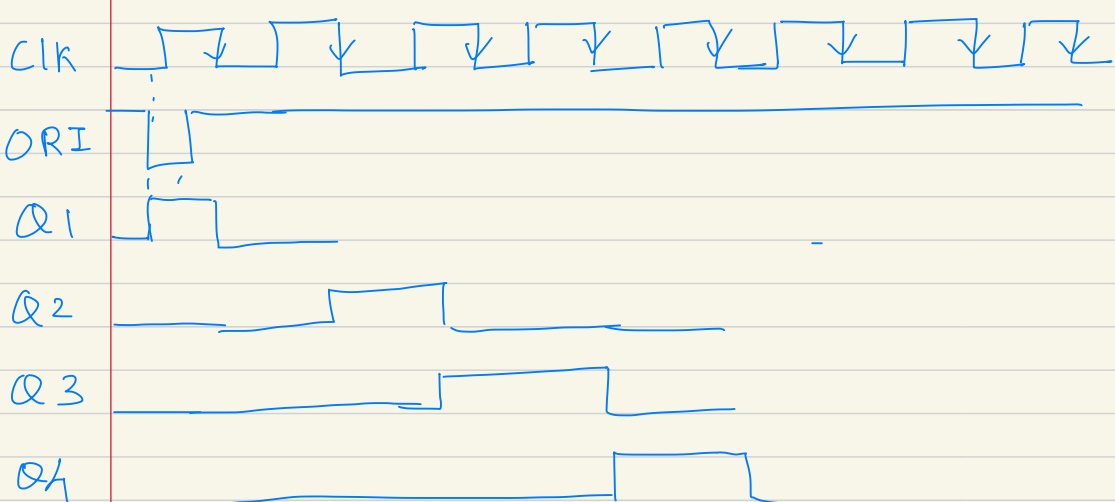
so if PR = 0 ⇒ Q = 1
CLR = 0 ⇒ Q = 0 → use this for above dgt
{active low}

ORI always overrides regardless of CLK & D.

We only set the first FF to 1 so that we can initialise it to a known state & set the rest of the states as zero



becomes a ring structure.



Applicat^n → ring counter helps in sequential control

Just some background on ripple counter (UP)

1) (a) 3-bit ripple counter.

* UP Counter (3 bit) & down counter.

why
- Q connected to clk
- M = 0 up counting
  M = 1 down counting
- $\bar{Q}$ is connected to clk.

0 → 1 → 2 → 3 UP Counter

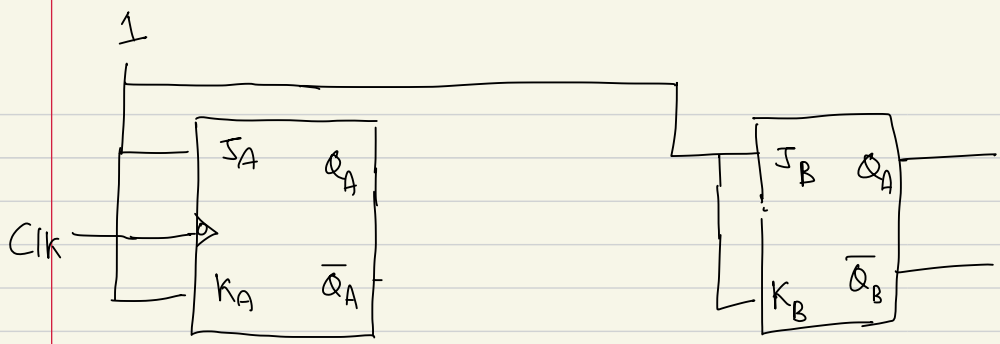
3 → 2 → 1 → 0 Down Counter.

Asynchronous Flip Flop Counters

(Ripple means asynchronous).

why should JK be in Toggle mode?
(otherwise it won't be counting in binary as the nos. ↑)

M	Q	$\bar{Q}$
0	0	0
0	0	1
0	1	0
0	1	1
1	0	0
1	0	1
1	1	0
1	1	1

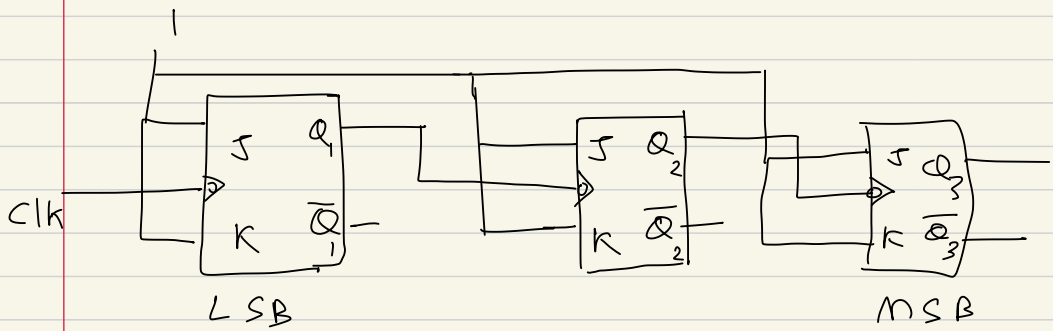


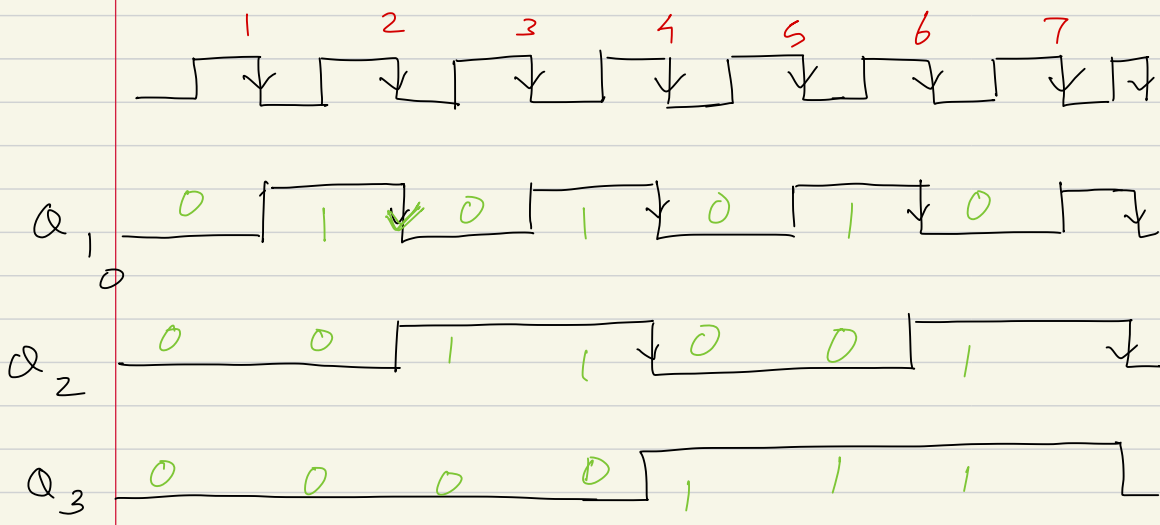
What

Why

How?

UP counter (asynchronous





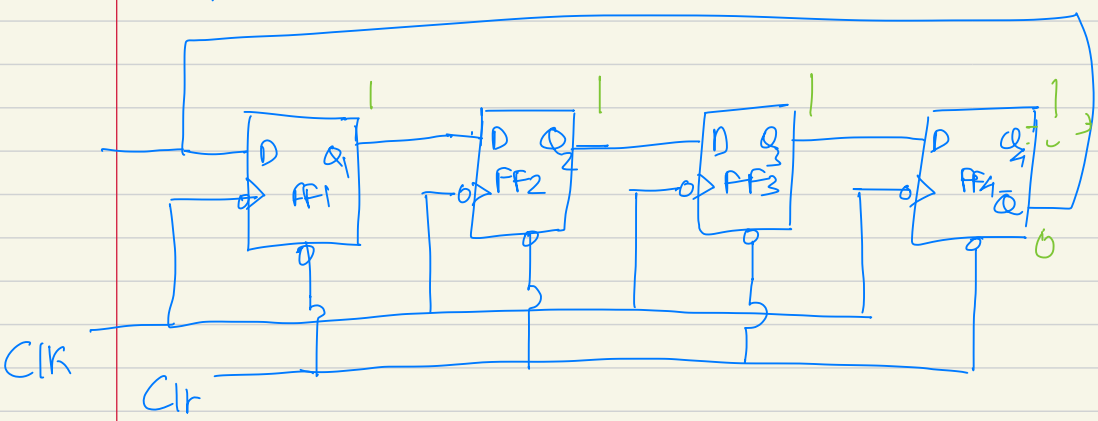
Q_3	Q_2	Q_1
0	0	0
0	0	1
0	1	0
0	1	1
1	0	0
1	0	1
1	1	0
1	1	1

Initial
1st edge

This means it is an up counter.

(b) 4 bit Johnson's counter

The difference b/w 4-bit Johnson's counter & ripple counter is that there is no initial state condn req. for Johnson's counter as opposed to ripple counter.

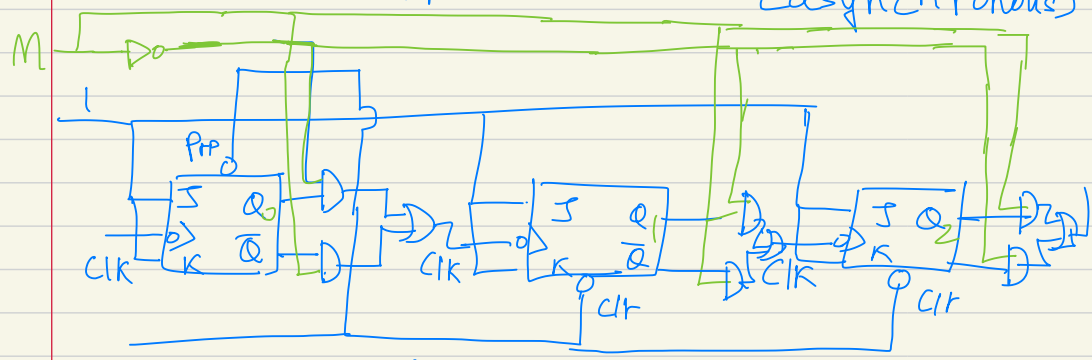


initially all the FFs are initialized at 0.

Clr	Clk	Q_1	Q_2	Q_3	Q_4	no. of States
0	X	0	0	0	0	1
1	↓	1	0	0	0	2
1	↓	1	1	0	0	3
1	↓	1	1	1	0	4
1	↓	1	1	1	1	5
〃	〃	0	1	1	1	6
〃	〃	0	0	1	1	7
〃	〃	0	0	0	1	8
		0	0	0	0	

Hence, for 4 flip flops we can see that there are 8 states.

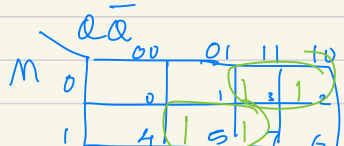
(c) 3 bit ripple up/down counter. (asynchronous)



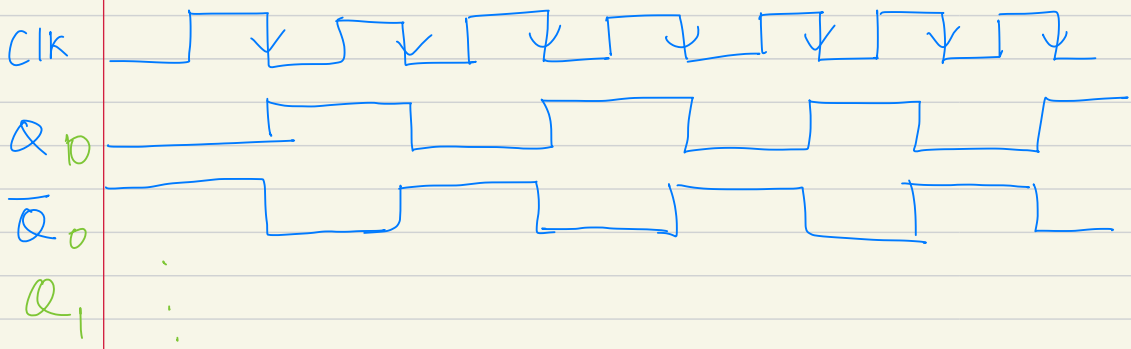
for M=0 ; y follows Q
M=1 ; y follows Q̄

M	Q		Y	
0	0	0	0	up counter
0	0	1	0	
0	1	0	1	
0	1	1	1	
1	0	0	0	down counter
1	0	1	1	
1	1	0	0	
1	1	1	1	

$Y =$

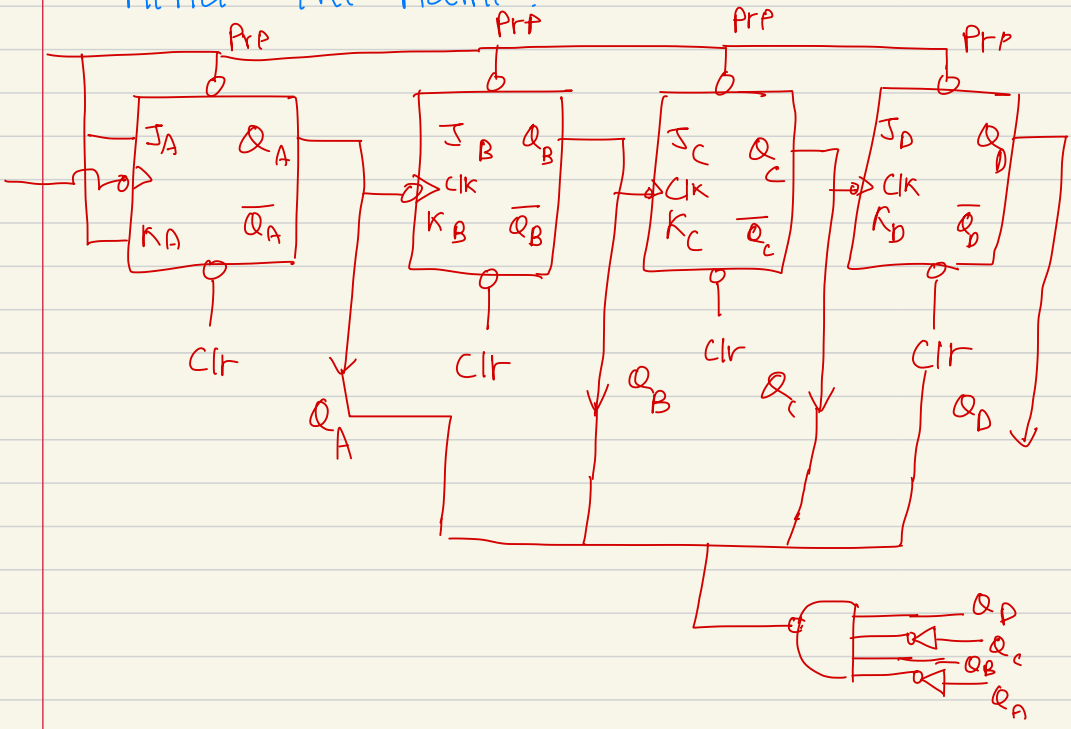


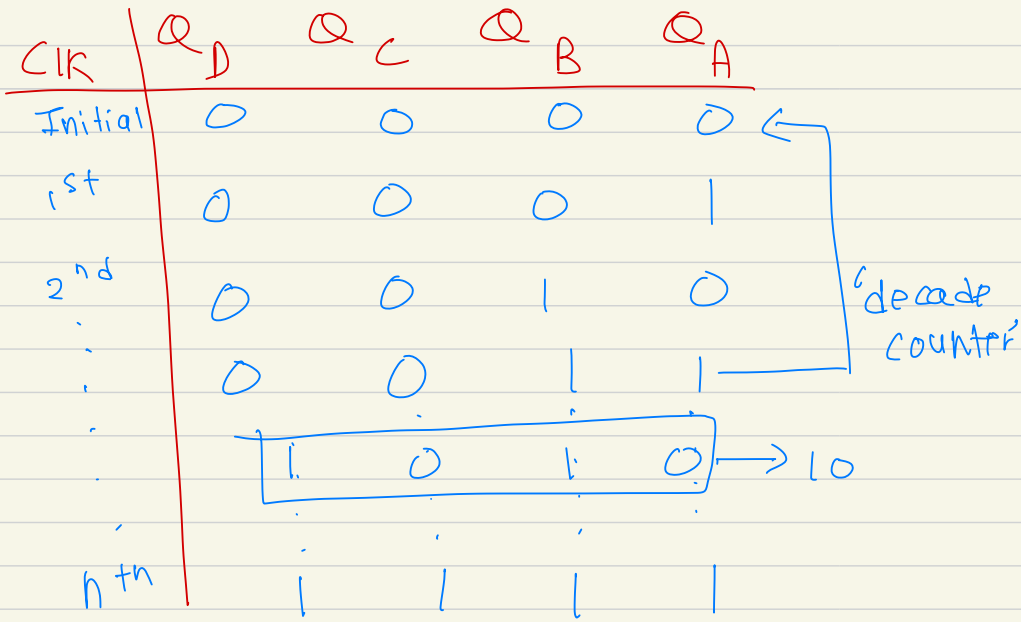
$Y = M\bar{Q} + \bar{M}Q$



(d) Decade Counter

This counter counts from 0 to 9, hence the name.





The mini ckt resets after a count of 10 ∴ it is a decade counter.

2 (a) **Timers vs Counters**

→ Timers ∴ It basically evaluates the amount of time passed by & it is triggered based on clock S/N.

→ Counters ∴ It helps to count the occurrences of inp events. Counter counts based on the external clocks.

2 (b)

*Asynchronous counter:

The clock of the next F/F is based on the input from the prev stage. IP, not all FFs are given the clocks synchronously.

* Synchronous counter:

All the clocks are given the signal at the same time.