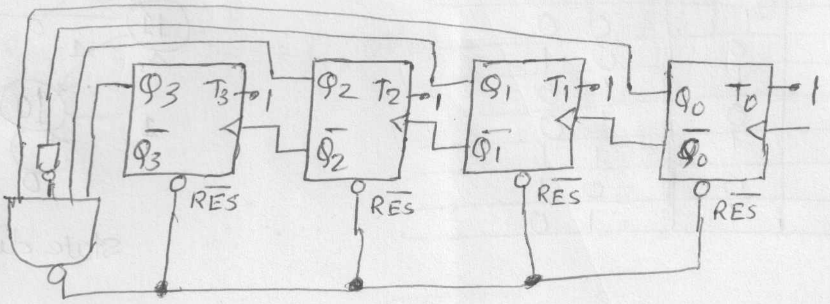
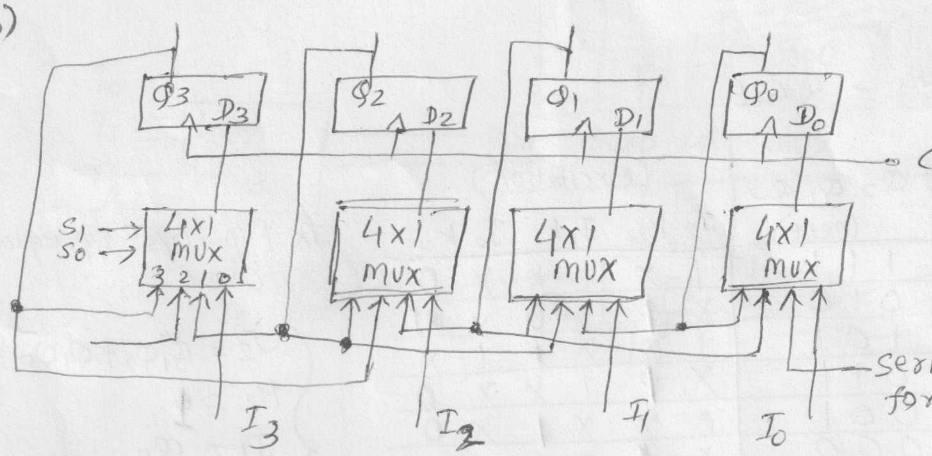
SOLUTION: B.Tech (II) CO, 3rd sem. , Endsem Exam ~~May~~ Dec. 2014

Q.3(a)

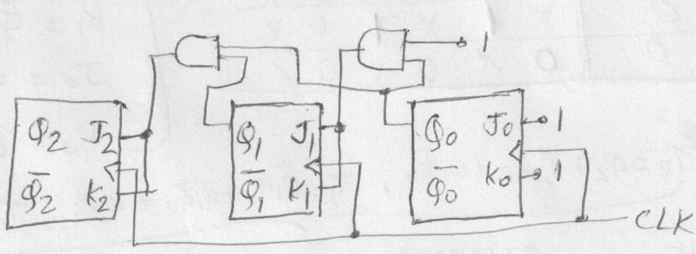
Mod-13 counter → 0, 1, 2, ..., 12, 0, 1, 2, ...
We reset counter when count 13 occurs.



(b)



(c)



t_{ff} → F/F delay

t_{pd} → AND gate delay

$T_{c,min} = t_{ff} + t_{pd}$

(d)

Since sequence length $L = 8$, we need at least 4 flip-flops

Q_0	Q_1	Q_2	Q_3	D_0
0	1	0	1	1
1	0	1	0	0
0	1	0	1	0
0	0	1	0	0
1	0	0	1	1
1	1	0	0	0
0	1	1	0	1
1	0	1	1	0

state 0101 gives two different values of D_0. Therefore Seq. ~~can't~~ can't be generated with 4 flip flop.
By adding one flip-flop (Q_4) we get all distinct states. Hence seq. can be generated.

K map for D_0

Q_0Q_1 \ $Q_2Q_3Q_4$	000	001	011	010	110	111	101	100
00	X	X	X	X	X	X	1	X
01	X	X	1	0	X	X	X	1
11	X	0	X	X	X	X	X	X
10	X	X	X	1	0	X	0	X

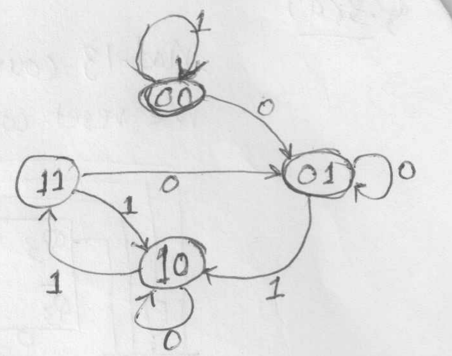
$$\boxed{D_0 = \overline{Q_0}Q_2 + Q_3\overline{Q_4} + \overline{Q_1}\,\overline{Q_2}}$$

OR

$$D_0 = \overline{Q_0}Q_4 + \overline{Q_3}\,\overline{Q_4} + \overline{Q_1}\,\overline{Q_2}$$

(e)

Present state A	B	i/p x	Next state A(t+1)	B(t+1)
0	0	0	0	1
0	0	1	0	0
0	1	0	0	1
0	1	1	1	0
1	0	0	1	0
1	0	1	1	1
1	1	0	0	1
1	1	1	1	0



State diagram.

Q.4(a)

Unused states → 4, 6, 0

$Q_2 Q_1 Q_0$ (Present)	$Q_2 Q_1 Q_0$ (next)	J_2	K_2	J_1	K_1	J_0	K_0
001	111	1	X	1	X	X	ϕ
111	010	X	ϕ	X	0	X	ϕ1
010	101	1	X	X	ϕ	1	X
101	011	X	ϕ	1	X	X	ϕ
011	001	0	X	X	ϕ	X	ϕ
100	000	X	ϕ	0	X	0	X
110	000	X	ϕ	X	ϕ	0	X
000	000	ϕ	X	0	X	0	X

(excitation)

JK Flip-flops i/p equations are:

$$J_2 = \bar{Q}_1 Q_0 + Q_1 \bar{Q}_0 = Q_1 \oplus Q_0$$
$$K_2 = 1$$
$$J_1 = Q_0$$
$$K_1 = \bar{Q}_2 + \bar{Q}_0$$
$$J_0 = \overline{Q_1 Q_0}$$
$$K_0 = Q_2 Q_1$$

With T-FF:

$T_2 = Q_2 + \bar{Q}_1 Q_0 + Q_1 \bar{Q}_0$, $T_1 = \bar{Q}_1 Q_0 + Q_1 \bar{Q}_0 + \bar{Q}_2 Q_1$, $T_0 = \bar{Q}_2 Q_1$

(c)

Co-efficient: sign, ← 15 →

exponent: sign, ← 9 →

Radix point in co-efficient is located at after sign bit.

(i) for positive normalized fraction digit after sign bit has to be non zero.

$$\text{Smallest quantity} = 0.100\ldots0 \times 2^{-255} = 2^{-256}$$

$$\text{Largest quantity} = 0.11\ldots1 \times 2^{255}$$

(ii) $(23.25)_{10}$ = 0 101110100000000 0 00000101

$-(67.125)_{10}$ = 1 100001100100000 0 00000111

OR

(c) (i)

$$
\begin{array}{r}
{\scriptstyle 0\,1\quad\;\; 1\,1} \\
0\,1000100 \rightarrow +68 \\
0\,1001000 \rightarrow +76 \\
\hline
1\,0010000
\end{array}
$$

$C_{in,s} = 1$, $C_{out,s} = 0$, $OV=1$

$S=1$

$$
\begin{array}{r}
{\scriptstyle 0\;\;0\qquad 1} \\
0\,1000100 \\
+\;1\,0110100 \rightarrow \text{2's comp of 76} \\
\hline
1\,1111000
\end{array}
$$

$C_{in,s}=0$, $C_{out,s}=0$, $OV=0$, $S=1$

(d)