Register No.: ……………………………… Name: ……………………………………………………….

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

FIRST SEMESTER M.TECH DEGREE EXAMINATION (Regular), FEBRUARY 2022

(Telecommunication Engineering)

(2021 Scheme)

Course Code: **21TE101**

Course Name: **Applied Linear Algebra**

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

PART A

(Answer all questions. Each question carries 3 marks)

1. Explain the algebraic structures ring and field.

2. Solve the linear system

$$x + y = 4$$
$$3x + 3y = 6$$

3. Find the matrix representation of the linear map T: R^2 to R^3 defined by T(x,y)= (2x-5y,3x+y) relative to the basis {u_1=(2,1) , u_2=(3,2) of R^2.

4. State Pythagoras theorem and verify the theorem for the following orthogonal set u=(1,2,-3,4), v=(3,4,1,-2) and w=(3,-2,1,1).

5. Explain positive and negative definite matrices.

6. Check whether the given matrix A= $\begin{bmatrix} 2 & 0 & 1 \\ 0 & 2 & 0 \\ 1 & 0 & 2 \end{bmatrix}$ is diagonalizable or not.

7. Explain about singular values of a matrix.

8. Determine the null space of the given matrix A= $\begin{bmatrix} 1 & 2 & 3 \\ 0 & 1 & -1 \end{bmatrix}$

PART B

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

MODULE I

9. a) Show that the three vectors v_1=(1,2,2,-1), v_2=(4,9,9,-4), v_3=(5,8,9,-5) are linearly independent. (3)

   b) Express the vector v = (9,2,7) as a linear combination of vectors u=(1,2,-1) and v=(6,4,2). (3)

OR

10. a) Determine whether the vector v =(3,-2,-4,1) is in the span of S={ v_1=(1,2,3,4), v_2=(1,-1,1,-1), v_3=(2,0-3,1) } (3)

    b) Show that the vectors (1,-1,1), (0,1,2) ,(3,0,-1) form a basis for R^3. (3)

MODULE II

11. Given a system of equation

$$-mx + y = A$$
$$-nx + y = B$$

where m,n,A,B are constants. (6)

i)Show that the system will have a unique solution if $m \neq n$.

ii)Show that if m=n, then the system will be consistent only if A=B.

OR

12. Solve the following system using Gauss Elimination method. (6)

$$x - 2y + z = 0$$
$$2x + y - 3z = 5$$
$$4x - 7y + z = -1$$

MODULE III

13. Check whether the $T:R^2 \rightarrow R^3$ is linear transformation or not. (6)

$$T\left\{\begin{bmatrix} x \\ y \end{bmatrix}\right\} \rightarrow \begin{bmatrix} x-y \\ x+y \\ 2x \end{bmatrix}$$

OR

14. Find the fundamental subspaces of the matrix $A=\begin{bmatrix} 1 & 5 & 3 & 7 \\ 2 & 0 & -4 & -6 \\ 4 & 7 & -1 & -2 \end{bmatrix}$ (6)

MODULE IV

15. Apply the Gram–Schmidt process to transform the basis vectors $u_1=(1,1,1,\ )$ $u_2=(0,1,1)$ $u_3=(0,1,1)$ into an orthogonal basis (v_1,v_2,v_3) and then normalize the orthogonal basis vectors to obtain an orthonormal basis (q_1,q_2,q_3). (6)

OR

16. a) Show that vectors $\{(v_1,v_2,v_3)$ are orthonormal basis of R^3 where $v_1=\left(\frac{3}{\sqrt{11}},\frac{1}{\sqrt{11}}\frac{1}{\sqrt{11}}\right)$, $v_2=\left(\frac{-1}{\sqrt{6}},\frac{2}{\sqrt{6}}\frac{1}{\sqrt{6}}\right)$, $v_3=\left(\frac{-1}{\sqrt{66}},\frac{-4}{\sqrt{66}}\frac{7}{\sqrt{66}}\right)$. (4)

b) Determine the inner product of the vectors $u_1=(1,2,3)$, $u_1=(2,-3,4)$. (2)

MODULE V

17. Diagonalize the given matrix $A=\begin{bmatrix} 1 & 3 & 0 \\ 3 & 1 & 0 \\ 0 & 0 & -2 \end{bmatrix}$ (6)

OR

18. Given that 2 is an eigen value of $A=\begin{bmatrix} 2 & 0 & 0 \\ 0 & 3 & -2 \\ 0 & 1 & 0 \end{bmatrix}$. Determine its geometric multiplicity and give a basis for the associated eigen space. (6)

MODULE VI

19. Determine the SVD of the matrix $A=\begin{bmatrix} 2 & 2 \\ 1 & 1 \end{bmatrix}$ (6)

OR

20. Determine the Pseudo inverse of the matrix $A=\begin{bmatrix} 1 & 2 \\ -1 & 3 \\ 2 & 4 \end{bmatrix}$ using singular value decomposition method. (6)

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