# Syllabus

Math 23 Differential Equations (Winter 2023) Section 01

Instructor : Dimitris Giannakis

Class: Tu, Th 4:30 - 6:20 PM (Location: TBD)

X-hour: F 4:35 - 5:25 PM (will be announced in advance when there is a class during X-hour)

Contact: dimitrios.giannakis@dartmouth.edu

Office hours: Kemeny 337: W: 4:45 - 5:45 PM (by appointment)

TA: (TBD)

## General Information

**Please see Lecture Plan for detailed information.**

**Lectures**
All lectures will be held in person.

**Office hour**
Office hours will be held in person or via Zoom by appointment.

**Math 23 tutorial sessions**

(TBD)

## Grading

The course grade will be based on weekly homework (total 120 points), exam 1 (100 points), exam 2 (120 points), exam 3 (160 points). Total points possible: 500.

Violations of the Academic Honor Principle will be referred to the Committee on Standards. In particular, please be aware of rules regarding plagiarism and collusion.

**Exams: 380 points**

- Exam 1: 100 points, Wednesday, January 27, 4:30 – 6:30 pm
- Exam 2: 120 points, Friday, February 17, 4:30 – 6:30 pm
- Exam 3 (cumulative final): 160 points, Wednesday, March 13, 3 – 6 pm

There are some old past exams given in previous terms. Please note that these are only meant to be used as practice problems. You should not draw any conclusions about the topics, problem structure, or level of difficulty from them. Working on the problems at the end of each section and carefully reviewing your class notes is a great way to prepare for exams.

**Homework: 120 points**
Homework reinforces concepts and skills while challenging students to extend what they have learned to other types of problems. Because it is important for students to have this experience, instructors will not solve assigned homework problems during office hours before the due date. We will of course answer questions you may have in approaching problems that give you difficulty. It is therefore essential to begin homework sets early so that you may get help if difficulties do arise.

Written homework is assigned weekly and posted on the homework page. It is due each Tuesday before 11:00 PM Eastern time. As all homework is posted well in advance, no late homework will be accepted.

**Homework grading policy:** The goal of homework is to learn to work through problems. Therefore, each problem set will be assigned a grade on a 15-point scale as submitted through Gradescope.

## Honor Principle

We will strictly enforce Dartmouth's Academic Honor Principle.

On Exams: Giving and/or receiving assistance during an examination violates the Academic Honor Principle.

On Homework: Collaboration is both permitted and encouraged, but it is a violation of the honor code for someone to provide the answers for you.

## Textbook

Elementary Differential Equations and Boundary Value Problems (11th Edition) by Boyce & DiPrima, Wiley 2017. It is fine to use the $9^{th}$, $10^{th}$, or $12^{th}$ edition. The problems may differ at the end of each section, but the content is primarily the same. You may find online versions of some older editions.

## ORC Course description

This course is a survey of important types of differential equations, both linear and nonlinear. 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.

## Prerequisite:

Mathematics 13 (Calculus of Vector-valued Functions)

## Disabilities

Students with learning, physical, or psychiatric disabilities enrolled in this course that may need disability-related classroom accommodations are encouraged to make an office appointment to see their 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 the 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 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.

## Student Religious Observances

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

## Tentative Lecture Plan

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

| Lectures | Sections | Description | Tentative homework |
|---|---|---|---|
| Week 1<br>Th Jan 5 | 1.1, 1.2, 1.3 | Introduction to differential equations; classification of ODEs | 1.1: #5, 6, 8, 18, 20<br>1.2: #5, 10 (Hint: do (b) first), 11 |
| Week 2<br>T Jan 10 | 2.1, 2.2 | Integrating factors; separable equations | 2.1: #9, 12, 20, 23<br>2.2: #6,15, 20 |
| Week 2<br>Th Jan 12 | 2.3, 2.4 | Modeling with differential equations; existence-uniqueness theorems | 2.3: #2, 6 (Hint: solve 6(c) numerically), 11<br>2.4: #8, 10, 18, 21, 24, 27 |
| Week 3<br>T Jan 17 | 2.5, 2.6 | Autonomous equations; exact equations | 2.5: #3, 8, 15<br>2.6: #2, 10, 12 |
| Week 3<br>Th Jan 19 | 3.1, 3.2 | Second-order constant coefficient equations with distinct roots; the Wronskian | 3.1: #11, 16, 17, 20<br>3.2: #8, 15, 17,21, 27 |
| Week 4<br>T Jan 24 | 3.3, 3.4 | Complex conjugate roots; repeated roots and reduction of order | 3.3: #4, 8, 14, 26<br>3.4: #5, 9, 22 |
| Week 5<br>Th Jan 26 | 3.5, 3.6 | Inhomogeneous equations; method of underdetermined coefficients and variation of parameters | 3.5: #7, 10, 11, 22<br>3.6: #9, 12 |
| Week 5<br>F Jan 27 | Midterm exam 1 | Material through 3.3 | |
| Week 6<br>T Jan 31 | 7.1, 7.2, 7.3 | Review of matrices; systems of ODEs | 7.1: #6,12<br>7.2: #2, 12, 16<br>7.3: #9, 19 |
| Week 6<br>Th Feb 2 | 7.4, 7.5, | Existence and uniqueness of solutions of systems of ODEs; systems with distinct real eigenvalues | 7.4: #8 (only (a,b,c)), 11, 12(only (a,b))<br>7.5: #6, 12, 18, 21 |
| Week 7<br>T Feb 7 | 7.6; 7.7, | Systems with complex eigenvalues; fundamental solutions | 7.6: #8, 9, 23<br>7.7: (TBD) |
| Week 7<br>Th Feb 9 | 7.8, 7.9 | Systems with repeated eigenvalues; inhomogeneous linear systems | 7.8: #8, 13, 17 (only (a,b,c,d))<br>7.9: # 2, 3, 7, 10 (only verify the general solution of the |

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| | | | corresponding homogeneous part) |
| Week 8<br>T Feb 14 | 9.1, 9.2 | The phase plane; autonomous systems and stability | 9.1: #15, 17, 18<br>9.2: #3, 7 (only (a,b,c)), 19 |
| Week 8<br>Th Feb 16 | 9.3 | Locally linear systems | 9.3: #3, 7, 17, 24 |
| Week 8<br>W Feb 17 | Midterm exam 2 | Material from 3.4 through 7.9 | Review |
| Week 9<br>T Feb 21 | 9.4, 9.5 | Competing species; predator-prey equations | 9.4: #3, 6<br>9.5: #4, 12 |
| Week 9<br>Th Feb 23 | 6.1, 6.2 | Laplace transform and the IVP | 6.1: #2, 11, 18<br>6.2: #12, 18, 21, 24 |
| Week 10<br>T Feb 28 | 6.3 | Step functions | 6.3: #12, 14, 17 |
| Week 10<br>Th Mar 2 | 6.4, 6.5 | Discontinuous forcing functions, impulse functions | 6.4: #5, 12<br>6.5: #6, 10, 14 |
| Week 11<br>T Mar 7 | 6.6 | The convolution integral | 6.6: #1, 2, 13, 16 |
| Wednesday<br>March 13 | Final exam (3-6pm) | Exam covers material from the whole course | |