

**BACHELOR OF TECHNOLOGY (CBCS - 2023)**  
**B. Tech. Sem-III INFORMATION TECHNOLOGY : SUMMER : 2025**  
**SUBJECT: DISCRETE STRUCTURE & GRAPH THEORY**

Day : Tuesday  
Date : 13/05/2025

**S-29243-2025**

Time : 02:30 PM-05:30 PM  
Max. Marks : 60

**N.B.:**

- 1) All questions are **COMPULSORY**.
- 2) Figures to the right indicate **FULL** marks.
- 3) Use of non-programmable **CALCULATOR** is allowed.
- 4) Assume suitable data if necessary.

- Q.1** Among 130 students, 60 study Mathematics, 51 Physics and 30 both Mathematics and Physics. Of the 54 students studying Chemistry, 26 study Mathematics, 21 Physics and 12 both Mathematics and Physics. All the students studying neither Mathematics nor Physics are studying Biology. [10]
- a) How many students are studying Biology?
  - b) How many students not studying Chemistry are studying Mathematics but not Physics?
  - c) How many students are studying neither Mathematics nor Physics nor Chemistry?

**OR**

- Q.1** Simplify the following propositional formula using logical equivalences: [10]  
 $\neg(P \vee Q) \wedge (P \Rightarrow R) \vee (Q \Rightarrow S)$   
Show all the steps involved in simplifying the formula, and explain why the equivalences used are valid.

- Q.2** Given the relation R on the set  $A = \{1, 2, 3, 4\}$  defined by  $R = \{(1, 1), (2, 2), (3, 3), (4, 4), (1, 2), (2, 1), (3, 4), (4, 3)\}$ , prove whether R is an equivalence relation. Justify your answer by checking the properties of reflexivity, symmetry and transitivity. [10]

**OR**

- Q.2** Let R be a relation on the set  $A = \{1, 2, 3\}$  given by  $R = \{(1, 2), (2, 3)\}$ . [10]  
Compute the reflexive closure, symmetric closure and transitive closure of R. Discuss the closure properties and explain how each closure affects the original relation.

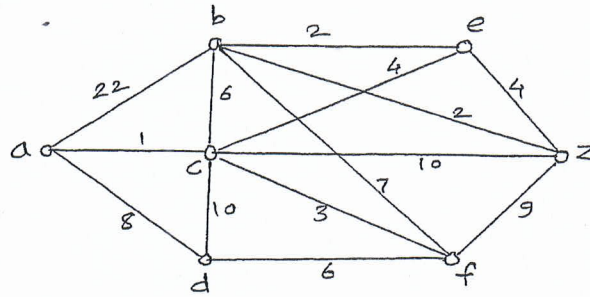
- Q.3** A student wishes to prepare for four subjects during a seven day period; so that she may be able to devote at least one day for each subject. Find the number of ways in which she can plan her time table. Explain the calculations step by step with formulae. [10]

**OR**

- Q.3** Evaluate the difference in outcomes between problems using permutations versus combinations. Analyze the scenario of seating arrangements versus group selection among 10 people. [10]

**P.T.O.**

- Q.4 For the following graph, find the shortest path from a to z using Dijkstra's algorithm. [10]



OR

- Q.4 Analyze the difference between Hamiltonian paths and Euler paths. For each, [10]  
provide an example graph where one exists but the other does not. Explain the conditions under which each type of path or circuit can be found in a graph.
- Q.5 Explain the concept of minimal spanning trees and describe why they are [10]  
essential in network design. Compare Kruskal's and Prim's algorithms for finding the minimal spanning tree and discuss their time complexities and use cases.

OR

- Q.5 Insert the following sequence of numbers into a binary search tree (BST) : 10, [10]  
20, 5, 6, 15, 2. After constructing the BST, perform in-order traversal and explain the output. What are the advantages of performing in-order traversal in a binary search tree?
- Q.6 Prove that the set of positive integers under addition forms a monoid. Show [10]  
that it satisfies the closure, identity and associativity properties. Discuss how this example contrasts with a semi-group.

OR

- Q.6 Given a group  $G$  under addition, show that the set of even integers forms a [10]  
subgroup of  $G$ . Prove the subgroup properties: closure, identity, inverses and associativity.

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