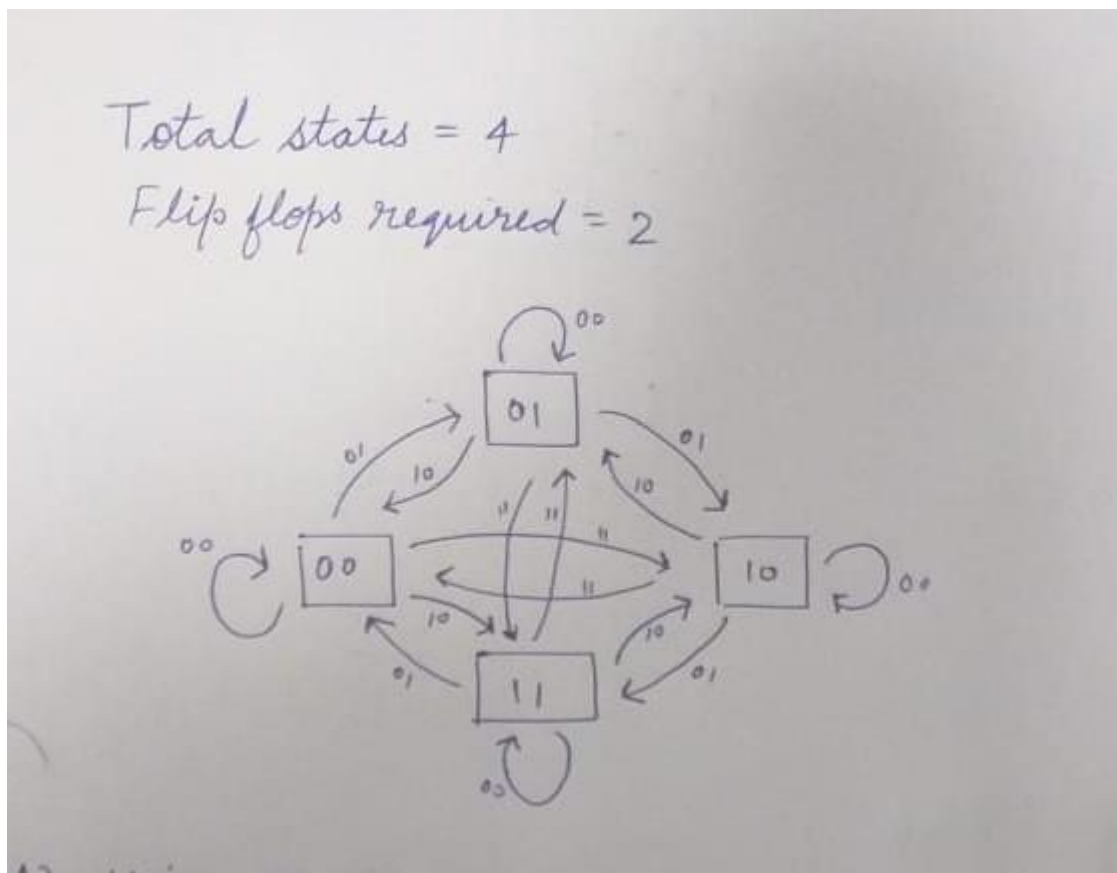Name – Samrathpreet Singh Randhawa

Roll No.- 1801CS43

LAB-10

Q1)

a) Using T Flip Flop

(A) Using T flip flop

C_0	C_1	Q_1	Q_D	Q_1^*	Q_D^*	T_1	T_0
0	0	0	0	0	0	0	0
0	0	0	1	0	1	0	0
0	0	1	0	1	0	0	0
0	0	1	1	1	1	0	0
0	1	0	0	0	1	0	1
0	1	0	1	1	0	1	1
0	1	1	0	1	1	0	1
0	1	1	1	0	0	1	1
1	0	0	0	1	1	1	1
1	0	0	1	0	0	0	1
1	0	1	0	0	1	1	1
1	0	1	1	1	0	0	1
1	1	0	0	1	0	1	0
1	1	0	1	1	1	1	0
1	1	1	0	0	0	1	0
1	1	1	1	0	1	1	0

$$T_1 = C_1 Q_D + C_0 \bar{Q_0}$$

$$T_0 = C_0 \oplus C_1$$

b)Using D flip flop

C_0	C_1	S_1	S_0	N_1	N_0	D_1	D_0
0	0	0	0	0	0	0	0
0	0	0	1	0	1	0	1
0	0	1	0	1	0	1	0
0	0	1	1	1	1	1	1
0	1	0	0	0	1	0	1
0	1	0	1	1	0	1	0
0	1	1	0	1	1	1	1
0	1	1	1	0	0	0	0
1	0	0	0	1	1	1	1
1	0	0	1	0	0	0	0
1	0	1	0	0	1	0	1
1	0	1	1	1	0	1	0
1	1	0	0	1	0	1	0
1	1	0	1	1	1	1	1
1	1	1	0	0	0	0	0
1	1	1	1	0	1	0	1

$$D_1 = C_0 \overline{S_0} \overline{S_1} + C_1 S_0 \overline{S_1}$$
$$+ \overline{C_1} S_0 S_1 + \overline{C_0} \overline{S_0} S_1$$

$$D_0 = S_0 (\overline{C_1}\overline{C_0} + C_1 C_0)$$
$$+ \overline{S_0} (C_1 \overline{C_0} + \overline{C_1} C_0)$$
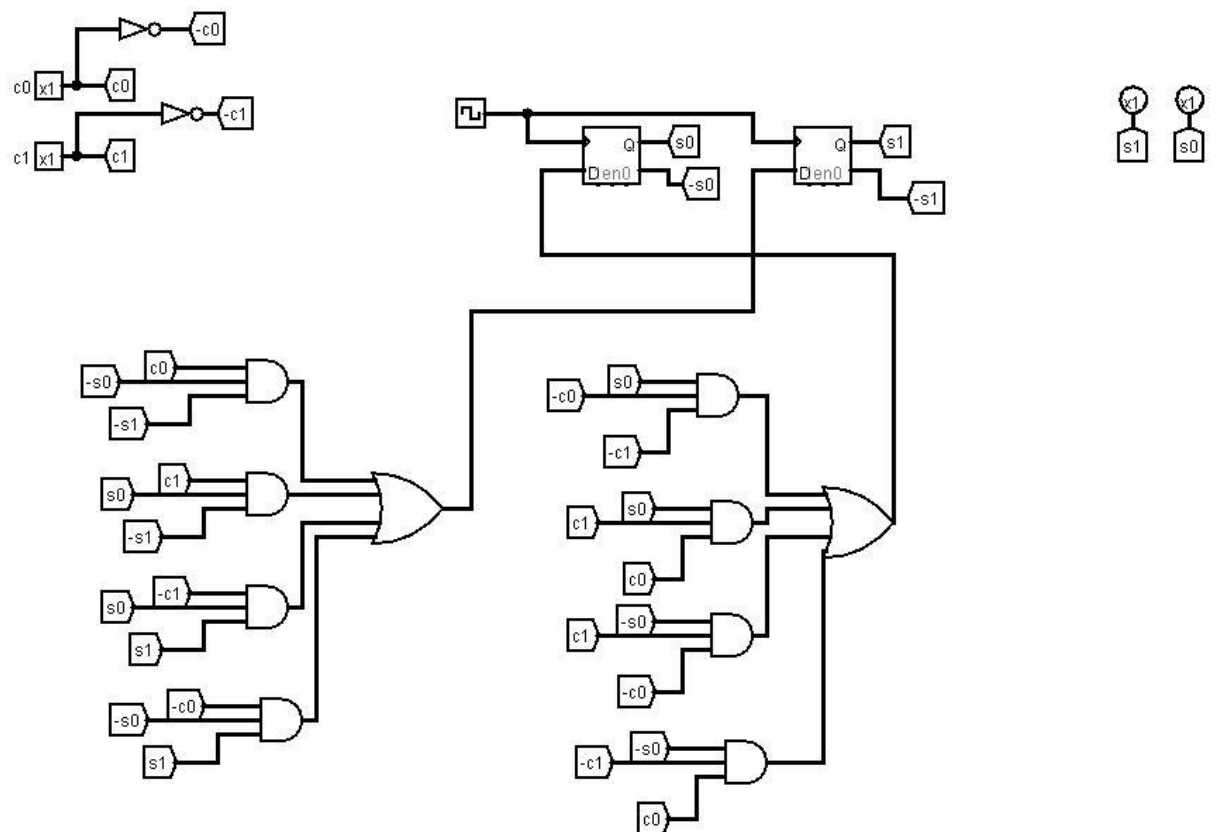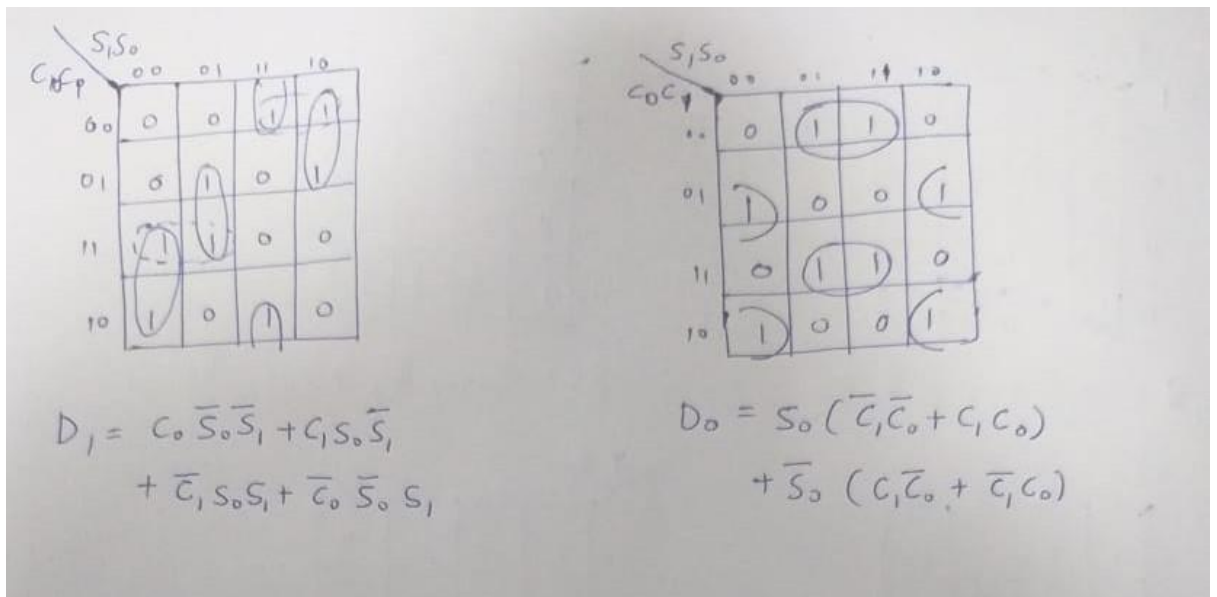
Fig.2 used d flip flop

c)Using SR Flip flop

C_0	C_1	Q_1	Q_0	Q_1^*	Q_0^*	S_1	R_1	S_0	R_0
0	0	0	0	0	0	0	X	0	X
0	0	0	1	0	1	0	X	X	0
0	0	1	0	1	0	X	0	0	X
0	0	0	0	1	1	X	0	X	0
0	1	0	0	0	1	0	X	1	0
0	1	0	1	1	0	1	0	0	1
0	1	1	0	1	1	X	0	1	0
0	1	1	1	0	0	0	1	0	1
1	0	0	0	1	1	1	0	1	0
1	0	0	1	0	0	0	X	0	1
1	0	1	0	0	1	0	1	1	0
1	0	1	1	1	0	X	0	0	1
1	1	0	0	1	0	1	0	0	X
1	1	0	1	1	1	1	0	X	0
1	1	1	0	0	0	0	1	0	X
1	1	1	1	0	1	0	1	X	0

$$S_1 Q_1 = C_0 \overline{Q_1} \overline{Q_0} + C_1 \overline{Q_1} Q_0$$

$$S_0 = \overline{C_0} C_1 \overline{Q_0} + C_0 \overline{C_1} \overline{Q_0}$$

$$R_1 = C_1 Q_1 Q_0 + C_0 Q_1 \overline{Q_0}$$

$$R_0 = \overline{C_0} C_1 Q_0 + C_0 \overline{C_1} Q_0$$
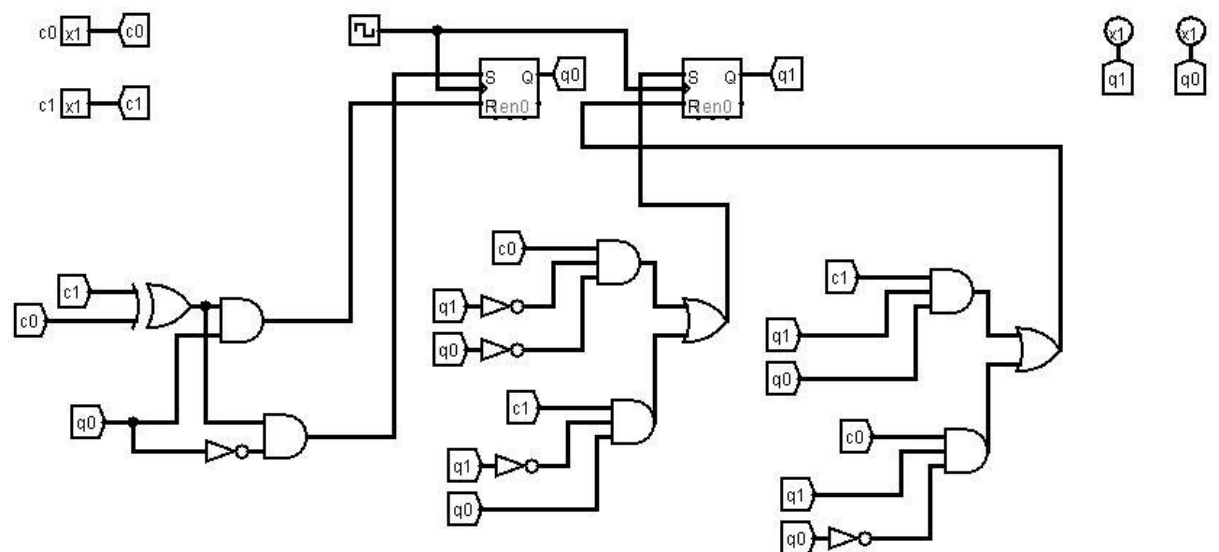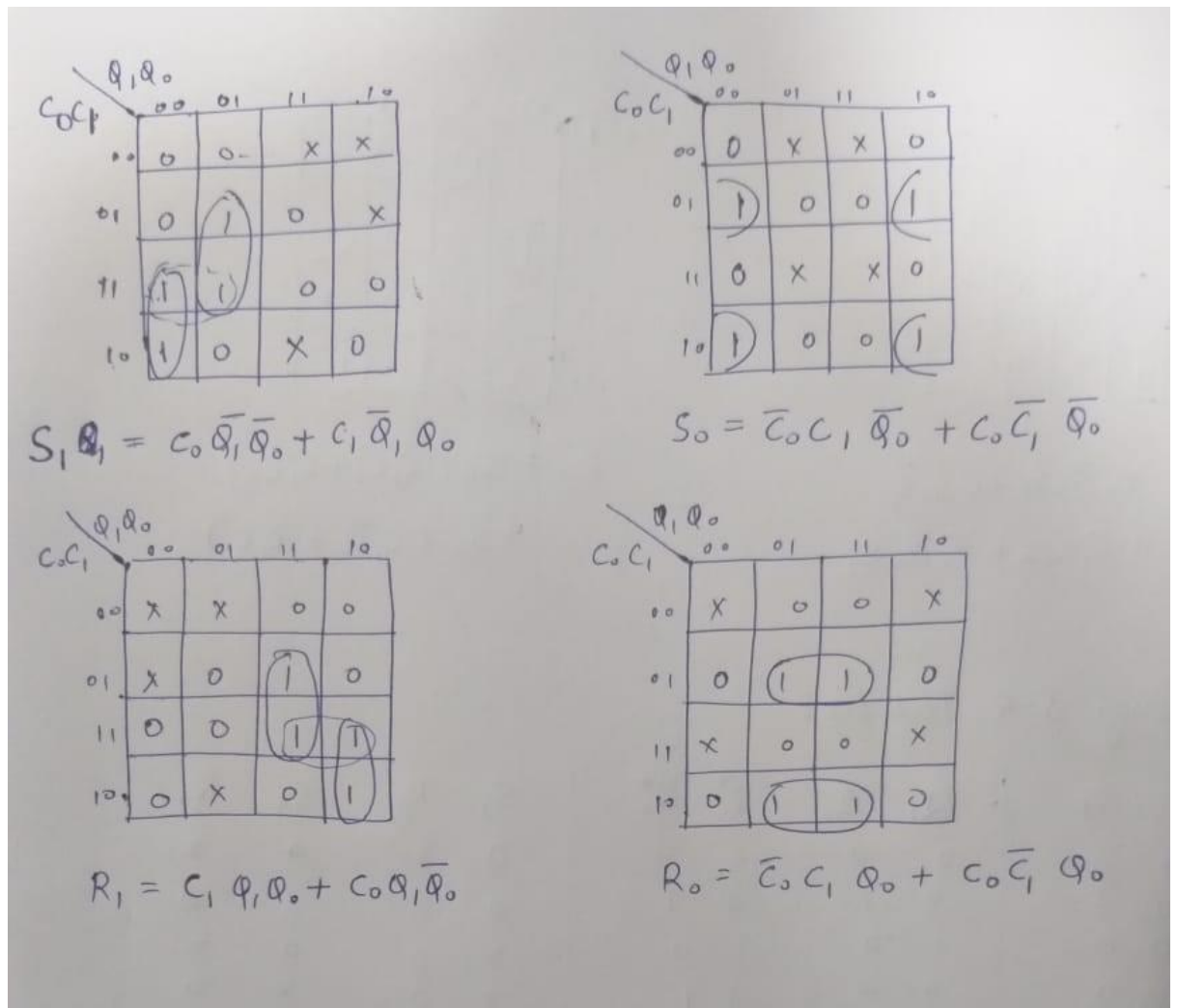
Fig.3 used SR flip flop

d)Using JK Flip Flop

(D) Using J-K flip flop.

C_0	C_1	Q_1	Q_0	Q_1^*	Q_0^*	J_1	K_1	J_0	K_0
0	0	0	0	0	0	0	X	0	X
0	0	0	1	0	1	0	X	X	0
0	0	1	0	1	0	X	0	0	X
0	0	1	1	1	1	X	0	X	0
0	1	0	0	0	1	0	X	1	X
0	1	0	1	1	0	1	X	X	1
0	1	1	0	1	1	X	0	1	X
0	1	1	1	0	0	X	1	X	1
1	0	0	0	1	1	1	X	1	X
1	0	0	1	0	0	0	X	X	1
1	0	1	0	0	1	X	1	1	X
1	0	1	1	1	0	X	0	X	1
1	1	0	0	1	0	1	X	0	X
1	1	0	1	1	1	1	X	X	0
1	1	1	0	0	0	X	1	0	X
1	1	1	1	0	1	X	1	X	0

$$J_1 = C_0 \bar{Q}_0 + C_1 Q_0$$

$$J_0 = \bar{C}_0 C_1 + C_0 \bar{C}_1$$

$$K_1 = C_1 Q_0 + C_0 \overline{Q}_0$$

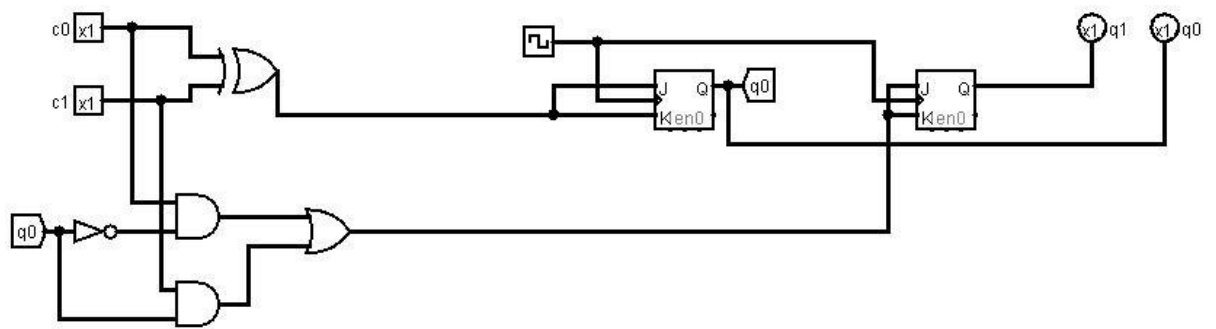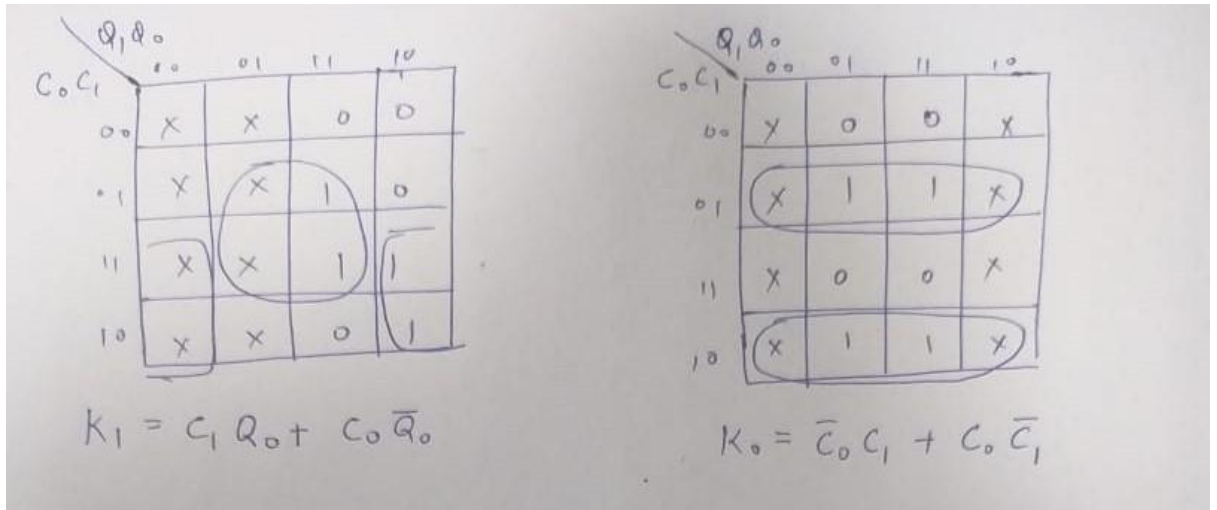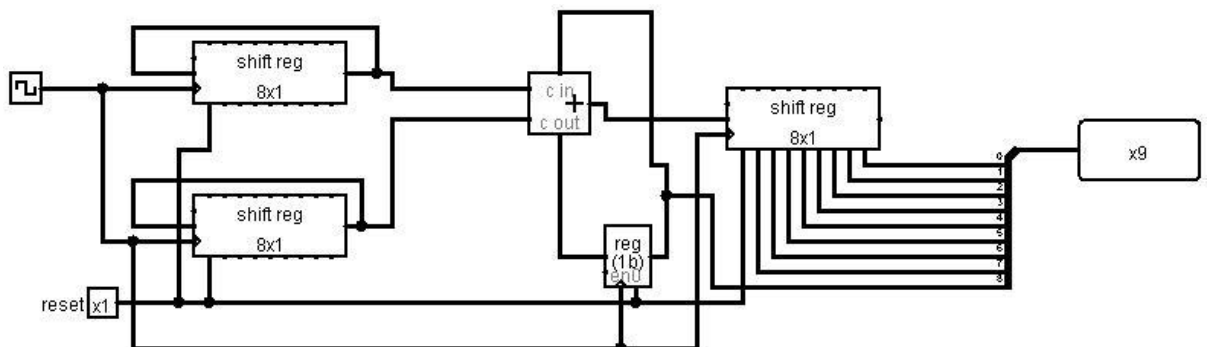$$K_0 = \overline{C}_0 C_1 + C_0 \overline{C}_1$$

Fig.4 used JK flip flop

Q2) 8-bit adder using shift registers and a full adder.

In above circuit it will require 8 clock pulses for complete addition Y= A+B

If we use a FA which is capable of adding more no. of bits then cosequently no. of clock pulses required will reduce proportionally

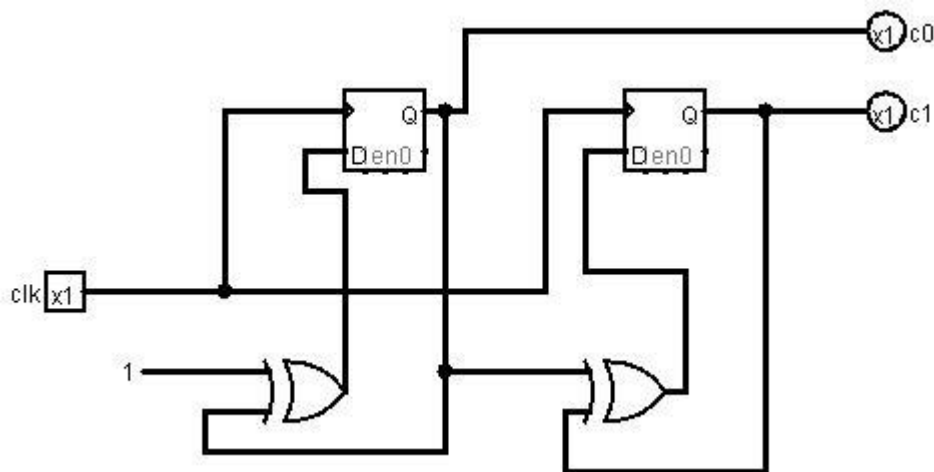**Q3)** 4-bit counter using two 2-bit counters.

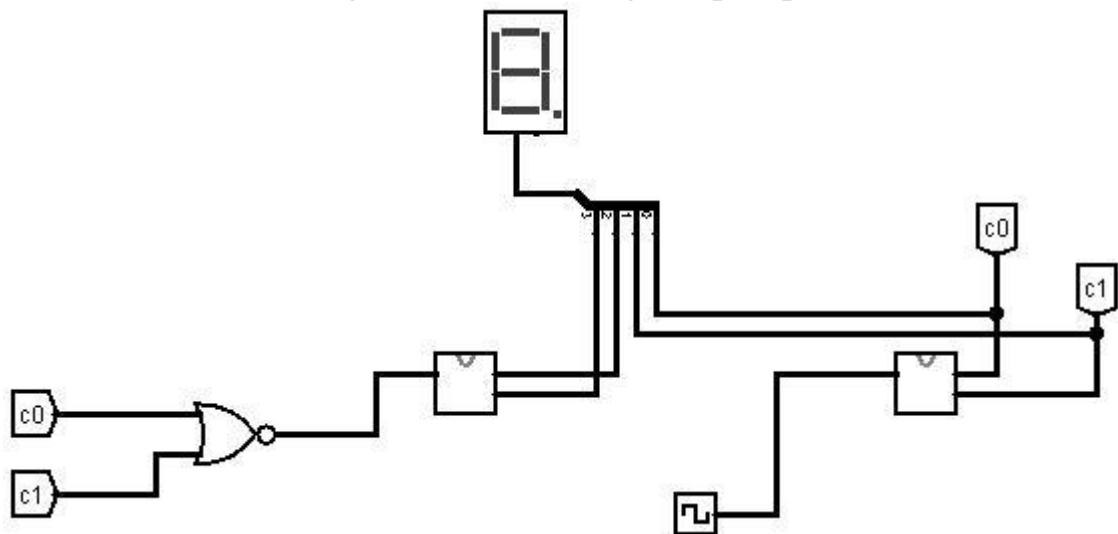
Fig 2bit counter using d flip flop

Fig 4 bit counter using two 2 bit counters

Just for the counter representing Most significant bits we have to reduce frequency to $\frac{1}{4}$ of the other. This can be done if clock for the MSB counter is made by taking a NOR of two LSBs.