CAAM 336 – Spring 2017
Suggested Study Topics
Exam Two

This list of suggested study topics is provided to assist you in preparing for exam two. This list contains topics that may appear on the exam, and contains topics that do not appear on the test. Questions on the exam can blend several topics together into a single problem; it is therefore suggested you understand both (a) the topic concept in isolation, and (b) how the concept can be combined with closely related ideas.

- Know the relationship between the Range of a general linear operator \( L \) defined on a vector space \( V \), and the ability to solve equations of the form \( Lu = f \)
- Know the relationship between the Null space of a general linear operator \( L \) defined on a vector space \( V \), and the uniqueness of solutions (if they exist) to equations of the form \( Lu = f \)
- Know the definition of symmetry for a linear operator \( L \) on an inner product space \( V \)
  - Given an inner product space, and a linear operator \( L \) be able to determine if the operator is symmetric or not
  - Know what symmetry implies about the eigenvectors and eigenvalues of a general linear operator \( L \) on an inner product space \( V \).
- Know the relationship between the Null space of a linear operator \( L \) and the existence of a zero eigenvalue. What is the Eigenspace corresponding to the zero eigenvalue?
- Given a linear differential operator \( L \) defined on \( C^2[a,b] \) be able to derive its eigenvectors and eigenvalues. You may suppose that the boundary conditions for \( L \) are similar to those we saw in class (i.e. they involve a mix of specifying the value, a derivative, or second derivative, etc)
- Know how to verify that a given vector is (or is not) an eigenvector of \( L \), and if it is an eigenvector how to find its corresponding eigenvalue.
- Know how to integrate functions such as \( \int f(x) \sin(n\pi x) \) for simple functions \( f(x) \); simple functions could include, but are not limited to, polynomials of degree six or less, \( \sin(m\pi x) \), \( \cos(m\pi x) \), \( e^x \), etc. The idea is that you should be comfortable performing integration by parts on the exam; practice these integrals on intervals of the form \([0,L]\) or \([-L,L]\) where \( L \) is any real number.
- Know how to solve homogeneous boundary value problems using the spectral method.
- Know how to solve inhomogeneous boundary value problems using the spectral method.
  - Know how to handle inhomogeneous boundary conditions of Dirichlet, or Mixed type: these settings are appropriate for choosing \( g(x) \) in the Nullspace of the negative second derivative (why?)
  - Know how to handle inhomogeneous boundary conditions of Neumann type: these settings are not appropriate for choosing \( g(x) \) in the Nullspace of the negative second derivative (why?)
- Know how to derive the weak problem for the variable-diffusivity steady state heat equation with homogeneous Dirichlet boundary conditions.