GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER–VI EXAMINATION – SUMMER 2025

Subject Code: 3160704   **Date: 20-05-2025**

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.

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Q.1	**(a)**	Differentiate between constructive proofs and proofs using contradiction with examples.	**03**
	(b)	Write the Strong Principle of Mathematical Induction and prove that for any integer $n \geq 2$, n is either a prime or a product of two or more primes.	**04**
	(c)	Explain the importance of distinguishable strings and equivalent classes' w.r.t. regular languages.	**07**
Q.2	**(a)**	Define Pushdown Automata.	**03**
	(b)	Explain the idea of Finite State Machines with examples.	**04**
	(c)	Apply the subset construction technique and draw the FA accepting the same language represented by given NFA.	**07**

OR
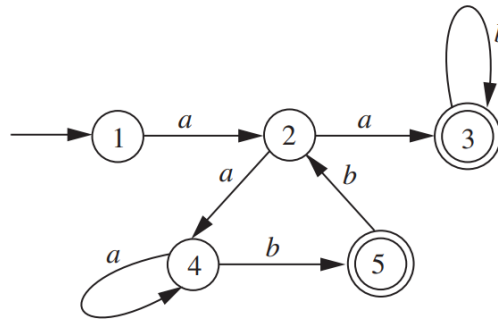
	(c)	Convert the given regular expression to its equivalent NFA-λ.	**07**

$$r = 1 + (101)^* 0 + 01 (01)^* + 11(101)^* + 00(11)^*$$

Q.3	**(a)**	Construct a Finite Automata that accepts all strings over $\{0,1\}^*$ NOT containing the sub-string 101.	**03**
	(b)	Show what languages are generate by the given context free grammar in each case.	**04**

   1. $S \rightarrow aSb \mid bSa \mid$

   2. $S \rightarrow SS \mid bS \mid a \ \lambda$

	(c)	Construct the CFG for the language $L = \{x \in \{0,1\}^* \mid n_0(x) \neq n_1(x)\}$.	**07**

OR

Q.3 (a) Show that the language *pal* of palindrome is not regular. **03**
(b) Find CFG generating the language of even-length strings in $\{a, b\}^*$ with the two **04** middle symbols equal.

(c) Apply the rules and show step by step conversion of the following grammar to CNF. **07**
$$S \rightarrow ABCBCDA$$
$$A \rightarrow CD$$
$$B \rightarrow Cb$$
$$C \rightarrow a \mid \lambda$$
$$D \rightarrow bD \mid \lambda$$

Q.4 (a) Explain the pumping lemma for context free languages. **03**
(b) Explain unambiguous grammar with an example of converting ambiguous grammar **04** to unambiguous.
(c) Apply the rules and step by step create a Turing Machine to accept $\{a, b\}^*\{aba\}$ **07**

OR

Q.4 (a) Explain Ogden's Lemma. **03**
(b) Discuss the decision problems involving CFL. **04**
(c) Construct a Turing machine to accept the strings $x. x^{rev}$ **07**

Q.5 (a) Explain the halting problem? **03**
(b) Discuss the Chomsky hierarchy. **04**
(c) Define and explain the working of Turing Machines. **07**

OR

Q.5 (a) Explain the difference between decidability and acceptability of a language with **03** respect to TM?
(b) Explain Context-Sensitive Grammars and give example of a context-sensitive **04** language.
(c) Discuss the summary of Church – Turing thesis. **07**

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