Enrolment No/Seat No.: _____

R.N.G.PATEL INSTITUTE OF TECHNOLOGY-RNGPIT

(An Autonomous College U/s UGC Act 1956)

IMSc-IT. SEMESTER-II, SEMESTER END EXAMINATION - SUMMER 2025

Subject Code: 1BS202 **Date: 12-05-2025**

Subject Name: DISCRETE MATHEMATICS

Time: 11:00 AM to 02:00 PM **Total Marks: 70**

Instructions

1. It is **compulsory** for students to write **Enrolment No. /Seat No.** on the question paper.
2. Write answers of **Section A** and **Section B** in **separate answer books**.
3. Attempt all questions from both **Section A** and **Section B**.
4. Each section carries **35 marks**, with a total of **70 marks** for the examination.
5. The figures to the right of each question indicate full marks, make suitable assumptions with justification.
6. BL - Bloom's Taxonomy Levels (R-Remember, U-Understanding, A –Application, N –Analyze, E – Evaluate, C -Create), CO - Course Outcomes.

SECTION (A)

		Marks	BL	CO
Q.1	**Multiple-Choice Questions**	**[05]**		
(a)	The relation $R: A \to B$ is said to be equivalence if it is _____ **(i)** Reflexive **(ii)** Symmetric **(iii)** Transitive **(iv)** All of the above	**1**	**R**	**1**
(b)	In a truth table, if all truth values are true then it is said to be: **(i)** Tautology **(ii)** Contradiction **(iii)** Both (i) and (ii) **(iv)** Information is insufficient	**1**	**R**	**2**
(c)	Which of the following is correct for De Morgan's Law: **(i)** $\sim(A \wedge B) \equiv \sim A \vee \sim B$ **(ii)** $\sim(A \wedge B) \equiv \sim A \wedge \sim B$ **(iii)** $\sim(A \vee B) \equiv \sim A \vee \sim B$ **(iv)** $\sim(A \vee B) \equiv \sim A \wedge B$	**1**	**R**	**2**
(d)	Which of the following is a requirement for a set to be a partially ordered set (poset)? ___ **(i)** It must be totally ordered **(ii)** It must be symmetric **(iii)** It must have no repeated elements **(iv)** It must have a transitive, reflexive, and antisymmetric relation	**1**	**U**	**3**

(e) If 10 pigeons are placed into 9 pigeonholes, at least how many pigeonholes must contain more than one pigeon? **1** **U,A** **3**

(i) 0 **(ii)** 1

(iii) 2 **(iv)** 10

Q.2 Attempt Any Two **[10]**

(a) Let R be the relation on set $\{1, 2, 3, 4, 5\}$ defined by $aRb: a + b \leq 6$. Find the following: **5** **U,A** **1**

i. List of element of R
ii. Domain of R
iii. Range of R
iv. List of element of R^{-1}
v. Range of R^{-1}

(b) Let $R: \mathbb{Z} \to \mathbb{Z}$ defined as $R = \{(a, b); b = a + 1\}$ and $S: \mathbb{Z} \to \mathbb{Z}$ defined as $S = \{(a, b); b = a^2\}$ then find $S \circ R$ and $R \circ S$. **5** **A** **1**

(c) Use Warshall's algorithm to find the transitive closures of the following relations $R = \{(1,2), (2,3), (3,1)\}$ on $\{1,2,3\}$. **5** **A** **1**

Q.3 Attempt Any Two **[10]**

(a) State and prove De Morgan's Law by using truth table. **5** **R,A** **2**

(b) Define logical equivalence and show that **5** **R,A** **2**

$$p \to (q \wedge r) \equiv (p \to q) \wedge (p \to r)$$

(c) Find principal disjunctive normal form of **5** **A** **2**

$$q \vee (p \vee \sim q)$$

Q.4 Attempt Any Two **[10]**

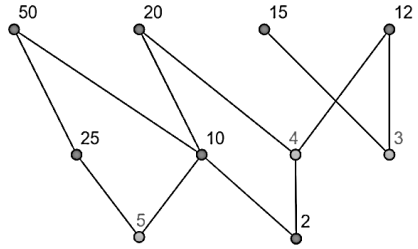
(a) Draw Hasse diagram of the following: **5** **A** **3**

i. $(P(S), \subseteq)$ for $S = \{a, b, c\}$, where $P(S)$ is the power set of the finite set S and $\subseteq$ be an inclusion relation on the elements of P(S).
ii. The set of all divisor of $24 (D_{24})$.

(b) Define the following terms: **5** **R,A** **3**

a. Maximal Element
b. Minimal Element
c. Greatest Element
d. Least Element

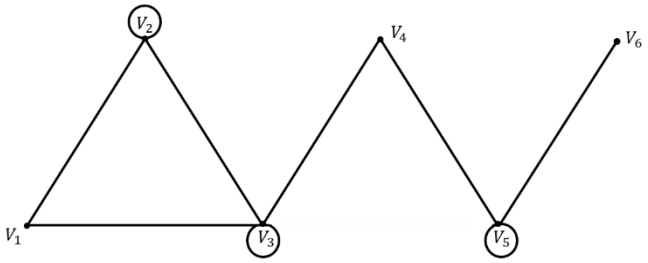
Also, Find maximal, minimal, greatest and least element for the Hasse diagram:



(c) Show that the set of all divisors of 70 forms a Lattice and find the complements of all elements. **5** **A** **3**

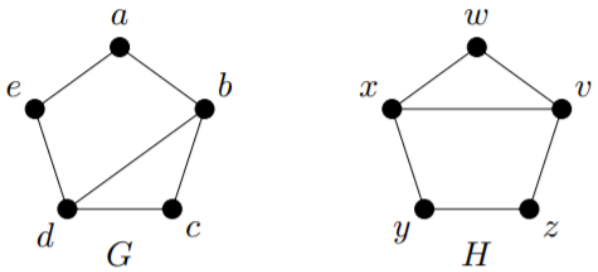
SECTION (B)

		Marks	BL	CO
Q.5	**Multiple-Choice Questions**	**[05]**		
	(a) A group in which the operation is commutative is called **(i)** Monoid **(ii)** Semi-group **(iii)** Quotient group **(iv)** Abelian group	**1**	**R**	**4**
	(b) The identity element in a group $(G,*)$ satisfies: **(i)** $a * e = a = e * a$ **(ii)** $a * e = e = e * a$ **(iii)** $a * b = e = b * a$ **(iv)** None of the above	**1**	**R**	**4**
	(c) Which of the following is true for every field? **(i)** It is a ring without zero divisors **(ii)** It is a ring without identity **(iii)** It is a ring with zero divisors **(iv)** It is a commutative ring without identity	**1**	**R**	**4**
	(d) A vertex v_i is called isolated if degree of vertex is... **(i)** 0 **(ii)** 1 **(iii)** 2 **(iv)** More than 2	**1**	**R**	**5**
	(e) In a tree, which of the following is true? **(i)** There is exactly one path between any two vertices **(ii)** Every node has exactly one child **(iii)** There are no leaf nodes **(iv)** All nodes must have the same degree	**1**	**U**	**5**
Q.6	**Attempt Any Two**	**[10]**		
	(a) Show that $(\mathbb{Z}^+,+)$ is Monoid.	**5**	**A**	**4**
	(b) Construct the table for (i) addition modulo 4 and (ii) multiplication modulo 4 for $Z_4 = \{0,1,2,3\}$.	**5**	**A**	**4**
	(c) Show that $(\mathbb{Z},+)$, where $\mathbb{Z}$ is the set of integers with the operations of addition '+' is a group.	**5**	**A**	**4**
Q.7	**Attempt Any Two**	**[10]**		
	(a) Show that $(\mathbb{Z},+,\cdot)$, where $\mathbb{Z}$ is the set of integers with the operations of addition $+$ and multiplication '$\cdot$' is ring.	**5**	**A**	**4**
	(b) Is it possible to construct a graph having 5 vertices each of them having degree 3?	**5**	**U,A**	**4**
	(c) Find adjacency matrix of the following graph:	**5**	**A**	**5**

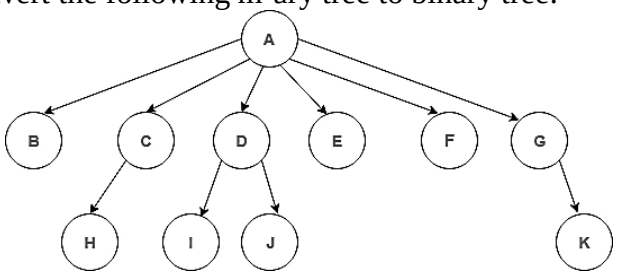


Q.8 Attempt Any Two **[10]**

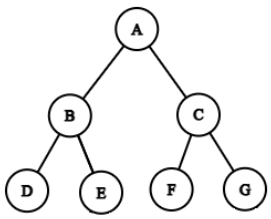
(a) Define Isomorphism of graphs. Check whether the following graphs are isomorphic or not? **5** **R,A** **5**



(b) Convert the following m-ary tree to binary tree: **5** **A** **5**



(c) Define Tree traversal and write preorder, inorder and postorder traversal for the following tree. **5** **R,A** **5**



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