Syllabus
Math 23 Differential Equations - Sec 01 (Spring 2025)

1 General Information

Instructor: Yanbing Gu
Class: MWF 10:10 - 11:15 AM, Kemeny 004
X-hour: Th 12:15 - 1:05 PM, Kemeny 004
Contact: yanbing.gu.gr@dartmouth.edu
Office Hours: MW 11:30 AM - 12:30 PM, Th 1:30 - 2:30 PM, or by appointment, Kemeny 245
TA: Friedrich Bauermeister, Rohan Kapoor
Tutorial Times: MTTh 7 - 9 PM, Kemeny 004

2 Lectures

All lectures will be held in person. Please see Lecture Plan at the end for detailed information.

3 Textbooks

- **Primary Reference**: Elementary Differential Equations and Boundary Value Problems (11th Edition) by Boyce & DiPrima, Wiley 2017. It is fine to use the 9th, 10th, or 12th Edition, the problems may differ at the end of each section, but the contents are primarily the same.
- **Additional Reference**: Differential Equations with Applications and Historical Notes (3rd Edition) by Simmons, CRC Press 2016.

4 Grading

The course grade will be based on

- **Weekly Homework**: 20%
- **Midterm 1**: 25%
- **Midterm 2**: 25%
- **Final Exam**: 30%

5 Exams

- **Midterm 1**: Time TBA, location TBA
- **Midterm 2**: Time TBA, location TBA
- **Final Exam (cumulative)**: Saturday. June 7th, 11:30 AM - 2:30 PM, location TBA

Some old exams given in previous terms will be provided as practice problems. Please do not draw any conclusions about the topics, problem structure, or level of difficulty in our exams from these problems. Working on the problems at the end of each section of Boyce & Diprima and carefully reviewing your class notes is a great way to prepare for exams.

6 Homework

Written homework is assigned weekly and posted on the Assignments page, it is due **each Wednesday at 11:59 PM EDT**. No late homework will be accepted.

Collaboration on homework is permitted and encouraged but if you work together to solve problems, each person must write an individual submission for the homework, Please acknowledge any collaborative work at the start of each homework.

You must submit your homework through Gradescope:

- Gradescope can be accessed from the Canvas course page or at www.gradescope.com/courses/1007454
- Try to upload your file as a single pdf file if possible (if not, multiple image files are also accepted).
- Clarity and neatness are vital workplace skills, so it is important that your problems are clearly numbered and we can recognize which part of work corresponds to which problem. The simplest way to ensure this is by doing each problem on a separate page and uploading them individually; however, you can also choose to write your solutions to multiple problems on a single page, as long as they are clearly labelled by the problem number.
- After uploading your file to Gradescope, please remember to associate each problem in the homework to the corresponding page(s) on which it occurs, in the file that you uploaded. **You will automatically lose 25% of the total points for any homework where you fail to associate the corresponding page(S) in the file you uploaded to the respective problem(s) in the homework.**
- Check that your uploaded file opens correctly. If it doesn't open for you, it won't open when it is being graded.
- A guide on how to submit assignments on Gradescope can be found at help.gradescope.com/article/ccbpppziu9-student-submit-work

- More general questions regarding using Gradescope can be located through Gradescope Help Center at help.gradescope.com/
- If you experience technical difficulties in uploading your homework to Gradescope and are still having problems after repeated attempts, contact your instructor before the homework is due and include the file you are trying to submit in your email.
- If there are any other outstanding circumstances, contact your instructor as soon as possible to find a way to resolve the issue.

7 Honor Principle

We will strictly enforce Dartmouth's Academic Honor Principle.

On homework: Collaboration is permitted and encouraged, but it is a violation of the Academic Honor Principle for someone to provide the answers for you. If you are part of a group of students that produces an answer to a problem, you cannot then simply copy that group answer. You must write up the answer individually, in your own words.

On exams: You may not give or receive help from anyone. Exams in this course are closed book, and no notes, calculators or other electronic devices are permitted.

8 ORC Course Description

This course is a survey of important types of differential equations, both linear and non-linear. Topics include the study of systems of ordinary differential equations using eigenvectors and eigenvalues, numerical solutions of first and second order equations and of systems, and the solution of elementary partial differential equations using Fourier series.

9 Prerequisite

MATH 13 Calculus of Vector-valued Functions

10 Accessibility Accommodations

tudents with learning, physical, or psychiatric disabilities enrolled in this course that may need disability-related classroom accommodations are encouraged to come speak with your instructor before the end of the second week of the term. All discussions will remain confidential, although the Student Accessibility Services office may be consulted to discuss appropriate implementation of any accommodation requested. At such a meeting please provide your instructor with a copy of a disability registration form, which lists the accommodations recommended for the student by the Student Accessibility Services within the Academic Skills Center. The person you might want to

contact at the Academic Skills center is Ward Newmeyer, Director of Student Accessibility Services, 205 Collis Center - (603) 646-9900.

11 Student Religious Observances

Some students may wish to take part in religious observances that fall during this term. Should you have a religious observance that conflicts with your participation in the course or any exam, please come speak with your instructor before the end of the second week of the term to discuss appropriate accommodations.

12 Title IX

At Dartmouth, we value integrity, responsibility, and respect for the rights and interests of others, all central to our Principles of Community. We are dedicated to establishing and maintaining a safe and inclusive campus where all have equal access to the educational and employment opportunities Dartmouth offers. We strive to promote an environment of sexual respect, safety, and well-being. In its policies and standards, Dartmouth demonstrates unequivocally that sexual assault, gender-based harassment, domestic violence, dating violence, and stalking are not tolerated in our community.
The Sexual Respect Website (`https://sexual-respect.dartmouth.edu`) at Dartmouth provides a wealth of information on your rights with regard to sexual respect and resources that are available to all in our community.
Please note that, as a faculty member, I am obligated to share disclosures regarding conduct under Title IX with Dartmouth's Title IX Coordinator. Confidential resources are also available, and include licensed medical or counseling professionals (e.g., a licensed psychologist), staff members of organizations recognized as rape crisis centers under state law (such as WISE), and ordained clergy (see `https://dartgo.org/titleix_resources`).
Should you have any questions, please feel free to contact Dartmouth's Title IX Coordinator. Their contact information can be found on the sexual respect website at: `https://sexual-respect.dartmouth.edu`.

13 Tentative Lecture Plan

The following is a tentative plan for the lectures in this course. This page may be updated during the term. Please refer to the Canvas course page for up-to-date homework assignments and new files.

Sections and homework problems are from Boyce & DiPrima, 11th Edition.

Week	Lecture	Sections	Brief Description	Homework Problems
1	Mar 31	1.1, 1.2	Introduction to differential equations; direction fields; solutions to some differential equations	1.1: 1, 5, 11 1.2: 1, 7
1	Apr 2	1.2, 1.3	Solutions to some differential equations; classification of differential equations	1.3: 11, 14 **HW 1 Due Apr 9**
1	Apr 4	2.1, 2.2	Linear first order differential equations; integrating factors; separable equations	2.1: 15, 17, 27 2.2: 4, 8
2	Apr 7	2.4	Existence and uniqueness theorems	2.4: 3, 8, 24, 27
2	Apr 9	2.3	Modeling with differential equations	2.3: 2, 4 **HW 2 Due Apr 16**
2	Apr 11	2.5	Autonomous equations and population dynamics	2.5: 14
3	Apr 14	2.6	Exact equations and integrating factors	2.6: 2, 19, 22
3	Apr 16	3.1, 3.2	Second order constant coefficient equations with distinct roots; the Wronskian	3.1: 1, 11, 18 3.2: 8, 15, 17, 21 **HW 3 Due Apr 23**
3	Apr 18	3.3	Characteristic equations and Complex conjugate roots	3.3: 4, 8, 14
4	Apr 21	3.4	Repeated roots and reduction of order	3.4: 1, 9, 19
4	Apr 23	3.5, 3.6	Nonhomogeneous equations and method of undetermined coefficients	3.5: 1, 2, 11 **HW 4 Due Apr 30**
4	Apr 25	3.6	Variation of parameters	3.6: 9, 12
5	Apr 28	7.1, 7,2	Review of matrices	7.1: 1, 5 7.2: 2, 12, 15
5	Apr 30	7.3, 7.4	Systems of ODEs; Existence and uniqueness of solutions of systems of ODEs	7.3: 3, 8, 19 7.4: 1, 11 **HW 5 Due May 7**
5	May 2	7.5	Constant coefficient systems with distinct real eigenvalues	7.5: 6, 10, 12
6	May 5	7.6	Constant coefficient systems with complex conjugate eigenvalues	7.6: 7, 11
6	May 7	7.7	Fundamental solutions	7.7: 4, 9, 13 **HW 6 Due May 14**

Week	Lecture	Sections	Brief Description	Homework Problems
6	May 9	7.8	Repeated eigenvalues	7.8: 2, 5, 8
7	May 12	7.9	Nonhomogeneous linear systems	7.9: 2, 3, 7, 10
7	May 14	9.1	The phase plane	9.1: 11, 17 **HW 7 Due May 21**
7	May 16	9.2	Autonomous systems and stability	9.2: 3, 5, 19
8	May 19	9.3	Locally linear systems	9.3: 3, 7, 24
8	May 21	9.4	Competing species	9.4: 2, 6 **HW 8 Due May 28**
8	May 23	9.5	Predator-prey equations	9.5: 4, 12
9	May 26		Memorial Day	
9	May 28	6.1, 6.2	Laplace transform and the IVP	6.1: 2, 11, 18 6.2: 12, 18, 21, 24
9	May 30	6.3	Step functions	6.3: 12, 14
10	Jun 2	6.4, 6.5	Discontinuous forcing functions; impulse functions	6.4: 5 6.5: 6, 10
10	Jun 4	6.6	The convolution integral	6.6: 1, 13, 16