

Roll No.

Total No. of Pages : 02

Total No. of Questions : 09

MCA (Sem.-1)

DISCRETE STRUCTURES & OPTIMIZATION

Subject Code : PGCA-1917

M.Code : 79035

Date of Examination : 03-06-2025

Time : 3 Hrs.

Max. Marks : 60

INSTRUCTIONS TO CANDIDATES :

1. **SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.**
2. **SECTION - B & C have FOUR questions each.**
3. **Attempt any FIVE questions from SECTION B & C carrying EIGHT marks each.**
4. **Select atleast TWO questions from SECTION - B & C.**

SECTION-A

- I. Write short notes on :**
- a) What is the relationship between Boolean algebra[^] logic gates and Karnaugh maps?
 - b) What are partial orders and equivalence relations in set theory?
 - c) Define morphisms in ideal rings and their connection to quotient rings.
 - d) Define a Boolean sub-algebra and its relationship to Boolean rings.
 - e) Provide a brief overview of generating functions in combinatorial mathematics.
 - f) Differentiate between semi-groups, subgroups and normal subgroups in group theory.
 - g) List characteristics and properties of dihedral groups.
 - h) Define plane and connected graphs in graph theory.
 - i) State the applications and significance of trees in graph theory.
 - j) Explain the concepts of isomorphism and homomorphism in group theory and graph theory.

SECTION-B

2. Explain the concept of recurrence relations in mathematics. Provide a detailed overview of their significance, applications, and how they are used to model various real-world phenomena such as Tower of Hanoi problem and codeword enumeration problems. Take suitable examples.
3. Consider a partially ordered set (poset) P with eight elements, $\{a, b, c, d, e, f, g, h\}$, where the partial order is defined by divisibility. In other words, for any two elements x and y in P , x is less than or equal to y ($x \leq y$) if x divides y .
 - a) Find all minimal and maximal elements in the poset P .
 - b) Determine the greatest lower bound (meet) and least upper bound (join) for the pairs of elements (a, b) , (c, d) , (e, f) , and (g, h) in the poset P .
 - c) Construct the Hasse diagram for the poset P , indicating all the elements and the relationships between them.
 - d) Verify whether the poset P forms a lattice, and if so, determine if it is a distributive lattice or not.
4. Use generating functions to find the number of ways to collect \$15 from 20 distinct people if each of the first 19 people can give a dollar (or nothing) and the twentieth person can give either \$1 or \$5 (or nothing).
5. Describe the concept of a quotient ring and its creation from an ideal within a given ring. Offer a detailed example to demonstrate the formation and properties of a quotient ring.

SECTION-C

6. Explain how Dihedral groups relate to symmetries and transformations of polygons. Take relevant examples to justify your answer.
7. Consider a group G and a subgroup H . Define left and right cosets of H in G . Show that for any subgroup H of G , the left cosets and right cosets have the same number of elements.
8. Describe a Hamiltonian cycle in a graph G and provide an example of a graph that has one. Explain the challenges in determining if a graph has a Hamiltonian cycle.
9. Investigate the characteristics of Eulerian graphs and explain how to find an Eulerian path or circuit in a given graph.

NOTE : Disclosure of Identity by writing Mobile No. or Marking of passing request on any paper of Answer Sheet will lead to UMC against the Student.