(10)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 4379 **G**

Unique Paper Code : 32341502

Name of the Paper : Theory of Computation

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

Semester : V (Admissions 2019-2021)

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. Question No. **1** is compulsory.
3. Attempt any **four** of Question nos. **2** to **7**.
4. Parts of a Question must be answered together.
5. Consider $\Sigma = \{a, b\}$ for all the questions unless specified otherwise.

P.T.O.

1. (a) Let S = {ab, bb} and T = {ab, bb, bbbb}.

- Is $S^* \subset T^*$?
- Is $S^* = T^*$?

Explain. (

(b) Write a regular expression for the language, havi words with exactly one double letter in them. (

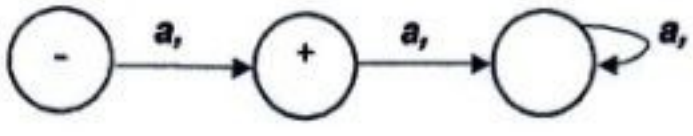
(c) Show that the language PRIME = {a^p, where p a prime} is non-regular. (

(d) Prove that the complement of a context-fr language may not be context-free. (

(e) (i) What are recursive languages?

(ii) State the Church-Turing thesis. (

(f) For the following Finite Automata that accepts the language L, draw a deterministic FA that accepts (i) L' (ii) L* (4)



(g) Determine whether the following CFG is ambiguous or not. Justify.

S -> aSX | Λ

X -> aX | a (4)

(h) Convert the following CFG to Chomsky Normal Form :

E -> E + E

E -> E * E

E -> (E)

E -> 7

The terminals are +, *, (,), 7 (4)

P.T.O.

(i) Design a deterministic PDA for the followi language: $a^n b^{n+1}$, n >= 1 (

(j) Design a deterministic finite automata that accep a string defined over the English alphabet {a- and ending with 'ied'. For instance, "died" wou be accepted, but not "dead". (

2. Consider the following languages

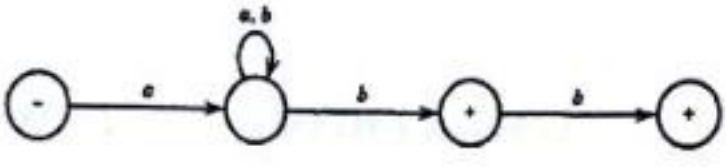
L_{11}: the language of all words that do not contain double a

L_{12}: the language of all words that do not contain double b and end in a

(a) Write a regular expression for each of L and L_{12}. Hence write a regular expression f $L_{11} \cup L_{12}$. (

(b) Draw a finite automata for each of L_{11} and L_{12}. Hence, systematically find a finite automata for $L_{11} \cap L_{12}$. (6)

3. (a) Convert the following non-deterministic finite automata to deterministic finite automata : (4)



(b) Design a Turing Machine that decides the language $L = \{a^n b^n c^{n+2} : n \geq 0\}$. (6)

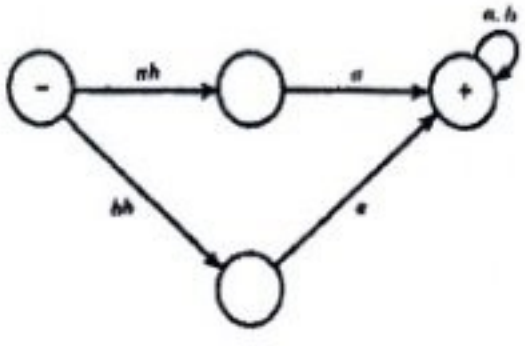
4. (a) Find a CFG for the language $L_4 = a(bb)^*$. Also, find a CFG for L_4^*. (4)

(b) Construct a deterministic PDA for the language L given below :

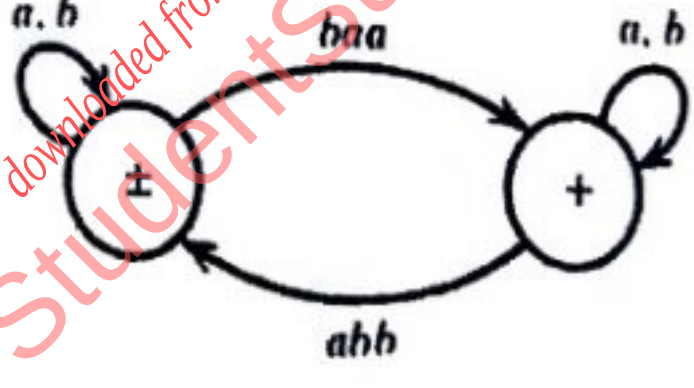
$L = \{a^m b^n \mid n >= 1, m >= 1, m > n+2\}$ (6)

P.T.O.

5. (a) (i) Convert the following Transition graph int regular expression :



(ii) Construct a TG for L* if L is defined by following TG:



(b) Show that the following language defined over alphabet {a, b} is not context free :

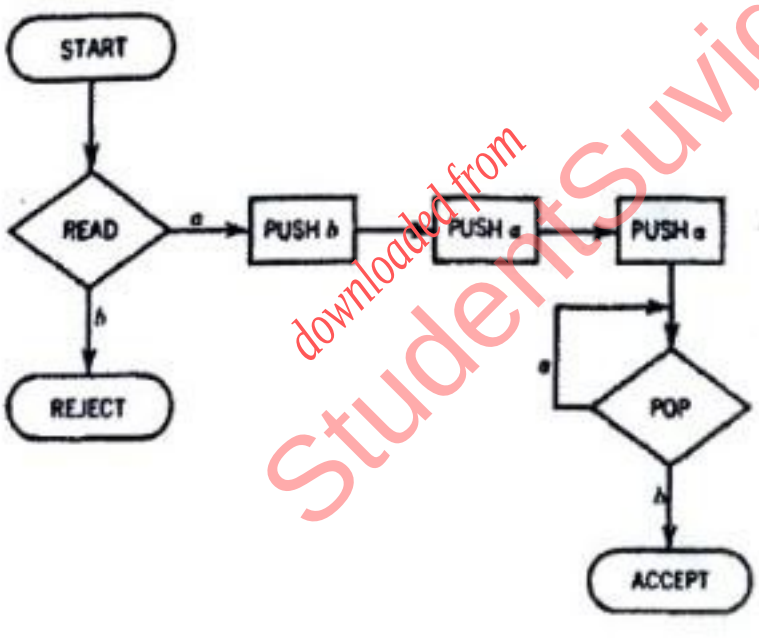
$a^n b^n a^n b^n$

6. (a) Build a finite automata that accepts the language of words having a double letter in them. (4)

(b) Prove that recursively enumerable languages are not closed under complementation. (4)

(c) What would be the length of the shortest string in the language mentioned in part (a) above? List the shortest strings. (2)

7. (a) Describe the language accepted by the following PDA and give its regular expression. (4)



P.T.O.

(b) Consider the following CFG :

S -> aAS, S -> a, A -> SbA, A -> SS, A -> ba

For the input string 'aabbaa', find

(i) leftmost derivation

(ii) parse tree (6)