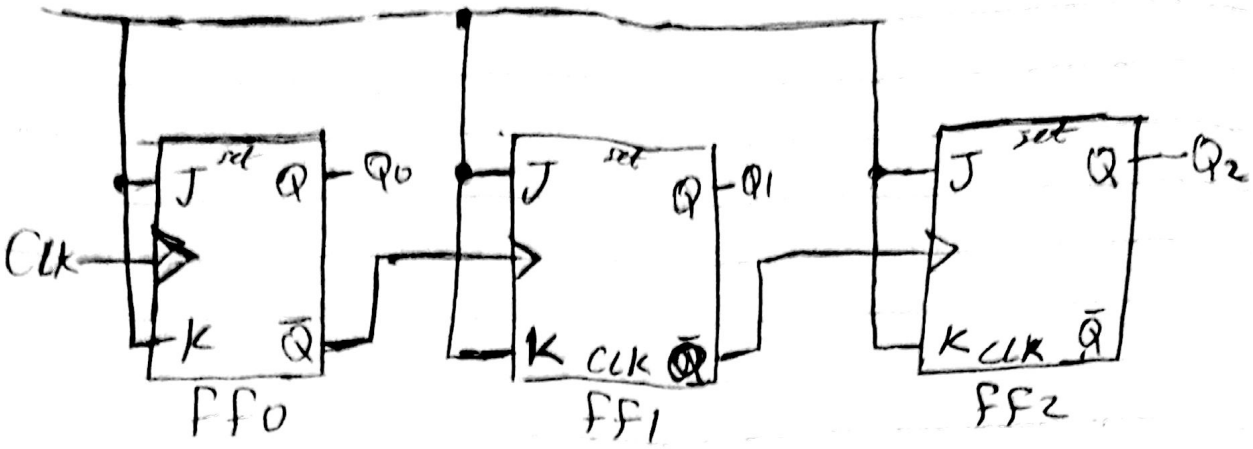
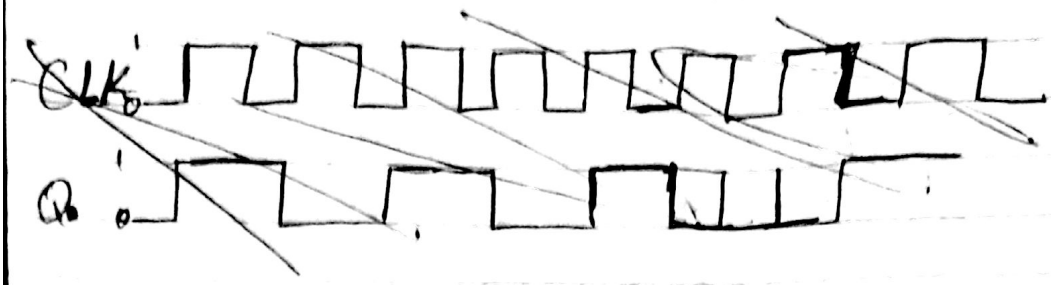
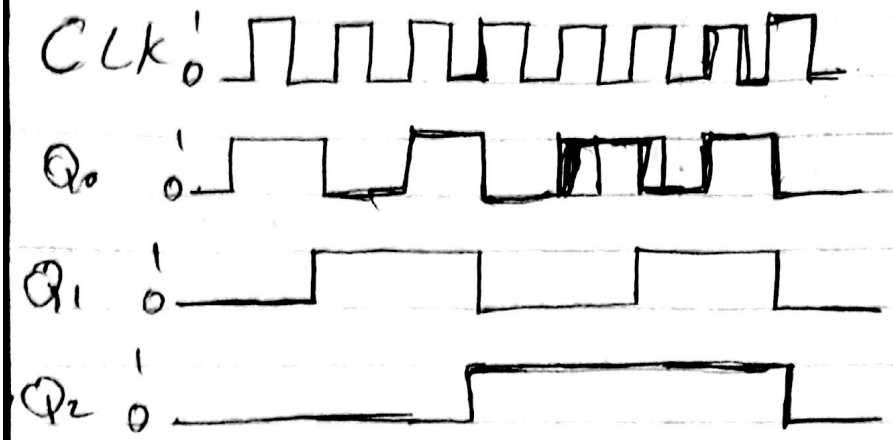
A 3-Bit Asynchronous Counter







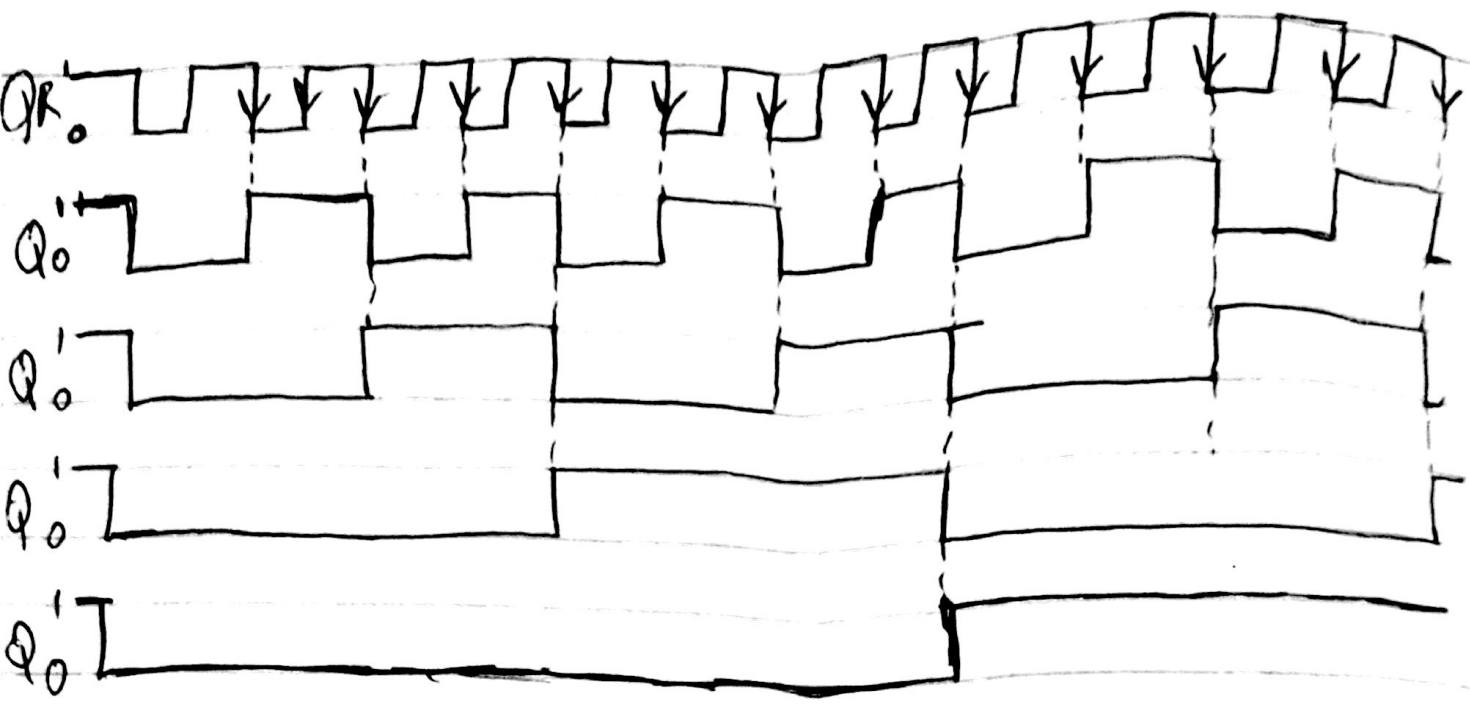
Timing Diagram

State	Q_2	Q_1	Q_0
0	0	0	0
1	0	0	1
2	0	1	0
3	0	1	1
4	1	0	0
5	1	0	1
6	1	1	0
7	1	1	1

Truth table

BINARY COUNTING SYSTEM

2^3 Q_3	2^2 Q_2	2^1 Q_1	2^0 Q_0	
0	0	0	0	Before applying Clock Pulse
0	0	0	1	After Pulse 1
0	0	1	0	After Pulse 2
0	0	1	1	After Pulse 3
0	1	0	0	After Pulse 4
0	1	0	1	" " 5
0	1	1	0	" " 6
0	1	1	1	" " 7
1	0	0	0	After Pulse 8
1	0	0	1	After Pulse 9
1	0	1	0	" " 10
1	0	1	1	" " 11
1	1	0	0	" " 12
1	1	0	1	" " 13
1	1	1	0	" " 14
1	1	1	1	" " 15
0	0	0	0	After Pulse 16 (returns to 0000)
0	0	0	1	After Pulse 17
0	0	1	0	" " 18
0	0	1	1	" " 19



Timing diagram showing frequency division

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2) i) MOD number $= 2^6 = 64$

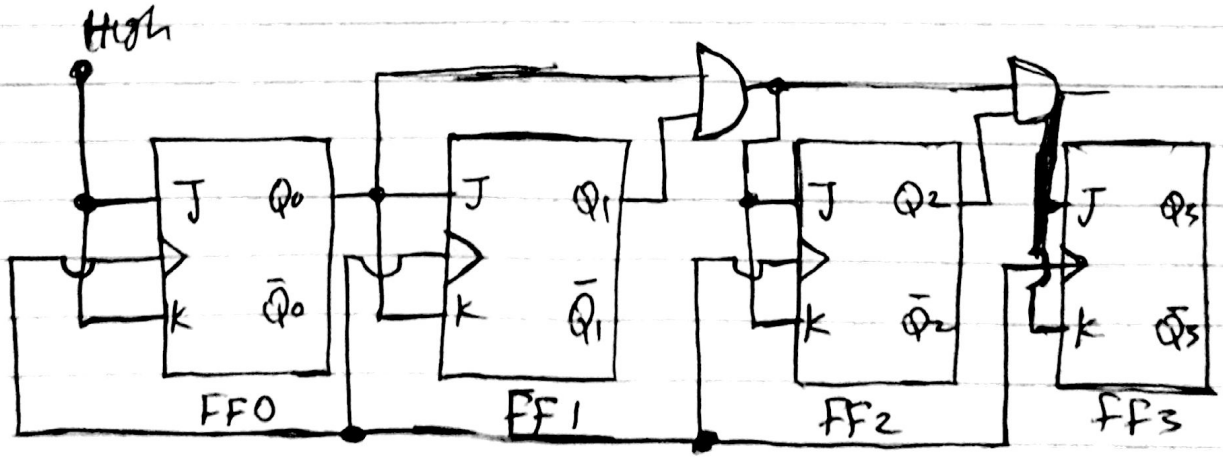
ii) Frequency at the last flip flop $= \frac{\text{Input Clock Freq.}}{\text{MOD number}}$

$\Rightarrow$ Frequency at $Q_5 = 1/64\ \text{MHz} = 15625\ \text{kHz}$

iii) The counter will count from 000000 to 111111 (total of 64 states)

iv) Since it is a MOD 64 counter, every 64 pulse will bring the counter back to it's initial state. Therefore, after 128 pulses, the counter is back to 000000 and after the 129th pulse, it brings the counter to 000001 state

A 4-BIT BINARY COUNTER



JK Truth table

J	k	Q
0	0	No change
0	1	Reset (0)
1	0	Set (1)
1	1	Toggle