MATH 356: ELEMENTARY DIFFERENTIAL EQUATIONS
FALL 2019 SYLLABUS (Sec. 2)

Instructor/Location:  Jeffrey Wong (Physics 029B)
Office Hours:  See course website
Class times/location:  T/Th 4:40-5:55 in Physics 259
Course Website:  Math 356.02 Piazza site (Sakai for grades).

Course objectives:  This course will introduce the classical theory of differential equations. We will begin with the fundamentals of ordinary differential equations and then build on this theory to solve some partial differential equations. While we will learn the mechanics of computing solutions, the primary goal of the course is to develop a way of thinking and an understanding of the rich structure that underlies the methods.

Important prerequisites:  A solid understanding of fundamentals from linear algebra 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. We will also make frequent use of single-variable and multi-variable calculus as covered in Math 212. It will be beneficial to review this material on your own; some key concepts will be briefly reviewed in class/homework.

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

• Weekly homework (15%). The lowest homework score will be dropped.
• Midterm (40%): Two in-class midterm exams (for dates, see Sakai).
• Final exam (45%): The final exam will be held on Dec. 11 from 2-5 PM.
• Exams are closed book and closed notes. A formula sheet will be provided.

Important disclaimer:  Your final grade will be based on a complete evaluation of your performance in the course, which includes some instructor discretion. The percentages listed are intended to give you a sense of the relative importance of each component; consider the computed value to be a baseline and not a formula for computing your grade.
Homework:

- Homework will be assigned weekly, except before midterms and the final exam. Due dates will be listed on Sakai; typically one week after assigned.

- **No late homework will be accepted**, barring exceptional circumstances as per Duke policy. The lowest homework score will be dropped.

- Working and studying in groups is encouraged. 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. When appropriate (which is often), use complete sentences to develop your arguments.

- Solutions should be clearly readable and in the order of the assigned problems.

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 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 (at least) all the topics listed below; the outlined schedule may change. For the detailed, up-to-date schedule, consult the course website. Section numbers refer to the textbook.

**Part I: Fundamentals, linear ODEs**

- Week 1-2: Fundamentals and first order ODEs: Linearity, solution techniques, existence and uniqueness (Ch. 2)
- Week 3-4: Systems of linear ODEs (Ch. 3, 4 and parts of 8/9)

**Part II: Qualitative analysis, non-linear ODEs**

- Week 5: Modeling, qualitative behavior, autonomous equations (part of Ch. 2)
- Week 6-8: Nonlinear ODEs: phase plane analysis and other topics (Ch. 10)

**Part III: Eigenfunctions and introduction to PDEs**

- Week 9-10: Fourier series, boundary value problems (Ch. 12)
- Week 11-12: Linear PDEs: solution by eigenfunctions (Ch. 13)
- Week 13: Inhomogeneous PDEs, Sturm-Liouville theory
- Week 14-15: Examples, PDEs in higher dimensions and more