FACULTY OF SCIENCE

MATH 2050U: Linear Algebra

CRN: 72677, 75803

Course outline for Winter 2025[1]

Ontario Tech University acknowledges the lands and people of the Mississaugas of Scugog Island First Nation. We are thankful to be welcomed on these lands in friendship. The lands we are situated on are covered under the Williams Treaties and the traditional territory of the Mississaugas, a branch of the greater Anishinaabeg Nation, including Algonquin, Ojibway, Odawa and Pottawatomi. These lands remain home to a number of Indigenous nations and people.

We acknowledge this land out of respect for the Indigenous nations who have cared for Turtle Island, also called North America, from before the arrival of settler peoples until this day. Most importantly, we remember the history of these lands has been tainted by poor treatment and a lack of friendship with the First Nations who call them home.

This history is something we are all affected by as we are all treaty people in Canada. We all have a shared history to reflect on, and each of us is affected by this history in different ways. Our past defines our present, but if we move forward as friends and allies, then it does not have to define our future.

1. Course Details and Important Dates

Term	Instructor	CRN	Day	Location	Time
Winter 2025	Jane Breen	72677	M/W	UA1140	6:40pm–8:00pm
Winter 2025	Mihai Beligan	75803	Tu/Th	UA1120	12:40pm–2:00pm

Classes start: January 6th, 2025
Classes end: April 4th, 2025
Reading week: February 17th–23rd, 2025
Final exam period: April 7th–17th, 2025

For other important dates see here.

Tutorials for this course shall start the week of January 13th.

[1]The instructor reserves the right to amend this syllabus on an as-needed basis throughout the term. Students will be notified by email or by announcement in class when revisions are made.

Note: Additional important information will be posted in "Announcements" on Canvas throughout the semester – make sure you stay up to date on this. We recommend that you turn on the setting that a copy of announcements be sent to your university e-mail account immediately.

2. Instructor Contact Information

Instructor Name	Office	Phone	Email
Dr. Jane Breen	UA 3025	n/a	Please use Canvas email!
Dr. Mihai Beligan	UA 3016	n/a	Please use Canvas email!

3. Teaching Assistants and Tutorials

The teaching assistants for this course are:

- Ben Fedoruk
- Travis Durrant
- Marian Kowalski
- Farzaneh Nikbakhtsarvestani

The TA schedule will be posted on Canvas, and you will meet your TA in your tutorial.

To contact your TA, please use Canvas email.

4. Office Hours

The finalized Office Hours schedule will be available in Canvas during the second week of the semester. You can attend ANY of these office hours to get extra help with your course materials and ask your math questions regardless of which tutorial you're in—all of the TAs and profs will be happy to help you. You are strongly encouraged to start using the office hours as soon as the schedule is posted in Canvas.

5. Course Calendar Description

This course is designed to develop the fundamental ideas of linear algebra, and to demonstrate some applications of linear algebra to other areas. Topics include the algebra of matrices; qualitative and quantitative solutions of systems of linear equations; determinants and matrix inverses; real and complex vector spaces, and subspaces, linear independence, bases, dimension and co-ordinates; inner product spaces and the Gram-Schmidt process; inconsistent (over determined) systems of equations, least squares solutions and regression; linear maps and matrices, change of basis and similar matrices; eigenvalues, eigenvectors and matrix diagonalization; diagonalization of real symmetric matrices and quadratic forms.

6. Learning Outcomes

On the successful completion of the course, students will be able to:

- solve systems of equations
- evaluate determinants
- perform basic calculations involving matrices
- perform basic calculations related to vectors
- apply the concepts of linear algebra to problems involving general vector spaces
- compute the eigenvalues and eigenvectors of a given matrix
- apply linear transformations and compute the corresponding transformation matrix
- solve multi-step Linear Algebra problems
- demonstrate an understanding of, and ability to complete simple proofs
- recognize the appropriate technique to solve a problem
- justify a conclusion to a mathematical problem

7. Course Design

Two 1.5 hour in-person lectures weekly. One 1.5 hour in-person tutorial weekly. MATLAB software will be used occasionally in lecture and tutorials. The tutorials will allow students to get help with homework, gain additional practice, and use technology to further explore concepts from class. Weekly online quizzes (in Mobius) will allow for practice and feedback. Two midterms, 1 final exam.

8. Outline of Topics in the Course

- **Week 1** Linear Systems
  - setting up linear systems;
  - matrix operations;
  - Gaussian elimination.
- **Week 2** Linear Systems Cont'd
  - invertibility, the inverse matrix;
  - elementary matrices;
  - diagonal, triangular, and symmetric matrices.
- **Week 3** Determinants
  - introduction to determinants, cofactor expansion;
  - finding determinants using row reduction;
  - properties of determinants.
- **Week 4** Euclidean Vector Spaces

  - vectors in 2-space and 3-space;
  - norm, dot product, and distance;
  - orthogonality;
  - cross product;
  - lines and planes.
- **Week 5** General Vector Spaces
  - real vector spaces.
- **Week 6** General Vector Spaces
  - subspaces;
  - span;
  - linear independence.
- **Week 7** General Vector Spaces cont'd
  - coordinates and basis
- **Week 8** General Vector Spaces cont'd
  - dimension;
  - row space, column space, and nullspace;
  - rank, nullity, and fundamental matrix spaces.
- **Week 9** General Vector Spaces cont'd
  - matrix transformations;
  - properties of matrix transformations.
- **Week 10** Eigenvalues and Eigenvectors;
  - eigenvalues and eigenvectors.
- **Week 11** Inner Product Spaces
  - diagonalization;
  - inner products.
- **Week 12** Inner Product Space Cont'd
  - orthogonality;
  - orthonormal bases: Gram-Schmidt process.

9. Required Texts

Elementary Linear Algebra: Applications Version. Loose-leaf text. H. Anton et al., Wiley, 12th edition, ISBN: 9781119282365

[or 9781118474228 is the 11th edition of the text…there are only a few differences]

OR

Online version (includes solutions manual): ISBN : 9781119406716

Note: Solutions to assigned homework problems from this textbook will be posted in Canvas.

The text and solution manual is available on reserve at the library. Just ask for MATH1850/2050.

10. Evaluation Methods

The course mark will be calculated as follows (see Section 11 for details)

Assignments:	10%
Weekly Online Quizzes:	10%
In-tutorial activities:	10%
Midterm I:	20% (tentatively scheduled for Feb 10th/11th)
Midterm II:	20% (tentatively scheduled for March 12th/13th)
Final Exam:	30%
Bonus Engagement Credit:	3%

11. Assignments and Tests

Assignments:

There will be 4–6 assignments throughout the semester. Assignments will be done in groups of four, and will be submitted electronically through Canvas. The single lowest assignment grade will not count towards the final grade.

Assignments will often require some independent study of a concept not covered in class. Their purpose is to provide *enrichment* by giving you some insight into applications.

In-tutorial activities:

These are learning activities that you complete in tutorial. Some include reading that needs to be completed beforehand (questions about the reading will appear as part of the weekly online quiz preceding that tutorial. They are marked based on effort; in order to receive this grade, you must come to tutorial prepared and contribute to the work.

Activities may be computer-oriented and will cover applications and extensions of material presented in class that students will be responsible for on tests; therefore:

1. It is imperative that students complete honour homework in order to prepare for online quizzes, midterms, and the final. In-tutorial activities are NOT a substitute for this!

2. Although the activities are marked based on effort, it is important to take them seriously in order to master the independent study topics, and help you extend your knowledge of the concepts from lecture in preparation for tests.

You are welcome to hand in your work for the activity for additional written feedback if desired. For complete details on this process as well as what to expect from in-tutorial activities and how they're marked, please see the "In-Tutorial Activity Guide" posted on Canvas. The three lowest tutorial grades will not count towards the final grade.

Weekly Online Quizzes:

The online quiz will be completed in Mobius following each week of lectures (it will be available from 8:00am each Friday until 8:00am on Monday). It is an opportunity to practice and master basic concepts. You will get 3 attempts at each quiz (this is to account for possible technical issues or syntax mistakes, so if you experience an issue, please just re-take the quiz—we will not make changes to scores), and the best attempt will count. The three lowest online quizzes will not count towards the final grade.

Midterm Tests and Final Exam:

Midterm tests and the final exam will be in-person. A non-graphing, non-programmable calculator is permitted. Although material that will be tested on the first midterm will not be directly tested on the second midterm, understanding of the concepts which appear in the first part of the course will be necessary for the second midterm. The final exam will test all material covered in the course. The midterm tests and final exam may consist of a hand written component OR a timed multiple choice component OR a combination of both.

Bonus Engagement Credit:

You will receive a 3% bonus if you attend at least four of the following offerings by Student Learning Centre:

- Linear Algebra Workshop
- Math Study Hall
- Linear Algebra Appointment with a Specialist
- Linear Algebra appointment with a Peer Tutor, PASS (Peer Assisted Study Sessions)

Note that there are multiple linear algebra workshops throughout the term. The Student Learning Centre will take attendance at these workshops and at study hall, as well as keeping records of those who make appointments with learning specialists and peer tutors. Those who attend at least four of these will get the 3%. Please note that this is all-or-nothing; there will be no partial marks for attending fewer than 4 of these offerings.

For more information, please see the intro announcement on the Student Learning Centre, and the link to the Student Learning Centre on Canvas.

12. Missed Work Policies

Missed Quiz and Assignment

If you miss an online quiz or assignment, then you receive a 0 on it. We recognize that times may arise when you are forced to miss a quiz/assignment through no fault of your own, but it is for this very reason that the 3 lowest online quizzes, and the 1 lowest assignment is dropped. This is extremely generous, so no notes will be accepted for missed quizzes and/or assignments. This policy applies to all students.

Missed Tests:

For information on how missed/late assignments and medical excuses are managed, please refer to the university's revised Procedures for Consideration of Missed In-Term Course Work and Examinations `https://usgc.ontariotechu.ca/policy/policy-library/policies/academic/procedures-for-consideration-of-missed-in-term-course-work-and-examinations.php`.

Final Exam View

We do not release final exam grades to students; if you would like to view your exam/find out your exam grade, you will need to do an exam view. Once grades are released on mycampus, if you want to view your final exam/find out your exam grade, you need to complete the Exam View Request Form for MATH2050U that's available here: `https://forms.gle/5y7UvP4KjWCnzV9P6`; you'll need to login with your @ontariotechu.net account to access the form. The form will become available once grades are released on mycampus.

Important: The above form is the only way to request an exam view for this course; e-mail requests are not acceptable. As per the University policy, you have 5 business days from the day that marks are released to submit the exam view request form. Late requests will not be accepted. Once you complete the exam view request form, it will provide you with a link to register for an exam view appointment timeslot. Missed appointments will not be rescheduled. If you have a course conflict with all of the appointment times, please e-mail your professor in Canvas with a copy of your course schedule from MyOntarioTech; only Ontario Tech course conflicts will be accommodated. And, unless there is a clerical mistake, instructors cannot change marks as a result of an exam view.

13. Technology Requirements and Learning Management System Information

Ontario Tech uses Canvas as its learning management system (LMS). Access to the LMS is limited to students formally registered in courses. That access is for the duration of the semester and for an additional 120 days once the semester is over. Students are strongly encouraged to download any/all relevant course material during that access period. Any requests for access post this period must be made in writing to the instructor/faculty member responsible for the course.

To support online learning, the university recommends certain technology requirements for laptops, software and internet connectivity which are available at: https://itsc.ontariotechu.ca/remote-learning.php.

Students experiencing technical difficulties such that they are unable to meet the technology requirements may contact the IT Service Help Desk at: servicedesk@dc-uoit.ca Students experiencing financial difficulties such that they are unable to meet the technology requirements may contact Student Awards and Financial Aid Office at: connect@ontariotechu.ca

By remaining enrolled in this course, you acknowledge that you have read, understand and agree to observe the Recommended Technology Requirements for accessing university online learning resources, including those minimum requirements that are specific to your faculty and program.

14. Student Support

Any student who faces challenges securing their food or housing and believes this may affect their performance in the course is urged to contact studentlife@uoit.ca for support. Furthermore, please notify your professor if you are comfortable in doing so. This will enable them to provide any resources and help that they can.

15. Sexual Violence Support and Education

Ontario Tech is committed to the prevention of sexual violence in all is forms. For any student who has experienced Sexual Violence, Ontario Tech can help. We will make accommodations to cater to the diverse backgrounds, cultures, and identities of students when dealing with individual cases.

If you think you have been subjected to or witnessed sexual violence:

- Reach out to a Support Worker, a specially trained individual authorized to receive confidential disclosures about incidents of sexual violence. Support Workers can offer help and resolution options which can include safety plans, accommodations, mental health support, and more. To make an appointment with a Support Worker, call 905.721.3392 or email studentlife@uoit.ca
- Learn more about your options at: https://studentlife.uoit.ca/sexualviolence/

16. Students with Disabilities

Accommodating students with disabilities at Ontario Tech is a responsibility shared among various partners: the students themselves, SAS staff and faculty members. To ensure that disability-related concerns are properly addressed during this course, students with documented disabilities and who may require assistance to participate in this class are encouraged to speak with me as soon as possible. **Students who suspect they have a disability that may affect their participation in this course are advised to go to Student Accessibility Services (SAS) as soon as possible.** Maintaining communication and working collaboratively with SAS and faculty members will ensure you have the greatest chance of academic success.

Students taking courses on north Oshawa campus can visit Student Accessibility Services in UL Building, Room 2 (located near the library). Students taking courses on the downtown Oshawa campus can visit Student Accessibility Services in the 61 Charles St. Building, 2nd Floor, Room DTA 225 in the Student Life Suite.

Disability-related and accommodation support is available for students with mental health, physical, mobility, sensory, medical, cognitive, or learning challenges. Office hours are 8:30am-4:30pm, Mon-Fri. For more information on services provided, you can visit the SAS website here. Students may contact Student Accessibility Services by calling 905.721.3266, or email studentaccessibility@uoit.ca.

Students who require the use of the Test Centre to write tests, midterms, or quizzes MUST register online using the SAS test/exam sign-up module, found here. Students must sign up for tests, midterms or quizzes AT LEAST seven (7) days before the date of the test.

Students must register for final exams by the registration deadline, which is typically two (2) weeks prior to the start of the final examination period. SAS will notify students of the registration deadline date.

17. Academic Integrity

Students and faculty at Ontario Tech University share an important responsibility to maintain the integrity of the teaching and learning relationship. This relationship is characterized by honesty, fairness and mutual respect for the aim and principles of the pursuit of education. Academic misconduct impedes the activities of the university community and is punishable by appropriate disciplinary action.

Students are expected to be familiar with and abide by Ontario Tech University's regulations on Academic Conduct which sets out the kinds of actions that constitute academic misconduct, including plagiarism, copying or allowing one's own work to be copied, use of unauthorized aids in examinations and tests, submitting work prepared in collaboration with another student when such collaboration has not been authorized, among other academic offences. The regulations also describe the procedures for dealing with allegations, and the sanctions for any finding of academic misconduct, which can range from a resubmission of work to a failing grade to permanent expulsion from the university. A lack of familiarity with these regulations on academic conduct does not constitute a defense against its application. Please note that generative artificial intelligence (GAI) tools should not be utilized without advance, specific written approval by the faculty member teaching the course. More information can be found here.

Extra support services are available to all Ontario Tech University students in academic development, study skills, counseling, and peer mentorship. More information on student support services can be found here.

18. Final examinations

Final examinations are held during the final examination period at the end of the semester and when on campus access is allowed, may take place in a different room and on a different day from the regularly scheduled class. Check the published Examination Schedule for a complete list of days and times.

While the University remains online, final exams will require online submission, so you will require internet access along with a webcam.

Students are required to show their Student ID card (campus ID) when in-person examinations are allowed. Students are advised to obtain their Student ID Card well in advance of the examination period as they will not be able to write their examinations without it. More information on ID cards can be found at https://registrar.ontariotechu.ca/campus-id/index.php.

Students who are unable to write a final examination when scheduled due to religious obligations may make arrangements to write a deferred examination. These students are required to submit a Request for Accommodation for Religious Obligations to the Faculty concerned as soon as possible and no later than three weeks prior to the first day of the final examination period.

Further information on final examinations can be found at https://usgc.ontariotechu.ca/policy/policy-library/policies/academic/procedures-forfinal-examination-administration.php

19. Freedom of Information and Protection of Privacy Act

The following is an important notice regarding the process for submitting course assignments, quizzes and other evaluative material in your courses in the Faculty of Science.

As you may know, Ontario Tech University is governed by the Freedom of Information and Protection of Privacy Act ("FIPPA"). In addition to providing a mechanism for requesting records held by the university, this legislation also requires that the University not disclose the personal information of its students without their consent.

FIPPA's definition of "personal information" includes, among other things, documents that contain both your name and your Banner (student) ID. For example, this could include graded test papers or assignments. To ensure that your rights to privacy are protected, the Faculty of Science encourages you to use only your Banner ID on assignments or test papers being submitted for grading. This policy is intended to prevent the inadvertent disclosure of your information where graded papers are returned to groups of students at the same time. If you still wish to write both your name and your Banner ID on your tests and assignments, please be advised that Ontario Tech University will interpret this as an implied consent to the disclosure of your personal information in the normal course of returning graded materials to students.

If you have any questions or concerns relating to the new policy or the issue of implied consent addressed above, please contact accessandprivacy@uoit.ca.

20. Student Course Feedback Surveys

Student evaluation of teaching is a highly valued and helpful mechanism for monitoring the quality of Ontario Tech University's programs and instructional effectiveness. To that end, course evaluations are administered by an external company in an online, anonymous process during the last few weeks of classes. Students are encouraged to participate actively in this process and will be notified of the dates. Notifications about course evaluations will be sent

via e-mail, and posted on Blackboard, Weekly News, and signage around the campus.