BT-5/D09

AUTOMATA THEORY

Paper : CoT-307

Opt. (ii)

Time : Three Hours]   [Maximum Marks : 100

Note : Attempt any *five* questions.

1. (a) Design non-deterministic Finite Automata for the following regular expressions :

   (i) $0^* [10^* + 0^*1]$

   (ii) $[10 + (01 + 10)^* + 0^*(1 + 0)^*]$ 10

   (b) Construct DFA for a language defined over $\Sigma = \{0, 1\}$ accepting strings containing odd No. of 0's and even no. of 1's.   5

   (c) Construct of Finite state machine for a parity bit generator.   5

2. (a) Design a Mealy machine implementing residue mod 4, when input is in the form of binary strings.   10

   (b) State and prove pumping lemma.   10

3. (a) What are the steps to check the equivalence of two finite automata ?   10

   (b) Find regular expression for the following Finite Automata :   10
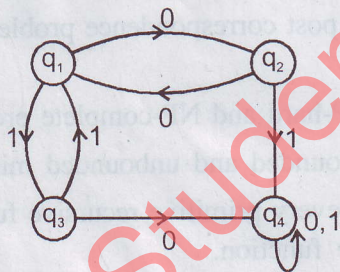
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4. (a) Construct CFG for following languages :

   (i) $L = \{x \mid n_0(x) \neq n_1(x), \text{ where } x \in \{0, 1\}^x\}$

   (ii) $L = \{a^i b^j c^k \mid (i = j) \text{ or } (i = k)\}$ 5

   (b) What are the rules to remove ambiguity from a CFG generating algebraic expressions ?   5

   (c) Prove that context free language is closed under union, concatenation and closure operation.   10

5. (a) Convert the following CFG into Chomsky Normal form :

   $$S \rightarrow ABC$$
   $$A \rightarrow aAa \mid \wedge$$
   $$B \rightarrow bBb \mid \wedge$$
   $$C \rightarrow dCd \mid \wedge$$ 10

   (b) Construct a Pushdown Automata for language

   $$L = \{ww^R \mid w \in \{a, b\}^x\}$$ 10

6. Draw Turing Machine for following languages :

   (a) Set of strings with same number of a and b.

   (b) $L = \{a^n b^n c^n \mid n \geq 0\}$ $10 \times 2 = 20$

7. (a) Explain the working of Universal Turing Machine.   10

   (b) Prove that post correspondence problem is unsolvable.   10

8. (a) Explain NP-hard and NP-complete problems.   5

   (b) Describe bounded and unbounded minimization.   5

   (c) Prove that every primitive recursive function is a total computable function.   10

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