

GUJARAT TECHNOLOGICAL UNIVERSITY**BE- SEMESTER-V (NEW) EXAMINATION – WINTER 2024****Subject Code:3151605****Date:28-11-2024****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) Define Deterministic Finite Automata (DFA) and give an example.	03
	(b) Explain the difference between Deterministic Finite Automaton (DFA) and a Nondeterministic Finite Automaton (NFA) with example.	04
	(c) Explore the various closure properties of regular languages, including how the union, intersection, and complement of regular languages can be characterized and computed.	07
Q.2	(a) Define Regular Expressions. Write the regular expression for the language that accepts all strings over $\{0,1\}$ ending with 01.	03
	(b) Describe the Pumping Lemma for regular languages. State the lemma and briefly explain how it is used to prove that a language is not regular.	04
	(c) Design a DFA to accept the language $L = \{w \mid w \text{ has both an even number of 0's and even number of 1's}\}$	07
	OR	
	(c) Describe what Epsilon (ϵ) transitions are in a finite automaton. Illustrate with an example how an NFA with ϵ transitions can be converted into an equivalent NFA without ϵ transitions.	07
Q.3	(a) Define Context-Free Grammar (CFG) and give an example of a CFG.	03
	(b) Explain how ambiguity in a grammar arises with an example.	04
	(c) Consider following grammar: $S \rightarrow aB / bA$ $S \rightarrow aS / bAA / a$ $A \rightarrow bS / aBB / b$ Give leftmost and rightmost derivations of string $w = aaabbabbba$. Also draw the parse tree corresponding to this string.	07
	OR	
Q.3	(a) Define Backus-Naur Form (BNF). Give an example of a BNF notation representing a simple arithmetic expression grammar.	03
	(b) Explain how unit productions are eliminated from a CFG. Provide an example of a grammar before and after eliminating unit productions.	04
	(c) Define CFG. Write CFG for the following language. (i) $L = \{ a^i b^j c^k \mid i, j, k \geq 0, \text{ and } i+j = k \}$ (ii) $L = \{ a^i b^j c^k \mid i, j, k \geq 0, \text{ and } i=j \text{ or } j=k \}$	07

- Q.4** (a) Explain intersection and complements of CFL. **03**
 (b) Describe Chomsky Hierarchy in brief. **04**
 (c) Define Push Down Automata. List out the operations performed on Push Down Automata (PDA). Construct the PDA over alphabet $\Sigma = \{0,1\}$ for the Language $L = \{0^n 1^n \mid n \geq 0\}$. Justify your answer. **07**
- OR**
- Q.4** (a) Explain Context-Free Grammars (CFGs). **03**
 (b) Explain difference between "deterministic Pushdown Automaton" (DPDA) and non-deterministic PDAs (NPDAs). **04**
 (c) Define Push Down Automata and Construct PDA for $L = \{a^i b^j c^k \mid i, j, k \geq 0 \text{ and } i=j \text{ or } i=k\}$ **07**
- Q.5** (a) Explain Recursive Function. **03**
 (b) Explain partial, total and constant function. **04**
 (c) Construct a Turing machine accepting $\{xx \mid x \in \{a, b\}^*\}$. **07**
- OR**
- Q.5** (a) Explain Bounded Minimization. **03**
 (b) Explain primitive recursion function with example. **04**
 (c) Construct a Turing Machine computing the reverse string. **07**
