COURSE SYLLABUS

COURSE TITLE: MATH-251-Matrix Algebra for Engineers
CLASS SECTION: X03

TERM: 2025W

COURSE CREDITS: 3

DELIVERY METHOD(S): Lecture

Camosun College respectfully acknowledges that our campuses are situated on the territories of the Lək̓ʷəŋən (Songhees and Kosapsum) and WSÁNEĆ peoples. We honour their knowledge and welcome to all students who seek education here.

INSTRUCTOR DETAILS

NAME: George Ballinger

EMAIL: ballinger@camosun.ca

OFFICE: E260

HOURS: Mon-Fri 10:30am-11:20am

Camosun College endeavours to provide an inclusive learning environment. However, if you experience barriers to learning in this course, then the college suggests you discuss them with your instructor. 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):

CO-REQUISITE(S):

EQUIVALENCIES:

COURSE LEARNING OUTCOMES / OBJECTIVES

Upon completion of this course a student will be able to:

Perform vector operations and use vectors to write parametric equations for lines and planes.

Use the dot product to find projections and to find angles between vectors.

Solve linear systems using row reduction.

Perform matrix operations and give examples of matrices with specific properties.

Determine if a transformation is a linear transformation and find the standard matrix for a linear transformation.

Find the inverse of an invertible matrix and use it to solve matrix equations.

Construct and use elementary matrices to perform row operations.

Find LU decompositions.

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.

Determine whether a set of vectors in n-dimensional Euclidean space forms a subspace.

Use the Gram-Schmidt process to construct an orthonormal basis.

Find the matrix of a linear transformation in a different basis.

Find matrices for general linear transformations. Determine the kernels and ranges of general linear transformations.

Find determinants by cofactor expansion and use Cramer's rule to solve linear systems of equations.

Use the cross product to find areas, volumes, and perpendicular vectors.

Find eigenvalues and eigenvectors of matrices and linear transformations and construct diagonal matrices for the transformations.

Perform operations with complex numbers including finding the n'th roots of complex numbers.

REQUIRED MATERIALS & RECOMMENDED PREPARATION / INFORMATION

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

Calculator: Sharp EL-531 (or EL-510R) scientific calculator

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.

WEEK or DATE RANGE	ACTIVITY or TOPIC	OTHER NOTES
Feb 7	Test 1 (sec 1.1-1.3, Expl. Cross Product and 2.1-2.4)	
Mar 7	Test 2 (sec 3.1-3.6)	
Apr 4	Test 3 (sec App. C, 4.1-4.4, Expl. Determinants and 5.1-5.2)	
Apr 14-25	Final Exam	

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×n Matrices

4.4 Similarity and Diagonalization

5. Orthogonality

5.1 Orthogonality in 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

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 can be reviewed on the CAL exams page. https://camosun.ca/services/academic-supports/accessible-learning/academic-accommodations-exams

EVALUATION OF LEARNING

DESCRIPTION	WEIGHTING
Test 1	15%
Test 2	15%
Test 3	15%
Assignments (best 6 of 7)	15%
Final Exam	40%
TOTAL	100%

If you have a concern about a grade you have received for an evaluation, the College recommends you contact your instructor as soon as possible. Refer to the Grade Review and Appeals policy for more information.

https://camosun.ca/sites/default/files/2021-05/e-1.14.pdf

COURSE GUIDELINES & EXPECTATIONS

Homework: There will be periodic assignments (7 all together) to be completed and handed in for marking. They must be completed on the worksheets provided (not on blank paper), copies of which will be handed out in class. 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 and ChatGPT.

Due dates for assignments will be posted on the course webpage, and assignments are due by the end of class on the due dates. If you are unable to hand in a hardcopy of your assignment solutions, you may scan and email me a single PDF file (not JPG images) of your assignment so long as it prints legibly and arrives by the deadline. Solutions will be posted soon after assignments are collected. As such, *late assignments will not be accepted under any circumstances*. To further 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.

Test Absences: 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, 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.

SCHOOL OR DEPARTMENTAL INFORMATION

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.

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 camosun.ca/services.

Support Service	Website
Academic Advising	camosun.ca/services/academic-supports/academic-advising
Accessible Learning	camosun.ca/services/academic-supports/accessible-learning
Counselling	camosun.ca/services/health-and-wellness/counselling-centre
Career Services	camosun.ca/services/co-operative-education-and-career-services
Financial Aid and Awards	camosun.ca/registration-records/financial-aid-awards
Help Centres (Math/English/Science)	camosun.ca/services/academic-supports/help-centres
Indigenous Student Support	camosun.ca/programs-courses/iecc/indigenous-student-services
International Student Support	camosun.ca/international
Learning Skills	camosun.ca/services/academic-supports/help-centres/writing-centre-learning-skills
Library	camosun.ca/services/library
Office of Student Support	camosun.ca/services/office-student-support
Ombudsperson	camosun.ca/services/ombudsperson
Registration	camosun.ca/registration-records/registration
Technology Support	camosun.ca/services/its
Writing Centre	camosun.ca/services/academic-supports/help-centres/writing-centre-learning-skills

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 Integrity

Students are expected to comply with all College policy regarding academic integrity; which is about honest and ethical behaviour in your education journey. The following guide is designed to help you understand your responsibilities: https://camosun.libguides.com/academicintegrity/welcome
Please visit https://camosun.ca/sites/default/files/2021-05/e-1.13.pdf for Camosun's Academic Integrity policy and details for addressing and resolving matters of academic misconduct.

Academic Accommodations for Students with Disabilities

Camosun College is committed to achieving full accessibility for persons with disabilities. Part of this commitment includes arranging appropriate academic accommodations for students with disabilities to ensure they have an equitable opportunity to participate in all of their academic activities. If you are a student with a documented disability and think you may need accommodations, you are strongly encouraged to contact the Centre for Accessible Learning (CAL) and register as early as possible. Please visit the CAL website for more information about the process of registering with CAL, including important deadlines: https://camosun.ca/cal

Academic Progress

Please visit https://camosun.ca/sites/default/files/2023-02/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 https://camosun.ca/sites/default/files/2021-05/e-2.2.pdf for further details about course withdrawals. For deadline for fees, course drop dates, and tuition refund, please visit https://camosun.ca/registration-records/tuition-fees#deadlines.

Grading Policy

Please visit https://camosun.ca/sites/default/files/2021-05/e-1.5.pdf for further details about grading.

Grade Review and Appeals

Please visit https://camosun.ca/sites/default/files/2021-05/e-1.14.pdf for policy relating to requests for review and appeal of grades.

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 (see Medical/Compassionate Withdrawals policy). Please visit https://camosun.ca/services/forms#medical to learn more about the process involved in a medical/compassionate withdrawal.

Sexual Violence

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 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 Policy: https://camosun.ca/sites/default/files/2021-05/e-2.9.pdf and camosun.ca/services/sexual-violence-support-and-education.

To contact the Office of Student Support: oss@camosun.ca or by phone: 250-370-3046 or 250-370-3841

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 https://camosun.ca/sites/default/files/2021-05/e-2.5.pdf to understand the College's expectations of academic integrity and student behavioural conduct.

Looking for other policies?

The full suite of College policies and directives can be found here: https://camosun.ca/about/camosun-college-policies-and-directives

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.