

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



**MATH-251- X01,X02**  
**Matrix Algebra for Engineers**

**2019 Winter**

**COURSE OUTLINE**

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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.*

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### 1. Instructor Information

Instructor:	Raymond Lai			
Office Hours: (and by Appointment)	Monday 12:30pm – 1:20pm	Tuesday 12:30pm – 1:20pm	Wednesday 12:30pm – 1:20pm	Friday 11:30am – 12:20pm
Location:	CBA 152			
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Website:	<a href="https://sites.camosun.ca/raymondlai/">https://sites.camosun.ca/raymondlai/</a>			

### 2. Intended Learning Outcomes

Upon completion of this course a 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.

### 3. Required Materials

- (a) Texts: (Optional Reference) David Poole, *Linear Algebra: A Modern Introduction*, 4<sup>th</sup> Edition, Brooks/Cole.
- (b) Other: Non-graphing non-programmable scientific calculator

### 4. Course Content and Schedule

#### Unit 1: Systems of Linear Equations

Section 1.1: Solving System of Linear Equations by using Gaussian Elimination and Gauss-Jordan Elimination (Reference: Sections 2.1, 2.2)

#### Unit 2: Complex Numbers (Part 1)

Section 2.2: Complex Numbers – Rectangular Form (Reference: Appendix C)

#### Unit 3: Vectors (Part 1)

Section 3.3: The Geometry and Algebra of Vectors (Reference: Sections 1.1, 1.2, exploration of section 1.3)

Section 3.4: Lines and Planes (Reference: Section 1.3)

#### Unit 4: Matrices (Part 1)

Section 4.5: Matrix Operations (Reference: Section 3.1)

Section 4.6: Inverse of a Matrix and Matrix Algebra (Reference: Sections 3.2, 3.3)

Section 4.7: LU Factorization (Reference: Section 3.4)

#### Unit 5: Vectors (Part 2)

Section 5.8: Spanning Sets and Linear Independence (Reference: Section 2.3)

Section 5.9: Subspaces and Basis (Reference: Section 3.5)

#### Unit 6: Least Squares Approximation

Section 6.10: Least Squares Approximations (Reference: Section 7.3)

#### Unit 7: Orthogonality

Section 7.11: Orthogonality in  $\mathbb{R}^n$  (Reference: Section 5.1)

Section 7.12: The Gram-Schmidt Process (Reference: Sections 5.2, 5.3)

#### Unit 8: Applications of Matrices

Section 8.13: Linear Transformations (Reference: Section 3.6 + bits from sections 6.3, 6.5, 6.6)

#### Unit 9: Eigenvalues, Eigenvectors

Section 9.14: Determinants (Reference: Section 4.2 + exploration)

Section 9.15: Eigenvalues and Eigenvectors of  $n \times n$  matrices (Reference: Sections 4.1, 4.3)

Section 9.16: Similarity and Diagonalization (Reference: Section 4.4)

Section 9.17: Orthogonal Diagonalization of Symmetric Matrices (Reference: Section 5.4)

#### Unit 10: Complex Numbers (Part 2)

Section 10.18 Complex Numbers – Polar Form and Exponential Form (Reference: Appendix C)

Lectures, Reviews, Study Sessions	Tests (see 5 below)	Holiday	Total
61 hours	4 hours	5 hours	70 hours

	Test 1	Test 2	Test 3	Test 4
Tentative Date	TBA	TBA	TBA	TBA

## 5. Basis of Student Assessment (Weighting)

It is important for you to understand the minimum grade requirements for courses in the program (you may find some information at the website <http://camosun.ca/learn/programs/engineering-bridge/admission-requirements/>). Please contact the program coordinator if you need more information or you have any question.

Your course grade will be determined by using one of the following two methods:

- (a) If your performance on each of the four term tests is at least 30%, your course grade can be determined 100% by your performances on the term tests using the following weighting – Table 1 (you do not need to write the comprehensive final exam but you can opt in if you want to – see Table 2 below):

<b>Table 1</b>	Test 1	Test 2	Test 3	Test 4
Weight	28%	28%	28%	16%

- (b) If you fall short of getting at least 30% in any of the term tests, you will need to write the comprehensive final exam. and your course grade will then be determined using the following weighting – Table 2:

<b>Table 2</b>	Test 1	Test 2	Test 3	Test 4	Comprehensive Final Exam.
Weight	14%	14%	14%	8%	50%
	(Term tests together count for 50%)				

The final examination will take place during the period of Apr 15<sup>th</sup> to Apr 26<sup>th</sup>.

Note:

- There is no makeup for missed term test (except for documented medical reasons).
- Regardless of what your term mark is, you can opt in to write the comprehensive final examination (by notifying the instructor with email during the last week of classes and receiving confirmation from the instructor).
- Once you opt in writing the final examination, you cannot go back to use 100% term work for your course grade.
- Writing the final examination can lead to a better or a worse course grade, for instance,

	Term Test Minimum	Weighted Term Tests	Final Exam	Course
Student 1	40%	80%	Do not write	80%
Student 2	40%	80%	(Opt in to write) 90%	85%
Student 3	40%	80%	(Opt in to write) 60%	70%
Student 4	40%	55%	(Opt in to write) 75%	65%
Student 5	40%	55%	(Opt in to write) 45%	50%
Student 6	20%	80%	(Need to write) 90%	85%
Student 7	20%	80%	(Need to write) 60%	70%
Student 8	20%	55%	(Need to write) 75%	65%
Student 9	20%	55%	(Need to write) 45%	50%

## 6. Grading System

Standard Grading System (GPA)

Competency Based Grading System

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

### LEARNING SUPPORT AND SERVICES FOR STUDENTS

There are a variety of services available for students to assist them throughout their learning. This information is available in the College calendar, at Student Services, or the College web site at [camosun.ca](http://camosun.ca).

### STUDENT CONDUCT POLICY

There is a Student Conduct Policy **which includes plagiarism**. It is the student's responsibility to become familiar with the content of this policy. The policy is available in each School Administration Office, at Student Services, and the College web site in the Policy Section.

### How to do well in the course and where to get help

1. Do not skip classes.
2. Start working on the exercises as soon as we finish a section.
3. It is important to understand the principles involved rather than to memorize a method of solution – try variations of questions.
4. Study efficiently:
  - Working in groups is a smart way to learn mathematics; however, make sure you can solve problems yourself.
  - Keep and organize your work: Doing so will be a big time saver before term tests as you won't have time to redo all the exercises.
  - It is important **not** to spend too much time on a single exercise – as a general rule of thumb, if you spend 15 minutes either staring at a problem not knowing what to do or having trouble finding arithmetic mistakes you might have made, move on to the next exercise (bring me your work and we can go over it together – there may be typo in the answer provided, check typo corrections posted on the course website).
5. Extra help available from assistant at the Math Lab located at Technologies Centre (TEC) Room 142 (phone: 370-4492). This drop-in centre is freely available for your use to work on math homework and to seek help from the tutor on staff (see hours posted on the door).

## 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.