Review for First Exam

The first exam will cover sections 1.1 through 1.4 and 2.1 through 2.4 of the text.

1.1, 1.2 You don't really need to know much about heat for this course, but to understand the statements of some of the homework problems and to get a feel for what the solutions of the heat equation actually represent, I recommend you learn at least the following:

a) The relation between thermal energy and temperature given in equation (1.2.6).

b) The law of conservation of energy, given in equations (1.2.3) and (1.2.4). Equations (1.2.3) and (1.2.4) are actually two different ways of saying the same thing. The book illustrates this by using (1.2.4) to derive (1.2.5), which is the same as (1.2.3).

c) Fourier's law of heat conduction (1.2.8).

You should also try to remember what physical quantities the variables u, e, ρ, ϕ, c, K_0, and k stand for, along with the correct physical units for each one.

You don't need to worry too much about the *meanings* of these physical quantities. The text makes little attempt to explain them, anyway. A rough intuitive idea is enough. As our class discussion made clear, a correct analysis of the meanings of "heat energy" and "temperature" is quite involved. If you're interested, the Wikipedia article on "heat transfer" is actually a good place to start (check the references at the end of that article, too).

Also, you do not need to know the material in the subsection titled "Diffusion of a chemical pollutant".

1.3 You can skip, for now, the subsection titled "Newton's law of cooling".

1.4 You should reread the entire section. Notice that the law of conservation of energy, in the form of equation (1.2.4), is used again here.

1.5 This section is not covered on Test 1.

2.1, 2.2 In chapter 2 we only consider boundary-value problems that satisfy the *principle of superposition*. This just means that if u_1 and u_2 are two solutions of the boundary-value problem, then any linear combination $C_1u_1 + C_2u_2$ is also a solution.

The terms "homogeneous" and "linear" are used to distinguish boundary-value problems which satisfy the principle of superposition from those which do not. For now we won't need to use these terms much, since all the problems we're considering are linear and homogeneous. Later on, we may consider a few nonhomogeneous or nonlinear problems.

2.3, 2.4 You should reread these sections in their entirety to make sure you grasp all the details, except you can skip the subsection titled "Spring-mass analog" if you like. The section is long, but fairly easy to read, since the author works most things out in detail for you. You should also take a look at Appendix 2.3, which explains why the procedure finding the constants B_n in the eigenfunction series expansion for a function f is similar to finding the components of a vector by taking its inner product with basis vectors.

I recommend memorizing the information in Table 2.4.1 on page 69. It's not strictly necessary to memorize it, since you can work it out on your own if you have to, but having it memorized will free up your mind for other things while you're working on the test.