Syllabus

MA 2051 - Differential Equations

A-Term, Fall 2024

Department of Mathematical Sciences

Worcester Polytechnic Institute

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TA: **Evan Sayer**

PLA: **Lauren Braconnier**

Textbook: *An Introduction to Differential Equations and Their Applications*, by Stanley J. Farlow, Dover. ISBN: 04864495X.

NOTE:

- Although a very readable book, it does have typos which have been catalogued at UMBC. Students can get electronic access to this text via the George C. Gordon Library. See the course Canvas page for more details
- Students are responsible for all material described in the text in the sections covered in lecture. See the Lecture Schedule for more details.

Course Objectives

This is a first course in ordinary differential equations which requires the material in Calculus (MA 1021- MA 1024). The material in this course provides fundamental mathematical content for topics in science and engineering, since the mathematical models that describe many processes in these disciplines are ordinary differential equations. The objectives of this course center not only on the mathematical topics of differential equations, but also on the qualitative interpretation of the solutions to ordinary differential equations. The goal is for students to be proficient in the material covered, and at the end of the course, the student should be able to do

- Solve separable differential equations by integration
- Solve first-order linear differential equations by different methods, and qualitatively interpret their solutions
- Find fundamental solutions to second-order linear constant-coefficient differential equations
- Mathematically model fundamental processes from science and engineering using ordinary differential equations
- Quantitatively and qualitatively interpret solutions to second-order linear constant-coefficient differential equations
- Use Laplace Transforms to find solutions to linear constant-coefficient differential equations.

Class Expectations:

Collaborative learning and active engagement are expected. *Collaborative learning* meas that students collaborate together to learn the material in the course. *Active engagement* by students means that students accept the responsibility for their own learning of the material and do not perceive the instructor (professor/TA/PLA) as a source of all knowledge.

In order to meet these expectations, the classroom environment must be professional and supportive. Students are expected to treat each other with mutual respect, provide constructive feedback to other students, and to realize that as humans we all need guidance at times.

Course Organization

The class meets five times per week:

- **Lectures** MTRF, 1:00-1:50 pm, UH 400
- **Discussion:** Just one hour per week. Check your course schedule for your Discussion section. Students can only attend their assigned Discussion section.
  - **AD07:** T 4:00-4:50 pm, SH 301
  - **AD08:** T 12:00-12:50 pm, SH 301
  - **AD09:** T 3:00-3:50 pm, SH 301

Students are responsible for any and all material discussed in lecture and in discussion. Expectations for these activities are:

- **Lectures**:This is the first opportunity for a student to see the material, and my expectation of students after a lecture is to have an introduction of the material, *not* to demonstrate mastery. The goal is to give a high-level description of the main points of the topics, and to provide some examples illustrating the topic. **Lectures will be in person, but videos of all lectures can be found through Echo 360 on the course Canvas site. For any WPI-defined *significant weather event*, the lecture will be given remotely (either through Echo 360 or through Zoom). Check the Canvas site for further details.**
- **Discussion**: Students have an opportunity to sit down and work through problems on a topic and have their individual questions addressed. It is through the discussion that the student can get major questions asked so that after discussion, the student can continue to work through the problems to develop mastery. Discussion sessions are not recorded.

Students are expected to spend an additional **8-10 hours per week** studying outside of class: reading the text, organizing notes, and solving problems. In previous years, the average time, self-reported, spent outside of class on this class is **9 hours.**

Special Arrangements

Students with approved academic accommodations should plan to submit their accommodation letters through the Office of Accessibility Services Student Portal. Should you have any questions about how accommodations can be implemented in this particular course, please contact me as soon as possible. Students who are not currently registered with the Office of Accessibility Services (OAS) but who would like to find out more information about requesting accommodations, documentation guidelines, and what the accommodated interactive process entails should plan to contact OAS either by email: AccessibilityServices@wpi.edu, by phone (508) 831-4908, or by stopping by the office on the 5th floor of Unity Hall.

Final Grade Components

There are two components that make up the final grade:

- **WebWorK (15% of Final Grade)**: There will be assignments using this online tool through the course Canvas site to understand your basic knowledge of the topics for that day's lecture. You receive full credit for correct answers, independent of the number of attempts made. Each problem is equally weighted (1 point per problem is a perfect score). **These assignments need to be completed by their due date, typically within three days of the lecture.**
- **Three Exams: Closed book, closed notes, and no electronic devices are allowed.**
  - **Exam 1 (25% of Final Grade)** The first exam (45 minutes) takes place on **September 5, 2024** in lecture, and focuses on **first-order initial value problems and their applications.**
  - **Exam 2 (25% of Final Grade)** The second exam (45 minutes) takes place on **September 19, 2024** in lecture, and focuses on **homogeneous second-order initial value problems and their applications.**
  - **Final Exam (35% of Final Grade)**: This 45-minute exam takes place on **October 10, 2024** in lecture, and focuses on **nonhomogeneous second-order initial value problems, their applications, and Laplace Transforms.**
  - ***Retake Exams:*** Students can retake either **Exam 1** or **Exam 2** on **October 11, 2024** in lecture, but not both. The grade on the retake replaces the grade on the original exam.

Exam Policy:

Prior to the start of each exam or quiz, you must place all of your belongings (e.g., cell phone, study materials, etc.) in your backpack and under your desk, so that no items are visible during the exam. ***All exams this term are closed book, closed notes, and no calculators or electronic devices are permitted.***

Final Grades:

Final grades will be assigned as A,B,C,I or NR. In general, grades will be distributed approximately as follows:

A: 90-100%

B: 80-89%

C: 68-79%

NR: other

Lecture Schedule

Sun	Monday	Tuesday	Wednesday	Thursday	Friday
8/18			Exam 1 Topics Exam 2 Topics Exam 3 Topics	Introduction, Basic Concepts, Classification of ODE's	First-Order Nonlinear Equations, Separation of Variables,
8/25	Integrating Factors	Growth/Decay Phenomena		Mixing Phenomena	More Applications to First-Order Linear Equations
9/1	Labor Day: No class	Review for Exam 1		Exam 1	Second-Order Homogeneous Linear Equations, Fundamental Solutions
9/8	Constant Coefficients: Real Roots	Constant Coefficients: Repeated Real Roots		Constant Coefficients: Complex Roots	Simple Harmonic Motion
9/15	Unforced Damped Vibrations	Review for Exam 2		Exam 2	Undetermined Coefficients
9/22	Undetermined Coefficients	Variation of Parameters		Forced Vibrations	Wellness Day: No class
9/29	Forced Vibrations	Laplace Transforms: Definition and Properties		Inverse Laplace Transforms	Inverse Laplace Transforms, Laplace Transforms: Initial-Value Problems
10/6	Laplace Transforms: Initial-Value Problems	Review for Final Exam		Final Exam	Retake Exam 1/2