

MATH*6041 Partial Differential Equations I
Fall 2020
Section(s): C01
Department of Mathematics & Statistics
Credit Weight: 0.50
Version 0.00 – July 18, 2020

Disclaimer

Please note that the ongoing COVID-19 pandemic may necessitate a revision of the format of course offerings and academic schedules. Any such changes will be announced via CourseLink and/or class email. All University-wide decisions will be posted on the COVID-19 website

<https://news.uoguelph.ca/2019-novel-coronavirus-information/>

1 Course Details

1.1 Calendar Description (outdated. This version stems from the time when MATH6041 was cross-listed with MATH*4270, a revised version is currently being produced. MATH*4270 is offered as well this term.)

Classification of partial differential equations. The Hyperbolic type, the Cauchy problem, range of influence, well- and ill-posed problems, successive approximation, the Riemann function. The elliptic type: fundamental solutions, Dirichlet and Neumann problems. The parabolic type: boundary conditions, Green's functions and separation of variables. Introduction to certain non-linear equations and transformations methods. Offered in conjunction with MATH*4270. Extra work is required for graduate students.

1.2 Course Description

This course will be an introduction to nonlinear partial differential equations. The focus will be on parabolic equations, more specifically diffusion-reaction problems which play an important role in many branches of engineering (environmental, chemical, biological) and in many biological and biomedical applications (cancer modeling, epidemiological modeling, ecological modeling, environmental modeling). Such application will be discussed.

The focus will be on the spatially one dimensional setting (although higher dimensional problems will occasionally be considered) and classical solution theory of diffusion-reaction equations. Other types of PDEs and related ODEs will be touched upon, in their relation to these problems. For equations of this type, in general exact solutions typically cannot be found. We will focus on analytical techniques that allow a study of the properties of solution such equations in the absence of a closed form. This includes questions of existence and

uniqueness of solutions, estimates on unknown solutions and their longterm behavior, and certain classes of special solutions.

1.3 Timetable

TUE, THU – 10:00-11:20AM

This is a synchronous online course with lectures delivered via video conferencing. Login information will be provided to registered students through courselink.

Timetable is subject to change. Please see WebAdvisor for the latest information.

1.4 Final Exam

Individual oral examinations will be held in the period between December 9-16, or on another mutually agreed upon (by instructor and student) day.

2 Instructional Support

Instructor: Hermann Eberl
Email: heberl@uoguelph.ca
Office Hours: TUE 15:30-16:30 (by appointment, video conferencing will be used)

For questions on course content and assignments, please visit my office hours. Email is a good tool for inquiries concerning course logistics, etc, but it is not an efficient vehicle to discuss mathematics. Also keep in mind that email is a means of asynchronous communication, and that immediate replies cannot be guaranteed.

3 Learning Resources

3.1 Lecture notes

Students are encouraged to take their own notes during lectures, no lecture notes will be distributed. Written assignments will be an important part of the course that contain practice exercises and a more in depth treatment of some material. Assignments will be posted on course link. An important resource will be solutions to the assignment.

Material for the independent learning portion of the course will be distributed in due time, after the topics have been established.

3.2 Textbooks

Many textbooks cover the material of our course, but they differ in the way they present it and in the depth and detail of coverage.

A recommended text, which I will follow more or less closely, is

J.D.Logan, *An Introduction to Nonlinear Partial Differential Equations*, 2nd ed. Wiley, 2008. (in particular Chapters 5,6; selected parts of chapters 3,4,7 may be covered in student seminars). This book is available in electronic form through the library.

Additional resources will be announced in class.

4 Learning Outcomes

1. Numeracy and quantitative skills
2. Critical and logical thinking
3. Application of mathematical knowledge
4. Independent learning of advanced mathematical concepts
5. Mathematical and scientific communication

5 Teaching and Learning Activities

Method of instruction

The main thrust of the course follows a traditional lecture model (delivered remotely and synchronously) and include written assignments to practise the material covered in the lectures.

An important aspect of the course will be independent reading/learning. This will culminate in a professional seminar presentation to the class, in which the students will explain the independently learned material to the class. A list of potential topics for these seminars will be provided in class. These could cover a more in-depth treatment of a topic discussed in lectures, an introduction to material that extends beyond the lecture material, a presentation of one or more papers from the research literature or textbooks, a presentation of project work, or a combination of some of these. These topics might connect the material of MATH*6041 to other graduate courses that students take concurrently, such as MATH*6020 or MATH*6031.

As per graduate calendar, students should expect to spend 10-12 hrs/wk for their course work (including lectures).

Lecture Topics:

1. Introduction/Scope of course

2. Existence proof for the initial value problem of semilinear diffusion-reaction equations
3. Maximum principles and their applications
4. Energy Estimates
5. Pattern formation in reaction-diffusion systems
6. Travelling waves

The focus in our course is in all topics on nonlinear problems and extends beyond the application of these concepts to linear problem which are sometimes taught in undergraduate courses.

6 Assessments

6.1 Marking Schemes & Distributions

Final grades will be determined based on the following:

Three written assignments in which the students will practise applying the concepts covered in class. The assignments should be written using professional language and style and provide sufficient explanation and detail of the rationale on which the answers/solutions are based.

Each student will give an oral, seminar style, professional presentation to the class on a topic of their independent learning. Possible topics will be announced during the semester.

A final exam will be held as a 30 minute long individually scheduled oral examination, reviewing the material of the course.

6.2 Assessment Details

Written assignments will be distributed at least one week before the due date, solutions will be posted after they have been marked:

- Assignment 1 (16.67), due October 8
- Assignment 2 (16.67%), due November 5
- Assignment 3 (16.67%), due December 2

Seminar presentation (18%), to be scheduled for the last 5 weeks of the semester.

Participation in seminar discussions (7%) in the last 5 weeks of the semester

Final Exam (25%), to be scheduled during the period December 9-16.

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.

7 Further information

7.1 Email Communication

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

7.2 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 in writing, with your name, id#, and e-mail contact. The grounds for Academic Consideration are detailed in the Undergraduate and Graduate Calendars.

Graduate Calendar - Grounds for Academic Consideration

<https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml>

See also Sec. 8.2.

7.3 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.

7.4 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.

Information can be found on the SAS website <https://www.uoguelph.ca/sas>

7.5 Academic Integrity

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 encourages academic integrity. 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.

Graduate Calendar - Academic Misconduct

<https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml>

7.6 Recording of Materials

Presentations that are made in relation to course work - including lectures - cannot be recorded or copied without the permission of the presenter, whether the instructor, a student, or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted. See below, 8.3.

7.7 Resources

The Academic Calendars are the source of information about the University of Guelph's procedures, policies, and regulations that apply to undergraduate, graduate, and diploma programs.

Academic Calendars

<https://www.uoguelph.ca/academics/calendars>

8. Additional University Statements

8.1 Online Behaviour

Inappropriate online behaviour will not be tolerated. Examples of inappropriate online behaviour include:

- Posting inflammatory messages about your instructor or fellow students
- Using obscene or offensive language online
- Copying or presenting someone else's work as your own
- Adapting information from the Internet without using proper citations or references
- Buying or selling term papers or assignments
- Posting or selling course materials to course notes websites
- Having someone else complete your quiz or completing a quiz for/with another student
- Stating false claims about lost quiz answers or other assignment submissions
- Threatening or harassing a student or instructor online
- Discriminating against fellow students, instructors and/or TAs
- Using the course website to promote profit-driven products or services
- Attempting to compromise the security or functionality of the learning management system
- Sharing your user name and password
- Recording lectures without the permission of the instructor

8.2 Medical Notes

The University will not normally require verification of illness (doctor's notes) for fall 2020 or winter 2021 semester courses. However, requests for Academic Consideration may still require medical documentation as appropriate.

8.3 Recording of Lecture Materials

The University of Guelph's primary mode of course delivery has shifted from face-to-face instruction to remote and online learning due to the ongoing COVID-19 pandemic. As a result, some learning activities (e.g., synchronous lectures or student presentations) may be recorded by faculty, instructors and TAs and posted to CourseLink for grading and dissemination; students may be recorded during these sessions.

The following statements may be added to the course outline and it is recommended these are discussed in any synchronous courses during the first week of classes.

By enrolling in a course, unless explicitly stated and brought forward to their instructor, it is assumed that students agree to the possibility of being recorded during lecture, seminar or other “live” course activities, whether delivery is in-class or online/remote.

If a student prefers not to be distinguishable during a recording, they may:

1. turn off their camera
2. mute their microphone
3. edit their name (e.g., initials only) upon entry to each session
4. use the chat function to pose questions.

Students who express to their instructor that they, or a reference to their name or person, do not wish to be recorded may discuss possible alternatives or accommodations with their instructor.