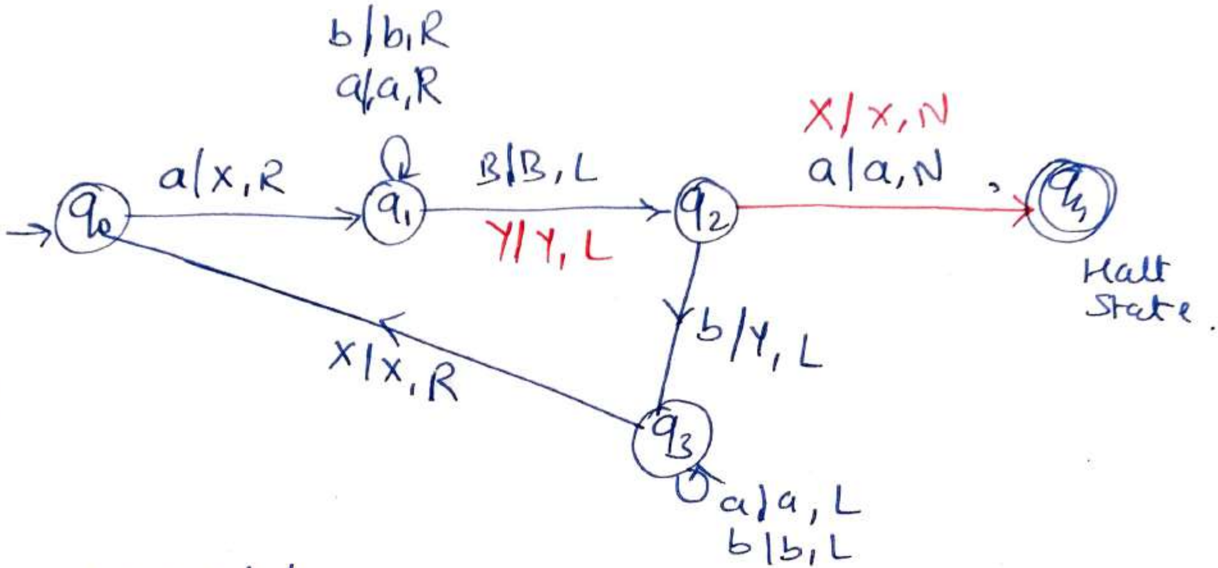
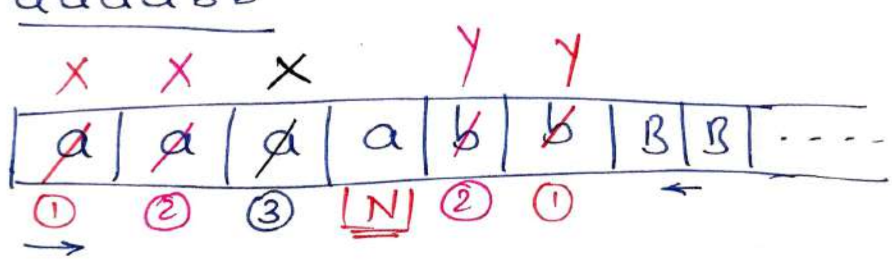
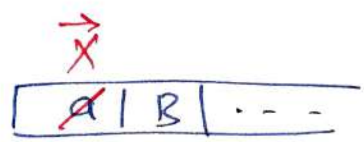
(5) $L = \{a^n b^m \mid n > m\}$



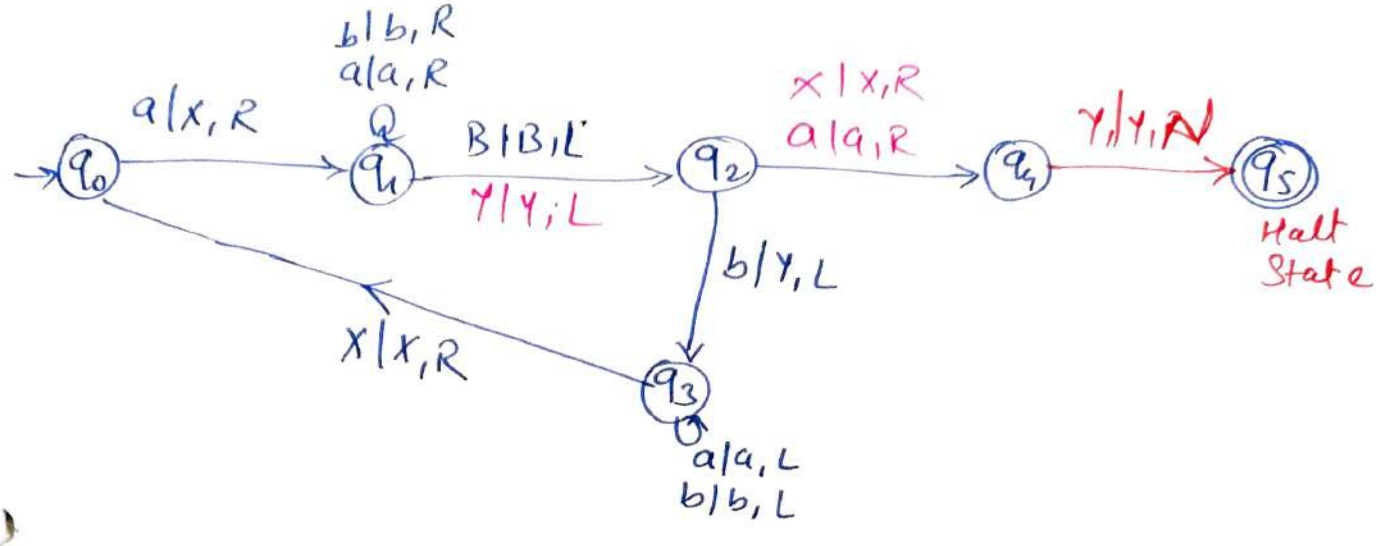

(1) $w = aaaabb$



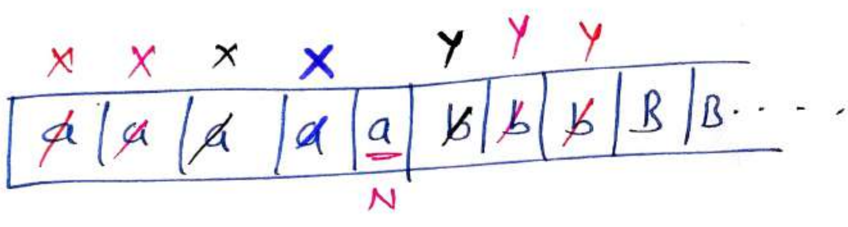

(2) $w = a$



⑥ $L = \{a^n b^m \mid n > m ; n, m \geq 1\}$

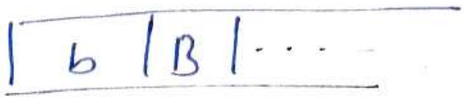



w = aaaaabbb

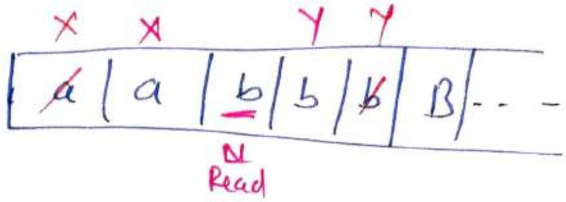


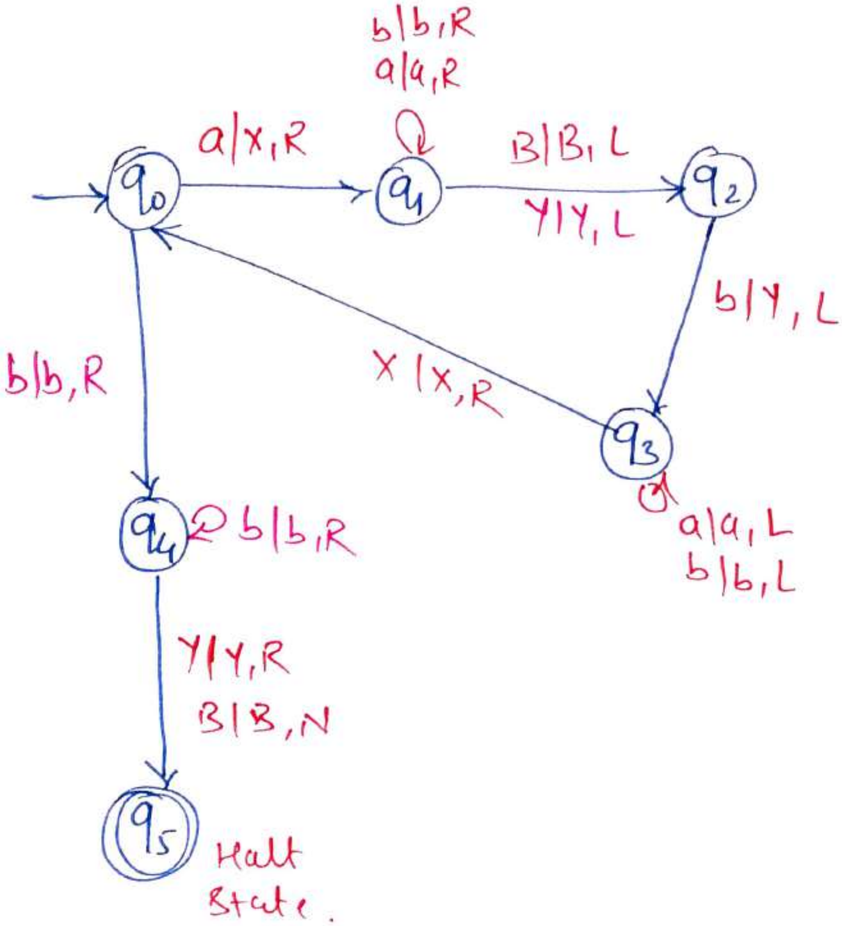
7 $L = \{ a^n b^m \mid n < m \}$

$\Rightarrow$ $a = 0$, $b = 1$




$a = 2$, $b = 3$




$M = \{ Q, \Sigma, \delta, q_0, F, \Gamma, B \}$

$Q = \{ q_0, q_1, q_2, q_3, q_4, q_5 \}$ ; $F = \{ q_5 \}$

$\Sigma = \{ a, b \}$ ; $\Gamma = \{ a, b, \cancel{B} X, Y, B \}$

Processing Sequence for w = aabbb

aabbbB ⊢ XabbbB ⊢ XabbbB ⊢ XabbbB

$q_0$ $\quad$ $q_1$ $\quad$ $q_1$ $\quad$ $q_1$

XabbbB ⊢ XabbbB ⊢ XabbbB ⊢ XabbYB ⊢

$q_1$ $\quad$ $q_1$ $\quad$ $q_2$ $\quad$ $q_3$

XabbYB ⊢ XabbYB ⊢ XabbYB ⊢ XabbYB ⊢

$q_3$ $\quad$ $q_3$ $\quad$ $q_3$ $\quad$ $q_0$

XXbbYB ⊢ XXbbYB ⊢ XXbbYB ⊢ XXbbYB ⊢

$q_4$ $\quad$ $q_2$

XXbYYB ⊢ XXbYYB ⊢ XXbYYB ⊢ XXbYYB

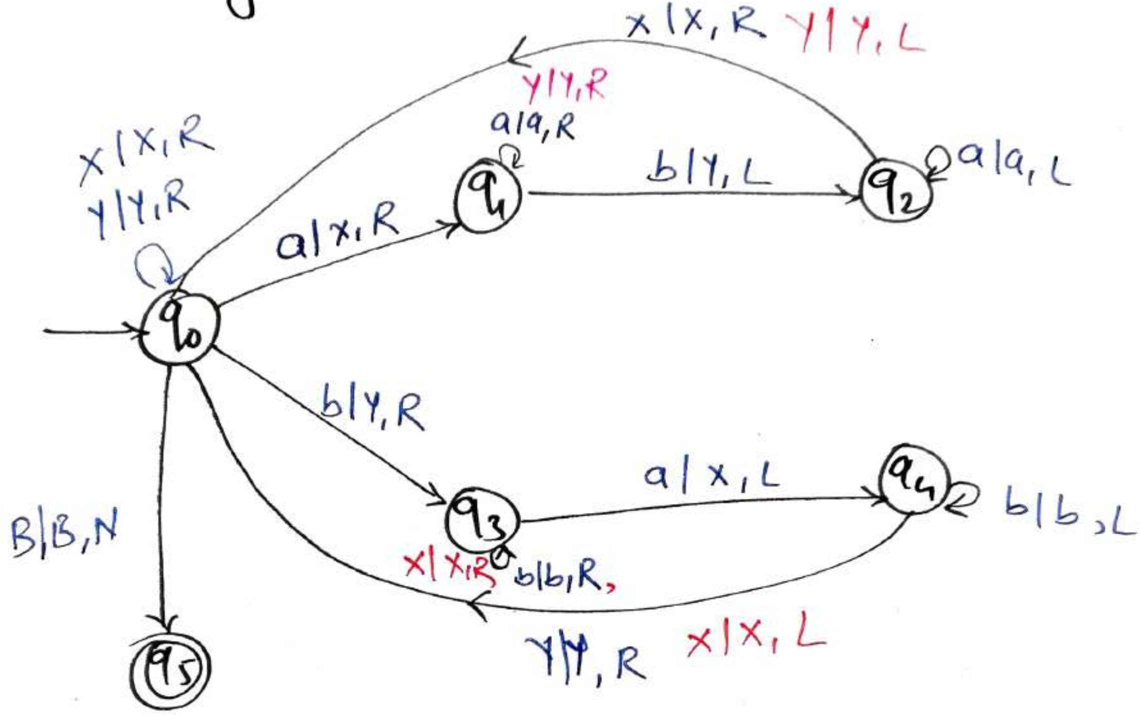
$q_3$ $\quad$ $q_3$ $\quad$ $q_4$ $\quad$ $q_5$

⊢ XXbYYB

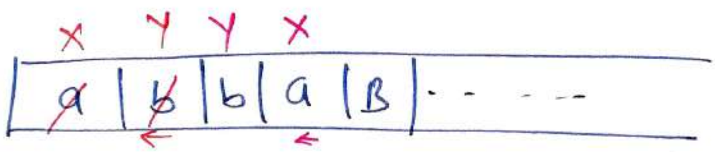
$q_5$ Accept

(8) Design a TM to check whether a string over $\{a, b\}$, contains equal no. of a's & b's.

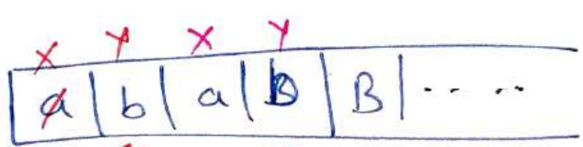
$\Rightarrow$ Initially a (or) b can be there.



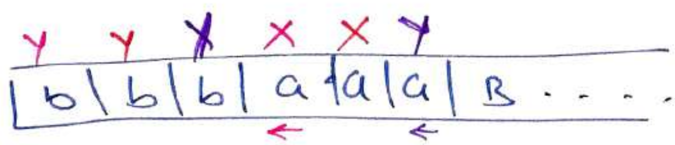

(1)



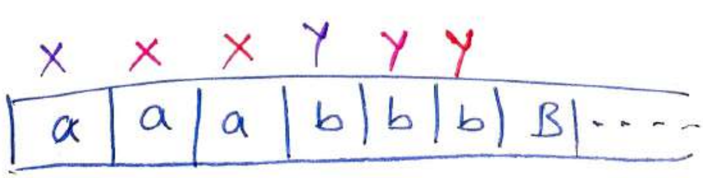

(2)




(3)

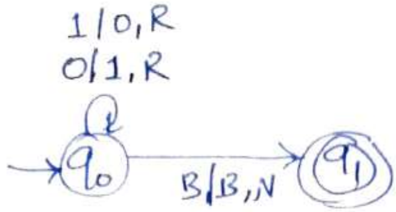



(4)



(9) Construct a TM for 1's complement.

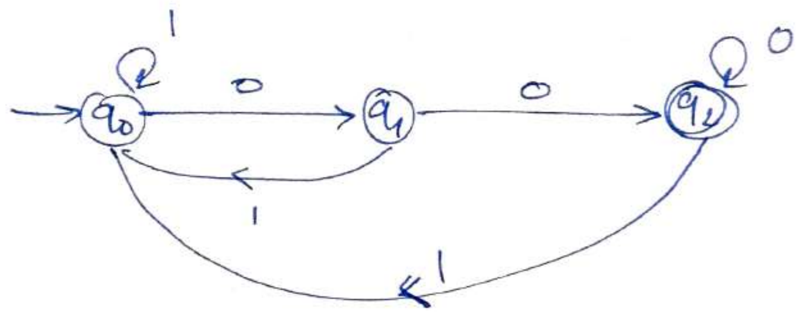
⇒



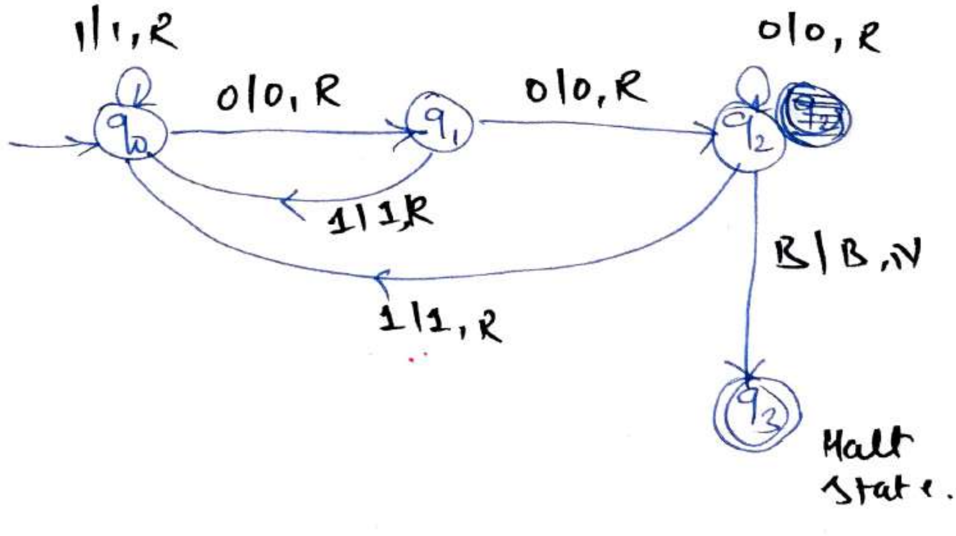

(10) Construct a TM that recognizes the language

$L = \{ x \in \{0,1\}^* \mid x \text{ ends in } 00 \}$

⇒ DFA

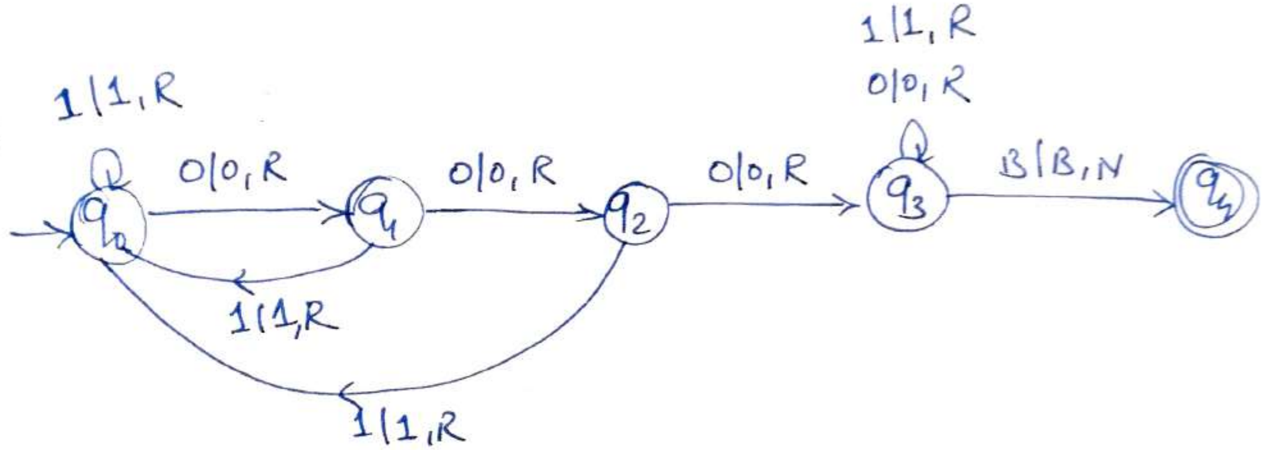



TM



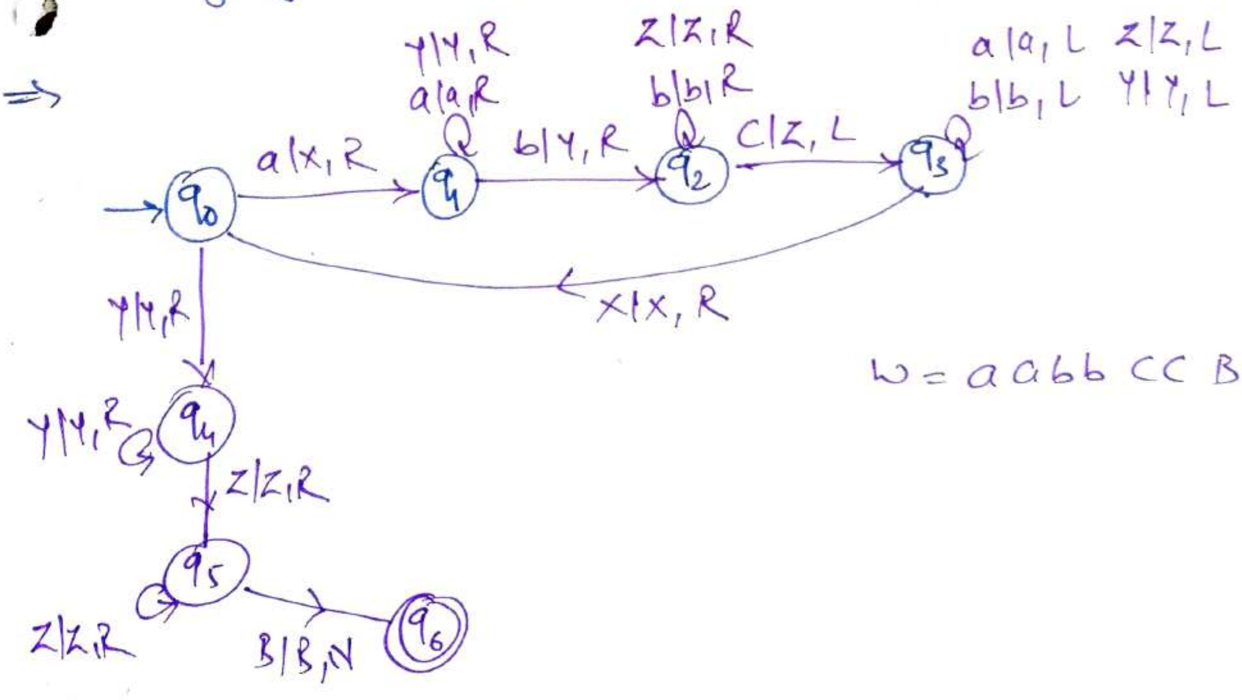
(11) Design a TM to accept strings formed with 0 & 1 that have the substring 000.

⇒ To accept strings with substrings 000, the TM would be similar to the FA constructed for same language.




(12) Design a TM for accepting strings of a language $L = \{a^n b^n c^n \mid n \geq 1\}$

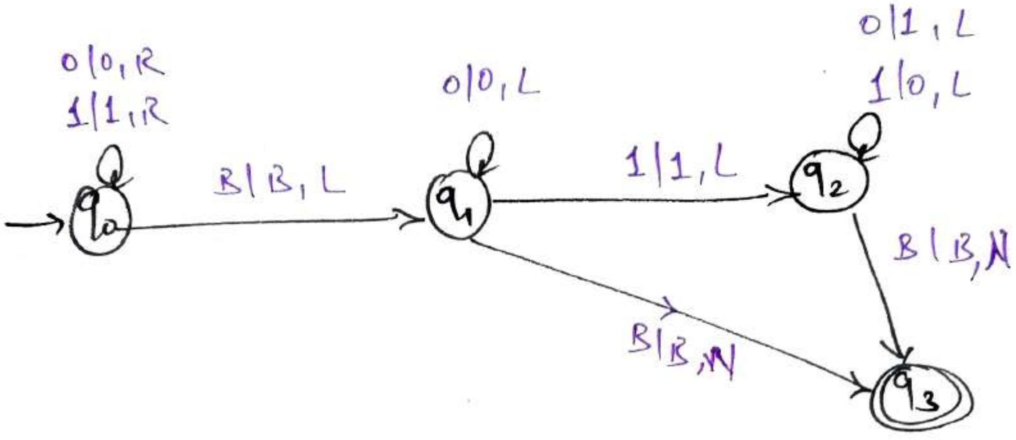
⇒




w = aabbCCB

⑫ Construct TM for 2's complement of binary no.

⇒




① | B | 0 | B .. ⇒ 2's ⇒ 0

② | B | 1 | B .. ⇒ 2's ⇒ 1

③ B | 1 | 0 | 1 | 1 | B ⇒ 2's ⇒ 0 1 0 1 B

0 1 ↑ ↑ ↑

0 1 0 1 B

1011
0100 ⇒ 1's
0101 ⇒ 2's

(13) Design a TM to make a copy of string over {0, 1}

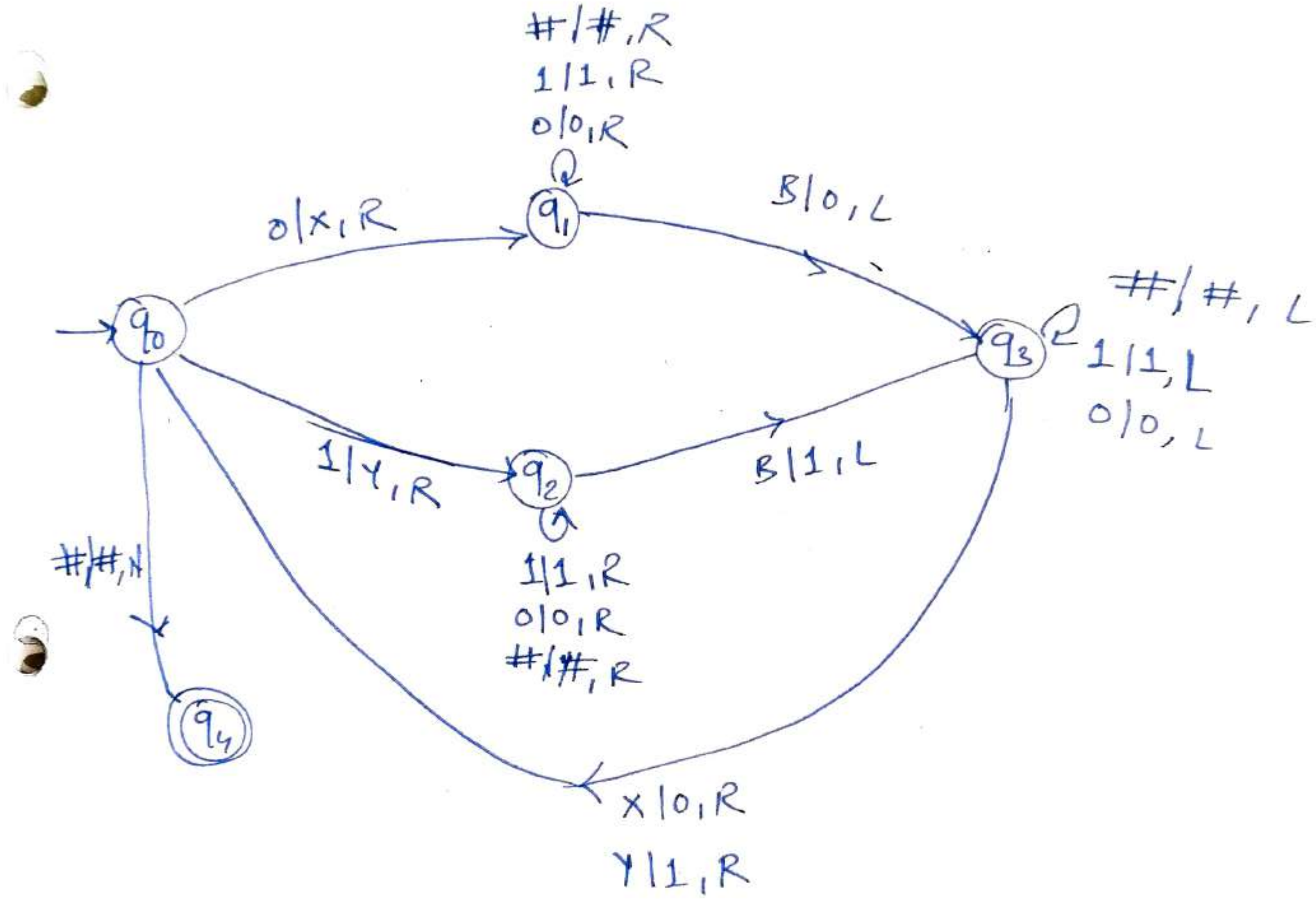
⇒ I/P:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| B | 1 | 1 | 0 | 0 | # | B | ... |

O/P:

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| B | 1 | 1 | 0 | 0 | # | 1 | 1 | 0 | 0 | B | ... |

⇒ Two copies are seperated by #




⇒ First input & Blank 'B' should be updated then again update the X & Y inputs.

| | | | | | |
|---|---|---|---|---|---|
| B | 0 | 1 | 1 | # | B |

| | | | | | |
|---|---|---|---|---|---|
| B | X | 1 | 1 | # | 0 |

| | | | | | |
|---|---|---|---|---|---|
| X | 1 | 1 | # | 0 | B |

| | | | | | |
|---|---|---|---|---|---|
| 0 | 1 | 1 | # | 0 | B |

| | | | | | | |
|---|---|---|---|---|---|---|
| 0 | Y | 1 | # | 0 | 1 | B |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0 | 1 | Y | # | 0 | 1 | 1 | B |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0 | 1 | 1 | # | 0 | 1 | 1 | B |

(14) Construct a TM for checking well formness of parenthesis.

⇒ To solve this, we need to match every occurence of "(" for every occurence of ")". At the end if any parenthesis is unmatched then the given string is declared not balanced.

(1) First search for the occurence of ")", for this process, in the initial state $q_0$ ignore all "(" until ")" is seen.

$$\delta(q_0, () = (q_0, (, R)$$

(2) On the occurence / finding ")" replace it by 'X' change to new state & travel left for the first occurence of "(". It is used to find "(" for ")" while travelling back it can see 'X'.

$$\delta(q_0, )) = (q_1, X, L)$$
$$\delta(q_1, X) = (q_1, X, L)$$

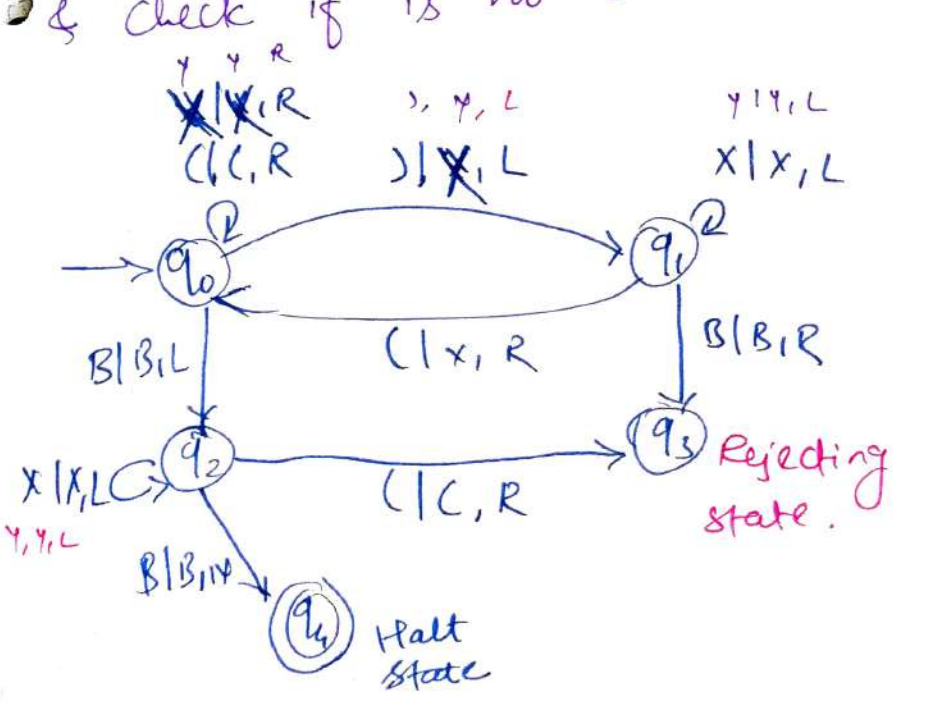
③ If "(" is found, replace it by 'X', If X is not found, enter into rejecting state. In this for ex. $q_1$ acts as both initial state & return state

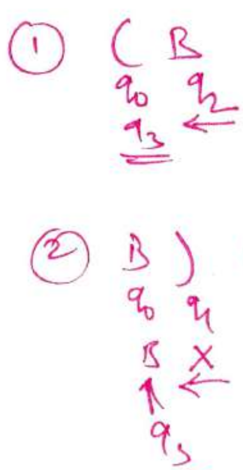
$$\delta(q_1, ( ) = (q_0, X, R)$$
$$\delta(q_1, B) = (q_3, B, R)$$

④ Repeat step 1 & 2 until a B is encountered.

$$\delta(q_0, X) = (q_0, X, R)$$
$$\delta(q_0, B) = (q_2, B, L)$$

⑤ If B is encountered enter into a new state & check if is no "(" unbalanced.



( ( ) ) ( ) B

$q_0$ $q_0$

( ( ) ) ( ) B

$q_0$

( ( X ) ( ) B

$q_1$ ←

( X X ) ( ) B

→ $q_0$

( X X ) ( ) B

$q_0$

( X X X ( ) B

$q_1$ $q_1$ $q_1$

X X X X ( ) B

$q_0$ $q_0$ $q_0$

X X X X ( ) B

$q_0$ $q_0$

X X X X ( X B

$q_1$ ← $q_0$

B X X X X X X B

← $q_0$

←

B X X X X X X B ←

$q_1$ $q_2$ $q_2$ $q_2$ $q_2$ $q_2$ $q_2$