



**School of Arts & Science  
MATHEMATICS DEPARTMENT**

**MATH 251-Section X02  
Matrix Algebra for Engineers  
2007Q4**

## COURSE OUTLINE

The Approved Course Description is available on the web @ \_\_\_\_\_

Ω Please note: this outline will be electronically stored for five (5) years only.  
It is strongly recommended students keep this outline for your records.

### 1. Instructor Information

(a)	Instructor:	Raymond Lai	
(b)	Office Hours:	Monday: 7:30am-9:20am; Tuesday: 7:30am-9:20am, 11:30am-3:20pm Wednesday: 7:30am-8:20am, 11:30am-12:20pm, 2:30pm-3:20pm Thursday: 7:30am-8:20am, 11:30am-1:20pm, 2:30pm-3:20pm Friday: 7:30am-9:20am, 11:30am-12:20pm	
(c)	Location:	CBA 152	
(d)	Phone:	370-4491	Alternative Phone:
(e)	Email:	<a href="mailto:lai@camosun.bc.ca">lai@camosun.bc.ca</a>	
(f)	Website:	<a href="http://lai.disted.camosun.bc.ca/">http://lai.disted.camosun.bc.ca/</a>	

### 2. Intended Learning Outcomes

(No changes are to be made to this section, unless the Approved Course Description has been forwarded through EDCO for approval.)

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

1. Determine the dimension of a matrix. State and use the properties of matrices, matrix inverses, and matrix transposes. Add subtract, and multiply two matrices. Find the transpose, scalar multiple, and inverse of a matrix. Express a matrix product as a linear combination.
2. Determine the inverse of a matrix by the Gauss-Jordan Method and by the Adjoint Matrix method. Solve linear systems using the augmented matrix method, Cramer's Rule and by using inverse matrices. Recognize and make use of the properties of diagonal, triangular, and symmetric matrices.
3. Evaluate determinants by reducing the associated matrix to row-echelon form, by the method of co-factors, and by using the properties of determinants.
4. Graph points and vectors in three-dimensions. Apply vector operations to two-dimensional, and three-dimensional vectors. State and use the properties of inner products to determine the angle between vectors, and the projection of vector  $\mathbf{u}$  upon vector  $\mathbf{v}$ . Calculate the norm, the dot product, cross product, and triple scalar product of two three-dimensional vectors.
5. Express the equation of a line in space in parametric, vector, and standard form. Express the equation of a plane in space in point-normal, vector and standard

- forms. Find the distance between points, planes, and lines in space. Use the cross product to find the areas of triangles, parallelograms, and the volume of a pyramid.
6. Extend the properties of vectors in two-dimensional and three-dimensional space to Euclidean  $n$ -space.
  7. Identify and employ the matrices for reflection, projection, counter clockwise rotation, and dilation and contraction operators in  $\mathbb{R}^2$  and  $\mathbb{R}^3$ .
  8. State the properties of a real vector space, and use them to establish whether a given subset of  $\mathbb{R}^n$  with given operations of addition and scalar multiplication form a vector space. Determine whether a subset of a vector space forms a subspace.
  9. Define linear independence and dependence and determine whether two vectors determine a linearly independent set. Use the Wronskian to determine whether functions are linearly independent or dependent.
  10. Determine the dimension of a vector space. Determine whether a given set of vectors form a basis for a vector space. Find the coordinates of a vector with respect to a given basis. Find the span of a given set of vectors.
  11. Find bases for the row space, column space, and nullspace of a given matrix. Find a subset of a given set of vectors that forms a basis for the space spanned by these vectors. Determine the rank and nullity of a matrix.
  12. Determine if a given function is an inner product for a given vector space. Use a weighted Euclidean inner product, an inner product generated by a matrix, an integral inner product, or any given inner product to find the norm of a vector in the associated vector space.
  13. State the Cauchy-Schwarz Inequality and the properties of length and distance. For any two vectors in an inner product space determine the angle between them, and find the distance between them. Use the fact that the nullspace and the row space of  $A$  are orthogonal complements in  $\mathbb{R}^n$  to determine a basis for the orthogonal complement for a given set of vectors.
  14. Use the Gram-Schmidt process to transform a given basis of vectors in any non-zero finite-dimensional inner product space into an orthonormal basis for that space.
  15. Determine the least squares solution of a given linear system  $A\mathbf{x} = \mathbf{b}$ .
  16. Given that  $B_1$  and  $B_2$  are any two bases of a vectors space, find the transition matrix for a change of basis from  $B_1$  to  $B_2$  and use the result to determine the coordinates of a given vector relative to the new basis.
  17. Determine the eigenvalues and eigenvectors of a given square matrix. Determine the bases for the eigenspaces of a given square matrix. Determine a basis for  $\mathbb{R}^n$  consisting of eigenvectors of a given square matrix. Determine if a given square matrix  $A$  is diagonalizable and if it is, find a matrix that diagonalizes  $A$ .
  18. Determine if a function from one vector space to another is linear. Given the images of standard basis vectors under a linear transformation, determine a formula for the linear transformation. Determine bases for the kernel and the range of a given linear transformation. Determine rank and nullity of a given matrix. Determine the matrix for a linear transformation between finite-dimensional vector spaces.
  19. Use linear algebra to construct equations of: lines through 2 points, circles through 3 points, and a general conic through 5 points.
  20. Express complex numbers as vectors or points in the complex plane and geometrically determine sums, differences, and scalar multiples of complex numbers. Represent complex numbers in rectangular, polar form, and exponential form. Determine the sum, difference, product, and quotient of two complex numbers. Determine the modulus and conjugate of a complex number. Use the properties of the conjugate to simplify complex expressions. Use Demoivre's Formula to determine the  $n$ th roots of a complex number.

### 3. Required Materials

(a)	Texts	Howard Anton and Chris Rorres, <i>Elementary Linear Algebra</i> , 9th Edition, Wiley, 2005.
(b)	Other	

### 4. Course Content and Schedule

(Can include: class hours, lab hours, out of class requirements and/or dates for quizzes, exams, lectures, labs, seminars, practicums, etc.)

Test 1 Friday, July 13, 2007
Test 2 Friday, July 27, 2007
Test 3 Friday, August 17, 2007
Test 4 Friday, August 31, 2007

### 5. Basis of Student Assessment (Weighting)

(Should be linked directly to learning outcomes.)

(a)	Assignments	
(b)	Quizzes	50%
(c)	Exams	50%
(d)	Other (eg, Attendance, Project, Group Work)	

### 6. Grading System

(No changes are to be made to this section, unless the Approved Course Description has been forwarded through EDCO for approval.)

#### Standard Grading System (GPA)

Percentage	Grade	Description	Grade Point Equivalency
95-100	A+		9
90-94	A		8
85-89	A-		7
80-84	B+		6
75-79	B		5
70-74	B-		4
65-69	C+		3
60-64	C		2
50-59	D		1
0-49	F	Minimum level has not been achieved.	0

#### 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 [camosun.ca](http://camosun.ca) or 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.

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 E-1.5 at [camosun.ca](http://camosun.ca) for information on conversion to final grades, and for additional information on student record and transcript notations.

## 7. Recommended Materials or Services 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 on the College web site in the Policy Section.

ADDITIONAL COMMENTS AS APPROPRIATE OR AS REQUIRED