	School of Arts & Science *MATHEMATICS DEPARTMENT* **MATH 251-Sections X01 and X02** **Matrix Algebra for Engineers** **2010 Q4**

COURSE OUTLINE

1. Instructor Information

Instructors:	Raymond Lai (section X01)	Leah Howard (section X02)

Office Hours:	Monday, Tuesday, Thursday:
	    11:30-1:20
	Wednesday & Friday:
	    11:30 – 12:20
	By Appointment
		To Be Announced

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2. Course Description

This course is a component of the Engineering Bridge Program. Topics discussed include linear equations and matrices, matrix operations, determinants, vectors in 2-space and 3-space, vector spaces, linear dependence and independence, orthogonality, eigenvalues and eigenvectors, linear transformations, and complex numbers.

Offered: Quarter 2 and quarter 4
Credit: 3
In-Class Workload and Format: 6 hours of lecture/week for 11 weeks
Out-of-Class Workload: 6-12 hours/week
Prerequisites: Restricted to students enrolled in the Engineering Bridge Program

3. Intended Learning Outcomes

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 **u** upon vector **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 R^2 and R^3.
8. State the properties of a real vector space, and use them to establish whether a given subset of 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 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 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 simply complex expressions. Use Demoivre's Formula to determine the nth roots of a complex number.

4. Required Materials

Text: Howard Anton and Chris Rorres, *Elementary Linear Algebra*, 10th Edition, Wiley, 2010. Scientific calculator (see Course Policy (7) below).

5. Course Content and Tentative Schedule

8 hours	Sections 1.1-1.8	Systems of Linear Equations and Matrices
5 hours	Sections 2.1-2.3	Determinants
7 hours	Sections 3.1-3.5	Euclidean Vector Spaces
11 hours	Sections 4.1-4.10	General Vector Spaces
4 hours	Sections 5.1-5.2	Eigenvalues and Eigenvectors
8 hours	Sections 6.1-6.5	Inner Product Spaces
5 hours	Sections 8.1, 8.3, 8.4	Linear Transformations
1 hours	Sections 10.1	Constructing Curves through Specified Points
2 hours	Appendix B	Complex Numbers

6. Basis of Student Assessment (Weighting)

- 5 Assignments (10%)
  due on: 12 July,   27 July,   16 August,   31 August,   9 September.
- 4 Tests (40%) – **Test 1 is calculator free**
  on: 16 July,   30 July,   20 August,   3 September.
- Comprehensive Final Exam (50%)
  During the week of 13 Sept – 17 Sept.

<u>Guarantee Pass Option</u>:

> If your term work is 50% (or better) AND your final exam is 60% (or better),
>
> then you are guaranteed to have a course grade of C or better – your course grade
>
> will be the higher of 60% and (50% term work + 50% final exam)

7. Course Policy

- Students are required to set their mobile phones on vibrate while attending class and writing term tests and final examination.

- Students are responsible for announcements made in class (check with your fellow students if you have to miss a class).

- The mathematics department has a calculator policy on writing tests and exams of math courses in the Engineering Bridge programs:

    - Students can only use a scientific (non-graphing, non-programmable) calculator

    - The mathematics department recommends the Sharp EL-531W

    - Students who want to use a scientific calculator other than the Sharp EL-531W need to obtain approval from their mathematics instructors

8. Grading System

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

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 or information on conversion to final grades, and for additional information on student record and transcript notations.

Temporary Grade	Description
I	*Incomplete*: 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	*In progress*: 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	*Compulsory Withdrawal:* 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** for information on conversion to final grades, and for additional information on student record and transcript notations.

9. **Recommended Materials or Services to Assist Students to Succeed Throughout the Course**

    Extra help available from assistant at the Math Lab: TEC142.

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.

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.

Tentative Schedule

Week (Dates)	Monday (1 hr)	Tuesday (1 hr)	Wednesday (1 hr)	Thursday (1 hr)	Friday (2 hrs)
1 (6/28/10-7/2/10)	28-Jun Orientation	29 1.1	30 1.2	1-Jul **No Class** (Canada Day)	2 1.3, 1.4
2 (7/5/10-7/9/10)	5 1.5	6 1.6	7 1.7	8 1.8	9 2.1, 2.1
3 (7/12/10-7/16/10)	12 2.2 **Hw 1 due**	13 2.3	14 2.3	15 3.1	16 **Test 1**
4 (7/19/10-7/23/10)	19 3.2	20 3.3	21 3.4	22 3.4	23 3.5, 3.5
5 (7/26/10-7/30/10)	26 4.1	27 4.2 **Hw 2 due**	28 4.3	29 4.4	30 **Test 2**
6 (8/2/10-8/6/10)	2-Aug **No Class** (BC Day)	3 4.5	4 4.6	5 4.7	6 4.8, 4.9
7 (8/9/10-8/13/10)	9 4.9	10 4.10	11 5.1	12 5.1	13 5.2, 5.2
8 (8/16/10-8/20/10)	16 6.1 **Hw 3 due**	17 6.1	18 6.2	19 6.3	20 **Test 3**
9 (8/23/10-8/27/10)	23 6.3	24 6.4	25 6.4	26 6.5	27 8.1, 8.1
10 (8/30/10-9/3/10)	30 8.3	31 8.4 **Hw 4 due**	1-Sep 8.4	2 10.1	3 **Test 4**
11 (9/6/10-9/10/10)	6 **No Class** (Labour Day)	7 Appendix B	8 Appendix B	9 Review **Hw 5 due**	10 Review