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06CS56

Fifth Semester B.E. Degree Examination, December 2011

Formal Languages and Automata Theory

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Define finite automata. What are the applications of finite automation? **(06 Marks)**

b. What are the difference between DFA and NFA? **(04 Marks)**

c. Design a DFA which accept strings of 0's and 1's which when interpreted as a binary integer is multiple of 5. Also give the sequence of states that DFA is in while processing the input string : 1001011. **(10 Marks)**

2 a. Obtain the regular expression to accept strings of a's, b's and c's such that fourth symbol from the right is : a and ends with : b. **(04 Marks)**

b. Consider the following ε-NFA :

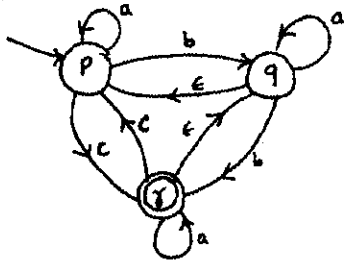

Fig.Q2(b)

i) Compute ε-Closure of each state

ii) Convert the automaton to a DFA. **(10 Marks)**

c. Convert the following automaton to a regular expression using state elimination technique :

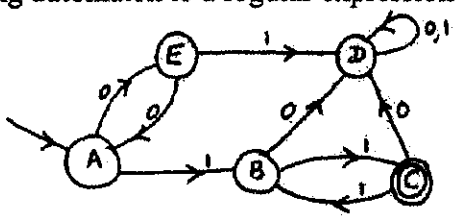

Fig.Q2(c)

(06 Marks)

3 a. Prove that the language $L = \{0^m 1^n \mid m > n, \Sigma = \{0,1\}\}$ is not regular. **(06 Marks)**

b. Consider the DFA given by the transition diagram :

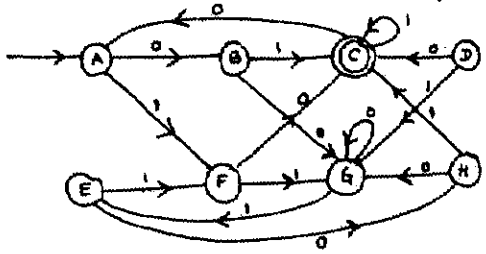

Fig.Q3(b)

i) Draw the table of distinguishabilities for this automaton.

ii) Construct the minimum state equivalent DFA. **(10 Marks)**

c. Show that if L is regular language, then complement of L denoted by $\overline{L}$ is also regular. **(04 Marks)**

4 a. Define context-free grammar. Obtain the CFG for the following languages :

i) $L = \{ w \mid w \in \{0,1\}^* \text{ with at least one occurrence of '101'} \}$

ii) $L = \{ a^i b^j c^k \mid i = j + k, \Sigma = \{a, b, c\} \}$ **(08 Marks)**

b. Explain the following with suitable examples :

i) Left most derivation ii) Right most derivation iii) Parse tree **(06 Marks)**

c. What is an ambiguous grammar? Show that grammar shown below is ambiguous.

$S \rightarrow AB \mid aaB$

$A \rightarrow Aa \mid a$

$B \rightarrow b$

(06 Marks)

PART – B

5 a. What is an instantaneous description of PDA? Obtain a PDA to accept the following language by final state :

$L = \{ a^n b^{2n} \mid n \geq 1, \Sigma = \{a, b\} \}$

Draw the transition diagram for PAD. Also, show the moves made by PDA for the string : aabbbb. **(12 Marks)**

b. Design a PDA for the following CFG :

$S \rightarrow aSb \mid bSa \mid SS \mid \in$

(08 Marks)

6 a. What is an unit production? Begin with the grammar :

$S \rightarrow ABC \mid BaB$

$A \rightarrow aA \mid BaC \mid aaa$

$B \rightarrow bBb \mid a \mid D$

$C \rightarrow CA \mid AC$

$D \rightarrow \in$

i) Eliminate $\in$-productions

ii) Eliminate any unit productions in the resulting grammar

iii) Eliminate any useless symbols in the resulting grammar. **(10 Marks)**

b. Obtain the following grammar in CNF.

$S \rightarrow 0A \mid 1B$

$A \rightarrow 0AA \mid 1S \mid 1$

$B \rightarrow 1BB \mid 0S \mid 0$

(10 Marks)

7 a. Define a Turing machine. Explain how the Turing machine would be designed to simulate a computer. **(08 Marks)**

b. Design a Turing machine to accept the set of all palindromes over {0, 1}*. Also, indicate the moves made by Turing machine for the string : 1001. **(12 Marks)**

8 Write short notes on :

a. Universal machine

b. Post correspondence problem

c. Halting problem of TM

d. Recursive languages.

(20 Marks)

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