विश्वजीवनामृतं ज्ञानम्

ABV- Indian Institute of Information Technology & Management, Gwalior

Theory of Computation (IT206)

Major Examination (Session 2023–24)

Maximum Time: 3 Hours **Max Marks: 60**

Note: Attempt all questions. Marks are indicated against each question.

1. (a) Define Regular Expressions. Write a regular expression for the language of binary strings that contain exactly two 1's. (b) Show that DFA, NFA and Regular Expressions are equivalent models of computation. (8 Marks)

2. (a) Minimize the DFA given below and draw the minimized state diagram: States: $\{A, B, C, D, E\}$, Alphabet: $\{0, 1\}$, Start state: A, Final states: $\{C, E\}$. (Transitions will be provided in exam question). (b) Use Pumping Lemma to prove that the language $L = \{a^n b^n \mid n \geq 1\}$ is not regular. (10 Marks)

3. (a) Construct a Pushdown Automaton (PDA) for the language $L = \{a^n b^n \mid n \geq 0\}$. (b) Convert the following CFG into Chomsky Normal Form (CNF): $S \to aSb \mid ab$ (10 Marks)

4. (a) Design a Turing Machine to accept the language $L = \{a^n b^n c^n \mid n \geq 1\}$. (b) Define Unsolvable Problems. Give an example and explain why it is undecidable. (10 Marks)

5. (a) Define P, NP, NP-hard, and NP-complete problems with examples. (b) Show that SAT (Boolean Satisfiability Problem) is NP-complete. (12 Marks)

6. Write short notes on any **two**: (i) Equivalence of DFA and NFA (ii) Applications of Pumping Lemma (iii) Complexity classes beyond NP (iv) Applications of Automata in Compiler Design (10 Marks)