T.E. (Computer) (2003 Course) (Semester – I) Examination, 2009
THEORY OF COMPUTATIONS

Time : 3 Hours Max. Marks : 100

N.B. : 1) *Answer* ***three*** *questions from* ***each*** *Section.*
2) *Answer to the* ***two*** *Sections should be written in* ***separate*** *answer books.*
3) ***Neat*** *diagrams must be drawn* ***whenever*** *necessary.*
4) *Figures to the* ***right*** *indicate* ***full*** *marks.*
5) *Assume suitable data, if* ***necessary***.

SECTION – I

1. a) Show for any $n \geq 0$, **6**

$1 + 2 + ... + n = (n^2 + n) / 2$

Using principle of mathematical induction.

b) Construct NFA and DFA for accepting all possible strings of zeroes and ones not containing 101 as a substring. **10**

OR

2. a) Show by the principle of mathematical induction that $n^4 - 4n^2$ is divisible by 3 for all $n \geq 0$. **6**

b) Construct NFA and DFA for accepting all possible strings of zeroes and ones not containing 011 as a substring. **10**

3. a) Prove that L = {ww / w is in (0/1)*} is non Regular. **6**

b) Design the finite automata and then equivalent regular expression using Arden's theorem that accepts the set of all strings over the alphabet {a, b} with an equal number of a's and b's. such that each prefix has atmost one more a than b's and atmost one more b than a's. **10**

OR

4. a) Prove that $L = \{ww^R / w \text{ is in } (0/1)^* \text{ and } w^R \text{ is reverse of } w\}$ is not regular. **6**

   b) Give the examples of sets that demonstrate the following inequality. Here r_1, r_2, r_3 are regular expressions : **10**

   1) $r_1 + \varepsilon \neq r_1$

   2) $r_1 \cdot r_2 \neq r_2 \cdot r_1$

   3) $r_1 \cdot r_1 \neq r_1$

   4) $r_1 + (r_2 \cdot r_3) \neq (r_1 + r_2) \cdot (r_1 r_3)$.

5. a) In each case, find a CFG generating the given language : **12**

   1) The set of odd length strings in {a, b}* with middle symbol a

   2) The set of even length strings in {a, b}* with the two middle symbols equal

   3) The set of odd length strings in {a, b}* whose first, middle and last symbols are all same.

   b) Prove that $L = \{a^i b^i c^i / i \geq 1\}$ is not a CFL. **6**

OR

6. a) Describe the language generated by each of these grammar and justify your answer with the example string derive from the grammar of the productions given below : **12**

   1) $S \rightarrow aA / bC / b$

      $A \rightarrow aS / bB$

      $B \rightarrow aC / bA / a$

      $C \rightarrow aB / bS$

   2) $S \rightarrow bS / aA / \varepsilon$

      $A \rightarrow aA / bB / b$

      $B \rightarrow bS$

   b) Prove that $L = \{a^i b^i c^j / j \geq i\}$ is not a CFL. **6**

SECTION – II

7. a) Prove "Let L be a language accepted by deterministic PDA, then the complement of L, can also be accepted by DPDA". **8**

   b) Let $L = \{a^n b^n c^m d^m / n, m \geq 1\}$ find a PDA that accepts L. **10**

OR

8. Let $L = \{a^j b^j c^k / i, j, k \geq$ and $i + j = k\}$ **18**

   a) find a PDA (which accepts via final state) that recognizes L

   b) find a PDA (which accepts via empty stack) that recognizes L.

9. Draw a transition diagram for a Turing machine accepting each of the following languages **16**

   1) $\{a^i b^j / i < j\}$

   2) the language of balanced string of parenthesis

   3) the language of all non palindromes over {a, b}

   4) $\{www / w \in \{a, b\}^*\}$

   5) $\{a^n b^n c^n / n \geq 0\}$.

OR

10. a) Design the post machine which accepts the strings with an equal number of 0's and 1's. **6**

    b) Construct the Turing machine to accept the language **10**

       1) $\{w \in \{a, b\}^* / w$ contains the same number of a's and b's $\}$

       2) $\{w \in \{a, b\}^* / w = w^R\}$.

11. a) Explain with example complexity class P and complexity class NP problems. **4**

    b) What is undecidability ? How do you prove that a problem is undecidable ? Prove that "The blank tape halting problem is undecidable". **12**

OR

12. a) Define recursive and recursively enumerable languages. **4**

    b) What is undecidability ? How do you prove that a problem is undecidable ? Prove the theorem "the ambiguity problem for CFG is undecidable". **12**
