

Preparing for the First Exam

The test covers everything we've done up through the material from §34.3 of the lecture notes discussed Friday, February 14. The bulk of your work will be in computing series solutions. Calculators will be unnecessary, and the better ones, along with any computers, will be banned! Reviewing the homework assigned through that Friday would be a good idea.

In particular:

- ◆ Know the basic terminology and notation.
 - ◆ Know the material from *A Brief Review of Elementary Ordinary Differential Equations*, but do not expect any problems specifically on that material except, possibly, problems involving Euler equations.
 - ◆ We covered chapter 30 (the review of series) to prepare you to do the manipulations needed in the later chapters. So don't expect any problems on the test explicitly from that chapter.
 - ◆ Be able to find all the singular points for any differential equation, and be able to determine which of those are regular singular points. Know how to use these points to find the largest open interval(s) on which the power series solution (or modified power series solution) about some point x_0 is guaranteed to converge.
 - ◆ Be able to find the first few terms of the general power series solution about an ordinary point to some first- or second-order differential equation using the algebraic method. In your work, you will have to identify the recursion formula, and use it to compute several terms of the series (I will tell you how many). I will not ask you to identify the general formula for the terms.
 - ◆ Plan on finding at least the first few terms of one modified power series solution to some differential equation about a regular singular point using the method of Frobenius. In your work, you may have to explicitly identify the following: the indicial equation, the corresponding exponents (i.e., the solutions r_1 and r_2 to the indicial equation), the r for which there is guaranteed to be a power series solution (the larger r), and the corresponding recursion formula. I will tell you how many terms of the series to compute. I will not ask you to identify the general formula for the terms.
- There WILL be a “Frobenius method” problem or set of problems. It/They will be worth a lot of points!**
- ◆ Know what the big theorems on the Frobenius method (theorems 34.1 and 34.2) say about the indicial equation and its solutions, the existence of at least one series solution

corresponding to “the larger r ”, when the method will yield a second power series solution, the general nature of the second solution when the method does not yield a second series (do NOT memorize the formulas for the second solutions, but do remember about the $\ln|x - x_0|$), and the convergence of the series.

- ◆ Be able to approximate the modified power series solutions described in theorem 34.2 by solutions to the corresponding Euler equation. In particular, be able to find

$$\lim_{x \rightarrow x_0} y_1(x) \quad \text{and} \quad \lim_{x \rightarrow x_0} y_2(x)$$

for a given regular singular point x_0 and the solutions y_1 and y_2 corresponding, respectively, to the exponents r_1 and r_2 (as in the exercises in set 34.2).