

ELEMENTARY LINEAR ALGEBRA

The University of Toledo
Mathematics & Statistics Department, College of Natural Sciences and Mathematics
MATH1890-0XX, CRN XXXXX

Instructor:	(Insert Name]	Class Location:	(Insert Building/Room)
Email:	(Insert E-mail Address)	Class Day/Time:	(Insert Days/Time)
Office Hours:	(Insert Days/Time)	Lab Location:	(Insert Building/Office #, if applicable)
Office Location:	(Insert Building/Office Number)	Lab Day/Time:	(Insert Days/Time, if applicable)
Office Phone:	(Insert Phone Number)	Credit Hours:	3
Term:	(Insert Semester and Year)		

COURSE DESCRIPTION

MATH1890 is a first course in Linear Algebra at the undergraduate level. It begins by introducing students to the methods for solving linear systems of equations and the calculus of matrices. Building upon these topics the abstract notions of a vector space and linear transformations are introduced. The equivalence of matrices under similarity and conjugation is studied with the aid of the notions of inner product spaces and eigenvectors and eigenvalues.

STUDENT LEARNING OUTCOMES

The successful Linear Algebra students should be able to:

- 1. Vectors:** Utilize algebraic and geometric representations of vectors in \mathbb{R}^n and their operations, including addition, scalar multiplication and dot product. Determine the angle between vectors and the orthogonality of vectors.
- 2. Systems of Linear Equations:** Solve systems of linear equations using Gauss-Jordan elimination to reduce to echelon form. Solve systems of linear equations using the inverse of the coefficient matrix when possible. Interpret existence and uniqueness of solutions geometrically.
- 3. Matrix Algebra:** Perform common matrix operations such as addition, scalar multiplication, multiplication, and transposition.
- 4. Linear Independence:** Recognize spanning sets and linear independence for vectors in \mathbb{R}^n . Prove elementary theorems concerning rank of a matrix and the relationship between rank and nullity.
- 5. Linear Transformations:** For a given matrix write the corresponding linear transformation from \mathbb{R}^n to \mathbb{R}^m . Compute a transformation's kernel, image, nullity, and the rank. Write a linear transformation in terms of its matrix representation. Compute composition of linear transformations by multiplying their matrix representations.
- 6. Determinants:** Use the determinant to find the inverse of a matrix. Describe how row and column operations affect the determinant. Compute the determinant of the product of matrices by multiplying the determinants.
- 7. Eigenvalues and Eigenvectors:** Define eigenvalues and eigenvectors geometrically. Use characteristic polynomials to compute eigenvalues and eigenvectors. Use eigenspaces of matrices, when possible, to diagonalize a matrix.
- 8. Vector Spaces:** Use axioms for abstract vector spaces over the real numbers to give examples (and non-examples) of abstract vector spaces such as subspaces of the space of all polynomials.
- 9. Orthogonalization:** Recognize orthogonal and orthonormal bases, use Gram-Schmidt orthogonalization to find orthogonal and orthonormal bases, find orthogonal complements of sets, and projections of vectors.

PREREQUISITES

Minimum grade of C- in MATH 1840, or MATH1860, or MATH1940

TEXTBOOK

Linear Algebra and Its Applications, Books a la Carte Edition Plus MyMathLab with Pearson eText -- Access Code Card | Edition: 5, by David C Lay, Steven R. Lay, Judi J. McDonald (ISBN: 9780321989925), Pearson.

UNIVERSITY POLICIES:

POLICY STATEMENT ON NON-DISCRIMINATION ON THE BASIS OF DISABILITY (ADA)

The University is an equal opportunity educational institution. Please read The University's Policy Statement on Nondiscrimination on the Basis of Disability Americans with Disability Act Compliance.

ACADEMIC ACCOMMODATIONS

The University of Toledo is committed to providing equal access to education for all students. If you have a documented disability or you believe you have a disability and would like information regarding academic accommodations/adjustments in this course please contact the Student Disability Services Office (Rocket Hall 1820; 419.530.4981; studentdisabilitysvs@utoledo.edu) as soon as possible for more information and/or to initiate the process for accessing academic accommodations. For the full policy see: <http://www.utoledo.edu/offices/student-disability-services/sam/index.html>

ACADEMIC POLICIES:

STUDENT PRIVACY

Federal law and university policy prohibits instructors from discussing a student's grades or class performance with anyone outside of university faculty/staff without the student's written and signed consent. This includes parents and spouses. For details, see the "Confidentiality of student records (FERPA)" section of the University Policy Page at <http://www.utoledo.edu/policies/academic/undergraduate/index.html>

MISSED CLASS POLICY

If circumstances occur result in a student missing a quiz, test, exam or other graded item, the student must contact the instructor in advance by phone, e-mail or in person, provide official documentation to back up his or her absence (at the instructors request), and arrange to make up the missed item as soon as possible. For details, see the "Missed class policy" section of the University Policy Page at <http://www.utoledo.edu/policies/academic/undergraduate/index.html>

ACADEMIC DISHONESTY

Any act of academic dishonesty as defined by the University of Toledo policy on academic dishonesty (found at <http://www.utoledo.edu/dl/students/dishonesty.html>) will result in an F in the course or an F on the item in question, subject to the determination of the instructor.

GRADING AND EVALUATION

Syllabus should describe the methods of evaluation whether quizzes, exams or graded assignments. There should be at least two one-hour in class exams. If quiz scores are not used as a portion of the grade, there should be three one-hour exams. As mentioned above there is the expectation that counted in the grade will be an evaluation of at least one project assignment. A description of a grading method that includes the proportion that each evaluating method counts toward the grade should be described. If

the grading method uses a grading scale it should be clearly stated. In scheduling quizzes and exams it should be kept in mind that the last day to add/drop the class is the end of the second week of classes and the last day to withdraw from the class is the end of the tenth week. By these dates students like to have some measure of their progress in the class.

IMPORTANT DATES

*The instructor reserves the right to change the content of the course material if he perceives a need due to postponement of class caused by inclement weather, instructor illness, etc., or due to the pace of the course.

MIDTERM EXAM:

FINAL EXAM:

OTHER DATES

The last day to drop this course is _____

The last day to withdraw from this course is _____

STUDENT SUPPORT SERVICES

Free math tutoring on a walk-in basis is available in the **Math Learning and Resources Center** located in Rm B0200 in the lower level of Carlson Library (phone ext 2176). The Center operates on a walk-in basis. MLRC hours can be found at <http://www.math.utoledo.edu/mlrc/MLRC.pdf>

CLASS SCHEDULE

Syllabus should provide a list of sections to be covered and should indicate the material that might be covered on each in-class examination. It is advisable to provide at least a tentative exam schedule. In formulating a schedule for the class enough time should be budgeted to cover the following topic thoroughly.

COURSE CONTENT:

Chapter 1 Linear Equations in Linear Algebra (total 10 hours)

1.1 Systems of Linear Equations (2)	2 hour
1.2 Row Reduction and Echelon Forms (2)	1 hour
1.3 Vector Equations (1)	2 hour
1.4 The Matrix Equation $Ax = b$ (2)	1 hour
1.5 Solution Sets of Linear Systems (2)	1 hour
1.7 Linear Independence (4)	1 hour
1.8 Introduction to Linear Transformations (5)	1 hour
1.9 The Matrix of a Linear Transformation (5)	1 hour

Chapter 2 Matrix Algebra (total 8 hours)

2.1 Matrix Operations (3)	2 hour
2.2 The Inverse of a Matrix (3)	2 hour
2.3 Characterizations of Invertible Matrices (3)	1 hour
2.8 Subspaces of \mathbb{R}^n (4)	2 hour
2.9 Dimension and Rank (4)	1 hour

Chapter 3 Determinants (total 5 hours)

3.1 Introduction to Determinants (6)	1 hour
3.2 Properties of Determinants (6)	2 hour
3.3 Cramer's Rule, Volume, and Linear Transformations (6)	2 hour

Chapter 4 Vector Spaces (total 9 hours)

4.1 Vector Spaces and Subspaces (8)	2 hour
4.2 Null Spaces, Column Spaces, and Linear Transformations (5)	2 hour
4.3 Linearly Independent Sets; Bases (4)	1 hour
4.4 Coordinate Systems (9)	1 hour
4.5 The Dimension of a Vector Space (4)	1 hour
4.6 Rank (4)	1 hour
4.7 Change of Basis (9)	1 hour

Chapter 5 Eigenvalues and Eigenvectors (total 6 hours)

5.1 Eigenvectors and Eigenvalues (7)	1 hour
5.2 The Characteristic Equation (7)	1 hour
5.3 Diagonalization (7)	2 hour
5.4 Eigenvectors and Linear Transformations (7)	1 hour
5.5 Complex Eigenvalues (7)	1 hour

Chapter 6 Orthogonality and Least Squares (total 2 hours)

6.1 Inner Product, Length, and Orthogonality (1)	1 hour
6.2 Orthogonal Sets (1)	1 hour
6.3 Orthogonal Projections	optional
6.4 The Gram-Schmidt Process	optional

Total : 40 hours lecture + 3 hours exams = 43 hours

***The numbers in parentheses refer to students outcome and 1-8 are the essential outcomes.**

***In Fall semesters there are 43 lecture for a MWF class.**