Math 0290: Differential Equations   Spring 2017

Overview: Differential equations are an important branch of mathematics. They have a rich mathematical formalization, as well as a very successful history of being applied to important problems in physics, chemistry, engineering, and biology. This course will introduce primarily linear, first and second order differential equations. Solution techniques for separable equations, homogeneous and inhomogeneous equations, as well as an intuition for modeling-based applications 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 introduced. Fourier series and their application to simple partial differential equations will be treated. MATLAB based numerical solution and visualization will be briefly covered.

Textbooks: Polking, Boggess and Arnold, *Differential Equations with Boundary Value Problems*, second edition, Pearson Prentice-Hall; Polking and Arnold, *Ordinary Differential Equations using MatLab*, Third Edition, Pearson Prentice-Hall. These two items will be packaged together in the Pitt Bookstore.

Other Materials: You will need some MatLab add-on software for differential equations. It can be downloaded from http://math.rice.edu~dfield/ at Rice University.

Grades: Your course grade will be determined as follows: Two midterm exams 40% (20% each); Final exam 40%; Homework 20%. Your final grade should not exceed your final exam grade by more than one letter grade.

MATLAB component: The study of differential equations often uses computer algorithms to gain solutions to relevant problems in physics, biology, chemistry, and engineering. Several assignment problems will be taken from the problem sets in the MATLAB supplemental textbook. These problems will be of use to the student in both acquiring a visual sense of differential equations and their solutions, as well as give an introduction into standard-practice techniques currently used in many disciplines.

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. Students are encouraged to discuss with your professor about homework problems if you'd like additional feedback.

Academic Integrity: The University of Pittsburgh Academic Integrity Code is available at http://www.fcas.pitt.edu/academicintegrity.html. 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. On homework, you may work with other students or use library resources, but each student must write up his or her solutions independently. Copying solutions from other students will be considered cheating, and handled accordingly.

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 or 412-383-7355 (TTY) as early as possible in the term. DRS will verify your disability and determine reasonable accommodations for this course.

Schedule and practice problems: Approximate schedule for lectures. References of the form a.b refer to sections in the main textbook. References of the form Ma refer to Chapter a of the MatLab supplement.

Week 1: January 4, 6
Introduction to differential equations; First order initial value problems; Introduction to Matlab
1.1 Number 1-11
2.1 Number 3-6, 10-15, 21-28
M1 Number 1

Week 2: January 9, 11, 13

Numerical methods; Plotting with MatLab
6.1 Number 1-9, 11
6.2 Number 1-9
6.3 Number 1-6, 11-13

Week 3: January 18, 20
Separation of variables; Modeling
2.2 Number 1-22, 23-29, 33-35
2.3 Number 1-10

Week 4: January 23, 25, 27
Linear equations; Mixing problems; Electrical circuits
2.4 Number 1-21, 29
2.5 Number 1-7, 9-10
3.4 Number 1-19

Week 5: January 30, February 1, 3
Second order equations
4.1 Number 1-20, 26-30
4.3 Number 1-36

Week 6: February 6, 8, 10
Harmonic motion; Method of undetermined coefficients
4.4 Number 1-12, 14-16, 18
4.5 Number 1-29

Week 7: February 13, 15, 17
Variation of parameters; Forced harmonic motion
4.6 Number 1-10
4.7 Number 3-11
Review for Midterm 1

Week 8: February 20, 22, 24
Laplace transform
Midterm 1 on February 20, 2017
5.1 Number 1-29
5.2 Number 1-41

Week 9: February 27, March 1, 3
Laplace transform (Cont.)
5.3 Number 1-36
5.4 Number 1-26
5.5 Number 1-25

Week 10: Spring Break

Week 11: March 13, 15, 17
Delta function; Convolutions; System of differential equations
5.6 Number 1-9
5.7 Number 4-24
8.1 Number 1-16
8.2 Number 1-6, 13-16

Week 12: March 20, 22, 24
Qualitative analysis; Planar systems
8.3 Number 1-6
9.1 Number 1-8, 16-23
9.2 Number 1-27, 58-61

Week 13: March 27, 29, 31
Phase plane; Trace-Determinant plane
9.3 Number 1-6, 12-15
9.4 Number 1-12
Review for Midterm 2

Week 14: April 3, 5, 7
Nonlinear systems; Fourier series
Midterm 2 on April 3, 2017
10.1 Number 1-16
12.1 Number 1-22

Week 15: April 10, 12, 14
Fourier series; Heat equation
12.3 Number 1-32
12.4 Number 1-11
13.2 Number 1-18

Week 16: April 17, 19, 21
Separation of variables for the heat equation; Review for the final

FINAL EXAM: 4:00pm – 5:50pm, April 28, 2017