Math 504 Abstract Linear Algebra Winter 2016

Instructor	Amites Sarkar
Text	Linear Algebra Done Right (2^{nd} ed.) Sheldon Axler

Course content

This is a second course in linear algebra, with an emphasis on finite-dimensional complex vector spaces and linear maps. Highlights will include the real and complex spectral theorems, the Cayley-Hamilton theorem, and the Jordan canonical form. In terms of the book, we'll cover most of the first 8 chapters.

Exams

Midterm 1	Friday 29 January
Midterm 2	Friday 26 February
Final	Wednesday 16 March 1–3 pm

Grading

The midterms are each worth 20%, and the final is worth 40%. If you feel too ill to take an exam, don't take it, but bring a doctor's certificate to me when you feel better and I will make arrangements. There will also be two homework assignments, worth 10% each.

Office hours

My office hours are 1–1:50 on Mondays, Tuesdays, Thursdays and Fridays, in 216 Bond Hall. My phone number is 650 7569 and my e-mail is amites.sarkar@wwu.edu

Relation to Overall Program Goals

Among other things, this course will (i) enhance your problem-solving skills; (ii) help you recognize that a problem can have different useful representations (graphical, numerical, or symbolic); (iii) increase your appreciation of the role of mathematics in the sciences and the real world.

Course Objectives

The successful student will demonstrate:

1. Knowledge of the following definitions: an abstract vector space over an arbitrary field, a subspace of a vector space, the sum and direct sum of subspaces, the span of a set of vectors, linear independence of a set of vectors, and the dimension of a finite-dimensional vector space.

2. Knowledge of the basic theorems and proofs involving the above concepts; for example, the Steinitz exchange lemma and the basis theorem.

3. Knowledge of the definitions of a linear operator and of the following related concepts: the null space, range, invertibility and the matrix of a linear operator relative to given bases.

4. Knowledge of the statement and proof of the rank-nullity theorem.

5. The ability to prove the existence of an eigenvalue and of a fan basis for a linear operator on a complex vector space.

6. Knowledge of the definitions of a positive definite inner product and a norm, and of the basic theorems involving these concepts; for example, the abstract Pythagorean theorem, the parallelogram law, and the Cauchy-Schwarz inequality.

7. Understanding of the importance of orthonormal bases, and of the Gram-Schmidt process, the Bessel inequality, and the proof of the orthogonal complement theorem.

8. Knowledge of the definitions of a linear functional, adjoint operator, self-adjoint operator, normal operator, unitary operator and of an isometry.

9. Knowledge of the spectral theorem (and its proof) for normal operators on finite dimensional complex inner product spaces, and of the applications of the spectral theorem to positive operators, isometries, polar and singular value decompositions.

10. Knowledge of the following definitions: the characteristic polynomial of an operator, generalized eigenvector, Jordan chain, and Jordan basis of a vector space relative to an operator.

11. Knowledge of the basic theorems and proofs involving the concepts in 10. above; for example, the Cayley-Hamilton theorem, the primary decomposition theorem, and the existence of a Jordan basis.

12. The ability to use the concepts and theorems covered in the course to solve problems and prove new propositions.