**Roll No.** □□□□□□□□□□□□ **Total No. of Pages : 03**

**Total No. of Questions : 09**

**B.Tech. (AI&ML / AI&DS / Block Chain / CE / CSE / CS / DS / CSD / EE / ECE / EEE / ETE / IT / ME / Robotics & Artificial Intelligence / Internet of Things and Cyber Security including Block Chain Technology) (Sem.–2)**

# ENGINEERING MATHEMATICS-II

**Subject Code : BTAM201-23**

**M.Code : 93811**

**Date of Examination : 10-01-2025**

**Time : 3 Hrs.** **Max. Marks : 60**

**INSTRUCTIONS TO CANDIDATES :**

1. **SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.**
2. **SECTION - B & C have FOUR questions each.**
3. **Attempt any FIVE questions from SECTION B & C carrying EIGHT marks each.**
4. **Select atleast TWO questions from SECTION - B & C.**

## SECTION-A

**1. Answer the following :**

a) Using Echelon form, find the rank of the matrix $A = \begin{pmatrix} 3 & 1 & 7 \\ 1 & 2 & 4 \\ 4 & -1 & 7 \\ 4 & -1 & 5 \end{pmatrix}$.

b) Determine the eigen values of the matrix $\begin{pmatrix} 1 & 4 \\ 3 & 2 \end{pmatrix}$.

c) Let $V$ be a vector space in $\mathbb{R}^3$. Examine whether $W = \{(a, b, c) : a^2 + b^2 + c^2 \leq 1\}$ is a subspace of $V$.

d) Let $V$ be a vector space over a field $F$. Show that any subset $S$ of $V$ containing zero vector is Linearly Dependent over $F$.

e) Determine the value of $k$ for which the system of equations :

$x - ky + z = 0$; $kx + 3y - kz = 0$; $3x + y - z = 0$ has only trivial solution.

(f) Verify if $y = \frac{x^2}{2} + C$ satisfies the differential equation $y' = x$.

(g) Solve the initial value problem $\frac{dy}{dx} = x + 2$ given $y(0) = 1$.

(h) Find an integrating factor for the differential equation $\frac{dy}{dx} + y\tan(x) = \sin(x)$.

(i) Solve the nonlinear first-order PDE $\frac{\partial z}{\partial x} + z\frac{\partial z}{\partial y} = 0$.

(j) Verify if the surfaces defined by $z = xy$ and $z = x^2 + y^2$ are orthogonal to each other at the point (1, 1, 1).

## SECTION-B

2. Solve the following system of equations using Gauss Elimination method :

$x - y + z = 4;\quad 2x + y - 3z = 0;\quad x + y + z = 2.$

3. Find a Linear transformation $T : \mathbb{R}^3 \to \mathbb{R}^4$ whose range is spanned by (1, 2, 0, –4) and (2, 0, –1, –3).

4. Verify Cayley-Hamilton theorem for the matrix $A = \begin{pmatrix} 1 & 1 & 2 \\ 1 & 3 & -1 \\ -2 & -1 & 1 \end{pmatrix}$. Find $A^{-1}$.

5. Find the inverse of the matrix using the Gauss-Jordan method : $\begin{pmatrix} 2 & -1 & 1 \\ 1 & 1 & -1 \\ 1 & -2 & 3 \end{pmatrix}$.

## SECTION-C

6. Solve $y'' + y = \sin x$ using variation of parameters.

7. An electric RLC circuit has a resistance of 10 Ω, an inductance of 5 H, and a capacitance of 0.02 F. Form and solve the differential equation for the charge $Q(t)$ on the capacitor, given that $Q(0) = 0$ and $Q'(0) = 0$.

8. Solve the PDE $x\frac{\partial z}{\partial x} + y\frac{\partial z}{\partial y} - z = 0$ using Lagrange's method, and verify your solution by checking if it satisfies the original equation.

9. Find the general solution of the linear PDE $u_{xxx} + 3u_{x^2y} + 3u_{yyy} = e^{x}$.

**NOTE : Disclosure of Identity by writing Mobile No. or Marking of passing request on any paper of Answer Sheet will lead to UMC against the Student.**