Linear Algebra	Code & No:	MATH 107
	Credits:	3(3,0,1)
	Pre-requisite:	MATH 112
	Co-requisite:	None
	Level:	5

Course Description:

This course includes the following topics:

1. **Introduction to Matrices:** Matrices, Type of matrices, Operations of Matrices, echelon form and Normal form, Determinants and their properties, classical adjoint matrix, matrix inverses, matrix inverse using cofactor, powers of a matrix, Applications involving power of a matrices, Characteristic polynomial, Eigenvalues and eigenvectors, Diagonalization of a matrix, Vectors: their addition, subtraction, and multiplication by scalars (i.e. real numbers). Graphical interpretation of these vector operations Developing geometric insight. Inner products and norms in $\mathbf{R}^n$: inner products of vectors, norm of a vector, unit vectors. Applications of inner products in $\mathbf{R}^n$: lines, planes in $\boldsymbol{R}^3$, and lines and hyperplanes in $\boldsymbol{R}^n$

2. **System of Linear equations:** System of linear equations, Gauss eliminations, inverse method, Cramer's rule

3. **Vector spaces**: Vector spaces on $\boldsymbol{R}^n$, subspaces, Algebra of subspaces, Linear Span, Linear dependence and Independence, Bases and dimensions in $\boldsymbol{R}^n$, Orthogonal bases, Rank of a matrix Range, nullity of a matrix, fundamental theorem of linear algebra

4. **Linear transformations:** Linear Transformation, Kernel and Range of a linear transformation, Null space, Coordinates change, Change of basis and similarity

Course Aims:

a) To understand the concepts of matrices and some operations, eigenvalues and eigenvectors, the concepts of vectors in $\boldsymbol{R}^n$
b) To develop the skills to Solve systems of linear equations using Gauss Elimination, Cramer's rule and inverse matrix method
c) To understand the concepts of vector spaces, subspaces, linear dependence and independence, bases and linear transformations, Rank and nullity of a matrices, fundamental theorem of linear algebra
d) To get the knowledge of linear transformations and some of its applications

Student Outcomes (SOs):

☒(a) An ability to apply knowledge of computing and mathematics appropriate to the program's student outcomes and to the discipline

☒(b) An ability to analyze a problem, and identify and define the computing requirements appropriate to its solution

☐(c) An ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs

☐(d) An ability to function effectively on teams to accomplish a common goal

☐(e) An understanding of professional, ethical, legal, security and social issues and responsibilities

☐(f) An ability to communicate effectively with a range of audiences

☐(g) An ability to analyze the local and global impact of computing on individuals, organizations, and society

☐(h) Recognition of the need for and an ability to engage in continuing professional development

☒(i) An ability to use current techniques, skills, and tools necessary for computing practice.

☐(j) An ability to apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems in a way that demonstrates comprehension of the tradeoffs involved in design choices. [CS]

☐(k) An ability to apply design and development principles in the construction of software systems of varying complexity. [CS]

☐(j) An ability to use and apply current technical concepts and practices in the core information technologies of human computer interaction, information management, programming, networking, and web systems and technologies. [IT]

☐(k) An ability to identify and analyze user needs and take them into account in the selection, creation, evaluation, and administration of computer-based systems. [IT]

☐(l) An ability to effectively integrate IT-based solutions into the user environment. [IT]

☐(m) An understanding of best practices and standards and their application. [IT]

☐(n) An ability to assist in the creation of an effective project plan. [IT]

Course Learning Outcomes (CLOs):

Upon successful completion of the course, students should be able to:

1. To understand the concepts of matrices and some operations, eigenvalues and eigenvectors, the concepts of vectors in $\boldsymbol{R}^n$

2. To develop the skills to Solve systems of linear equations using Gauss Elimination, Cramer's rule and inverse matrix method
3. To understand the concepts of vector spaces, subspaces, linear dependence and independence, bases and linear transformations, Rank and nullity of a matrices, fundamental theorem of linear algebra
4. To get the knowledge of linear transformations and some of its applications

SOs and CLOs Mapping:

CLO/SO	a	b	c	d	e	f	g	h	i	j	k	l	m	n
CLO1	√	√							√					
CLO2	√	√							√					
CLO3	√	√							√					
CLO4	√	√							√					

No.	Topics	Weeks	Teaching hours
1	**Introduction to Matrices:** Matrices, Type of matrices, Operations of Matrices, echelon form and Normal form, Determinants and their properties, classical adjoint matrix, matrix inverses, matrix inverse using cofactor, powers of a matrix, Applications involving power of a matrices, Characteristic polynomial, Eigenvalues and eigenvectors, Diagonalization of a matrix, Vectors: their addition, subtraction, and multiplication by scalars (i.e. real numbers). Graphical interpretation of these vector operations Developing geometric insight. Inner products and norms in $\mathbf{R}^n$: inner products of vectors, norm of a vector, unit vectors. Applications of inner products in $\mathbf{R}^n$: lines, planes in $\boldsymbol{R}^3$, and lines and hyperplanes in $\boldsymbol{R}^n$	5	15
2	**System of Linear equations:** System of linear equations , Gauss eliminations, inverse method, Cramer's rule	2	6
3	**Vector spaces**: Vector spaces, subspaces, Algebra of subspaces, Linear Span, Linear dependence and Independence, Bases and dimensions in $\boldsymbol{R}^n$,	4	12

	Orthogonal bases, Rank of a matrix, Range, nullity of a matrix, fundamental theorem of linear algebra		
4	**Linear transformations:** Linear Transformation, Kernel and Range of a linear transformation, Null space, Coordinates change, Change of basis and similarity	3	9
	Total	**14**	**42**

Textbook:

- Linear Algebra with Applications byJones and Bartlett, Publisher: Gareth Williams, Eighth Edition, 2014

Essential references:

- Advanced Engineering Mathematics by Erwin Kreyszig, John Wiley & Sons, 2008
- Linear Algebra by Seymour Lipchitz and Marc Lipson, Schaum's Outlines, Fifth Edition, 2013
- Linear Algebra, and Its Applications by David C. Lay, Publisher: Pearson, Fifth Edition, 2015
- Linear Algebra, with Application by W. Keith Nicholson, Publisher: McGraw-Hill , Sixth Edition, 2009
- Linear Algebra: A Modern Introduction by D. Poole, Publisher: Brooks Cole, Third Edition, 2011