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Name.....

Reg. No.....

**FIRST SEMESTER M.Sc. DEGREE (REGULAR/SUPPLEMENTARY)
EXAMINATION, NOVEMBER 2025**

(CBCSS)

Mathematics

MTH 1C 04—DISCRETE MATHEMATICS

(2019 Admission onwards)

Time : Three Hours

Maximum : 30 Weightage

Part A (Short Answer Type Questions)*Answer all questions.**Each question carries a weightage 1.*

1. Define Lattice.
2. Define total order.
3. Let $(X, +, \cdot, ')$ be a Boolean algebra. Then prove that for all elements x, y and z of X ,

$$x \cdot (y \cdot z) = (x \cdot y) \cdot z.$$

4. Define labeled graph.
5. Prove that the Petersen graph P is nonplanar.
6. Show that every plane triangulation of order $n \geq 4$ is 3-connected.
7. Define language accepted by an nfa. Give an example.
8. Define dfa.

(8 × 1 = 8 weightage)

Turn over

Part B (Paragraph Type Questions)

Answer any **two** questions from each module.

Each question carries a weightage 2.

MODULE I

9. Define a chain in a poset. Prove that the intersection of two chains is a chain.
10. State the law of double complementation in a Boolean algebra.
11. Write the following Boolean function in their disjunctive normal form.

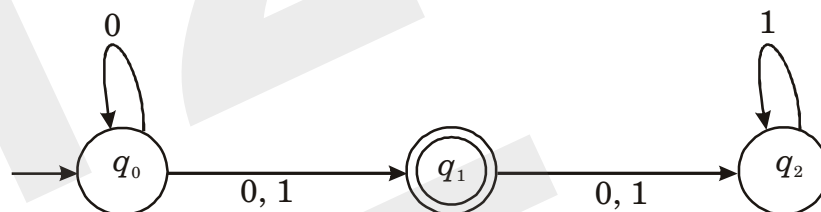
$$f(x_1, x_2, x_3) = (x_1 + x_2')x_3' + x_2x_1'(x_2 + x_1'x_3).$$

MODULE II

12. In any group of n persons ($n \geq 2$), prove that there are at least two with the same number of friends.
13. Prove that an edge $e = xy$ is a cut edge of a connected graph G if and only if there exist vertices u and v such that e belongs to every u - v path in G .
14. Prove that every connected graph contains a spanning tree.

MODULE III

15. Convert the nfa in the following figure into an equivalent deterministic machine.



16. Find a deterministic finite accepter that recognizes the set of all strings on $\Sigma = \{a, b\}$ starting with the prefix ab .
17. Show that the language

$$L = \{awa : w \in \{a, b\}^*\}$$

is regular.

(6 × 2 = 12 weightage)

Part C (Essay Type Questions)

Answer any two questions.

Each question carries a weightage 5.

18. Let X be a finite set and \leq a partial order on X . Define a binary relation R on X by xRy if and only if y covers x (w.r.t. \leq). Then prove that \leq is generated by R .
19. Prove that the number of edges in a tree on n vertices is $n - 1$. Also prove that a connected graph on n vertices and $n - 1$ edges is a tree.
20. State and prove Euler Formula.
21. Let $M = (Q, \Sigma, \delta, q_0, F)$ be a deterministic finite acceptor, and let G_M be its associated transition graph. Then prove that for every $q_i, q_j \in Q$, and $w \in \Sigma^+$, $\delta^*(q_i, w) = q_j$ if and only if there is in G_M a walk with label w from q_i to q_j .

(2 × 5 = 10 weightage)