S.No. 8044

24DPMAE03

(For the candidates admitted from 2024 – 25 onwards)

M.Sc. DEGREE EXAMINATION, AUGUST 2025.

First Semester

Maths

DISCRETE MATHEMATICS

Time : Three hours Maximum : 75 marks

PART A — ($10 \times 2 = 20$ marks)

Answer ALL questions.

1. Define proposition.
2. What is Prepositional Logic?
3. Write the pigeonhole principle.
4. Define Permutations and Combinations.
5. Define Recurrence relation.
6. How do you calculate recurrence?
7. Define Boolean Expression.
8. What are the 4 logic gates?
9. Write the types of Finite-State Machines.
10. What are the 4 parts of the Turing machine?

PART B — ($3 \times 5 = 15$ marks)

Answer any THREE questions out of five questions.

11. Explain about the types of propositions.
12. How many numbers are there between 99 and 1000, having at least one of their digits 7?
13. What is the recurrence relation? Explain with an example.
14. What are the basic logic gates? Explain with an example.
15. Discuss Finite-State Machines with Output.

PART C — ($5 \times 8 = 40$ marks)

Answer ALL questions.

16. (a) (i) Prove $[(A \to B) \wedge A] \to B$ is a tautology using truth table.

(ii) Prove $(A \vee B) \wedge (\neg A)$ a contingency using truth table.

Or

(b) Explain propositional equivalence and logical implications with suitable examples. Discuss how these concepts are used in constructing valid arguments.

17. (a) State and prove the Pigeonhole Principle. Discuss its applications in real-world scenarios.

Or

(b) Twenty-five crates of apples are delivered to a store. The apples are of three different sorts, and all the apples in each crate are of the same sort. Show that among these crates there are at least nine containing the same sort of apples.

18. (a) Explain the concept of generating functions and demonstrate how to solve the recurrence relation: $b_{n-}3b_{n-1} = 2^n$ with $b_0 = 1$ using generating functions.

Or

(b) Use generating functions to solve the following recurrence relation: $a_n = 2a_{n-1} + 3^n$ for $n \geq 1$ with the initial condition $a_0 = 1$. Verify your solution for $n - 2$.

19. (a) Define and discuss: Boolean algebra and its basic operations.

Or

(b) Explain various types of Logic gates with examples.

20. (a) Discuss the states and transitions with a state transition diagram.

Or

(b) Explain how a Turing Machine differs from a Finite-State Machine (FSM) in terms of computational power.

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