Syllabus template

Semester: I	
Programme: Mathematics	
Course: Linear Algebra [Economics + Computer Science]	
Paper code: B1MT230121T	**Credits: 4**
Hours/week: 4	
Category: Core/MDC/SEC/VAC: Minor	
Theory / Practical / Composite: Theory	
No of Modules: NA	

Course Overview: This course introduces the core ideas of Linear Algebra with emphasis on applications relevant to Economics and Computer Science. Students explore matrices, determinants, vector spaces, and linear transformations as tools for modelling real-world systems and solving complex problems. Concepts such as orthogonality, inner products, and the Gram-Schmidt process offer geometric understanding and computational clarity. The module also develops proficiency in eigenvalues, eigenvectors, and matrix diagonalisation, enabling simplified analysis of dynamic models. By the end, learners gain both conceptual insight and practical techniques essential for algorithm design, data interpretation, optimisation, and quantitative reasoning.

Course Outcome: On successful completion of this course, the student will be able to:

1. **Explain** how matrices represent linear transformations and interpret determinants to identify properties such as invertibility.
2. **Describe and apply** the concept of linearity to construct and analyse vector spaces and their generating sets.
3. **Determine** the consistency of a system of linear equations and solve such systems using row operations and matrix methods.
4. **Formulate** systems of linear equations in matrix form and manipulate them effectively for computational solution.
5. **Compute** eigenvalues and eigenvectors of matrices and interpret eigenvectors as invariant directions under linear transformations.
6. **Define** inner product and vector norm and **apply** the Gram–Schmidt process to **construct** orthonormal bases.
7. **Analyse** real quadratic forms and **reduce** them to canonical form to classify the nature of associated surfaces.

Prerequisites: *Basic knowledge of algebra at the Higher Secondary level, including matrices, sets, and real numbers.*

SYLLABUS

UNIT/Module	CONTENT	HOURS or NUMBER OF CLASSES	CO Mapping	COGNITIVE LEVEL
I. Determinants, Matrices and Systems of Linear Equations	Product of two determinants, Adjoint, symmetric and skew-symmetric determinants and related problems [3]. Laplace's expansion method for fourth-order determinants [1]. Trace of a square matrix- its basic results, symmetric,	**17 hours**	**CO1, CO3, CO4**	**K2, K3, K4**

		skew-symmetric and orthogonal matrices and related problems [3]. Hermitian, Skew Hermitian and Unitary matrices and related problems [2]. Elementary row operations on a matrix: Row Echelon form, Inverse of a matrix by elementary row operations, Rank of a matrix [4]. Consistency and solution of a system of linear equations [2]. Gauss Elimination method [2].			
II.	**Linear Spaces and Linear Operators**	Definition of vector space over R, examples [2]. Concepts of linear span, linear dependence and independence of a finite set of vectors, subspaces [4]. Idea of basis of a finite-dimensional real vector space [2]. Statement of addition, deletion and replacement theorems with examples [2]. Linear Operators on linear spaces and its matrix representation [6].	**16 hours**	**CO1, CO2, CO4**	**K3, K4**
III.	**Inner Product Spaces**	Definition and examples, Orthogonal and Orthonormal set of vectors [2]. Schwarz Inequality, Gram-Schmidt process [4].	**6 hours**	**CO6**	**K3, K4**
IV.	**Eigenvalues & Diagonalisation of Matrices**	Eigenvalues and eigenvectors and related problems [5]. Diagonalisation of Matrices [4].	**9 hours**	**CO5**	**K4**
V.	**Real Quadratic Forms.**	Real Quadratic Forms. [4]	**4 hours**	**CO7**	**K4**
Text Books					
1. Higher Algebra (Linear and Abstract): S.K.Mapa.					
2. Linear Algebra- A Geometric Approach: S. Kumaresan.					
3. Linear Algebra- Concepts and Applications: P.K.Nayak.					
Suggested readings					
1. Linear Algebra and Its Applications: Gilbert Strang.					
2. Linear Algebra: Serge Lang.					
3. Linear Algebra: Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence					
Web Resources					

1. https://youtu.be/9h_Q-R6sXbM
2. https://youtu.be/nH05UiErAX4
Evaluation: Theory CIA: 20+5+5=30; Semester Exam: 70.
Paper Structure for Theory Semester Exam Module: 7 questions each carrying 10 marks need to be answered out of 12/13 questions.

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive levels
CO1	**Explain** how matrices represent linear transformations and interpret determinants to identify properties such as invertibility.	K2
CO2	**Describe and apply** the concept of linearity to construct and analyse vector spaces and their generating sets.	K3
CO3	**Determine** the consistency of a system of linear equations and solve such systems using row operations and matrix methods.	K3
CO4	**Formulate** systems of linear equations in matrix form and manipulate them effectively for computational solution.	K3, K4
CO5	**Compute** eigenvalues and eigenvectors of matrices and interpret eigenvectors as invariant directions under linear transformations.	K4
CO6	**Define** inner product and vector norm and **apply** the Gram–Schmidt process to **construct** orthonormal bases.	K3, K4
CO7	**Analyse** real quadratic forms and **reduce** them to canonical form to classify the nature of associated surfaces.	K4