NORTH SOUTH UNIVERSITY

Center of Excellence in Higher Education

The first private university in Bangladesh

Department of Mathematics and Physics

Course Title	Introduction to Linear Algebra
Course Code	MAT-125
Section No	9
Semester	SPRING 2024
Course Coordinator	Dr. Mohammad Monir Uddin (monir.uddin@northsouth.edu)
Instructor & Department Information	
Instructor's Name	
Office Room	
Office Hours	
Office Phone	
Email Address	
Links	

Marks Distribution:

Attendance	10%
Assignments	10%
Quizzes	20%
Mid-Term	25%
Final Exam	35%

Grading Policy:

Numerical Scores	Letter Grade	Grade Points
93 & above	A	4.0
90 - 92	A-	3.7
87 – 89	B+	3.3
83 – 86	B	3.0
80 – 82	B-	2.7
77 – 79	C+	2.3
73- 76	C	2.0
70 – 72	C-	1.7
67 - 69	D+	1.3
60 - 66	D	1.0

Course Short Description

This is an introductory course in linear algebra. The course will introduce the basic concepts and techniques of linear algebra, along with the insights of its wide applications in physics, economics and social sciences, natural sciences, and engineering. The course will require the development of theoretical results, which will require the use of mathematical rigor, algebraic manipulation, and geometry.

This course covers, but is not limited to, the study of systems of linear equations, matrices, determinants, vectors and vector spaces, basis and dimension of vector spaces, linear transformations, eigenvalues and eigenvectors, and their applications. Computer software will be used to enhance the learning of the topics and techniques covered.

Course Objectives

1. To understand the fundamental properties of matrices including determinants, inverse matrices, matrix factorizations, eigenvalues, eigenvectors along with their application, and linear transformations.
2. Understanding the basic concepts of the system of linear equations, apply the matrix calculus to solve linear systems of equations.
3. To comprehend the Euclidean n-space, vector spaces, subspaces, linear span, and determine the basis and dimension of vector spaces.
4. Solving problems using computer programming and graphing calculators to gain an insight into the applicability of linear algebra.

Course Learning Outcomes

Upon successful completion of this course, students will be able to:

- **(CO-1)** Demonstrate the ability to understand the basic properties of matrices including determinants, inverse matrices, matrix factorizations, eigenvalues, eigenvectors, and linear transformations, the applications of eigenvectors including the investigation of the diagonalizability of matrices.
- **(CO-2)** Explain the fundamental concepts of the system of linear equations using geometry and graphs; and apply the matrix calculus to solve linear systems of equations.
- **(CO-3)** Comprehend the concept of Euclidean n-space, vector spaces, subspaces, linear span, and determine the basis and dimension of vector spaces.
- **(CO-4)** Develop problem solving ability using computer programming and graphing calculators and have an appreciation of the wide application of this discipline within the scientific field.

CLOs	**Course Outcomes (CO)**	**Bloom's taxonomy domain/level** *(C: Cognitive P: Psychomotor A:Affective)*	**Delivery methods and activities**	**Assessment tools**
CO-1	Demonstrate the ability to understand the basic properties of matrices including determinants, inverse matrices, matrix factorizations, eigenvalues, eigenvectors, and linear transformations, the applications of eigenvectors including the investigation of the diagonalizability of matrices.	**C1, C2, C3, C4**	Lectures, notes	Quiz, Assignment, Midterms, Final Exam
CO-2	Explain the fundamental concepts of the system of linear equations using geometry and graphs; and apply the matrix calculus to solve linear systems of equations.	**C2, C3, P2**	Lecture, notes, group discussion	Assignment, Class participation, Quiz, Midterms
CO-3	Comprehend the concept of Euclidean n-space, vector spaces, subspaces, linear span, and	**C1, C2, C3**	Lecture, notes	Discussion, Quiz, Midterms, Final Exam

	determine the basis and dimension of vector spaces.			
CO-4	Develop problem solving ability using computer programming and graphing calculators and have an appreciation of the wide application of this discipline within the scientific field.	**C2, C3, C6, P3**	Lecture, notes, group discussion	Assignment, Discussion, Class participation

Lecture	Topics	Article no. in the text book	Assessment tools	Learning Outcomes
1	Matrices and Matrix Operations, Inverse; Rules of Matrix Arithmetic,	1.3, 1.4, 1.7	Quiz1, Discussions	CO-1
2	Diagonal, Triangular and Symmetric Matrices, Matrices and Matrix Operations,	1.3, 1.4,	Quiz 1, Discussions	CO-1
3	Inverse; Rules of Matrix Arithmetic, Diagonal, Triangular and Symmetric Matrices	1.7	Assignment I, Midterm	CO-1
4	Elementary Matrices and a Method for Finding inverse of Matrix, Elementary Matrices and a Method for Finding inverse of Matrix	1.5	Assignment I, Midterm	CO-1
5	Determinant by Cofactor Expansion	2.1	Quiz 1, Midterm	CO-1
6	Evaluating Determinants by Row Reduction	2.2	Midterm	CO-1
7	Properties of Determinant Function	2.3	Midterm, Assignment I	CO-1
8	Introduction to System of Linear Equations, Gaussian Eliminations	1.1, 1.2	Discussions,	CO-2
9	Gaussian Eliminations (No solution and Unique solution)	1.2	Midterm,	CO-2
10	Gaussian Eliminations (many solutions),Solution of Homogeneous system of Linear Equations	1.2	Midterm,	CO-2
11	Further Results on Systems of Equations and Invertibility,	1.2	Midterm,	CO-2
12	Euclidean n-space and properties, Euclidean n-space and Gramsmith Orthogonalization	1.6	Discussions Midterm	CO-2, CO-3
13	Midterm Exam			
14	Linear Transformation	4.2	Final,	CO-1
15	Linear Transformation and properties, General Linear Transformations, Kernel and Range,	4.2 , 4.3	Final,	CO-1
16	Inverse Linear Transformations, Matrices of General Linear Transformations	8.1, 8.2,	Final, Assignment II	CO-2, CO-3
17	Inverse Linear Transformations, Matrices of General Linear Transformations	8.3, 8.4	Final, Assignment II	CO-2, CO-3
18	Real Vector Spaces, Subspaces	5.1	Quiz 2	CO-1
19	Linear combination,Linear Independence and Dependence	5.2	Final	CO-3
20	Linear combination,Linear Independence and Dependence	5.3	Final	CO-3
21	Basis, Dimension, Solution Space and Null Space	5.4	Quiz 2, Final Exam	CO-3

22	Fundamental Subspace of Linear Algebra (Row Space, Column Space and Null Space)	5.5	Quiz 3, Final Exam	CO-3
23	Fundamental Subspace of Linear Algebra (Row Space, Column Space and Null Space)	5.5	Quiz 3, Final Exam	CO-3
24	Rank and Nullity	5.6	Final Exam	CO-3
25	Eigenvalues and Eigenvectors	7.1	Quiz 3	CO-3
29	Diagonalization	7.2	Final Exam	CO-3
26	Algebraic and Geometric Multiplicity	7.2	Final exam, Assignment II	CO-3
27	Cayley Hamilton Theorem (CHT) and its applications	7.3	Final exam, Quiz3	CO-3
28	Applications of Linear Algebra	11.2, 11.3	Discussions Final exam	CO-4
29	Applications of Linear Algebra	11.6, 11.7	Discussions Final exam	CO-4
30	Applications of Linear Algebra	11.16	Discussions, Final exam	CO-4
Final Exam (Declared by the Controller of Examinations)				

Mapping of Course Outcomes

Class Schedule

Note: The instructor reserves the right to make changes to the syllabus if necessary.

List of additional readings

- **Chapter 3: Vectors in 2-Space and 3-Space:** Introduction to Vectors, Norm of a Vector; Vector Arithmetic, Dot Product; Projections, Lines and Planes in 3-Space
- **Chapter 6: Inner Product Spaces:** Inner Products, Angle and Orthogonality in Inner Products, Orthonormal Bases; Gram-Schmidt Process, Orthogonal Matrices; Change of Basis.

Classroom Rules of Conduct

Please Refer to NSU Student Handbook, Sections: “Disciplinary Actions” and “Procedures and Guidelines”.

Exams & Make-up Exam Policy

NO makeup for quizzes and NO Formative assessment will be retaken under any circumstances. If a student misses the Midterm and/or Final exams due to circumstances beyond their control (official valid documents are required) and is informed beforehand (if possible), reasonable arrangement may be considered. Please note that the retake exam questions are generally a bit tricky and critical compare to the regular exam questions. **Students may get the opportunity to see/recheck their midterm and Final exam scripts. Cell phones are prohibited in exam sessions**.

Attendance Policy: As per NSU policy.