Writing Assignment

As advanced students in the sciences, it is reasonable to assume that at some point in your career you will need to communicate mathematical reasoning in writing to someone, whether it be for a paper in a published journal, a Ph.D. dissertation or master’s thesis, or a “white paper” for one’s employer. Though each homework assignment in and of itself is a written assignment where you (should) explain your mathematical reasoning in writing, it is much less structured than a standard paper. In addition, your audience is one which is very familiar with the material at hand. Therefore, you can be justified in skipping some steps in your analysis.

In order to give you some practice in scientific writing, I would like you to write up thoroughly your solution (using perturbation methods) to a physical problem of your own choosing. In theory, this would be a problem related to your area of thesis research, though it need not be. When working on the problem, you should try to keep in mind the techniques we have learned in this course. How should the governing equations be scaled? What effects are important/unimportant? How will a perturbation analysis simplify the problem? I want you to gain practice in expressing your ideas, rather than testing your knowledge of difficult mathematical concepts.

The assignment consists of four parts:

1. On March 4 you should submit a brief description of the topic you wish to explore in your paper. The description should be similar to an abstract: short, but indicative of the problem at hand and the mathematical techniques you think might be required. That way, I may be able to assist you in finding references and avoiding mathematical pitfalls which would needlessly complicate the project. This abstract should also be posted to the newsgroup to keep everyone apprised of what you’re doing, as well as to facilitate shared effort.

2. On April 1 you should submit an outline of your project. It should consist of
   (a) a short introduction to the problem,
   (b) a description or derivation of the equations and a nondimensionalization thereof, and
   (c) a brief description of how your perturbation analysis will proceed.
   At this time I will perform another check just to make sure you aren’t trying to do a thesis-level problem in a few weeks.

3. On May 6 you should submit the written paper, which should consist of
   (a) an introduction to the physical problem.
   (b) your model and any simplifications you employed.
   (c) a careful exposition of how you solved the problem. This should be written for an audience which has some knowledge of the mathematical and background material, but not an extensive one. Pretend you are teaching the class.
   (d) an analysis of your mathematical results, and what they reveal about the real-world problem. Were the final equations too simple to capture the real-world behavior? Does your solution have any useful predictive capabilities?
   Though it would be nice if the paper were typed, it is not required.
4. Once the papers have been turned in and I have had a chance to examine them, I would like for us to discuss them (hopefully over refreshments), with each of you sharing the problem on which you worked, how you attacked it mathematically, and what you learned from the experience. This discussion is **NOT** to be a formal presentation. I don’t want to put pressure on anyone and frankly, we don’t have the time for each of you to speak for more than a few minutes.