**COMPUTER ENGINEERING DEPARTMENT**

**ASSIGNMENT NO-09**

**Sub: Theory of Computer Science**

COURSE: T.E. Year: 2020-2021 Semester: V
DEPT: Computer Engineering
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Class: TE-Comps B Date of Submission: 25/11/2020

**Tutorial 9**

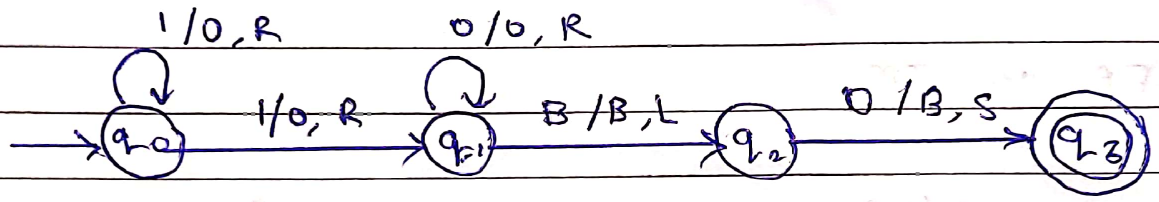
1. Design TM to add two binary numbers, and simulate"110+10"
2. Design TM as an acceptor for the language L= {$a^n b^m$| m>=0and m>=n}
3. Design Turing machine to replace the substring "111" by "101" from a sequence of 0's and 1's
4. Design TM for the regular expression 0(0+1)*11

Q.1. Design TM to add two binary numbers and simulate "110+10".

Ans:

000000100

- Bypass all zeros and head movements towards right to search for 1.
- When we get the 1 replace it with 0 and move right till blank symbol.
- After getting B head movement towards left and replace the last 0 to blank




000000100 B

$q_0$ 000000100 B

0 $q_0$ 00000100 B

0 0 $q_0$ 0000100 B

0 0 0 $q_0$ 000100 B

0 0 0 0 $q_0$ 00100 B

0 0 0 0 0 $q_0$ 0100 B

0 0 0 0 0 0 $q_0$ 100 B

0 0 0 0 0 0 0 $q_0$ 00 B

0 0 0 0 0 0 0 0 $q_1$ 0 B

0 0 0 0 0 0 0 0 0 $q_1$ B

0 0 0 0 0 0 0 0 0 $q_2$ B

0 0 0 0 0 0 0 0 $q_2$ 0 B

0 0 0 0 0 0 0 0 B $q_3$

- $q_1$ is for Binary but upto this step it is correct after that write 1 stat as 6 zero are represented in binary as 110 and 00 as 10 so addition is 1000 and output of simulation is 8 zeros represented as 1000 in binary

Q.2. Turing machine for the language $L = \{a^n b^m \mid m \geq 0 \text{ and } m > n\}$

Sol^n:

The language becomes,

$L = \{abb, aabbb, aaabbbb, aaaabbbbb, \ldots\}$

Logic:

- Each a is replaced by X and head movement towards right till b.
- Each b is replaced by Y and head movement towards left till X.
- Repeat above two steps till all a's and b's are over.
- For last b make it Blank

Implementation:

Let $M = (Q, \Sigma, \Gamma, \delta, B, F, q_0)$

where,

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

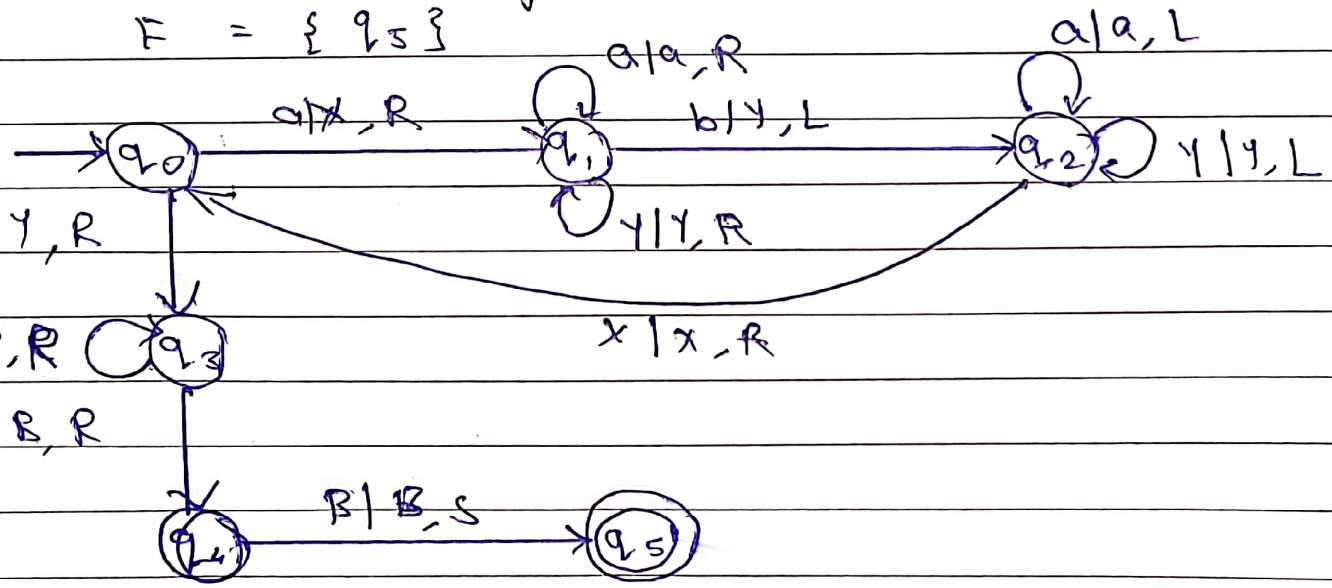
$\Sigma = \{a, b\}$

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

$q_0$ = Initial state

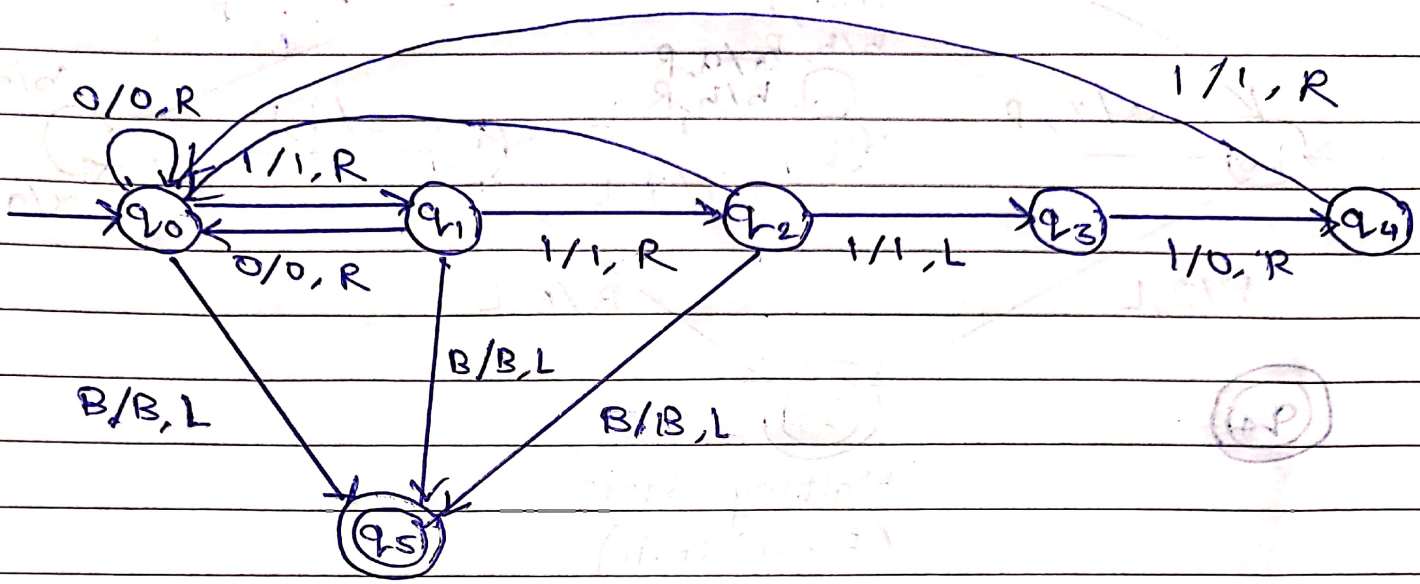
$B$ = Blank symbol

$F = \{q_5\}$



Q.3. Design Turing Machine to replace the substring 111 by 101 from a sequence of 0s and 1s.

Ans:




The TM M is given by

$M = (Q, \Sigma, \Gamma, \delta, q_0, B, F)$

where,

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

$\Sigma = \{0, 1\}$

$\Gamma = \{0, 1, B\}$

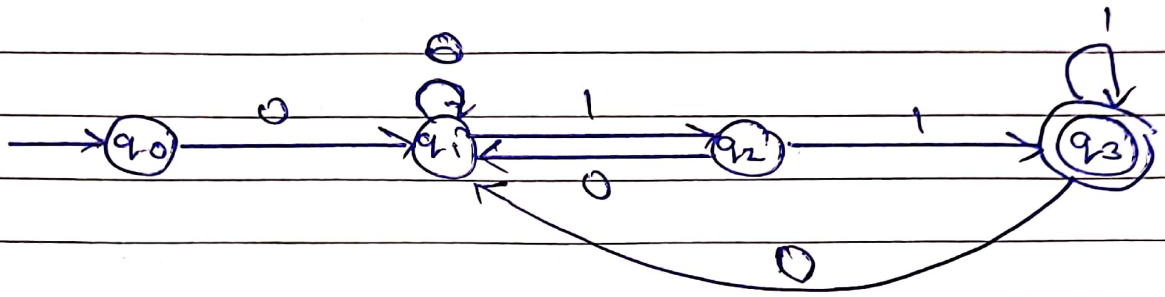
$q_0$ = Initial state

$F = \{q_5\}$

Q.4. Design TM for the regular expression $0(0+1)^* 11$

Ans:

(i) First, we can design an FA to recognize a string with 0 and ending in 11.




(ii) From FA to TM