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**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 $A \times B$ 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 $f: A \rightarrow B$ 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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**TIME: 3 HRS****M.MARKS: 100****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 $(P \rightarrow Q) \wedge (\neg Q \rightarrow \neg P)$ 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: $(P \vee Q), (\neg P \rightarrow R), (\neg Q \rightarrow S), (\neg R \vee \neg S)$ Conclusion: $\neg P \wedge \neg Q$	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