

This question paper contains 4 printed pages]

Roll No.

--	--	--	--	--	--	--	--	--	--	--

S. No. of Question Paper : 52

Unique Paper Code : 32341502

I

Name of the Paper : Theory of Computation

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

Semester : V

Duration : 3 Hours

Maximum Marks : 75

(Write your Roll No. on the top immediately on receipt of this question paper.)

Instructions for Candidates :

- (1) All questions from Part A are compulsory. Attempt any *four* questions from Part B.
- (2) 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 strings that do not end with double letter. 2

P.T.O.

- (c) Show that $(ab)^*a$ and $a(ba)^*$ defines the same language over alphabet $\{a, b\}$. 3
- (d) Build an FA that accepts only those words that have exactly four letters. 4
- (e) Build an FA that accepts only those words that do not end with ba . 4
- (f) Find a CFG for the language $\text{Trailing count} = \{sa^{\text{length}(s)} \mid s \in (a+b)^*\}$. 4
- (g) Use the pumping lemma to show that the language $\text{Square} = \{a^n \mid n \text{ is a square}\}$ is non-regular. 4
- (h) Show that if L_1 and L_2 are regular language then so are $L_1 + L_2$, $L_1 L_2$ and L_1^* . 4
- (i) Construct a PDA for the language $L = \{a^n b^{2n} \mid n = 0, 1, 2, 3, \dots\}$. 4
- (j) Design a right shifting turing machine. 4

Part B

2. (a) Define Regular Expression. 2
- (b) Build a regular expression for all words that have odd no. of b's. 3
- (c) Build an FA that accepts all strings that start and end with different letters. 5
3. (a) For languages, $L_1 = (a+b)^*a$ and $L_2 = (a+b)^*aa(a+b)^*$, find the deterministic finite automata for $L_1 + L_2$. 6
- (b) Show that the following context free grammar is ambiguous : 4
- $$S \rightarrow aSb \mid Sb \mid Sa \mid a.$$
4. (a) Use the pumping lemma to show that the language $a^n b a^n$ where $n=1, 2, 3, \dots$ is non-regular. 4
- (b) For the given, $L_1 = (a+b)^*a$ and $L_2 = b(a+b)^*$, find the automata and regular expression for $L_1 \cap L_2$. 6
5. (a) Construct a PDA for the language $a^n b^m a^m b^n$ where $m, n \geq 1$. 6
- (b) Construct a CFG for the language $(ba+ab)^*$. 4

P.T.O.

6. (a) Prove that a recursive language is also recursively enumerable. 6
- (b) Using pumping lemma prove that the language $a^n b^n a^n b^n$ for $n=1, 2, 3, \dots$ is non-context free. 4
7. (a) Design a Turing machine for the language $a^n b^n c^n$ where $n=1, 2, 3, \dots$ 6
- (b) Describe "Universal Turing Machine". 4