University of Pittsburgh
Department of Mathematics

MATH 0290 Differential Equations

Term: Spring 2017
1500/1501 Posvar
MWF 12:00pm - 12:50pm
MWF 1:00pm - 1:50pm

Instructor: Dr. Patrick Cooper
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Office Hours: Monday 2:00-3:00pm / Monday 3:00pm-4:00pm

Course Description: This course serves as a first introduction into the subject of differential equations. Every scientific endeavor in way or another studies how coupled systems change in time. The language of such interaction is precisely that of differential equations. In this course we'll learn a menagerie of analytic techniques for solving first order, second order and systems of linear equations. We'll also briefly touch on non-linear systems and some introductory Fourier analysis and partial differential equations. 3 credits.

Prerequisites: Calculus 1 and Calculus 2. Calculus 3 would be helpful.

Text: "Differential Equations with Boundary Value Problems" 2nd edition by Polking, Boggess, and Arnold (Pearson / Prentice Hall).

Other Materials: Some computational software, whatever you're comfortable with (MatLab, Mathematica, Maple, Python, C, C++, Fortran, Haskell, quantum computer &c)

Academic Integrity Policy: 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.

Students with Disabilities: 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.

Grading:

20% - Homework
40% - 2 Midterms
40% - Final Exam

Course Grades:

A	**93-100**
A-	**90-92**
B+	**87-89**
B	**83-86**
B-	**80-82**
C+	**77-79**
C	**70-76**
D	**60-69**
F	**<60**

Final Exam: Your grade cannot exceed your final exam grade by more than one letter grade. All students must take the departmental final exam at the time and location chosen by the registrar. Only verifiable, conflicting, *departmental* final exams will be accommodated for.

Homework Policy: Assignments will be collected Monday at the **beginning** of class. By 15 minutes into the class period, **no** more assignments will be received. This is to prevent the temptation to spend the class period working on your assignment instead of paying attention to the lecture. I highly encourage you to work together but please turn in assignments which are your own. See academic integrity policy.

Approximate Class Schedule:

Jan 4-6 Week 1: Introduction

4 Introduction to Differential Equations (1.1)
6 What is a Derivative? What is an Integral? (1.2, 1.3)

Jan 9-13 Week 2: Defining 'Differential Equations'

9 What is a Differential Equation? (2.1)
11 How to solve them: Euler's Method (6.1)
13 How to solve them II: Runge-Kutta and error (6.2, 6.3)

Jan 18-20 Week 3: Linear Equations I

18 Separable Equations (2.2)
20 Models of Motion (2.3)

Jan 23-27 Week 4: Linear Equations II

23 Integration Factors (2.4)
25 Mixing Problems (2.5)
27 Modeling: Population, Finance and Circuits (3.1-3.4)

Jan 30 - Feb 3 Week 5: Modeling and Second-Order Equations I

30 Intro to Second Order (4.1)
1 Second Order Equations and Systems (4.2)
3 Linear Homogeneous Constant Coefficient (4.3)

Feb 6-10 Week 6: Second Order Equations II

6 Harmonic Motion (4.4)
8 Inhomogeneous Equations (4.5)
10 Variation of Parameters (4.6)

Feb 13-17 Week 7: Midterm and the Laplace Transform I

13 Forced Harmonic Motion (4.7)
15 MIDTERM 1
17 The Laplace Transform (5.1)

Feb 20-24 Week 8: The Laplace Transform II

20 Basic Properties (5.2)
22 The Inverse Laplace Transform (5.3)
24 Using the Laplace Transform (5.4)

Feb 27 - March 3 Week 9: The Laplace Transform III

27 Discontinuous Forcing Terms (5.5)
1 The Dirac Delta Function (5.6)
3 Convolutions (5.7)

March 13-17 Week 10: Introduction to Systems of Equations

13 Introduction (8.1)
15 Geometric Interpretations of Solutions (8.2)
17 Qualitative Analysis (8.3)

March 20-24 Week 11: Systems with Constant Coefficients

20 Introduction to Eigenvectors/Eigenvalues (9.1)
22 Planar Systems (9.2)
24 Phase Plane Portraits (9.3)

March 27-31 Week 12: Midterm 2 and Non-linear Systems

27 The Trace-Determinant Plane (9.4)
29 MIDTERM 2
31 Non-linear Systems (10.1)

April 3-7 Week 13: Fourier Series

3 Computation of Fourier Series I (12.1)
5 Computation of Fourier Series II (12.1)
5 Fourier Cosine and Sine Series (12.3)

April 10-14 Week 14:

10 The Complex Form of a Fourier Series (12.4)
12 Buffer (Potential topics: Hamiltonian Systems and Chaos)
14 Buffer (Potential topics: Hamiltonian Systems and Chaos)

<u>April 17-21 Week 15:</u> Partial Differential Equations

17 The Heat Equation (13.1)

19 Separation of Variables I (13.1)

21 Separation of Variables II (13.1)