Spring 2016

Syllabus for Math 311 – Introduction to Linear Algebra

Course Description: Algebra of matrices, linear equations, real vector spaces and transformations. There is an emphasis on concepts and abstraction and instruction of careful writing. Students may receive credit for only one of Math 307 and 311.

Prerequisite: Math 243 (or concurrent) or 253A (or concurrent) or consent.

Possible Textbooks: Any standard introduction to linear algebra like the books by Kolman and D. Hill (Prentice Hall, some editions are free online), or R. Hill, or G. Strang (Cengage Learning, Brooks/Cole, 34 free recorded lectures are on the MIT website), or O. Bretscher (Prentice Hall).

Topics: (The order of the items may change depending on the instructor's preferences and chosen text.)

1. **Linear equations and matrices (1.5 weeks)**: Systems of linear equations, Matrix operations and $\mathbb{R}^n$, Matrix transformations.

2. **Solving linear systems (1.5 weeks)**: Row–echelon form of a matrix, Solving linear systems, Elementary operations and matrices, A^{-1}, Similar matrices.

3. **Determinants (1.5 weeks)**: Definition and properties, Cofactor expansion, Computation of inverses, applications.

4. **Real vector spaces (3 weeks)**: Definition and examples of vector spaces, Subspaces, Span and linear independence, Basis and dimension, Homogeneous systems, Coordinates and isomorphisms, Rank.

5. **Inner Product spaces (2.5 weeks)**: Definition of inner product space, Geometry (length, angles, orthogonality, projections), Gram–Schmidt orthogonalization, Orthogonal complements.

6. **Linear transformations and matrices (2.5 weeks)**: Definition and examples, Kernel and range of a linear transformation, Matrix of a linear transformation, Vector space of linear transformation, Similarity.

7. **Eigenvalues and eigenvectors (2.5 weeks)**: Eigenvalues and eigenvectors, Diagonalization of similar matrices, Diagonalization of symmetric matrices.

Math 311 is a writing intensive course: Students will be required to do a substantial amount of mathematical writing. This course will be conducted so as to satisfy the hallmarks for writing-intensive courses, as described here: http://manoa.hawaii.edu/mwp/faculty/hallmarks .

Course and program objectives: Linear algebra is one of the basic and foundational topics in mathematics that every mathematics major needs to understand, and upon successful completion of Math 311, students will understand and be able to apply at least basic concepts from linear algebra.

Linear algebra is one of the early courses in which the student is exposed to mathematics at an abstract level. The emphasis is on concepts, theorems and proofs, which are often made concrete through examples and counterexamples. To communicate at this level, students need to learn to express themselves clearly and concisely in writing in proper English.