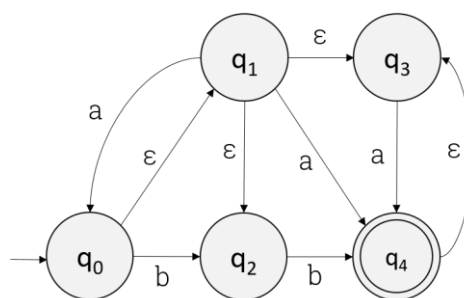


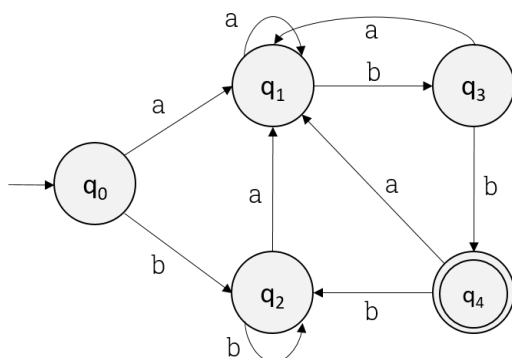
GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-VI (NEW) EXAMINATION – SUMMER 2023****Subject Code:3164203****Date:12-07-2023****Subject Name: Theory of Computation****Time:10:30 AM TO 01:00 PM****Total Marks:70****Instructions:**

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) Define power set. Find the power set of the set $A = \{ \emptyset, \{ \emptyset \} \}$	03
	(b) Describe following relations with example: • Asymmetric relation • Anti-symmetric relation	04
	(c) Explain Principal of Mathematical Induction. Using it, prove following equality: $(7 + 13 + 19 + \dots + (6n + 1)) = n(3n + 4)$	07
Q.2	(a) Differentiate: DFA vs NFA	03
	(b) Write regular expressions for following languages over $\Sigma = \{a, b\}$: • Starting and ending with different symbols • Number of a's are in multiple of 3	04
	(c) Convert following ϵ -NFA to DFA	07

**OR**

(c)	Minimize given DFA using state minimization method	07
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Q.3	(a) Differentiate: Mealy Machine vs Moore Machine	03
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(b)	Convert following Mealy Machine to Moore Machine	04												
	<table border="1"> <thead> <tr> <th>Mealy</th><th>0</th><th>1</th></tr> </thead> <tbody> <tr> <td>$\rightarrow q_0$</td><td>$q_1, 0$</td><td>$q_2, 0$</td></tr> <tr> <td>q_1</td><td>$q_1, 1$</td><td>$q_2, 0$</td></tr> <tr> <td>q_2</td><td>$q_1, 0$</td><td>$q_2, 1$</td></tr> </tbody> </table>	Mealy	0	1	$\rightarrow q_0$	$q_1, 0$	$q_2, 0$	q_1	$q_1, 1$	$q_2, 0$	q_2	$q_1, 0$	$q_2, 1$	
Mealy	0	1												
$\rightarrow q_0$	$q_1, 0$	$q_2, 0$												
q_1	$q_1, 1$	$q_2, 0$												
q_2	$q_1, 0$	$q_2, 1$												

- (c)** Construct FA for given regular expressions: **07**
- $(b(aa)^*b + ab^*a)^*$
 - $(ab + ba)(ab + ba)^*$

OR

- Q.3 (a)** Discuss ambiguous grammar with suitable example. **03**

- (b)** Give two examples of following languages: **04**
- Context free but not regular
 - Not context free

- (c)** Convert following grammar to CNF form **07**

$S \rightarrow AACD$

$A \rightarrow aAb \mid \epsilon$

$C \rightarrow aC \mid a$

$D \rightarrow aDa \mid bDb \mid \epsilon$

- Q.4 (a)** How pushdown automata differs from Finite Automata? **03**

- (b)** Design PDA for following language: **04**
- $\{a^i b^j c^k \mid i, j, k \geq 0 \text{ and } k = i + j\}$

- (c)** Illustrate Pushdown automata for $L = \{w \mid w \in \{a, b\}^* \text{ and } n_a(w) = n_b(w)\}$. **07**

Also show Instantaneous Description for string “aabbababbaa”

OR

- Q.4 (a)** Give formal definition of Turing machine. **03**

- (b)** Solve following Turing Machine problem: Construct TM for $L = \{a^n b^m \mid n < m\}$ **04**

- (c)** Construct Turing Machine for the language **07**
- $L = \{a^n b^n c^n \mid n \geq 1\}$

- Q.5 (a)** Define following functions: **03**

1). Partial 2). Total 3). Constant

- (b)** Discuss primitive recursion with suitable example **04**

- (c)** What is μ -Recursive function? Infer: “All Computable Functions Are μ -Recursive” **07**

OR

- Q.5 (a)** Summarize recursive language and recursively enumerable language **03**

- (b)** Discuss and give example of decidable and undecidable language **04**

- (c)** Explain P and NP problem. Discuss and differentiate. **07**