Seat No.: _____ Enrolment No._____

# GUJARAT TECHNOLOGICAL UNIVERSITY

**BE – SEMESTER – VI EXAMINATION – WINTER 2015**

**Subject Code:160704 Date:14/12/ 2015**

**Subject Name: Theory of Computation**

**Time:2:30pm to 5:00pm 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)** Answer the following. **07**

(i) What is meant by "one to one" and "onto" function? Check whether function f: R ---> R+, $f(x) = x^2$ is one to one and onto.

(ii) What do you mean be recursive definition? Give the recursive definition of Palindrome.

**(b)** Define NFA – Λ. Explain how to convert NFA – Λ into NFA and FA with suitable example. **07**

**Q.2** **(a)** Write Regular Expressions for following **07**

(i) The language of all strings in {0,1}* that do not end with 11.

(ii) The language of all strings containing both 101 and 010 as substrings.

(iii) Strings with length 6 or less in {a,b}.

**(b)** Using Principle of Mathematical Induction, prove that for every n >= 1, **07**

$7 + 13 + 19 + \ldots + (6n + 1) = n(3n + 4)$

**OR**

**(b)** Prove that √2 is Irrational by method of Contradiction. **07**

**Q.3** **(a)** Draw Finite Automata to accept following. **07**

(i) Strings that ends in 11 or 10.

(ii) Strings of the language in {0,1}* with odd no. of zeroes and odd no. of ones.

**(b)** Prove Kleene's Theorem Part 1 with illustration. **07**

**OR**

**Q.3** **(a)** Draw Finite Automata (FA) for following languages: **08**

$L_1$ = {x / 00 is not a substring of x }

$L_2$ = {x / x ends with 01 }

Find FA accepting the language (i) $L_1 - L_2$ and (ii) $L_1 \cap L_2$

**(b)** What is Pumping Lemma and Equivalence Relation ? Explain. **06**

**Q.4** **(a)** Define Push Down Automata (PDA). Design and draw a deterministic PDA accepting strings with more a's than b's. Trace it for the string "abbabaa". **07**

**(b)** Define Context Free Grammar(CFG). **07**

Find CFG for following language:

$L = \{ \mathbf{0^i 1^j 0^k} \ / \ j > i + k \}$

**OR**

**Q.4** **(a)** Define Push Down Automata (PDA). Draw PDA accepting strings of Brackets like following. **07**

$S \rightarrow SS \mid \{S\} \mid [S] \mid \Lambda$

| | | | |
|---|---|---|---|
| | **(b)** | Prove that following CFG is Ambiguous and convert it into unambiguous.<br>$S \rightarrow S + S \mid S * S \mid (S) \mid a$ | **07** |
| **Q.5** | **(a)** | Define Turing Machine. Draw TM for accepting Palindrome Strings in {a,b}*. | **07** |
| | **(b)** | Answer the following<br>(i) Explain time and space complexity<br>(ii) Explain P and NP completeness | **07** |
| | | **OR** | |
| **Q.5** | **(a)** | Explain Universal Turing Machine and Halting Problem. | **07** |
| | **(b)** | Design a Turing Machine to copy strings. | **07** |

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