MATH 221 Introduction to Linear Algebra
Section 0201 Spring 2008

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- Lectures: Mon and Wed, 2:30–3:45 pm, at ACIV 145
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- Course web-page: http://www.math.umbc.edu/~shenj
- Prerequisites: Math 140, 151 or 155
- Text: *Linear Algebra and Its Applications* by David C. Lay, 3rd Edition, Addison-Wesley, text web-page: http://www.laylinalgebra.com
- **Tentative exam dates**:
  - Exam I: Wed, Feb. 27 (in class)
  - Exam II: Mon, Apr. 7 (in class)
  - Final Exam: Mon, May 19
- **Tentative in-class quiz dates**:
  - Quiz I: Wed, Feb. 13
  - Quiz II: Wed, Mar. 12
  - Quiz III: Mon, Apr. 28

  These dates are subject to change.

Course Description Linear algebra deals with multi-variable linear equations/functions and their fundamental properties as well as transformations of vector spaces, which are an extension of one-dimensional lines, two-dimensional planes, and three-dimensional spaces we are familiar with. The basic objects are vectors and matrices. The course starts from solving linear equations and then treats matrix operations, vector spaces, and eigenvalues/eigenvectors, with a final exposition on orthogonality and orthogonal projections.

Linear algebraic techniques are widely used in many areas, such as math, sciences, engineering, economics, finance, and many branches of social sciences. They are also cornerstones for a variety of advanced classes in sciences and engineering. This course will equip you with basic concepts and tools of linear algebra that you will find useful in the near future.

Objectives One should learn the following three aspects from this course: the algebra of linear equations and matrices, the geometry of vector spaces, and the algorithms for solving linear equations and performing matrix operations. Specifically, by the end of this course, one should be able to know how to:

- characterize existence, uniqueness and solution sets of linear, vector and matrix equations via the row reduction algorithm;
- perform matrix operations with fluency, including inverse and determinant computations, and understand the implications of matrix inverse and the determinant properties;
- characterize vector spaces or subspaces and determine their dimensions and matrix ranks;
- compute eigenvalues and eigenvectors for a given matrix and perform diagonalization;
- understand the concepts of orthogonality and orthogonal bases, carry out orthogonal projections and an orthonormal transformation for a given set of vectors.

Homework Weekly homework will be assigned. Each homework set includes some calculation problems and/or conceptual questions for each section covered that week. The homework is usually collected in Monday's class unless a due date change is announced. No late homework will be accepted. Please present your answers neatly and show all your work; answers without supporting work may not receive full credit.

Exams and Quizzes There will be two (2) mid-term exams, one (1) final exam, and three (3) in-class quizzes (see the tentative dates on Page 1). Each mid-term exam mainly focuses on topics covered in that month, but the final exam will be comprehensive. The quizzes will consist of a few short numerical problems and conceptual questions that cover materials from the previous weeks of each quiz. Please be alerted that

- there will be *no* optional final exam, and all the quizzes and exams are closed-book;
- calculators and other computing devices are *not* allowed for quizzes, mid-term exams and final exam.

Grading Policy The grading scheme is as follows:

- homework: 15%
- quizzes: 20% (5% for each of the first two and 10% for the third one)
- mid-term exams: 40% (20% for each)
- final exam: 25% (the final is comprehensive)

The letter grade will be computed based upon the numerical grade:

$A : \geq 90; \quad B : 89 - 80; \quad C : 79 - 65; \quad D : 64 - 50; \quad F :< 50$

Academic Integrity

- The UMBC Academic Integrity Statement:

  "*By enrolling in this course, each student assumes the responsibilities of an active participant in UMBC's scholarly community in which everyone's academic work and behavior are held to the highest standards of honesty. Cheating, fabrication, plagiarism, and helping others to commit these acts are all forms of academic dishonesty, and they are wrong. Academic misconduct could result in disciplinary action that may include, but is not limited to, suspension or dismissal. To read the full Student Academic Conduct Policy, consult the UMBC Student Handbook, the Faculty Handbook, or the UMBC Policies section of the UMBC Directory [or for graduate courses, the Graduate School website]* ".

- All work in a homework, a quiz or an exam must be your own; collaborating on a quiz or an exam is *not* permitted. Discussions with other students on homework problems are allowed, but you should present your own work in the final turn-in; simply copying other people's work is a violation of UMBC's academic integrity code.

- If you wish to contest a graded exam/quiz, you must make an appeal within *one week* of the return date to the class. All appeals should be made in writing to the instructor with a signed and dated note on the exam or quiz. End of the semester appeals for earlier exams or quizzes will be ignored.

- Regarding make-up quizzes/exams: if you must miss a quiz or an exam due to a prior obligation, you must speak to the instructor *in advance* of the quiz/exam. If you must miss a quiz or an exam due to an unforseen but valid reason (e.g. illness), you must submit a written excuse. Failing to do so may result in loss of substantial points off the top in your make-up.

Some Suggestions This course contains a vast number of topics, ranging from basic techniques for solving linear equations to a variety of matrix operations and fundamental properties of vector spaces as well as important transformations between these spaces. You will be exposed to many new notions and new tools in each class, somewhat abstract, especially in the first several weeks. Here are a few suggestions that will help you grasp materials efficiently so that you can use them with the desired fluency:

- Read the scheduled materials before going to class. If you have difficulty in understanding any concepts or results, bring them to the class.
- Review notes and the textbook before doing homework. Though discussions are allowed for homework problems, try your best to solve them with your own effort.
- If you have already done your best but sill have questions about materials, do not put them aside. Either see the instructor at office hours or get helps from other sources right away. If you are left behind at certain point, it could take you much more time and effort to catch up, since we will move in a relatively fast pace in this course.

Tentative Schedule and Topics

Here is a list of the tentative schedule and topics we will be covering in chronological order with text citations:

No.	Week	Topic	Section(Lay)
1	Jan. 28–Feb. 1	Introduction, linear equations	1.1
2	Feb. 4–Feb. 8	Row reduction, vector equations	1.2, 1.3
3	Feb. 11–Feb. 15	Matrix eqns., solution sets of linear eqns.	1.4, 1.5
4	Feb. 18–Feb. 22	Linear independence, linear transformation	1.7, 1.8
5	Feb. 25–Feb. 29	Matrix operations, Exam I	2.1
6	Mar. 3–Mar. 7	Matrix inverse and its characterizations	2.2, 2.3
7	Mar. 10–Mar. 14	Vector spaces and subspaces, Null spaces and column spaces	4.1 4.2
8	Mar. 17–Mar. 21	No class (spring break)	
9	Mar. 24–Mar. 28	Bases, coordinate systems, Dimension	4.3, 4.4, 4.5
10	Mar. 31–Apr. 4	Rank, determinants	4.6, 3.1
11	Apr. 7–Apr. 11	Exam II, properties of determinants	3.2
12	Apr. 14–Apr. 18	Eigenvalues & eigenvectors, The characteristic equation	5.1, 5.2
13	Apr. 21–Apr. 25	Diagonalization, Inner products, length & orthogonality	5.3, 6.1
14	Apr. 28–May 2	Orthogonal sets, orthogonal projections	6.2, 6.3
15	May 5–May 9	The Gram-Schmidt process, Diagonalization of symmetric matrices	6.4, 7.1
16	May. 12–May. 16	Review	

Please notice that the topics and dates in the list are subject to change, depending on the class progress.