5/5/26

UMA120526AB-1

Reg No.: _____ Name : _____

Jyothi Engineering College(Autonomous)

B. Tech Degree S2 (R) Examination, May 2026(2025 Scheme)

25MAT201- MATHEMATICS FOR INFORMATION SCIENCE - 2

Total Mark: 60 AD, CS, CY **Total Time: 2 Hr 30min**

CO MARK

PART A

(Answer all questions. Each question carries 3 marks.)

1. By reducing to Echelon form, find the rank of the matrix $A = \begin{bmatrix} 1 & 2 & 1 \\ 2 & 4 & 3 \\ 1 & 2 & 2 \end{bmatrix}$. CO1 (3)

2. Examine whether the matrix $A = \begin{bmatrix} 2 & 0 & 0 \\ 0 & 3 & 4 \\ 0 & 4 & 9 \end{bmatrix}$ is diagonalizable. CO1 (3)

3. Let $x = \begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix}$, $y = \begin{bmatrix} 3 \\ 2 \\ 9 \end{bmatrix}$, $z = \begin{bmatrix} 5 \\ 2 \\ -1 \end{bmatrix}$. Is $\{x, y, z\}$ linearly independent? CO2 (3)

4. Find a basis and dimension for the vector space of all 3×3 diagonal matrices. CO2 (3)

5. Determine all vectors orthogonal to $u = (4, 2)$. CO3 (3)

6. Apply the Gram-Schmidt orthogonalization process to transform the basis $B = \{(-8, 3, 5)\}$ for a subspace of $\mathbb{R}^3$ into an orthonormal basis for the subspace. CO3 (3)

7. Find the kernal of $T : R^3 \to R^3$ represented by $T(x, y, z) = (x, y, 0)$. CO4 (3)

8. Let $T : R^5 \to R^7$ be a linear transformation. Find Nullity (T), if Rank(T) = 2. CO4 (3)

PART B

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

Module - 1

9. a) Solve the following homogeneous system using the Gauss elimination method:

$2x + y + z + w = 0$
$x + 3y + 2z + w = 0$
$3x + 4y + 3z + 2w = 0$
$4x + 7y + 5z + 3w = 0.$ CO1 (5)

b) Find the eigenvalues and eigenvectors of the matrix $A = \begin{bmatrix} 5 & 0 \\ 0 & -2 \end{bmatrix}$. CO1 (4)

OR

10. a) Investigate for what values of λ and μ the system of equations CO1 (5)

$x + 2y + 3z = 4$
$x + 3y + 4z = 5$
$x + 3y + \lambda z = \mu$

has (i) no solution

(ii) a unique solution

(iii) infinitely many solutions.

b) If 2 is an eigen value of $A = \begin{bmatrix} 6 & 2 \\ 2 & 3 \end{bmatrix}$, without using characteristic equation, find the other eigen values. Also find the eigen values of $7A$, A^{-1} and A^T. CO1 (4)

Module - 2

11. a) Determine whether R^2 with standard operation of vector addition and with non- standard definition of scalar multiplication given by $c(x_1, x_2) = (cx_1, 0)$ is a vector space. CO2 (5)

b) Determine whether the given matrix $\begin{bmatrix} 6 & -19 \\ 10 & 7 \end{bmatrix}$ is a linear combination of matrices $A = \begin{bmatrix} 2 & -3 \\ 4 & 1 \end{bmatrix}$ and $B = \begin{bmatrix} 0 & 5 \\ 1 & -2 \end{bmatrix}$. CO2 (4)

OR

12. a) Find the transition matrix from the basis $B = \{(1,0,0), (0,1,0), (0,0,1)\}$ to the basis $B' = \{(1,3,2), (2,-1,2), (5,6,1)\}$. CO2 (5)

b) Determine whether $S = \{(1,5,3), (0,1,2), (0,0,6)\}$ is a basis for R^3. CO2 (4)

Module - 3

13. a) Using matrix multiplication, find the following dot products: if $u = \begin{bmatrix} 1 \\ 2 \\ -1 \end{bmatrix}$ and $v = \begin{bmatrix} 3 \\ -2 \\ 4 \end{bmatrix}$. CO3 (5)

i) **u.v** ii) **u.u** iii) **v.v** iv) **(u+v).(u+v).**

b) Find the angle between **u = (3, 1)** and **v = (- 2, 4).** CO3 (4)

OR

14. a) Find the least squares regression quadratic polynomial for the data points $(0,0), (2,2), (3,6), (4,12)$. CO3 (5)

b) Determine whether the set of vectors $\left\{\left(\frac{\sqrt{2}}{2}, 0, 0, \frac{\sqrt{2}}{2}\right), \left(0, \frac{\sqrt{2}}{2}, \frac{\sqrt{2}}{2}, 0\right), \left(-\frac{1}{2}, \frac{1}{2}, -\frac{1}{2}, \frac{1}{2}\right)\right\}$ in $\mathbb{R}^4$ is orthogonal. CO3 (4)

Module - 4

15. a) Determine whether the transformation $T: R^2 \to R^3$ defined by $T(x,y) = (\sqrt{x}, xy, \sqrt{y})$ is linear. CO4 (5)

b) Find the image of $v = (-1, 7)$ and preimage of $(11, -8)$ if $T(x,y) = (x+y, x-y)$. CO4 (4)

OR

16. a) Let $T: R^5 \to R^4$ defined by $T(X) = AX$ where $A = \begin{bmatrix} 1 & 2 & 0 & 1 & -1 \\ 2 & 1 & 3 & 1 & 0 \\ -1 & 0 & -2 & 0 & 1 \\ 0 & 0 & 0 & 2 & 8 \end{bmatrix}$. Find a basis for Range of T. CO4 (5)

b) Let $T: R^2 \to R^2$ be a linear transformation defined by $T(x,y) = (x+y, 2x-y)$. Find the matrix for T relative to the bases $B = \{(1,2), (-1,1)\}$ and $B^1 = \{(1,0), (0,1)\}$. CO4 (4)

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