MATH*4050 Topics in Mathematics
MATH*6181 Topics in Applied Mathematics
Environmental Transport Models
Winter 2021
Section(s): C01
Department of Mathematics & Statistics
Credit Weight: 0.50
Version 0.01 – December 31, 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://www.uoguelph.ca/covid19/

1 Course Details

1.1 Calendar Description

MATH*4050: In this course students will discuss selected topics at an advanced level. It is intended mainly for mathematics students in the 6th to 8th semester. Content will vary from year to year. Sample topics include: probability theory, Fourier analysis, mathematical logic, operator algebras, number theory combinatorics, philosophy of mathematics, fractal geometry, chaos, stochastic differential equations.

MATH*6181: This course provides graduate students, either individually or in groups, with the opportunity to pursue topics in applied mathematics under the guidance of graduate faculty. Course topics will normally be advertised by faculty in the semester prior to their offering. Courses may be offered in any of lecture, reading/seminar, or individual project formats.

1.2 Course Description

This course gives an introduction into mathematical aspects that arise in the modeling of transport phenomena. They will be illustrated in examples drawn from environmental problems, more specifically the Streeter-Phelps model, which is the most basic river quality model. Extensions of this model will be introduced, leading to increased levels of mathematical complexity. Time permitting also models of open channel hydraulics will be discussed. The mathematical aspects will focus on 1^{st} order semilinear PDEs and singularly perturbed second order two point boundary value problems of ODEs. We will discuss the mathematical analysis (qualitative and quantitative) of these equations and their numerical

treatment. This course will utilise techniques from calculus, numerical methods, ordinary differential equations, linear algebra, real analysis. Graduate students enroled in MATH*6181 will carry out a programming project.

A good preparation for this course will be, in addition to the formal requirements, some of MATH*2130, MATH*2270, MATH*3100, MATH*3510, and the overall mathematical maturity that can be expected from a 4th year student.

1.3 Timetable

TUE, THU – 11:30-12:50

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

Oral examinations will be held in the period April 19-23, or on another mutually agreed upon (by instructor and student) day. A detailed exam schedule will be provided in the last two weeks of classes.

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 asynchronuous communication, i.e. immediate responses should not be expected. I will get to your emails eventually.

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

courselink. An important resource will be be solutions to the assignment that will also be made available on courselink.

The programming projects for MATH*6181 students will be discussed individually during the first half of the semester.

3.2 Textbooks

There is no textbook on the market that covers the material of this class. I will occassionally provide information about reearch papers or pointers to book chapters that support the lectures. These resources will be announced in class and on course link.

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 synchronuously) and include written assignments to practise the material covered in the lectures. Students need to take their own notes during lectures.

Students should expect to spend 10-12 hrs/wk for their course work (including lectures).

Lecture Topics (tentative):

1. Advection-reaction equations in river quality modeling
1.1 Analysis for infinite river stretches
1.2 Finite river stretches and river networks
1.3 Numerical treatment

2. Singularly perturbed problems
2.1 Diffusive transport
2.2 Analysis of singularly perturbed problems
2.3 Numerical treatment

Time Permitting

3. Models of open channel hydraulics
3.1 The de Saint Venant equations
3.2 The kinematic wave approximation and its weak solutions

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:

Four 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.

A final exam will be held as a 25 minute long individually scheduled oral examination, reviewing the material of the course.

6.2 Assessment Details

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

Assignment 1 (15%), due January 30
Assignment 2 (15%), due February 25
Assignment 3 (15%), due March 18
Assignment 4 (15%), due April 8

Late submissions will not be accepted.

Final Exam (40%), to be scheduled during the period April 19-23. The final exams will be recorded. By taking the final exam you agree to this recording.

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

Assignment 1 (10%), due January 30
Assignment 2 (10%), due February 25
Assignment 3 (10%), due March 18
Assignment 4 (10%), due April 8

Late submissions will not be accepted.

Programming project (30%), to be discussed in the first half of the course, due on April 16.

Final Exam (30%), to be scheduled during the period April 19-23. The final exams will be recorded. By taking the final exam you agree to this recording.

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 academic 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

Undergraduate Calendar - Grounds for Academic Consideration

https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac-ac.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

Undergraduate Calendar - Academic Misconduct

https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.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.

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 of a lecture, they may:

1. turn off their camera
2. mute their microphone (does not apply to the oral examination)
3. edit their name (e.g., initials only) upon entry to each session
4. use the chat function to pose questions (does not apply to the oral examination)

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.