COURSE SYLLABUS

Camosun College respectfully acknowledges that our campuses are located on the traditional territories of the Lək̓ʷəŋən and W̱SÁNEĆ peoples. We honour their knowledge and welcome to all students who seek knowledge here.

COURSE TITLE: MATH-251: Matrix Algebra for Engineers

CLASS SECTION: X01 and X02

TERM: WINTER 2025

COURSE CREDITS: 3

DELIVERY METHOD(S): FACE-TO-FACE

INSTRUCTOR DETAILS

NAME: LEAH HOWARD

EMAIL: HowardL@camosun.ca

OFFICE: CBA 151, Interurban

HOURS: Tues 11:30-1:20, Wed 9:30-10:20, Thurs 11:30-12:20, Fri 9:30-10:20

WEBSITE: www.leahhoward.com

As your course instructor, I endeavour to provide an inclusive learning environment. However, if you experience barriers to learning in this course, do not hesitate to discuss them with me. Camosun College is committed to identifying and removing institutional and social barriers that prevent access and impede success.

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.

PREREQUISITE(S):
Restricted to students in Engineering Bridge or Engineering Transfer

CO-REQUISITE(S):
Not Applicable

EXCLUSION(S):
Not Applicable

COURSE LEARNING OUTCOMES / OBJECTIVES

Upon completion of this course students 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.

REQUIRED MATERIALS & RECOMMENDED PREPARATION / INFORMATION

Any scientific calculator (non-programmable, non-graphing).

There is no required textbook. Suggested homework problems are on D2L and full solutions are on the course website.

Skeleton notes are available at www.leahhoward.com/251skeleton.pdf
These can be printed at the Satellite Printshop (in the Atrium of the CBA Building).
Bring the file on a flash drive and the Satellite Printshop will print it for you at a low cost.

Optional Text: ***Linear Algebra: A Modern Introduction by Poole.***
This can be purchased at the Camosun Bookstore.

COURSE SCHEDULE, TOPICS, AND ASSOCIATED PREPARATION / ACTIVITY / EVALUATION

The following schedule and course components are subject to change with reasonable advance notice, as deemed appropriate by the instructor.

A detailed pacing schedule can be found on the last page of this outline.

1.1 Geometry and Algebra of Vectors
1.2 Length and Angle
1.3 Lines and Planes
1.4 Cross Product

2.1 Linear Systems
2.2 Solving Systems
2.3 Spanning Sets and Linear Independence
2.4 Applications of Linear Systems

3.1 Matrix Operations
3.2 Matrix Algebra
3.3 The Inverse of a Matrix
Introduction to MATLAB
3.4 LU Factorization
3.5 Subspaces, Basis, Dimension and Rank
3.6 Linear Transformations

4.1 Eigenvalues and Eigenvectors of 2 x 2 Matrices
4.2 Determinants
4.3 Eigenvalues and Eigenvectors of n x n Matrices
4.4 Diagonalization

5.1 Orthogonality
5.2 Orthogonal Complements and Projections
5.3 The Gram-Schmidt Process and QR Factorization
5.4 Orthogonal Diagonalization

7.3 Least Squares Approximation
Complex Numbers

Students registered with the Centre for Accessible Learning (CAL) who complete quizzes, tests, and exams with academic accommodations have booking procedures and deadlines with CAL where advanced noticed is required. Deadlines scan be reviewed on the CAL exams page. http://camosun.ca/services/accessible-learning/exams.html

EVALUATION OF LEARNING

DESCRIPTION	WEIGHTING
Test 1 (50 minutes long, Covers 1.1-1.4, 2.1-2.2) Wed Jan 29	17%
Assignment 1 (Covers MATLAB) Due Tues Feb 25	4.5%
Test 2 (50 minutes long, Covers 2.3-2.4, 3.1-3.3) Wed Feb 26	17%
Test 3 (50 minutes long, Covers 3.4-3.6, 4.1-4.2) Wed Mar 19	17%
Assignment 2 (Covers 4.3-4.4, 5.1-5.3) Due Tues April 8	4.5%
Final Exam (Three Hours Long, Covers Entire Course)	40%
TOTAL	100%

If you have a concern about a grade you have received for an evaluation, please come and see me as soon as possible. Refer to the Grade Review and Appeals policy for more information. http://camosun.ca/about/policies/education-academic/e-1-programming-and-instruction/e-1.14.pdf

COURSE GUIDELINES & EXPECTATIONS

The secret to success in this course is doing your suggested homework problems after each section. If you have questions: Ask me after class, come to office hours, or email me.

SCHOOL OR DEPARTMENTAL INFORMATION

Free math help is available in the Math Lab, TEC 142. Hours are posted on the door.

STUDENT RESPONSIBILITY

Enrolment at Camosun assumes that the student will become a responsible member of the College community. As such, each student will display a positive work ethic, assist in the preservation of College property, and assume responsibility for their education by researching academic requirements and policies; demonstrating courtesy and respect toward others; and respecting expectations concerning attendance, assignments, deadlines, and appointments.

SUPPORTS AND SERVICES FOR STUDENTS

Camosun College offers a number of services to help you succeed in and out of the classroom. For a detailed overview of the supports and services visit http://camosun.ca/students/.

Academic Advising	http://camosun.ca/advising
Accessible Learning	http://camosun.ca/accessible-learning
Counselling	http://camosun.ca/counselling
Career Services	http://camosun.ca/coop
Financial Aid and Awards	http://camosun.ca/financialaid
Help Centres (Math/English/Science)	http://camosun.ca/help-centres
Indigenous Student Support	http://camosun.ca/indigenous
International Student Support	http://camosun.ca/international/
Learning Skills	http://camosun.ca/learningskills
Library	http://camosun.ca/services/library/
Office of Student Support	http://camosun.ca/oss
Ombudsperson	http://camosun.ca/ombuds
Registration	http://camosun.ca/registration
Technology Support	http://camosun.ca/its
Writing Centre	http://camosun.ca/writing-centre

If you have a mental health concern, please contact Counselling to arrange an appointment as soon as possible. Counselling sessions are available at both campuses during business hours. If you need urgent support after-hours, please contact the Vancouver Island Crisis Line at 1-888-494-3888 or call 911.

COLLEGE-WIDE POLICIES, PROCEDURES, REQUIREMENTS, AND STANDARDS

Academic Accommodations for Students with Disabilities

The College is committed to providing appropriate and reasonable academic accommodations to students with disabilities (i.e. physical, depression, learning, etc). If you have a disability, the Centre for Accessible Learning (CAL) can help you document your needs, and where disability-related barriers to access in your courses exist, create an accommodation plan. By making a plan through CAL, you can ensure you have the appropriate academic accommodations you need without disclosing your diagnosis or condition to course instructors. Please visit the CAL website for contacts and to learn how to get started: http://camosun.ca/services/accessible-learning/

Academic Integrity

Please visit http://camosun.ca/about/policies/education-academic/e-1-programming-and-instruction/e-1.13.pdf for policy regarding academic expectations and details for addressing and resolving matters of academic misconduct.

Academic Progress

Please visit http://camosun.ca/about/policies/education-academic/e-1-programming-and-instruction/e-1.1.pdf for further details on how Camosun College monitors students' academic progress and what steps can be taken if a student is at risk of not meeting the College's academic progress standards.

Course Withdrawals Policy

Please visit http://camosun.ca/about/policies/education-academic/e-2-student-services-and-support/e-2.2.pdf for further details about course withdrawals. For deadline for fees, course drop dates, and tuition refund, please visit http://camosun.ca/learn/fees/#deadlines.

Grading Policy

Please visit http://camosun.ca/about/policies/education-academic/e-1-programming-and-instruction/e-1.5.pdf for further details about grading.

Grade Review and Appeals

Please visit http://camosun.ca/about/policies/education-academic/e-1-programming-and-instruction/e-1.14.pdf for policy relating to requests for review and appeal of grades.

Mandatory Attendance for First Class Meeting of Each Course

Camosun College requires mandatory attendance for the first class meeting of each course. If you do not attend, and do not provide your instructor with a reasonable reason in advance, you will be removed from the course and the space offered to the next waitlisted student. For more information, please see the "Attendance" section under "Registration Policies and Procedures" (http://camosun.ca/learn/calendar/current/procedures.html) and the Grading Policy at http://camosun.ca/about/policies/education-academic/e-1-programming-and-instruction/e-1.5.pdf.

Medical / Compassionate Withdrawals

Students who are incapacitated and unable to complete or succeed in their studies by virtue of serious and demonstrated exceptional circumstances may be eligible for a medical/compassionate withdrawal. Please visit http://camosun.ca/about/policies/education-academic/e-2-student-services-and-support/e-2.8.pdf to learn more about the process involved in a medical/compassionate withdrawal.

Sexual Violence and Misconduct

Camosun is committed to creating a campus culture of safety, respect, and consent. Camosun's Office of Student Support is responsible for offering support to students impacted by sexual violence. Regardless of when or where the sexual violence or misconduct occurred, students can access support at Camosun. The Office of Student Support will make sure students have a safe and private place to talk and will help them understand what supports are available and their options for next steps. The Office of Student Support respects a student's right to choose what is right for them. For more information see Camosun's Sexualized Violence and Misconduct Policy: http://camosun.ca/about/policies/education-academic/e-2-student-services-and-support/e-2.9.pdf and camosun.ca/sexual-violence. To contact the Office of Student Support: oss@camosun.ca or by phone: 250-370-3046 or 250-3703841

Student Misconduct (Non-Academic)

Camosun College is committed to building the academic competency of all students, seeks to empower students to become agents of their own learning, and promotes academic belonging for everyone. Camosun also expects that all students to conduct themselves in a manner that contributes to a positive, supportive, and safe learning environment. Please review Camosun College's Student Misconduct Policy at http://camosun.ca/about/policies/education-academic/e-2-student-services-and-support/e-2.5.pdf to understand the College's expectations of academic integrity and student behavioural conduct.

Changes to this syllabus: Every effort has been made to ensure that information in this syllabus is accurate at the time of publication. The College reserves the right to change courses if it becomes necessary so that course content remains relevant. In such cases, the instructor will give the students clear and timely notice of the changes.

Math 251 Schedule, Winter 2025

Jan 6-10	1.1, 1.2
Jan 13-17	1.3, 1.4
Jan 20-24	2.1, 2.2
Jan 27-31	2.3, 2.4 **Test 1 is Wed Jan 29**
Feb 3-7	3.1, 3.2
Feb 10-14	3.3, MATLAB
Feb 17-21	Reading Week
Feb 24-28	3.4, 3.5 **Assignment 1 due Tues Feb 25, Test 2 is Wed Feb 26**
Mar 3-7	3.5, 3.6
Mar 10-14	4.1, 4.2
Mar 17-21	4.3, 4.4 **Test 3 is Wed Mar 19**
Mar 24-28	5.1, 5.2
Mar 31-Apr 4	5.3, 5.4
Apr 7-11	7.3, Complex Numbers **Assignment 2 due Tues Apr 8**

Tentative Test Coverage
Test 1: 1.1-1.4, 2.1-2.2
Test 2: 2.3-2.4, 3.1-3.3
Test 3: 3.4-3.6, 4.1-4.2

Suggested Homework Problems for Poole 3rd Edition

Section	Numbers
1.1	1, 3, 5ab, 7, 9, 13, 17, 19, 21
1.2	3, 5, 11, 15, 17, 19, 25, 41, 43, 47, 49, 63
1.3	1, 3, 5, 7, 9, 13, 15, 19, 21, 23, 27, 29, 35, 37, 43
	Cross Product Parts I and II Problems and answers in the coursepack (after Section 1.3)
2.1	1, 3, 5, 15, 17, 21, 23, 27, 29, 33, 35 Correction to answers: #5 is nonlinear
2.2	1, 3, 7, 9, 11, 13, 23, 25, 27, 29, 33, 43, 45, 49
2.3	1, 3, 5, 7, 11, 13, 15, 23, 27, 29
2.4	5, 7, 15, 45a
3.1	1, 3, 5, 7, 9, 13, 15, 17, 19, 21, 35, 38a
3.2	1, 3, 5, 7, 9, 11, 13, 25, 35a, 37, 42
3.3	1, 5, 7, 9, 11, 19, 23, 31, 33, 35, 39, 43, 53, 55 #11: Use the inverse matrix to solve
3.4	1, 3, 7, 9
3.5	1, 3, 7, 11, 15, 17, 27, 29, 31, 35, 39, 41, 45, 51
3.6	1, 9, 11, 13, 15, 17, 21, 23, 25, 37, 39
4.1	1, 3, 5, 7, 11, 13, 15, 17, 23, 25, 37
4.2	1, 3, 11, 23, 27, 33, 35, 37, 45, 49, 51, 55, 57, 59, 63 #63: Use the adjoint formula
4.3	1, 3, 5, 9, 15, 22, 23
4.4	5, 7, 9, 13, 15, 17, 23

5.1	1, 3, 5, 7, 9, 13, 15, 17, 23 #23 Let Q be an orthogonal matrix Show that det Q equals plus or minus one
5.2	3, 7, 9, 13, 17, 21
5.3	1, 3, 5, 7, 9, 11, 13, 15, 17
5.4	1, 3, 5, 13a, 17, 19, 21, 23
7.3	7, 17, 21
	Complex Numbers Problems and answers in the coursepack (after Section 7.3)