Seat No.: _____ **Enrolment No._____**

GUJARAT TECHNOLOGICAL UNIVERSITY

MCA SEM-II Examination- Dec.-2011

Subject code: 620007 **Date: 23/12/2011**

Subject Name: Theory of Computation

Time: 02.30 pm-05.00 pm **Total marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** Describe the following infinite sets precisely, using a formula that does not involve "…". **04**

(i) {0,-1,2,-3,4,-5, …}

(ii) {10,1100,111000,11110000, …}

(iii) {{0},{1},{2},{3}, …}

(iv) {{0},{0,1},{0,1,2},{0,1,2,3}, …}

(b) Define One-to-one and onto functions. Give examples of (i) Neither One-to-one nor onto (ii) One-to-one but not onto and (iii) Onto but not one-to-one. **04**

(c) State the principle of mathematical induction. Prove that for every $n \geq 0$ **06**

$\sum i^2 = n(n+1)(2n+1) / 6$

Q.2 **(a)** Answer the following

(1) Consider the following regular expressions **03**

R = 0* + 1* s = 01* + 10* + 1*0 + (0*1)*

(i) Find a string corresponding to both r and s.

(ii) Find a string in {0,1}* corresponding to neither r nor s.

(iii) Find a string corresponding to s but not r.

(2) Find a regular expression corresponding to each of the following subsets of {0,1}* **04**

(i) The language of all strings containing exactly two 0's

(ii) The language of all string that do not end with 01

(iii) The language of all strings that begin or end with 00 or 11

(iv) The language of al strings in which every 0 is followed immediately by 11.

(b) Define finite automaton. Draw an FA recognizing the following languages. **07**

(i) (11 + 10)*

(ii) (0+1)(1+00)(0+1)*

(iii) (111+100)*0

OR

(b) Define regular languages and Regular expressions over ∑. Describe as simply as possible the language corresponding to each of the following regular expressions. **07**

(i) 0*1(0*10*1)*0*

(ii) (1+01)*(0+01)*

Q.3 **(a)** Consider languages L1 and L2 as under. **07**

L1 = {x | 00 is not a substring of x}
L2 = {x | x ends with 01}
Draw FAs recognizing
(i) L1 U L2
(ii) L1 ∩ L2
(iii) L1-L2.

(b) Define Nondeterministic Finite automaton. Give recursive definition of δ* for an NFA. Find δ*(q0, 011) for the following NFA. **07**

q	δ(q,0)	δ(q,1)
q0	{q0}	{q2}
q1	{q2}	{q3}
q2	{q3}	φ
q3	φ	

OR

Q.3 **(a)** Define ∧-closure. Give recursive definition of δ* for an NFA-∧. Draw NFA-∧ accepting {0}{1*}{0*}{1}. **07**

(b) Draw NFA-∧ and Transition table for the language {0}*({01*}{1} U {1}*{0}). Convert it to NFA and FA. **07**

Q.4 **(a)** State the pumping lemma for regular languages. Prove that the language L = $\{0^i1^i \mid i \geq 0\}$ is not regular. **05**

(b) Define Context free grammar. Find CFG for the following languages. **09**

(i) {x | n0(x) = n1(x)}
(ii) { x | n0(x) ≠ n1(x)}
(iii) (011 + 1)*(01)*
(iv) Palindrome over {a,b}

OR

Q.4 **(a)** Define Deterministic Pushdown Automaton. Show transition table and draw PDPA for accepting even palindromes. **07**

(b) State pumping lemma for context free languages. Prove that the language L = $\{a^ib^jc^k \mid I < j < k\}$ is not a Context free language. **07**

Q.5 **(a)** Define Turing machine. Draw and describe a TM accepting the language {a,b}*{aba}{a,b}*. **07**

(b) Write a note on recursively enumerable languages. **07**

OR

Q.5 **(a)** State the Chomsky Normal Form. Explain the steps involved in conversion of a Context Free Grammar into a Chomsky Normal Form using appropriate example. **07**

(b) What do you mean by unambiguous Context free grammar? State unambiguous grammar for the "if statement" in C language and draw the parse tree for the same. **07**

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