# ENGG*1500 Engineering Analysis
## Winter 2018

UNIVERSITY
*of* GUELPH

School of Engineering
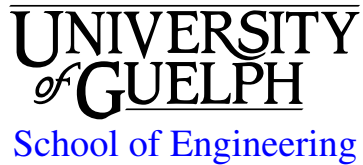
(Revision 0: December, 2017)

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# 1 INSTRUCTIONAL SUPPORT

## 1.1 Instructors

| | |
|---|---|
| Instructor: | Julie Vale, Ph.D., P.Eng. |
| Office: | THRN 2340, ext. 54863 |
| Email: | jvale@uoguelph.ca |
| Office hours: | TBD |

| | |
|---|---|
| Instructor: | Sheng Chang, Ph.D., P.Eng. |
| Office: | RICH 2519, ext. 56619 |
| Email: | schang01@uoguelph.ca |
| Office hours: | TBD |

| | |
|---|---|
| Instructor: | Jhantu Kumar Saha, Ph.D., EIT |
| Office: | THRN 2361, ext. 53385 |
| Email: | jsaha@uoguelph.ca |
| Office hours: | TBD |

## 1.2 Teaching Assistants

| GTA | Email |
|---|---|
| Abeer Al-Hyari | aalhyari@uoguelph.ca |
| Fil D'Alessandro | fdalessa@uoguelph.ca |
| Boris Knyazev | bknyazev@uoguelph.ca |
| Kelsie McNeill | kmcnei02@uoguelph.ca |
| Teresa Pilato | tpilato@uoguelph.ca |
| Sebastian Sadowski | ssadowsk@uoguelph.ca |
| Carlos Sanchez Ramirez | sanchezc@uoguelph.ca |
| Robinderpal Singh | robinder@uoguelph.ca |
| Eu Wern Teh | eteh@uoguelph.ca |
| Sandra Vrban | svrban@uoguelph.ca |

# 2 LEARNING RESOURCES

## 2.1 Course Website

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

## 2.2 Required Resources

1. D. Norman and D. Wolczuk, *Introduction to Linear Algebra for Science and Engineering* 2nd ed., Pearson, 1995.

## 2.3 Alternate textbook

W. Keith Nicholson, *Linear Algebra with Applications, 7th ed*, McGraw-Hill Ryerson, 2013 (A copy has been placed in the library course reserve)

## 2.4 Additional Resources

**Lecture Information:** Lecture notes will be posted to courselink prior to each lecture.

**Assignments:** Assignment questions are located at the end of each section of the course notes. Solutions to selected questions will be posted to the lecture notes section in Courselink by the instructor and the GTAs. Students are encouraged to post their attempts at solutions to the remaining questions in the discussion forums; GTAs and the instructor will monitor these discussions and will provide support to help students arrive at the correct solutions.

Assignments are not graded.

## 2.5 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 and forum correspondence:

- Send all email 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, Courselink announcements, or the discussion forums to see if your question has already been answered there.

- For forum questions, students are expected to answer each others questions as much as possible.

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

- Sheng, Dr. Chang, or Professor

- Jhantu, Dr. Saha, or Professor

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

- Visit the forum at least once daily on weekdays to 'approve' or 'like' student questions or solutions or to correct misinterpretations. The GTAs and the instructor will not answer questions unless a student has already attempted an answer.

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 for missing it. Please resend your email and we will try to respond to it immediately.

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# 3 ASSESSMENT

## 3.1 Dates and Distribution

**Quizzes:** Quizzes are held in the first 5-10 minutes of every tutorial. These are tightly timed quizzes designed to help you improve your mental math skills. No extra time will be given to students who arrive late. If you typically write tests with SAS, please contact Jhantu Saha jsaha@uoguelph.ca to discuss alternate options.

**Tutorials and Matlab labs:** 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 code. Please see courselink for guidelines and expectations for each lab.

All sections are full, so please attend your assigned tutorial section.

A makeup session will be available in the last week of class.

**Midterm** Thursday, February 15, 17:30-19:00, ROZH 104

**Final Exam:** Exam time and location is subject to change. Please see Webadvisor for the latest information.

**The breakdown for grading** the course is given below. Define Overall Course Grade $:= G$, Final exam $:= F$, Midterm $:= M$, and tutorials $=: T$ (all in percent).

If you do better on the final than midterm, more weight is placed on the final:

$$E := \frac{1}{0.85} \max\{0.5F + 0.35M, 0.6F + 0.25M\}.$$

If the overall exam grade is less than 60%, we use a linear interpolation to de-weight the tutorials and labs. This means that it is difficult (but not impossible) to pass the course if you fail both the midterm and the final, without having any 'if-then' discontinuities in the grades (note that it is common in engineering courses to have a 'you must pass the exams to pass the course' clause... this is actually gentler than that). To implement this linear interpolation, we use the following scaling factor

$$x := \frac{E - 40\%}{20\%}.$$

Your final grade is then given by

$$G := \begin{cases} 0.85E + 0.15T, & E \geq 60\% \\ \min\{(1-x)E + x(0.85E + 0.15T), \\ \qquad\qquad 0.85E + 0.15T\}, & 40\% \leq E \leq 60\% \\ \min\{E, \ 0.85E + 0.15T\} & E \leq 40\%. \end{cases}$$

The nominal weighting (i.e., if you get over 60% on everything and do better on the final than the midterm) is

- midterm=25%

- final=60%

- tutorials = 15%

In one of the tutorials, you will create a MATLAB-based grade calculator to help you experiment with different possible grade outcomes.

## 3.2 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 course 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 Jhantu Saha jsaha@uoguelph.ca 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 Jhantu Saha jsaha@uoguelph.ca. If your documentation is adequate, you will have the opportunity to write a make-up midterm exam on Monday February 26, 17:30-19:00. If you are unable to attend the make-up exam as well due to grounds for granting academic consideration or religious accommodation, please contact Jhantu Saha jsaha@uoguelph.ca.

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 (week of April 2). 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 Jhantu Saha jsaha@uoguelph.ca. If your documentation is adequate, the weight of the missed lab/tutorials will be placed onto the final exam.

**Bonus mark cap:** There are some bonus marks available in this course; however, no single assessment grade can be greater than 100%.

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# 4 AIMS, OBJECTIVES & GRADUATE ATTRIBUTES

## 4.1 Calendar Description

This course deals with engineering applications of matrix algebra, vector spaces and computer techniques to solve linear systems. Topics include linear transformations, eigenvalues and eigenvectors, diagonalization and their applications. Additional topics include complex variable algebra, multi-variable functions, partial derivatives, maxima and minima.
*Prerequisite(s):* MATH*1200 - Calculus

## 4.2 Course Aims

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.

## 4.3 Learning Outcomes

At the successful completion of this course, a student will be able to:

1. Describe and evaluate the properties of vectors and basic vector spaces and subspaces.

2. Set up, manipulate, and solve systems of linear equations for a variety of engineering applications.

3. Describe and evaluate the properties of matrices including inverse matrices, identity matrices, and transpose matrices.

4. Calculate, comprehend, and apply determinants and their applications

5. Calculate, comprehend, and apply eigenvalues and eigenvectors and their applications

6. Calculate, comprehend, and apply complex numbers and their applications

7. Use Matlab to solve various linear algebra problems.

### 4.4 Graduate Attributes

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

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

# 5 TEACHING AND LEARNING ACTIVITIES

Timetables are subject to change. Please see Webadvisor for the latest information.

Tutorials run in alternating weeks, with the even group starting in week 2, and the odd group in week 3. There are no tutorials during reading week.

### 5.1 Lecture Schedule

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

- Solving systems of equations (3 weeks):
    - Vector/matrix addition and multiplication
    - Writing system of equations in matrix form (thinking of a matrix as a relational table)
    - REF, RREF
    - How to express solutions when there is more than one possible answer (i.e., how to express a solution space)
    - Lecture on proofs
- Solution Space (3 weeks):
    - Idea of a matrix as a linear mapping (input and output spaces  heres where we can hint at the idea of a vector space)
    - Linear independence
    - Basis and span, including orthogonality, norms
    - Nullspace, and column space
- MIDTERM
- Reading week
- Determinants and inverse (1 week)
- Eigenvalues and eigenvectors (2 weeks)

- Complex numbers : addition, multiplication, powers, conjugates, polar ($re^{jtheta}$) and rectangular ($a + bj$) forms

- Finding Eigenvalues/vectors

- Using Eigenvalues/vectors

- Extras (3 weeks)

  - Definiteness

  - Similarity transform

  - Diagonalization

  - Markov

## 5.2 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

# 6 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.

# 7 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.

### 7.1    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/

Please also review the section on Academic Misconduct in your Engineering Program Guide.

The School of Engineering has adopted a Code of Ethics that can be found at:
http://www.uoguelph.ca/engineering/undergrad-counselling-ethics

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# 8   ACCESSIBILITY

The University of Guelph is committed to creating a barrier-free environment. Providing services for students is a shared responsibility among students, faculty and administrators. This relationship is based on respect of individual rights, the dignity of the individual and the University community's shared commitment to an open and supportive learning environment. Students requiring service or accommodation, whether due to an identified, ongoing disability for a short-term disability should contact the Student Accessibility Services (SAS) as soon as possible

For more information, contact SAS at 519-824-4120 ext. 56208 or email csd@uoguelph.ca or see the website: http://www.uoguelph.ca/csd/

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# 9   RECORDING OF MATERIALS

Presentations which are made in relation to 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.

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# 10   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