

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

IM.Sc-IT SEMESTER-I, SEMESTER END EXAMINATION – SUMMER 2025

Subject Code: 1BS102

Date: 04-06-2025

Subject Name: FUNDAMENTAL OF 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) For a matrix A , if $AA^{\theta} = I$, then matrix A is called____	1	U	3
(i)Symmetric			
(ii)Skew- symmetric			
(iii)Hermitian			
(iv)Unitary			
(b) A matrix A is said to be Hermitian if ...	1	U	3
(i) $(A^c)^T = A$			
(ii) $(A^c)^T = -A$			
(iii) $A^T = A$			
(iv) $A^T = -A$			
(c) In a Diagonalization of a matrix A , $D = P^{-1}AP$, the matrix P is known as:	1	U	3
(i) Symmetric Matrix			
(ii) Hermitian Matrix			
(iii) Modal Matrix			
(iv) Diagonal Matrix			
(d) Which of the following is known as second order partial derivative of f with respect to x	1	U	5
(i) $\left(\frac{df}{dx}\right)^2$			
(ii) $\frac{d^2f}{dx^2}$			
(iii) $\frac{\partial^2 f}{\partial x^2}$			
(iv) $\left(\frac{\partial f}{\partial x}\right)^2$			

(e) A function $f(x)$ is said to be continuous at $x = a$ if 1 U 4

(i) $\lim_{x \rightarrow a} f(x)$ does not exist (ii) $\lim_{x \rightarrow a} f(x) = f(a)$

(iii) $\lim_{x \rightarrow a^-} f(x) \neq \lim_{x \rightarrow a^+} f(x)$ (iv) $f(a)$ is not defined

Q.2 Attempt Any Two [10]

(a) Find the characteristic equation of the matrix $\begin{bmatrix} 2 & 1 & 1 \\ 0 & 1 & 0 \\ 1 & 1 & 2 \end{bmatrix}$ 5 A 3

(b) Verify Cayley Hamilton Theorem for the matrix $\begin{bmatrix} 2 & -1 & 1 \\ -1 & 2 & -1 \\ 1 & -1 & 2 \end{bmatrix}$ 5 A 3

(c) Find eigenvalues and eigen vectors of the matrix $\begin{bmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{bmatrix}$ 5 A 3

Q.3 Attempt Any Two [10]

(a) Let A be the matrix $\begin{bmatrix} 1 & 2 & -3 \\ 0 & 3 & 2 \\ 0 & 0 & -2 \end{bmatrix}$. Find eigen values of $A^3 + 5A^2 - 6A + 2I$. 5 A 3

(b) Check Continuity of the function: 5 A 4

$$f(x) = \begin{cases} x + 2, & \text{if } x < 1 \\ 1, & \text{if } x = 1 \\ 2 - x, & \text{if } x > 1 \end{cases}$$

(c) Find derivative of the following: 5 A 4

i. $\frac{d}{dx} [e^x \sin x]$

ii. $\frac{d}{dx} [\log(x^2 - 3x + 2)]$

Q.4 Attempt Any Two [10]

(a) Verify Lagrange's Mean Value Theorem for $f(x) = x^3$ in $[-2, 2]$. 5 U,A 5

(b) Find Maclaurin's series of e^x . 5 A 5

(c) Find the extreme values of the function 5 A 5

$$f(x, y) = x^2 + y^2 - 4x - 12y + 20$$

SECTION B

Marks BL CO

Q.5 Multiple-Choice Questions

[05]

(a) Set Operation Difference is _____.

1 R 1

(i) commutative

(ii) associative

(iii) both (i) and (ii)

(iv) neither (i) nor (ii)

(b) What is the value of $\begin{vmatrix} 1 & 0 \\ 4 & 2 \end{vmatrix}$.

1 A 1

(i) 2

(ii) 1

(iii) 0

(iv) not exist

(c) Which of the following represents the empty set?

1 R 1

(v) { }

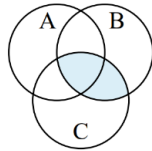
(vi) \emptyset

(vii) $\{\emptyset\}$

(viii) both (i) and (ii)

(d) Which of the following is the correct set notation for the following venn diagram:

1 U 1



(i) $A \cup B \cup C$

(ii) $A \cup (B \cap C)$

(iii) $B \cap C$

(iv) $B \cup C$

(e) If the function $f: A \rightarrow B$ is then domain and codomain is _____.

1 R 2

(i) A and B respectively

(ii) B and A respectively

(iii) Both domain and codomain are A

(iv) Both domain and codomain are B

Q.6 Attempt Any Two

[10]

(a) Do as the following:

5 U,A 1

(i) Represent the set $A = \{x \in \mathbb{N} \mid x < 5\}$ into Tabular (Roster) form

(ii) Represent the set $A = \{2, 4, 6, 8, 10\}$ into Set-Builder form

(b) Find domain, codomain and range of the following functions: 5 A 1

(i) $f: A \rightarrow B$ defined by $f(x) = x^2 - 1$;

where $A = \{1, 2, 3, 4\}$ and $B = \{0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$

(ii) If $f: \mathbb{Z} \rightarrow \mathbb{N}$ be a function defined by

$$f(x) = x + 3.$$

(c) Let the function $f: \mathbb{R} \rightarrow \mathbb{R}$ defined by $f(x) = x^2 + 1$ and $g: \mathbb{R} \rightarrow \mathbb{R}$ defined 5 A 1

by $g(x) = 3x - 2$ then find $f \circ g$ and $g \circ f$.

Q.7 Attempt Any Two [10]

(a) Find inverse if the matrix $A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 5 & 3 \\ 1 & 0 & 8 \end{bmatrix}$ by using elementary 5 A 2

transformation.

(b) Reduce the matrix $\begin{bmatrix} 1 & 2 & 3 \\ 2 & 5 & 7 \\ 3 & 1 & 2 \end{bmatrix}$ into upper triangular form (Echelon form). 5 A 2

(c) Solve the following system of equations using Cramer's Rule: 5 A 2

$$5x - 7y + z = 11$$

$$6x - 8y - z = 15$$

$$3x + 2y - 6z = 7$$

Q.8 Attempt Any Two [10]

(a) Transform the matrix $\begin{bmatrix} 1 & 3 & 3 \\ 2 & 4 & 10 \\ 3 & 8 & 4 \end{bmatrix}$ into a unit matrix. 5 A 2

(b) Reduce the matrix A to its normal form, when 5 A 2

$$A = \begin{bmatrix} 1 & 2 & -1 & 4 \\ 2 & 4 & 3 & 4 \\ 1 & 2 & 3 & 4 \\ -1 & -2 & 6 & -7 \end{bmatrix}.$$

(c) Discuss the consistency of the following system of equations: 5 A 2

$$x - y + z = 3$$

$$2x - 3y + 5z = 10$$

$$x + y + 4z = 4$$
