(8)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1095 **I**

Unique Paper Code : 2342013502

Name of the Paper : Theory of Computation

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

Semester : V

Duration : 3 Hours Maximum Marks : 90

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. The paper has **two** sections. **Section A** is compulsory.
3. Attempt any **four** questions from **Section B**.
4. Part of the questions to be attempted together.
5. Assume $\Sigma = \{a, b\}$ is the underlying alphabet unless mentioned otherwise.

P.T.O.

Section A

1. (a) Prove that for all sets S, $(S^+)^* = (S^*)^*$. (3)

(b) Prove that if x is in PALINDROME then so is x^n for any n. (3)

(c) Construct a Regular expression for the language consisting of all words with exactly two a's. (3)

(d) Consider the language S*, where S = {aa, b}. How many words of this language have a length of 6? (3)

(e) Construct a Deterministic Finite Automata that accepts all strings from the language L = {all strings with odd number of b's}. (3)

(f) Determine whether the language L = { w | w = $a^m b^n$ and m, n ≥ 1} regular or not. Justify. (3)

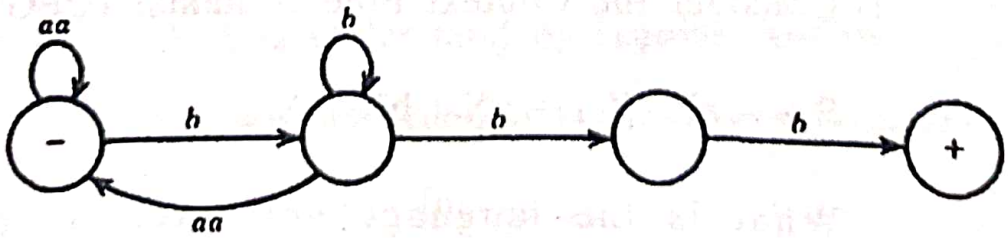
(g) Show that the complement of a context free language may or may not be context free. (4)

(h) Find the Context Free Language for language $L = \{aa^nb^nb \text{ where } n >= 0\}$. (4)

(i) Design a Turing machine for the language a(a+b)*. (4)

Section B

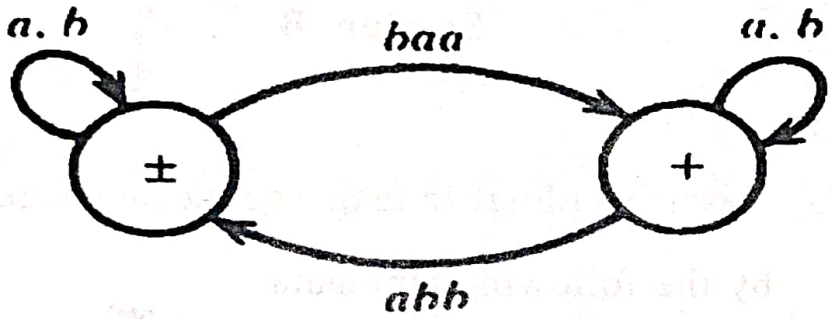
2. (a) Describein English language the language accepted by the following automata (2)



(b) Construct a regular expression for all words that contain two b's or exactly three b's. (3)

(c) Build a finite automata that accepts only those words that do not end with ba. (5)

(d) Convert the following Transition Graph into Regular Expression (5)



3. (a) Consider the Context Free Grammar (CFG):

S -> aX, X -> aX | bX | ^.

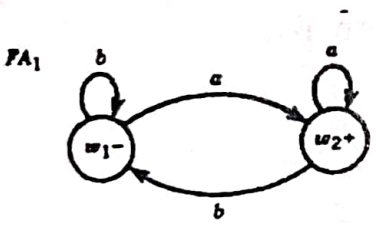
What is the language generated by above CFG? (3)

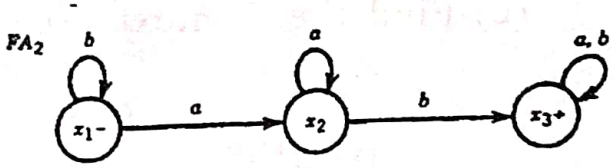
(b) What do you understand by Total language tree? Explain with an example. (6)

(c) Explain what this machine does. (6)

$$>R \xrightarrow{a \neq \sqcup} R \xrightarrow{b \neq \sqcup} R_{\sqcup}aR_{\sqcup}b$$

4. (a) For the following Finite Automata, find a finite automaton for $FA_1 \cup FA_2$. (5)





(b) What do you understand by regular language? If L_1 and L_2 are two regular languages, then so are $L_1 + L_2$ and L_1L_2. Justify your answer. (5)

(c) Convert the given Context Free Grammar into Chomsky Normal Form :

S - > aXX, X - > aS | bS | a (5)

5. (a) Construct a finite automata for $L_1 \cap L_2$ where $L_1 = (a+b)^*a$ and $L_2 = b(a+b)^*$. (5)

(b) Using pumping lemma show that the language $L = \{a^{n+1}b^n$ where n = 1 2 3 ...$\}$ is non regular. (5)

(c) Find the Context Free Grammar for

(i) a*b*

(ii) (ab+ba)* (5)

6. (a) Show that the Context Free Grammar,

S -> aSb | Sb | Sa | a is ambiguous. (5)

(b) Design a Push down automata for language $L = \{a^{2n}b^n$ where $n = 0, 1, 2, 3...\}$. (5)

(c) Prove that the language $\{a^nb^na^nb^na^n$ where $n = 1\ 2\ 3\ 4\ ...\}$ is non context free. (5)

7. (a) Explain Church Turing thesis. (3)

(b) Consider the following Push Down Automata : (6)