

R.N.G.PATEL INSTITUTE OF TECHNOLOGY-RNGPIT
(An Autonomous Institute U/s UGC Act 1956)

B.Tech. SEMESTER-III, SEMESTER END EXAMINATION – WINTER 2025

SUBJECT CODE: 1IT301

DATE: 16-12-2025

SUBJECT NAME: DISCRETE MATHEMATICS

TIME: 11:00 AM to 01:30 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 - Cognitive Level (As per Revised Bloom's Taxonomy) (R-Remember, U-Understanding, A –Application, N –Analyze, E – Evaluate, C -Create), CO - Course Outcomes.

SECTION A

		Marks	BL	CO
Q.1	(a) Check whether the given function $f: R^+ \rightarrow R^+$ defined by $f(x) = x $ is one to one, onto or bijective.	03	A	2
	(b) Find the number of permutations that can be made from the letters of the DAUGHTER (i) taking all the letters together (ii) beginning with D (iii) beginning with D and ending with R (iv) vowels being always together	04	A	2
Q.2	(a) Construct the truth table for the following expressions and check whether each of the following expressions are tautology or not. (i) $(p \wedge r) \rightarrow p$ (ii) $(p \wedge q) \rightarrow (p \rightarrow q)$	03	A	1
	(b) Show that the proposition $\sim(p \wedge q)$ and $\sim p \vee q$ are logically equivalent.	04	A	1
	(c) Obtain DNF of the following. (i) $(p \rightarrow q) \wedge (\sim p \wedge q)$ (ii) $\sim(p \rightarrow (q \wedge r))$	07	A	1

OR

Q.2	(a) Rewrite the following statements using quantifiers, variables, and predicate symbols. i) All birds can fly. ii) Not all birds can fly. iii) Some men are genius.	03	A	1
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- (b) Use truth table to prove DeMorgan's law. 04 A 1
 (i) $\sim(p \vee q) = \sim p \wedge \sim q$ (ii) $\sim(p \wedge q) = \sim p \vee \sim q$
- (c) Find out using truth tables, whether each of the following implications is a tautology. 07 A 1
 $((p \vee (\neg(q \wedge r))) \rightarrow ((p \leftrightarrow q) \vee r))$

- Q.3** (a) Show that the operation $*$ defined by $x*y=x^y$ on the set \mathbf{N} of natural numbers is neither commutative nor associative. 03 A 4
- (b) Show that the algebraic system $(\mathbf{Z}, +)$, where \mathbf{Z} is the set of integers $+$ is a binary operation of addition is a group. 04 A 4
- (c) Let Q_+ be the set of all positive rational numbers and $*$ is a binary operation on Q_+ defined by, $a*b = \frac{ab}{3}$ is an abelian group. 07 A 4

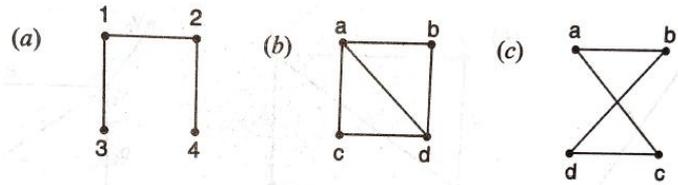
OR

- Q.3** (a) Show that the group $(\mathbf{G},*)$ is an abelian group if $(a*b)^2 = a^2 * b^2, \forall a, b \in G$. 03 A 4
- (b) Show that the set $Z_9 = \{0,1,2,3,4,5,6,7,8\}$ is a ring under the operations of addition modulo 9. 04 A 4
- (c) Check $\{Z_5, +_5, \times_5\}$ is an example of finite integral domain which is field. 07 A 4

SECTION B

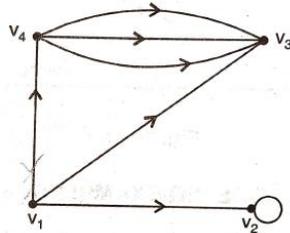
		Marks	BL	CO
Q.4	(a) A tree has two vertices of degree 2, one vertex of degree 3 and three vertices of degree 4. How many vertices of degree 1 does it have?	03	A	6
	(b) Draw binary trees whose post-order produced the string d-e-c-g-j-h-f-b-l-n-q-r-p-m-k-a and pre-order produced the string a-b-d-h-e-i-j-c-f-g-k and in-order produced the string h-d-b-i-e-j-a-f-c-k-g.	04	A	6
Q.5	(a) Let R be the relation on the set $\{1,2,3,4,5\}$ defined by the rule $(x, y) \in R$ if $x+y \leq 6$. Find the following: (i) List the elements of R (ii) List the elements of R^{-1} (iii) Domain of R and Range of R	03	A	3
	(b) Define Lattice. Draw the Hasse diagram of (S_{12}, D) , where D is the relation of "division" in N such that for any $a, b \in N$, aDb iff a divides b and S_{12} is the set of all divisors of 12.	04	A	3
	(c) Let $A = \{1, 2, 3, 4\}$, for the relation R whose matrix is given. Find the matrix of transitive closure by using Warshall's algorithm	07	A	3
	$M_R = \begin{bmatrix} 1 & 0 & 0 & 1 \\ 1 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 \end{bmatrix}$			
OR				
Q.5	(a) Find the diagraph of the following relation R on the set $A = \{1, 2, 3, 4\}$ (i) $R = \{(1,1), (1,2), (1,4), (2,2), (2,1), (2,4), (3,3), (3,4), (3,2), (4,1), (4,2), (4,3)\}$ (ii) $R = \{(1,2), (1,3), (1,4), (2,1), (3,1), (3,3), (3,4), (4,1), (4,2), (4,4)\}$ (iii) $R = \{(1,3), (1,4), (3,2), (3,3), (3,4)\}$	03	A	3
	(b) If R is a relation in the set of integers Z defined by $R = \{(x, y) : x \in Z, y \in Z, (x - y) \text{ is divisible of } 3\}$. Describe the distinct equivalence classes of R	04	A	3
	(c) Solve $a_{n+2} - 5a_{n+1} + 6a_n = 2$ with initial condition $a_0 = 1$ and $a_1 = -1$	07	A	3
Q.6	(a) Define undirected graph. Draw the undirected graph $G = (V, E)$ where, $V = \{a, b, c, d, e\}$ and $E = \{e_1, e_2, e_3, e_4, e_5, e_6, e_7\}$ and its incidence relation given as: $e_1 = (a, b)$, $e_2 = (a, b)$, $e_3 = (b, c)$, $e_4 = (c, d)$, $e_5 = (b, b)$, $e_6 = (a, d)$ & $e_7 = (e, d)$	03	A	5

- (b) Define with example: Graph, Null graph, complete graph, pseudo graph. **04 A 5**
- (c) Define adjacency matrix of graph. Find the adjacency of the following graphs: **07 A 5**



OR

- Q.6** (a) Define with example: cut edges, cut vertices, cut set **03 A 5**
- (b) Define directed graph. Find in degree, out degree and total degree of each vertex of the following graph **04 A 5**



- (c) Define Isomorphic and Check whether the following pair of graphs G & H are isomorphic or not with description. **07 A 5**

