

Roll No.

Total Pages : 03

BT-5/D-23

45170

**FORMAL LANGUAGE &
AUTOMATA THEORY**

PC-CS-303A

Time : Three Hours]

[Maximum Marks : 75

Note : Attempt *Five* questions in all, selecting at least *one* question from each Unit. All questions carry equal marks.

Unit I

1. (a) Explain the concept of the 'epsilon' (ϵ) transition in an NFA and its significance.
- (b) Provide an example of a regular grammar that generates the language of valid identifiers in a programming language. Explain, how the grammar enforces the rules for identifiers.
2. (a) Discuss the process of converting an NFA into an equivalent DFA (NFA to DFA conversion).
- (b) Provide an example of a regular expression for a language that recognizes valid email addresses.

Unit II

3. (a) What is the Chomsky hierarchy ? Where do context-free languages fit within it ?
(b) What is the Pumping Lemma for Regular Languages, and how is it used to prove that a language is not regular ?
4. (a) Explain, how CFGs are used in the syntax analysis phase of compilers. How can you convert a CFG into a parse tree or an abstract syntax tree ? Discuss.
(b) What is the Greibach Normal Form (GNF) for a context-free grammar ? How does it differ from other normal forms like Chomsky Normal Form (CNF) ? Discuss.

Unit III

5. (a) Can you convert a Moore machine into an equivalent Mealy machine ? Provide an example of this conversion.
(b) Describe the closure properties of context-free languages.
6. (a) Explain the differences between deterministic and non-deterministic PDAs in terms of language recognition and computational complexity.

- (b) Describe the role of PDAs in parsing and interpreting programming languages. How do they help in syntax analysis and error checking ?

Unit IV

7. (a) How does Rice's Theorem relate to the Halting Problem and the decidability of specific properties of Turing machines ? Discuss.
- (b) How does the concept of non-deterministic polynomial time (NP) relate to Turing machines, and what is the significance of the P vs. NP problem ?
8. (a) Explain the reduction of the Halting Problem to the Post Correspondence Problem. How does this reduction demonstrate the undecidability of the Post Correspondence Problem ?
- (b) Describe the concept of a universal Turing machine, and how can it simulate the execution of any other Turing machine.