Math 0290: Differential Equations, Fall 2017
Departmental Syllabus - M. Lewicka section - MWF 11:00am, G31 Benedum Hall

Overview: Differential equations represent an important branch of mathematics. Many of their properties have been by now fully understood and their analysis is fundamental to solving important problems in all areas of science and engineering. This introductory course will focus primarily on linear, first-order, and second-order differential equations. Solution techniques for separable equations and homogeneous and inhomogeneous equations as well as a range of modeling-based applications arising in the context of engineering, physics and chemistry will be presented. The application of Laplace transforms to differential equations, systems of linear differential equations, linearization of nonlinear systems, and phase plane methods will be covered. Fourier series, which is a crucial tool for example in signal processing, will also be introduced, and we will discuss how the Fourier series arises in solving the heat equation by separation of variables. The idea of approximating and visualizing solutions using Matlab, will be introduced early in the term and students are encouraged to use this software as a resource in their work.

Textbook: Polking, Boggess and Arnold, *Differential Equations with Boundary Value Problems*, second edition, Pearson Prentice-Hall.

Instructor information: Professor Marta Lewicka, Thackeray 408, lewicka@pitt.edu
Office Hour: Mondays at 5:30PM or by appointment.

Grades: Homework 20%, One midterm exam 40%, Final exam 40%.

Assessments: (1) Weekly homework assignments will be collected at the beginning of the lecture every Monday. (2) There will be one in-class Midterm Exam. (3) The cumulative Final Exam will take place *at a time to be determined by the University.* (4) Your course grade will not exceed your Final Exam grade by more than one letter grade.

Grading scale: A/A±:90-100%, B/B±: 80-89%, C/C±: 70-79%, D/D±: 60−69%, F:<60%.

Matlab: Computers are often used to deal with differential equations encountered in physics, biology, chemistry, and engineering. Right from the outset, we will discuss how Matlab can help us to visualize the behavior of solutions of differential equations and to approximate these solutions and we will give an introduction to numerical solution techniques. Matlab will not be available on exams however, and will not factor heavily into statements of homework problems; mostly, it is a tool that can possibly help you visualise the abstract material better and check your solutions.

Homework policies: Students are required to complete the homework problems; very few students can learn this material without constant practice. Students are welcome to work together on homework. However, each student must turn in his or her own assignments, and no copying from another student's work is permitted. Deadline extensions for homework will not be given.

Midterm exam: This assessment is to be completed in class at the assigned time. The only exception to this policy is as follows: if you have a legitimate and documented medical or academic conflict that will prevent you from being in class for a midterm. In this case, your grade on it will be the prorated grade of your final exam. Incompletes will almost never be given, and only for cases of extreme personal tragedy.

Final Exam policy: All students must take the departmental Final Exam at the time and place scheduled by the registrar.

Academic Integrity: The University of Pittsburgh Academic Integrity Code is available at:
https://as.pitt.edu/faculty/policies-and-procedures/academic-integrity-code.
The code states that "A student has an obligation to exhibit honesty and to respect the ethical standards of the academy in carrying out his or her academic assignments." The website lists examples of actions that violate this code. Students are expected to adhere to the Academic Integrity Code, and violations of the code will be dealt with seriously.

Disability Resource Services: If you have a disability for which you are or may be requesting an accommodation, you are encouraged to contact both your instructor and Disability Resources and Services, 140 William Pitt Union, 412-648-7890 as early as possible in the term. DRS will verify your disability and determine reasonable accommodations for this course.

Schedule and practice problems: The following is an approximate schedule for lectures and a full list of practice problems from the course textbook.

Week 1:
Introduction to differential equations, numerical methods and computer tools including Matlab for DEs
1.1 Number 1-11.
2.1 Number 3-6, 10-15, 21-28.
6.1 Number 1-9, 11.

Week 2:
Numerics (cont.), separation of variables.
6.2 Number 1-9.
6.3 Number 1-6, 11-13.
2.2 Number 1-22, 23-29, 33-35.

Week 3:
Modeling, linear first-order equations.
2.3 Number 1-10.
2.4 Number 1-21, 29.
2.5 Number 1-7, 9-10.

Week 4:
Modeling (cont.), second order equations.
3.4 Number 1-19.
4.1 Number 1-20, 26-30.
4.3 Number 1-36.

Week 5:
Second order equations (cont.), harmonic motion.
4.3 (cont.) Number 1-36.
4.4 Number 1-12, 14-16, 18.
4.5 Number 1-29.

Week 6:
Inhomogeneous second order equations.
4.5 (cont.) Number 1-29.
4.6 Number 1-10.
4.7 Number 3-11.

Week 7:
Laplace Transform.
5.1 Number 1-29.
5.2 Number 1-41.
5.3 Number 1-36.

Week 8:
Laplace Transform (cont.)
5.4 Number 1-26.
5.5 Number 1-25.
5.6 Number 1-9.

Week 9:
Laplace Transform (cont.), systems of differential equations
5.7 Number 4-24.
8.1 Number 1-16.
8.2 Number 1-6, 13-16.

Week 10:
Systems of differential equations, constant coefficient homogeneous systems.
8.3 Number 1-6.
9.1 Number 1-8, 16-23.
9.2 Number 1-27, 58-61.
9.3 Number 20-23.

Week 11:
MIDTERM, *Constant coefficients homogeneous 2×2 systems*
9.4 Number 1-12.

Week 12:
Nonlinear systems, Fourier series.
10.1 Number 1-16.
12.1 Number 1-22.

Weeks 13-14:
Fourier series, separation of variables for heat equation.
12.3 Number 1-32.
12.4 Number 1-11.
13.2 Number 1-18.

Week 15:
Review.