

MATH 4270 — Partial Differential Equations Fall 2023

Department of Mathematics and Statistics, University of Guelph

Web Site: University's CourseLink system, <http://www.courselink.uoguelph.ca/>.

Calendar Description

This course focuses on first and second-order partial differential equations, with examples and applications from selected fields such as physics, engineering and biology. Topics may include the wave equation, the heat equation, Laplace's equation, linearity and separation of variables, solution by Fourier series, Bessel, Legendre and Green's functions, an introduction to the method of characteristics and Fourier transforms. The classification of linear second-order partial differential equations is discussed.

Credit weight: 0.50

Prerequisites: MATH*3100

Objectives

To gain a solid understanding of introductory partial differential equations, including classification of pdes, types of solutions associated with this classification, and methods of solution for linear PDEs.

Resources

The following text is required and is available electronically through the library. It has been placed on electronic course reserve.

- *Applied Partial Differential Equations*, Third Edition. J. David Logan, 2015, Springer.

We will cover most of the material in the first four chapters of this text.

Topics

The numbers indicate relevant sections of the text book.

- **The Physical Origins of PDEs**
 - 1.1-1.2. Models and Conservation laws; flux; constitutive relations.
 - 1.2 and handout. First order PDEs and the method of characteristics.
 - 1.3-1.4. Diffusion
 - 1.5 (first part). String Vibrations,
 - 1.7. Heat Flow in 3D
 - 1.8. Laplace's Equation.
 - 1.9 and handout. Classification of PDEs, canonical forms.
- **PDEs on Unbounded Domains**
 - 2.1-2.2 Cauchy Problem for the Heat and Wave Equations.
 - 2.3 Well-Posed Problems.
 - 2.4 Semi-Infinite Domains.
 - 2.5 Sources and Duhamel's Principle.
 - 2.6 Laplace Transforms.
 - 2.7 Fourier Transforms.
- **Orthogonal Expansions**

- 3.1-3.2. Orthogonal Functions.
- 3.3. Classical Fourier Series.
- **PDEs on Bounded Domains**
 - 4.1. Separation of Variables.
 - 4.2. Sturm-Liouville Problems.
 - 4.3. Generalizations and Singular Problems.
 - 4.4. Laplace's Equation.
 - 4.5-4.6. Examples: Cooling of a sphere; Diffusion in a disk.
 - 4.7. Sources on Bounded Domains.

If time restricts, not all of the above topics will be covered.

Evaluation

There will be three assignments, a midterm test, and a final exam.

Assessment	date	weight
3 Assignments	Sep. 28, Oct. 19, Nov. 28	45%
Midterm Test	Nov. 9, in class.	25%
Final Exam	Friday Dec. 15 8:30-10:30am	30%

Collaboration and Use of Artificial Intelligence (AI)

For all of the assignments you are expected to hand in your own work. The only type of collaboration permissible is discussing with other members of the class or with the instructor how to approach a certain problem. This discussion should be high-level in nature. In particular:

1. You are *not* permitted to copy other people's material, whether that person is in the class or not.
2. You are *not* permitted to use AI in any manner to complete your assignments. This includes chatGPT and other AI chatbots.

University Policies

Illness

Medical notes will not normally be required for singular instances of academic consideration, although students may be required to provide supporting documentation for multiple missed assessments or when involving a large part of a course (e.g., final exam or major assignment).

COVID-19 Safety Protocols

For information on current safety protocols, follow these links:

- <https://news.uoguelph.ca/return-to-campus/how-u-of-g-is-preparing-for-your-safe-return/>
- <https://news.uoguelph.ca/return-to-campus/spaces/#ClassroomSpaces>

Please note, that these guidelines may be updated as required in response to evolving University, Public Health or government directives.

E-mail Communication

As per university regulations, all students are required to check their *uoguelph.ca* e-mail account regularly: e-mail is the official route of communication between the University and its students.

When You Cannot Meet a Course Requirement

When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons, please advise the course instructor (or designated person, such as a teaching assistant) in writing, with your name, id#, and e-mail contact. See the Undergraduate Calendar for information on regulations and procedures for [Academic Consideration](#).

Drop Date

Courses that are one semester long must be dropped by the end of the last day of classes; two-semester courses must be dropped by the last day of classes in the second semester. The regulations and procedures for [Dropping Courses](#) are available in the Undergraduate Calendar.

Copies of out-of-class assignments

Keep paper and/or other reliable back-up copies of all out-of-class assignments: you may be asked to resubmit work at any time.

Accessibility

The University promotes the full participation of students who experience disabilities in their academic programs. To that end, the provision of academic accommodation is a shared responsibility between the University and the student.

When accommodations are needed, the student is required to first register with Student Accessibility Services (SAS). Documentation to substantiate the existence of a disability is required, however, interim accommodations may be possible while that process is underway.

Accommodations are available for both permanent and temporary disabilities. It should be noted that common illnesses such as a cold or the flu do not constitute a disability.

Use of the SAS Exam Centre requires students to make a booking at least 14 days in advance, and no later than November 1 (fall), March 1 (winter) or July 1 (summer). Similarly, new or changed accommodations for online quizzes, tests and exams must be approved at least a week ahead of time.

More information: wellness.uoguelph.ca/accessibility/.

Academic Misconduct

The University of Guelph is committed to upholding the highest standards of academic integrity and it is the responsibility of all members of the University community - faculty, staff, and students - to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff and students have the responsibility of supporting an environment that discourages misconduct. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant

for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor.

The [Academic Misconduct Policy](#) is detailed in the Undergraduate Calendar.

Recording of Materials

Presentations which are made in relation to course work, including lectures, cannot be recorded in any electronic media without the permission of the presenter, whether the instructor, a student, or guest lecturer. When recordings are permitted they are solely for the use of the authorized student and may not be reproduced, or transmitted to others, without the express written consent of the presenter.

Resources

The [Academic Calendars](#) are the source of information about the University of Guelph's procedures, policies and regulations which apply to undergraduate, graduate and diploma programs.

Disclaimer

Please note that the ongoing COVID-19 pandemic may necessitate a revision of the format of course offerings, changes in classroom protocols, and academic schedules. Any such changes will be announced via Courselink and/or class email.

This includes on-campus scheduling during the semester, mid-terms and final examination schedules. All University-wide decisions will be posted on the COVID-19 website (<https://news.uoguelph.ca/2019-novel-coronavirus-information/>) and circulated by email.