



Mathematics 251 Matrix Algebra for Engineers Winter, 2023

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Timetable:

Time	Monday	Tuesday	Wednesday	Thursday	Friday
8:30 am - 9:20 am					
9:30 am - 10:20 am	MATH 101-003 Room Y219				
10:30 am - 11:20 am					
11:30 am - 12:20 pm	Office Hour E260				Office Hour E260
12:30 pm - 1:20 pm	MATH 251-X03 Room Y219		MATH 251-X03 Room Y219		MATH 251-X03 Room Y219
1:30 pm - 2:20 pm		MATH 101-003 Room Y219	Office Hour E260	MATH 101-003 Room Y219	MATH 101-003 Room Y219
2:30 pm - 3:20 pm		MATH 251-X03 Room Y219		MATH 251-X03 Room Y219	
3:30 pm - 4:20 pm			MATH 101-003 Room Y219		
4:30 pm - 4:50 pm					
5:00 pm - 5:50 pm		Office Hour E260		Office Hour E260	
6:00 pm - 6:50 pm		MATH 101-002 Room Y217	MATH 101-002 Room Y217	MATH 101-002 Room Y217	
7:00 pm - 7:50 pm					

Important Dates:	January 9	First day of class
	January 15	Add Course deadline
	January 15	Drop Course with 80% Tuition Refund deadline
	January 23	Deferred Tuition & Fee Payment deadline
	February 20	Family Day (no class)
	February 21-24	Reading Break (no class)
	April 7	Good Friday (no class)
	April 10	Easter Monday (no class)
	April 14	Last day of class
	April 15	Withdrawal deadline
	April 17-25	Final exam period

Calendar Description: This course in matrix algebra includes solving linear systems, performing matrix operations, performing computations with complex numbers, finding determinants, performing vector operations in 2-space and 3-space, vector spaces, linear dependence and independence, orthogonality, eigenvalues and eigenvectors, and linear transformations. Applications to engineering are provided throughout the course. [3 Credits]

(Source: Camosun College Calendar
calendar.camosun.ca/preview_course_nopop.php?catoid=11&coid=19166)

Prerequisites: This section of MATH 251 is restricted to Engineering Transfer program students. Program admission requires a B in Pre-calculus 12, MATH 115 or MATH 097; or A in MATH 107; or assessment.

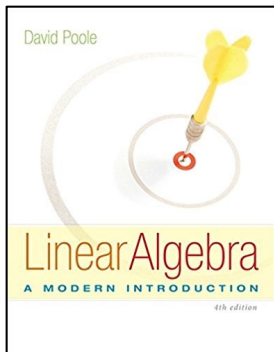
Exit Grade: A grade of at least C (60%) is required for Camosun's Engineering Transfer (First Year Engineering) Certificate and for transfer to UVic's Engineering program.

Textbook: David Poole, *Linear Algebra: A Modern Introduction*, 4th Edition, Cengage Learning, 2015.

Course Content:

Chapters and Sections

1. Vectors
 - 1.1 The Geometry and Algebra of Vectors
 - 1.2 Length and Angle: The Dot Product
 - 1.3 Lines and Planes
Exploration: The Cross Product
 2. Systems of Linear Equations
 - 2.1 Introduction to Systems of Linear Equations
 - 2.2 Direct Methods for Solving Linear Systems
 - 2.3 Spanning Sets and Linear Independence
 - 2.4 Applications
 3. Matrices
 - 3.1 Matrix Operations
 - 3.2 Matrix Algebra
 - 3.3 The Inverse of a Matrix
 - 3.4 The LU Factorization
 - 3.5 Subspaces, Basis, Dimension, and Rank
 - 3.6 Introduction to Linear Transformations
- Appendix C – Complex Numbers
4. Eigenvalues and Eigenvectors
 - 4.1 Introduction to Eigenvalues and Eigenvectors
 - 4.2 Determinants
Exploration: Geometric Applications of Determinants
 - 4.3 Eigenvalues and Eigenvectors of $n \times n$ Matrices
 - 4.4 Similarity and Diagonalization
 5. Orthogonality
 - 5.1 Orthogonality in \mathbb{R}^n
 - 5.2 Orthogonal Complements and Orthogonal Projections
 - 5.3 The Gram-Schmidt Process and the QR Factorization
 - 5.4 Orthogonal Diagonalization of Symmetric Matrices
 7. Distance and Approximation
 - 7.3 Least Squares Approximation



Learning Outcomes:

The Intended Learning Outcomes for this course, as approved by the Education Council, are as follows. Upon completion of this course the student will be able to:

1. Perform vector operations and use vectors to write parametric equations for lines and planes.
2. Use the dot product to find projections and to find angles between vectors.
3. Solve linear systems using row reduction.
4. Perform matrix operations and give examples of matrices with specific properties.
5. Determine if a transformation is a linear transformation and find the standard matrix for a linear transformation.
6. Find the inverse of an invertible matrix and use it to solve matrix equations.
7. Construct and use elementary matrices to perform row operations.
8. Find LU decompositions.
9. Determine whether a set of vectors is a basis and be able to prove simple facts about linear independence and spans. Find the components of a vector with respect to a given basis.
10. Determine whether a set of vectors in n -dimensional Euclidean space forms a subspace.
11. Use the Gram-Schmidt process to construct an orthonormal basis.
12. Find the matrix of a linear transformation in a different basis.
13. Find matrices for general linear transformations. Determine the kernels and ranges of general linear transformations.
14. Find determinants by cofactor expansion and use Cramer's rule to solve linear systems of equations.
15. Use the cross product to find areas, volumes, and perpendicular vectors.
16. Find eigenvalues and eigenvectors of matrices and linear transformations and construct diagonal matrices for the transformations.
17. Perform operations with complex numbers including finding the n 'th roots of complex numbers.

A&S Math Lab:

Ewing 224: This drop-in centre is freely available for your use to work on math homework and to seek help from the instructional assistant. Hours are posted on the door or online at camosun.ca/services/academic-supports/help-centres/math-help.

Academic Integrity:

The Department of Mathematics and Statistics has prepared a handout called [Student Guidelines for Academic Integrity](#) to help you interpret college policies involving student conduct, academic dishonesty, plagiarism, etc. It is your responsibility to become familiar with the contents of the document and the college policies it references.

Calculator Policy:

As per department policy, the only calculator permitted for use on tests and the final exam is the Sharp EL-531 (or EL-510R) scientific calculator. No other calculator or any other electronic device including cell phones, smartwatches, etc. is allowed.

Homework:

There will be periodic assignments (7 all together) to be completed on the worksheets provided and handed in for marking. While collaboration with your classmates is permitted, you must submit your *own* work and ensure you don't let collaboration turn into plagiarism. You may not post assignment questions to, or copy solutions from, "cheat" websites such as Chegg.

Due dates for assignments will be posted on the course webpage, and assignments are due before the end of class on the due dates. Solutions will be posted soon after assignments are collected. As such, *late assignments will not be accepted under any circumstances*. To accommodate situations where a student is unable to submit his or her assignment on time (e.g. due to illness), the lowest assignment mark will be dropped when computing the assignment average.

Tests:

Three term tests are tentatively scheduled for the following dates:

- Test 1 on Friday, February 10
Sec 1.1-1.3, Expl. Cross Product, 2.1-2.4
- Test 2 on Friday, March 10
Sec 3.1-3.6
- Test 3 on Tuesday, April 11
Sec App. C, 4.1-4.4, Expl. Determinants, 5.1-5.2

If you miss a test for a legitimate reason such as illness, accident or family affliction, you should notify me (by email, phone/voicemail, or in person) *as soon as possible* and *before* the test (unless circumstances reasonably prevent you from doing so) and be prepared to provide supporting documentation upon your return. There will be no "make-up" tests, but instead, in the event of an excused absence, the mark from your final exam, or relevant subset thereof, will replace your test mark.

Final Exam:

A comprehensive, 3-hour final exam will take place during the final exam period of April 17-25. The specific date, time, and location will be announced on or about February 17. You must write the final exam at the scheduled time as per Camosun College's policy on final examinations. See camosun.ca/registration-records/policies-and-procedures-students/academic-policies-and-procedures-students.

Grade Calculation:

The final grade will be calculated according to the following breakdown:

- 7 Assignments: 15%*
- 3 Term Tests: 45%
- Final Exam: 40%

* The lowest assignment mark will be dropped when calculating the assignment average. This allows you to miss one assignment for any reason, including illness, without penalty. *Late assignments will not be accepted.*

Grade Scale:

Final letter grades are assigned as follows:

0-49	50-59	60-64	65-69	70-72	73-76	77-79	80-84	85-89	90-100
F	D	C	C+	B-	B	B+	A-	A	A+

For information on Camosun College's grading policy, see policy E-1.5 online at camosun.ca/about/camosun-college-policies-and-directives/education/academic.