GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER–VI(NEW) – EXAMINATION – SUMMER 2019

Subject Code:2160704   **Date:16/05/2019**
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.

			MARKS
Q.1	**(a)**	Define 1) Parse tree 2) Ambiguous grammar	03
	(b)	Prove by mathematical induction: for every $n \geq 1$, $1 + 3 + 5 + \ldots + (2n - 1) = n^2$	04
	(c)	Consider the grammar: $S \rightarrow ABA$, $A \rightarrow aA \mid \in$, $B \rightarrow bB \mid \in$ Is given grammar ambiguous? If so then remove ambiguity	07
Q.2	**(a)**	Design Moore machine to generate 1's complement of binary number.	03
	(b)	Write Regular Expression over the alphabets {a, b} consisting strings: • Second last character as *'a'* • Starting with *'a'* and ending with *'b'*	04
	(c)	Find context free grammar for the following language. $L_1 = \{a^i b^j c^k \mid i = j + k\}$, $L_2 = (011+1)^* (01)^*$, $L_3 = (0+1)1^*(1+(01)^*)$	07

OR

	(c)	Draw FA for following languages: • L1 = {w | 00 is not substring of w} • L2 = {w | w ends in 01} Find FA accepting languages (i). L1 $\cup$ L2 and (ii). L1 $\cap$ L2	07
Q.3	**(a)**	Give the left linear grammar for RE $(10)^*1$	03
	(b)	Minimize the given DFA:	04

State / Transition	a	b
→ ①	{3}	{2}
2	{4}	{1}
3	{5}	{4}
4	{4}	{4}
5	{3}	{2}

	(c)	Eliminate useless symbols, $\in$-productions and unit productions for the following grammar: $S \rightarrow 0A0 \mid 1B1 \mid BB$, $A \rightarrow C$, $B \rightarrow S \mid A$, $C \rightarrow S \mid \in$	07

OR

Q.3	**(a)**	Consider the grammar: $S \rightarrow aAS \mid a$ $A \rightarrow SbA \mid SS \mid ba$ Derive left most and right most derivation of string *aabbaa* using given grammar.	03
	(b)	Give CFG for following languages: 1). L = a*b* 2). L = $\{a^{n+2} b^n \mid n \geq 0\}$	04
	(c)	Construct finite automata for following left linear grammar: $S \rightarrow X0 \mid Y1$	07

X → Y1
Y → Y0 | 1

Q.4	(a)	Compare PDA with FSM	03
	(b)	Write a note on DPDA and NPDA	04
	(c)	Design a pushdown automata to check well-formed parenthesis.	07

OR

Q.4	(a)	Give the formal definition of Turing machine. Also compare the power of DFA, NFA, DPDA, NDPA and TM	03
	(b)	Write a note on post machines.	04
	(c)	Design a Turing machine to reverse the string over alphabet {0, 1}	07

Q.5	(a)	Compare and contrast push down automata and Turing machine.	03
	(b)	Enlist limitations of Turing machines.	04
	(c)	Design a Turing machine which accepts the language consisting string which contain aba as a substring over alphabets {a, b}	07

OR

Q.5	(a)	Discuss universal Turing machine	03
	(b)	Write a short note on Halting problem	04
	(c)	What is decidability? How to prove that the given language is undecidable? List some undecidable problems.	07

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