

**BACHELOR OF TECHNOLOGY (CBCS) (2021-COURSE)**  
**B. Tech. Sem - III Computer Science & Engineering : SUMMER : 2025**  
**SUBJECT: DISCRETE MATHEMATICAL STRUCTURES**

Day : Wednesday  
Date : 14/05/2025

S-25311-2025

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) Assume suitable data **WHEREVER** necessary.
- 4) Draw neat labeled diagrams **WHEREVER** necessary.

- Q.1** What are the key differences between propositional logic and predicate logic. (10)  
Prove the following:  
Show that  $r$  follows from  $p, p \rightarrow q$  and  $q \rightarrow r$ .  
Show that  $\neg p$  follows from  $p \rightarrow q$  and  $\neg q$ .  
Show that  $r$  follows from  $p, p \rightarrow q$  and  $(p \wedge q) \rightarrow r$ .  
**OR**
- Q.1** List the Rules of Inference. Prove any five rules. (10)
- Q.2** What is a set? Explain different operations on set. Also list the fundamental set identities. Prove De Morgan's Laws. (10)  
**OR**
- Q.2** How does the Chinese Remainder Theorem (CRT) provide a systematic approach to solving systems of congruence? Also explain its principles and significance in number theory. (10)
- Q.3** State the Pigeonhole Principle. Explain how the Pigeonhole Principle applies to this scenario: You are organizing a conference with  $n$  attendees. Each attendee is assigned to one of  $m$  breakout sessions with  $m < n$ . (10)  
**OR**
- Q.3** Consider the directed graph  $G$  with vertices  $V = \{A, B, C, D\}$  and edges  $E = \{(A, B), (B, C), (C, D), (D, A)\}$ . (10)  
Compute the Transitive Closure of the graph  $G$  using Warshall's algorithm.  
Explain how the Transitive Closure matrix obtained from Warshall's algorithm represents the reachability information between pairs of vertices in the original graph  $G$ .
- Q.4** Consider the set  $S = \{a, b, c, d, e, f\}$  with the relation  $\leq$  defined as follows: (10)  
 $a \leq b, a \leq c, b \leq d, c \leq d, b \leq e, c \leq f$   
i. Determine whether  $S$  with the relation  $\leq$  forms a partially ordered set (POSET). Justify your answer.  
ii. Determine whether  $S$  with the relation  $\leq$  forms a lattice.  
**OR**
- Q.4** Define Homomorphism and Isomorphism. How do homomorphism and Isomorphism serve as fundamental concepts for studying and comparing Algebraic Structures? (10)

P.T.O

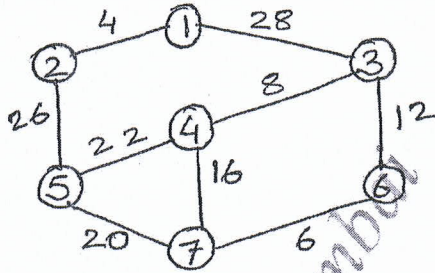
Q.5 Explain with example and suitable formulae what are Sum Rule and Product Rule. (10)  
Solve the following:

- i. In New Hampshire, license plates consisted of two letters followed by 3 digits. How many possible license plates are there?
- ii. How many legal configurations are there in Towers of Hanoi with  $n$  rings?

OR

Q.5 What is Recurrence Relation? Explain First Order and Second Order Recurrence Relations. Consider the sequence  $a_0, a_1, a_2, \dots$  defined by the recurrence relation  $a_n = 3a_{n-1} + 2$  with initial condition  $a_0 = 1$ . Calculate the first five terms of the sequence. (10)

Q.6 What is a Minimum Spanning Tree (MST)? Differentiate between Kruskal's and Prim's Minimum Spanning Tree. Find MST in the given graph using Kruskal's algorithm. (10)



OR

Q.6 Explain what a planar graph is? Differentiate between Eulerian and Hamiltonian paths and circuits using suitable example. (10)

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