

Elementary Differential Equations II

UBCV MATH 257/316 (3 credits)

Power series methods for ordinary differential equations. Introduction to partial differential equations: boundary value problems for the heat, wave, and potential equations; separation of variables, Fourier series, and other orthogonal series.

Prerequisites

Basics of linear algebra (orthogonality, eigenvalues, eigenvectors, etc.) and linear ordinary differential equations (general solutions, initial-value problems, non-homogeneous equations, etc.). Students must have completed one of MATH 215, MATH 255, MATH 256, MATH 258.

Instructors

Name	Email	Office Location	Office Hours
Philip D Loewen (Section 101)	loew@math.ubc.ca	Math 207	TBA
Juncheng Wei (Section 102)	jcwei@math.ubc.ca	LSK 303B	TBA

Delivery Format

This is a traditional lecture-based course, with weekly assignments submitted on paper. Plenty of supporting materials will be made available online through the course's Canvas site, but these will not include daily transcripts or lecture notes. Students are encouraged to attend class in person.

Course Web Page

Bookmark this, and visit often: <https://canvas.ubc.ca/courses/75089>.

Textbook

William F. Trench, *Elementary Differential Equations with Boundary Value Problems*, free online at <https://math.libretexts.org/@go/page/9389>. We will concentrate on Chapters 7, 11, 12, 13.

Supplementary and Alternative Resources

The following standard text addresses the key topics to be covered; any recent edition will serve:

William E. Boyce, Richard C. DiPrima, (and recently Douglas B. Meade), *Elementary Differential Equations and Boundary Value Problems*, Wiley.

UBC Professor Richard G. Froese has also released an excellent set of Lecture Notes for MATH 257/316.

Topic Outline

Topic	Text Sections	Hours (approx)
Elementary ODE's		2
Review	2.1, 2.6, 5.1–5.5	
Euler type	7.5	
Power Series Solutions for ODE's		5
Polynomial and formal series solutions	7.1	
Review of series	7.2	
Ordinary points	7.3–7.4	
Regular singular points	7.5–7.8	
Numerical Methods for the Heat and Wave Equations in 1D		2
Forward-difference in time, centred-difference in space	(notes)	
Fourier Series		5
Linear Algebra Review	11.1	
Eigenvalues and eigenfunctions for $L[y] = -y''$ with simple BC's	11.2	
Orthogonality and eigenfunction series	11.2	
Convergence of eigenfunction series	11.2	
Eigenfunction series solutions for nonhomogeneous ODE's	11.2	
Separation of Variables in PDE's		6
Eigenfunction series solutions	11.2	
Nonhomogeneous PDE's		
Nonhomogeneous BC's		
The Heat Equation		3
Derivation, interpretations	12.1	
The Wave Equation		3
Derivation	12.2	
Travelling waves and D'Alambert's Solution	12.2	
Laplace's Equation		3
Rectangular domains	12.3	
Numerical methods	(notes)	
Disk, annulus, and wedge domains	12.4	
Sturm-Liouville Extensions		5
Eigenvalue Problems	13.1	
PDE applications	13.2	

Assessment

Description	Value
Weekly Homework (due Fridays; WeBWorK + paper)	10%
Midterm 1 (in class Fri 08 Oct 2021)	20%
Midterm 2 (in class Fri 05 Nov 2021)	20%
Final Exam (sometime 11–22 Dec 2021)	50%
TOTAL	100%

The homework score is computed by averaging the best 9 marks earned; late submissions are not accepted.

There are no make-up quizzes or assignments in this course. If you miss any of the assessments for a valid reason, the weight of that assessment will be transferred to your final exam. Any student who misses an assessment must present to their instructor within 72 hours the completed Department of Mathematics self declaration form (available on the Canvas site).

Piazza for Discussion

We will use Piazza for class discussion. The system gives you access to the knowledge of classmates, TAs, and Instructors. Please post your questions there instead of emailing them to the teaching team. You can navigate to our discussion page through Canvas, or get started with this direct link: <https://piazza.com/ubc.ca/winterterm12021/math2573162021w>.

Academic Integrity

Everything you submit for assessment in this course must be your own work. On assignments, this means you personally did the thinking and made the calculations that you present. Collaboration and discussion is encouraged, but verbatim copying of another's work is forbidden. On tests and exams, you are to demonstrate what you can do individually. Collaboration and discussion are not permitted; copying the work of another student, relying on outside information, or deliberately exposing your work to the view of another student, are serious offences. To defend the integrity of all the grades in this course, the instructional team will watch closely for cheating and engage the University's full disciplinary apparatus if it is detected.

University Supports and Expectations

UBC provides resources to support student learning and to maintain healthy lifestyles. Sometimes crises arise and UBC has additional resources, 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 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 on the UBC Senate website.

Acknowledgement

UBC's Point Grey Campus is located on the traditional, ancestral, and unceded territory of the 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 their culture, history, and traditions from one generation to the next on this site.

Copyright

All the materials in this course (course handouts, lecture slides, assessments, readings, etc.) are the intellectual property of the Course Instructor or licensed to be used in this course by their copyright owner. Redistribution of these materials by any means without permission of the copyright holder(s) constitutes a breach of copyright and may lead to academic discipline.

Students are not permitted to record class sessions or office hours.

Last update: 2021-09-08