

Reg No.: _____

Name: _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
B.Tech Degree S2 (R,S) Examinations April 2026 (2024 Scheme)



Course Code: GAMAT201

Course Name: MATHEMATICS FOR INFORMATION SCIENCE-2

Max. Marks: 60

Duration: 2 hours 30 minutes

PART A

(Answer all questions. Each question carries 3 marks)

- | | | CO | Marks |
|---|---|----|-------|
| 1 | Write an inconsistent linear system of two equations with two unknowns. | 1 | (3) |
| 2 | Find the rank of the matrix $A = \begin{bmatrix} 1 & 2 & 5 \\ 2 & 0 & 3 \\ -1 & 2 & 2 \end{bmatrix}$. | 1 | (3) |
| 3 | Determine whether $W = \{(x, 2x + 1) : x \in \mathbb{R}\}$ is a subspace of \mathbb{R}^2 under standard operations or not. | 2 | (3) |
| 4 | Find the basis B of \mathbb{R}^3 such that $P = \begin{bmatrix} 1 & -1 & 2 \\ 0 & 3 & 2 \\ 1 & 2 & 0 \end{bmatrix}$ is the transition matrix from B to the basis $B' = \{(1, 0, -1), (2, 0, 1), (1, 1, -2)\}$ of \mathbb{R}^3 . | 2 | (3) |
| 5 | Find the vector with length 5 and in the direction of $\mathbf{u} = (\sqrt{5}, 5, 0)$. | 3 | (3) |
| 6 | Find the orthogonal projection of $\mathbf{u} = (1, 1)$ onto $\mathbf{v} = (2, -1)$ in \mathbb{R}^2 with the inner product given by $\langle \mathbf{u}, \mathbf{v} \rangle = u_1v_1 + 3u_2v_2$. | 3 | (3) |
| 7 | Show that $T: \mathbb{R}^2 \rightarrow \mathbb{R}^2$ defined by $T(x, y) = (x + y, x - y)$ is a linear transformation. | 4 | (3) |
| 8 | Find the nullity of the linear transformation $T: \mathbb{R}^3 \rightarrow \mathbb{R}^4$ if the rank is 2. | 4 | (3) |

PART B

(Answer any one full question from each module, each question carries 9 marks)

Module -1

- 9 a) Find a relation connecting a, b, c under which the system of equations $x - 2y + z = a, -2x + y + z = b, x + y - 2z = c$ has infinitely many solutions.

- b) Find the eigen values and eigen vectors of the matrix $A = \begin{bmatrix} 1 & 2 & -1 \\ 0 & 2 & 0 \\ 0 & -1 & -1 \end{bmatrix}$. 1 (5)
- 10 a) Using Gauss elimination method, solve the non-homogeneous linear system 1 (4)
 $x + 2y - z = 0, 2x - y + z = -1, -x + 3y - 2z = 1$
- b) Diagonalize the matrix $A = \begin{bmatrix} 1 & 3 \\ 0 & -4 \end{bmatrix}$ and hence find A^4 . 1 (5)

Module -2

- 11 a) For which values of λ do the set of vectors $\{(1,2,0), (-1, \lambda, 3), (0,1, \lambda)\}$ form 2 (4)
 a linearly dependent set in R^3 .
- b) Show that the set of vectors $\{(1,1,3), (-1,0, -1)\}$ is a basis of the subspace 2 (5)
 $x + 2y - z = 0$ of R^3 .
- 12 a) Check whether the set of points on the plane $x - 3y + 2z = 1$ is a subspace 2 (4)
 of R^3 or not.
- b) Find the transition matrix from the basis B to the basis B' of R^3 where B and 2 (5)
 B' are given by $B = \{(-3,2, -3), (1, -1, -1), (5,4,9)\}$ and $B' =$
 $\{(1,2,1), (-1,2, -1), (1,1,3)\}$. Hence find the coordinate matrix $[x]_{B'}$ if
 $[x]_B = \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix}$.

Module -3

- 13 a) Verify Cauchy-Schwarz inequality for the vectors $u = (1,0,2)$ and $v = 3$ (4)
 $(1,3, -2)$ in R^3 with the inner product $\langle u, v \rangle = u_1v_1 + 2u_2v_2 + 3u_3v_3$.
- b) Use Gram-Schmidt orthonormalization to find an orthonormal basis 3 (5)
 corresponding to the basis $B = \{(1,0, -1), (0,2,3), (1,2, -3)\}$ of R^3 .
- 14 a) Find the least square solution of the system $Ax = b$ where $A = \begin{bmatrix} 1 & 2 \\ 0 & 1 \\ 1 & 1 \end{bmatrix}$ and 3 (4)

$$b = \begin{bmatrix} 2 \\ -2 \\ 1 \end{bmatrix}$$

- b) Find the orthogonal projection of the vector $v = \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix}$ in R^3 onto the subspace 3 (5)

spanned by the columns of the matrix $\begin{bmatrix} 1 & -1 \\ 1 & 0 \\ 2 & 2 \end{bmatrix}$.

Module -4

- 15 a) If $A = \begin{bmatrix} a & -1 \\ 2 & 2a+b \end{bmatrix}$ is the standard matrix of the linear transformation 4 (3)
 $T: R^2 \rightarrow R^2$, find a and b such that $T(1,1) = (2,5)$.

- b) Find any bases of kernel and range of the linear transformation $T: R^4 \rightarrow R^3$ 4 (6)

defined by $T(x) = Ax$, $x \in R^4$ and $A = \begin{bmatrix} 1 & 0 & 2 & -3 \\ 4 & 2 & -1 & 3 \\ 2 & 2 & -5 & 9 \end{bmatrix}$.

- 16 a) Find the linear transformation which rotates every vector in R^2 4 (3)
 counterclockwise about the origin through an angle $\theta = 30^\circ$.

- b) If $[T]_B^B = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$ is the matrix representation of the linear transformation 4 (6)

$T: R^2 \rightarrow R^2$ with respect to the basis $B = \{(1,1), (2,1)\}$, find $T(x, y)$ where
 $(x, y) \in R^2$.
