MATH 257/316: Partial Differential Equations
Course Syllabus

University of British Columbia

Winter Term 1, 2024/2025

Course Information

Course Title:	Partial Differential Equations/Elementary Differential Equations II
Course Code:	Math 257/316
Credit Value:	3 Credits. Credit only given for one of Math 257, 316.
Prerequisites:	One of Math 215, 255, 256.

Contacts

Course Instructor(s):	Victor Juma
Contact Details:	`vjuma23@math.ubc.ca`
Office Location:	PIMS 4114 (and Zoom for office hours)
Office Hours:	Wednesdays 10.30-12 pm and Fridays 10.30-12 pm

Course Structure

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.

Schedule of Topics (2012 Edition of Boyce and Diprima)

Topics:	**Approx. Time**
1. Review of techniques to solve ODEs	1 hr
2. Series Solutions of variable coefficient ODEs (Chapter 5)	
a. Series solutions at ordinary points (5.1-5.3)	3 hrs
b. Regular singular points (5.4-5.7, 5.8 briefly)	4 hrs

3. Introduction to PDEs (Chapter 10): heat equation (10.5), wave equation (10.7), Laplace equation (10.8)	2 hrs
4. Introduction to numerical methods for PDEs using spreadsheets	3 hrs
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)	9 hrs
b. The wave equation (10.7)	3 hrs
c. Laplace equation (10.8)	5 hrs
6. Boundary Value Problems and Sturm-Liouville Theory (Chapter 11)	
a. Eigenfunctions and eigenvalues (11.1)	1 hr
b. Sturm-Liouville boundary value problems (11.2)	1 hr
c. Nonhomogeneous boundary value problems (11.3)	2 hrs
Mid term Tests	2 hrs
Total:	**36 hrs**

Learning Outcomes

This course introduces the heat, wave, and Laplace equations in different physical contexts. Students are taught to formulate and implement finite difference numerical solution schemes as well as analytic methods to solve homogeneous boundary value problems (BVP) via separation of variables and Fourier series and inhomogeneous BVP using eigenfunction expansions.

Learning Materials

- Class notes and all other course materials will be posted on Canvas.
- Any edition of *Elementary Differential Equations & Boundary Value Problems* by W.E. Boyce & R.C. DiPrima, (John Wiley & Sons) will serve as an optional text.
- Professor Anthony Peirce course materials: `https://www.math.ubc.ca/~peirce/`

Assessments of Learning

The final grades will be based on:

- Written homework assignments (10%)
- Two Midterm Exams (40%)
- One Final Exam (50%)

Course policies on assignments and exams:

- There are no make-up exams or assignments in this course. The lowest mark of the written homework will be dropped. If you miss any of the midterm exams for a valid reason, the weight of that assessment will be transferred to the final exam. Any student who misses an assessment must present within 72 hours the completed Department of Mathematics self-declaration form (available on Canvas).
- Homework assignments will typically be assigned weekly. There will be 9-10 written homework assignments in total (depending on our progress in the term). Written work should be scanned and uploaded in a pdf format on Canvas by 11:59 pm on the due date. Missing a homework assignment normally results in a mark of zero.

Midterm dates:

- Midterm 1: OCTOBER 11, 2024
- Midterm 2: NOVEMBER 8, 2024

Final date: TBA

University Policies

UBC provides resources to support student learning and maintain healthy lifestyles, but recognizes that sometimes crises arise, and so there are additional resources to access, including those for survivors of sexual violence. The University of British Columbia values the 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 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 policies and how to access support are available on the UBC Senate website.

Learning Analytics

This course will be using the following learning technologies: Canvas, Piazza.

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