

## Mth 256, Section 001: Applied Differential Equations I

**Instructor:** Dacian Daescu

**Office:** Neuberger Hall 313

**E-mail:** daescu@pdx.edu

**Phone:** (503) 725-3581

**Office Hours:** MW 11:30AM-12:30PM. Also by appointment.

**Class Time and Location:** MWF 12:45-13:50, NH 375 (Neuberger Hall)

**Textbook:** *Differential Equations*, Paul Blanchard, Robert L. Devaney and Glen R. Hall, 4<sup>rd</sup> Edition.

**Final Examination:** Monday, June 11, 12:30-14:20, in class

**Course web site:** Syllabus, class assignments, and other information about the course will be available on the web site: <http://www.mth.pdx.edu/~daescu/mth256.html>

Students are responsible for checking this site on a regular basis.

**Course Description:** This course provides an introduction to the theory of differential equations and applications. Basic topics within differential equations will be covered as follows:

### *Chapter 1: First-order differential equations*

- 1.1 Modeling via differential equations
- 1.2 Analytic techniques: Separation of variables
- 1.3 Qualitative techniques: slope fields
- 1.4 Numerical Techniques: Euler's method
- 1.5 Existence and uniqueness of solutions
- 1.6 Equilibria and the phase line
- 1.8 Linear differential equations
- 1.9 Integrating factors for linear equations

### *Chapter 2: First-order systems*

- 2.1 Modeling via systems
- 2.2 The geometry of systems
- 2.3 The damped harmonic oscillator
- 2.4 Analytic methods
- 2.5 Euler's method for systems
- 2.6 Existence and uniqueness for systems

### *Chapter 3: Linear systems of differential equations*

- 3.1 Properties of linear systems
- 3.2 Straight-line solutions
- 3.3 Phase planes - real eigenvalues
- 3.4 Complex eigenvalues
- 3.5 Repeated and zero eigenvalues
- 3.6 Second-order linear equations
- 3.8 Linear systems in 3D

### *Chapter 4: Forcing and resonance*

- 4.1 Forced Harmonic Oscillators
- 4.2 Sinusoidal Forcing
- 4.3 Undamped forcing and resonance
- 4.4 Amplitude and phase of the steady state

### *Chapter 5: Nonlinear systems*

- 5.1 Equilibrium point analysis

### *Chapter 6: Laplace transforms*

- 6.1 Laplace transforms
- 6.2 Discontinuous functions
- 6.3 Second-order equations
- 6.4 Delta functions and impulse forcing
- 6.5 Convolutions

This course plan may be modified during the semester. Such modifications will be announced in advance in class and on the course web page; the student is responsible for keeping abreast of such changes.

## Student Learning Objectives

After completing this course, a successful student should achieve the following objectives:

1. Understand the fundamental role of differential equations in the study of change in the physical world.
2. Develop the ability to build mathematical models for some simple physical processes.
3. Learn basic analytical techniques for studying and solving differential equations (as specified in the course topics).
4. Develop an intuitive and working experience in the analysis, visualization and interpretation of the solutions using graphical techniques.

**Prerequisites:** Mth 252; Mth 261

**Grading Policy:** The final grade will be based on tests, quizzes, and a project, as follows:

1. **Final Exam, 40% of the course grade:** Monday, June 11, 12:30-14:20, in class.
2. **Midterm Exam, 30% of the course grade:** Monday, May 7, in class.
3. **Quizzes, 30% of the course grade:** There will be 7 quizzes scheduled as follows: 4/13, 4/23, 4/30, 5/14, 5/21, 5/30, 6/6. The top 6 scores will be considered for your grade.

In assigning final course grades, plus/minus grading will be used.

*Homework will be assigned on a weekly basis.* Although homework will not be graded, it will provide the basis for the examinations. Questions related to homework problems will be addressed in class and students should actively participate in the discussion of the homework solutions.

Your quizzes and exams will be evaluated based on correctness, completeness, and *clarity* of the presentation.

Calculators are allowed, but no notes (or books) will be allowed during the Quizzes and the Midterm Exam.

**The Final Exam is comprehensive, closed book, 1 page of notes is allowed.**

*Makeup quizzes* will be accepted only if special permission of the instructor is obtained *in advance*. **Only under exceptional circumstances** will a student be permitted to shift the time of the **final examination**.

**Disability requests:** If you have a disability which may require special arrangements for seating, testing or other class requirements, please contact me after class or during my office hours.