



# ENGG\*1500 Engineering Analysis

01

Winter 2024

Section(s): C01

School of Engineering

Credit Weight: 0.50

Version 1.00 - January 05, 2024

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## 1 Course Details

### 1.1 Calendar Description

This course deals with engineering applications of matrix algebra, vector spaces and computer techniques to solve linear systems. Topics include theory and applications of linear transformations, eigenvalues and eigenvectors, diagonalization, complex-variable algebra, and multi-variable functions.

**Restrictions:**

MATH\*1160, MATH\*2150, MATH\*2160. This is a Priority Access Course. Enrolment may be restricted to students in the BENG and BENG:C programs. See department for more information. Non-BENG students may take a maximum of 4.00 ENGG credits.

### 1.2 Course Description

This is an introductory course in linear algebra. Linear algebra is one of the most important subjects that you will study in Engineering, as it is used in many courses and design projects. The main goal of the course is to give you a solid foundation in the elementary concepts of linear algebra and associated software tools (MATLAB) and to give you exposure to real problems that you will encounter throughout your engineering career.

### 1.3 Timetable

Times and room locations are subject to change. Please see WebAdvisor for the latest information.

**Lectures**

Section 01: M/W/F - 2:30 - 3:20 PM - LA 204

Section 02: M/W/F - 8:30 - 9:20 AM - MACN 113

### **Labs**

Section 01/02 - Wednesday 11:30 - 1:20 PM - THRN 2313

Section 03/04 - Tuesday 3:30 -5:20 PM - THRN 2313

Section 05/06 - Thursday 10:30 - 12:20 PM - THRN 2313

## **1.4 Final Exam**

Date: April 19, 2024, Friday, 8:30 AM- 10:30 AM

Location: TBA on WebAdvisor

Exam time and location is subject to change. Please see WebAdvisor for the latest information.

## **2 Instructional Support**

### **2.1 Instructional Support Team**

<b>Instructor:</b>	Jhantu Kumar Saha Ph.D.,P.Eng
<b>Email:</b>	jsaha@uoguelph.ca
<b>Telephone:</b>	+1-519-824-4120 x53085
<b>Office:</b>	RICH 1517A
<b>Office Hours:</b>	TBA on CourseLink or by appointment

### **2.2 Teaching Assistants**

<b>Teaching Assistant (GTA):</b>	Vahid Haseltalab
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<b>Office Hours:</b>	TBA on CourseLink or by appointment

<b>Teaching Assistant (GTA):</b>	Hossein Farani Sani
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<b>Teaching Assistant (GTA):</b>	Joelle Tiangco
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<b>Teaching Assistant (GTA):</b>	Ali Madadizadeh
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<b>Office Hours:</b>	TBA on CourseLink or by appointment
<b>Teaching Assistant (GTA):</b>	Hafiza Mamoona Khalid
<b>Email:</b>	hafizama@uoguelph.ca
<b>Office Hours:</b>	TBA on CourseLink or by appointment

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## 3 Learning Resources

### 3.1 Required Resources

#### Course Website (Website)

<https://courselink.uoguelph.ca/>

Course material, news, announcements, and grades will be regularly posted to the ENGG\*1500 Courselink site. You are responsible for checking the site daily.

#### Introduction to Linear Algebra for Science and Engineering 3rd ed. (Textbook)

D. Norman and D. Wolczuk, 2020, Pearson.

### 3.2 Communication and Email Policy

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 students.

It is your responsibility to abide by the following guidelines for all email correspondence:

- Send all emails from your uoguelph.ca e-mail account.
- Include the course code "ENGG\*1500" in the subject line of all emails.
- Use a professional tone and appropriate etiquette in all your correspondence. This includes addressing the email using the correct salutation (correct name and correct title).
- Before emailing a GTA or the instructor with a question, check the course outline and CourseLink announcements/newsfeed to see if your question has already been answered there.

Failure to follow these guidelines may result in your email being disregarded.

**Important:** Unprofessional emails will not be responded to. This includes those using l33t, text messaging shorthand, a complete lack of punctuation or capitals, etc. Furthermore, Miss., Mrs., Ms., and Mr. are inappropriate forms of address for any staff or faculty member who has a PhD. When communicating with a course instructor, (verbally or via email), please use Dr. Saha, or Professor. Emails using Mr. will not be responded to.

For all correspondence satisfying the above guidelines, the instructor and TAs will abide by the following guidelines:

- Respond to questions within 24 hours on weekdays. Do not expect replies on evenings, holidays, or weekends.
- Use a professional tone and appropriate etiquette in all correspondence.

Occasionally, an email may get missed, especially during busy times in the term. If you have not received a timely reply and you are confident that you have abided by all of the guidelines above, we apologize. Please resend your email and we will try to respond to it immediately.

## 4 Learning Outcomes

### 4.1 Course Learning Outcomes

By the end of this course, you should be able to:

1. Carry out operations on vectors and matrices
2. Characterise vector sets and sub-spaces based on linear combinations, linear independence, and bases
3. Set up, manipulate, and solve systems of linear equations for a variety of engineering applications.
4. Solve matrix mapping problems.
5. Comprehend bases and dimensions of column, row, and null spaces and determine vectors in these sub-spaces
6. Calculate and comprehend determinants, eigenvalues and eigenvectors
7. Describe and evaluate the properties of matrices including inverse matrices, identity matrices, and transpose matrices.
8. Apply the concepts of determinant , eigenvalues, and eigenvectors to solve linear algebra problems
9. Calculate and comprehend complex numbers
10. Use Matlab to solve linear algebra problems.

### 4.2 Engineers Canada - Graduate Attributes (2018)

Successfully completing this course will contribute to the following:

#	Outcome	Learning Outcome
1	Knowledge Base	1, 2, 3, 4, 5, 6, 7, 8, 9, 10
1.1	Recall, describe and apply fundamental mathematical principles and	1, 2, 3, 4, 5, 6, 7, 8, 9,

#	Outcome	Learning Outcome
	concepts	10
5	Use of Engineering Tools	10
5.1	Select appropriate engineering tools from various alternatives	10
5.2	Demonstrate proficiency in the application of selected engineering tools	10
5.3	Recognize limitations of selected engineering tools	10

## 5 Teaching and Learning Activities

### 5.1 Lecture Schedule

The following is a rough guideline for the lecture topics and is subject to change:

- **Lectures 1-2 - Introduction to vectors:** notation, scalar multiplication, vector addition, vector definition, basic vector/matrix forms (Identity, transpose, diag, etc.), linear combinations
- **Lectures 3-6 - Solving systems of linear equations (SLE):** reduced row echelon form, irrigation example
- **Lectures 7-9 - Existence and uniqueness:** homogeneous and general forms, irrigation and chemical balance applications
- **Lectures 10-12 - Spaces:** Subspace and vector spanning, bases, dimensions, rank, column space, null space
- **Lectures 13-15 - Summative review**
- **Lecture 16: Proofs**
- **Lectures 17-19 - Coordinates and projection:** Norm, dot product, projection, perpendicular, coordinates, closest point
- **Lectures 20-22 - Additional Matrix concepts:** matrix multiplication, determinant, inverse.
- **Lectures 23-25 - Eigenvalues and eigenvectors:** characteristic polynomial, eigenspaces, algebraic and geometric multiplicity, principal component analysis
- **Lectures 26-28 - Summative review:** PCA
- **Lectures 29-31 - Diagonalization:** matrix diagonalization, updated equations, Markov
- **Lectures 32-33 - Complex numbers:** addition, multiplication, conjugate
- **Lectures 34-36 - Summative review**

### 5.2 Lab/tutorial schedule

Labs run in alternate weeks, starting in week 1 (Jan.8).

If you are in lecture section 1 (2:30-3:20 PM lectures), you will attend the lab in weeks 1,3,6,7,9,11.

If you are in lecture section 2 (8:30-9:20 AM lectures), you will attend the lab in weeks 2,4,6,8,10,11.

Reading week (week of Feb 19) does not count as a week.

Due to space/safety constraints, you must attend your scheduled lab time/date.

### 5.3 Other Important Dates

Please see the schedule of dates for other important dates in the academic year:  
<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c03/index.shtml>

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## 6 Assessments

### 6.1 Marking Schemes & Distributions

If you do better on the final exam than on midterm 1, the weight of midterm 1 will be moved to the final.

If you do better on the final exam than on midterm 2, the weight of midterm 2 will be moved to the final.

Name	Scheme A (%)	Scheme B (%)	Scheme C (%)	Scheme D (%)
Matlab Quizzes	10	10	10	10
Midterm 1	20	0	20	0
Midterm 2	20	20	0	0
Final Exam	50	70	70	90
Total	100	100	100	100

### 6.2 Assessment Details

#### Lab Assessments (10%)

**Date:** Week 6, 11

**Learning Outcome:** 1, 3, 4, 6, 7, 8, 9, 10

There are two lab tests. These are 5-minute oral tests where you are expected to present to GTA with your

code displayed on monitor and answer questions about your Matlab code. You may be asked to change to the

code during the test. Each test is worth 5%. Week 6 will be Lab for test 1 and Week 11 will

be for lab test 2. Students of section 1 will be attending during 1st half of the lab and students of section 2 will be attending during 2nd half of the lab.

#### **Midterm 1 (20%)**

**Date:** Sat, Feb 10, 3:00 PM - 4:30 PM, RICH 2520 and RICH 2529

**Learning Outcome:** 1, 2, 3, 5, 10

Exam time and location is subject to change. Please see the CourseLink announcement for the latest information.

#### **Midterm 2 (20%)**

**Date:** Sat, Mar 23, 3:00 PM - 4:30 PM, RICH 2520 and RICH 2529

**Learning Outcome:** 1, 2, 3, 5, 10

Exam time and location is subject to change. Please see the CourseLink announcement for the latest information.

#### **Final Exam (50%)**

**Date:** Fri, Apr 19, 8:30 AM - 10:30 AM, TBA on Web Advisor

**Learning Outcome:** 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

Exam date and location is subject to change. Please see WebAdvisor for the latest information.

## **7 Course Statements**

### **7.1 Course Grading Policies**

**Important:** These are challenging times. If you or your loved ones are experiencing complications or stresses due to COVID or any other circumstances, please reach out for help **before** the assessments.

**Missed midterm:** If you miss a midterm for any reason (school policy applies), you must notify the professor ASAP and the weight of the midterm will be placed on the final exam. If no notice is received by the professor within 1 week after the midterm exam you will receive zero for the corresponding midterm.

**Missed lab:** If you miss a lab due to grounds for academic or religious consideration, you must contact the instructor and the GTA **before** the missed lab. If you do not contact the instructor before your scheduled lab slot, you will receive a grade of zero.

- Be noted: all the weights of the lab test are not transferrable to the final.

## **8 School of Engineering Statements**

### **8.1 Instructor's Role and Responsibility to Students**

The instructor's role is to develop and deliver course material in ways that facilitate learning for a variety of students. Selected lecture notes will be made available to students on Courselink but these are not intended to be stand-alone course notes. Some written lecture

notes will be presented only in class. During lectures, the instructor will expand and explain the content of notes and provide example problems that supplement posted notes. Scheduled classes will be the principal venue to provide information and feedback for tests and labs.

## 8.2 Students' Learning Responsibilities

Students are expected to take advantage of the learning opportunities provided during lectures and lab sessions. Students, especially those having difficulty with the course content, should also make use of other resources recommended by the instructor. Students who do (or may) fall behind due to illness, work, or extra-curricular activities are advised to keep the instructor informed. This will allow the instructor to recommend extra resources in a timely manner and/or provide consideration if appropriate.

## 8.3 Lab Safety

Safety is critically important to the School and is the responsibility of all members of the School: faculty, staff and students. As a student in a lab course you are responsible for taking all reasonable safety precautions and following the lab safety rules specific to the lab you are working in. In addition, you are responsible for reporting all safety issues to the laboratory supervisor, GTA or faculty responsible.

# 9 University Statements

## 9.1 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.

## 9.2 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>

## 9.3 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>

## 9.4 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.

## 9.5 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 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.

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>

## 9.6 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>

## 9.7 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.

## 9.8 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>

## 9.9 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).

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