Math 311 §503, Fall 2011

Learning objectives and outline of schedule

At the end of the course, a successful student should be able to do the following.

From Leon’s book:

Chapter 1 [Sections 1-5, 2 weeks*]

- Find general solutions to systems of linear equations using Gaussian and Gauss-Jordan elimination.

- Perform basic matrix arithmetic and matrix algebra; compute the inverse of a square matrix; prove basic propositions concerning transposes and inverses of matrices. Explain the relation between elementary matrices and inverting matrices.

Chapter 2 [Sections 1-3, 1/2 week*]

- Compute determinants of square matrices by cofactor expansion. Explain the effect of elementary row operations on determinants. Explain and make use of the connection between determinant and invertibility of a matrix.

Chapter 3 [Sections 1-6, 3.5 weeks*]

- Explain the definition of a vector space.

- Verify whether a given set, with given operations, is a vector space.

- Given a subset of a vector space, be able to determine if it is a subspace.

- Explain the concepts of linear combinations and spanning sets of vectors; prove basic propositions involving these notions.

- Explain the concept of linear independence of a set of vectors. Given a set of vectors in a vector space, be able to determine whether this set is a linearly independent set. Be able to prove basic propositions concerning linear dependence and independence.

- Explain the concept of a basis for a vector space. Find bases of given vector spaces.

- Explain the concept of a coordinate vector with respect to a given basis. Find the transition matrix from one basis to another.

- Explain what a row space and a column space of a given matrix is, the relationship between the consistency of a linear system and the column space of the coefficient matrix. Be able to state the Rank-Nullity Theorem and use it to prove basic propositions.
Chapter 4 [Sections 1-3, 1 week*]

- Explain the concept of a linear transformation; be able to determine whether a given transformation is linear; prove basic propositions concerning linear transformations.
- Be able to find the matrix representation of a linear transformation with respect to given bases.
- Explain the concept of similar matrices and how this relates to matrix representation of linear transformations.

Chapter 6 [Sections 1-3, 1 week*]

- Explain the concept of eigenvalue and eigenvector of a matrix and of a linear operator. Find eigenvalues and eigenvectors of given matrices and linear operators; prove basic propositions concerning these notions.
- Apply theory of eigenvalues and eigenvectors to solve systems of linear ordinary differential equations.
- Explain what it means to diagonalize a matrix and be able to do it.

Chapter 5 [Sections 1,4,5, 6#, 1.5 weeks*]

- Find the scalar product of two vectors in $\mathbb{R}^n$; find the angle between two vectors in $\mathbb{R}^n$.
- Explain the concept of an inner product on a vector space, and a norm on a vector space.
- Explain the concept of an orthonormal set of vectors and the relationship between orthonormal bases and coordinates.
- Given a basis for a subspace of a vector space, produce an orthonormal basis by using the Gram-Schmidt procedure.

From Spiegel’s book:

Chapter 1# [1.5 weeks*]

- Be able to classify partial differential equations as linear, nonlinear, elliptic, hyperbolic, parabolic. Find solutions to partial differential equations in special cases. Be able to solve partial differential equations using separation of variables.

Chapter 2# [1.5 weeks*]

- Compute Fourier series corresponding to given functions. Apply Fourier series to solve boundary value problems.
Chapter 6# [1.5 weeks*]

- Explain the definition of Bessel functions of the first and second kind. Find series solutions to ordinary differential equations using the method of Frobenius. Show how Bessel’s equation arises from the Laplace equation in cylindrical coordinates. Be able to verify basic identities for Bessel functions.

* Approximate time to cover the material.
# It may be necessary to cover less than the entire section/chapter.