[This question paper contains 4 printed pages.]

**Sr. No. of Question Paper : 779** **G** **Your Roll No.....**

Unique Paper Code : 234501

Name of the Paper : Theory of Computation (CSHT-511)

Name of the Course : **B.Sc. (H) Computer Science**

Semester : V

Duration : 3 Hours Maximum Marks : 75

**Instructions for Candidates**

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. **All** questions from **Part A** is compulsory and attempt any **four** questions from **Part B.**
3. Assume $\Sigma = \{a,b\}$ is the underlying alphabet unless mentioned otherwise. Parts of a question must be answered together.

## PART A

1. (a) Prove that for all sets S, $(S^+)^+=S^+$. (2)

   (b) Give regular expression for the language of all words that have at least two a's in them. (2)

   (c) Consider the language PALINDROME over the alphabet {a b}. Prove that if x is in PALINDROME then so is $x^n$ for any n. (3)

   (d) Show that (a*+b)* and (a+b)* defines the same language over alphabet {a b}. (3)

   (e) Build an FA that accepts only those words that have more than four letters. (3)

(f) Build FA for the regular expression (a+b)b(a+b)*. (3)

(g) Find a CFG for the language defined by regular expression (baa + abb)*. (3)

(h) Use the pumping lemma to show that the language $\{a^n b^n a^n$ n= 1 2 3...$\}$ is non regular. (4)

(i) Show that if L1 and L2 are regular languages, then so are $L_1 + L_2$, $L_1L_2$ and $L_1$*. (4)

(j) Construct a PDA for the language L = $\{a^{2n}b^n$ n=0 1 2 3 ...$\}$. (4)

(k) Explain the Church Turing Thesis. (4)

## PART B

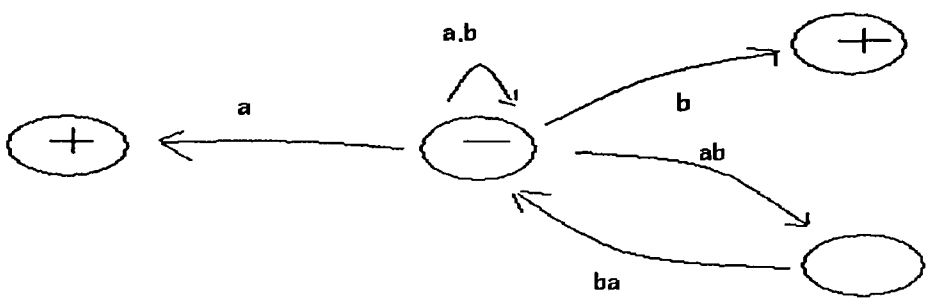
2. (a) Define Finite Automata. (2)

(b) Build a regular expression for all words that have exactly two b's or exactly three b's not more. (3)

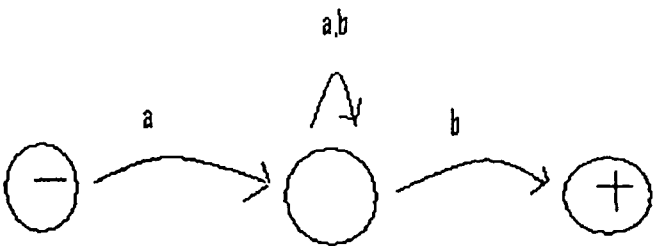
(c) Build an FA that accepts only those words that begin or end with double letter. (5)

3. (a) Define Non Deterministic Finite Automaton. (2)

(b) Convert the following Transition graph into regular expression. (4)



(c) Convert the following NFA into DFA : (4)




4. (a) For the given languages L1 = (a+b)b(a+b)* and L2 = b(a+b)*, find regular expression and finite automata that define $L_1 \cap L_2$. (5)

(b) Use pumping lemma to show that language $\{a^{2n}b^n\ n = 1\ 2\ 3\ ...\}$ is non regular. (5)

5. (a) Construct a CFG for the language L = $\{a^m b^n\ n>m,\ m,\ n>=1\}$. (5)

(b) Construct a PDA for the language L = $(a^n bb^n\ n=1\ 2\ 3\ ...\}$. (5)

6. (a) State pumping lemma for context free languages. (2)

(b) Show that the family of context free languages is not closed under intersection. (4)

(c) Show that the language $\{a^n b^n a^n b^n a^n$ for $n = 1\ 2\ 3\ ...\}$ is non context free. (4)

7. (a) Define Turing Machine. (2)

(b) Prove that If L is a recursive language, then its compliment L' is also recursive. (4)

(c) Design a Turing Machine that provides output as a compliment of the given number which is provided to the machine as input in binary form over the alphabet {01}. (4)