

MATH*6400 Numerical Analysis I
Winter 2022
Section(s): 01
Department of Mathematics & Statistics
Credit Weight: 0.50
Version 0.02 – December 29, 2022

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.

1 Course Details

1.1 Calendar Description

Topics selected from numerical problems in: matrix operations, interpolation, approximation theory, quadrature, ordinary differential equations, partial differential equations, integral equations, nonlinear algebraic and transcendental equations.

1.2 Course Description

This course will focus on the mathematical analysis of selected well known numerical methods. The emphasis will be on the convergence of methods for ordinary or partial (of elliptic or parabolic type) boundary value problems. In preparation for this numerical methods for interpolation, differentiation, quadrature, and ordinary initial value problems will be analysed as well.

1.3 Timetable

TUE,THU 10:00AM – 11:20AM before Jan 24: via zoom (cf courselink)
after Jan 24: [ALEX](#), Room 309

Timetable and mode of delivery is subject to change. Please see WebAdvisor and the university's Covid-19 information for the latest information.

1.4 Final Exam

Oral examinations will be held, via zoom (recorded), tentatively on April 14, 2022 or on another mutually agreed upon (by instructor and student) day. A detailed exam schedule will be provided in the last one or two weeks of classes.

2 Instructional Support

Instructor: Hermann Eberl
Email: heberl@uoguelph.ca
Office Hours: TUE 12:00-13:00 (video conferencing will be used until Jan 18, after that MacN508)

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, i.e. immediate responses should not be expected. I will get to your email inquiries eventually.

Credit Weight: 0.5

Academic Department (or campus): Mathematics & Statistics

Campus: University of Guelph

Semester Offering: Winter 2022

3 Learning Resources

3.1 Lecture notes

Students are encouraged and expected to take their own notes during lectures. 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 solutions to the assignment that will also be made available on courselink. The programming project will be posted on courselink in due time.

3.2 Textbooks

Required Texts: none

Recommended Texts:

MJ Gander, F Kwok, Numerical Analysis of Partial Differential Equation, SIAM, 2018

Many books cover the material of the course, all emphasising different aspects and at different levels of detail. Learners are encouraged to also inspect and consult additional texts (and sometimes papers) that will be announced in class. The focus here will be on resources available through the library.

4 Learning Outcomes

General 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. Active and passive mathematical and scientific communication

Specific Learning Outcomes:

1. To increase the students computational literacy
2. To improve algorithmic thinking and problem solving
3. Students will be introduced to important numerical methods and learn about theoretical considerations to assess suitability, efficiency and accuracy of numerical approximations to unknown exact solutions

Lecture/project Content :

- Technical Preliminaries
 - Review of important theorems of Calculus
 - Review of big-O notation, floating point systems and computer arithmetics
- Analysis of Selected Basic Numerical Methods
 - Numerical Differentiation
 - Numerical Quadrature
 - Numerical Integration of ODEs
- Numerical Methods for elliptic PDEs and 2nd order 2pt Boundary Value Problems
 - Finite Difference Methods
 - Finite Volume Methods
 - Finite Element Methods
- Numerical Methods for parabolic 2nd order PDEs
 - Explicit methods
 - Implicit methods
 - Semi-implicit methods

5 Teaching and Learning Activities

Method of instruction

The main thrust of the course follows a traditional lecture model and include regular written assignments to practise and apply the material covered in the lectures, but in more depth. Students are expected to take notes during lectures. Students should expect to spend 10-12 hrs/wk for their course work (including lectures).

6 Assessments

6.1 Marking Schemes & Distributions

Final grades will be determined based on the following:

Three six 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.

A course project will be carried out in the last phase of the term where students will individually work on a task that requires the use of methods discussed in the lecture. The project phase will be accompanied by Q&As during scheduled lecture hours and additional lectures specific to the project.

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 **(10%)**, due January 28
- Assignment 2 **(10%)**, due February 11
- Assignment 3 **(10%)**, due February 18
- Assignment 4 **(10%)**, due March 11
- Assignment 5 **(10%)**, due March 25
- Assignment 6 **(10%)**, due April 8

Final examination (40%): The Final Exam will be an oral exam of 25min per student. By default, these exams will take place on Thu Apr 14, 9:30-16:00, or at another time that week, as mutually agreed by instructor and student. The final exam will be held by zoom and recorded.

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.

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7 University Statements

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 (or designated person, such as a teaching assistant) in writing, with your name, id#, and e-mail contact. The grounds for Academic Consideration are detailed in the Undergraduate and Graduate Calendars.

Undergraduate Calendar - Academic Consideration and Appeals

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

Graduate Calendar - Grounds for Academic Consideration

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

Associate Diploma Calendar - Academic Consideration, Appeals and Petitions

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

7.3 Drop Date

Students will have until the last day of classes to drop courses without academic penalty. The deadline to drop two-semester courses will be the last day of classes in the second semester. This applies to all students (undergraduate, graduate and diploma) except for Doctor of Veterinary Medicine and Associate Diploma in Veterinary Technology (conventional and alternative delivery) students. The regulations and procedures for course registration are available in their respective Academic Calendars.

Undergraduate Calendar - Dropping Courses

<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-drop.shtml>

Graduate Calendar - Registration Changes

<https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/genreg-reg-regchg.shtml>

Associate Diploma Calendar - Dropping Courses

<https://www.uoguelph.ca/registrar/calendars/diploma/current/c08/c08-drop.shtml>

7.4 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.

7.5 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 14 days in advance and not later than the 40th Class Day.

For Guelph students, information can be found on the SAS website
<https://www.uoguelph.ca/sas>

For Ridgetown students, information can be found on the Ridgetown SAS website
<https://www.ridgetownc.com/services/accessibilityservices.cfm>

7.6 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.

Undergraduate Calendar - Academic Misconduct
<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml>

Graduate Calendar - Academic Misconduct
<https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml>

7.7 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.

7.8 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>

7.9 Disclaimer

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7.10 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).

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

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 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

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.

This does not apply to the oral exams, during which the student must be identifiable. Exams are recorded solely for later use in dispute resolution if the need arises.

8.3 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).

8.4 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>

8.5 Mental Health Services:

One out of every five students in Canada experiences some sort of mental health issue at some point in their

academic career. If you find yourself facing a mental health crisis, or just need to talk to someone, please consider taking advantage of one of the following resources available to University of Guelph students:

Counselling Services: Visit the Counselling Services website (<https://wellness.uoguelph.ca/counselling>) to get information on resources available to you, both online and in-person. You can also visit them at Health Services (J.T. Powell Building, ext 53244) where they offer individual and group counselling sessions by appointment or walk-in.

Student Support Network: is located in the Wellness & Education Promotion Centre in the J.T. Powell Building and offers confidential, peer-based, drop-in support.

Good2Talk: ([1-866-925-5454](tel:1-866-925-5454)) is a free, 24/7 student hotline that provides professional counselling and referrals for mental health, addictions and well-being.

Here 24/7: ([1-844-437-3247](tel:1-844-437-3247)) specializes in assessment, referral and appointment booking and is available 24/7 for crisis support.

You are not alone and you will not be judged for asking for help.