Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

MCA - SEMESTER–II • EXAMINATION – WINTER 2013

Subject Code: 620007 Date: 30-12-2013

Subject Name: Theory of Computation

Time: 10.30 am - 01.00 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) {1/2, ¼, ¾, 1/8, 3/8, 5/8, 5/8, 1/16, 3/16, 5/16, ,5/16, …}

(ii) {{0},{1},{2},{3}, …}

(iii) {{0}, {0,1}, {0,1,2,3}, {0,1,2,3,4,5,6,7}, {0,1,2,…..,15}

(iv) {{0},{0,1},{0,1,2},{0,1,2,3}, …}

(b) In each case, find an expression for the indicated set, involving A,B,C and the three operations, U, ∩, and '. **04**

(1) {x|x ε A or x ε B but not both}

(2) {x|x is an element of exactly one of the three sets A,B, and C}

(c) Define Fibonacci function (f) in terms of recursion. Prove that for every $n \geq 0$, $f(n) \leq (5/3)^n$ **06**

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

(1) In each case, find a string of minimum length in {0,1}* NOT in the language corresponding to the given regular expression. **03**

(1) 0*(100*)*1*

(2) (0+1)*0

(3) (11+10)*

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

(i) The language of all strings containing either 01 or 110.

(ii) The language of all strings ending with 10.

(iii) Strings of size five or less.

(iv) The language of all strings containing no more than one occurrence of the sting 00.

Q.2 **(b)** Define finite automaton. Draw an FA recognizing the following languages. **07**

(i) (0+1)*(01+110)

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

OR

Q.2 **(b)** Define regular languages and Regular expressions over ∑. **07**
Describe how the accepting states are considered in the FA for L1 U L2, L1 ∩ L2 and L1 – L2 is drawn.

Q.3 **(a)** Define NFA and δ^* for NFA. **07**

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

OR

Q.3 **(a)** A transition table is given for NFA-∧ with seven states. **07**

q	δ (q,a)	δ (q,b)	δ (q, ∧)
1	{5}	φ	{4}
2	{1}	φ	φ
3	φ	{2}	φ

4	φ	{7}	{3}
5	φ	φ	{1}
6	φ	{5}	{4}
7	{6}	φ	Φ

Calculate δ^* (1,ba)

(b) Draw DFA for the regular equation {0,1}*{10} and Find minimized DFA for the same. **07**

Q.4 **(a)** State the pumping lemma for regular languages. **07**

Prove that the language L = $\{0^i1^i \mid i \geq 0\}$ is not regular.

(b) Define Context free grammar. Describe the language generated by each of these grammars. **07**

(1) S → sA | bC | b
A → aS | bB
B → aC | bA | a
C → aB | bS

(2) S → aSa | bSb | a | b

OR

Q.4 **(a)** Find the unambiguous context-free grammar for the language of all algebraic expressions involving parenthesis, the identifier a, and the following four binary operators +, –, *, & /. **07**

(b) Find context-free grammars generating each of these languages. **07**

(1) $\{a^i b^j c^k \mid i = j + k\}$

(2) Palindrom over {0,1}

Q.5 **(a)** Describe PDA. Find out DPDA to accept Strings with More a's than b's. **07**

(b) Define Turing machine. Draw a transition diagram for a Turing machine accepting language $\{a^ib^j \mid i<j\}$ **07**

OR

Q.5 **(a)** Write a note on Recursively Enumerable and Recursive Languages. **07**

(b) 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**

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