Course Information:
Title: Applied Linear Algebra
Course ID: Math 4242
Credits: 4

Prerequisites:
Math 2243, 2373, or 2573, with a minimum grade of C–.

Instructor:
Name: William Leeb (Will)
Office: Vincent Hall 536
Email: wleeb@umn.edu

Meeting Information:
Time: MWF 2:30p - 3:20p
Location: Vincent Hall 211

Office Hours:
Time: MWF 3:30p - 4:20p
Location: Vincent Hall 536

Course Description:
Topics to be covered include the solution of linear systems by Gaussian elimination; linear spaces, subspaces, and bases; inner products and orthogonality; the Gram-Schmidt procedure; linear transformations and matrices; determinants; eigenvalues and eigenvectors; the singular value decomposition; quadratic forms; matrix factorizations.

Textbook:
Applied Linear Algebra, 2nd Edition, by Peter Olver and Chehrzad Shakiban. A PDF copy of the textbook is available through the UMN Library website.

Homework:
Problem sets will be assigned each Friday and due the next Friday at the end of class. Late homework will not be accepted. Students are encouraged to work together on problem sets; however, each student must write up and understand his/her own solutions.

Quizzes:
I will give occasional in-class quizzes, which might not be announced in advance. Unlike for problem sets, collaboration with other students and/or use of outside resources will not be permitted on quizzes (unless stated otherwise at the time).

Exams:
There will be two in-class midterm exams and a cumulative final exam. Collaboration with other students and/or use of outside resources, including calculators, will not be permitted on exams. The exam schedule is as follows:

	Date	Time	Location
Midterm 1	October 9^{th}	2:30p - 3:20p	Vincent 211
Midterm 2	November 13^{th}	2:30p - 3:20p	Vincent 211
Final exam	December 16^{th}	1:30p - 3:30p	Vincent 211

Grades:
The final grade will be based on your scores on the homeworks/quizzes, the two in-class midterm exams, and the final exam. The percentage breakdown is as follows:

Item	Percentage
HW/Quizzes	15%
Midterms	50% (25% each)
Final exam	35%

Attendance:
Students are expected to attend lectures and participate when appropriate. If a student misses class on the day of an exam/quiz, a make-up exam/quiz will only be given under exceptional circumstances and at the instructor's discretion.

Drop Deadline:
For the university calendar, including drop deadlines, visit: `https://onestop.umn.edu/dates-and-deadlines`.

University Policies:
For the university's policies on student conduct, electronic devices, scholastic dishonesty, make-up work, use of notes/course materials, grading/transcripts, sexual harassment, equal opportunity, disability accommodations, mental health and stress management, and academic freedom and responsibility, visit: `https://policy.umn.edu/education/syllabusrequirements-appa`. For more information on academic dishonesty, visit: `https://communitystandards.umn.edu/`. For more information on grading policy, visit: `https://policy.umn.edu/education/gradingtranscripts`. For more information on disability accomodations, visit: `https://diversity.umn.edu/disability/`.

Schedule:
The following table lists approximately which sections from the textbook have been covered during each lecture. This table will be updated throughout the semester.

#	**Date**	**Sections**	**Description**
1	9/4/2019	§1.1 – 1.2	Matrix operations; Gaussian elimination
2	9/6/2019	§1.3	LU factorization for regular matrices
3	9/9/2019	§1.4	Permuted LU factorization for nonsingular matrices
4	9/11/2019	Begin §1.5	Matrix inverses
5	9/13/2019	Finish §1.5	Gauss-Jordan elimination
6	9/16/2019	§1.6; begin §1.8	Transposes; general linear systems
7	9/18/2019	Finish §1.8; begin §1.9	Homogeneous linear systems; determinants
8	9/20/2019	Finish §1.9; begin §2.1	Properties of determinants; vector spaces
9	9/23/2019	Finish §2.1; §2.2	Properties of vector spaces; subspaces

The following table lists approximately which sections from the textbook will be covered during future lectures, based on last year's course. This schedule is subject to change.

#	**Sections**	**Description**
10	§2.3	Spans; linear independence
11	Begin §2.4	Bases; dimension
12	Finish §2.4; begin §2.5	Kernel and image of a matrix
13	Finish §2.5	The fundamental subspaces of a matrix
14	§3.1	Inner product spaces
15	§3.2	Cauchy-Schwarz/triangle inequalities; orthogonality
16	Begin §3.3	Normed spaces; matrix norms
17	Finish §3.3; begin §3.4	Positive definite matrices
18	Finish §3.4; §3.5	Cholesky decomposition; Gram matrices
19	§3.6; begin §4.1	Orthogonal/orthonormal bases
20	Finish §4.1	Orthogonal/orthonormal expansions
21	Begin §4.2; begin §4.3	Orthogonal matrices; Gram-Schmidt
22	Finish §4.2	2D rotations; more on Gram-Schmidt
23	Finish §4.3	The QR factorization
24	Begin §4.4	Complementary subspaces
25	Finish §4.4	The Fredholm alternative
26	Begin §7.1	Linear operators
27	Finish §7.1; begin §7.2	The dual space; composition; examples
28	Continue §7.2	Change-of-basis for linear operators
29	Finish §7.2	Canonical form; diagonalizing inner products
30	Begin §8.2	Eigenvectors and eigenvalues
31	Finish §8.2; begin §8.3	Completeness and diagonalizability
32	Finish §8.3; begin §8.5	The Spectral Theorem
33	Continue §8.5	More on the Spectral Theorem
34	Finish §8.5; §8.6	Norms of symmetric matrices; incomplete matrices
35	Begin §8.7	Singular values and singular vectors
36	Begin §8.7	Singular values and singular vectors
37	Finish §8.7	Pseudo-inverse; least-squares