

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) $\{1/2, 1/4, 3/4, 1/8, 3/8, 5/8, 5/8, 1/16, 3/16, 5/16, 5/16, \dots\}$
 - (ii) $\{\{0\}, \{1\}, \{2\}, \{3\}, \dots\}$
 - (iii) $\{\{0\}, \{0,1\}, \{0,1,2,3\}, \{0,1,2,3,4,5,6,7\}, \{0,1,2,\dots,15\}\}$
 - (iv) $\{\{0\}, \{0,1\}, \{0,1,2\}, \{0,1,2,3\}, \dots\}$
- (b)** In each case, find an expression for the indicated set, involving A,B,C and the three operations, U, $\cap$, and '. **04**
- (1) $\{x|x \in A \text{ or } x \in B \text{ but not both}\}$
 - (2) $\{x|x \text{ is an element of exactly one of the three sets A,B, and C}\}$
- (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 string 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 Σ . Describe how the accepting states are considered in the FA for $L1 \cup L2$, $L1 \cap L2$ and $L1 - L2$ is drawn. **07**
- Q.3 (a)** Define NFA and δ^* for NFA. **07**
- (b)** Draw NFA- $\wedge$ for the language $\{0\}^*(\{01\}^*\{1\} \cup \{1\}^*\{0\})$. And convert it to NFA and FA. **07**

OR

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

q	$\delta(q,a)$	$\delta(q,b)$	$\delta(q, \wedge)$
1	{5}	$\varnothing$	{4}
2	{1}	$\varnothing$	$\varnothing$
3	$\varnothing$	{2}	$\varnothing$

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

Calculate $\delta^*(1,ba)$

- (b) Draw DFA for the regular equation $\{0,1\}^*\{10\}$ and Find minimized DFA 07
for the same.
- Q.4 (a) State the pumping lemma for regular languages. 07
Prove that the language $L = \{0^i 1^i \mid i \geq 0\}$ is not regular.
- (b) Define Context free grammar. Describe the language generated by each of 07
these grammars.
(1) $S \rightarrow sA \mid bC \mid b$
 $A \rightarrow aS \mid bB$
 $B \rightarrow aC \mid bA \mid a$
 $C \rightarrow aB \mid bS$
(2) $S \rightarrow aSa \mid bSb \mid a \mid b$
- OR**
- Q.4 (a) Find the unambiguous context-free grammar for the language of all 07
algebraic expressions involving parenthesis, the identifier a, and the
following four binary operators +, -, *, & /.
- (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 07
accepting language $\{a^i b^j \mid i < j\}$
- 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 07
a Context Free Grammar into a Chomsky Normal Form using appropriate
example.
