



WPI

MA2051 - B Term - 2024

Lectures MTRF, 3:00 PM - 3:50 PM, Fuller Labs PHL Perreault Hall - Upper Section

Discussion: Group 01: T, 10:00 AM - 10:50 AM, Unity Hall 520

Discussion: Group 02: T, 8:00 AM - 8:50 AM, Fuller Labs 311

Discussion: Group 03: T, 9:00 AM - 9:50 AM, Goddard Hall 227

Discussion: Group 05: T, 9:00 AM - 9:50 AM, Higgins Labs 154

Instructor:

- Name: Dr. Yonatan Ashenafi
- Email: yashenafi@wpi.edu
- Physical Office: Salisbury Labs 405B
- Office Hours: MT 11-11:50 AM, RF 10 - 10:50 AM, (Online) W 2:30 - 3:30 PM
- Zoom: <https://wpi.zoom.us/j/3308040066>

Teaching Assistant (TA):

- Name: Andrey Martemyanov
- Email: amartemyanov@wpi.edu
- Physical Office: SH 115 (October 24), SH 410 (October 31)
- Office Hours: R 2-3 PM

Peer Learning Assistant (PLA): Navpreet Kaur with office hour W 11 AM-12 PM, I&E center on the second floor of the innovation studio

*The information in this syllabus is subject to change as the course progresses. Please keep up to date regarding any changes.

Course Logistics

Course content will be organized and posted to Canvas under the Pages and the Modules tabs. The course content will consist of lecture notes, and/or slides as well as assigned reading material. The lecture videos and other material are created by me and will be posted before the assigned course lecture sessions. This course will be partially taught in a reverse or “flipped” classroom model. This means that students are responsible for completing the reading assignments (posted on the Canvas Calendar) before their assigned lecture session. During office hours, you will have the opportunity to ask me questions regarding the material so that you get a better and deeper understanding of the material and its value in solving problems in applied mathematics/engineering.

Please make sure to check Canvas several times each day to follow the assigned material and to stay informed about any updates regarding scheduling.

Course Description

Ordinary Differential Equations (ODEs) are essential tools in mathematical modeling and analysis across various scientific and engineering disciplines. This course provides an introduction to the theory, methods, and applications of ODEs. The course emphasizes problem-solving skills, both analytically and computationally.

Text

Introduction to Differential Equations and Their Applications. Edition 06 published by Dover.

Author: Farlow, Stanley J.

Speak to the instructor if you are interested in more reading material in particular areas covered in the class.

Learning Outcomes

1. **Understanding of ODE Fundamentals:** Students will demonstrate a comprehensive understanding of the fundamental concepts related to ordinary differential equations, including order, degree, and initial value problems.
2. **Application of Solution Techniques:** Students will be able to apply various solution techniques, such as separation of variables, integrating factors, and Laplace transforms, to solve first-order and higher-order ordinary differential equations.
3. **Analysis of First-Order ODEs:** Upon completion of the course, students will be proficient in analyzing and solving first-order ordinary differential equations both analytically and numerically. They will apply these skills to model real-world phenomena such as growth and decay problems, population dynamics, and physical processes.
4. **Solving Second-Order Linear ODEs:** Students will develop the ability to solve second-order linear ordinary differential equations, including both homogeneous and nonhomogeneous cases. They will understand concepts such as constant coefficient equations, method of undetermined coefficients, and variation of parameters.
5. **Understanding Systems of ODEs:** Through the study of systems of ordinary differential equations, students will learn how to solve elementary coupled first order linear ODEs.
6. **Applying to real world problems:** Students will learn some applications of differential equations in science and engineering.

Time and Study

Besides the time for classes, you will spend time on reading the text, doing the assignments, and studying for quizzes and tests. That comes to about five to nine hours outside of class on average per week, the actual amount varying from week to week. Below is a summary of the typical semester's work:

- Reading the relevant material to prepare for class
- Doing quizzes and homework assignments
- Meeting with Professor and TA/PLA team for office hours
- Reviewing for the exams and taking them

Academic Resources Center

The Academic Resources Center (ARC) offers individual tutoring and Math and Science Help (MASH, group drop-in tutoring) in person on the 5th floor of Unity Hall for undergraduate students. Some MASH sessions that occur after 6pm may take place in the Exam Proctoring Center (EPC, UH 505). Tutoring sessions are 50 minutes long and are facilitated by peer undergraduate students. Tutoring availability is dependent on tutor's schedules within the ARC hours of operation. Students should use Tutortrac to sign up for individual tutoring appointments that fit their schedule. Students are encouraged to schedule 1-on-1 appointments in advance. No appointments are needed for MASH group drop-in sessions.

B Term 2024 tutoring will begin on Wednesday October 23, 2024 and end on Wednesday December 11, 2024. There will be no tutoring on: November 5, 2024; November 27-29, 2024; December 9, 2024. Information about MASH and 1-on-1 tutoring offered by the ARC is located on the Academic Resources Center Canvas Page (<https://canvas.wpi.edu/courses/8168>) and on the Academic Resources Center WPI Webpage(<https://www.wpi.edu/student-experience/resources/academic-resources-center>).

Grade Distribution

Assessment	Weight	Date	Regulations
Postclass quizzes	5%	Due 11:59 PM EST for each class day	Best 19 of 23
Written assignments	25%	Due on Tuesdays at 11:59 PM EST	
Online(WebWork) assignments	25%	Due on Fridays at 11:59 PM EST	Best 3 of 4
Midterm Exam	15%	Friday, November 15	In class
Final Exam	30%	Friday, December 13	In class

Exams

The exams will be closed book, with no calculators permitted.

Post-class Quizzes

This task consists of reading a short reading assignment about the topics covered in class, followed by a short pre-class quiz (one question) administered electronically. You may also want to review the lecture notes that will be posted in the appropriate folders for your section on Canvas.

WebWork Homework

There will be four online homework assignments using the WebWork system. This is free of charge, and is a great method of practicing the concepts introduced in the reading, lectures, and ALAs because it gives you instant feedback on how you are doing. Please make sure to only access the WebWork through the Canvas page when the assignments are posted, this will ensure that you get registered properly. No late WebWork assignments will be accepted unless there are dire circumstances, so you are encouraged to submit what you have before the deadlines. The due dates for the WebWork assignments will be November 01, November 08, 22, and December 06.

Written Homework

There will also be written homework assignments that will be assigned and collected via Canvas. It is your responsibility to submit these assignments on Canvas by the time they are due. The only proper submission format is a scanned pdf or Microsoft Word document. Do not submit a collection of individual image files. Late submissions will be penalized 10 percent per twenty-four hours. The due dates for the written assignments will be October 29, November 12, 19, and December 03.

Accessibility Services

The University is committed to providing students with documented accommodations equal access to all university programs and facilities. If you require academic accommodations, you must register with The Office of Accessibility Services (OAS). If you are registered with OAS, and qualify for accommodations that you would like to utilize in this course, please request those accommodations through OAS in a timely manner. For information, please contact the director of OAS at WPI.

Grades

Scores from 90 to 100 corresponds to the A range. A score greater than 80 earns at least a B and above 70 is at least a C. Scaling can occur depending on the difficulty of exams. A passing grade (C) will scale no lower than a 65.

Assignments

- Students are expected to work independently. Offering and accepting solutions from others is an act of plagiarism, which is a serious offense and all involved parties will be penalized according to the Academic Honesty Policy.
- Discussion among students is encouraged, but when in doubt, direct your questions to the professor or teaching assistant.

Attendance and Absences

- Students are responsible for all missed work, regardless of the reason for absence. It is also the absentee's responsibility to get all missing notes or materials.

Academic Honesty Policy Summary

Introduction

In addition to skills and knowledge, The University aims to teach students appropriate Ethical and Professional Standards of Conduct. The Academic Honesty Policy exists to inform students and Faculty of their obligations in upholding the highest standards of professional and ethical integrity. All student work is subject to the Academic Honesty Policy. Professional and Academic practice provides guidance about how to properly cite, reference, and attribute the intellectual property of others. Any attempt to deceive a faculty member or to help another student to do so will be considered a violation of this standard.

Instructor's Intended Purpose

The student's work must match the instructor's intended purpose for an assignment. While the instructor will establish the intent of an assignment, each student must clarify outstanding questions of that intent for a given assignment.

Unauthorized/Excessive Assistance

The student may not give or get any unauthorized or excessive assistance in the preparation of any work.

Authorship

The student must clearly establish authorship of a work. Referenced work must be clearly documented, cited, and attributed, regardless of media or distribution. Even in the case of work licensed as public domain or Copyleft, the student must provide attribution of that work in order to uphold the standards of intent and authorship.

Online submission of, or placing one's name on an exam, assignment, or any course document is a statement of academic honor that the student has not received or given inappropriate assistance in completing it and that the student has complied with the Academic Honesty Policy in that work.

Consequences

An instructor may impose a sanction on the student that varies depending upon the instructor's evaluation of the nature and gravity of the offense. Possible sanctions include but are not limited to, the following:

1. Require the student to redo the assignment;
2. Require the student to complete another assignment;
3. Assign a grade of zero to the assignment;
4. Assign a final grade of "NR" for the course.

A student may appeal these decisions according to the Academic Grievance Procedure. (See the relevant section in the Student Handbook.) Multiple violations of this policy will result in a referral to the Conduct Review Board for possible additional sanctions.

Data for Research Disclosure

Any and all results of in-class and out-of-class assignments and examinations are data sources for research and may be used in published research. All such use will always be anonymous. The full text of the Academic Honesty Policy is in the Student Handbook.

Tentative Class Plan

Below is the plan for how topics will be covered throughout the term. The videos will be posted on a weekly basis. It is open to change as circumstances arise. In the event that such changes occur, you will be promptly informed.

Week 1 Starting October 21

- Introduction
- Classifications of ODEs
- Initial Value Problem
- Further Examples of ODEs
- Integrating Factors

Week 2 Starting October 28

- Separation of Variables
- Growth and Decay Models
- Newton's Law of Cooling
- Mixing Problems

Week 3 Starting November 4

- Qualitative Methods
- Introduction to Systems of ODEs
- Second-order ODEs, Wronskian
- Reduction of Order

Week 4 Starting November 11

- Constant Coefficients
- Nonhomogeneous Problems
- Review for Midterm Exam on November 14
- Midterm Exam on Friday November 15

Week 5 Starting November 18

- Undetermined Coefficients
- Variation of Parameters (optional)
- Spring-Mass Systems

Week 6 Starting November 25

- Electrical Circuits
- Laplace Transform 1

Week 7 Starting December 02

- Laplace Transform 2
- Inverse Laplace Transform
- Non-standard Forcing Functions

Week 8 Starting December 09

- Bifurcations of Differential Equations (optional)
- Review for Final Exam on December 12
- Final Exam on Friday the 13th