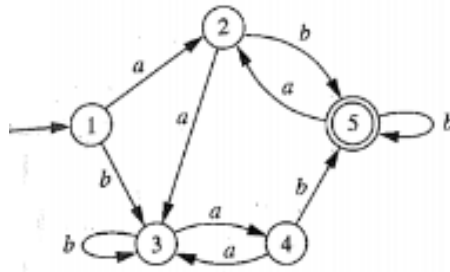


GUJARAT TECHNOLOGICAL UNIVERSITY**BE- SEMESTER- VI EXAMINATION – SUMMER 2026****Subject Code:3160704****Date:08-06-2026****Subject Name: Theory of Computation****Time: 10:30 AM TO 01:00 PM****Total Marks:70****Instructions:**

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.

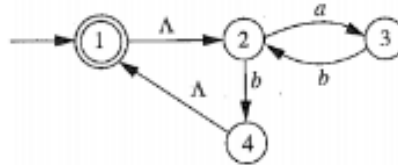
		MARKS
Q. 1	(a) In each case, say whether the indicated function is one-to-one and onto.	03
	i. $f : \mathbb{R}^+ \rightarrow \mathbb{R}^+$ defined by $f(x) = 2x$	
	ii. $g : \mathbb{R}^+ \rightarrow \mathbb{N}$ defined by $g(x) = \lfloor x \rfloor$ (the largest integer $\leq x$)	
(b)	Derive the string $a + (a * a) / a - a$ using leftmost derivation and rightmost derivation for following grammar.	04
	$G : S \rightarrow S + S \mid S - S \mid S * S \mid S / S \mid (S) \mid a$	
(c)	i. Using the principle of Mathematical Induction, Prove that for every $n \geq 1$,	05
	$\sum_{i=1}^n \frac{1}{i(i+1)} = \frac{n}{n+1}$	
	ii. In following case, a relation on the set $\{1, 2, 3\}$ is given. Of the three properties, reflexivity, symmetry, and transitivity, determine which ones the relation has. Give reasons.	02
	$R = \{ (1, 1), (2, 2), (3, 3), (1, 2) \}$	
Q.2	(a) Find a regular expression corresponding to each of the following subsets of $\{0, 1\}^*$.	03
	i. The language of all strings that begin or end with 00 or 11.	
	ii. The language of all strings in which every 0 is followed immediately by 11.	
(b)	Convert the following mealy machine into moore machine.	04
(c)	Use minimization algorithm to find a minimum-state FA.	07



OR

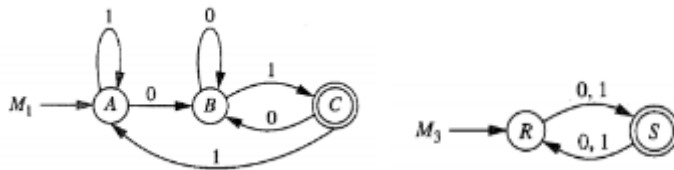
- (c) Convert following NFA- Λ to an NFA.

07



- Q.3 (a) Let M_1 and M_3 be the FAs shown in below figure, recognizing languages L_1 and L_3 respectively.

03



Draw FAs recognizing the language $L_1 \cap L_3$.

- (b) Write a CFG for the regular expression : $(011 + 1)^*(01)^*$.

04

- (c) Find context-free grammar for the following language :

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

04

(ii) The set of odd-length strings in $\{a, b\}^*$ whose first, middle and last symbols are all the same.

03

OR

- Q.3 (a) For following regular expression, draw an FA recognizing the language $0 + 10^* + 01^*0$.

03

- (b) Check whether the grammar is ambiguous or not ?

04

i. $G : S \rightarrow A \mid B$ ii. $G : S \rightarrow aSb \mid aaSb \mid \Lambda$

$A \rightarrow aAb \mid ab$

$B \rightarrow bB \mid \Lambda$

- (c) Given the context-free grammar G , find a CFG G' in Chomsky Normal Form.

07

$G : S \rightarrow aAa \mid bBb \mid \Lambda$

$A \rightarrow aBb \mid bBa$

$B \rightarrow aB \mid bB \mid \Lambda$

- Q.4 (a) Explain in brief Post's Correspondence Problem.

03

- (b) Construct the equivalent PDA for the following CFG :

04

$S \rightarrow XaY \mid YbX$

$X \rightarrow YY \mid aY \mid b$

$Y \rightarrow b \mid bb$

- (c) Design PDA for the language which accepts balanced strings of brackets $\{ \}$ and $[]$.

07

OR

- Q.4 (a) Define Bounded Minimalization.

03

- (b) Show that $L = \{ww \mid w \in \{0, 1\}^*\}$ is not context free language.

04

- (c) Design PDA to accept $L = \{x \in \{a, b\}^* \mid n_a(x) > n_b(x)\}$.

07

- Q.5** (a) Define Constant function, successor function and Projection function. **03**
(b) Write short note on Universal Turing Machine. **04**
(c) Design a Turing Machine that accepts the language of all strings which contain aba as substring. Trace on input string ababab. **07**
- OR**
- Q.5** (a) Show that the multiplication is primitive recursive. **03**
(b) Write short note on Church-Turing Thesis. **04**
(c) Design a Turing Machine that accepts the language of palindromes over {a, b}. **07**
