Douglas College

EFFECTIVE: JANUARY 2003
CURRICULUM GUIDELINES

A.	Division:	Instructional	Effective Date:	January 2003	
B.	Department / Program Area:	Mathematics/ Faculty of Science & Technology	Revision [X]	New Course [ ]	
			If Revision, Section(s) Revised:	F, G, M, P, Q	
			Date of Previous Revision:	January 14, 1993	
			Date of Current Revision:	June 28, 2002	
C:	Math 232	**D:** Linear Algebra		**E:** 3	
	Subject & Course No.	Descriptive Title		Semester Credits	

F: Calendar Description:

Math 232 is a one semester introductory course designed to provide a solid foundation in the mathematics of linear algebra. This course is often the first course in abstract mathematics and the student is taught how to prove theorems. Topics include the solving of systems of equations, matrices and determinants, the vector space $\mathbb{R}^n$, n-dimensional Euclidean space, general vector spaces, linear transformations, eigenvalues and eigenvectors and the diagonalisation of matrices.

G: Allocation of Contact Hours to Type of Instruction / Learning Settings

Primary Methods of Instructional Delivery and/or Learning Settings:

Lecture

Number of Contact Hours: (per week / semester for each descriptor)

4

Number of Weeks per Semester:

13.5

H: Course Prerequisites:

Math 120

I: Course Corequisites:

None

J: Course for which this Course is a Prerequisite

Math 421

K: Maximum Class Size:

35

L: PLEASE INDICATE:

[ ] Non-Credit

[ ] College Credit Non-Transfer

[X] College Credit Transfer:

SEE BC TRANSFER GUIDE FOR TRANSFER DETAILS (www.bccat.bc.ca)

M: Course Objectives / Learning Outcomes

Upon completion of Math 232 the student should be able to:

- solve systems of *n* equations in *m* unknowns using Gauss-Jordan elimination and Gaussian elimination
- prove and apply the basic properties of matrix addition, scalar multiplication, matrix multiplication, the transpose of a matrix and the inverse of a matrix
- express a system of equations as a matrix equation and vice versa
- determine the inverse of a matrix by Gauss-Jordan elimination and use the inverse to find the unique solution of a system of equations
- understand the terms square matrix, symmetric matrix, zero matrix, diagonal matrix, triangular matrix and identity matrix
- evaluate the determinant of an $n \times n$ matrix
- prove and apply the basic properties of the determinant of a matrix
- understand the terms singular, non-singular and invertible as applied to a matrix
- determine the adjoint of a matrix and use the adjoint to calculate the inverse of a matrix
- solve systems of equations using Cramer's Rule
- prove, apply and explain the basic properties of vector addition and scalar multiplication on the vector space $\mathbb{R}^n$
- give the geometrical interpretation of subspaces of $\mathbb{R}^2$ and $\mathbb{R}^3$
- prove that a given set of vectors is a subspace of $\mathbb{R}^2$ or $\mathbb{R}^3$
- solve problems involving linear combinations, linear dependence, linear independence, the span of a set of vectors, bases and dimension in $\mathbb{R}^n$
- determine the rank of a matrix, the basis and dimension of the column space of a matrix and the basis and dimension of the row space of a matrix
- prove and apply the basic properties of the dot product and use the dot product to solve problems and define the norm of a vector, the angle between two vectors, the distance between two vectors and orthogonality in $\mathbb{R}^n$
- determine a basis for the set of vectors orthogonal to a given vector in $\mathbb{R}^n$
- calculate the projection of one vector onto another in $\mathbb{R}^n$
- explain the terms standard basis, orthogonal basis and orthonormal basis and be able to convert a basis into an orthonormal basis using the Gram-Schmidt Process (max of three vectors) in $\mathbb{R}^n$
- prove and apply the basic properties of the cross product and use the cross product to calculate the area of a triangle and the volume of a parallelepiped
- determine the various forms of the equations of lines and planes in three-space and be able to calculate the distance from a point to a plane and the distance from a point to a line
- prove that the set of polynomials of degree less than or equal to n, P_n, and the set of 2×2 matrices, M_{22}, are vector spaces
- determine which subset s of P_2 and M_{22} are subspaces
- solve problems involving linear combinations, linear dependence, linear independence, the span of a set of vectors, basis and dimension in P_2 and M_{22}
- prove and apply the basic properties of an inner product in P_2 and M_{22} and use the inner product to solve problems and define the norm of a vector, the angle between two vectors, the distance between two vectors and orthogonality
- prove or disprove that a given transformation is a linear transformation
- form composite transformations from given linear transformations
- determine the standard matrix for a linear transformation from $\mathbb{R}^n$ to $\mathbb{R}^m$
- determine the matrices that describe a rotation, a shear, a dilation or contraction and a reflection in $\mathbb{R}^2$, and given a 2×2 matrix, describe the transformation in terms of the foregoing
- determine the kernel and range of a linear transformation and be able to express the solution as a basis of a subspace
- determine the rank and nullity of a linear transformation
- determine if a linear transformation is one-to-one
- determine the coordinate vectors of vectors in P_2 and M_{22}
- explain isomorphism of vector spaces
- find the transition matrix from one basis to another and the image of a given vector
- find the matrix of a linear transformation relative to given bases and the image of a given vector using the matrix of the transformation

- determine the characteristic polynomial, eigenvalues and corresponding eigenspaces of a given matrix
- prove that similar matrices have the same eigenvalues and use this property to diagonalise a square matrix
- compute the power of a square matrix using the fact that $A^n = PD^nP^{-1}$
- prove the triangular inequality using the Cauchy-Schwartz Inequality (optional)
- solve systems of first order recurrence equations and second order recurrence (difference) equations (optional)
- apply techniques of linear algebra to solve problems related to : electrical network analysis, traffic flow, Leontif Input-Output models, Markov chains, and/or computer graphics (optional)

N: Course Content:

1. Solving Systems of Equations
2. The Algebra of Matrices
3. Determinants
4. The Vector Space $\mathbb{R}^n$
5. Vector Geometry
6. General Vector Spaces
7. Inner Product Spaces
8. Linear Transformations and Linear Operators
9. Eigenvalues and Diagonalisation

O: Methods of Instruction

Lectures, problem sessions and assignments

P: Textbooks and Materials to be Purchased by Students

Lay, David C., <u>Linear Algebra and its Applications</u>, 2nd Edition, Addison Wesley Longman, Inc., 2000.

Q: Means of Assessment

Evaluation will be carried out in accordance with Douglas College policy. The instructor will present a written course outline with specific evaluation criteria at the beginning of the semester. Evaluation will be based on some of the following:

1. Weekly tests	0 – 40 %
2. Midterm tests	20 – 70%
3. Assignments	0 – 20%
4. Attendance	0 – 5%
5. Class Participation	0 – 5%
6. Final Examination	30 – 40%

R: Prior Learning Assessment and Recognition: specify whether course is open for PLAR

None

Course Designer(s)

Education Council / Curriculum Committee Representative

Dean / Director

Registrar