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**Fifth Semester B.E. Degree Examination, December 2012**

**Formal Languages and Automata Theory**

Time: 3 hrs.

Max. Marks:100

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

**PART - A**

- 1 a. Define a DFA and the languages accepted by it. (05 Marks)
- b. Design a DFA to accept a string of a's and b's not ending with abb. (05 Marks)
- c. Design a DFA which accepts odd number of 0's and odd number of 1's. (05 Marks)
- d. Convert the following NFA to DFA. (05 Marks)

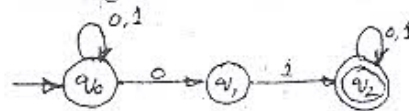


Fig.Q1(d)

- 2 a. Write a note on applications of finite automata. (04 Marks)
- b. Define an  $\epsilon$ -NFA and  $\epsilon$ -closure. (04 Marks)
- c. Prove that for every regular expression, there exists a finite automaton which accepts the same language accepted by the regular expression. (08 Marks)
- d. Give regular expressions for the following languages: (04 Marks)
  - i)  $L = \{W/W \text{ is in } \{a, b\}^* \text{ and } |W| \bmod 3 = 0\}$
  - ii)  $L = \{W/W \text{ is a string of even number of 0's followed by odd number of 1's}\}$
- 3 a. Prove that regular languages are closed under homomorphism. (05 Marks)
- b. State and prove pumping lemma of regular languages. (05 Marks)
- c. Prove that the language  $L = \{WW^R : W \in \{a, b\}^*\}$  is not a regular language. (05 Marks)
- d. Write a note on table filling method. When two states are equivalent or distinguishable? (05 Marks)
- 4 a. Define the following terms: (05 Marks)
  - i) Leftmost derivation
  - ii) Rightmost derivation
  - iii) Sentential form
  - iv) Yield of a tree
  - v) Parsing
- b. Design a context free grammar for the language  $L = \{W = W^R : W \text{ is in } \{a, b\}^*\}$  (05 Marks)
- c. Design a context free grammar for the language  $L = \{a^n b^m c^k \text{ where } k = m + n, n, m, k \geq 0\}$ . (05 Marks)
- d. Show how ambiguity in grammars are verified with an example. (05 Marks)

**PART - B**

- 5 a. Explain the working of a PDA with a diagram. (05 Marks)
- b. Design a PDA for accepting  $a^{2n}b^n$ . (05 Marks)
- c. Define two languages of a PDA. Show that they are equivalent. (05 Marks)
- d. Convert the following CFG to PDA: (05 Marks)
 
$$E \rightarrow E + E \mid E * E \mid id.$$

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.

- 6 a. Define CNF. Give an example.  
b. Define the following:  
i) Generating symbol  
ii) Reachable symbol  
iii) Unit production  
iv) Null production  
v) Nullable production (05 Marks)  
c. Convert the following CFG to CNF:  
 $E \rightarrow E + E \mid E * E \mid (E) \mid id.$  (05 Marks)  
d. Show that  $a^n b^n c^n$  is not a context free language using pumping lemma of CFL. (05 Marks)
- 7 a. Define a Turing machine. Explain the working of a Turing machine. (06 Marks)  
b. Design a Turing machine to accept  $a^n b^n c^n$ . (08 Marks)  
c. Show that a multi tape TM is equivalent to a basic TM. (06 Marks)
- 8 a. Write a detailed note on halting problem of Turing machine. (06 Marks)  
b. Prove that complement of a recursively enumerable language is recursive. (06 Marks)  
c. Write a note on universal Turing machine and show that simulate a computer. (08 Marks)

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