Math 4163 — Review for Exam 2

Exam 2 covers sections 2.5.2, 3.2, 3.3, 4.4, 5.3, and 5.8 of the text. The relevant assignments are Assignments 3, 4, and 5. Here is a study guide for the material we covered in these sections.

2.5.2. Laplace's equation for a circular disk. We covered all the material in this section. The method used in this section is the same as was used for all the previous problems we've covered: namely, separation of variables and Fourier series. Also the eigenvalue problem for the function $\phi(\theta)$ involves the same ODE as the eigenvalue problems covered previously. The main new aspect of the problem covered in this section is that the ODE for the function $G(r)$ is a little more complicated than the ODE for the function $G(t)$ we encountered in solving the heat equation. Also, the boundary condition at $r = 0$ is a little different from what we're used to: it's not a condition on the value of $G(0)$ or $G'(0)$, but rather the condition that $G(r)$ does not go to infinity as r approaches zero.

You should be familiar with the expression of Laplace's equation in polar coordinates, equation 2.5.30. You don't need to memorize it, but you should be used to working with it.

3.2, 3.3. Convergence theorems for Fourier series and Fourier cosine and sine series. You should review these sections in their entirety, except that you can skip the paragraph about the Gibbs phenomenon (last paragraph on page 101). Section 3.3 is a little long, and it's not strictly speaking necessary to read everything in it, since a lot of it is just discussion of various examples. But it's quite helpful to read it nonetheless.

At any rate, you should know at least the statements of the convergence theorems and the procedures for sketching the graph of the function that the Fourier series (or cosine series or sine series) converge to. In other words, you should know at least the material that the text emphasizes by putting boxes around.

4.4. Vibrating string with fixed ends. We covered most of this section, except the last paragraph, which you can skip. The new feature of the problem discussed in this section is that there are two initial conditions to satisfy, instead of just one as for the heat equation. These are used to find the two sets of constants A_n and B_n in the formula (4.4.11) for the solution of the problem.

5.3. Sturm-Liouville eigenvalue problems. We covered everything in this section, except the material about Rayleigh quotients, which you can skip. (Rayleigh quotients can give you useful information, though; maybe we'll talk about them after this exam.) You don't need to memorize all the facts in the box on page 163; it will be enough to be able to do problems like the homework assigned from this section.

5.8. Boundary conditions of the third kind. In class, we mostly covered the material from the beginning of this section through the end of page 201. You can skip the remainder of the section if you want to. However, on the principle that when preparing for a test it's better to know a little more about a subject than the minimum you need to know, I'd recommend at least taking a look at what's in the rest of the section. Also remember to review the homework problems for this section (6.2, 6.3, 6.4 on the supplemental sheet).