MATRIX THEORY

MATH 4450.001

SPRING 2011

Instructor: Dr. J. Iaia
Office: GAB 420
Office Hours: MW 11-1, or by appt.
Email: iaia@unt.edu
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Time: MWF 10:00-10:50
Place: GAB 201

Text: S. Axler, *Linear Algebra Done Right, 2nd ed.*

GRADING POLICY

Exam 1	*Feb.* 11	20%	
Exam 2	*Mar.* 11	20%	
Exam 3	*April* 18	20%	
Final	*May* 13	20%	$8am - 10am$
Homework	*collected weekly*	20%	

Exams: Exams *must* be taken on the dates listed above and neither earlier nor later. Exceptions will be considered if a student can provide *written documentation* certifying one's absence.

Homework: Homework will be assigned and collected weekly. Several problems will be chosen at random and graded.

Attendance: *Students are responsible* for *all* work assigned and announcements made during any absence.

Code of Conduct, Cheating: Students are expected to be *respectful of others* at all times. Any student being disruptive may be asked to leave the class meeting. *Cheating* will *not* be tolerated and anyone found guilty of cheating is subject to *failure* for the semester.

The **Student Evaluation of Teaching Effectiveness (SETE)** is a requirement for all organized classes at UNT. This short survey will be made available to you at the end of the semester, providing you a chance to comment on how this class is taught. I am very interested in feedback from students, as I work to continually improve my teaching. I consider the SETE to be an important part of your participation in this class.

Students with Disabilities: It is the responsibility of students with disabilities to provide the instructor with appropriate documentation from the Dean of Students Office.

Last day to drop with automatic W: Feb. 25

Last day to drop with W or WF : Mar. 29

Grade Distribution: A 90- ; B 80-89; C 70-79; D 60-69; F 0-59

Course Description

This course is an introduction to vector spaces and the theory of matrices. We will begin talking *vector spaces* which are basically spaces that is closed under addition and scalar multiplication. We will talk about *linearly independent sets, spanning sets,* and a *basis for a vector space*. We will talk about *linear transformations* from one vector space to another and the matrix of a linear transformation. Next we will talk about the composition of linear transformations and multiplication of matrices. Then we will discuss the inverse of a linear transformation. We will also discuss inner product spaces and the adjoint of a linear transformation and we will prove the spectral theorem for real and complex vector spaces. Finally we will discuss the determinant of a matrix and eigenvalues and eigenvectors of a matrix.

Course Objectives

By the end of this course, students should be able to determine whether a set of vectors is linearly independent and whether or not it is a spanning set. Students should be able to calculate the matrix of a linear transformation with respect to a given basis. They should also know how to find the null space and range of a linear transformation. They should know how to calculate the eigenvalues and eigenvectors of a linear transformation. They should know what it means for a set of vectors to form an orthonormal basis and how to find the adjoint of a linear transformation. They should be able to determine if a linear transformation is self-adjoint or normal. They should know the complex spectral theorem and the real spectral theorem. Finally, students should know about determinants and traces of linear transformations.

Course Outline

Meeting 1 - Definition of a vector space and proofs of elementary properties of vector spaces

Meeting 2 - Subspaces of a vector space

Meeting 3 - Linear dependence and linear independence of vectors

Meeting 4 - The span of a set of vectors

Meeting 5 - Basis of a vector space

Meeting 6 - Dimension of a vector space

Meeting 7 - Linear transformations and the matrix of a linear transformation with respect to a basis

Meeting 8 - The null space of a linear transformation

Meeting 9 - The range of a linear transformation

Meeting 10 - Review for Exam 1

Meeting 11 - Exam 1

Meeting 12 - Injective and surjective linear transformations

Meeting 13 - Composition of linear transformations and matrix multiplication

Meeting 14 - Isomorphisms

Meeting 15 - Polynomials

Meeting 16 - Eigenvalues and Eigenvectors

Meeting 17 - More eigenvalues and eigenvectors

Meeting 18 - Diagonal matrices

Meeting 19 - Upper triangular matrices

Meeting 20 - Invariant subspaces

Meeting 21 - More invariant subspaces

Meeting 22 - Review for exam 2

Meeting 23 - Exam 2

Meeting 24 - Inner product spaces

Meeting 25 - Norms and orthonormal bases

Meeting 26 - Gram-Schmidt orthogonalization process

Meeting 27 - The adjoint of a linear transformation

Meeting 28 - Self-adjoint linear transformations

Meeting 29 - More self-adjoint linear transformations

Meeting 30 - Normal linear transformations

Meeting 31 - More normal linear transformations

Meeting 32 - The complex spectral theorem

Meeting 33 - The real spectral theorem

Meeting 34 - Review for exam 3

Meeting 35 - Exam 3

Meeting 36 - Normal linear transformations on real inner product spaces

Meeting 37 - Orthogonal complements

Meeting 38 - Isometries

Meeting 39 - More isometries

Meeting 40 - Determinant of a matrix

Meeting 41 - More on determinants

Meeting 42 - Trace of a matrix

Meeting 43 - Review for final exam

Meeting 44 - Review for final exam

Meeting 45 - Final Exam