Sr. No. of Question Paper: **Your Roll No……..…**

Unique Paper Code :

Name of the Course :

Name of the Paper : THEORY OF COMPUTATION

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. Part A is of 35 marks and all its questions are compulsory. Attempt any four questions from Part B.
3. Assume $\Sigma = \{a, b\}$ as the underlying alphabet set unless mentioned otherwise.
4. 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 contains at least one 'a' and one 'b' in any order, no matter where they are distributed. 2

(c) Does $a(aa)^*$ and $a^*a\,a^*$ defines the same language. (Consider $\Sigma = \{a\}$). Generate first 6 words of each of the language in the lexicographic order. 3

(d) Build deterministic finite automata (DFA) machine that accept all strings that either begin or end with double letters. 4

(e) Build a DFA machine that accepts only those strings that do not end with substring 'ba' (including Λ). 4

(f) Find a Context Free Grammar (CFG) for a language PALINDROME. 4

(g) Use pumping lemma for regular languages to show that the language $L= \{ a^n b\, a^n \mid n \geq 0 \}$ is not regular. 4

(h) Show that if L_1 and L_2 are regular languages then so are L_1+L_2, L_1L_2 and L_1^*. 4

(i) Construct a PDA for the language $L = \{a^m b^n \mid m, n > 0 \text{ and } m > n\}$. 4

(j) Design a Turing Machine for the language $L = \{ a^n b^n \mid n \geq 1\}$. 4

Part B

2 (a) Define deterministic finite automat (DFA). 2

(b) Build a regular expression for all strings that do not have 'ab' as substring. 3

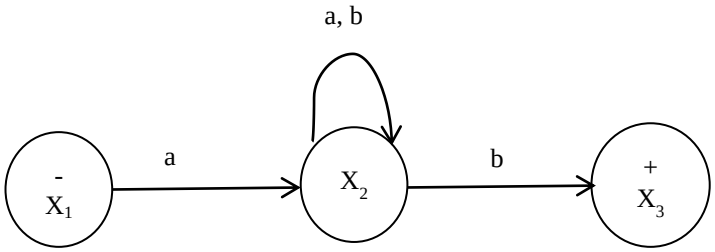
(c) Build an FA that accepts all strings that have different first and last letters. 5

3 (a) For languages, $L_1=(a+b)b(a+b)^*$ and $L_2=(a+b)^*b$, Construct respective DFA's and derive the finite automata that define $L_1 \cap L_2$. 6

(b) Show that if the following context free grammar is ambiguous or not: 4

$$S \rightarrow XbaaaX \mid aX.$$
$$X \rightarrow aX \mid bX \mid \Lambda.$$

4 (a) Convert the following NFA to DFA. 5



(b) Write a regular expression and construct a DFA for the language of all words that do not contain 'bbb' as substring. 5

5 (a) Construct a PDA for the language $L = \{a^m b^n a^{m+n} \mid m, n > 0\}$. 6

(b) Construct a CFG for the language NON-PALINDROME. 4

6 (a) If L is a recursive language, then prove that its complement is also recursive. 5

(b) Determine whether the given CFG in ambiguous or not: 5

$$S \rightarrow XaX$$

$X \rightarrow aX \mid bX \mid \Lambda$.

7 (a) Design a Turing machine which gives two's complement of a given input in binary form on the input tape. 6

(b) Describe Turing machine. 4