T.E. (Computer) (Semester – I) Examination, 2010
THEORY OF COMPUTATIONS
(2003 Course)

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) Define the Moore and Mealy machine and how the equivalence of Moore and Mealy machines can be design ? With any example. 6

1. b) Construct NFA and DFA for accepting all possible strings of zeroes and ones which does not contain 011 as a substring. 10

OR

2. a) Design a Moore machine for the 1's complement of binary number. 6

2. b) Design DFA for a language of string 0 and 1 that 10
   I) Ending with 10
   II) Ending with 11
   III) Ending with 1

3. a) Prove the formula 6
   a) $(r^*s^*)^* = (r + s)^*$
   b) $(00^*1)^*1 = 1 + 0(0 + 10)^*11$

3. b) Find the regular expression corresponding to each of the following subset of $\{0, 1\}^*$ 10
   a) The language of all strings not containing the substring 000
   b) The language of all strings that do not contain the substring 110
   c) The language of all strings containing both 101 and 010 as substring.

OR

4. a) Consider the two regular expressions $r = 0^* + 1^*$ $s = 01^* + 10^* + 1^*0 + (0^*1)^*$. **8**

a) find the string corresponding to r but not to s

b) find the string corresponding to s but not to r

c) find the string corresponding to both r and f

4. b) For each of the following draw DFA of following regular expression **8**

a) $(11 + 00)^*$

b) $(111 + 100)^*0$

5. a) In each case, show that the grammar is ambiguous, and find the equivalent unambiguous grammar **12**

a) $S \rightarrow SS / a / b$

b) $S \rightarrow ABA \quad A \rightarrow aAb / \varepsilon \quad B \rightarrow bB / \varepsilon$

c) $S \rightarrow aSb / aaSb / \varepsilon$

5. 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) $S \rightarrow aSa / bSb / aAb / bAa$

$A \rightarrow aAa / bAb / a / b / \varepsilon$

2) $S \rightarrow bT / aT / \varepsilon$

$T \rightarrow aS / bS$

6. b) Convert the following Grammar to CNF **6**

$S \rightarrow AACD$

$A \rightarrow aAb / \varepsilon$

$C \rightarrow aC / a$

$A \rightarrow aDa / bDb / \varepsilon$

SECTION – II

7. a) Construct pushdown automata for each of the following language. 12

   1) the set of all string over alphabet {a, b} with exactly equal number of a's and b's

   2) the set of all string over alphabet {a, b} with the language of even length palindromes

   3) the set of all string over alphabet {a, b} with the language of odd length palindromes

7. b) Show that if L is accepted by a PDA in which no symbols are removed from the stack, then L is regular. 6

OR

8. a) Consider the PDA with the following moves : 8

   $\delta(q_0, a, z_0) = \{(q_0, a, z_0)\}$

   $\delta(q_0, a, a) = \{(q_0, aa)\}$

   $\delta(q_0, b, a) = \{(q_1, \in)\}$

   $\delta(q_1, b, a) = \{(q_1, \in)\}$

   $\delta(q_0, \in, z_0) = \{(q_1, \in)\}$

   Obtain CFG equivalent to PDA.

8. b) Give the CFG generating the language accepted by the following PDA :

   $M = (\{q_0, q_1\}, \{0,1\}, \{Z_0, X\}, \delta, q_0, Z_0, \phi)$ where δ is given below 8

   $\delta(q_0, 1, Z_0) = \{(q_0, XZ_0)\}$

   $\delta(q_0, 1, X) = \{(q_0, XX)\}$

   $\delta(q_0, 0, X) = \{(q_1, X)\}$

   $\delta(q_0, \in, Z_0) = \{(q_0, \in)\}$

   $\delta(q_1, 1, X) = \{(q_1, \in)\}$

   $\delta(q_1, 0, Z_0) = \{(q_0, Z_0)\}$

9\. a) Explain the following variations of the turing machine. **8**

1) Single infinite tape Turing machine
2) Multitape or Multitrack Turing Machine
3) Multitape or Multi track Turing machine

9\. b) Design a turing machine for accepting the strings with an equal number of 0's and 1's. **8**

OR

10\. a) Design the post machine which accepts the strings of a & b having odd length and the element at the center is 'a'. **6**

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

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

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

11\. a) Let G be a CFG and r be a regular expression. Show that the problem **10**

1) $L(G) = L(r)$
2) $L(r) \in L(G)$ are undecidable

11\. b) Show that an infinite recursively enumerable set has an infinite recursive subset. **6**

OR

12\. a) Show that if L_1 and L_2 are recursive languages then $L_1 \cup L_2$ and $L_1 \cap L_2$ also recursive. **8**

12\. b) Show that the set of languages L over {0, 1} so that neither L nor L' is recursively enumerable is uncountable. **8**

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