



ENGG*1500 Engineering Analysis

Fall 2019

Section(s): C01

School of Engineering

Credit Weight: 0.50

Version 1.00 - September 04, 2019

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 to give you exposure to real problems that you will use throughout your engineering career.

1.3 Timetable

Lectures: Tuesday and Thursday

4:00AM - 5:20 PM, ALEX Room 200

Labs and Tutorials:

101, 102 Tuesday, 8:30 AM -10:20 AM THRN 2313

103, 104 Thursday, 8:30 AM - 10:20 AM THRN 2313

Midterm: 3:00 PM to 4:30 PM, Saturday, October 19, 2019; Location: RICH 2520

Midterm exam will be closed-book but a formula sheet will be provided. The time and location of midterm are subject to change. Please see Couselink for the latest information.

Midterm make-up: 2:00 PM to 3:30 PM, Wednesday, October 23, 2019; Location: TBD

Pre-approval is required for attending the make-up midterm (please see 6. Assessments for details). Midterm make-up exam will be closed-book but a formula sheet will be provided. The time and location of midterm make-up exam are subject to change. Please see Couselink for the latest information.

1.4 Final Exam

FINAL EXAM,

Date & Time, 2:30 PM - 4:30 PM, 2019/12/04

Room TBA

Final exam will be closed-book but a formula sheet will be provided. Final exam time and location is subject to change. Please see Webadviser for the latest information.

2 Instructional Support

2.1 Instructional Support Team

| | |
|----------------------|--|
| Instructor: | Sheng Chang Ph.D., P.Eng |
| Email: | schang01@uoguelph.ca |
| Telephone: | +1-519-824-4120 x56619 |
| Office: | THRN 2519 |
| Office Hours: | Thursday 11:00 AM -12:00 PM, THRN 2519 |

2.2 Teaching Assistants

Aneela Hayder

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3 Learning Resources

3.1 Required Resources

2.1 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 regularly.

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

D. Norman and D. Wolczuk, 1995, Pearson.

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 |

5 Teaching and Learning Activities

5.1 Lecture Schedule

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

- Week 1: Course introduction, vector definition and linear combinations, vector dot products, matrix multiplication;
- Week 2: Solving systems of linear equations (SLE) using row echelon form method, ranks & SLE solutions,
- Week 3: Balance chemical equilibrium equations, solutions of $Ax=0$, vector linear independence
- Week 4: Subspace and vector spanning, bases and dimensions of subspaces, column space, row space, and null space, bases and dimensions of $Col(A)$, $Row(A)$, and $Null(A)$,
- Week 5: Proof examples and Irrigation application example
- Week 6: Midterm review
- Week 7: Matrix mapping, sensor application
- Week 8: Norm, projection, and orthonormal vectors, determinant, inverse matrices.
- Week 8: Eigenvalues and eigenvectors, algebraic and geometric multiplicity

- Week 9: Matrix diagonalization, applications of eigenvalues and eigenvectors
- Week 10: Markov Processes, symmetric matrix and quadratic form
- Week 11: Complex numbers, polar forms of complex numbers, operations on complex numbers,
- Week 12: Final review

5.2 Other Important Dates

September 5, Thursday,: Classes commence

October 14 Monday: holiday

October 15 Tuesday: holiday

November 29, Friday: Classes conclude

Please see 2019-2020 undergraduate calendar for other important dates.

<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c03/index.shtml>

6 Assessments

6.1 Marking Schemes & Distributions

- Midterm: 25%
- Final: 60%
- Quizzes: 5%
- Tutorial and Lab: 10%

6.2 Assessment Details

Quizzes (5%)

Date: Tue, Sep 17 - Thu, Nov 28

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

Quizzes: Quizzes are held in the first 5 - 10 minutes of every tutorial. These are tightly timed quizzes designed to help you improve your linear algebra calculation skills. No extra time will be given to students who arrive late. If you typically write tests with SAS, please contact the instructor to discuss alternate options.

Tutorials and Matlab labs (10%)

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

There are five (5) tutorial/labs. Attendance will be taken at tutorials. Grades are allocated based on a combination of submitted worksheets and in-lab assessment of MATLAB codes. Please see courselink for guidelines and expectations for each lab. Please attend your assigned tutorial section. A makeup session will be available in the last week of class.

Midterm (25%)

Date: Sat, Oct 19, 3:00 PM - 4:30 PM, RICH 2520

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

Final Exam (60%)

Date: Wed, Dec 4, 2:30 PM - 4:30 PM, TBD

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

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

Missed Assessments: If you are unable to meet an in-course requirement due to medical, psychological, or compassionate reasons, please email the instructor. 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>

Accommodation of Religious Obligations: If you are unable to meet an in-course requirement due to religious obligations, please email the instructor within two weeks of the start of the

semester to make alternate arrangements. 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>

Missed midterm: If you miss the midterm exam due to grounds for granting academic consideration or religious accommodation, please contact the instructor. If your documentation is adequate, you will have the opportunity to write a make-up midterm exam. If you are unable to attend the make-up exam as well due to grounds for granting academic consideration or religious accommodation, please contact the instructor. If your documentation is adequate, the weight of the midterm will be moved to the final exam as there will be no further make-up midterm exam.

No extra time will be given to students who arrive late to any of these assessments.

Missed labs/tutorials: If you miss ONE lab/tutorial, you can attend the tutorial sessions during the makeup week. No documentation is required. If you miss more than one lab/tutorial due to grounds for granting academic consideration or religious accommodation, you must have documentation for ALL missed lab/tutorials. Please contact the instructor. The weight of the missed lab/tutorials will be placed onto the final exam only if your documentation for grounds for granting academic consideration or religious accommodation is adequate.

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>
