Course goals:

Expertise with first-order and second-order linear differential equations, including

- Power series techniques, including proof of convergence
- Variation of parameters and Green's functions
- Reduction to matrix algebra in the finite-dimensional case
- Laplace transform methods

Familiarity with the Hilbert space approach, including

- Issues of closure and completeness
- Compatibility conditions for differential operators
- Hermitian operators with orthogonal eigenvectors
- Recurrence realtions and generating functions

- Differential equations of mathematical physics. including
  Legendre and Hermite polynomials
  Wave equation, heat equation, Schroedinger equation
  Bessel and spherical Bessel functions
  Fourier series expansions

Course format:

Lecture format, but all the lectures are in R markdown format and there are fifteen minutes left for in-class discussion.

Everything is converted to pdf format, and one student last year [roved that it is possible to do quite well in the course without attending a single lecture.

Typical enrollees:

Anyone who has studied, is studying, or will study quantum mechanics and wants a deeper understanding of the underlying mathematics.

Mathematics students who want to know standard techniques for solving linear differential equations and to be able to prove most of the key results.

Anyone who uses generalized Fourier series, wherther in physics, engineering, and data science.

When is course typically offered?

Fall only. This course is offers infrequently.

What can students expect from you as an instructor?

Aiming for a small, friendly class with lots of questions.

Lots of examples in R built into the lectures

Assignments and grading:

Homework 25%

Two rather long closed-book takehome quizzes, 25% each

Final paper, preferably one that connects with another course in physics, mathematics, or data science. 25%

No final exam

Sample reading list:

Holland, Applied Analysis by the Hilbert Space Method (in the Coop). This book starts from the beginning, with first-order linear differential equations.

Past syllabus:

Here is the syllabus for Fall 2023.

The final exam was replaced by a final paper, and the conversion of course material to R Markdown is now complete.

Here is a sample .Rmd file with lots of interactive R code snippets.

Here is a PDF file automatically created from an .Rmd file

Absence and late work policies:

As long as the course remains small, these can remain flexible.