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06CS/IS56

Fifth Semester B.E. Degree Examination, June/July 2013
Formal Languages and Automata Theory

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

PART – A

1 a. Explain the working of finite automata with a neat diagram. **(04 Marks)**

b. Define a DFA and NFA. **(06 Marks)**

c. Design a finite automata which accepts odd number of 0's and odd number of 1's and verify your answer. **(10 Marks)**

2 a. Define a regular expression, prove that for every regular expression, there exists a finite automata which accepts same language accepted by the regular expression. **(10 Marks)**

b. Write a note on applications of regular expressions. **(04 Marks)**

c. Give regular expressions for the following languages:

i) $L = \{W/W \text{ is in } \{a, b\}^* \text{ and } |w| \bmod 3 = 0\}$

ii) $L = \{W/W \text{ is a string of a's and b's ending with aab}\}$. **(06 Marks)**

3 a. Prove that regular languages are closed under union, complementation and intersection operations. **(08 Marks)**

b. State and prove pumping lemma of regular languages. **(08 Marks)**

c. Prove that the language $\{a^n b^n : n \geq 1\}$ is not regular. **(04 Marks)**

4 a. Define a context free grammar. Design a context free grammar for the languages

i) $L = \{W\, a^n\, b^n\, W^R : W \text{ is in } \{a, b\}^*\}$

ii) $L = (a^{2n}\, b^n : n \geq 1\}$. **(12 Marks)**

b. Define the following terms:

i) Derivation tree

ii) Parsing

iii) Inherently ambiguous grammar

iv) Left most and right most derivations. **(08 Marks)**

PART – B

5 a. Explain the working of a PDA with a neat diagram. Which data structure helps a PDA to accept a context free language? **(06 Marks)**

b. Design a PDA for all strings of a's and b's with equal number of a's and b's. **(08 Marks)**

c. How can we construct a PDA for a given grammar? Explain the steps. **(06 Marks)**

6 a. Define Chomsky normal form. Why normalization is essential for grammars? **(06 Marks)**

b. Define the following and show how these can be eliminated in a grammar:
   i) Useless
   ii) Null
   iii) Unit productions. **(06 Marks)**

c. Convert the following CFG to CNF. S is the start symbol.
   $S \rightarrow BC$, $B \rightarrow AB/\in$, $A \rightarrow 011/1$ $C \rightarrow DC/\in$ $D \rightarrow 01$. **(08 Marks)**

7 a. Define a Turing machine. Explain the working of a TM. How it differs from FA? **(10 Marks)**

b. Design a TM to accept a language which has number of b's equal to twice the number of a's. **(10 Marks)**

8 a. Show that a multi-track TM is equivalent to a basic TM. **(08 Marks)**

b. Write a detailed note on halting problem of Turing machine. **(06 Marks)**

c. Write a note on universal Turing machine with an example. **(06 Marks)**

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