PAPER ID-311475

Roll No: | | | | | | | | | | | | |

MCA
(SEM I) THEORY EXAMINATION 2024-25
DISCRETE MATHEMATICS

TIME: 3 HRS   **M.MARKS: 100**

Note: Attempt all Sections. In case of any missing data; choose suitably.

SECTION A

1. **Attempt *all* questions in brief.**   **2 x 10 = 20**

Q no.	Question	CO	Level
a.	Find the Cartesian product A × B when A = {1, 2, 3} and B = {a, b, c, d}.	1	K1, K2
b.	Describe the different types of relations.	1	K1, K2
c.	Compare the properties of modular and complemented lattices.	2	K2, K3
d.	Summarize the importance of Hasse diagrams in representing partially ordered sets.	2	K2, K3
e.	Explain the difference between universal and existential quantifiers.	3	K3, K4
f.	Classify Mathematical Induction.	3	K3, K4
g.	Categorize groups.	4	K3, K4
h.	Compare the properties of rings and fields.	4	K3, K4
i.	Define Peano's axioms.	5	K1, K3
j.	Define pigeonhole principle.	5	K1, K3

SECTION B

2. **Attempt any *three* of the following:**   **10 x 3 = 30**

Q no.	Question	CO	Level
a.	Summarize the key properties of functions, including injective, surjective, and bijective functions, and discuss their significance in mathematical modeling.	1	K1, K2
b.	Explain the significance of logic gates in digital circuits. Discuss how NAND and NOR gates are functionally complete.	2	K2, K3
c.	Solve how truth tables can be used to determine logical equivalences. Provide an example of two logically equivalent statements.	3	K3, K4
d.	Simplify the role of homomorphism and isomorphism in group theory. Provide examples where these concepts are applicable.	4	K3, K4
e.	Show how Polya's counting theorem can be used to determine the number of distinct colorings of a hexagonal object using 3 colors.	5	K1, K3

SECTION C

3. **Attempt any *one* part of the following:**   **10 x 1 = 10**

Q no.	Question	CO	Level
a.	Show that if a function f: A → B is both injective and surjective, then it is bijective. Provide an example and counterexample.	1	K1, K2
b.	Explain the difference between recursively defined functions and explicitly defined functions. Provide an example of each.	1	K1, K2

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4.   Attempt any *one* part of the following: 10 x 1 = 10

Q no.	Question	CO	Level
a.	Apply the simplified Boolean expression for the function F(A, B, C) = A'B + AB' + ABC using Karnaugh maps. Show all steps.	2	K2, K3
b.	Solve and minimize the Boolean function F(A, B, C, D) = A'B + A'CD + BCD.	2	K2, K3

5.   Attempt any *one* part of the following: 10 x 1 = 10

Q no.	Question	CO	Level
a.	Analyze the truth table for the compound proposition (P → Q) ∧ (¬Q →¬P) and determine whether it is a tautology, contradiction, or contingency.	3	K3, K4
b.	Inspect the validity of the argument using the rules of inference: Premises: (P ∨ Q), (¬P → R), (¬Q → S), (¬R ∨ ¬S) Conclusion: ¬P ∧ ¬Q	3	K3, K4

6.   Attempt any *one* part of the following: 10 x 1 = 10

Q no.	Question	CO	Level
a.	Solve the order of a group with 10 elements under modulo addition and verify whether it forms an Abelian group.	4	K3, K4
b.	Inspect whether the set of integers under multiplication forms a group. Justify your answer with group properties.	4	K3, K4

7.   Attempt any *one* part of the following: 10 x 1 = 10

Q no.	Question	CO	Level
a.	Compute the sum of the first 50 natural numbers using mathematical induction.	5	K1, K3
b.	Determine the number of ways to distribute 10 identical objects among 4 people using combinatorial techniques.	5	K1, K3