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 → SS | {S} | [S] | Λ

(b) Prove that following CFG is Ambiguous and convert it into unambiguous. **07**
$S \rightarrow S + S \mid S * S \mid (S) \mid a$

Q.5 **(a)** Define Turing Machine. Draw TM for accepting Palindrome Strings in {a,b}*. **07**

(b) Answer the following **07**
(i) Explain time and space complexity
(ii) Explain P and NP completeness

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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