Mathematics 232 Linear Algebra Spring 2013

MWF 10:00 – 10:50 am King 337

Instructor: Susan Jane Colley
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Office Hours:

Monday	2:00 – 3:30 pm
Tuesday	9:30 – 10:30 am, 3:00 – 4:30 pm
Wednesday	11:00 am – noon, 3:30 – 5:00 pm
Friday	11:00 am – noon, 1:30 – 2:30 pm

Also by appointment

Text: B. Kolman and D. Hill, *Elementary Linear Algebra* (9th ed.), Prentice Hall. This text is required. Recommended supplements if you are not familiar or comfortable reading and writing mathematical proofs are D. Solow, *How to Read and Do Proofs*, D. Solow, *The Keys to Advanced Mathematics*, and K. Houston, *How To Think Like a Mathematician*. These books are on reserve, and the Houston book should be available in the bookstore.

Goals: There are three main objectives for this course. One is to learn the basic tools and computational techniques of matrix algebra and vector spaces. Another is to become more comfortable and conversant with abstract concepts as they occur in mathematics and to develop skill with techniques of formal proof. Finally, as time permits, we will explore some applications of the techniques and theory discussed.

Homework: The attached syllabus contains suggested problems for you to work in order to gain some familiarity with the material. These problems are *not* to be turned in (unless otherwise noted). You should do as many or as few of them as you need in order to feel comfortable with the topics discussed in class. In addition, there will be separately assigned, hand-in problem sets due weekly (usually Wednesdays). Solutions to the hand-in problem sets will be available online.

Exams: There will be one in-class, closed-book exam, two open-book, take-home exams, and a two-hour, closed-book final. Tentative dates for the midterm exams are **March 6** (in-class), **April 10** (take-home due), and **May 1** (take-home due). Please let me know as soon as possible if there is a problem with any of these dates. The final exam will take place on **Wednesday, May 15 from 7:00 to 9:00 pm**.

Participation: Class attendance is not a formal part of your grade for the course. Therefore, you need not explain if you must miss a class, but you are responsible for finding out what material was discussed. It is recommended that you attend as many classes as possible, and that you are an active participant in them. Please try to arrive on time; it can be quite disruptive to your classmates to have latecomers and, moreover, it can be much more difficult for you to get what you need from class if you are late.

Grading:

Midterm exams (100 points each)	300
Final exam	200
Homework	100
TOTAL	600

Deadlines: I will endeavor to be as clear as I can about the nature of assignments, and I will provide fair warning about when they are due. **Late assignments normally will not be accepted.** At the same time, I do understand that emergencies arise, so if *unforeseen* circumstances are interfering with your ability to complete some work in the course (e.g., significant illness, but *not* assignments for other classes), please contact me immediately, preferably *before* the assignment is due.

Online: Copies of assignments, handouts, etc. will be posted on the course Blackboard site. Go to **`blackboard.oberlin.edu`** (and your "Academic Hub") to access these materials.

Note: If you have a documented disability and wish to discuss academic accommodations, please contact me as soon as possible.

Help: You should feel free to ask me questions about the material discussed in class, problems with the homework, life outside of mathematics, etc. My office hours appear above, but if they are inconvenient, you are welcome to arrange another time to meet with me. Besides me, you can also get help through Student Academic Services. This is mainly for more extensive help. To obtain this service, you need to get a card from Kay Knight (Peters 114) and bring it to me. After I sign the card, you will be assigned a private undergraduate tutor.

Outline of the Course

Matrix algebra and linear systems (Chapters 1 and 2)	2.5 weeks
Vector spaces (Chapter 4)	4 weeks
Inner product spaces (Chapter 5)	2 weeks
Linear transformations (Chapter 6)	1.5 weeks
Determinants (Chapter 3)	1+ weeks
Eigenvalues and eigenvectors (Chapter 7)	2 weeks

Readings and problems below are from B. Kolman and D. Hill, *Elementary Linear Algebra with Applications* (9th ed.). Note that "9/1" means problem 1 on page 9 of Kolman and Hill. The problems assigned below are *not* to be turned in (unless otherwise noted); they are intended for your own practice. As a result, you should feel free to work together on these questions, ask me about them, etc. Many of the problems have answers in the back of the text.

A recommended routine is for you to do some relevant reading in the text *before* a topic is discussed in class, then to reread and work problems once that topic has been discussed.

Date	Topics	Reading	Problems
	MATRICES		
M 2/4	Introduction Linear systems	1.1	9/ 1,3,5,7,8,18,21
W 2/6	Matrices and matrix algebra	1.2 1.3	19/ 1,7,9(a)–(d),13,17,21 30/ 1,3,9,11,13,15,17,21, 23,27,30
F 2/8	Matrix algebra (contd.)	1.4	40/ 1,3,9,13,14,17,22,29,32
M 2/11	Matrix algebra (contd.)	1.5	52/ 2,9,23,25,29,33,35,43, 52,55,56
	SOLVING LINEAR SYSTEMS		
W 2/13	Echelon form	2.1	94/ 1,5,7,9,10,11
F 2/15	Solving Systems Elementary matrices	2.2 2.3	113/ 1,5,7,9,15
M 2/18	Elementary matrices and inverses	2.3	124/ 3,5,7,11,17,18
W 2/20	Equivalent matrices	2.4	129/ 1,2,4,6,10(a)
	VECTOR SPACES		
F 2/22	Vector spaces	4.1	187/ 1,3,9,13,17
M 2/25	Vector spaces (contd.) Subspaces	4.2 4.3	196/ 1,3,9,11,14,17,19 205/ 1,3,5,7,9,15,17,19,37
W 2/27	Span Linear independence	4.4 4.5	215/ 1,5,7,9,10,11

F 3/1	Span and independence (contd.)	4.4 4.5	226/ 1,3,9,11,15,17,19,21
M 3/4	Bases and dimension	4.6	
W 3/6	**Exam 1** (in class)		
F 3/8	Bases and dim. (contd.)	4.6	242/ 1,3,5,7,8,9,13,23,33
M 3/11	Homogeneous systems	4.7	251/ 1,3,9,11,15
W 3/13	Coords. & isoms (contd.)	4.8 (to p. 261)	
F 3/15	Coords. & isoms (contd.)	4.8 (to p. 261)	267/ 1,3,5,6,7,11,29,30,31
M 3/18	Transition matrices	4.8	267/ 15,17,33,37
W 3/20	Row space, column space, rank	4.9	
F 3/22	Rank (contd.)	4.9	282/ 1,3,9,12,13,15,16,19

INNER PRODUCT SPACES

M 4/1	Inner products	5.1 (skim 5.2)	297/ 1,2,3,4,9,12,13,17,30 306/ 1,9
W 4/3	Inner products (contd.)	5.3	317/ 1,3,7,9,10,11,15,18, 24,27,29
F 4/5	Gram-Schmidt process Orthogonal complements	5.4 5.5	329/ 1,3,5,9,11,20,25
M 4/8	Orthogonal comp's (contd.) Applications	5.5	348/ 1,3,7
W 4/10	More Applications **Exam 2 due** (take-home)	Handouts, 5.6	

LINEAR TRANSFORMATIONS

F 4/12	Linear transformations	6.1	372/ 1,3,4,6,9,11,13,15,17
M 4/15	Matrix transformations Linear trans. (contd.)	1.6 6.2	62/ 1,5,7,9,15,19,21 387/ 1,4,5,16,17,23,25
W 4/17	Matrix of a lin. trans.	6.3	397/ 1,2,7,9,11
F 4/19	Matrices and lin. trans. as vector spaces	6.4	405/ 1,3,4,11,13,15,16, 21,22
	Similarity	6.5	413/ 2,3,5,13,16

DETERMINANTS

M 4/22	Definition of determinant	3.1	145/ 1,3,5,7,9,11,15
W 4/24	Some properties	3.2	154/ 1,6,7,8,10,13,15,17,18, 25,27
F 4/26	Cofactor expansion	3.3	164/ 1,2,3,5,8
M 4/29	Inverses Cramer's rule	3.4 3.5	169/ 1,2,7,9,11 172/ 1,2,3,5

EIGENVALUES AND EIGENVECTORS

W 5/1	Eigenstuff **Exam 3 due** (take-home)	7.1	450/ 1,2,6(a)(c),11,15,17(b)
F 5/3	Diagonalization	7.2	
M 5/6	Diagonalization (contd.)	7.2	461/ 1,3,7(a),8,11(a)(c), 17(a)(b),19,27
W 5/8	Markov chains	8.1	487/ 1,3,5,9(a)(c),11
F 5/10	Symmetric diagonalization Further topics Review	7.3	475/ 3, 4 15, 19

Wednesday 5/15 7:00 – 9:00 pm **FINAL EXAM**

Honor Code Policies

Homework

You are permitted, even encouraged, to collaborate on homework. For homework that is not graded, feel free to consult anyone at all: your classmates, me, other students, friends, relatives, Britney Spears, Stephen Colbert (these last two not really). For homework that is to be handed in and graded, I expect you to be somewhat more careful. Specifically, you should continue to ask questions of me regarding homework problems and you may collaborate with one or two of your classmates (per assignment). Please do not undertake significant collaboration with more than two students without permission. If you do collaborate, you are expected to write your own solution to problems (i.e., not to copy) and to indicate the name(s) of any student(s) with whom you worked.

You may consult any written sources for hand-in homework, provided that you give appropriate citations. Please write your homework solutions with care.

Examinations

Unless specifically indicated otherwise, in-class tests are assumed to be closed-book. Collaboration of any sort (other than to ask me questions) will **not** be permitted. Take-home exams will have specific provisions for using books and notes, but, again, you are **not** to discuss the content of the exam with anyone other than me. Any time limits will be indicated with each test.

Honor Pledge

On every assignment that you submit for credit, you are expected to sign the Oberlin College Honor Pledge:

"I have adhered to the Honor Code on this assignment."

If you need clarification of the policies above, please do not hesitate to ask. Should you require some variation in these rules, you must discuss the matter with me well in advance of any assignment.

For general information about the Honor System at Oberlin, consult

<http://www.oberlin.edu/students/links-life/honorcode.html>.

Guidelines for Written Work

Mathematics is not only a means for understanding quantitative issues, but is also provides an effective and efficient notational and conceptual supplement to natural language. Good communication of mathematics requires thoughtful and precise prose writing, especially when trying to convey complex arguments and ideas.

When you attempt any mathematical writing, you should bear the following in mind:

- Mathematical symbols provide an extremely compact and concise form of expression, so it is important that you surround your symbols with words, phrases, and sentences. It is expected that you will write your problem solutions in clear, grammatically correct prose consisting of complete sentences. Remember, you are providing a coherent solution, not just a list of answers. The reader should not have to guess about what you are thinking.
- "2 + 2 = 4" is a symbolic way of writing a sentence. In particular, the symbol "=" means "equals" and is a verb, equivalent to the verb "to be".
- While we're on the subject, you should have the greatest respect and reverence for the equals sign. Use it only to indicate that two quantities are actually equal (to the best of your knowledge), not as punctuation or to fill space on the page.
- You should expect to revise and rewrite your solutions before submission. Do not hand in your rough scratch work. If you cannot solve a problem completely, then write an honest, coherent attempt and indicate where you've had difficulties.
- Homework should be neatly and legibly written, the problems properly labeled (and in order), and the pages stapled. Final answers should be clearly marked as such. Presentation does make a difference and can even help you with your understanding.

It takes time and practice to write mathematics well. If you make the effort, your written presentation is certain to improve.