Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI (NEW) EXAMINATION – WINTER 2023

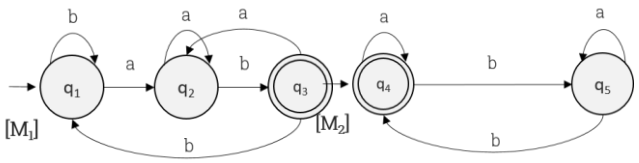
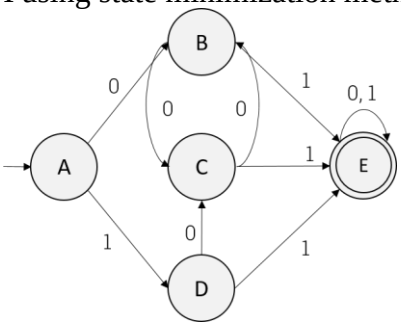
Subject Code:2160704 Date:07-12-2023

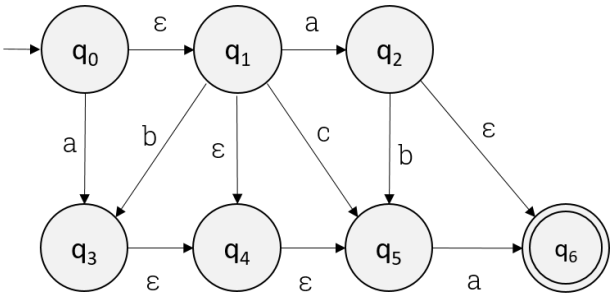
Subject Name: Theory of Computation

Time:02:30 PM TO 05:00 PM Total Marks:70

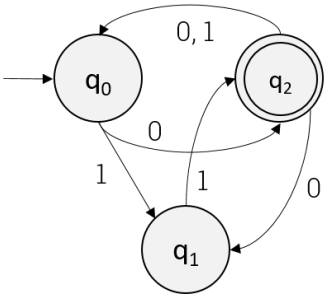
Instructions:

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
Q.1	**(a)**	Discuss various types of function with example.	**03**
	(b)	Prove using contra positive proof method: For $x \in Z$, if $7x + 9$ is even, then x is odd	**04**
	(c)	Summarize principal of mathematical induction and prove $1 + 4 + 7 + \ldots + (3n – 2) = n(3n – 1)/2$ using the same.	**07**
Q.2	**(a)**	Give formal definition of NFA	**03**
	(b)	• Construct DFA over $\Sigma = \{a, b\}$ which accepts all the strings of length at least 2 • Design FA for $\|w\| \bmod 3 = 0$	**04**
	(c)	 Let M_1 and M_2 be DFA representing languages L_1 and L_2 respectively. Construct combined DFA which accepts the language $L_1 \cap L_2$.	**07**
		OR	
	(c)	Minimize following DFA using state minimization method. 	**07**
Q.3	**(a)**	State the differences between DFA and NFA	**03**
	(b)	Explain ε-Closure. Find ε-Closure of following ε-NFA	**04**



(c) Convert following NFA to DFA **07**



OR

Q.3 **(a)** Write regular expression for following languages over Σ = {0, 1} **03**

- Strings having odd number of 1
- Strings having 1 as second last symbol

(b) Compare and contrast Mealy and Moore Machine **04**

(c) Write CFG for following languages over Σ = {a, b}: **07**

- Even length Palindrome
- String starting and ending in different symbols

Q.4 **(a)** Illustrate left and right most derivation for the string "bbaaab" using following grammar: **03**

S → aB | bA
A → a | aS | bAA
B → b | bS | aBB

(b) Illustrate unambiguous grammar with suitable example **04**

(c) Convert following CFG to CNF: **07**

S → ABA
A → aA | ε
B → bB | ε

OR

Q.4 **(a)** Construct PDA for following grammar: **03**

S → AB, A → CD, B → b, C → a, D → a

(b) Design PDA for L = $\{a^n b^n c^m d^m \mid n >= 0, m > 1\}$ **04**

(c) Explain Pumping lemma for CFG. Using pumping lemma, show that L = $\{a^n b^n c^n \mid n >= 0\}$ is not CFL **07**

Q.5 **(a)** Write brief note on Church Turing Thesis **03**

(b) Illustrate the design of Turing machine to find 2's complement of binary number **04**

(c) Construct Turing machine for language: L = $\{a^n b^n c^n \mid n >= 1\}$ **07**

OR

Q.5 **(a)** Explain partial, total and constant function with example. **03**

(b) Summarize working of primitive recursion **04**

(c) Discuss Primitive predicate and Bounded Mineralization **07**

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