Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE – SEMESTER- V EXAMINATION-SUMMER 2023

Subject Code: 3151605 Date: 26/06/2023

Subject Name: Formal Language and Automata Theory

Time: 02:30 PM TO 05:00 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.**

Q.1 **(a)** Define Finite Automata and Pushdown Automata. **03**

(b) What is ambiguous grammar? Does S→ aSbS | bSaS | ϵ ambiguous? **04**

(c) List out the steps involved in pumping lemma for regular language. Prove that L= $\{a^n b^n, n>=0\}$ is a non-regular language using pumping lemma. **07**

Q.2 **(a)** Define Context Free Grammar (CFG) with example. **03**

(b) I. Write CFG which contains at least three times 1 **04**

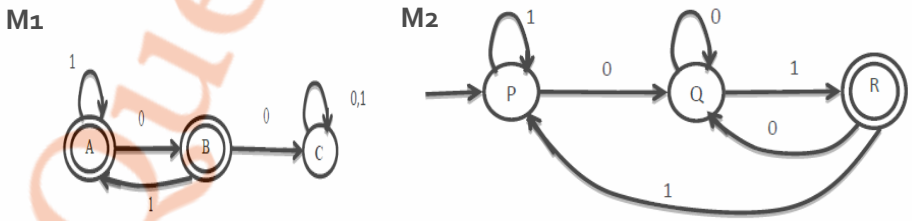
II. Write CFG that must start and end with same symbol

(c) Convert given NFA into an equivalent FA using subset construction method. **07**

δ	Input	
State	0	1
q_0	$\{q_o\}$	$\{q_0, q_1\}$
q_1	$\{q_2\}$	$\{q_2\}$
q_2	$\{q_3\}$	$\{q_3\}$
q_3	$\emptyset$	$\emptyset$

OR

(c) Draw the Finite Automata recognizing the languages: $L_1 \cup L_2$, $L_1 \cap L_2$ and $L_1 - L_2$. **07**



Q.3 **(a)** Differentiate Finite Automata vs. Pushdown Automata **03**

(b) Given a CFG, G = ({S, A, B}, {0, 1}, P, S) with P as follows: **04**

S → 0B| 1A

A → 0S|1AA|0

B → 1S| 0BB | 1

Convert it into an equivalent Pushdown Automata (PDA).

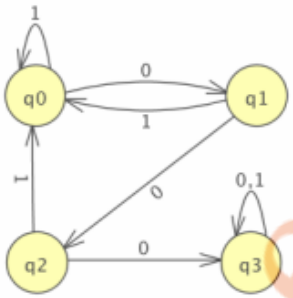
(c) Design a Pushdown Automata (PDA) for L = $\{a^n b^{2n} | n \geq 0\}$. **07**

OR

Q.3 **(a)** Perform leftmost derivation and draw parse tree. **03**

S→A1B
A→0A | ϵ
B→0B | 1B | ϵ
Output string: 1001

(b) Using Extended Transition Function δ^* for FA {{q0,q1,q2,q3}, {0.1}, {q0},{q3},δ}. Calculate $\delta^*(q0,1010010001)$. **04**

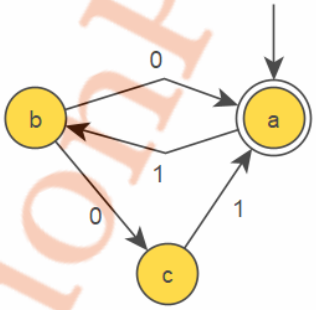


(c) Design a Pushdown Automata (PDA) for L = $\{a^n b^{n+m} c^m \mid n,m>=1\}$. **07**

OR

Q.4 **(a)** Write a note on Chomsky Hierarchy. **03**

(b) Using recursive definition of δ^* in NFA, check acceptability of string 101010 over $\Sigma = \{0,1\}$. **04**



(c) Design a TM for accepting palindrome strings of even & odd length. **07**

OR

Q.4 **(a)** Differentiate Recursively Enumerable Language vs. Recursive Language. **03**

(b) Write short note on Universal Turing Machine. **04**

(c) Write a Turing Machine to delete a symbol from tape head position from given string. **07**

Q.5 **(a)** Show that function f(x, y) = x + y is primitive recursive. **03**

(b) Convert given Context Free Grammar (CFG) to an equivalent Chomsky's Normal Form (CNF). **04**

S→aAbB
A→Ab|b
B→Ba|a

(c) Prove that If L_1 and L_2 are context - free languages, then the languages $L_1 \cup L_2$, $L_1 \cap L_2$, and L_1^* are also CFLs. **07**

OR

Q.5 (a) What are Primitive Recursive Functions? **03**

(b) Explain Post correspondence problem with example. **04**

(c) Convert given NFA- ^ to an equivalent FA. **07**

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

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