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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 automata? (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 :

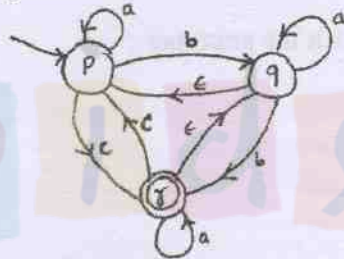


Fig.Q2(b)

- 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 :

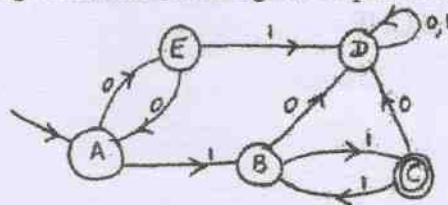


Fig.Q2(c)

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 :

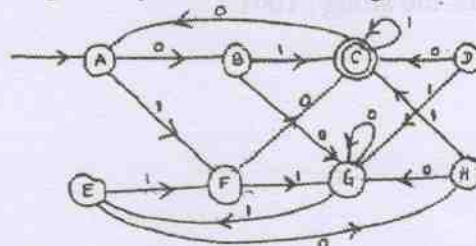


Fig.Q3(b)

- 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 \bar{L} is also regular. (04 Marks)

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.

- 4 a. Define context-free grammar. Obtain the CFG for the following languages :
- $L = \{w \mid w \in \{0, 1\}^* \text{ with at least one occurrence of '101'}\}$
 - $L = \{a^i b^j c^k \mid i = j + k, \Sigma = \{a, b, c\}\}$
- (08 Marks)
- b. Explain the following with suitable examples :
- Left most derivation
 - Right most derivation
 - 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 :
- $$S \rightarrow aSb \mid bSa \mid SS \mid \epsilon$$
- (08 Marks)

- 6 a. What is an unit production? Begin with the grammar :
- $$S \rightarrow ABC \mid BaB$$
- $$A \rightarrow aA \mid BaC \mid aaa$$
- $$B \rightarrow bBb \mid a \mid D$$
- $$C \rightarrow CA \mid AC$$
- $$D \rightarrow \epsilon$$
- Eliminate ϵ -productions
 - Eliminate any unit productions in the resulting grammar
 - 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 :
- Universal machine
 - Post correspondence problem
 - Halting problem of TM
 - Recursive languages.
- (20 Marks)
