

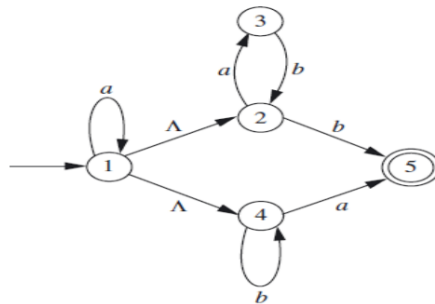
GUJARAT TECHNOLOGICAL UNIVERSITY**BE- SEMESTER- V EXAMINATION – SUMMER 2026****Subject Code:3151605****Date:25-05-2026****Subject Name: Formal Language and Automata Theory****Time: 02:30 PM TO 05:00 PM****Total Marks:70****Instructions:**

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.

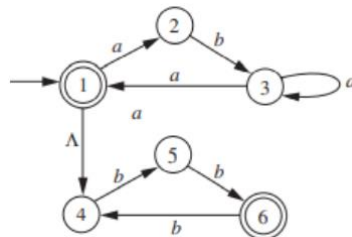
		MARKS	Attribute
Q.1	(a) Define NFA. How does it differ from DFA?	03	R
	(b) Write CFG for regular expression $(a \mid b)^* a (a \mid b)^* a (a \mid b)^*$ Write CFG for $(011 \mid 1)^* (01)^*$	04	U
	(c) Convert given NFA into an equivalent DFA using subset construction method.	07	U/A

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

Q.2	(a) Perform leftmost derivation and draw parse tree. $S \rightarrow A1B$ $A \rightarrow 0A \mid \epsilon$ $B \rightarrow 0B \mid 1B \mid \epsilon$ Output string: 1001	03	R/A
	(b) Explain grammar and Chomsky hierarchy.	04	R
	(c) Convert the following NFA- Λ into NFA and DFA.	07	U/A

**OR**

(c)	Convert the following NFA- Λ into NFA and DFA.	07	U/A
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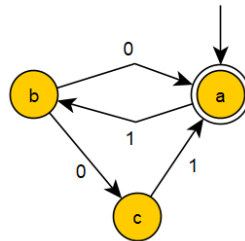


Q.3	(a) Differentiate Finite Automata vs Pushdown Automata	03	R/U
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- (b) Convert following CFG to Chomsky Normal Form (CNF) 04 U/A
 $S \rightarrow AA$
 $A \rightarrow B \mid BB$
 $B \rightarrow abB \mid b \mid bb$
- (c) Draw FA for following languages: 07 A
 • $L_1 = \{w \mid 00 \text{ is not substring of } w\}$
 • $L_2 = \{w \mid w \text{ ends in } 01\}$
 Find FA accepting languages (i). $L_1 \cup L_2$ and (ii). $L_1 \cap L_2$

OR

- Q.3** (a) Prove that the given CFG is ambiguous. 03 R/U
 $S \rightarrow S + S \mid S * S \mid (S) \mid a$
- (b) Convert following CFG to Chomsky Normal Form (CNF) 04 A
 $S \rightarrow ASB \mid \wedge$
 $A \rightarrow aAS \mid a$
 $B \rightarrow SbS \mid A \mid bb$
- (c) Using recursive definition of δ^* in NFA, check acceptability of string 101010 over $\Sigma = \{0,1\}$. 07 U/A



- Q.4** (a) Compare and contrast Pushdown Automata and Turing Machine. 03 R/U
- (b) Convert given CFG into an equivalent PDA. 04 U/A
 $S \rightarrow 0B \mid 1A$
 $A \rightarrow 0S \mid 1AA \mid 0$
 $B \rightarrow 1S \mid 0BB \mid 1$
 Check if generated PDA accepts string 001101 or not?
- (c) Design a PDA for palindrome over $\{a, b\}$ with middle symbol X. 07 A

OR

- Q.4** (a) What is Primitive Recursive Functions? 03 R
- (b) Prove that the language $L = \{a^n b^n a^{n+1} \mid n = 1, 2, 3, \dots\}$ is nonregular using pumping lemma. 04 U
- (c) Design a PDA to check well-formed parenthesis. 07 U/A
- Q.5** (a) Describe recursive languages and recursively enumerable languages. 03 R/U
- (b) Define Primitive Recursive Functions and give complete primitive recursive derivations for the function, $f : \mathbb{N} \rightarrow \mathbb{N}$ defined by $\text{Add}(x, y) = x + y$. 04 R
- (c) Draw a Turing Machine that accepts the language $\{a^n b^n c^n \mid n \geq 0\}$ over $\{a, b, c\}$. 07 A

OR

- Q.5** (a) What is Bounded Mineralization? 03 R
- (b) Explain Post correspondence problem with example. 04 U
- (c) Draw a Turing Machine that accepts Even and Odd Palindrome strings over $\{a,b\}$. 07 U/A
