Seat No.: _____ Enrolment No.______

# GUJARAT TECHNOLOGICAL UNIVERSITY

**MCA. Sem-II Remedial Examination December 2010**

## Subject code: 620007
## Subject Name: Theory of Computation

**Date: 22 /12 /2010** **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)** 1. Prove the statement "*$(p \vee q) \rightarrow r$ and $(p \rightarrow r) \vee (q \rightarrow r)$ are logically equivalent*". **03**

2. Show that for any integer n > 2, there is a prime $p$ that must satisfy $n < p < n!$ **02**

3. Explain the logical quantifiers and quantified statement. **02**

**(b)** 1. Define Fibonacci function ($f$) in terms of recursion. Prove that for every $n \geq 0$ $f(n) \leq (5/3)^n$ **04**

2. Define Regular language & give the Regular expression corresponding to the strings having even length **03**

**Q.2** **(a)** 1. Given regular expressions are **03**

$r = 0^* + 1^*$ and

$s = 01^* + 10^* + 1^* + (0^*1)^*$

**(1)** Give the strings corresponding to $r$ but not in $s$.

**(2)** Give the strings corresponding to $s$ but not in $r$.

**(3)** Give the strings corresponding to both $r$ and $s$.

2. Give regular expression corresponding to strings ending in 1 & not containing 00. **01**

3. Construct a DFA that recognizes the language **03**

$L = \{ x \in \{0,1\}^* \mid |x| \geq 3$ and $3^{rd}$ symbol from the right side in $x$ is $1\}$

**(b)** 1. Define NFA with suitable example in details. Also differentiate NFA and DFA. **04**

2. Show that, any Language is recognized by an NFA if and only if it is recognized by a DFA **03**

**OR**

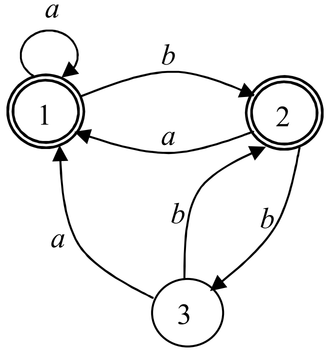
**(b)** 1. Calculate and define recursive definition of extended notation of δ for NFA. **04**

2. Show that any NFA has its equivalent DFA, accepting the same language L. **03**

**Q.3** **(a)** Prove that any regular language can be accepted by a finite automaton with all details **07**

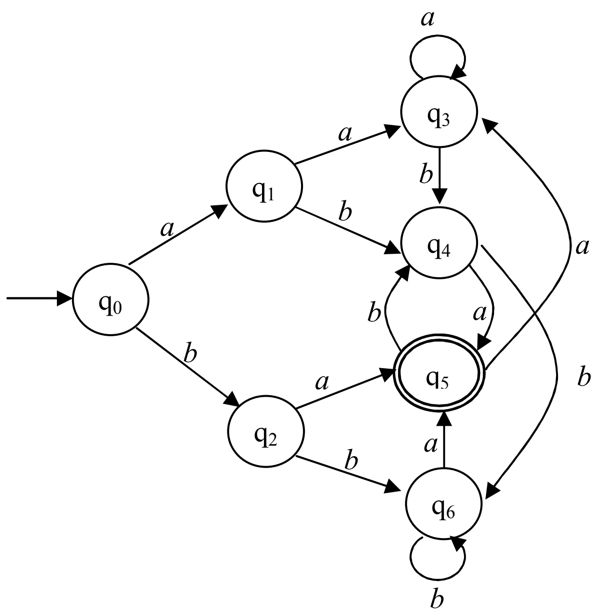
**(b)** 1. Convert a regular expression $(0+1)^*(10) + (00)^*(11)^*$ to an NFA-Λ. **05**

2. For the following finite automaton calculate $r(1, 3, 1)$ and $r(3, 2, 1)$. **02**



**OR**

**Q.3** **(a)** 1. Find the minimized DFA for the following: **04**




2. Define Myhill and Nerode's Theorem for the regular languages and show that $L = \{ ww \mid w \in \{a, b\}^* \}$ is non regular. **03**

**(b)** 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**

**Q.4** **(a)** Construct a DPDA to accept the language of strings with more a's than b's given by $L = \{ x \in \{a, b\}^* \mid n_a(x) > n_b(x) \}$ **07**

**(b)** 1. Remove the Λ-productions from the CFG with given productions and find a CFG generating the equivalent language without Λ. **04**

$S \rightarrow AB \mid \Lambda \qquad A \rightarrow aASb \mid a \qquad B \rightarrow bS$

2. Explain the Chomsky's Hierarchy. **03**

**OR**

**Q.4** **(a)** Design the PDA & its corresponding CFG for the language that accepts simple palindromes given by $L = \{ xcx^r \mid x \in \{a, b\}^* \}$ **07**

**(b)** Convert the CFG with following productions to CNF: **07**

$S \rightarrow AACD \qquad A \rightarrow aAb \mid \Lambda \qquad C \rightarrow aC \mid a \qquad D \rightarrow aDa \mid bDb \mid \Lambda$

**Q.5** **(a)** Explain Pumping Lemma for the Context-Free Language and verify the language $L = \{ a^n b^n c^n \mid n \geq 1 \}$ is Context-free or not. **07**

**(b)** 1. Show that if $L_1$ & $L_2$ are recursive languages, then $L_1 \cup L_2$ and $L_1 \cap L_2$ are also recursive **04**

2. Explain the concept of Context-Sensitive grammar. **03**

**OR**

**Q.5** **(a)** Construct a Turing Machine that accepts the language of palindromes over $\{a, b\}$ Also specify the moves to trace the strings *abaa*, *abba*, *aabaa*. **07**

**(b)** 1. Construct a Turing Machine for accepting $\{a,b\}^*\{aba\}\{a,b\}^*$ **05**

2. Define Turing Machine and give its advantages. **02**

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