

Wks Mapped with the course

WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
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Mark Distribution:

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	40	60	2.5 hrs

Continuous Internal Evaluation Pattern:

Attendance : 5 marks

Continuous Assessment : 20 marks

Continuous Assessment Assignment: 15 marks

SYLLABUS**Module 1 (14 Hrs)**

Review of linear systems of equations and matrix algebra , Vector Spaces and Subspaces, Null Spaces, Column Spaces, and Linear Transformations, Linearly Independent Sets; Bases, The Dimension of a Vector Space, Rank, Applications to Difference Equations, Applications to Markov Chains.

Module 2 (14 Hrs)

Eigenvectors and Eigenvalues, The Characteristic Equation, Similarity, Diagonalization, Eigenvectors and Linear Transformations, Complex Eigenvalues, Discrete Dynamical Systems, Applications to Differential Equations.

Module 3 (14 Hrs)

Inner Product, Length, and Orthogonality, Orthogonal Sets, Orthogonal Projections, The Gram–Schmidt Process, Least-Squares Problems, Applications to Linear Models, Inner Product Spaces, Applications of Inner Product Spaces.

Module 4 (14 Hrs)

Diagonalization of Symmetric Matrices, Quadratic Forms, Constrained Optimization, The Singular Value Decomposition, Applications to Image Processing and Statistics.

Text Books

1. Lay, D. C. (2016). *Linear algebra and its applications* (5th ed.). Pearson.
2. Strang, G. (2018). *Linear algebra and its applications* (5th ed.). Cengage Learning.
3. Anton, H., Rorres, C., & Kaul, A. (2019). *Elementary linear algebra* (12th ed.). John Wiley & Sons.
4. Nicholson, W. K. (2018). *Linear algebra with applications* (7th ed.). McGraw-Hill Education.

Reference Books:

1. Boyd, S., & Vandenberghe, L. (2018). *Introduction to applied linear algebra: Vectors, matrices, and least squares*. Cambridge University Press.
2. Meyer, C. D. (2000). *Matrix analysis and applied linear algebra*. Society for Industrial and

END SEMESTER EXAMINATION – MODEL QUESTION PAPER

Course Code	25HECT401
Course Name	LINEAR ALGEBRA FOR COMMUNICATION
Max. Marks: 60	Duration: 2.5 Hours

Part A <i>(Answer all questions. Each question carries 3 marks)</i>				
Qn No.	Question	Marks	CO	BL
1	A communication network is represented by the matrix $A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 4 & 6 \\ 1 & 1 & 2 \end{bmatrix}$ Determine the rank of the matrix.	3	CO1	L2
2	A population growth model follows a second-order difference equation. Apply matrix methods to obtain the next state vector.	3	CO1	L3
3	Determine the eigenvalues & eigenvectors. $A = \begin{bmatrix} 4 & 1 \\ 2 & 3 \end{bmatrix}.$	3	CO2	L2
4	A population growth model is represented by $A = \begin{bmatrix} 4 & 2 \\ 1 & 3 \end{bmatrix}$ Write the characteristic polynomial of the matrix.	3	CO2	L2
5	Determine whether the vectors $u=(2,1,-1), v=(1,-2,0)$ are orthogonal.	3	CO3	L2
6	Demonstrate the projection of $u = (3,4)$ onto $v = (1,0)$.	3	CO3	L3
7	Express $Q(x,y)=3x^2+4xy+2y^2$ in matrix form.	3	CO4	L2
8	Determine whether $A = \begin{bmatrix} 2 & 1 \\ 1 & 4 \end{bmatrix}$ is symmetric.	3	CO4	L2
Part B				

(Answer any one full question from each Module. Each carries 9 marks)				
Qn No.	Question	Marks	CO	BL
Module I				
9.	A customer may purchase from one of three competing brands. The transition matrix is $P = \begin{bmatrix} 0.7 & 0.2 & 0.1 \\ 0.3 & 0.5 & 0.2 \\ 0.2 & 0.3 & 0.5 \end{bmatrix}.$ If the initial state vector is $X_0 = [1 \ ; \ 0 \ ; \ 0]$, Determine the probability distribution after two purchases.	9	CO1	L3
OR				
10.	Determine the basis and dimension of the solution space of the homogeneous system $\begin{aligned} x+y+z &= 0 \\ 2x+2y+2z &= 0 \\ x-y+z &= 0. \end{aligned}$	9	CO1	L3
Module II				
11.	A coordinate transformation is represented by $T(x,y) = \begin{bmatrix} 2 & 1 \\ 1 & 2 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix}$ Determine the eigenvalues and eigenvectors of the transformation. Hence, diagonalize the transformation matrix.	9	CO2	L3
OR				
12.	A financial investment model is represented by $X_{k+1} = \begin{bmatrix} 0.8 & 0.2 \\ 0.1 & 0.9 \end{bmatrix} X_k. \text{ If } X_0 = \begin{bmatrix} 1000 \\ 500 \end{bmatrix}$ Determine the investment distribution after one iteration and discuss the significance of the dominant eigenvalue.	9	CO2	L3
Module III				
13.	Apply the Gram–Schmidt process to construct an orthonormal vector. $(1,1,0), (1,0,1)$.	9	CO3	L3
OR				
14.	A set of data points $(1,2), (2,3), (3,5)$ is to be fitted using	9	CO3	L3

	$y=ax+b$. Determine the least-squares line.			
Module IV				
15. a	A grayscale image is represented by $A = \begin{bmatrix} 4 & 2 \\ 2 & 1 \end{bmatrix}$ Determine the Singular Value Decomposition (SVD) of the matrix and explain how SVD can be used for image compression.	5	CO4	L3
15. b	The cost function of a manufacturing system is $Q(x,y)=2x^2+4xy+5y^2$; Represent the function as a quadratic form and determine its matrix representation.	4	CO4	L3
OR				
16.	A company wants to minimize $f(x,y)=x^2+y^2$ subject to $x+y=6$ Formulate and solve the constrained optimization problem using Lagrange multipliers.	9	CO4	L3
