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BT–5/D–21 **45170**

FORMAL LANGUAGE AND AUTOMATA THEORY

Paper–PC–CS–303A

Time Allowed : 3 Hours] [Maximum Marks : 75

Note : Attempt **five** questions in all, selecting at least **one** question from each Unit. All questions carry equal marks.

UNIT–I

1. (a) Prove that the Language $A = \{0^n 1^n \mid n \geq 0\}$ is not regular using pumping lemma.

   (b) Prove that every NFA can be converted to an equivalent DFA that has a single accepting state.

2. Give state diagrams of DFAs recognizing the following languages over the alphabet $\{0, 1\}$.

   (a) $\{W \mid W$ contains at least two 0s and at most one 1$\}$.

   (b) $\{W \mid W$ starts with 0 and has odd length, or starts with 1 and has even length$\}$.

UNIT–II

3. (a) Show that the given language $\{a^i b^{2i} a^i \mid i \geq 0\}$. is not a CFL using the pumping lemma.

   (b) Describe the language generated by the CFG with productions $S \rightarrow ST \mid \wedge \; T \rightarrow aS \mid bT \mid b$.

4. (a) Let L be the language generated by the CFG with productions $S \rightarrow aSb \mid ab \mid SS$. Show that no string in L begins with abb.

   (b) Draw an NFA accepting the language generated by the grammar with productions $S \rightarrow abA \mid bB \mid aba \quad A \rightarrow b \mid aB \mid bA \quad B \rightarrow aB \mid aA$.

UNIT–III

5. (a) Give a transition table for PDA that accept the language $\{a^i b^j \mid i \le j \le 2i\}$.

   (b) Construct a Mealy machine which can generate strings having EVEN and ODD numbers of 1's or 0's.

6. (a) Draw a PDA that accept the language :

   $\{0^i 1^j 2^k \mid i, j, k \ge 0 \text{ and } j = i \text{ or } j = k\}$.

   (b) Give a transition table for a deterministic PDA that accepts the language $\{a^i b^{i+j} a^j \mid i, j \ge 0\}$.

UNIT–IV

7. (a) Write down an unrestricted grammar that generate the language $\{a^n b^n a^n b^n \mid n \ge 0\}$.

   (b) State and explain Cook-Levin theorem.

8. (a) Show that the set of languages L over $\{0, 1\}$ such that neither L nor L′ is recursively enumerable is uncountable.

   (b) Prove that language satisfiable (or the decision problem sat) is NP-complete.