



ABV- Indian Institute of Information Technology & Management, Gwalior

Theory of Computation (IT206)

Major Examination (Session 2024–25)

Maximum Time: 3 Hours

Max Marks: 45

Note: Attempt all questions. Justify your steps clearly to secure full marks.

1. (a) Define and explain the equivalence of DFA and NFA with proof. (b) Minimize the DFA given by the state transition diagram below (diagram to be provided). (8 Marks)
2. (a) Prove using the Pumping Lemma that $L = \{a^n b^n c^n \mid n \geq 1\}$ is not regular. (b) Show that every regular language can be accepted by a DFA with at most 2^n states if the NFA has n states. (8 Marks)
3. (a) Construct a Pushdown Automaton (PDA) for the language $L = \{a^n b^n \mid n \geq 0\}$. (b) Convert the PDA into an equivalent CFG. (8 Marks)
4. (a) Design a Turing Machine that accepts the language $L = \{a^n b^n \mid n \geq 1\}$. (b) Explain how a Turing Machine can simulate a PDA. (7 Marks)
5. (a) Define NP-completeness. Prove that SAT (Boolean Satisfiability) is NP-complete. (b) Explain polynomial-time reductions with an example. (7 Marks)
6. Write short notes on any **two**: (i) Chomsky Hierarchy and its significance (ii) Applications of Automata in Compiler Design (iii) Undecidability of the Halting Problem (7 Marks)