Seat No.: ________ Enrolment No.___________

GUJARAT TECHNOLOGICAL UNIVERSITY

BE – SEMESTER – VI (NEW).EXAMINATION – WINTER 2016

Subject Code: 2160704 **Date: 25/10/2016**

Subject Name: Theory of Computation

Time: 10:30 AM to 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)** Use the principle of mathematical induction to prove that **07**

$1 + 3 + 5 + \ldots + r = n^2$ for all n>0 where r is an odd integer & n is the number of terms in the sum. (Note : r= 2n-1)

(b) Convert the CFG, G ({S,A,B},{a,b},P , S) to CNF , where P is as follows **07**

S --> aAbB A --> Ab | b B --> Ba | a

Q.2 **(a)** Draw a Turing Machine(TM) to accept Palindromes over {a,b}. (Even as well as Odd Palindromes) **07**

(b) Convert the NFA given in Table below to its corresponding DFA and draw the DFA . **07**

Current State	Input symbol	
	0	1
→Q_0	Q_1	Q_0, Q_2
Q_1	Q_2	Q_0
Q_2 *	Q0	---

OR

(b) Prove that the following CFG is Ambiguous. **07**

S -> S + S | S * S | a | b

Write the unambiguous CFG based on precedence rules for the above grammar. Derive the parse tree for expression (a + a)*b from the unambiguous grammar.

Q.3 **(a)** Let A = {1, 2, 3, 4, 5, 6} and R be a relation on A such that aRb iff a is a multiple of b. Write R. Check if the relation is i) Reflexive ii) Symmetric iii) Asymmetric iv) Transitive **07**

(b) There are 2 languages over $\sum = \{a , b\}$ **07**

L1 = all strings with a double "a"
L2 = all strings with an even number of "a"

Find a regular expression and an FA that define L1∩ L2

OR

Q.3 **(a)** If $L = \{ 0^i 1^i \mid i \geq 0\}$ Prove that L is regular. **07**

(b) Prove that if L1 and L2 are regular languages then L1∩ L2 is also a regular language. **07**

Q.4	**(a)**	Given a CFG , G =({S,A,B},{0,1},P,S) with P as follows S --> 0B| 1A A --> 0S|1AA|0 B --> 1S| 0BB | 1 Design a PDA M corresponding to CFG, G. Show that the string 0001101110 belongs to CFL , L(G)	**07**
	(b)	Design a PDA, M to accept L = { $a^n b^{2n}$ | $n \geq 1$ }	**07**

OR

Q.4	**(a)**	Design a FA for the regular expression (0 + 1)(01)*(011)*	**07**
	(b)	Write a regular expression for language L over {0,1} such that every string in L i) Begins with 00 and ends with 11. **ii)** Contains alternate 0 and 1.	**07**
Q.5	**(a)**	Draw a transition diagram for a Turing machine accepting the following language. { $a^n b^n c^n$ | $n \geq 0$ }	**07**
	(b)	Explain Universal Turing machine with the help of an example	**07**

OR

Q.5	**(a)**	Define functions by Primitive Recursion. Show that the function f(x, y) = x + y is primitive recursive.	**07**
	(b)	Prove Kleene’s Theorem (Part I): Any Regular Language can be accepted by a Finite Automaton (FA).	**07**

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