MATHEMATICS 257/316 - Section 201

Partial Differential Equations

January-April 2025 (2024-2025 WT2)

Acknowledgement

UBC's Point Grey Campus is located on the traditional, ancestral, and unceded territory of the xʷməθkʷəy̓əm (Musqueam) people. The land it is situated on has always been a place of learning for the Musqueam people, who for millennia have passed on in their culture, history, and traditions from one generation to the next.

Course information

All lectures will be in-person. During the lectures, we will discuss the concepts and theory behind each topic and go over plenty of examples. All class lecture notes will be posted on Canvas. Occasionally, we will use Matlab and/or Python to numerically solve the PDEs and also to plot and visualize the solutions. All Matlab codes will be posted on Canvas. Students who are not familiar with Matlab are expected to acquire a basic knowledge of Matlab during the term.

Instructor

- instructor = Cyrille Kenne
- email = send through Canvas.
- office hours = there will be weekly office hours - see the course webpage

Class time and location

- class time = MoTuFr 11:00 am-12:00 pm
- class location = LSK-Floor 2-Room 201
- First day of teaching: Monday January 06
- Last day of teaching: Monday April 07

Course webpage

- The course webpage is on Canvas

Prerequisites

- One of Math 215, 255, 256

Topics

The course will cover

- Ordinary differential equations (Revisit)
- Partial differential equations (PDEs): Heat, Wave, Laplace
- Numerical methods for PDEs
- Analytic methods to solve homogeneous boundary value problems (BVP)

Schedule (Chapters refer to the 2012 Edition of Boyce & DiPrima)

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 PDEs (Chapter 10): heat equation (10.5), wave equation (10.7), Laplace equation (10.8)
4. Introduction to numerical methods for PDEs
    a. First and second derivative approximations using finite differences - errors
    b. Explicit finite difference schemes for the heat equation - Stability and derivative boundary conditions
    c. Explicit finite difference schemes for the wave equation
    d. Finite difference approximation of Laplace Equation and iterative methods
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 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. Nonhomogeneous boundary value problems (11.3)

Text

There is no required textbook for this course, however class notes and all other course materials will be posted on Canvas

Some recommended texts are:

- Elementary Differential Equations and Boundary Value Problems' by Boyce & DiPrima, Any edition.
- Applied Partial Differential Equations with Fourier Series and Boundary Value Problems (4th Ed), R. Haberman, (Pearson), 2004.
- Partial Differential Equations for Scientists and Engineers (1st Ed), S. Farlow, (Dover), 1993.

Online resources:

- Professor Anthony Peirce's course material: https://www.math.ubc.ca/~peirce/
- Professor Richard Froese's lecture notes: http://www.math.ubc.ca/~rfroese/notes/Lecs316.pdf

Assessment

Breakdown of marks

- 10% Homework - one each week
- 40% Midterm
- 50% Exam - TBA.

Homework

See the course webpage for details

- I expect to give around 9 or 10 homework assignments.
- Homeworks will be posted on Mondays and due on Sundays at 11:59 pm (ie around 6 days later)
- I will not accept late homework.
- There will be no "make up" homeworks.
- Instead your homework score will be taken from the best 8 homework assignments.
- Note that if you miss a significant number of homework assignments due to valid reasons then part of the weight of the homework will be put onto the exam.

Presentation of homework

- Handwritten or messy homework will not be accepted.
- Homework must be typeset and submitted as a PDF through Canvas.
- I recommend that you use latex to prepare your homework
- I recommend using Overleaf (which you can do free of charge) or (if you feel up to the challenge) installing it on your own computer.
- You could also try typst, but I cannot offer tech support for it.

Midterms - February 14 and March 28

See the course webpage for details

- It will be held during regular class-time.
- It will be 50 minutes long (though this may be changed closer to the time).
- It will cover all topics done in class up until that point in the term unless otherwise specified.

Note - there is no "make up" midterm - if you miss the midterm due to valid reasons, the weight of the midterm is passed onto the exam.

Exam

See the course webpage for details

It will cover all topics done in class unless otherwise specified.

General syllabus information

- The Mathematics Department has standard syllabus information. This includes standardised policies for academic concessions (ie missed homework + midterm) academic integrity (ie cheating)
- registration issues (I have no control over anything to do with registration) misc student resources
- You can find that information here