

# Math 2250 Elementary Linear Algebra

## Syllabus – Summer 2014

**Instructor:** Keivan Hassani Monfared

**Office:** Ross Hall 207

**Email:** khassani@uwoyo.edu

**Office Hours:** TWR 9:30am-10:30am

**Class:** MTWRF 10:35pm - 11:50pm

**Course Website:** [students.uwoyo.edu/KHASSANI/Courses/ElemLinAlgSu2014.html](http://students.uwoyo.edu/KHASSANI/Courses/ElemLinAlgSu2014.html)

**Prerequisites:** Grade of C or better in MATH 2200 or 2350.

**Textbook:** Strang, Gilbert. **Introduction to Linear Algebra**. 4th ed. Wellesley, MA: Wellesley-Cambridge Press, February 2009. ISBN: 9780980232714. Buy at Amazon: <http://www.amazon.com/exec/obidos/ASIN/0980232716/ref=nosim/mitopencourse-20> (Note: When you purchase this book from the provided link (or other media) from Amazon.com, MIT OpenCourseWare will receive up to 10% of this purchase and any other purchases you make during that visit. Learn more.)

**How this class works:** You are required to watch a video before each class, and read the related section in the book. Videos are provided on MIT's open-course-ware website: <http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/index.htm>, and the lectures are given by Professor Gilbert Strang. These topics are listed below, and the links to the videos are provided. During the class period I answer questions that you might have, work examples, and we will work on more examples and homework problems together. This is assumed to be an interactive course with collaboration between students and the instructor.

**Homework:** Homework problems will be assigned during the semester and the due dates will be negotiated in class.

**Quizzes:** There will be 27 daily short quizzes **at the beginning of each class**, except the days of exam, each 5 minutes long. You cannot make up any of these quizzes, or take them separately. Each quiz is worth 1% of the total grade. These quizzes are on the topics that are listed for that day in the table. The quizzes are to ensure that you are watching the videos and reading the book. If you are going to miss the class on any day, you can email me a 1-2 page summary of the video lecture of that day before the class starts.

**Exams:** There are three semester exams, on Fridays 05/30/14, 06/13/14, and 06/27/14 during the class period.

**Grading Policy:** Your percentage grade is determined by the following:

Homework	10%
Quizzes	1% each
Exam 1,2,3	21% each

You can estimate your letter grade by using the following scale:  $\geq 90\%$  is an A,  $80\% - 89\%$  is a B,  $70\% - 79\%$  is a C,  $60\% - 69\%$  is a D, and  $< 60\%$  is an F.

**Getting Help:** You are encouraged to work in groups as much as possible on homework. Often, having a second perspective helps in the understanding process. You are also welcome to stop by my office. Additionally, the tutors in the Math Lab in Ross Hall 29 (northwest corner on bottom floor) will be able to help you.

Finally, Tau Beta Pi, the Engineering honor society, offers free tutoring in many engineering, mathematics and science courses. See <http://uwoyo.collegiatelink.net/organization/tpb> for more information.

**Goals of Math 2250:** Here are key computations and some of the ideas behind them:

- Solving  $Ax = b$  for square systems by elimination (pivots, multipliers, back substitution, invertibility of  $A$ , factorization into  $A = LU$ )
- Complete solution to  $Ax = b$  (column space containing  $b$ , rank of  $A$ , nullspace of  $A$  and special solutions to  $Ax = 0$  from row reduced  $R$ )
- Basis and dimension (bases for the four fundamental subspaces)

- Least squares solutions (closest line by understanding projections)
- Orthogonalization by Gram-Schmidt (factorization into  $A = QR$ )
- Properties of determinants (leading to the cofactor formula and the sum over all  $n!$  permutations, applications to  $\det(A)$  and volume)
- Eigenvalues and eigenvectors (diagonalizing  $A$ , computing powers  $A^k$  and matrix exponentials to solve difference and differential equations)
- Symmetric matrices and positive definite matrices (real eigenvalues and orthogonal eigenvectors, tests for  $x^T Ax > 0$ , applications)
- Linear algebra in engineering (graphs and networks, Markov matrices, Fourier matrix, Fast Fourier Transform, linear programming)

**Academic Dishonesty and Classroom Conduct:** The University of Wyoming is built upon a strong foundation of integrity, respect and trust. All members of the university community have a responsibility to be honest and the right to expect honesty from others. Any form of academic dishonesty (see UW Regulation 6-802) is unacceptable to our community and will not be tolerated.

You are expected to avoid any behaviors that would be disruptive in class. I reserve the right to ask you to leave or to put away any devices that are not helpful should I deem it necessary. Persistence in such behavior may get you dropped from the course. Please see the document entitled *Students and Teachers – Working Together* produced by the UW College of Arts and Sciences for more information.

**Disability Statement:** If you have a physical, learning, or psychological disability and require accommodations, please let me know as soon as possible. You must register with, and provide documentation of your disability to University Disability Support Services (UDSS) in SEO, room 330 Knight Hall. 766-6189, TTY: 766-3073.

The policies in this syllabus are subject to change. Minor changes will be announced in class and substantive changes shall be communicated in writing.

### Elementary Linear Algebra - Math 2250 - Summer 2014 Schedule

Day	Date	Quiz Topic	Reading
1	05/19/14	The geometry of linear equations	1.1-2.1
<a href="http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-1-the-geometry-of-linear-equations">http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-1-the-geometry-of-linear-equations</a>			
2	05/20/14	Elimination with matrices	2.2-2.3
<a href="http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-2-elimination-with-matrices">http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-2-elimination-with-matrices</a>			
3	05/21/14	Multiplication and inverse matrices	2.4-2.5
<a href="http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-3-multiplication-and-inverse-matrices">http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-3-multiplication-and-inverse-matrices</a>			
4	05/22/14	Factorization into $A = LU$	2.6
<a href="http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-4-factorization-into-a-lu">http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-4-factorization-into-a-lu</a>			
5	05/23/14	Transposes, permutations, spaces $R^n$	2.7
<a href="http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-5-transposes-permutations-spaces-r-n">http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-5-transposes-permutations-spaces-r-n</a>			
6	05/26/14	No class	
7	05/27/14	Column space and nullspace	3.1-3.2
<a href="http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-6-column-space-and-nullspace">http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-6-column-space-and-nullspace</a>			
8	05/28/14	Solving $Ax = 0$ : pivot variables, special solutions	3.2-3.4
<a href="http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-7-solving-ax-0-pivot-variables-special-solutions">http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-7-solving-ax-0-pivot-variables-special-solutions</a>			
9	05/29/14	Solving $Ax = b$ : row reduced form $R$	3.3-3.4
<a href="http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-8-solving-ax-b-row-reduced-form-r">http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-8-solving-ax-b-row-reduced-form-r</a>			
10	05/30/14	Exam I	
<a href="http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-13-quiz-1-review">http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-13-quiz-1-review</a>			
11	06/02/14	Independence, basis, and dimension	3.5
<a href="http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-9-independence-basis-and-dimension">http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-9-independence-basis-and-dimension</a>			
12	06/03/14	The four fundamental subspaces	3.6
<a href="http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-10-the-four-fundamental-subspaces">http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-10-the-four-fundamental-subspaces</a>			
13	06/04/14	Matrix spaces, rank 1, small world graphs	
<a href="http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-11-matrix-spaces-rank-1-small-world-graphs">http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-11-matrix-spaces-rank-1-small-world-graphs</a>			
14	06/05/14	Graphs, networks, incidence matrices	8.2

<a href="http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-12-graphs-networks-incidence-matrices">http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-12-graphs-networks-incidence-matrices</a>	15	06/06/14	Orthogonal vectors and subspaces	4.1
<a href="http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-14-orthogonal-vectors-and-subspaces">http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-14-orthogonal-vectors-and-subspaces</a>	16	06/09/14	Projections onto subspaces	4.2
<a href="http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-15-projections-onto-subspaces">http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-15-projections-onto-subspaces</a>	17	06/10/14	Projection matrices and least squares	4.3
<a href="http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-16-projection-matrices-and-least-squares">http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-16-projection-matrices-and-least-squares</a>	18	06/11/14	Orthogonal matrices and Gram-Schmidt	4.4
<a href="http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-17-orthogonal-matrices-and-gram-schmidt">http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-17-orthogonal-matrices-and-gram-schmidt</a>	19	06/12/14	Properties of determinants	5.1
<a href="http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-18-properties-of-determinants">http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-18-properties-of-determinants</a>	20	06/13/14	Exam II	
<a href="http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-24b-quiz-2-review">http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-24b-quiz-2-review</a>	21	06/16/14	Determinant formulas and cofactors	5.2
<a href="http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-19-determinant-formulas-and-cofactors">http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-19-determinant-formulas-and-cofactors</a>	22	06/17/14	Cramer's rule, inverse matrix, and volume	5.3
<a href="http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-20-cramers-rule-inverse-matrix-and-volume">http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-20-cramers-rule-inverse-matrix-and-volume</a>	23	06/18/14	Eigenvalues and eigenvectors	6.1
<a href="http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-21-eigenvalues-and-eigenvectors">http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-21-eigenvalues-and-eigenvectors</a>	24	06/19/14	Diagonalization and powers of A	6.2
<a href="http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-22-diagonalization-and-powers-of-a">http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-22-diagonalization-and-powers-of-a</a>	25	06/20/14	Differential equations and $\exp(At)$	6.3
<a href="http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-23-differential-equations-and-exp-at">http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-23-differential-equations-and-exp-at</a>	26	06/23/14	Markov matrices, fourier series	8.3, 8.5
<a href="http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-24-markov-matrices-fourier-series">http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-24-markov-matrices-fourier-series</a>	27	06/24/14	Symmetric matrices and positive definiteness	6.4-6.5
<a href="http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-25-symmetric-matrices-and-positive-definiteness">http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-25-symmetric-matrices-and-positive-definiteness</a>	28	06/25/14	Complex matrices, fast fourier transform	8.5, 10.2-10.3
<a href="http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-26-complex-matrices-fast-fourier-transform">http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-26-complex-matrices-fast-fourier-transform</a>	29	06/26/14	Positive definite matrices and minima	6.5, 8.1
<a href="http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-27-positive-definite-matrices-and-minima">http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-27-positive-definite-matrices-and-minima</a>	30	06/27/14	Exam III	-
<a href="http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-32-quiz-3-review">http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-32-quiz-3-review</a>	-	-	Optional	-
-	-	-	-	-
-	-	-	Similar matrices and jordan form	6.6
<a href="http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-28-similar-matrices-and-jordan-form">http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-28-similar-matrices-and-jordan-form</a>	-	-	Singular value decomposition	6.7
<a href="http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-29-singular-value-decomposition">http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-29-singular-value-decomposition</a>	-	-	Linear transformations and their matrices	7.1-7.2
<a href="http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-30-linear-transformations-and-their-matrices">http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-30-linear-transformations-and-their-matrices</a>	-	-	Change of basis, image compression	7.3, 8.1
<a href="http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-31-change-of-basis-image-compression">http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-31-change-of-basis-image-compression</a>	-	-	Left and right inverses, pseudoinverse	7.3
<a href="http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-33-left-and-right-inverses-pseudoinverse">http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-33-left-and-right-inverses-pseudoinverse</a>	-	-	Final Course Review	-
<a href="http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-34-final-course-review">http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/lecture-34-final-course-review</a>	-	-	-	-

If you are using a printed version of this schedule, type in the links, or go to the following link on your browser to access the above videos:  
<http://goo.gl/DoiMQw> (Case sensitive.)

Or visit: <http://students.uwyo.edu/KHASSANI/Courses/ElemLinAlgSu2014/schedule.html>

Or scan this QR code:

