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. Write the DFAs for the following languages over $\Sigma = \{a, b\}$
       (i)   The set of all strings ending with a & b.
       (ii) The set of all strings not containing the substring aab.
       (iii) Set of all strings with exactly three consecutive a's.   **(10 Marks)**

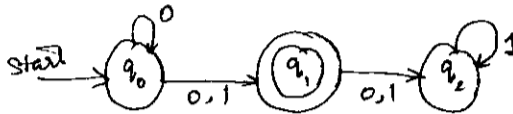   b. Define NFA. Convert the following NFA to its equivalent DFA. [Refer Fig.Q1(b)] **(10 Marks)**

Fig.Q1(b)

2 a. Consider the following $\in$- NFA:

	$\in$	a	b	c
→p	ϕ	{p}	{q}	{r}
q	{p}	{q}	{r}	ϕ
*r	{q}	{r}	ϕ	{p}

       (i)   Compute the $\in$-closure of each state
       (ii) Convert the $\in$- NFA to DFA.   **(08 Marks)**

   b. Define Regular expression. Convert the following automation to a regular expression using
       state elimination technique. [Refer Fig.Q2(b)]   **(08 Marks)**
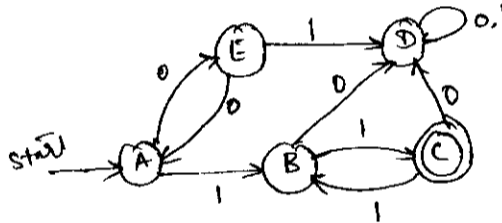

Fig.Q2(b)

   c. Convert the regular expression $(0 + 1)^* \mid (0 + 1)$ to an NFA.   **(04 Marks)**

3 a. State and prove pumping lemma for regular languages.   **(10 Marks)**

   b. Define distinguishable and indistinguishable states. Minimize the following DFA using table
       filling algorithm.   **(10 Marks)**

	0	1
A	B	F
B	G	C
* C	A	C
D	C	G
E	H	F
F	C	G
G	G	E
H	G	C

4 a. Define CFG. Write CFG for the following languages.
   (i) $L = \{0^n 1^n \mid n \geq 1\}$
   (ii) $L = \{$String l of a's and b's with equal number of a's and b's $\}$ **(06 Marks)**
   b. What is an ambiguous grammar? Show that the following grammar is ambiguous.
        $E \rightarrow E + E \mid E - E \mid E * E \mid E / E \mid (E) \mid a$
      where E is the start symbol. Find the unambiguous grammar. **(10 Marks)**
   c. Discuss the applications of CFG. **(04 Marks)**

PART – B

5 a. Define PDA. Construct PDA that accepts the language $L = \{ww^R \mid w \in (a+b)^* $ and w^R is the reversal of w $\}$. Write IDs for the string aabbaa. **(10 Marks)**
   b. Convert the following CFG to PDA and give the procedure for the same.
        $S \rightarrow aABB \mid aAA$
        $A \rightarrow aBB \mid a$
        $B \rightarrow bBB \mid A$
        $C \rightarrow a$ **(10 Marks)**

6 a. Consider the following CFG:
        $S \rightarrow ABC \mid BaB$
        $A \rightarrow aA \mid BaC \mid aaa$
        $B \rightarrow bBb \mid a \mid D$
        $C \rightarrow CA \mid AC$
        $D \rightarrow \epsilon$
   (i) What are useless symbols?
   (ii) Eliminate ϵ-productions unit productions and useless productions from the grammar. **(10 Marks)**
   b. What is CNF and GNF? Obtain the following grammar in CNF:
        $S \rightarrow aBa \mid abba$
        $A \rightarrow ab \mid AA$
        $B \rightarrow aB \mid a$ **(10 Marks)**

7 a. Define a turing machine and explain with neat diagram, the working of a basic turing machine. **(06 Marks)**
   b. Design a turing machine to accept the set of all palindromes over $\{a \cdot b\}^*$. Also, indicate the moves made by turing machine for the string aba. **(14 Marks)**

8   Write short notes on :
   a. Multitape turing machine
   b. Post's correspondence problem
   c. Pumping lemma for CFL
   d. Recursive languages. **(20 Marks)**

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