Roll No.												

PRESIDENCY UNIVERSITY

BENGALURU

End - Term Examinations – December 2025

Date: 08-12- 2025 **Time:** 01:00pm – 04:00pm

School: SOE	**Program:** B. Tech. in ECE	
Course Code: ECE3017	**Course Name:** Linear Algebra for Communication Engineering	
Semester: V	**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.	**Determine whether the following matrix is a symmetric, skew symmetric, or an orthogonal matrix.** $\begin{bmatrix} 3 & 1 & -2 \\ 1 & 2 & 3 \\ -2 & 3 & -4 \end{bmatrix}$	2 Marks	L3	CO1
2.	**Show that A is 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.	**Apply the following basic elementary operation $R_2 \leftarrow R_2 + 4R_1$ on matrix A.** $A = \begin{bmatrix} 1 & 2 & -3 \\ 4 & -5 & 6 \\ -2 & 3 & -4 \end{bmatrix}$	2 Marks	L3	CO1
4.	**Justify whether the given matrix is in row-echelon form or not.**	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.	**Determine whether the given matrix is in row-echelon form or reduced row-echelon form. Also, determine the rank of the matrix.** $\begin{bmatrix} 1 & 0 & 4 & 0 \\ 0 & 1 & 2 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 \end{bmatrix}$	2 Marks	L4	CO1
6.	**Determine whether A is a normal matrix or not.** $A = \begin{bmatrix} 6 & -3 \\ 3 & 6 \end{bmatrix}$	2 Marks	L4	CO5
7.	**Determine whether C is a positive definite matrix or not.** $C = \begin{bmatrix} 1 & -2 \\ -2 & 5 \end{bmatrix}$	2 Marks	L4	CO4
8.	**Find the value of k that makes the following matrix positive definite.** $B = \begin{bmatrix} 4 & k \\ k & 9 \end{bmatrix}$	2 Marks	L4	CO4
9.	**Find the saddle point or pay-off value of 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.	**Find the DFT of the following sequence using matrix method.** $x(n) = \{1, 2, 0, 1\}$	2 Marks	L3	CO5

Part B

Answer the Questions. **Total Marks 80M**

11.	a.	**Determine whether** $u = \begin{bmatrix} 1 \\ 0 \\ 4 \end{bmatrix}$ **is in the column space of** $A = \begin{bmatrix} 2 & 5 & 1 \\ -1 & -7 & -5 \\ 3 & 4 & -2 \end{bmatrix}$	12 Marks	L4	CO1
	b.	**Given** $A = \begin{bmatrix} 2 & 0 & 1 \\ 1 & 0 & 1 \end{bmatrix}$**, find the row space of** A**.**	8 Marks	L3	CO1

		Or			
12.	a.	Determine whether $u = \begin{bmatrix} 2 \\ -1 \\ 1 \end{bmatrix}$ is in the column space of $A = \begin{bmatrix} 2 & 5 & 1 \\ -1 & -7 & -5 \\ 3 & 4 & -2 \end{bmatrix}$	12 Marks	L4	CO1
	b.	Given $A = \begin{bmatrix} 2 & 0 & 1 \\ 1 & 0 & 1 \end{bmatrix}$, find the left-hand null space of A.	8 Marks	L3	CO1

13.	a.	Let $u_1 = (1, 2, 4), u_2 = (2, -3, 1), u_3 = (2, 1, -1)$ in $\Re^3$. Show that u_1, u_2, u_3 are orthogonal and write v as a linear combination of u_1, u_2, u_3, where $v = (7, 16, 6)$.	10 Marks	L4	CO2
	b.	Given $A = \begin{bmatrix} 4 & 2 \\ 3 & -1 \end{bmatrix}$, find the i) characteristic polynomial, ii) Eigen values, iii) Eigen vectors, and iv) diagonal matrix.	10 Marks	L3	CO3
		Or			
14.	a.	Let $u_1 = (1, 2, 4), u_2 = (2, -3, 1), u_3 = (2, 1, -1)$ in $\Re^3$. Show that u_1, u_2, u_3 are orthogonal and write v as a linear combination of u_1, u_2, u_3, where $v = (3, 5, 2)$.	10 Marks	L4	CO2
	b.	Given $A = \begin{bmatrix} 5 & -1 \\ 1 & 3 \end{bmatrix}$, find the i) characteristic polynomial, ii) Eigen values, iii) Eigen vectors, and iv) diagonal matrix.	10 Marks	L3	CO3

15.	a.	Show that $A = \begin{bmatrix} 2 & 4 \\ 0 & -2 \end{bmatrix}$ and $B = \begin{bmatrix} 2 & 0 \\ -4 & -2 \end{bmatrix}$ are similar matrices through the invertible $P = \begin{bmatrix} 2 & -2 \\ 2 & 2 \end{bmatrix}$.	7 Marks	L4	CO3
	b.	Find the singular value decomposition (SVD) of the following matrix. $A = \begin{bmatrix} 2 & 3 \\ 4 & 10 \end{bmatrix}$	13 Marks	L5	CO5
		Or			
16.	a.	Find the singular value decomposition (SVD) of the following matrix. $A = \begin{bmatrix} 4 & 0 \\ 3 & -5 \end{bmatrix}$	13 Marks	L5	CO5
	b.	Find the matrix B if A and B are similar matrices. Given $A = \begin{bmatrix} 1 & 2 \\ 3 & -1 \end{bmatrix}$ and $P = \begin{bmatrix} 0 & 1 \\ 2 & 3 \end{bmatrix}$.	7 Marks	L4	CO3

17.	a.	A pay-off matrix without any saddle point comes under a game of mixed strategy. One method of solving such a	10 Marks	L4	CO2

		problem is an odd games method. Solve the following pay-off matrix using odd games method. $$A = \begin{bmatrix} 1 & 5 \\ 4 & 2 \end{bmatrix}$$			
	b.	**Find a range of values of a and b for which the following pay-off matrix will have a saddle point at (2, 2) position.** $$A = \begin{bmatrix} 2 & 4 & 5 \\ 10 & 7 & b \\ 4 & a & 6 \end{bmatrix}$$	**5 Marks**	**L5**	**CO4**
	c.	**Find the optimal mixed strategy for Player I and Player II if Player I chooses a row and Player II chooses a column in the given pay-off 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.**	**Compute the maximal and minimal values of $z = 5x + 3y$ for the following constraints:** $$x + 2y \leq 14$$ $$3x - y \geq 0$$ $$x - y \leq 2$$	**10 Marks**	**L4**	**CO2**
	b.	**Find a range of values of a and b for which the following pay-off matrix will have saddle points at (2, 2) and (2, 3) positions.** $$A = \begin{bmatrix} 2 & 4 & 5 \\ 10 & 7 & b \\ 4 & a & 6 \end{bmatrix}$$	**5 Marks**	**L5**	**CO4**
	c.	**Find the dual of the following linear programming problem.** $$\min 6x_1 + 4x_2 + 2x_3$$ $$\text{s.t. } 4x_1 + 2x_2 + x_3 \geq 5$$ $$x_1 + x_2 \geq 3$$ $$x_2 + x_3 \geq 4$$ $$x_i \geq 0, \text{for } i = 1, 2, 3$$	**5 Marks**	**L3**	**CO6**