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10CS56

Fifth Semester B.E. Degree Examination, Aug./Sept.2020
Formal Languages and Automata Theory

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***

PART – A

1 a. Define following terms :
(i) Language (ii) Alphabet (iii) Power set (iv) Powers of an alphabet (v) Null string **(05 Marks)**

b. Design a DFA for accepting strings of 0's and 1's containing two consecutive 0's in it. **(05 Marks)**

c. Design a DFA for accepting binary number which are divisible by 5. **(05 Marks)**

d. Design a DFA for accepting a sequence of a's and b's not ending with abb. **(05 Marks)**

2 a. Convert the following NFA to DFA. [Refer Fig.Q2(a)]

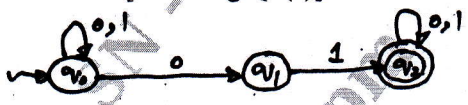

Fig.Q2(a) **(07 Marks)**

b. Define ∈-NFA and ∈-closure. **(03 Marks)**

c. Covert the following ∈-NFA to DFA. [Refer Fig.Q2(c)]

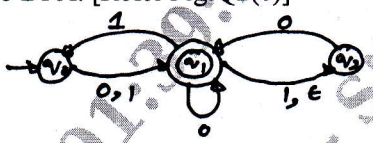

Fig.Q2(c) **(06 Marks)**

d. What are the applications of finite automata and regular expressions? **(04 Marks)**

3 a. State and prove pumping lemma of regular languages. **(05 Marks)**

b. Prove that the language $L = \{ww^R : w \in \{a,b\}^* \; w^R \text{ is reverse of } w\}$ is not regular. **(05 Marks)**

c. Prove that regular languages are closed under intersection. **(05 Marks)**

d. Prove that regular languages are closed under homomorphism. **(05 Marks)**

4 a. Define a context free grammar. Design a CFG which accepts all palindromes over a's and b's. **(06 Marks)**

b. Define the following terms:
(i) Derivation tree (ii) Yield of a tree (iii) Leftmost derivation
(iv) Rightmost derivation **(04 Marks)**

c. Design a CFG for accepting arithmetic expressions involving + and * operators. Check if your CFG is an ambiguous grammar or not. If it is an ambiguous grammar, then get an unambiguous grammar for the same. **(10 Marks)**

PART – B

5 a. Define a PDA and the languages accepted by it. (05 Marks)

b. Design a NPDA for the language $L = \{a^n b^{2n} : n \geq 0\}$ (05 Marks)

c. Design an NPDA for the language
$L = \{ a^n b^k c^m : k = n + m, n \geq 0, m \geq 0 \}$ (05 Marks)

d. Convert the following CFG to PDA.
$S \rightarrow aB \mid bA \qquad A \rightarrow aS \mid bAA \mid a$
$B \rightarrow bS \mid aBB \mid b$ (05 Marks)

6 a. When a production becomes useless / nullable? What problem is faced when unit productions present in the grammar? Simplify the following CFG to CNF.
$S \rightarrow aSb \mid bSa \mid \in \mid SS$ (10 Marks)

b. Define pumping lemma of CFGs. Show that $a^n b^n c^n$ is not a CFL using the same. (05 Marks)

c. Prove that context free languages are not closed under intersection and complementation operations. (05 Marks)

7 a. Define a Turing Machine. Design a TM for copying string of n 1's present in a tape to its right side. At the end of execution the number of 1's should be 2n in the tape. (10 Marks)

b. Design a TM to accept any palindrome of a's and b's. (08 Marks)

c. Design a TM that complements a given binary input. (02 Marks)

8 a. Define the diagonalization language. Show that for the language Ld, there is no turing machine exists. (10 Marks)

b. Define recursive languages. With a diagram explain the relationship of recursive, RE and non RE languages. (06 Marks)

c. What is post correspondence problem? Show that it is undecidable. (04 Marks)

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