MATH 648-01: LINEAR ALGEBRA AND MATRIX THEORY (SPRING 2016)

Course number: MAT 648-01

Course title: Linear Algebra and Matrix Theory

Credits: 3

Meetings: TR 12:30–1:45 pm in MHRA 1304.

Prerequisites: Grade of C or better in at least C in MAT 310 and 311 or equivalent

Instructor information:

Instructor: Dr. Dan Yasaki `d_yasaki@uncg.edu`
Homepage: `http://www.uncg.edu/math/faculty/d_yasaki/teaching.html`
Office Hours (146 Petty): MWF 10:00–11:00 AM

For whom planned: First and second year graduate students

Catalog description: Vector spaces. Linear operators and similarity. The eigenvalue problem and a spectral decomposition theorem. Normal forms: Smith form for matrices, rational and Jordan forms. Spectral resolution of matrix functions. Special topics.

Student learning outcomes: Upon successful completion of this course students shall be able to

SLO 1: define basic terms associated with linear algebra, such as vector space, linear operator, eigenvalues/eigenvectors, normal forms;

SLO 2: give examples of spaces, linear maps or matrices exhibiting properties outlined in SLO 1 in addition to examples of applications of linear algebra;

SLO 3: explain and give complete, careful statements of definitions and important theorems; and

SLO 4: construct and **defend** coherent mathematical proofs of statements in linear algebra.

Teaching methods and assignments for achieving learning outcomes:

Reading: Reading the sections we discuss before class is essential if you wish to get the most out of lectures. This allows you to form questions before you see me present the material so that you can focus on the confusing aspects of the topics we discuss. (SLO 1)

Lectures: This is the primary method of content delivery. I plan to follow the book closely, but I will supplement the book's material with some of my own when questions arise or when I feel it is appropriate. (SLO 1–3)

Tests: Tests serve as the primary gauge of evaluation. (SLO 1–4)

Homework: Homework is the most important way to actually "learn" mathematics. This is the same sort of practice that is used to learn to play tennis or learn to play the piano. One cannot learn these things by watching them on television or reading about them

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in a book no more than one can learn mathematics by watching a lecture or reading a mathematics book. (SLO1–4)

Presentations: You will prepare and present at least one 75 minute lecture on a special topic, chosen from the list below. The order will be chosen by random drawing on the first day of class. A student responsible for presentation k is also responsible for presentation $k + n$, where n is the number of students in the class.

- Maximal linearly independent sets (FIS 1.7)
- Homogeneous linear differential equations (FIS 2.7)
- A characterization of determinant (FIS 4.5)
- Matrix limits and Markov chains (FIS 5.3)
- Conditioning and the Rayleigh quotient (FIS 6.10)
- Tensor products (DF 10.4)
- Numerical least-squares algorithm (consult Tom Lewis)
- Stability questions (consult Tom Lewis)
- Applications of linear algebra in *** (consult relevant faculty)

You will also produce a short write-up (typeset using LaTeX) on the topic of your lecture. You can include additional information there, even if you do not have time for it in the lecture. You can find resources for making effective presentations at the MAT 490 Senior Seminar page.

`http://www.uncg.edu/mat/undergraduate/courses/mat490.html`

You can find advice on mathematical writing and LaTeX typesetting in the Useful Links and Documents at the department's LaTeX Resources page.

`http://www.uncg.edu/mat/grad/latex.php`

Evaluation and grading: A grade of A, B+, B, B-, C+, C, or F will be assigned based on performance on homweork and tests as described below.

Homework: Homework will be assigned often. Not all homework exercises will be collected. All collected assignments are weighted equally. Homework counts for 20% of your final grade.

Test: Test 1 counts 20% of your grade. The final exam counts for 30% of your grade. The final exam is cumulative and will cover material from MAT 647 and MAT 648.

Presentations: Oral presentations are scored using the *Rubric for Mathematical Presentations*. The presentation and write-up count 15% of your grade.

Required text:

(FIS) Friedberg, Insel, and Spence, *Linear Algebra*, 4th ed., Prentice Hall, 2003. ISBN 13: 0-13-008451-4.

Additionally, you will have readings from

(DF) Dummit and Foote, *Abstract Algebra*, 3rd ed., John Wiley & Sons, Inc., 2004. ISBN 13: 978-0-471-43334-7.

(HK) Hoffman and Kunze, *Linear Algebra*, 2nd ed., Prentice Hall, 1971. ISBN: 0-13-536797-2.

Academic Integrity Policy: Each student is required to sign the Academic Integrity Policy on all major work submitted for the course.

I have abided by the UNCG Academic Integrity Policy on this assignment.
Signature _____ Date _____

More information can be found at

http://sa.uncg.edu/handbook/academic-integrity-policy/.

Additional information:

(1) UNCG seeks to comply fully with the Americans with Disabilities Act (ADA). Students requesting accommodations based on a disability must be registered with the Office of Accessibility Resources and Services (OARS) in 215 Elliott University Center, 334-5440, http://oars.uncg.edu.

(2) Assignments Policy: Assignments are due at the beginning of class. Late assignments will not be accepted.

(3) Absence Policy: You are responsible for all missed material. Any missed assignment, test, or final exam will result in a score of 0. Make-up tests and final exam will be given only if you receive prior approval for a valid excuse by contacting me at least one week in advance.

(4) Copyright Policy: Selling or purchasing notes from classes for commercial gain is a violation of the UNCG Copyright Policy.

http://policy.uncg.edu/copyright/

Any student who sells notes taken in class for commercial gain, or who purchases notes taken by another student for commercial gain, is in violation of this policy and, by extension, is committing a violation of the Student Code of Conduct.

http://sa.uncg.edu/handbook/student-code-of-conduct/

(5) Email Policy: All email correspondence should be made using your UNCG email account. You must check your email regularly for updates and announcements.

(6) There will be homework exercises that may require the use of computer software.

Tentative schedule Spring 2016:

Tuesday	Thursday
Jan 12 Smith Normal Form (DF 12.2, HK 7.4)	Jan 14 Rational Canonical Form (DF 12.2, HK 7.2)
Jan 19† Inner products (FIS 6.1)	Jan 21† Gram-Schmidt orthogonalization (FIS 6.2)
Jan 26 Orthogonal projections (FIS 6.2)	Jan 28 Adjoint (FIS 6.3)
Feb 2 Normal operators (FIS 6.4)	Feb 4 Unitary and orthogonal operators (FIS 6.5)
Feb 9 Spectral Theorem (FIS 6.6)	Feb 11 SVD and pseudoinverse (FIS 6.7)
Feb 16 Bilinear and quadratic forms (FIS 6.8)	Feb 18 Modules (DF 10.1, HK 5.5)
Feb 23 V as $F[x]$-module (DF 10.1)	Feb 25 Chinese Remainder Theorem (DF 7.6)
Mar 1 Review	Mar 3 Test 1
Mar 8 Spring break: No class.	Mar 10 Spring break: No class.
Mar 15 Examples of matrix groups	Mar 17 Introduction to group representations
Mar 22 Presentation 1	Mar 24 Presentation 2
Mar 29 Presentation 3	Mar 31 Presentation 4
Apr 5 Presentation 5	Apr 7 Presentation 6
Apr 12 Presentation 7	Apr 14 Presentation 8
Apr 19† Presentation 9	Apr 21† Presentation 10
Apr 26† No class. Follow Fri schedule.	Apr 29†(Fri) Final Exam: 3:30 pm

†DY in Oberwolfach. SP will cover.