Q#01:

$\Rightarrow L_1 = \{[a^n]^m 0^m]^n \mid n, m \geq 0\}$

$S \rightarrow 0S1 \mid A$
$A \rightarrow 1S0 \mid \wedge$

$\Rightarrow L_2 = \{a^n b^m c^k d^l \mid n, m, k, l \geq 0, n = m + k\}$

$S \rightarrow AD$
$A \rightarrow aAb \mid aAc \mid \wedge$
$D \rightarrow dD \mid \wedge$

$S \rightarrow AD$
$A \rightarrow aAb \mid \wedge$
$C \rightarrow aCc \mid A$
$D \rightarrow dD \mid \wedge$

$\Rightarrow L_3 = \{a^n b^m c^k \mid n, m, k \geq 0 \text{ and } n = 2m + 3k\}$

$S \rightarrow aaSb \mid aaaSc \mid \wedge$

$\Rightarrow L_4 = \{a^n b^m \mid 0 \leq n \leq m \leq 2n\}$

$S \rightarrow aSb \mid aSbb \mid \wedge$

$\Rightarrow L_5 = \{a^n b^m \mid m \geq 2n\}$

$S \rightarrow aSbb \mid B$
$B \rightarrow bB \mid \wedge$

$\Rightarrow L_6 = \{a^n b^m \mid 2n \leq 2m \leq 3n, n > 0\}$

$S \rightarrow aA$
$A \rightarrow aAB_1 \mid B_2$
$B_1 \rightarrow b \mid bb$
$B_2 \rightarrow b \mid bB_2$

$\Rightarrow L_7 = \{a^i b^j c^k \mid i, j, k \geq 0 \text{ and } i = j + k\}$

$S \rightarrow aSc \mid B$
$B \rightarrow aBb \mid \wedge$

$\Rightarrow L_8 = \{a^i b^j c^k \mid i, j, k \geq 0 \text{ and } k = i + k\}$

$S \rightarrow aSc \mid B$
$B \rightarrow bBc \mid \wedge$

$\Rightarrow L_9 = \{a^i b^j c^k \mid i, j, k \geq 0 \text{ and } i \neq j + k\}$

$S_1 \rightarrow Ab \mid Ac$
$A \rightarrow aAB \mid \wedge$
$B \rightarrow b \mid c$

$S_2 \rightarrow aS \mid X$
$X \rightarrow aXB \mid \wedge$
$B \rightarrow b \mid c$

$S \rightarrow S_1 \mid S_2$

$\Rightarrow L_{10} = \{a^i b^j c^k \mid i,j,k \geq 0 \text{ and } k \neq i+k\}$

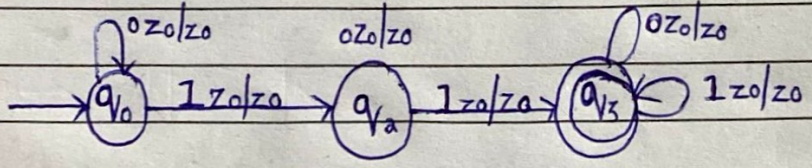
$S_1 \rightarrow aA$
$A \rightarrow aA \mid B$
$B \rightarrow bB \mid C$
$C \rightarrow cC \mid \wedge$

∵ In other word
$k \neq i+k$
$0 = i$ i cannot be zero

Q# 02:

1. $L = \{w \in [0,1]^* \mid w \text{ contains atleast three 1's}\}$

$S \rightarrow X1X1X1X$
$X \rightarrow 0X \mid 1X \mid \wedge$

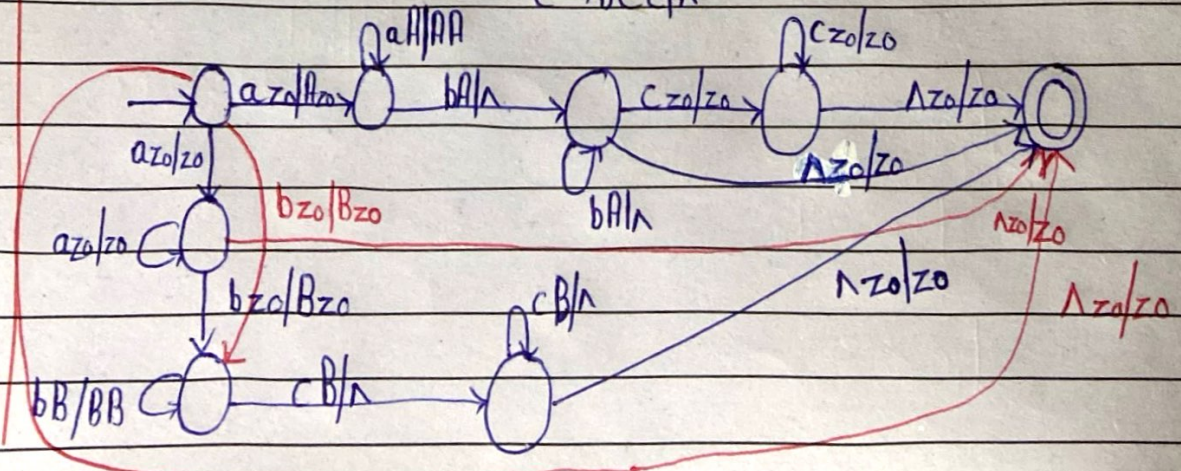


2. $L = \{a^i b^j c^k \mid i,j,k \geq 0 \text{ and } i=j \text{ or } j=k\}$

$S_1 = aS_1b \mid C$
$C = cC \mid \wedge$

$S_2 = AC$
$A \rightarrow aA \mid \wedge$
$C \rightarrow bCc \mid \wedge$

$S \rightarrow S_1 \mid S_2$

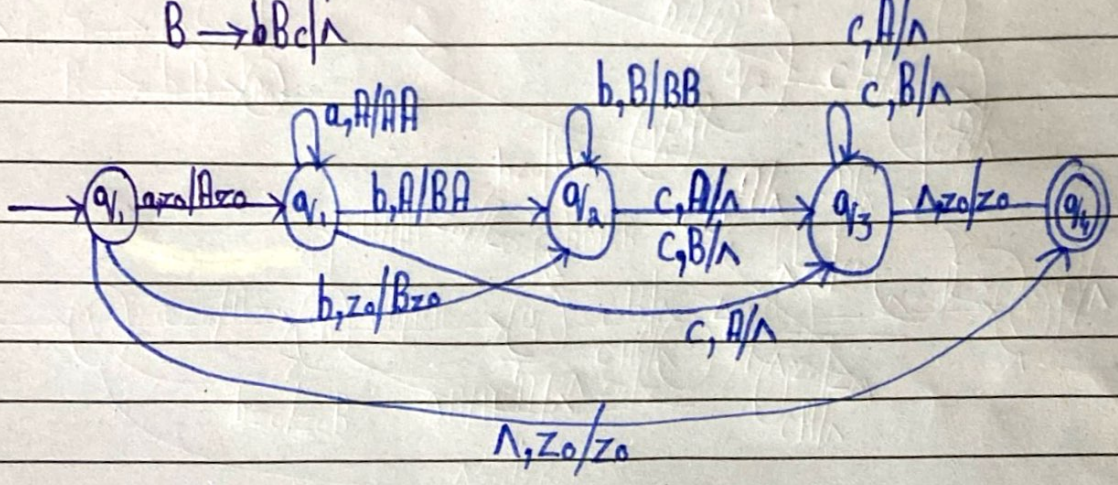


3.

$L=\{a^i b^j c^K \mid i,j,K \geq 0 \text{ and } K=i+j\}$

$S \rightarrow aSc \mid B$

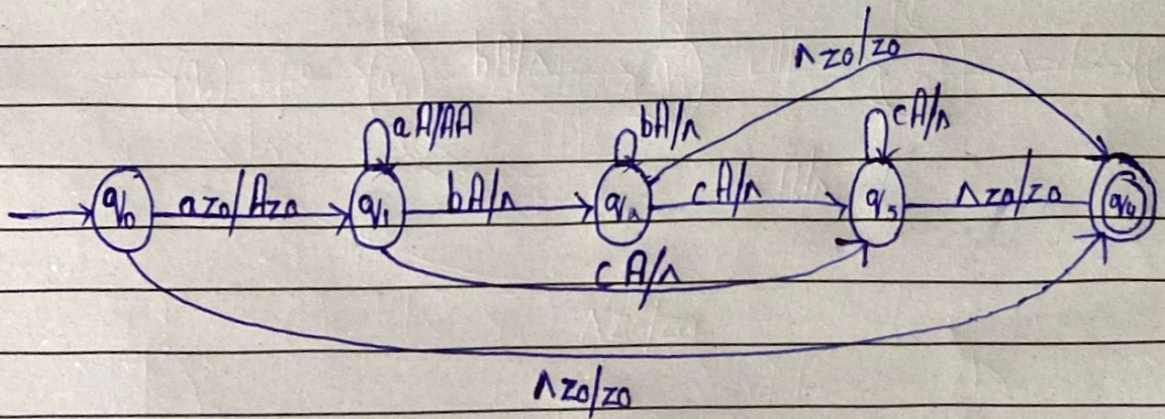
$B \rightarrow bBc \mid \wedge$



4. $\{a^i b^j c^K \mid i,j,K \geq 0 \text{ and } i=j+K\}$

$S \rightarrow aSc \mid B$

$B \rightarrow aBb \mid \wedge$

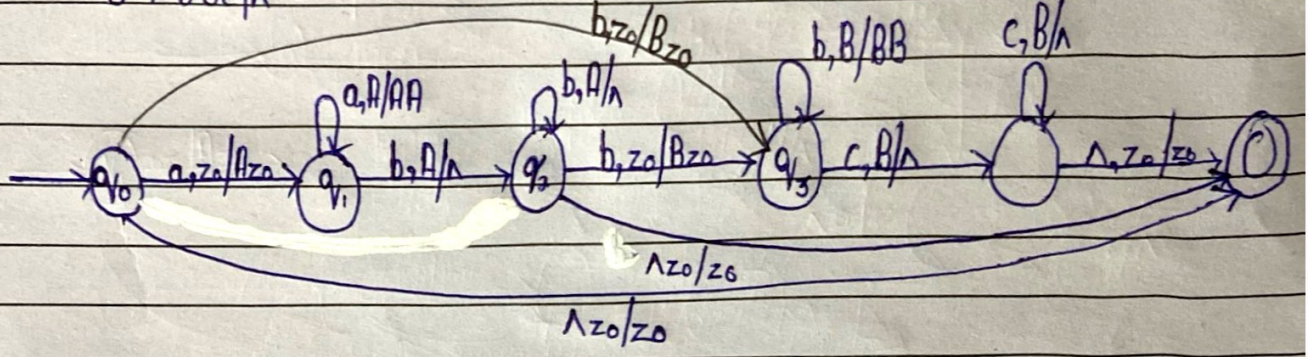


5.

$L=\{a^i b^j c^k \mid i,j,K \geq 0 \text{ and } j=i+K\}$

$S \to AB$
$A \to aAb \mid \Lambda$
$B \to bBc \mid \Lambda$

$S \to aSbX \mid \Lambda$
$X \to bXc \mid \Lambda$



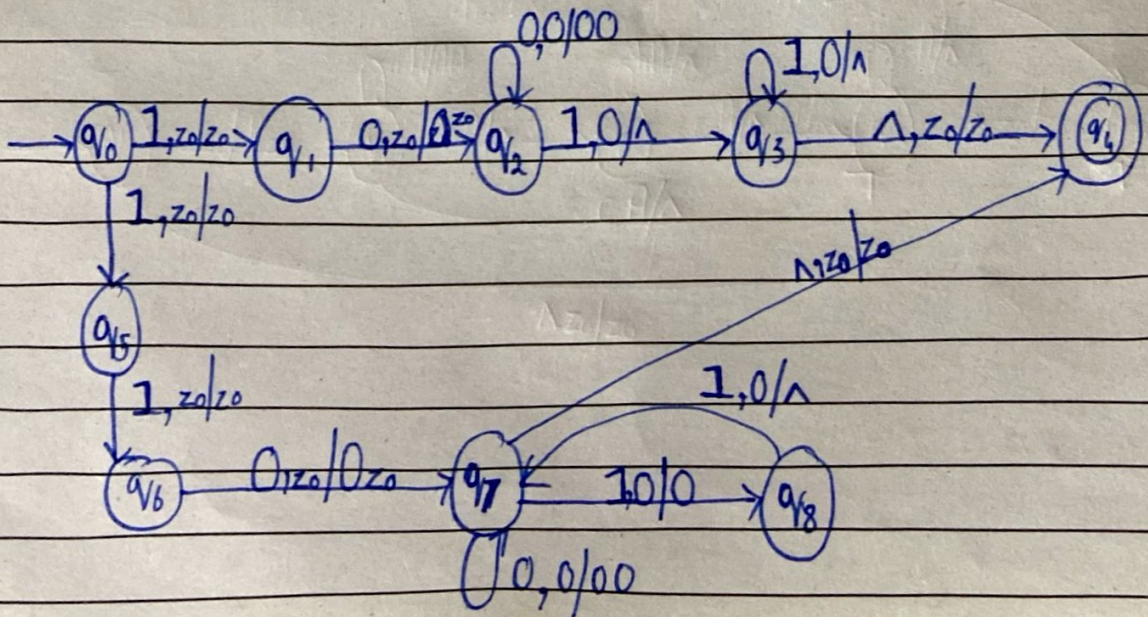
6.

$L=\{10^n 1^n \mid n>0\} \cup \{110^n 1^{2n} \mid n>0\}$

$S_1 \to 1X_1$
$X_1 \to 0X_1 1 \mid 01$

$S_2 \to 11X_2$
$X_2 \to 0X_2 11 \mid 011$

$S \to S_1 \mid S_2$

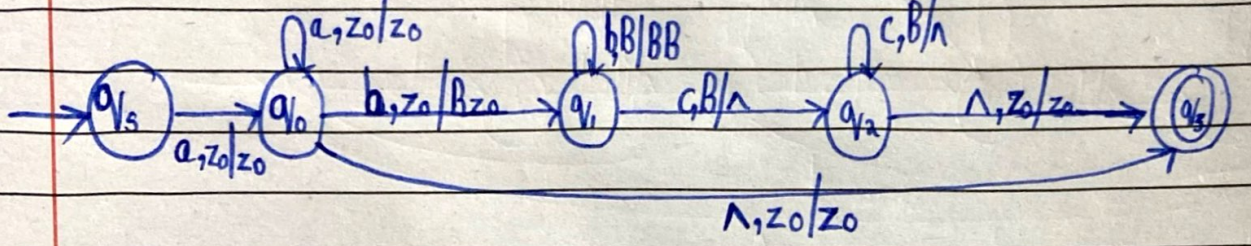


7.

$$L=\{a^n b^m c^m \mid n\geq 0, m\geq 0\}$$

$S \to aX \mid aS$
$X \to bXc \mid \Lambda$

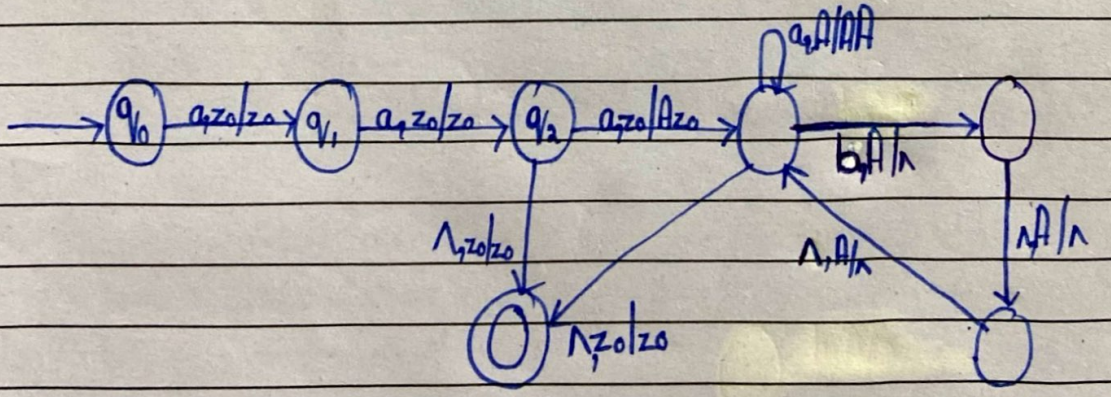
$S \to AB$
$A \to a \mid aA$
$B \to bBc \mid \Lambda$



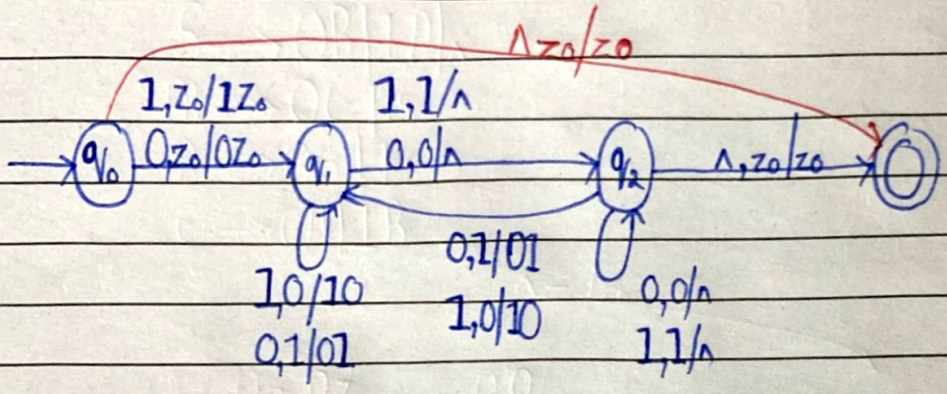
8.

$$L=\{a^i b^j \mid i=3j+2\}$$

$S \to aaX$
$X \to aaaXb \mid \Lambda$



9 $\{w \in [0,1]^* \mid$ no of 0's and 1's are even$\}$



$S \rightarrow 0B|1A|\wedge$
$B \rightarrow 0S|1C$
$A \rightarrow 0C|1S$
$C \rightarrow 0A|1B$

10 Binary string start and end with same symbol and no of 0's = no of 1's

$S \rightarrow 1X0X0X1|0X1X1X0$
$X \rightarrow X1X0X|X0X1X|\wedge$