Ordinary Differential Equations (Math 3230 Syllabus)

Instructor: Dr. Shijun Zheng
Lecture Hours & Location: MW 2:30-3:45. MP 1303
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Text: *Introductory Differential Equations with Boundary Value Problems*, Third Ed. by Abell and Braselton.

Prerequisites: Satisfactory completion (a grade of C or higher) of the equivalent of Calculus II, and an elementary knowledge of linear algebra as a pre- or co-requisite.

Course Description: We will cover most of Chapters 1-6 in the text. This is an introductory course in ordinary differential equations. Topics include: first, second, and higher-order differential equations as well as systems. The course emphasizes difference between linear and nonlinear ordinary differential equations and systems of ordinary differential equations. Students will demonstrate their understanding of the definitions of order, linearity, and nonlinearity; ability to perform computations with linear and nonlinear first-order equations, higher-order linear homogeneous and non-homogeneous linear equations, and higher-order linear homogeneous and non-homogeneous systems of linear equations. If time permits, we will also begin an elementary discussion of Laplace transforms in Chapter 8.

Differential Equations is a prerequisite for many advanced math courses, like Applied Mathematics. Some students find that Differential Equations is a demanding and challenging course. Consequently, it is expected of you and especially important that you have mastered the necessary prerequisite algebra, trigonometric, and calculus skills to satisfactorily complete this course.

Grading: The weighting in your course score points (360 possible) will be 120 Final exam, Two exams (one-hour exam 100 and one midterm 80), 60 Homework/Quizzes (Point totals will be normalized to these relative weights).

The grading scale is: A 90% or above; B 80–89 %; C 70-79%; D 60-69%; and F 59% or below.

Homework: *Working on homework problems or projects is essential and hence strongly recommended.* The written work you submit for grading should be neat so that it is easy-to-read by anyone. We will discuss the tentative course structure during the course. Time permitting, we may schedule *Group Discussions and Term Project*. During the course of the semester, several sets of problems will be given, either in-class or take-home. Students will form several groups to discuss and work on the assigned problems for better understanding the materials.

Philosophy: Real learning requires your active involvement. Practice on solving the homework problems is essential and very important. The result in a test usually reflects how much efforts you have put into the homework assignment as well as

class learning, and how well you have prepared for it. The problems at the end of each section of the text should be completed regularly and promptly. Students who earn high grades in differential equations typically master all standard exercises as well as a variety of the more difficult ones. In addition to solving problems and reviewing class notes, you should also read the text on a regular basis as it is well-written and contains a variety of examples.

Attendance Policy: Students are expected to attend each class meeting and pay attention. A student who misses class is responsible to find out what was discussed and learn the material that was covered on the missed day.

Make-up Policy: Late homework or project will not be accepted unless a reasonable excuse is given. No make-up exams will be given. When a student misses an exam the score from the final exam will be substituted for the missing exam score.

Math Tutoring: The Academic Success Center offers free peer tutoring during the week. Contact the tutorial centers for exact hours at 478-0321 or http://academics.georgiasouthern.edu/success/.

Classroom Etiquette: High expectations for appropriate behavior, which include ethical behavior and mutual respect as part of a productive learning environment.

Academic honesty: The Georgia Southern University Honor Code states: "I will be academically honest in all of my course work and will not tolerate the academic dishonesty of others. I also pledge to engage in ethical behavior on-campus and off-campus, to live an honorable lifestyle, and to create a campus environment that is characterized by individual responsibility, civility, and integrity."
http://students.georgiasouthern.edu/sta/guide/

Civility Statement: See the Student Conduct Code at
http://students.georgiasouthern.edu/judicial/SCC08-09.pdf

Important Dates:
August 22 Classes Begin
August 22-25 Drop/Add; Attendance Verification
September 5 Labor Day Holiday
October 17 Last day to withdraw without academic penalty
November 4-5 Homecoming; class canceled beginning at 2:00 p.m. Friday, Nov. 4
November 21-25 Thanksgiving holidays.
December 9 Last day of classes
December 12 *Final Exam:* Monday 3:00-5:00 pm.
http://students.georgiasouthern.edu/registrar/finalSchedule.htm
December 16 Commencement

Tentative Schedule (Outline of topics) 1. Introduction to Differential Equations
1.1. Introduction
1.2. A Graphical approach to solutions: Slope fields and Direction fields
2. First Oder Equations

2.1. Introduction to first-order equations.
2.2 Separable equations
2.3. First order linear equations
2.4. Exact equations
2.5. Substitution methods and special equations
2.5. Theory of first order equations
2.6. Numerical methods for first order equations
3.* Application of First Order Equations
3.1. Population growth and decay
3.2. Newton's law of cooling and related problems
3.3. Free falling bodies
4.* High Order Equations
4.1. Second-order equations: An introduction
4.2. Solutions of second-order linear homogeneous equations with constant coefficients
4.3. Higher-order equations: An introduction
4.4. Solutions to higher-order linear homogeneous equations with constant coefficients
4.5. Introduction to solving non-homogeneous equations with constant coefficients: Methods of undetermined coefficients
4.6. Non-homogeneous equations with constant coefficients: Methods of variation of parameters
4.7*. Cauchy-Euler equation
4.8*. Series solutions of ODE
5.* Applications of Higher Order Equations
5.1. Simple harmonic motion
5.2. Damped motion
5.3. Forced motion
5.4*. Other applications
5.5*. The pendulum problem
6. System of Differential Equations
6.1. Introduction
6.2. Review of Matrix Algebra and Calculus
6.3. Preliminary definitions and notation
6.4. First-Order linear homogeneous sys- tems with constant coefficients.
6.5. First-Order linear nonhomogeneous systems: Undetermined coefficients and variation of parameters
6.6*. Phase portraits
6.7. Nonlinear systems
6.8. Numerical methods
7.* Application of First-Order Systems
8. Laplace Transforms
8.1. The Laplace Transform: Preliminary Definitions and Notation
8.2. Solving Initial Value Problems with the Laplace Transform
8.3. Laplace Transforms of several important functions
8.4*. The convolution theorem
8.5*. Laplace Transforms for solving systems
8.6*. Applications using Laplace Transforms.

9*. Eigenvalue Problems and Fourier Series
9.1. Boundary-value problems, eigenvalue problems, Sturm-Liouville problems
9.2. Fourier sine series and cosine series
9.3. Fourier series
9.4. Generalized Fourier series
10*. PDE
10.1. Introductions to PDEs and Separation of variables.
10.2. The one-dimensional heat equations
10.3 The one-dimensional wave equations
10.4 Problems in two-dimensions: Laplace's equation.
10.5. Two-dimensional problem in a circular region.

TABLE 1. **Class Schedule by Chapters/Sections** (Tentative)

Introduction of ODEs	1.1-1.2
First Order Equations	2.1–2.6
Application of First Order Equations	3.1–3.3
Exam 1	Chapters 2 and 3
Higher Order Equations*	4.1–4.6
System of Differential Equations	6.1–6.8
Exam 2	Chapter 4 and part of Chapter 6
Laplace Transforms**	8.1–8.3
Cumulative Final Exam	December 12, Monday 3:00-5:00