Roll No. 2021218213 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.