Seat No.: ________ Enrolment No.___________

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER–V (NEW) EXAMINATION – WINTER 2020

Subject Code:3151605 **Date:27/01/2021**

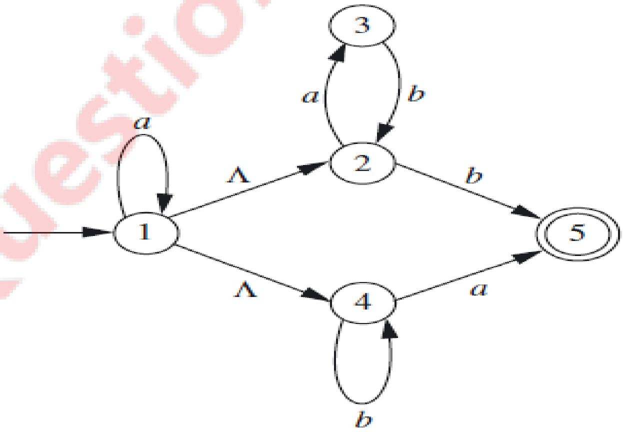
Subject Name:Formal Language and Automata Theory

Time:10:30 AM TO 12:30 PM **Total Marks: 56**

Instructions:

1. **Attempt any FOUR questions out of EIGHT questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

			MARKS
Q.1	**(a)**	Define DFA, NFA and NFA-Λ.	**03**
	(b)	Explain Addition, Multiplication, and Subtraction function for Primitive Recursive Functions.	**04**
	(c)	Draw a Turing Machine(TM) to accept Even and odd Palindromes over {a,b}.	**07**
Q.2	**(a)**	Define the pumping lemma for context free language. Using Pumping Lemma Prove that given Language is not CFL. $L=\{ 0^i 1^j 0^k \mid k > i+j\}$.	**03**
	(b)	Design and draw a deterministic PDA accepting "Balanced strings of Brackets" which are accepted by following CFG. $S \rightarrow SS \mid [\ S\ ] \mid \{\ S\ \} \mid \Lambda$	**04**
	(c)	Convert the following NFA - Λ into its equivalent DFA that accepts the same language.	**07**



Q.3	**(a)**	Write Regular Expression and Valid String for the following a) The Language of all strings Containing both 11 and 010 as Substring. b) The Language of all strings of length 6 or Less.	**03**
	(b)	Find context free grammar for the following language $L = \{a^i b^j c^k \mid i = j + k\}$	**04**
	(c)	Write a short note on Universal Turing Machine.	**07**
Q.4	**(a)**	Consider following grammar: $S \rightarrow ASB \mid \Lambda$ $A \rightarrow aAS \mid a$ $B \rightarrow SbS \mid A \mid bb$ a) Eliminate useless symbols, if any. b) Eliminate Λ productions	**03**

(b) Draw F.A. and Transition Table for following. **04**

c) The Language of all strings with 00 is not a Substring.

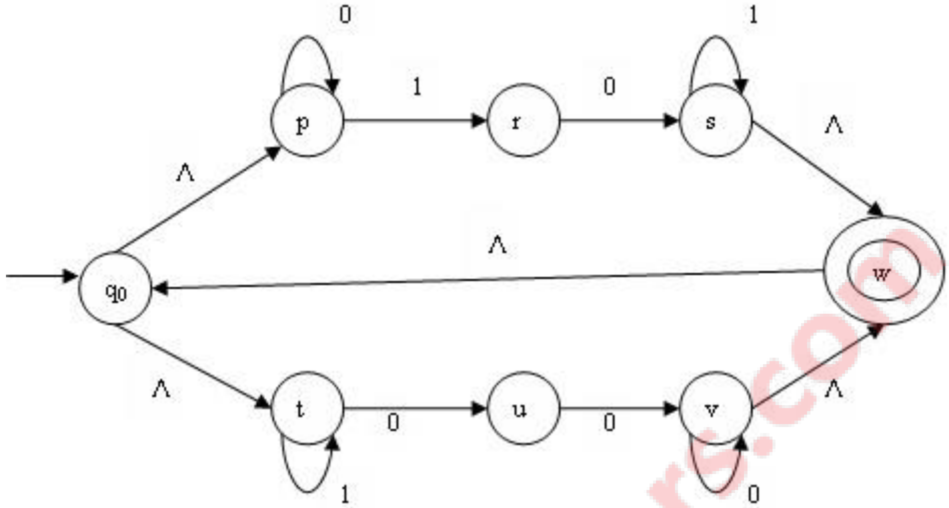
d) The Language of all strings end with 01.

(c) Write a Turing Machine to copy strings. **07**

Q.5 (a) Define: Context-Free Grammars, Chomsky Normal Form and Pushdown Automata. **03**

(b) Calculate following: **04**

1) $\delta^*(q_0, \Lambda)$ 2) $\delta^*(q_0, 0)$ 3) $\delta^*(q_0, 01)$ 4) $\delta^*(q_0, 010)$



(c) Given the context-free grammar G, find a CFG G' in Chomsky Normal Form generating L(G) – {^}. **07**

$S \rightarrow AACD \mid ACD \mid AAC \mid CD \mid AC \mid C$

$A \rightarrow aAb \mid ab$

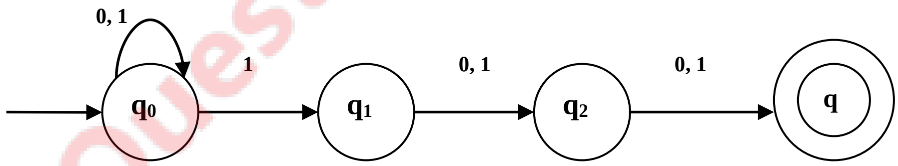
$C \rightarrow aC \mid a$

$D \rightarrow aDa \mid bDb \mid aa \mid bb$

Q.6 (a) Draw F.A. and Transition Table for following. **03**

(a+b)*baaa.

(b) Convert the given NFA to DFA **04**



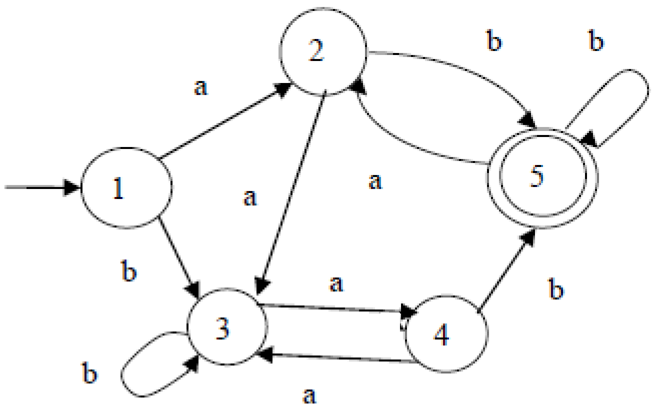
(c) Prove that the following CFG is Ambiguous. **07**

$S \rightarrow S + S \mid S * S \mid (S) \mid a$

Write the unambiguous CFG for the above grammar. Draw parse tree for string a+a*a

Q.7 (a) What is Initial Functions? **03**

(b) Find a minimum-state FA for the following FA **04**



(c) For the PDA, ({q0, q1}, {0, 1}, {0, 1, z0}, δ, q0, z0, ϕ), where δ is **07**

δ(q0, ε, z0) = {(q1, ε)}
δ(q0, 0, z0) = {(q0, 0z0)}
δ(q0, 0, 0) = {(q0, 00)}
δ(q0, 1, 0) = {(q0, 10)}
δ(q0, 1, 1) = {(q0, 11)}
δ(q0, 0, 1) = {(q1, ε)}
δ(q1, 0, 1) = {(q1, ε)}
δ(q1, 0, 0) = {(q1, ε)}
δ(q1, ε, z0) = {(q1, ε)}

Obtain CFG accepted by the above PDA.

Q.8 **(a)** What is Primitive Recursive Functions? **03**

(b) Define Pumping Lemma for Regular Language. Using Pumping Lemma Prove that given Language is not regular Language. **04**

$L = \{ 0^i 1^j 0^k \mid k > i + j\}$.

(c) For the language $L = \{ xcx^r \ / \ x \in \{a,b\}^* \}$ design a PDA(Push Down Automata) and trace it for string "bacab" **07**

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