

GUJARAT TECHNOLOGICAL UNIVERSITY
M.C.A.- SEMESTER – II • EXAMINATION – WINTER 2012

Subject code: 620007

Date: 31-12-2012

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** (i) List the elements of $2^{\{1,2,3\}}$ **14**
 (ii) Describe logical quantifiers.
 (iii) Define relation and its properties: reflexive, symmetric and transitive.
 (iv) Distinguish L^* and L^+
 (v) Give example of a function which is one-to-one but not onto.
 (vi) State the principle of mathematical induction.
 (vii) Give recursive definition of Palindrome over Σ .
- 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**
 (i) $1^*(01)0^*$
 (ii) $(0^*+1^*)(0^*+1^*)(0^*+1^*)$
 (iii) $1^*(0+10)^*1^*$
- (2) Find a regular expression corresponding to each of the following subsets of $\{0,1\}^*$ **04**
 (i) The language of all strings containing at least two 0's
 (ii) The language of all string in which the number of 0's is even.
- Q.2** (b) Define finite automaton. Draw an FA recognizing the following languages. **07**
 (i) A language over $\{a, b\}$ where all strings containing substring ab or bba.
 (ii) A language over $\{0, 1\}$ where all strings that do not end with 01.
- OR**
- Q.2** (b) 1. Prove that $\sqrt{2}$ is Irrational **04**
 2. Give example of following relations. **03**
 (i) Transitive but not reflexive.
 (ii) Symmetric but not transitive.
 (iii) Equivalence relation (other than $=$).
- Q.3** (a) Define NFA. For the regular expression $aa(ba)^* + b^*aba^*$ draw an NFA-□ **07**
 (b) 1. An NFA with states 1-5 and input alphabet $\{a, b\}$ has the following transition table. **04**

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

Draw NFA and FA.

2. Give the recursive definition of δ^* for an NFA. **03**

OR

- Q.3 (a)** Define regular languages and Regular expressions over Σ . Describe how the accepting states are considered in the FA for $L_1 \cup L_2$, $L_1 \cap$ and $L_1 - L_2$ is drawn. **07**
- (b)** Draw NFA- $\square$ and Transition table for the language $\{0\}^*({01})^*\{0\}^*$. Convert it to NFA and FA. **07**
- Q.4 (a)** Find minimum FA for the following FA
 $Q=\{1,2,3,4,5,6,7\}$ $A=\{2,6\}$ and $q_0=1$. **07**
- | State | a | b |
|-------|---|---|
| 1 | 2 | 3 |
| 2 | 4 | 5 |
| 3 | 6 | 7 |
| 4 | 4 | 5 |
| 5 | 6 | 7 |
| 6 | 4 | 5 |
| 7 | 6 | 7 |
- (b)** (i) State the pumping lemma for regular languages. Prove that the language $L = \{ww \mid w \in \{0,1\}^*\}$ is not regular. **07**
- OR**
- Q.4 (a)** Define Context-Free Grammar. Describe and Derive a CFG for the language $\{x \in \{0,1\}^* \mid n_0(x) \neq n_1(x)\}$ **07**
- (b)** Write a note on PDA. Design a PDA for $L = \{x \in \{0,1\}^* \mid n_0(x) > n_1(x)\}$ **07**
- Q.5 (a)** Define Turing machine. Draw and describe a TM accepting the language of palindromes over $\{a,b\}$. **07**
- (b)** What do you mean by unambiguous Context free grammar? State ambiguous and unambiguous grammar for the algebraic expression involved operations $+$, $-$, $*$ and $/$. **07**
- OR**
- Q.5 (a)** State the Chomsky Normal Form. Convert the following CFG into Chomsky Normal Form **07**
- $S \rightarrow ABAC$
 $A \rightarrow aAb \mid \square$
 $B \rightarrow aBa \mid bBb \mid \square$
 $C \rightarrow aC \mid a$
- (b)** Write a note on recursively enumerable languages. **07**