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 ∨ q) → r and (p → r) ∨ (q → 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 $n \geq 0$ **04**

$f(n) \leq (5/3)^n$

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**

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

(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

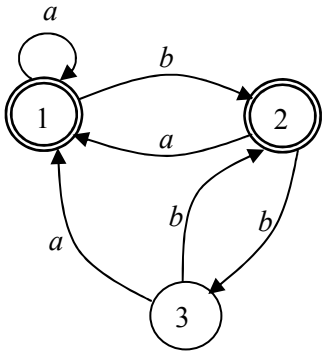
(b) 1. Calculate and define recursive definition of extended notation of δ for NFA. **04**

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**

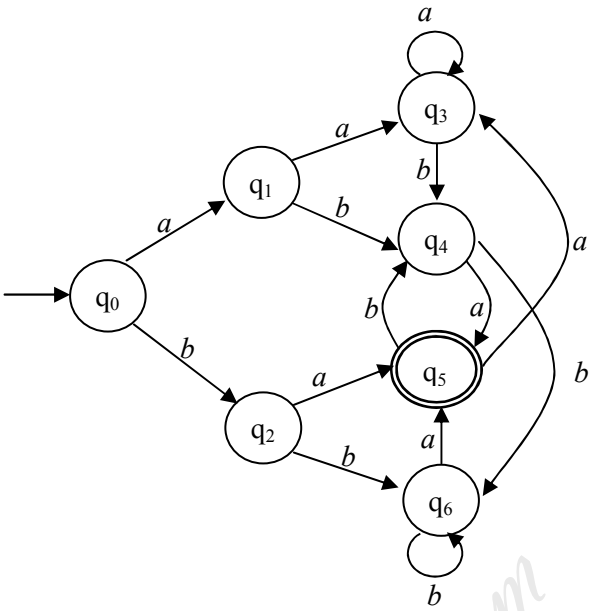
(b) 1. Convert a regular expression $(0+1)^*(10) + (00)^*(11)^*$ to an NFA-Λ. **05**

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 **03**
L = { $ww \mid w \in \{a, b\}^*$ } is non regular.

(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 **07**
L = { $x \in \{a, b\}^* \mid n_a(x) > n_b(x)$ }

(b) 1. Remove the Λ-productions from the CFG with given productions and find a CFG generating the equivalent language without Λ. **04**
S → AB | Λ A → aASb | a B → 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 → AACD A → aAb | Λ C → aC | a D → aDa | bDb | Λ

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

(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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