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**Fifth Semester B.E. Degree Examination, June/July 2014**  
**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. What is automata theory? Why we study automata theory? (05 Marks)
- b. Compare DFA and NFA. Design DFA to accept the following languages:
  - i)  $L = \{w|w \text{ is of even length and begins with } 01\}$
  - ii)  $L = \{w|w \text{ consists of } 0\text{'s and } 1\text{'s with } 011 \text{ as substring}\}$  (07 Marks)
- c. Convert the following DFA to NFA using subset construction method. (08 Marks)

$\delta_N$	0	1
$\rightarrow p$	{p, q}	{p}
q	{r}	{r}
r	{s}	$\{\phi\}$
*s	{s}	{s}

- 2 a. Define Regular Expressions. Design Regular expressions for following languages:
  - i) Set of all strings that consists of alternating 0's and 1's.
  - ii) Set of all strings over the alphabet {a, b, c} containing atleast one a and atleast one b. (06 Marks)
- b. Prove that every language defined by a regular expression is also defined by a Finite Automata. (06 Marks)
- c. Consider following  $\epsilon$ -NFA.

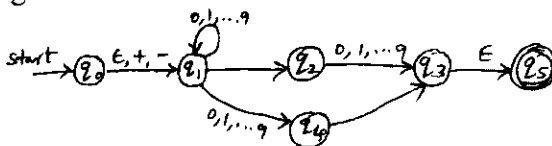


Fig.Q2(c)

- i) Compute  $\epsilon$ -closure of each state.
  - ii) Eliminate  $\epsilon$ -transitions and convert to a DFA. (08 Marks)
- 3 a. State and prove pumping lemma for Regular languages. (08 Marks)
- b. If L and M are Regular Languages, prove that  $L \cap M$  is also regular. (05 Marks)
- c. Consider the following DFA.

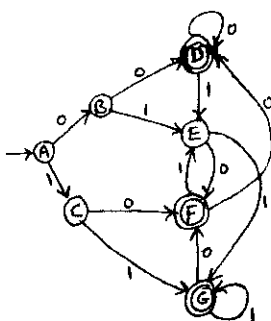


Fig.Q3(c)

- i) Draw a table of distinguishable and in-distinguishable states.
  - ii) Construct minimum state equivalent DFA. (07 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: i) Context free grammer, ii) Language of a grammer, iii) Sentential forms. (04 Marks)  
 b. Construct context free grammer for  $L = \{a^i b^j c^k \mid i + j = k\}$ . (03 Marks)  
 c. Following grammer generates the language consisting of strings of even length.  
 $S \rightarrow AS \mid \epsilon$   
 $A \rightarrow aa \mid bb \mid ba \mid ab$   
 Give leftmost and rightmost derivations for the following strings:  
 i) aabbaa ii) baabab (08 Marks)  
 d. What is ambiguous grammer? Prove that the following grammer is ambiguous for  $w = ababa$ :  
 $S \rightarrow SbS \mid a$  (05 Marks)

**PART - B**

- 5 a. Define PDA. Construct PDA for the following language by emptying the stack:  
 $L = \{w \mid w \text{ consist of equal number of } 0\text{'s and } 1\text{'s}\}$  over  $\Sigma = \{0, 1\}$   
 Write Instantaneous Descriptions for the string 001011. (12 Marks)  
 b. Construct PDA for the following grammer:  
 $S \rightarrow aABB \mid aAA$   
 $A \rightarrow aBB \mid a$   
 $B \rightarrow bBB \mid A$   
 $C \rightarrow a$  (08 Marks)
- 6 a. Consider the following grammer:  
 $S \rightarrow ABC \mid BaB$   
 $A \rightarrow aA \mid BaC \mid aaa$   
 $B \rightarrow bBb \mid a \mid D$   
 $C \rightarrow CA \mid AC$   
 $D \rightarrow \epsilon$   
 i) Eliminate  $\epsilon$  - productions.  
 ii) Eliminate unit productions from resulting grammer.  
 iii) Eliminate useless symbols and productions from in resulting grammer. (09 Marks)  
 b. Convert the following grammer into CNF form.  
 $E \rightarrow E + \bar{T} \mid T * F \mid (E) \mid a \mid b \mid Ia \mid Ib \mid I_0 \mid I_1$   
 $T \rightarrow T * F \mid (E) \mid a \mid b \mid Ia \mid Ib \mid I_0 \mid I_1$   
 $F \rightarrow (E) \mid a \mid b \mid Ia \mid Ib \mid I_0 \mid I_1$   
 $I \rightarrow a \mid b \mid Ia \mid Ib \mid I_0 \mid I_1$  (07 Marks)  
 c. Prove that  $L = \{0^n 1^n 0^n \mid n \geq 1\}$  is not a context free language. (04 Marks)
- 7 a. Explain with a neat diagram, the working of turing machine model. (06 Marks)  
 b. Design a turing machine to accept the set of all palindromes over  $\{0, 1\}^*$ . Write transition table and instantaneous descriptions on input string 10101. (14 Marks)
- 8 Write short notes on:  
 a. Pumping lemma for CFL  
 b. Universal Turing Machine  
 c. Recursive languages  
 d. Post's correspondence problem. (20 Marks)

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