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Roll No 09621DD54

MCADD-604

M.C.A. (Integrated), VI Semester

Examination, May 2024

Theory of Computation

Time : Three Hours

Maximum Marks : 70

Note: i) Attempt any five questions.

ii) All questions carry equal marks.

1. a) Describe the extended transition function of a NFA. Construct a NFA accepting the language over $\{a, b\}^*$ with each strings containing three consecutive b's. Show by extended function that it accepts abbb.

   b) Construct a PDA that accepts the strings of language $L = \{wwR \mid w \text{ is in } \{a, b\}^*\}$.

2. a) Define the term immediate left recursion. How can you convert a grammar with immediate left recursion into equivalent grammar without left recursion? Remove left recursion from the following grammar.

   $S \rightarrow S_1S$

   $S_1 \rightarrow S_1 + T \mid T$

   $T \rightarrow T*F \mid F$

   $F \rightarrow (S_1) \mid a$

   b) Describe multi tape Turing machine. Show that multi-tape Turing machine and one tape Turing machines are equivalent.

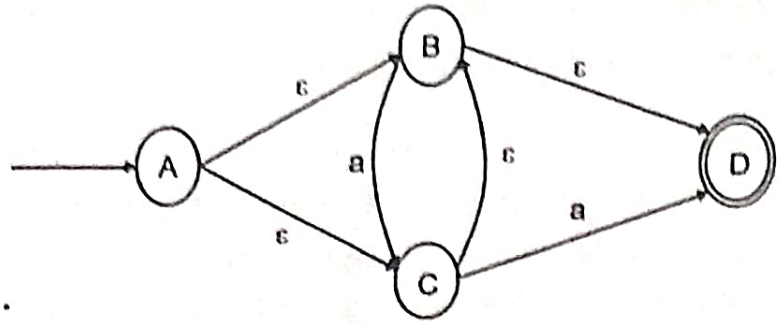
3. a) Explain, how can you encode a Turing machine into universal language?

   b) Construct FA recognizing the languages described by following regular expressions.

      i) (10*+01*)11*

      ii) (0+1) *(01+1000)0*

4. a) Convert the following NFA-ε into equivalent NFA without ε?



   b) What do you mean by a CFG in CNF? What are the criteria to be a CFG in CNF? Explain.

5. a) Define the term Regular Grammar. What is the relation of Regular Grammar with other grammars? Explain.

   b) How can you represent a finite Automata? Explain.

6. a) What do you mean by tractable and intractable problems? Is intractable problems are solvable by Turing machine?

   b) Explain about sub-set construction method to convert a NFA into equivalent DFA with suitable example.

7. a) Convert the following grammar into Chomsky Normal Form.

$S \rightarrow ASB|\varepsilon$

$A \rightarrow aAS|bAS|a$

$B \rightarrow SbS|A|CS|bb$

b) State and prove the pumping lemma for regular language. Explain about its application.

8. Write short notes on (Any two):
   a) Solvable vs Unsolvable problems
   b) CNF Satisfiability
   c) Recursive and Recursively Enumerable Languages

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