ORDINARY DIFFERENTIAL EQUATIONS (MATH 2030)

Section 2: Tuesdays and Thursdays 10:10am—11:25am

Columbia University, Spring 2021

BASIC INFORMATION

Lectures: Tuesdays and Thursdays 10:10am—11:25am by zoom

Course website: https://www.math.columbia.edu/~doan/ode.html

Instructor: Aleksander Doan (aleksander.doan@columbia.edu)

Office hours: Tuesdays and Thursdays 9:00am—10:00am by zoom

Teaching Assistants:

- Ioana Lia (il2332@columbia.edu)

- Chuwen Wang (wang.chuwen@columbia.edu)

Help room:
https://www.math.columbia.edu/general-information/help-rooms/

COURSE DESCRIPTION

Introduction to ordinary differential equations, including: various techniques of solving explicitly special types of first- and second-order equations, basic existence and uniqueness theory (without proofs), introduction to linear algebra and linear differential equations, examples of non-linear equations, elements of qualitative analysis and stability. The course will focus on real-life examples and applications in science and engineering.

PREREQUISITES

Calculus I and II are required; we will assume the ability to compute derivatives and integrals of functions involving trigonometric functions, the exponential function, logarithm, etc. Some knowledge of complex numbers and linear algebra will be helpful but is not required, as the course will include a brief overview of linear algebra. If you have a question regarding prerequisites, please don't hesitate to contact the instructor.

The main textbook for this class is *Elementary Differential Equations and Boundary Value Problems, 10th Edition* by Boyce and DiPrima. For some topics we will use also *Differential Equations and Their Applications: An Introduction to Applied Mathematics, 3rd Edition* by Braun. It is recommended but not required to have these books. Please note that an electronic version of Braun's book is available through Columbia University Libraries: https://clio.columbia.edu/catalog/11304604

LIST OF TOPICS

Please keep in mind that this list of topics may change in the course of the semester. The numbers in the bracket indicate the corresponding sections in the textbooks of Boyce–DiPrima (BD) and Braun (Br).

1. What is a differential equation? Historical remarks, motivation and examples from physics, biology, and social sciences (BD 1.1–1.4, Br 1.1,1.3,1.5–1.8)

2. First order linear differential equations (BD 2.1,2.4, Br 1.2)

3. Separable and exact equations (BD 2.2,2.6, Br 1.4,1.9)

4. Autonomous equations, equilibria, geometric methods (BD 2.5)

5. Discussion of existence and uniqueness theorems (BD 2.8, Br 1.10)

6. Second order linear equations; review of complex numbers (BD 3.1–3.6, Br 2.1–2.5)

7. Higher order equations and systems of equations (BD 4.1–4.2, Br 2.15)

8. Review of linear algebra (BD 7.2–7.3, Br 3.1–3.3,3.5.3.7)

9. Systems of first order linear equations (BD 7.4–7.9, Br 3.4,3.6,3.8–3.12)

10. Geometric interpretation of differential equations; phase space; vector fields (BD 9.1, Br 4.1–4.4)

11. Non-linear equations; introduction to stability and chaos (BD 9.2–9.8, Br 4.6–4.9)

GRADING SCHEME

The final grade will take into account the homework (15%), two midterms (25% each), and the final exam (35%).

DATES OF EXAMS

- Midterm 1: Thursday, February 11th (during class)

- Midterm 2: Thursday, March 18th (during class)

- Final exam: https://ssol.columbia.edu/

HOMEWORK

There will be one set of homework problems every week. Solutions must be uploaded to gradescope as a .pdf file by Thursday midnight every week. No late homework will be accepted. However, we will drop the lowest two homework grades.

It is very important to do all of the problem sets to the best of your ability, as this is the most effective way to absorb the material. The midterm and final problems will be similar to the homework problems.

You are welcome and encouraged to discuss homework problems with your peers. However, you must write your solutions individually and, if you worked on some of them with other students, please mention this in your solutions and write the names of the students that you collaborated with.

ACADEMIC INTEGRITY

It is your responsibility to understand what constitutes academic dishonesty and how disciplinary processes for violations of academic integrity are handled. For more details please visit:

http://www.college.columbia.edu/academics/academicintegrity

STUDENTS WITH DISABILITIES

In order to receive disability-related academic accommodations, students must first be registered with Disability Services (DS) . More information on the DS registration process is available online at

www.health.columbia.edu/ods

Faculty must be notified of registered students' accommodations before exam or other accommodations will be provided. Students who have, or think they may have, a disability are invited to contact Disability Services for a confidential discussion at (212) 854-2388 (Voice/TTY) or by email at disability@columbia.edu.