

# Partial Differential Equations 1 – MATH 436 (CRN 50437)

University of Northern British Columbia

1:30 pm - 2:20 pm MW Geoffrey R Weller Library 5-313

Sep 08, 2021 - Dec 06, 2021

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## ESSENTIALS

INSTRUCTOR: Dr. Mohammad El Smaily (<https://smaily.opened.ca>)

EMAIL: [mohammad.elsmaily@unbc.ca](mailto:mohammad.elsmaily@unbc.ca)

TEL: 250-960-6624

OFFICE: T&L, 10-2044

OFFICE HOURS: by appointment

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## LECTURES:

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## COURSE DESCRIPTION:

This is an introductory course on partial differential equations (PDE). The main focus is on PDE models of first and second order equations arising from various disciplines. The course introduces analytic techniques related to three classical types of PDE: elliptic, parabolic and hyperbolic. Topics include: method of characteristics; Sobolev spaces; distributional derivatives; variational methods; maximum principle; Harnack inequalities; and qualitative properties of solutions to certain models.

**Cross List Courses:** MATH 636

**Prerequisites:** MATH 336 Minimum Grade of C<sup>-</sup> or ( MATH 302 Minimum Grade of C<sup>-</sup> and MATH 230 Minimum Grade of C<sup>-</sup> ).

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## TEXTBOOK:

I will be often referring to the following texts

- Jürgen Jost, Partial Differential Equations (Springer Graduate Texts in Mathematics, Third Edition).
- Sandro Salsa, PARTIAL DIFFERENTIAL EQUATIONS IN ACTION (From Modelling to Theory, Springer, DOI 10.1007/978-88-470-0752-9

**Other recommended texts:** Lawrence C. Evans, Partial Differential Equations: Second Edition, Graduate Studies in Mathematics–American Mathematical Society

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## COURSE WEB PAGES:

We will use Blackboard <https://learn.unbc.ca> to post all materials for this course and make announcements.

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## GRADING SCHEME:

Your Math 436 final grade is computed according to the following scheme:

Assignments: **35%**

Midterm Exam: **25%**

Final Exam: **40%**

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## ASSIGNMENTS:

Assignments will be given/posted on Blackboard and will be **handed in online–Blackboard**.

The due dates will be written on the assignments. Assignments must be handed in on time. Late assignments will only be accepted for medical or compassionate reasons.

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## MIDTERM EXAM:

There will be **one midterm exam** on **Friday November 5**. If you have an unavoidable conflict with a scheduled exam, it is your responsibility to inform me as soon as possible (preferably one week in advance); decisions in this regard will be made on a case-by-case basis.

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## FINAL EXAM:

The final exam will be held online (Blackboard). TBA by the Registrar's Office. Final exam will be **comprehensive and will include all the material covered in the course**.

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## IMPORTANT DATES:

Orientation Day Tues 7 September

First Day of Classes Wed 8 September

Midterm Exam: **Friday November 5**

Add/Drop Date: Wed 22 September

Withdrawal Date: Fri 29 October

Last Day of Classes: Mon 6 December Final Exam Period: Tues 7 December – Friday, December 17

## Holidays/closures during the term

National Day for Truth and Reconciliation Thursday, September 30

Thanksgiving Day: Monday, October 11

Remembrance Day: Thursday, November 11.

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## EXPECTATIONS:

- It is recommended that you devote at least 10 extra hours of personal work per week to this course. Solve all problems from the assigned homework and the suggested problems posted weekly on the Blackboard course webpage. Discussion with your classmates is encouraged. However keep in mind that on the exams you work independently.
- Do not let yourself fall behind on assignments. Do not postpone getting help until the last minute. The main help in this course is provided by the instructor during office hours.
- Attend all lectures and lab sessions. Please be considerate of your classmates; try not to be late for class and do not use cell phones or laptop computers during class.
- Review your notes soon after class and prior to the next class.
- During the lecture, participate by answering questions and feel free to interrupt the instructor to ask questions.

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## SPECIAL ARRANGEMENTS:

Students with disabilities who would like to receive access and academic accommodations through the Access Resource Centre (ARC) need to self-identify and register with the centre. Please see <http://www.unbc.ca/access-resource-centre>. The students who have registered for accommodations with the ARC must ensure that the instructor is informed of the necessary arrangements as soon as possible.

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## ACADEMIC REGULATIONS:

It is the students' responsibility to familiarize themselves with the regulations concerning academic integrity and ensure that their course work conform to the principles of academic integrity. Please read the academic regulations found at:

<http://www.unbc.ca/calendar/undergraduate/general/regulations.html>.

In particular, read sections 40, 41, 42, 43, 44, and 45.

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## TENTATIVE SYLLABUS

see next page

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## TENTATIVE SYLLABUS

- Intro: What are PDEs
- The Laplace Equation as the Prototype of an Elliptic PDE
  - Harmonic Functions: Representation Formula of Sols. of the Dirichlet Problem on the Ball
  - Mean value Properties of Harmonic Functions
- The Maximum Principle
- Existence Techniques I: Methods Based on the Maximum Principle
- Existence Techniques II: Parabolic Methods. The Heat Equation
  - The Heat Eq.: Def and max principles
  - The Fundamental Solution of the Heat Equation
  - The Initial Boundary Value Problem for the Heat Equation
- The Dirichlet Principle. Variational Methods for the Solution of PDEs (Existence Techniques III)
  - Dirichlet's Principle
  - The Sobolev Space  $W^{1,2}$ , The Poincaré Inequality
  - Weak Solutions of the Poisson Equation
- Lax Millgram theorem

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