University of Guelph – Department of Mathematics and Statistics
Fall Semester 2018

MATH*4270 Partial Differential Equations (0.5 credit)

Prerequisite: MATH*3100

Instructor: Prof. Hermann J. Eberl
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office: MacN508

Office hours:

Time: TUE 15:30-16:30
Room: MacN508

Class schedule:

Time: TUE, THU 10:00-11:20 (am)
Room: CRSC 403
Note:
THU, 11/29: Class rescheduled from Tuesday, October 9, Tuesday schedule in effect
FRI, 11/30: Class rescheduled from Monday, October 8, Monday schedule in effect

Work load: Per undergraduate calendar, students should note that 10 to 12 hours of academic time and effort per week (including classes) are expected for a 0.50 credit course.

Final Examination:

Date: WED, Dec 12, 2018
Time: 11:30-13:30
Room: T.B.A.

Required Texts: none

Recommended Texts:

References to additional/supporting literature will be given in class for each chapter

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.

Detailed Course Description:

Statement of purpose, goals and objectives

Partial differential equations play an important role in many areas of mathematics and its applications. Computer simulations of aircrafts, automobiles, etc are based on partial differential equations. Predictions of weather patterns, flood waves, pollution outfalls etc, are based on partial differential equations. In physics partial differential equations are the language used in the formulation of theories. The formation of traffic jams can be explained using partial differential equations. Pattern formation in spatio-temporal chemical reactions is described by partial differential equations. Biochemical processes with spatial variability, e.g. in cells or tissues, and spatially or physiologically structured populations are often described by partial differential equations. In mathematics, partial differential equations arise, for example, in the context of certain optimal control problems (applied mathematics), or in differential geometry (pure mathematics).

This course is a first introduction to the topic, focusing on the most fundamental and best understood types of problems. It aims to draw connections between mathematics and its areas of science and technology, by discussing specifically partial differential equations that appear as models in biology, physics and various branches of engineering. It aims to be not only a course that provides methods that can be applied in other disciplines, but also to be an introduction to partial differential equations as a field of inquiry in its own right.

Method of instruction

The course follows a traditional lecture model, supported by regular assignments for students to practice and gain more in-depth understanding of the course material. Students will be expected to take their own notes in class.

Specific Learning Outcomes:

1. Numeracy and Quantitative Skills
2. Critical Thinking
3. Application of Knowledge
4. Knowledge of Methodologies
5. Mathematical, scientific and technical communication
6. Depth of Understanding

Syllabus (tentative)

1. Introduction: what are partial differential equations?
2. Linear and semilinear first order equations and their characteristics
3. Classification of linear and semilinear second order equations
4. Elliptic linear problems and the Laplace equation: separation of variables, variational

formulations, the maximum principle and comparison theorems

5. Parabolic linear problems and the Heat equation: separation of variables, ill-posed problems, upper and lower estimates, energy estimates
6. Hyperbolic linear problems and the Wave equations: separation of variables, the d'Alembert solution, domain of dependence and influence, energy estimates;
7. Quasilinear first order equations and their generalized solutions: Shocks and rarefaction waves
8. Diffusion reaction equations and their longterm behaviour: travelling waves and steady states

Evaluation – Methods, Breakdown (% of grade) and specific due dates

Final grades will be determined based on almost weekly assignments and a written final exam. The breakdown of grades is:

Final exam	44%
Assignments	56%

There will be 10 assignments. The average that enters the final grade calculation will be taken over the best 8 submissions.

Final Exam. The final exam will be a written exam, to be taken on Dec 12, 2018, 11:30-13:30, room tba. Exam work will be individual work. This is a closed book exam, but students will be allowed to bring one self-compiled sheet with notes.

Assignments. Assignments are an important part of the course, not only as a method of evaluation, but also and primarily so, as a method of learning, to gain a deeper understanding of the course material. Assignments are to be submitted in class on the due date. Late assignments are not accepted, with possible exceptions due to illness or compassionate reasons, see below. Students are **VERY STRONGLY** recommended to submit individual work for better learning success, but I will accept group submissions of up to three students. In the case of group submissions all students must contribute to the homework that is submitted. Group submissions require a statement to that effect, signed by all group members. Due dates for assignments are:

Assignment 1	September 20
Assignment 2	September 27
Assignment 3	October 11
Assignment 4	October 18
Assignment 5	October 25
Assignment 6	November 1
Assignment 7	November 8
Assignment 8	November 15
Assignment 9	November 22
Assignment 10	November 29

Grades and interpretation of grades. The normal grading system that is in use by the university applies, based on letter grade and percentage grades. The interpretation of grades is described in detail in the undergraduate calendar.

Course Evaluation:

The course evaluation will be conducted in class some day in the last three weeks of the semester. The exact date is t.b.d.

E-mail Communication

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

Please note:

1) Email is an asynchronous communication medium. While I try to respond to emails expeditiously, I do not monitor my inbox continuously, often not for hours, due to other commitments. Therefore, you cannot expect immediate replies.

2) Email is an excellent medium to communicate on administrative and logistic aspects of the course. Due to typesetting restrictions, email is not an efficient and precise, and therefore not a suitable medium to discuss mathematical details. To discuss mathematical content, see me during office hours or after class, where we can use the black board.

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 fortieth class day (November 2, 2018); two-semester courses must be dropped by the last day of the add period 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 book their exams at least 7 days in advance, and not later than the 40th Class Day. More information: www.uoguelph.ca/sas

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 or copied without the permission of the presenter, whether the instructor, a classmate or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

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.