Information Sheet for Math 504   Winter 2015

Class Meets: MTRF 3pm in BH 417

Instructor: Branko Ćurgus **Office:** BH 178 **Office Hours:** MTRF 12 noon

Course Website: `http://faculty.wwu.edu/curgus/Courses/504_201510/504.html`

Text: *Linear Algebra Done Right* by Sheldon Axler

Material covered. We plan to cover most of the first eight chapters of the textbook. The emphasis will be on the finite dimensional complex vector space.

Student learning outcomes: By the end of this course, a successful student will demonstrate: (1) Knowledge of the following definitions: an abstract vector space over an arbitrary field, a subspace of a vector space, a sum and a direct sum of subspaces, a span of a set of vectors, a finite dimensional vector space, linear independence of a set of vectors, a basis and the dimension of a finite dimensional vector space. (2) Knowledge of the basic theorems and their rigorous proofs involving the concepts in (1); for example, the Steinitz exchange lemma, the Basis theorem. (3) Knowledge of the definitions of a linear operator and the definitions 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 basic theorems and their rigorous proofs involving the concepts in (3); for example the Rank-nullity theorem. (5) Ability to prove the existence of an eigenvalue and 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 the basic theorems involving these concepts: the abstract Pythagorean theorem, parallelogram low, Cauchy-Bunyakovsky-Schwarz inequality, polarization identities. (7) Understanding of the importance of orthonormal bases and Gram-Schmidt orthogonalization process in inner product spaces, the Bessel inequality, the proof of orthogonal complement theorem. (8) Knowledge of the definitions of a linear functional, an adjoint operator, a self-adjoint operator, a normal operator, a unitary operator and an isometry. (9) Knowledge (with a rigorous proof) of the spectral theorem for normal operators on finite dimensional inner product complex vector spaces. and of the applications of the spectral theorem to positive operators, isometries, polar and singular-value decomposition. (10) Knowledge of the following definitions: a characteristic polynomials of an operator, a generalized eigenvector, a Jordan chain, a Jordan basis of a vector space relative to an operator. (11) Knowledge of the basic theorems and their rigorous proofs involving the concepts in (10); for example, Cayley-Hamilton theorem, the Primary Decomposition theorem, the existence of Jordan basis. (12) Ability to use concepts and theorems covered in the course to solve problems and prove new propositions.

Assessment. The assessment of Learning Outcomes will be done through exams and assignments. There will be two "mid-term" exams and a comprehensive final exam. The "mid-term" exams are scheduled for: Tuesday, February 16 and Tuesday, March 3. The final exam is scheduled for three hours on Wednesday, March 18 from 1pm to 4pm.

On each exam I will assign one or two questions related to the theory presented in class (a proof of an important theorem for example) and two problems. One of these problems might be a problem discussed in class or an exercise from the book.

There will be no make-up exams. If you are unable to take an exam for a very serious reason verified in writing, please see me beforehand.

There will be two written homework assignments. The assignments will be handed out in class one week before they are due. These assignments will be graded and the grade will count towards the final grade.

Homework. Your daily homework should consist of studying the material covered in class. Proofs that I will present in class will often differ from the proofs in the textbook. Study both: your class notes and the book. Analyze the similarities and the differences. This will help you to internalize the concepts and the methods that are being studied. Exercises in the book are there to enhance and challenge the learning process. Use them.

Grading. Each exam and assignment will be graded by an integer between 0 and 100. Your final grade will be determined using the following formula

$$\texttt{FG} = \lceil \texttt{0.2*E1 + 0.2*E2 + 0.1*A1 + 0.1*A2 + 0.4*FE} \rceil.$$

Your letter grade will be assigned according to the following table.

F : 0 - 49	D : 50 - 54	C−: 55 - 59	C : 60 - 64	C+ : 65 - 69
B− : 70 - 74	B : 75 - 79	B+ : 80 - 84	A− : 85 - 89	A : 90 - 100

Remarks. This is a fast-paced course. It builds on the concepts that you learned in undergraduate linear algebra courses and some ideas from calculus. It is essential that you keep up with the material presented every day. Do the exercises at the end of each chapter. Look for help if you encounter difficulties.

Remember that the best way to learn mathematics is to discuss it with others: other students in this class, students that took this class before, and me. I will be glad to talk to you during my office hours, or you can make an appointment.