ENGG*1500 Engineering Analysis

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Winter 2021
Section(s): C01

School of Engineering
Credit Weight: 0.50
Version 3.00 - January 12, 2021

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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

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.

All lectures and labs/tutorials are synchronous online.

1.4 Final Exam

Date & Time, Wednesday April 21, 2021 11:30AM - 01:30PM

Final exam time is subject to change. Please see Webadviser for the latest information.

The final exam and midterms will be open-book, closed internet, individual, submitted via Crowdmark, and invigilated via Zoom. A webcam and scanner/camera is required.

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2 Instructional Support

2.1 Instructional Support Team

Instructor: Julie Vale
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2.2 Teaching Assistants

Teaching Assistant: Nicholas Belanger
Email: belangen@uoguelph.ca

Teaching Assistant: Ye Eun Chai
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Teaching Assistant: Sara El-Shawa
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Teaching Assistant: Troy Kozlowski
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Teaching Assistant: Nikan Momenbeitollahi
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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 Julie, Dr. Vale, or Professor

Emails using Miss., Mrs., or Ms. 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.

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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 concepts	1, 2, 3, 4, 5, 6, 7, 8, 9, 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

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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 1-3 - 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, columnspace, null space
- **Lectures 13-15 - Summative review:** Sensor mapping problem, mind-map
- **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 application (part 1)
- **Lectures 26-28 - Summative review:** PCA
- **Lectures 29-31 - Diagonalization: m**atrix diagonalization, updated equations, Markov
- **Lectures 32-33 - Complex numbers:** addition, multiplication, conjugate
- **Lectures 34-36 - Summative review:** convergence of general update equations, mind map

5.2 Lab/tutorial schedule

Reading week (Feb 15) does not count as a week and occurs between weeks 5 and 6.

- Week 1 (Jan 11): No labs
- Week 2: Module 1
- Week 3: Module 2
- Week 4 and 5: Open office hours
- Week 6 and 7: Lab quiz 1
- Week 8: Module 4
- Week 9: Open office hours
- Week 10: Module 5

- Week 11 and 12: Lab quiz 2

Note that the lab on April 2 is moved to April 12 due to the Holiday weekend.

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

The scheme below assumes that you do better on all tests and quizzes than on the final exam.

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

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

If you do better on the final exam than on the combination of the quizzes, the weight of the overall quiz grade will be moved to the final.

A detailed table of all possibilities will be provided on courselink.

Name	Scheme A (%)
Lab tests	10
Quizzes	10
Test 1	15
Test 2	15
Final Exam	50
Total	100

6.2 Assessment Details

Lab tests (10%)

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 share you screen and answer questions about your matlab code. You may be asked to change to the

code during the test. Each test is worth 5%

Quizzes (10%)

Date: Dates listed below
Learning Outcome: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
There are 3 opportunities to complete short (10 minute) quizzes during the term. These quizzes are designed to help you build your mental math and procedural math skills.

The first quiz (2%) is in week 2 and the topic is the course outline. This quiz opens Monday January 18 at 8:30am and closes Friday January 22 at 4:30pm. You have infinite attempts and are welcome to collaborate.

The second quiz (4%) will open Friday February 12, 9am. You will have 10 minutes to complete it, one attempt, no going backwards on questions, no collaboration with classmates. There is no invigilation.

The third quiz (4%) will open Friday March 19, 9am. You will have 10 minutes to complete it, one attempt, no going backwards on questions, no collaboration with classmates. There is no invigilation.

If you do better on the final exam, the weight of the quizzes will be transferred to the final exam.

Test 1 (15%)

Date: Wed, Feb 10, 6:00 PM - , 8:00 PM
Learning Outcome: 1, 2, 3, 5, 10
Test 1 is open book, closed internet, and individual. Zoom will be used to invigilate.

If you do better on the final exam, the weight of this test will be shifted to the final.

Test 2 (15%)

Date: Sat, Mar 20, 3:00 PM - , 5:00 PM
Learning Outcome: 1, 2, 3, 5, 10
Test 2 is open book, closed internet, and individual. Zoom will be used to invigilate.

If you do better on the final exam, the weight of this test will be shifted to the final.

Final Exam (50%)

Date: Wed, Apr 21, 11:30 AM - 1:50 AM
Learning Outcome: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
Final is open book, closed internet, and individual. Zoom will be used to invigilate.

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7 Course Statements

7.1 Graduate Attributes

Successfully completing this course will contribute to the following CEAB Graduate Attributes:

Learning

Graduate Attribute	Objectives	Assessment
1. Knowledge Base	all	all
5. Use of Engineering Tools	7	tutorials
6. Communication	all	tutorials

7.2 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 term test: If you miss a term test for any reason, the weight of the test will be placed on the final exam.

Missed quiz: Missed quizzes will receive a grade of zero. If (for any reason) the overall quiz grade is less than the final exam grade, the weight of the quizzes will be transferred to the final exam.

Late test submissions: All term tests and exams will be summitted online through Crowdmark. Late submissions will be penalized at a rate of 5% per minute using Crowdmark's built-in late penalty system.

Missed lab test: If you miss a lab test due to grounds for academic or religious consideration, you must contact the instructor and the GTA **before** the missed lab, in which case you will be allowed to schedule a make-up time. If you do not contact the instructor before your scheduled lab slot, you will receive a grade of zero. In extenuating/extreme circumstances, notification of absence *after* the lab is acceptable - the instructor determines what constitutes extenuating/extreme circumstances.

General academic consideration regulations: See the undergraduate calendar for information on regulations and procedures for Academic Consideration:

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

Please also See the undergraduate calendar for information on regulations and procedures for Academic
Consideration of Religious Obligations:
http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-accomrelig.shtml

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 book their exams at least 7 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

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 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://news.uoguelph.ca/2019-novel-coronavirus-information/) and circulated by email.

9.10 Illness

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.
