

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**

$1 + 3 + 5 + \dots + r = n^2$ 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**

$S \rightarrow aAbB \quad A \rightarrow Ab \mid b \quad B \rightarrow Ba \mid a$

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
$\rightarrow Q_0$	Q_1	Q_0, Q_2
Q_1	Q_2	Q_0
Q_2^*	Q_0	---

OR

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

$S \rightarrow S + S \mid S * S \mid a \mid b$

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 $\Sigma = \{a, b\}$ **07**

L_1 = all strings with a double "a"

L_2 = all strings with an even number of "a"

Find a regular expression and an FA that define $L_1 \cap L_2$

OR

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

(b) Prove that if L_1 and L_2 are regular languages then $L_1 \cap L_2$ is also a regular language. **07**

- Q.4 (a)** Given a CFG , $G = (\{S,A,B\}, \{0,1\}, P, S)$ with P as follows **07**
 $S \rightarrow 0B \mid 1A$ $A \rightarrow 0S \mid 1AA \mid 0$ $B \rightarrow 1S \mid 0BB \mid 1$
Design a PDA M corresponding to CFG, G. Show that the string 0001101110 belongs to CFL , $L(G)$
- (b)** Design a PDA, M to accept $L = \{ a^n b^{2n} \mid n \geq 1 \}$ **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 **07**
i) Begins with 00 and ends with 11.
ii) Contains alternate 0 and 1.
- Q.5 (a)** Draw a transition diagram for a Turing machine accepting the following **07**
language. $\{ a^n b^n c^n \mid n \geq 0 \}$
- (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 **07**
primitive recursive.
- (b)** Prove Kleene's Theorem (Part I): Any Regular Language can be accepted by a **07**
Finite Automaton (FA).
