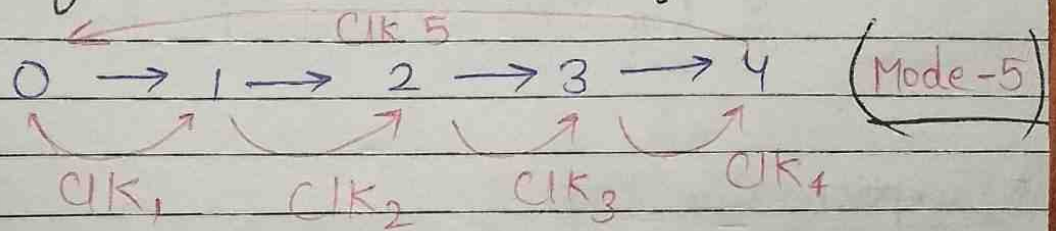# UNIT - 5

★ Counter :-

D, T, JK flip-flop (Not use SR flip-flop)
↓
(less use)

IMP How to find Mode value (Age Triggered use Krna hai)

Que How to find mode value of Counter.

$$0 \rightarrow 1 \rightarrow 2 \rightarrow 3 \rightarrow 4 \quad (\text{Mode-5})$$

Clk 5

Clk_1 Clk_2 Clk_3 Clk_4

(Mode-4)

(Continue mai same mode ko skip krna count nhi krte)

$$0 \rightarrow 1 \rightarrow 1 \rightarrow 2 \rightarrow 3$$

$$0 \rightarrow 1 \rightarrow 2 \rightarrow 1 \rightarrow 3$$

(Mode-5)

1

Piyush
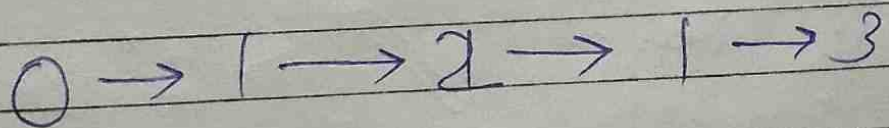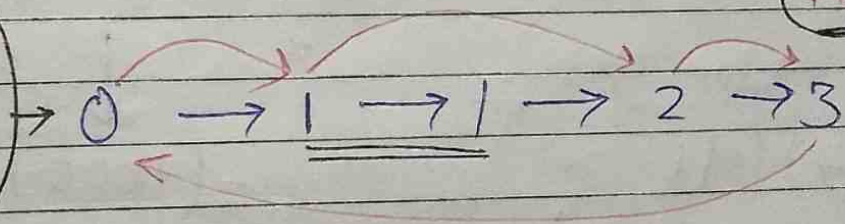
Que. How many flip-flop required to

IMP
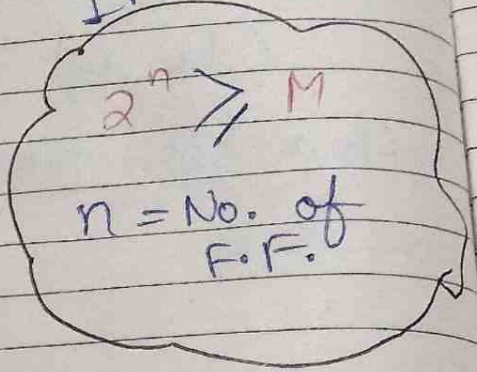
If $M = 5$

$2^n > M$

$2^n > 5$

$2^{\textcircled{3}} > 5$

$8 > 5$

3 flip-flop required

$\boxed{2^n \geqslant M}$

$n = $ No. of F.F.

$2^n \rightarrow M$

$2 \rightarrow 4$

$\bigstar$ **Exception Case** —

$0 \rightarrow 1 \rightarrow 8 \rightarrow 4$ (Mode-4)

Value agar $(7)(1\phi1)$ se Jada hai

Toh value ki hisab se krna hoga
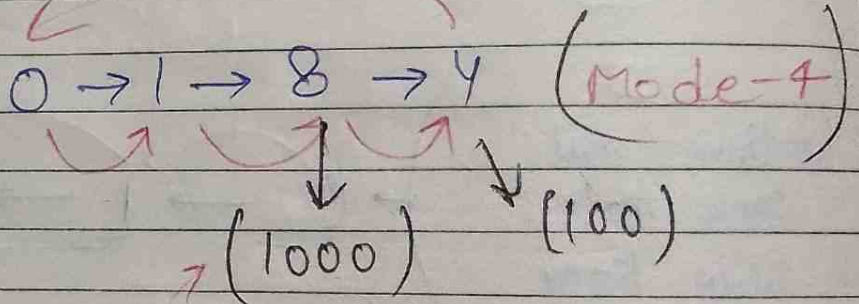
(1000)

(100)

$2^n > 4$

$2^3 > 4$

$\boxed{n = 4}$

$8 > 4$

Value ke hisab se karege $\boxed{n = 3}$ $\times$ wrong

Piyush

★ <u>Asynchronous counter</u> —

$(Q_1, Q_2, Q_3 \to O/p)$

CIK

CIK pulse ki tark Isam karega

| J_1 Q_1 |
| K_1 |

| J_2 Q_2 |
| K_2 |

| J_3 Q_3 |
| K_3 |

★ <u>Synchronous counter</u> :-

CIK

| J_1 Q_1 |
| K_1 |

| J_2 Q_2 |
| K_2 |
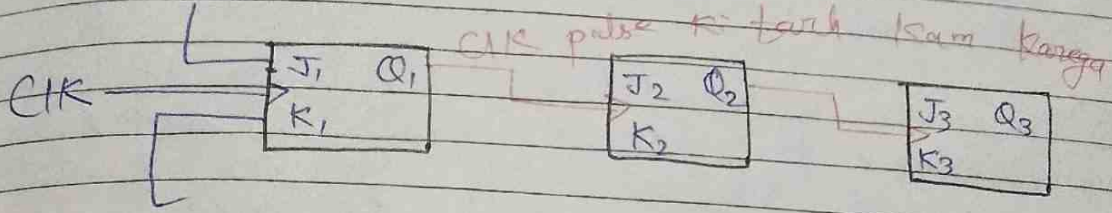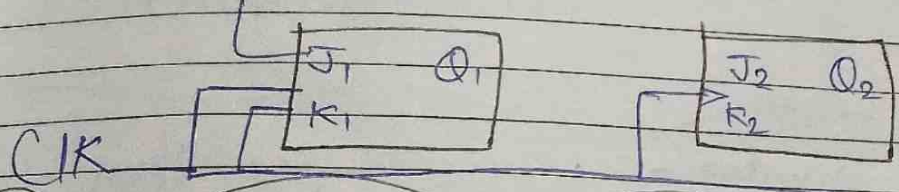
<u>Que</u> Difference b/w synchronous & Asychronous

Asychronous	Asychronous Sychronous
① In this type of counter F.F are connected in such a way that o/p of 1st F.F derives the clk the clock pulse of 2nd F.F, The o/p of 2nd F.F will be clk pulse. of 3rd F.F.	① In this type of counter there is no connection b/w The o/p of 1st F.F & clk pulse of 2nd F.F.

$(\overrightarrow{+ve\ age\ Trigged})$ $(\overrightarrow{-ve\ age\ Trigged})$

② All F.F are not clocked simultaneously.	② All F.F are clocked simultaneously.
③ Design an implementation is very simple for more no. of state.	③ Design an implementation become complex as the no. of state increase.
④ Low speed	④ High speed.

★ **Asynchronous counter/-**

reple / updown counter -

$0 \to 1 \to 2 \to 3 \to ...$ $\left(\begin{array}{c} up \\ counter \end{array}\right)$

$3 \to 2 \to 1 \to 0$ $\left(\begin{array}{c} down \\ counter \end{array}\right)$

$\left(\begin{array}{c} Jumping\ allowed \\ nhi\ hai\ ! \end{array}\right)$

M.I.* Table

★ IMP Table $\left(\begin{array}{c} For\ 2/3/4 \\ bit \end{array}\right)$

Same charge ⟹ down

opposite charge ⟹ up

		$+ve$ $\overline{Q(n)}$	$-ve$ $\overline{Q(n)}$
$\overset{+ve}{\longrightarrow}$		down	up
$\overset{}{\longrightarrow}$ $-ve$		Up	down

Q★ Two - bit repal counter / Two - bit up counter with ~~two~~ -ve age triggering

LSB
(Least - significant bit)

(MSB)
(Most - significiant) bit

CLK

Q_0

Q_1

(-ve age pr toggle Karega)

Timing Table	3 bit	-ve	CLK	MSB Q_1	LSB Q_0	MSB $\bar{Q_1}$	LSB $\bar{Q_0}$
		↓	0 →	0	0	1	1
		↓	1 →	0	1	1	0
		↓	2 →	1	0	0	1
$Q_0 Q_1$		↓	3 →	1	1	0	0
$(Q_0 Q_1)$	Q_2	↓	4				

For 2 bit

2nd Half

★ Two-bit up counter with +ve age trigger

CLK

Q_0

$\overline{Q_0}$

Q_1

Q_1	Q_0	$\overline{Q_1}$	$\overline{Q_0}$
0	0	1	1
0	1	1	0
1	0	0	1
1	1	0	0

Jitne bit = utne F.F required

2 bit $\longrightarrow$ 2^2 = (4 Mod)

3 bit $\longrightarrow$ 2^3 = (8 Mod)

4 bit $\longrightarrow$ 2^4 = (16 Mod)

★ <u>Synchronous counter</u>,—

① <u>Ring Counter</u> — $\overset{Exception}{\longrightarrow}$ (0000) Ke liye valid nhi hai
$\hookrightarrow$ 4 tak hi Kam krta hai.
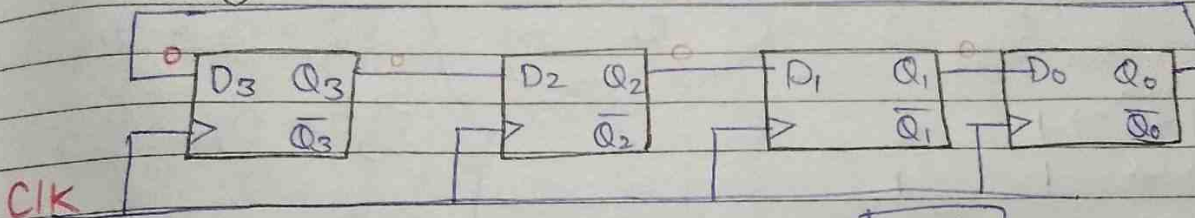
CLK

$Q_3 \quad Q_2 \quad Q_1 \quad Q_0$

$\boxed{n=4}$

$2^4 = 16$

	Q_3	Q_2	Q_1	Q_0
→	1	0	0	0
1 ↓	0	1	0	0
2 ↓	0	0	1	0
3 ↓	0	0	0	1
4 ↓	0	0	0	0
	1	0	0	0

$16 - 4 = \boxed{12}$

Clock
Pulse

$Q_3^+ = D_3 = Q_0(n)$

$Q_2^+ = D_2 = Q_3(n)$

$Q_1^+ = D_1 = Q_2(n)$

$Q_0^+ = D_0 = Q_1(n)$

Piyush

★ **John Son Counter** :-

CIK
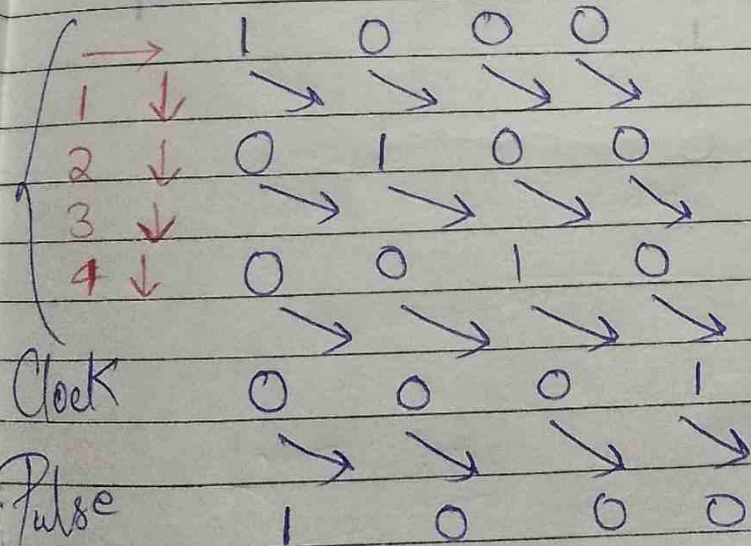
$$Q_3 \quad Q_2 \quad Q_1 \quad Q_0$$
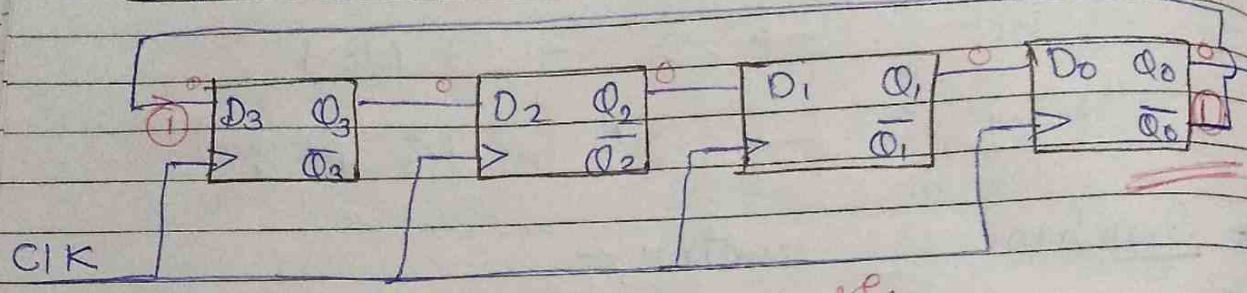
Wah se Ki

	Q_3	Q_2	Q_1	Q_0
	0	0	0	0	$\overline{Q_0}$
1 →	1	0	0	0
2 →	1	1	0	0
3 →	1	1	1	0
4 →	1	1	1	1
5 →	0	1	1	1
6 →	0	0	1	1
7 →	0	0	0	1
8 →	0	0	0	0

$$Q_3^+ = D_3 = \overline{Q_0(n)}$$

$$Q_2^+ = D_2 = Q_3(n)$$

$$Q_1^+ = D_1 = Q_2(n)$$

$$Q_0^+ = D_0 = Q_1(n)$$
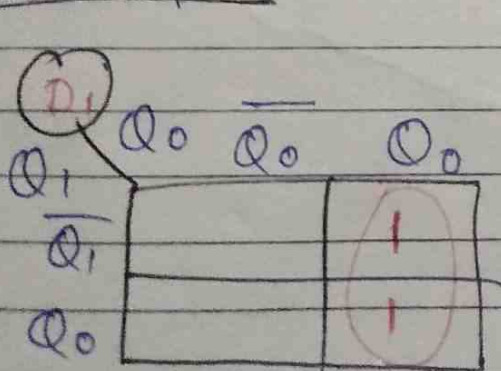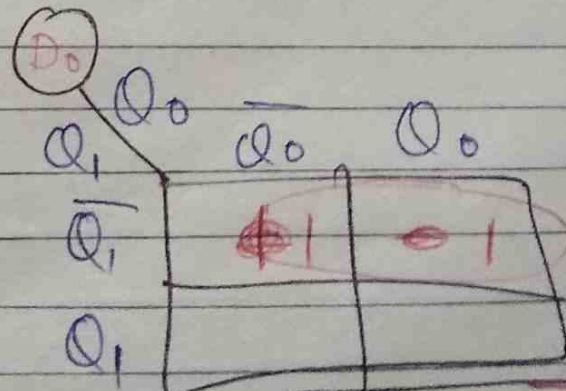
Piyush

Que. How to design synchronous counter.

$$0 \to 1 \to 3 \to 2 \qquad MOD = 4, \ F.F = 2$$

$$\boxed{2^n \geq M}$$

D₀ Q₀   D₁ Q₁

$\overline{Q_1}$

CLK
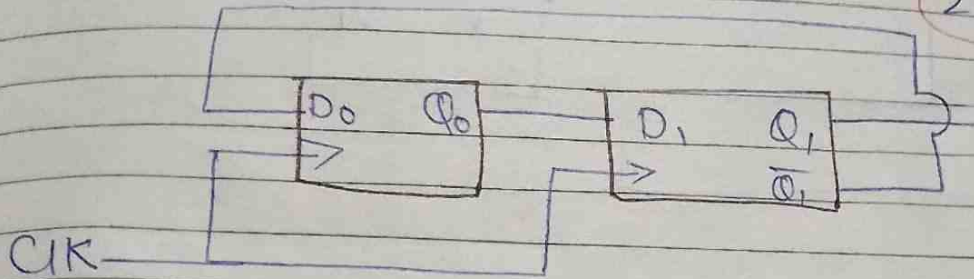
2	1	2	1		
Present State		Next State			
Q_1	Q_0	Q_1^+	Q_0^+	D_1	D_0
0	0	0	1	0	1
0	1	1	1	1	1
1	0	0	0	0	0
1	1	1	0	1	0

★ **K-Map**

D_1

Q_1 / $\overline{Q_1}$	Q_0	$\overline{Q_0}$	Q_0
		1	
Q_0		1	

$$\boxed{D_1 = Q_0}$$

D_0

Q_1 / $\overline{Q_1}$	Q_0	$\overline{Q_0}$	Q_0
Q_1		1	1

$$\boxed{D_0 = \overline{Q_1}}$$

Assign.

Que: Design synchronous counter for T flip-flop

$$0 \rightarrow 1 \rightarrow 3 \rightarrow 2$$

T_0	Q_0

T_1	Q_1

CIK
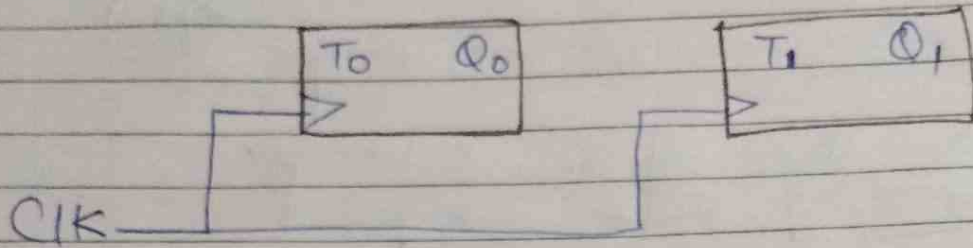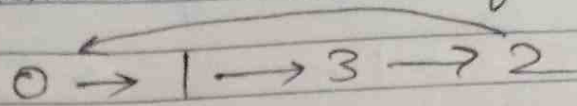
Q_1	Q_0	Q_1^+	Q_0^+
0	0		
0	1		
1	0		
1	1		

Piyush

up counter → 1 → 2 → 3
(Sidi ginti)

down counter → (7→6→ --)
(ulthi ginti)

★ 3 - bit synchr. counter with JK F.F, -

3 bit down counter	3 bit up counter	7 → 6 → 5 → 4 → 3 → 2 → 1 → 0
		1 1 1
0 0 0		1 1 0
1 1 1		1 0 1
1 1 0		1 0 0
1 0 1		0 1 1
1 0 0		0 1 0
0 1 1		0 0 1
0 1 0		0 0 0
0 0 1		
0 0 0		

Q_2	Q_1	Q_0	Q_2^+	Q_1^+	Q_0^+	J_2	K_2	J_1	K_1	J_0	K_0
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	1	1	0	X	0	1	X	X	1
1	1	0	1	1	1	X	0	X	0	1	X
1	1	1	0	0	0	X	1	X	1	X	1

★ K - Map
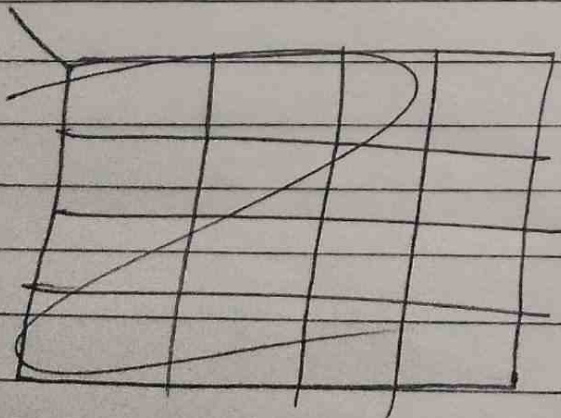
$Q_{(n)}$	$Q_{(n+1)}$	J	K
0	0	0	X
0	1	1	X
1	0	X	1
1	1	X	0

J_2

$Q_1 Q_0$

$\overline{Q_1}\,\overline{Q_0}$ $\overline{Q_1}\,Q_0$ $Q_1\,Q_0$ $Q_1\,\overline{Q_0}$

[Kuch common nhi aaega Toh ① aaega]

J_2
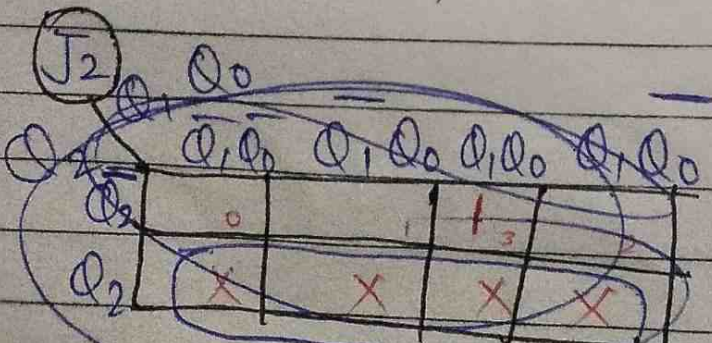
$Q_2 \backslash Q_1 Q_0$	$\overline{Q_1 Q_0}$	$\overline{Q_1} Q_0$	$Q_1 Q_0$	$Q_1 \overline{Q_0}$
$\overline{Q_2}$	x_4	x_5	① x_6	x_7
Q_2				

$$J_2 = K_2 = Q_0 Q_1$$

$$J_1 = K_1 = Q_0$$

$$J_0 = K_0 = 1$$

CLK
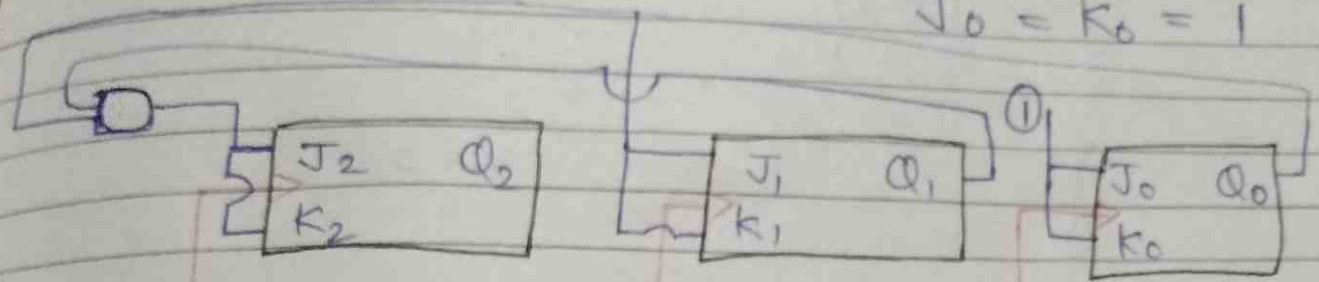
~~~~~~~~~~~~~~~~~~~~~~~~~~

★ BCD synchronous - T (10 Mod)

(0-9)

(0000 → 1001)

(Decade counter / BCD counter)

BCD Kmap mal

Don't Care aaega !

5 mode counter

Que   7 → 6 → 5 → 4 → 3

7	1	1	1
6	1	1	0
5	1	0	1
4	1	0	0
3	0	1	1
2			
1			
0			

X Don't care

Piyush