Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI(NEW) EXAMINATION – WINTER 2022

Subject Code:3160704 Date:13-12-2022

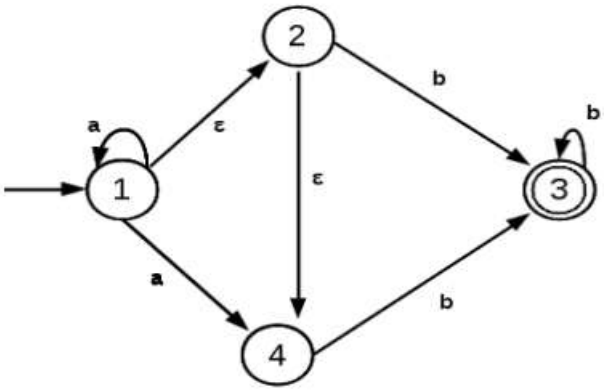
Subject Name:Theory of Computation

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)**	Define the following functions: one-one, on-to, and inverse.	**03**
	(b)	Prove "There must be a prime number between n and n!"	**04**
	(c)	Write down 5-tuple definition for the finite automata. Construct the minimal finite automata over $\Sigma = \{a,b\}$ for the following languages. L1 = {Where all the strings start and ends with different symbol} L2 = {Where every string has odd occurrences of "ba"}	**07**
Q.2	**(a)**	Enlist types of grammars, types of languages and types of automata.	**03**
	(b)	Define pumping lemma for regular language. Show that the language L= $\{a^n b^n c^n / n>=1\}$ is non-regular using pumping lemma theory.	**04**
	(c)	Construct the Moore machine that counts the no. of occurrences of substring "bba" over $\Sigma = \{a,b\}$. Now convert this Moore machine into Mealy machine. Show the transition table and transition diagram for both the machines.	**07**
		OR	
	(c)	Define the steps to convert ε -NFA into NFA. Then convert the following ε -NFA into NFA.	**07**



Q.3	**(a)**	Define type 2 grammar with example.	**03**
	(b)	Construct the regular expressions for the following languages. L1 = {Where the no. of 'a' is odd}, $\Sigma = \{a,b\}$ L2 = {Where every string starts with '0' and of even length}, $\Sigma = \{0,1\}$	**04**
	(c)	What is Instantaneous Description? Construct the pushdown automata over $\Sigma = \{a,b\}$ for the language L = $\{a^n c\, b^n / n>=1\}$.	**07**

OR

Q.3 **(a)** Define the following operations for Push Down Automata: PUSH, POP, and SKIP. **03**

(b) Construct the regular expressions for the following languages. **04**
L1 = {Where every string starts with 'b' and does not contain 2 consecutive a's}, $\Sigma = \{a,b\}$
L2 = {Where every string starts with '1' and of odd length}, $\Sigma = \{0,1\}$

(c) Define: CNF. Show the steps to convert CFG into CNF. Convert the following CFG into equivalent CNF. **07**
$S \rightarrow T\ U$
$T \rightarrow 0T1 \mid \varepsilon$
$U \rightarrow 1U0 \mid \varepsilon$

Q.4 **(a)** Enlist and explain the operations performed by tape in turing machine. **03**

(b) Define pumping lemma for context free language. **04**
Show that the language $L = \{ww / w \in \{a,b\}^*\}$ is not context free language using pumping lemma theory.

(c) Explain ambiguous and unambiguous context free grammar with example. **07**

OR

Q.4 **(a)** Enlist closure properties for the context sensitive language. **03**

(b) Discuss universal turing machine with example. **04**

(c) Write down 7-tuple definition for the turing machine. **07**
Construct the turing machine and its transition table over $\Sigma = \{a,b\}$ for the language $L = \{a^n b^n / n>=1\}$.

Q.5 **(a)** State the following functions: Partial, Constant and Total. **03**

(b) What is minimization? Explain with suitable example. **04**

(c) Discuss Post's Correspondence Problem with example. **07**

OR

Q.5 **(a)** Define the following terms: Recursive language, and Recursive Enumerable Language. **03**

(b) Explain in detail: Class P and Class NP. **04**

(c) Describe: Recursive function. Prove that every recursive function is computable. **07**

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