

Department of Mathematics and Statistics

University of Guelph

MATH*2130: Numerical Methods - Course Syllabus

Winter 2023

For information on current safety protocols, follow these links: <https://news.uoguelph.ca/return-to-campuses/how-u-of-g-is-preparing-for-your-safe-return/>, <https://news.uoguelph.ca/return-to-campuses/spaces/#ClassroomSpaces>

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

DISCLAIMER:

Please note that the ongoing COVID-19 pandemic may necessitate a revision of the format of course offerings, classroom schedules, 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. Instructional Support:

1.1. Instructors:

Geordie Richards, Ph.D.

Office: MacN 547, ext. 53033

Email: grichards@uoguelph.ca

Office hours: Wednesdays and Fridays
11AM-12PM over zoom (link will be provided on CourseLink)

1.2. Teaching Assistants:

Serge Adonsou

Courtney Allen

Michael Dube

Thomas Kielstra

David Lyver

William Rutherford

Valeria Telles

Sam Vermeulen

2. Learning Resources:

2.1. Course Website:

Course material, news, announcements, and grades will be regularly posted to the MATH*2130 CourseLink website. You are responsible for keeping up-to-date on this site.

2.2. Required Resources:

The primary resource for the course will be “fill-in-the-blank” style notes prepared by Prof. Matt Demers which be available (with empty “blanks”) for free via download from CourseLink. We will proceed to fill in the blanks during lecture as we work through the course content. Completed lecture notes will be posted to CourseLink throughout the semester.

2.3. Recommended Resources:

Numerical Analysis (Third Edition) by Timothy Sauer. Pearson Education, 2018. This textbook may provide an important source of exercises and background reading through the semester! While there is a small “For You to Try” section created for each chapter in our notes, it is useful to have many different examples throughout the semester, and you will find more in this resource.

2.4. Additional Resources:

Lecture Information: All lectures will be delivered entirely face-to-face, in person. Lecture recordings and completed lecture notes will be uploaded to the course website at the end of every week. However, attendance of class is strongly encouraged, and in particular there is an in-class component to assessments that could potentially improve your grade (see Section 3 below).

Lab Information and Computer Resources: Assignments involving theoretical math and coding in MATLAB will be due on a regular basis (see Section 3 below). The format required of your assignment submission will be clarified in posts on CourseLink. The weekly labs (starting in Week 2) will be held in THRN 1319, where students have access to MATLAB and can collaborate with each other on completing the assignments with support from course TAs. In fact, you are welcome to use the computers in THRN 1319 on a drop-in basis to help complete the assignments, and have been granted card access to THRN 1319 by being enrolled in this course. You may also consider obtaining your own license for MATLAB; a free clone, called OCTAVE, may also be used instead, though it may lack functionality in some cases.

YouTube Videos: Each week I will post links to previously recorded MATH*2130 lectures from Prof. Matt Demers on YouTube which cover the content appearing in the week that follows. Although much of the content covered will be the same, we may emphasize different material at various junctures, and due to the in-class quiz component, these videos can mainly serve to help prepare you for the quizzes. Having said that, you will likely be adequately prepared for the quizzes by attending class and paying attention during lecture.

Other: Past tests, supplementary questions, and other resources may be posted to the Course website as needed. Again, it is important that you check regularly to keep up-to-date.

- 2.5. **Communication & Email Policy:** Major announcements will be posted to the CourseLink page. It is your responsibility to check the CourseLink page regularly. As per university regulations, all students are required to check their <uoguelph.ca> e-mail account regularly: e-mail is the official route of communication between the University and its student.

Disclaimer: Student Identity Disclosure in Recordings

The university has requested that I include the following disclaimer regarding recorded materials. While I don't anticipate the use of any videos or recordings as our class will be run entirely face-to-face, I want to ensure that we are prepared in the case that the pandemic pushes us in this direction.

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.

2.6. Getting Help:

My number one priority is to ensure that you are supported and have lots of opportunities to ask questions and get help! Here are some options for getting help in this course:

- Please feel encouraged to ask questions during lecture.
- Come to office hours. Don't ever hesitate to drop in, even if you think you are behind in your studying. Getting you caught up is ****exactly**** what those opportunities are there for!
- Post to the discussion board on Courselink. This is a great place to post your questions. I will check this often and respond as soon as I am able. It is also a great way for you to help others if you see a question that someone else posts that you can help out with. This is one of the best ways to master a concept: by explaining it to someone else.
- Send me an email (grichards@uoguelph.ca). Since there are over 100 of you and only one of me, I would prefer to answer questions in a group forum (so that I can help more of you at once), but certainly for more personal queries, this is a great option. If you ask questions by email (or even in Courselink), it would be extremely helpful for you to attach a picture of your work, so I can easily see where you might be stuck and be able to help you more quickly. I usually try to respond within a few hours. However, I get a lot of email from students and I need to make sure that I have the chance to help as many people as I can in the time I have! So be warned that if you send me many emails with various questions, it may take a day or two to get back to you.

3. Assessment:

3.1. Dates and Distribution

You grade will be determined as the maximum of the following two schemes:

	Scheme 1
21 In-class Quizzes (top 15 only)	5%
5 Assignments (equally weighted)	15%
2 Midterm Tests (20% each)	40%
Final Exam	40%

	Scheme 2
5 Assignments (equally weighted)	10%
2 Midterm Tests (25% each)	50%
Final Exam	40%

In-class Quizzes: Quizzes will be single-question multiple choice assessments written on paper. They can be picked up at the beginning of class, students will be given a 5 minute break to complete the quiz (though they should only take 1-3 minutes to complete), and they must be returned at the end of class. **Starting in Week 2, two quizzes will be held every week.** More precisely, starting in Week 2, **in Lecture Section 2 there will be a quiz in every class, and in Lecture Section 1 there will be a quiz every Monday and Wednesday** (no quizzes on Fridays). There also won't be a quiz in either section on Monday February 28 (after the winter break) or on Monday April 10 (because this class has a Friday schedule - see Section 5 below). Each quiz will be graded out of 4 points: 3 points for submitting the quiz, and 1 point for selecting the correct response. **Only the top 15 out of your 21 quiz scores will count toward the 5% component of your final grade in Scheme 1.** The quizzes will be open book, similar to examples recently completed in class, and you will be allowed to collaborate with other students. You should be able to complete the quizzes with the correct response

by attending class regularly and paying attention, but **if you are interested in studying for the quizzes, I will provide, one week in advance, links to YouTube videos with most of our lecture content prepared by Prof. Matt Demers.** You can prepare for the quizzes by watching these videos before attending class.

Assignments: There will be 5 written assignments due throughout the term (see schedule below). Most assignments will involve a mix of theoretical and MATLAB/coding challenges. Assignments will cover 2-3 weeks worth of course content. You may use your course notes and work together with your peers to figure things out, but you must write and execute your own code, and complete your own written solutions when preparing your submission. Copying another person's code or answers (or obtaining your answer from another source) is academic misconduct and will not be tolerated.

- Assignment 1: Thursday, January 26, 2023 (Week 3) Upload by 11:59PM to Gradescope.
- Assignment 2: Thursday, February 9, 2023 (Week 5) Upload by 11:59PM to Gradescope
- Assignment 3: Thursday, March 2, 2023 (Week 7) Upload by 11:59PM to Gradescope
- Assignment 4: Thursday, March 16, 2023 (Week 9) Upload by 11:59PM to Gradescope
- Assignment 5: Thursday, April 6, 2023 (Week 12) Upload by 11:59PM to Gradescope

Midterm Tests: There will be 2 Midterm Tests (see schedule below).

The Midterm Tests will involve a mix of theoretical mathematical questions and MATLAB code related questions. Coding problems will be graded for structure, not for finer points of MATLAB syntax, which will be largely ignored. This will be discussed more via posts on CourseLink.

- Midterm Test 1: Friday, February 17, 2023 (Week 6) 6:00pm-7:30pm (90 minutes to write). Location: TBA. Closed-book, closed resource, independent. Exact topics TBA.
- Midterm Test 2: Friday, March 24, 2023 (Week 10) 6:00pm-7:30pm (90 minutes to write). Location: TBA. Closed-book, closed resource, independent. Exact topics TBA.

Final Exam: Wednesday April 19th, 2023 11:30am-1:30pm (120 minutes to write). Location: TBA. Closed-book, closed resource, independent. Cumulative.

*Should face-to-face instruction be shut down at any point by the administration, any assessments completed during such a shutdown will be proctored via Zoom according to the schedule above. Please ensure that you have a working web camera should we need to run assessments in this way.

3.2. Course Grading Policies

Academic Consideration: 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 number, and e-mail contact. See the academic calendar for information on regulations and procedures for Academic Consideration: <http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml>

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).

Accommodation of Religious Obligations: If you are unable to meet an in-course requirement due to religious obligations, please email the course instructor at the start of the semester to make alternate arrangements. See the undergraduate calendar for information on regulations and procedures for Academic Accommodation of Religious Obligations: <http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-accomrelig.shtml>

Missed term tests, assignments, or quizzes: For missed quizzes note that only the top 15 out of 21 quizzes will count toward your final grade in Scheme 1, which gives room for missed quizzes due to the reasons listed above without notifying me about it. Missed tests or assignments will receive a grade of 0%, unless you miss the assessment due to any of the above reasons and bring it to the attention of

the course instructor within 1 week of the assessment date in a written email, in which case the weight of the missed assessment will be added to the final exam. There will be no makeup tests or quizzes.

Group Work: You are encouraged to work together to learn the course material and complete For You to Try and textbook exercises. All term tests and the final exam are individual assessments and must be completed independently.

Copies of out-of-class assignments: Keep paper and/or other reliable back-up copies of assignments, homework, and your midterms. You may be asked to submit this work at any time.

4. Aims, Objectives & Graduate Attributes:

4.1. Calendar Description

This course provides a theoretical and practical introduction to numerical methods for approximating the solution(s) of linear and nonlinear problems in the applied sciences. The topics covered include: solution of a single nonlinear equation; polynomial interpolation; numerical differentiation and integration; solution of initial value and boundary value problems; and the solution of systems of linear and nonlinear algebraic equations.

Credit Weight: 0.5, **Department:** Mathematics & Statistics, **College:** CEPS, **Campus:** Guelph
Prerequisites: (CIS*1300 or CIS*1500), (1 of IPS*1510, MATH*1090, MATH*1210, MATH*2080)

4.2. Course Aims

This course is taught with the goal of putting into practice some of the concepts and intuition that students have developed with so far in other math courses. This means being able to develop computer programs that can run simple mathematical algorithms, and gaining an understanding of how continuous mathematical objects such as derivatives or solutions to differential equations might be approximated using a discrete numerical approach instead – as well as the error involved in doing so.

4.3. Learning Objectives

At the successful completion of this course, the student will have demonstrated the ability to:

1. Explain the general concepts of algorithms, limiting behaviour and asymptotic notation.
2. Gain an understanding of how computers handle numerical data, including floating-point operations, rounding, truncation, iteration, and error.
3. Find roots to single nonlinear equations through the use of various numerical algorithms.
4. Calculate a polynomial interpolant or cubic spline given a set of points.
5. Utilize difference approximations for various derivative operators.
6. Numerically approximate the solutions to initial value problems through a series of increasingly sophisticated approaches.
7. Understand the nature of a Boundary Value Problem and an introduction to numerical techniques for their solution.
8. Numerically approximate the results of definite integrals.
9. Create algorithms for solving linear systems of equations.
10. Use Taylor's Theorem to produce error bounds for numerical techniques.

4.4. Instructor's Role and Responsibility to Students

As your instructor, I must:

1. Develop and deliver course material in a professional way that facilitates learning for a variety of students and learning styles.
2. Attend all lectures, filling in the Course Manual as we proceed in each lecture. I will provide completed course notes online regularly, but I strongly urge you to come to class. Bear in mind that most Tutorials will not use the Course Manual and these completed notes might not be provided to you.

3. Respond to you. This includes, as time permits, questions in lectures and lab tutorials, after classes, during office hours, or through email (where I reserve the right to reply within a timeframe of 1-2 days). You are more than welcome to contact me at any time through these means if you have questions or concerns about the course or the course material.
4. Evaluate you fairly, and fairly as compared to your peers, providing prompt feedback on your performance and justification for your grade. I must provide academic consideration, where appropriate, as described in Section 3.

4.5. Students' Learning Responsibilities

As a member of this class, you are expected to:

1. Take advantage of the learning opportunities provided during lectures.
2. Treat others with respect and dignity whenever you address them, in-class or online.
3. Genuinely try "For You To Try" problems in a timely manner, on your own time.
4. Seek help if you have tried the homework and are still having difficulty with the course content. This means contacting me (not just at the last minute!) and possibly considering other resources as I recommend them to you.
5. Check all grades against tests that have been returned to you, once they are posted to the Course website, to verify that the correct mark has been recorded.
6. Notify me, as described in Section 3, in the case that there are missed tests/quizzes or academic conflicts that are known in advance. If illness, work, or extra-curricular activities are causing you to struggle, you are advised to keep me up-to-date on your progress, so that I can be more helpful to you.

5. Teaching and Learning Activities:

5.1. Timetable for Lectures and Labs

Lectures: (Starting Week 1)

MWF 3:30-4:20PM, MACN 105 (Section 1)

MW 5:30-6:50PM, THRN 1200 (Section 2)

Labs: (Starting Week 2)

W 12:30-1:20PM, THRN 1319 (Lab Section 1)

Tu 10:30-11:20AM, THRN 1319 (Lab Section 2)

Th 2:30-3:20PM, THRN 1319 (Lab Section 3)

Tu 7-7:50PM, THRN 1319 (Lab Section 4)

Th 7-7:50PM, THRN 1319 (Lab Section 5)

M 8:30-9:20AM, THRN 1319 (Lab Section 6)

Tu 11:30AM-12:20PM, THRN 1319 (Lab Section 7)

W 11:30AM-12:20PM, THRN 1319 (Lab Section 8)

Th 5:30-6:20PM, THRN 1319 (Lab Section 9)

Th 8:30-9:20AM, THRN 1319 (Lab Section 10)

5.2. Lecture Schedule

(schedule is approximate and subject to change depending on time constraints)

Week(s)	Topics	Chapter(s) from Sauer	Learning Outcomes
1-2	Programming and Algorithms	1	LO 1, 2, 10
3-4	Root Finding	2	LO 3, 10
5-6	Interpolation and Splines	8	LO 4
7-8	Numerical Differentiation and IVPs	1, 11, 12	LO 5, 6
8-9	BVPs and Finite Difference	-	LO 7
10	Numerical Integration	11	LO 8, 10
11-12	Linear Systems	3, 6	LO 9

5.3. Other Important Dates

First day of lecture: Monday, January 9.

First day of labs: Monday, January 16.

NOTE: There will be NO LABS in Week 1 (January 9-13).

Reading Week (no classes): Monday, February 20 - Friday February 24.

Holiday (classes rescheduled to Monday April 10): Friday, April 7.

Last day of classes: Monday, April 10 (Friday schedule)

Drop Date: Courses that are one semester long must be dropped by the end of the last day of classes (**Monday, April 10, 2023**). The regulations and procedures for Dropping Courses are available in the Undergraduate Calendar. <https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-drop.shtml>

Course Evaluation Information: Near the end of the term, you will be given the opportunity to evaluate your instructor and provide comments regarding your experience. The evaluations for this class will be done in-class. Your instructor will inform you of when these are to take place.

6. 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.

6.1. Resources

The Academic Misconduct Policy is detailed in the Undergraduate Calendar: <http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml>

A tutorial on Academic Misconduct produced by the Learning Commons can be found at: <http://www.academicintegrity.uoguelph.ca/>

7. 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 make a booking at least 14 days in advance, and no later than November 1 (fall), March 1 (winter) or July 1 (summer). Similarly, new or changed accommodations for online quizzes, tests and exams must be approved at least a week ahead of time.

More information: www.uoguelph.ca/sas

8. Recording of Materials :

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

Posted online videos and course notes are the property of the instructor and are not to be otherwise disseminated beyond this course.

9. 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.

<http://www.uoguelph.ca/registrar/calendars/index.cfm?index>

10. Mental Health Resources:

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) 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) 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.