USN ☐☐☐☐☐☐☐☐☐☐

10CS56

Fifth Semester B.E. Degree Examination, Dec.2016/Jan.2017
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 Finite automata. Write the application of finite automata.   **(05 Marks)**
    b.   Design a DFA to accept the following language over the alphabet $\{0, 1\}$.
         i) $L = \left\{ (01)^i \cdot 2^j \,\middle|\, i \geq 1, j \geq 1 \right\}$
         ii) $L = \left\{ \omega :\mid \omega \mid \bmod 3 = \mid \omega \mid \bmod 2 \right\}$ **(10 Marks)**
    c.   What is NFA? Explain with example.   **(05 Marks)**

2   a.   Define Regular expression. Find regular expression for the following languages.
         i) $L = \left\{ a^n b^m : (m + n) \text{ is even} \right\}$
         ii) Strings of a's and b's whose 3rd symbol from right is a.   **(05 Marks)**
    b.   Consider the following $\in$-NFA

δ	ε	a	b	c
→p	ϕ	p	q	r
q	p	q	r	ϕ
*r	q	r	ϕ	p

         i)   Compute $\in$-closure of each state
         ii) Convert the automata to DFA   **(10 Marks)**
    c.   Obtain an $\in$-NFA for the regular expression $a^* + b^* + c^*$ **(05 Marks)**

3   a.   If L and M are regular languages prove that $L \cap M$ is also regular.   **(05 Marks)**
    b.   Prove that the following language is not regular
         $L = \left\{ 0^n \mid n \text{ is prime} \right\}$ **(05 Marks)**
    c.   Minimize the following DFA.   **(10 Marks)**

Fig Q3(c)
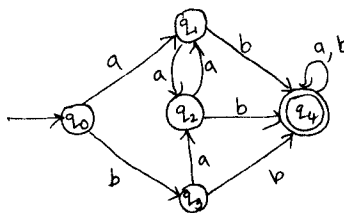
4   a.   Define CFG. Write CFG for the language.
         $L = \left\{ 0^n 1^n \,\middle|\, n \geq 1 \right\}$ **(06 Marks)**
    b.   Consider the grammar
         E→+EE | *EE | −EE | x | y
         Find leftmost and rightmost derivation for the string +* − xyxy and write parse tree.
                                                                                          (08 Marks)
    c.   Write the application of CFG.   **(06 Marks)**

PART – B

5 a. Design PDA for the language $L = \{\omega \mid \omega \in (a + b)^* \ \& \ n_a(\omega) = n_b(\omega)\}$ show that ID's for the string abbbaa and also write the transition diagram. **(12 Marks)**

   b. Convert the CFG to PDA by empty stack.

      $I \rightarrow a \mid b \mid Ia \mid Ib \mid I0 \mid I1$

      $E \rightarrow I \mid E * E \mid E + E \mid (E)$ **(08 Marks)**

6 a. Eliminate ε, unit and useless production from the following grammar and put the resulting grammar into CNF. **(12 Marks)**

      $S \rightarrow ABC \mid BaB$

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

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

      $C \rightarrow CA \mid AC$

      $D \rightarrow \varepsilon$

   b. State and prove pumping lemma for CFG. **(08 Marks)**

7 a. With a neat diagram, explain the working of basic Turing machine **(08 Marks)**

   b. Design TM to accept the language

      $L = \{0^n 1^n \mid n \geq 1\}$ **(12 Marks)**

8   Write short notes on :

   a. Multitape Turing machine **(05 Marks)**

   b. Halting problem in TM **(05 Marks)**

   c. Post correspondence problem **(05 Marks)**

   d. Recursive languages. **(05 Marks)**

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