Roll No.												

PRESIDENCY UNIVERSITY

BENGALURU

End - Term Examinations – May/June 2026

Date: 18-05-2026 **Time:** 01:00pm – 04:00pm

School: SOE	**Program:** B. Tech. in ECE
Course Code: ECE3017	**Course Name:** Linear Algebra for Communication Engineering
Semester: VI	**Max Marks**: 100 — **Weightage**: 50%

CO - Levels	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**	**CO6**
Marks	**30**	**20**	**17**	**9**	**17**	**7**

Instructions:

(i) Read all questions carefully and answer accordingly.

(ii) Do not write anything on the question paper other than roll number.

Part A

Answer ALL the Questions. Each question carries 2marks. 10Q x 2M=20M

1.	**Apply the appropriate matrix property tests to classify the following matrix as symmetric, skew-symmetric, or orthogonal.** $$\begin{bmatrix} 3 & 1 & -2 \\ 1 & 2 & 3 \\ -2 & 3 & -4 \end{bmatrix}$$	**2 Marks**	**L3**	**CO1**
2.	**Demonstrate that matrix A satisfies the conditions of a skew-Hermitian matrix.** $$A = \begin{bmatrix} 2i & 2-4i & -4+2i \\ -2-4i & 0 & 6-i \\ 4+2i & -6-i & -3i \end{bmatrix}$$	**2 Marks**	**L3**	**CO1**
3.	**Given the matrix A=$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}$ Find Minor $\|M_{23}\|$ and co-factor $\|A_{23}\|$ using Determinant properties**	**2 Marks**	**L3**	**CO1**
4.	**Analyze the given matrix to determine if it satisfies all conditions of row-echelon form, providing justification for your conclusion.**	**2 Marks**	**L4**	**CO1**

	$\begin{bmatrix} 1 & 2 & 3 & 5 \\ 0 & 0 & 1 & 2 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 4 \end{bmatrix}$			
5.	**Differentiate between row-echelon and reduced row-echelon forms by analyzing the given matrix, and determine its rank.** $\begin{bmatrix} 1 & 0 & 4 & 0 \\ 0 & 1 & 2 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 \end{bmatrix}$	**2 Marks**	**L4**	**CO1**
6.	**Analyze matrix A to determine if it satisfies the criteria for a normal matrix.** $A = \begin{bmatrix} 6 & -3 \\ 3 & 6 \end{bmatrix}$	**2 Marks**	**L4**	**CO5**
7.	**Analyze the definiteness of matrix C by examining its properties to determine if it is positive definite.** $C = \begin{bmatrix} 1 & -2 \\ -2 & 5 \end{bmatrix}$	**2 Marks**	**L4**	**CO4**
8.	**Determine the range of values for k that would make matrix B positive definite by analyzing its properties.** $B = \begin{bmatrix} 4 & k \\ k & 9 \end{bmatrix}$	**2 Marks**	**L4**	**CO4**
9.	**Apply saddle point criteria to identify any saddle points or determine the pay-off value in matrix A.** $A = \begin{bmatrix} 3 & 1 & 1 & 0 \\ 0 & 1 & 2 & 0 \\ 1 & 0 & 2 & 1 \\ 3 & 1 & 2 & 2 \end{bmatrix}$	**2 Marks**	**L3**	**CO6**
10.	**Apply the matrix method to compute the Discrete Fourier Transform of the given sequence.** $x(n) = \{1, 2, 0, 1\}$	**2 Marks**	**L3**	**CO5**

Part B

Answer the Questions. Total Marks 80M

11.	**a.**	**Analyze whether vector u belongs to the column space of matrix A by examining linear dependence.** $u = \begin{bmatrix} 1 \\ 0 \\ 4 \end{bmatrix}$ $A = \begin{bmatrix} 2 & 5 & 1 \\ -1 & -7 & -5 \\ 3 & 4 & -2 \end{bmatrix}$	**15 Marks**	**L4**	**CO1**

	b.	**Apply matrix operations to determine the row space of matrix A.** $$A = \begin{bmatrix} 2 & 0 & 1 \\ 1 & 0 & 1 \end{bmatrix}$$	**5 Marks**	**L3**	**CO1**
		Or			
12.	a.	**Analyze whether vector u belongs to the column space of matrix A by examining linear dependence.** $$u = \begin{bmatrix} 2 \\ -1 \\ 1 \end{bmatrix}$$ $$A = \begin{bmatrix} 2 & 5 & 1 \\ -1 & -7 & -5 \\ 3 & 4 & -2 \end{bmatrix}$$	**15 Marks**	**L4**	**CO1**
	b.	**Apply null space concepts to determine the left-hand null space of matrix A.** $$A = \begin{bmatrix} 2 & 0 & 1 \\ 1 & 0 & 1 \end{bmatrix}$$	**5 Marks**	**L3**	**CO1**

13.	a.	**Define Eigen Vector and Eigen Valus with an example and neat drawings**	**10 Marks**	**L4**	**CO2**
	b.	**Apply eigenvalue theory to compute the characteristic polynomial, eigenvalues, eigenvectors, and diagonal matrix for A.** $$A = \begin{bmatrix} 4 & 2 \\ 3 & -1 \end{bmatrix}$$	**10 Marks**	**L3**	**CO3**
		Or			
14.	a.	**Analyze the orthogonality of vectors $u_1 = (1, 2, 4), u_2 = (2, -3, 1), u_3 = (2, 1, -1)$ and express vector $v = (3, 5, 2)$ as their linear combination.**	**10 Marks**	**L4**	**CO2**
	b.	**Apply eigenvalue theory to compute the characteristic polynomial, eigenvalues, eigenvectors, and diagonal matrix for A.** $$A = \begin{bmatrix} 5 & -1 \\ 1 & 3 \end{bmatrix}$$	**10 Marks**	**L3**	**CO3**

15.	a.	**Analyze the similarity relationship between matrices A and B using the given invertible matrix P.** $$A = \begin{bmatrix} 2 & 4 \\ 0 & -2 \end{bmatrix}$$ $$B = \begin{bmatrix} 2 & 0 \\ -4 & -2 \end{bmatrix}$$ $$P = \begin{bmatrix} 2 & -2 \\ 2 & 2 \end{bmatrix}$$	**5 Marks**	**L4**	**CO3**

	b.	Evaluate the matrix decomposition by computing the Singular Value Decomposition (SVD) of matrix A. $$A = \begin{bmatrix} 2 & 3 \\ 4 & 10 \end{bmatrix}$$	15 Marks	L5	CO5
		Or			
16.	a.	Evaluate the matrix decomposition by computing the Singular Value Decomposition (SVD) of matrix A. $$A = \begin{bmatrix} 4 & 0 \\ 3 & -5 \end{bmatrix}$$	15 Marks	L5	CO5
	b.	Analyze the similarity transformation to determine matrix B given matrices A and P. Given $A = \begin{bmatrix} 1 & 2 \\ 3 & -1 \end{bmatrix}$ and $P = \begin{bmatrix} 0 & 1 \\ 2 & 3 \end{bmatrix}$.	5 Marks	L4	CO3

17.	a.	Analyze the given payoff matrix A to solve the game theory problem using the odd games method for mixed strategy scenarios. $$A = \begin{bmatrix} 1 & 5 \\ 4 & 2 \end{bmatrix}$$	15 Marks	L4	CO2
	b.	Apply linear programming principles to determine the optimal mixed strategy for both players in the given payoff matrix. $$A = \begin{bmatrix} 3 & 1 & 1 & 0 \\ 0 & 1 & 2 & 0 \\ 1 & 0 & 2 & 1 \\ 3 & 1 & 2 & 2 \end{bmatrix}$$	5 Marks	L3	CO6
		Or			
18.	a.	Apply the geometric method to compute the maximal and minimal values of the objective function $z = 5x + 3y$ under the given constraints. $$x + 2y \leq 14$$ $$3x - y \geq 0$$ $$x - y \leq 2$$	15 Marks	L4	CO6
	b.	Evaluate the conditions required for multiple saddle points by determining the range of values for parameters a and b in the given matrix. $$A = \begin{bmatrix} 2 & 4 & 5 \\ 10 & 7 & b \\ 4 & a & 6 \end{bmatrix}$$	5 Marks	L5	CO4