MCA-302

June - Examination 2026

MCA 2nd / MCA 3rd Year Examination

Formal Language and Automata

Paper : MCA-302

[*Time: **3** Hours*] [*Maximum Marks: **80***]

Note :- The question paper is divided into three Sections A, B and C. Write answers as per the given instructions in each section.

Section-A 8×2=16

(Very Short Answer Type Questions)

Note :- Answer **all** questions. As per the nature of the question delimit your answer in one word, one sentence or maximum up to **30** words. Each question carries **2** marks.

1. (i) Briefly explain the principle of Mathematical Induction.
   (ii) Define a Non-Deterministic Finite State Machine.
   (iii) What are the applications of Regular Expressions?
   (iv) What is the Kleene Star Operator? Explain it with an example.
   (v) Explain the NP-Complete Problem.
   (vi) What is the halting problem of a Turing Machine?
   (vii) Give a difference between Empty Set and Null Set.
   (viii) What is Tree? Give one example.

Section-B 4×8=32

(Short Answer Type Questions)

Note :- Answer **any four** questions. You have to delimit your each answer maximum up to **200** words. Each question carries **8** marks.

2. Convert the following transition table (→ indicate start state and * indicate final state) into DFA -

	0	1
→A	C	B
B	C	B
C	C	D
*D	D	D

3. Explain how finite automata concepts are utilized in the lexical analysis phase of a compiler.

4. Construct a PDA, that accepts the language $L = \{0^n 1^n | n <= 0\}$. Assume that at the start of computation, the tape head is on the leftmost symbol of the input tape.

5. Explain the fundamental computational difference between Recursive languages and Recursively enumerable languages.
6. What is ambiguity in Context-Free Grammars? Provide an example of an ambiguous grammar and its derivation trees.
7. Construct a finite automata for the regular expression 10 + (0 + 11) 0 * 1.
8. Write a short note on a Multi-track Turing Machine.
9. Given the Regular Expression (a + b) * abb, construct a Non-Deterministic Finite Automaton with null moves (ε-NDFA) representing this expression.

Section-C

2×16=32

(Long Answer Type Questions)

Note :- Answer **any two** questions. You have to delimit your each answer maximum up to **500** words. Each question carries **16** marks.

10. Outline the complete algorithmic steps required to convert a given Mealy machine into an equivalent Moore machine, and demonstrate this using a generalized transition table example.
11. Describe the step-by-step equivalence algorithm for the minimization of Finite Automata. Apply this method to mathematically minimize a given DFA with states $Q = q_0, q_1, q_2, q_3, q_4, q_5,$ where q_0 is the start state, q_2 and q_5 are the final states, and q_1, q_3, q_4 exhibit identical transition behaviors for inputs 0 and 1.
12. Explain the basic model of a Turing Machine. Design a Turing Machine over {1} which can compute a function $f(n) = n^2$ over $\sum = \{1\}$.
13. Explain the block diagram of the Turing Machine with its components specification, language and transition table.
