# Math 553 — Fall 2007 — Final Exam Guidelines

The final exam will be 3 hours long, Tuesday 11 December, 8-11am; on the entire course. Roughly one hour will be on the material covered by the midterm exam, and roughly 2 hours will be on the material since then.

Look again at the advice in the handout "How to prosper in grad school". Especially notice the part about thoroughly understanding every **homework** problem. And learn the **definitions** and the statements of all major **theorems** and **formulas**.

Some of the exam will consist of proofs. Here are the proofs you should learn:

- Solution of first order quasilinear equations by characteristics: assume the system of ODEs can be solved, and explain how and why this provides a solution of the PDE
- Derivation of the jump condition
- Derivation of the D'Alembert formula
- Duhamel's Principle: the statement, and how to apply it to solve the nonhomogeneous wave equation and heat equation
- Proof of Kirchhoff's formula (the part of the proof covered in class)
- Statement and proof of "continuous dependence on the data" for the homogeneous wave equation in 1, 2 and 3 dimensions, using either the $L^\infty$ definition of continuous dependence or the $L^2$ definition
- Uniqueness for Poisson's equation by energy methods (that is, by Green's formulas), for both Dirichlet and Neumann boundary conditions
- Statement and proof of "continuous dependence on the boundary data" for Poisson's equation, by maximum principle methods for Dirichlet boundary conditions
- Formal proof that if $L_x G = \delta_y$ and $w(x) = \int_\Omega G(x,y) f(y)\, dy$ then $Lw = f$ weakly
- Dirichlet's principle
- Formal proof that the eigenfunction expansion of the Green function satisfies $L_x G = \delta_y$.
- Weak maximum principle for the heat equation

Of course, there are lots of smaller topics you should learn and understand as well, so don't ignore a topic just because it is not on this list of proofs. (For example you should know the statement of the mean value formulas for subharmonic functions, even though you are not required to learn the proofs.) Re-read *all* your lecture notes carefully.

**Plan your study schedule today, so that you will have time to learn everything!**

# Math 553 — How to Prosper in Math Grad School

In graduate school you are always overworked and overcommitted. This is not going to change, as it is the only way to bring you rapidly up to the level required of professional mathematicians.

The way to succeed is to work consistently and promptly, and on the RIGHT THINGS:

- Go over your lecture notes after every class, trying to understand every detail but also the big picture ("what are we aiming at?")
- After you get your homework back, rewrite in full every problem on which you made significant errors. Do **not** put this task off until you study for the next test or exam.
- After you get your test back, rewrite in full every problem on which you made significant errors. Do **not** put this task off until you study for the final exam.

  Regard your errors as *system* failures, not personal failures. Ask: How could you improve your study *system* to eliminate that kind of error in future?
- At the end of every work day, ask yourself "Did I ask any good questions today?" Just *asking* a question can help you focus your own thoughts.

Here's the baseline level of competence you should attain before each test or exam:

- Be able to recognize every homework problem, then quickly recall its key points and graphs, and write out the solution. (Some exam problems will be similar to homework, and you are expected to recognize these problems.)
- Be able to write down every proof on the "list" without hesitation. Know where to start and stop, on each proof. When studying, you should write out each proof several times, to get quick at it.

To achieve this level of competence, start studying two weeks before the exam. Follow a detailed daily plan. Plan *exactly* what you will work on each day.