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SAINTGITS COLLEGE OF ENGINEERING
KOTTAYAM, KERALA

(AN AUTONOMOUS COLLEGE AFFILIATED TO
APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

FIRST SEMESTER M.TECH. DEGREE EXAMINATION (R), MARCH 2021
(TELECOMMUNICATION ENGINEERING)

Course Code: 20ECTET101

Course Name: APPLIED LINEAR ALGEBRA

Max. Marks: **60** **Duration:** **3 Hours**

PART A

(Answer all questions. Each question carries 3 marks)

1. Solve for 'a' if the vectors (1,5,6), (0,3,2) and (2,a,10) are linearly dependent.
2. Using rank, check the consistency of the system of equations,
   2x+z = 3, x-y+z = 1 and 4x-2y+3z = 3.
3. Verify that the function T: $R^2 \to R^3$defined as $T(x_{1,}x_2) = (x_1 - x_2, x_1 + x_2, x_2)$is a linear transformation and also find the kernal of T.
4. Using Gram-Schmidt orthogonalization, find an orthogonal basis for the span of the vectors $\mathbf{w}_1,\mathbf{w}_2 \in R^3$ if $\mathbf{w}_1=(1, 0, 3)^T,\mathbf{w}_2=(2, -1, 0)^T$.
5. Given that λ = 1 is one eigen value of the matrix $\begin{pmatrix} 0 & 1 & 2 \\ -4 & 1 & 4 \\ -5 & 1 & 7 \end{pmatrix}$. Find the remaining eigen values without finding the characteristic equation.
6. Give an example of a Hermitian matrix and verify that its eigen values are real.
7. Briefly state the significance of the concept of singular value decomposition.
8. Find the singular values of the matrix $\begin{pmatrix} 3 & 0 \\ 8 & 3 \end{pmatrix}$

PART B

(Answer one full question from each module, each question carries 6 marks)

MODULE I

9. Let V be the set of all vectors of the form (v_1, v_2, v_3) that satisfy $3v_1-2v_2+v_3 = 0$ and $4v_1+5v_2 = 0$. Find the dimension and basis for V. (6)

OR

10. Does the vector (5, 13, 32) belong to the span of the vectors (2, 3, 2), (-3, 1, 19) and (7, -3, -47) ? Verify. (6)

MODULE II

11. Find a least square solution of the system 4a = 2, 2b = 0, a+b = 11 (6)

OR

12. Find the basis of the null space of the matrix $\begin{pmatrix} -1 & 3 & 2 \\ 1 & 1 & 0 \\ 3 & 3 & 0 \end{pmatrix}$ (6)

MODULE III

13. Use Rank-Nullity theorem to find the rank of the linear transformation defined from $R^4 \to R^3$defined as $T(a,b,c,d) = (a+2b+3c-d, 3a+5b+8c-2d, a+b+2c)$ (6)

OR

14. Verify rank-nullity theorem for the linear transformation defined from $R^3 \to R^3$ defined as $T(a,b,c) = (a-b+2c, 2a+b, -a-2b+2c)$ (6)

MODULE IV

15. Find the orthogonal decomposition of v=[4 −2 3], with respect to (6)

W = span {[1 2 1], [1 −1 1] }

OR

16. Find an orthonormal basis for R^3 containing the vector $\mathbf{v}_1 = (2/3, 2/3, 1/3)^T$ (6)

MODULE V

17. Diagonalise the matrix $\begin{pmatrix} 3 & 1 & -1 \\ -2 & 1 & 2 \\ 0 & 1 & 2 \end{pmatrix}$ (6)

OR

18. The eigen vectors of a 3x3 matrix A corresponding to the eigen values 1,1,3 are $(1, 0, -1)^T$, $(0, 1, -1)^T$ and $(1, 1, 0)^T$. Find the matrix A. (6)

MODULE VI

19. Construct a singular value decomposition of the matrix $\begin{pmatrix} 2 & -1 \\ 2 & 2 \end{pmatrix}$ (6)

OR

20. Find the pseudo inverse of the matrix $\begin{pmatrix} 2 & -1 & 0 \\ 4 & 3 & -2 \end{pmatrix}$ using SVD . (6)

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