

Math 537 - Fundamentals of Applied Mathematics

Much of classical applied mathematics, especially when used to model physical phenomenon, relies on ordinary and partial differential equations. This course will focus on *analytic* techniques for solving ordinary and partial differential equations (ODEs and PDEs).

We will cover many of the topics below (but maybe not all!)

- Power series methods for ODEs. (Bessel equation, Legendre equation)
- Sturm-Liouville theory
- Asymptotic methods (steepest descent, stationary methods, Watson's Lemma)
- Transforms (Laplace, Fourier)
- Green's functions solutions to PDEs
- Similarity solutions
- Potential Theory, integral equations
- Calculus of Variations (Euler-Lagrange Equations)

What you will learn in this course

- Emphasis will be on "computational" techniques in the sense that we will solve lots of problems (not in the sense of programming!)
- Theory will be presented when it is especially beautiful or enlightening, and has a useful purpose. For example, Sturm-Liouville Theory, Potential Theory.
- You may be asked to use plotting packages (Matlab, Python) to plot solutions to problems posed in class, but numerical methods will not be discussed in this course, except in passing.

Textbook and other material

Below are some suggested textbooks :

- [Advanced Engineering Mathematics, 10th Edition \(https://www.amazon.com/Advanced-Engineering-Mathematics-10Th-lsv/dp/8126554231\)](https://www.amazon.com/Advanced-Engineering-Mathematics-10Th-lsv/dp/8126554231)
- [Partial Differential Equations: Analytical Solution Techniques \(https://www.amazon.com/Partial-Differential-Equations-Analytical-Mathematics/dp/0387986057\)](https://www.amazon.com/Partial-Differential-Equations-Analytical-Mathematics/dp/0387986057)
- [Advanced Mathematical Methods for Scientists and Engineers: Asymptotic Methods and Perturbation Theory \(https://www.amazon.com/Advanced-Mathematical-Methods-Scientists-Engineers/dp/0387989315\)](https://www.amazon.com/Advanced-Mathematical-Methods-Scientists-Engineers/dp/0387989315)

Course resources

- **Blackboard.** I will use Blackboard to post homework assignments. You will also submit homework through Blackboard. Your scores will also be available in Blackboard, although I maintain my own spreadsheet for all grades.
- **Slack.** We will use Slack as the main way of communicating with each other about homework questions. I will also post announcements in Slack, so be sure to check it regularly.
- **Course website.** I will also maintain a course website, but this will be mainly the "public" facing version of the course, and may not always be up to date.

http://www.forestclaw.org/teaching/Math537_Spring2021
(http://www.forestclaw.org/teaching/Math537_Spring2021)

- **Zoom Recordings.** Zoom recordings will be made available on Blackboard!

Homework and grading policy

- I will aim for weekly, short assignments. We may grade some of the assignments in class.
- Homework will be turned in electronically via Blackboard.
- You will be graded largely on how well you do on homework. You will be successful in this course if you turn in all homework, and do a reasonable job on every problem.