



CAMOSUN COLLEGE
School of Arts & Science
Department of Mathematics & Statistics

MATH-251-X03
Matrix Algebra for Engineers
Winter 2020

COURSE OUTLINE

The course description is online @ <http://camosun.ca/learn/calendar/current/web/math.html>

Ω Please note: This outline will not be kept indefinitely. It is recommended students keep this outline for their records, especially to assist in transfer credit to post-secondary institutions.

1. Instructor Information

| | | |
|------------------|---|------------------|
| (a) Instructor | George Ballinger | |
| (b) Office hours | Mon-Fri, 10:30am-11:20am | |
| (c) Location | E260 | |
| (d) Phone | 250-370-3116 | Alternative: n/a |
| (e) E-mail | ballinger@camosun.bc.ca | |
| (f) Website | georgeballinger.ca (click the MATH 251 link for course information) | |

Timetable:

| Time | Monday | Tuesday | Wednesday | Thursday | Friday |
|---------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|
| 8:30 am – 9:20 am | MATH 251-X03 Room Y219 | MATH 251-X03 Room Y219 | MATH 251-X03 Room Y219 | MATH 251-X03 Room Y219 | MATH 251-X03 Room Y219 |
| 9:30 am – 10:20 am | MATH 101-003 Room Y219 | MATH 101-003 Room Y219 | MATH 101-003 Room Y219 | MATH 101-003 Room Y219 | MATH 101-003 Room Y219 |
| 10:30 am – 11:20 am | Office Hour E260 | Office Hour E260 | Office Hour E260 | Office Hour E260 | Office Hour E260 |
| 11:30 am – 12:20 pm | MATH 101-002 Room Y217 | MATH 101-002 Room Y217 | MATH 101-002 Room Y217 | MATH 101-002 Room Y217 | |
| 12:30 pm – 1:20 pm | | | | | MATH 101-002 Room Y227 |
| 1:30 pm – 2:20 pm | | | | | |
| 2:30 pm – 3:20 pm | | A&S Chairs Meeting | | | |
| 3:30 pm – 4:20 pm | | | | | |

2. Intended Learning Outcomes

(If any changes are made to this part, then the Approved Course Description must also be changed and sent through the approval process.)

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 nth roots of complex numbers.

3. Required Materials

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

4. Course Content and Schedule

| | | |
|-------------------------|--------------------|--|
| Important Dates: | January 6 | First day of class |
| | January 16 | Add course deadline |
| | January 16 | Drop course with tuition refund deadline |
| | January 20 | Fee deadline |
| | February 17 | Family Day (no class) |
| | February 18-21 | Reading Break (no class) |
| | March 9 | Withdrawal deadline |
| | April 9 | Last day of class |
| | April 10 | Good Friday (no class) |
| | April 13 | Easter Monday (no class) |
| | April 14-18, 20-22 | Final exam period |

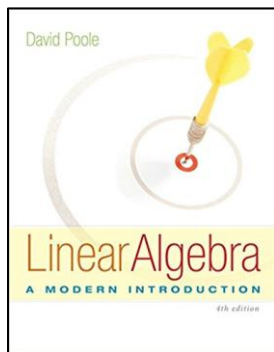
Calendar Description: This course in matrix algebra includes solving linear systems, performing matrix operations, performing computations with complex numbers, finding determinants, performing vector operations in 2-space and 3-space, vector spaces, linear dependence and independence, orthogonality, eigenvalues and eigenvectors, and linear transformations. Applications to engineering are provided throughout the course. [4 Credits]

(Source: Camosun College Calendar
camosun.ca/learn/calendar/current/web/math.html#MATH251)

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

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

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, electronic translators, smartwatches, iPods, etc. is allowed.

Tests: If you miss a test for a legitimate reason such as illness, accident or family affliction, you must notify me *before the test* and provide supporting documentation upon your return. There will be no "make-up" tests. 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 14-18, 20-22. The specific date, time, and location will be announced on or about February 21. You must write the final exam at the scheduled time as per Camosun College's policy on final examinations. See camosun.ca/learn/calendar/current/procedures.html#academic.

5. Basis of Student Assessment (Weighting)

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

| | |
|-------------|-----|
| Term Tests: | 50% |
| Final Exam: | 50% |

6. Grading System

Standard Grading System (GPA)

Competency Based Grading System

7. Recommended Materials to Assist Students to Succeed Throughout the Course

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/help-centres/#MATH

8. College Supports, Services and Policies



Immediate, Urgent, or Emergency Support

If you or someone you know requires immediate, urgent, or emergency support (e.g. illness, injury, thoughts of suicide, sexual assault, etc.), **SEEK HELP**. Resource contacts @ <http://camosun.ca/about/mental-health/emergency.html> or <http://camosun.ca/services/sexual-violence/get-support.html#urgent>

College Services

Camosun offers a variety of health and academic support services, including counselling, dental, disability resource centre, help centre, learning skills, sexual violence support & education, library, and writing centre. For more information on each of these services, visit the **STUDENT SERVICES** link on the College website at <http://camosun.ca/>

College Policies

Camosun strives to provide clear, transparent, and easily accessible policies that exemplify the college's commitment to life-changing learning. It is the student's responsibility to become familiar with the content of College policies. Policies are available on the College website at <http://camosun.ca/about/policies/>. Education and academic policies include, but are not limited to, Academic Progress, Admission, Course Withdrawals, Standards for Awarding Credentials, Involuntary Health and Safety Leave of Absence, Prior Learning Assessment, Medical/Compassionate Withdrawal, Sexual Violence and Misconduct, Student Ancillary Fees, Student Appeals, Student Conduct, and Student Penalties and Fines.

A. GRADING SYSTEMS <http://camosun.ca/about/policies/index.html>

The following two grading systems are used at Camosun College:

1. Standard Grading System (GPA)

| Percentage | Grade | Description | Grade Point Equivalency |
|------------|-------|--------------------------------------|-------------------------|
| 90-100 | A+ | | 9 |
| 85-89 | A | | 8 |
| 80-84 | A- | | 7 |
| 77-79 | B+ | | 6 |
| 73-76 | B | | 5 |
| 70-72 | B- | | 4 |
| 65-69 | C+ | | 3 |
| 60-64 | C | | 2 |
| 50-59 | D | | 1 |
| 0-49 | F | Minimum level has not been achieved. | 0 |

2. Competency Based Grading System (Non GPA)

This grading system is based on satisfactory acquisition of defined skills or successful completion of the course learning outcomes

| Grade | Description |
|-------|---|
| COM | The student has met the goals, criteria, or competencies established for this course, practicum or field placement. |
| DST | The student has met and exceeded, above and beyond expectation, the goals, criteria, or competencies established for this course, practicum or field placement. |
| NC | The student has not met the goals, criteria or competencies established for this course, practicum or field placement. |

B. Temporary Grades

Temporary grades are assigned for specific circumstances and will convert to a final grade according to the grading scheme being used in the course. See Grading Policy at <http://camosun.ca/about/policies/index.html> for information on conversion to final grades, and for additional information on student record and transcript notations.

| Temporary Grade | Description |
|-----------------|--|
| I | <i>Incomplete</i> : A temporary grade assigned when the requirements of a course have not yet been completed due to hardship or extenuating circumstances, such as illness or death in the family. |
| IP | <i>In progress</i> : A temporary grade assigned for courses that are designed to have an anticipated enrollment that extends beyond one term. No more than two IP grades will be assigned for the same course. |
| CW | <i>Compulsory Withdrawal</i> : A temporary grade assigned by a Dean when an instructor, after documenting the prescriptive strategies applied and consulting with peers, deems that a student is unsafe to self or others and must be removed from the lab, practicum, worksite, or field placement. |