Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V (NEW) EXAMINATION – WINTER 2023

Subject Code:3151605 Date:07-12-2023

Subject Name:Formal Language and Automata Theory

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.**
4. **Simple and non-programmable scientific calculators are allowed.**

			MARKS
Q.1	**(a)**	What is Finite Automata? Differentiate DFA vs. NFA.	**03**
	(b)	Write regular expressions (REs) over alphabet {0, 1} 1. Strings start with 0 and has odd length 2. Strings have odd length 3. Strings end with 1 and not contain 00 4. Strings start with 1 and has even length	**04**
	(c)	Draw Finite Automata for following languages: 1. L1 = {x/x 00 is not substring of x, x ∈ {0,1}*} 2. L2 = {x/x ends with 01, x ∈ {0,1}*} Draw FA for $L_1 \cup L_2$, $L_1 \cap L_2$ and $L_1 - L_2$	**07**
Q.2	**(a)**	Prove that CFG: S→ aSbS | bSaS | ϵ is ambiguous.	**03**
	(b)	Define Context Free Grammar. 1. Write CFG for regular expression (a|b)*a(a|b)*a(a|b)* 2. Write CFG for equal no. of ‘a’ and ‘b’	**04**
	(c)	Use the pumping lemma to show that following language is not Context Free: L = {$a^n b^n c^n$|n>=0}	**07**
		OR	
	(c)	Design PDA for palindrome with middle symbol ‘c’.	**07**
Q.3	**(a)**	Design FAs with ∑ = {0, 1} that accept 1. The set of all strings with three consecutive 0's. 2. The set of all strings those start with ‘1’ and end with ‘0’.	**03**
	(b)	Convert given CFG to CNF. S → ASB | ϵ A → aAS | a B → SbS | A | bb	**04**
	(c)	Convert NFA to FA using subset construction method.	**07**

NFA Transition table

q	$\delta(q,a)$	$\delta(q,b)$
1	{2,3}	{4}
2	$\{\phi\}$	{4}
3	{4}	{3}
4	$\{\phi\}$	$\{\phi\}$

OR

Q.3 **(a)** Write CFG for balanced parentheses and derive (( ) ( )) **03**

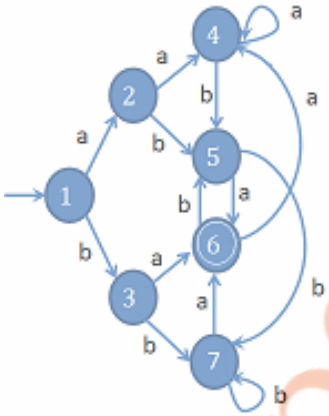
(b) Draw left most derivation tree for string 'aaabbabbba' using CFG **04**

S → aB | bA

A → aS | bAA | a

B → bS | aBB | b

(c) Minimize given FA **07**



Q.4 **(a)** Explain classification of grammar as per Chomsky hierarchy. **03**

(b) Draw right most derivation tree for string 'aaabbabbba' using CFG **04**

S → aB | bA

A → aS | bAA | a

B → bS | aBB | b

(c) Conversion from NFA - ^ to FA **07**

q	$\delta(q, ^)$	$\delta(q, 0)$	$\delta(q, 1)$
A	{B}	{A}	ϕ
B	{D}	{C}	ϕ
C	ϕ	ϕ	{B}
D	ϕ	{D}	ϕ

OR

Q.4 **(a)** Differentiate Finite Automata vs. Pushdown Automata **03**

(b) Show that the function f(x,y) = x + y is primitive recursive **04**

(c) Given a CFG, G = ({S, A, B}, {0,1}, P, S) with P as follows: **07**

S → 0B | 1A

A → 0S |1AA | 0

B → 1S | 0BB | 1

Convert it into equivalent PDA.

Q.5 **(a)** What operations are performed by Turing machine? **03**

(b) Explain the halting problem in brief. **04**

(c) Design a Turing machine for accepting ($a^n b^n c^n$ | n>=0) **07**

OR

Q.5 **(a)** Differentiate recursive language vs. recursively enumerable language **03**

(b) Explain Post's Correspondence Problem (PCP) in brief. **04**

(c) Design a Turing machine for copy a string. **07**

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