Math 4163 — Fall 2014
Review for Midterm Exam

The midterm exam will cover the following topics (see the lecture notes):
Basic ordinary differential equations: Linear equations with constant coefficients, eigenvalue problems
Basic linear algebra: vector spaces, inner products, orthonormal basis
Fourier sine series, Fourier cosine series, Fourier series
Method of separation of variables
Solution of initial boundary-value problems for the heat equation on an interval. Qualitative properties of the solution.
Solution of boundary-value problems for Laplace's equation on a rectangle.

The relevant homework assignments are Assignments 1, 2, 3, 4, and 5.

Most of these topics are also covered in the course text in chapters 2, 3, and 4:

Chapter 2. We have covered all the material in sections 2.1, 2.2, 2.3, and 2.4. We have also covered the material on Laplace's equation, in sections 2.5.1 (Laplace's equation on a rectangle) and 2.5.2 (Laplace's equation on a circle); however the material in section 2.5.2 is not part of this midterm exam. We did not cover section 2.5.3, so you do not have to read that. We did talk a little bit in class about the qualitative properties of solutions of Laplace's equation. I think it would be helpful to take a look at what's said in section 2.5.4, not because I'll ask anything specifically about it on the exam, but just because it gives you some idea of what issues can be important in the theory of PDE's.

Chapter 3. We did not talk much about Fourier series in class; only as much as we needed to compute the solutions of some PDE problems. We did, however, talk about what is the Fourier series of a function on $[-L, L]$ and the Fourier sine series and Fourier cosine series of a function on $[0, L]$. You should be familiar with the formulas for the coefficients of these three types of Fourier series, and you should study a few simple examples of each type. I recommend reviewing the definition of Fourier series of a function on $[-L, L]$ on page 88, the example on page 90 and 91, the definition of Fourier sine series on page 93, the example on page 95 (Fourier sine series of $f(x) = 100$), the example on page 100 (Fourier sine series of $f(x) = x$), the definition of Fourier cosine series on page 103, and the example on page 104 (Fourier cosine series of $f(x) = x$). There is a lot of other interesting material in chapter 3, but it wasn't covered in class and won't be needed for the exam.

Chapter 4. We covered the material in section 4.4 (solution of the one-dimensional wave equation on the interval $0 \leq x \leq L$). For this exam you do not need to know the material in the rest of the chapter, which concerns the physical motivation for the wave equation.