

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-VI EXAMINATION – SUMMER 2025****Subject Code: 3164203****Date: 28-05-2025****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

		MARKS
Q.1	(a) Define Finite Automata (FA) with an example.	03
	(b) Write regular expressions for the following.	04
	(i) Binary numbers that are multiple of 2.	
	(ii) Strings of a's and b's with no consecutive a's .	
	(iii) Strings of a's and b's containing consecutive a's.	
	(c) Construct a DFA for the language over $\{0, 1\}^*$ such that it contains "000" as a substring.	07
Q.2	(a) Define ε -closure(q) with an example.	03
	(b) State the difference between DFA and NFA.	04
	(c) Prove by pumping lemma, that the language $0^n 1^n$ is not regular.	07
	OR	
	(c) What is ambiguous grammar? Is the following grammar ambiguous? 1. $E \rightarrow E+E \mid E^*E \mid id$ 2. $E \rightarrow E+E \mid E^*E \mid (E)a$ Justify your answer.	07
Q.3	(a) Define Pushdown Automata (PDA).	03
	(b) Construct NPDA for the language $L = \{ww^R \mid w \in (a+b)^*\}$	04
	(c) Compare Deterministic PDA (DPDA) and Non-deterministic PDA (NPDA). Illustrate with an example, are they equivalent?	07
	OR	
Q.3	(a) Construct a CFG for set of strings that contain equal number of a's and b's over $\Sigma = \{a,b\}$.	03
	(b) Check language $L = \{p^n q^n r^n\}$ is context free or not. Justify your answer.	04
	(c) Explain Non-CFL with an example. (Hint: use pumping lemma for CFL.)	07
Q.4	(a) Define Chomsky's Normal Form (CNF)	03
	(b) Check whether the below grammars fulfills CNF. $G_1 = \{S \rightarrow aA \mid bB, B \rightarrow bB \mid b, A \rightarrow aA \mid a\}$ $G_2 = \{S \rightarrow aA \mid bB, B \rightarrow bB \mid \varepsilon, A \rightarrow aA \mid \varepsilon\}$ Justify your answer.	04
	(c) Convert the following grammar into CNF $S \rightarrow cBA, S \rightarrow A, A \rightarrow cB, A \rightarrow AbbS, B \rightarrow aaa$	07
	OR	
Q.4	(a) Define Greibach Normal Form (GNF).	03

- (b) Check whether the below grammars fulfills CNF. 04
 $G1 = \{S \rightarrow aAB \mid aB, A \rightarrow aA \mid a, B \rightarrow bB \mid b\}$
 $G2 = \{S \rightarrow aAB \mid aB, A \rightarrow aA \mid \epsilon, B \rightarrow bB \mid \epsilon\}$
- (c) Convert the following grammar CFG in Greibach Normal Form (GNF). 07
 $S \rightarrow ABb \mid a$
 $A \rightarrow aaA \mid B$
 $B \rightarrow bAb$
- Q.5** (a) What is a Turing machine? 03
 (b) Design a Turing machine with no more than three states that accepts the language $a(a+b)^*$. 04
 Assume $\Sigma = \{a, b\}$
 (c) Prove that for two recursive languages $L1$ and $L2$ their union and intersection is recursive. 07
- OR**
- Q.5** (a) How can we say a problem is decidable or undecidable? 03
 Give one-one example of decidable and undecidable problems.
 (b) Mention the difference between recursive language and recursive enumerable language. 04
 (c) Explain μ -Recursive Function with an example 07
