Math 353: Ordinary and Partial Differential equations
Fall 2020 Syllabus for Section 2

Instructor: Jeffrey Wong

Office: Online; see Piazza for details and office hours

Physical office: Physics 029B (not likely to be used)

Class times: M/W 3:30-4:45

Course Websites: Piazza site and Sakai websites for all sections and Section 2

Texts:

- William E. Boyce and Richard C. diPrima, *Elementary Differential Equations and Boundary Value Problems*, 11th edition.
- (*ODE and PDE NOTES I,II*) by Prof. Stephanos Venakides, on Sakai.

Course objectives: The goal of the course is for the students to learn not only "material" **but also a way of thinking.** This course will introduce the classical and rich theory of differential equations. It is a subject which can easily suffer from the perception that it is little more than a collection of rules and procedures to be appropriately (and blindly) applied to a handful of problem types. In reality, there are deep insights to be gained from this material. These fundamental ideas will (hopefully) influence the way you think and problem solve. Thus, our goal is to not only teach you the content outlined in the course synopsis, but to also more broadly impact the way you think about problems in your chosen discipline.

This is an advanced course with high expectations. Your submitted work should reflect your best effort. Solutions should be complete, legible, and easily understood. Complete sentences expressing well-developed ideas should be used whenever appropriate. We will compute, but we will also discuss and reflect.

Important Prerequisites: A solid understanding of fundamentals from linear algebra at the level of Math 216 is essential. This includes the concepts of linearity, span, basis, eigenvalues and eigenvectors as well as the ability to use them in argument and calculation. Thus, a review of linear algebra is a must (you may use *ODE and PDE Notes I* or review notes on Sakai). We will also make frequent use of single variable (and on occasion, multi-variable) calculus as covered in Math 212.

Course details

Technology: Lectures will be recorded and posted to Sakai, and lecture notes will be posted to Piazza. You will need Zoom to attend lectures; you are encouraged to use a camera to make the lecture a bit more like a regular class (but this is not required). Some way of turning in homework (a scanner, a way to take reasonable quality photos of work) is required. Typing solutions in LaTeXis suggested if you want to use it. If you run into issues turning in work, please let me know.

Online matters:: In addition to accessibility issues experienced in the typical academic year, I recognize that remote learning may present additional challenges such as unreliable internet, conflicts that prevent attendance of synchronous meetings, or lack of quiet study spaces. If you are experiencing such difficulties or any others, please feel free to contact me to discuss accommodations.

Homework:

- Homework will typically be assigned weekly and is due one week after assigned, collected at the start of class.
- Homework should be turned in on time for full credit. If late, you should still turn in work for partial credit and feedback. If you need an extension, you should let me know (via email informally or, if necessary, by the usual procedures for extensions as per Duke policy).
- The lowest homework score will be dropped (use this wisely).
- Working and studying in groups is encouraged (you will get much more out of doing homework if you discuss it with others!). However, you should write your own solutions to each problem in your own words.
- Solutions should be complete arguments; the process by which you arrive at the solution is far more important than a correct answer. Aim for clear (but concise) explanations and use complete sentences when appropriate.
- Solutions should be in the same order as in the list of assigned problems. Submissions must be clearly organized (e.g. numbered file names or a single pdf) and readable.
- Some more conceptual problems will be drawn from the *Additional homework problems* PDF (on Sakai). These problems are also a good resource for testing your understanding of the material (not just calculation).

Exams and Grading: Your grade will consist of the following components:

- Weekly homework (20%), lowest score dropped.
- Midterm exams (20% each): See below. Times TBA.
- Final exam (40%): See below. Times TBA.

Important disclaimer: Your final grade will be based on your performance in the course as a whole, not just a summation of the listed parts. The percentages listed are intended to give you a rough sense of the relative importance of each component; consider the computed value to be a baseline.

Exams information: All exams will be **open notes** (you may use your own notes, the lecture notes and the textbook, but not other resources). Exams will be done 'in class' (i.e. while you are connected to the class meeting via Zoom). Further details will be given during the semester.

Ethics: Students are expected to follow the Duke Community Standard. If a student is found responsible for academic dishonesty through the Office of Student Conduct, the student will receive a score of zero for that assignment. If a student's admitted academic dishonesty is resolved directly through a faculty-student resolution agreement approved by the Office of Student Conduct, the terms of that agreement will dictate the grading response to the assignment at issue.

Schedule

The goal is to cover all topics listed below; the outlined schedule is approximate and may change. For the detailed, up-to-date schedule, consult the course website.

- Week 1-2: Fundamentals and first order ODEs: Linearity, solution techniques, modeling and qualitative behavior
- Week 3-4: Second-order linear ODEs
- Week 5-6: Laplace transform for solving ODEs
- Week 7: Series solution (power series and regular singular points)
- Week 8-9: Fourier series
- Week 10-12: Linear PDEs: solution by eigenfunction expansion - the heat equation, wave equation, Laplace's equation
- Week 13-14: Further topics: Non-homogeneous PDEs, Sturm-Liouville theory, Laplace's equation in a disk