# MATH 316/257: Differential Equations II

Instructor: Shamil Asgarli

Summer 2020, Term 1: May 11-June 18, 2020

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Office Hours: TBD
Class Hours: Mon/Wed 10:30am-12:30pm
Class Hours: Tues/Thurs 12:30pm-14:00pm

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## Canvas Page

All the course information, course announcements and course materials will be posted on the Canvas page. Students are also recommended to contact me using the Canvas inbox.

## Course Description

This is a second course on differential equations (PDE), with the main emphasis on partial differential equations. Students have already learned how to solve constant coefficient linear ordinary differential equations (ODE) in a previous course, which we will review in the beginning. The first topic of the course will be explaining series solution to *variable coefficient* ODEs. The rest of the course will be devoted to studying PDEs. We will explain numerical aspects of the theory, and then learn about Fourier series. We will analyze three famous PDEs: the heat equation, Laplace's equation and the wave equation. The course will end with a brief introduction to eigenfunctions and Sturm-Liouville theory.

## Textbooks?

There is **no** required textbook for the course. I will post my lecture notes on Canvas. The notes will be primarily based on the following comprehensive notes by Professor Anthony Peirce:

- https://www.math.ubc.ca/∼peirce/

You may also consider reading the following freely available textbook:

- Notes on Diffy Qs by Lebl

Finally, any edition of the following textbook,

- *Elementary Differential Equations and Boundary Value Problems* by W.E. Boyce & R.C. DiPrima

can serve as an **optional** textbook for the course (if you want more practice).

## Schedule of Topics

We will cover the following topics. The reference in the parentheses indicates the relevant chapters in the textbook by Boyce & DiPrima (2012 edition).

1. Review of techniques to solve ODEs
2. Series solutions of variable coefficient ODEs (Chapter 5)
    (a) Series solutions at ordinary points (5.1-5.3)
    (b) Regular singular points (5.4-5.7, 5.8 briefly).
3. Introduction to Partial differential equations (Chapter 10)
    (a) The heat equation (10.5), the wave equation (10.7) and Laplace's equation (10.8)
4. Introduction to numerical methods for PDEs using Matlab
    (a) First and second derivate approximations using finite differences
    (b) Finite difference approximation of Laplace's equation - iterative methods
    (c) Explicit finite difference schemes for the heat equation
    (d) Explicit finite difference schemes for the wave equation
5. Fourier Series and Separation of Variables (Chapter 10)
    (a) The heat equation and Fourier Series (10.1-10.6)
    (b) The wave equation (10.7)
    (c) Laplace's equation (10.8)
6. Boundary Value Problems and Sturm-Liouville Theory (Chapter 11)
    (a) Eigenfunctions and eigenvalues (11.1)
    (b) Sturm-Liouville boundary value problems (11.2)
    (c) Non-homogeneous boundary value problems (11.3)

## Course Structure

### Lectures

Participation in class (through Zoom) is highly recommended. While no formal attendance will be taken, you are strongly encouraged to attend every lecture.

### Homework and Exams

There will be weekly homework and 5 in-class tests with dates that will be released on Canvas page. There will be a test each week. There will not be a midterm or a final exam for the course.

**Important information about the exams**

**The weekly tests will be invigilated via Zoom and it is absolutely necessary for every student to have a webcam**. If a student does not have a webcam in their computer, they will not be able to complete the course.

### Grading Scheme

Your final grade will count the assessments using the following proportions:

- **20%** of your grade will be determined by homework.
- **80%** of your grade will be determined by in-class tests.

There will be 5 homework sets, and I will drop the lowest homework grade, so each homework set will account for 5%. Similarly, there will be 5 in-class tests, and I will drop the lowest test grade, so each test will account for 20% of your grade. Given the changing circumstances around the world (COVID-19), the instructor reserves the right to change the grading scheme and the nature of the assessments at any point during the semester.

## UBC's policies and resources to support student success

UBC provides resources to support student learning and to maintain healthy lifestyles but recognizes that sometimes crises arise and so there are additional resources to access including those for survivors of sexual violence. UBC values respect for the person and ideas of all members of the academic community. Harassment and discrimination are not tolerated nor is suppression of academic freedom. UBC provides appropriate accommodation for students with disabilities and for religious and cultural observances. UBC values academic honesty and students are expected to acknowledge the ideas generated by others and to uphold the highest academic standards in all of their actions. Details of the policies and how to access support are available below:

https://senate.ubc.ca/policies-resources-support-student-success