



UNIVERSITY OF WATERLOO
FACULTY OF ENGINEERING
Department of Electrical &
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NE 112 *Linear algebra for nanotechnology engineering*

0 Course introduction

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Introduction

- In this topic, we will
 - Introduce the course and undergraduate studies





Territorial acknowledgement

- I acknowledge that I live and work on the traditional territory of the Attawandaron (Neutral), Anishnaabeg and Haudenosaunee (Iroquois) peoples.
- The University of Waterloo is situated on the Haldimand Tract, the land promised to the Six Nations of the Haudenosaunee (the Cayuga, Mohawk, Oneida, Onondaga, Seneca and Tuscarora peoples) that includes six miles on each side of the Grand River.





NE

- One aspect of nanotechnology engineering undergraduate program is the incredible *esprit de corps*
 - Every year bonds much more strongly than many other programs
 - Try to keep this up, even if you are not seeing your peers
 - It is a valuable character in the program





Linear algebra

- Course description:

Matrices, operations on matrices. Determinants. Adjoint and inverses. Solution of linear equations: elimination and iterative methods. Eigenvalues and eigenvectors with engineering applications. Complex numbers.





Linear algebra

- All course material will be available online at
<https://ece.uwaterloo.ca/~ne112/>
- You will be primarily interested in:
 - Lecture materials
https://ece.uwaterloo.ca/~ne112/Lecture_materials/
 - Assignments
 - Examinations
- Other material is optional extras:
 - Example code in Python is provided for nearly every topic
 - These are not required for the course





Linear algebra

- The evaluation in this course includes:
 - 10 weekly assignments 20 %
 - A mid-term examination 30 %
 - A final examination 50 %
- All of these will be submitted on CrowdMark
 - Weekly assignments will be marked as follows:
 - Each assignment is worth 2 %
 - Of that, 1 % will be based on the correct completion of one randomly chosen question
 - The other 1 % will be based on substantial completion of the balance of the assignment
 - You are encouraged to work together on the assignments, but discuss the answers, don't share them





Outline

- In this course, we will:
 1. Introduce and become comfortable with complex numbers
 2. Learn about vector spaces, scalar multiplication and vector addition
 3. Understand the idea of a subspace
 4. Learn to calculate the length of vectors
 5. Learn to calculate the angle between vectors
 6. Describe linear combinations of vectors and solving systems of linear equations
 7. Take a digression to 3-dimensional vectors and the cross product





Outline

- With this foundation in vectors and vector spaces:
 8. Introduce matrices and linear mappings
 9. Find the inverse of a matrix
 10. Describe how we can factor matrices
 11. Describe the determinant and trace
 12. Introduce the adjoint and isometric matrices
 13. Describe and use eigenvalues and eigenvectors





Lecture materials

- All material is available in the course text book:
 - You can download this for free
- All lectures will be on YouTube and linked to from the course web site
 - These will be online after this course, as well
- Also on that page are:
 - A primer on vectors
 - Trigonometry made somewhat easier...
 - How large is a coulomb?





Lecture materials

- This course has no in-person lectures
 - You are expected to view the lectures online yourself
 - You will need to keep up with the lectures to do the assignments
 - The in-person lectures and any on-line sessions will follow up and expand on what is covered in the lecture material
 - Material will not be taught during the in-person lectures and any on-line sessions, but rather there will be discussions on the material, examples, and a question-and-answer session





Lecture materials

- Each lecture on YouTube has a number
 - This number corresponds to a section in the course text
 - Each section has questions with some answers
 - You are expected to do these questions on your own and to ask for help from your peers, the teaching assistants and myself





Learning

- Please remember:
 - Your brain transfers information from short-term memory into long-term memory
 - Not everything is transferred:
 - Only those items that you have been repeatedly exposed to
 - In secondary school, your teachers did this by repeatedly exposing you to the same material
 - In university, you'll have to do this on your own...
- Many of you will discover this right before the mid-term





Learning

- Please, help each other, but do not share your solutions:
 - It is a Policy 71 Violation if you transmit your solutions to another student, or you submit another student's work as your own
- Help each other, work together and discuss the assignments, but in the end, do these yourself





Summary

- In this topic, you now:
 - Have an idea as to what this course will cover
 - Know what is expected
 - Know where to find the course material
 - See you in class or on on-line





References

- [1] <https://ece.uwaterloo.ca/~ne112/>
- [2] https://ece.uwaterloo.ca/~ne112/Lecture_materials/





Acknowledgments

None so far.





Colophon

These slides were prepared using the Cambria typeface. Mathematical equations use Times New Roman, and source code is presented using Consolas.

The photographs of flowers and a monarch butter appearing on the title slide and accenting the top of each other slide were taken at the Royal Botanical Gardens in October of 2017 by Douglas Wilhelm Harder. Please see

<https://www.rbg.ca/>

for more information.





Disclaimer

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