

**Quinsigamond Community College
School of Math and Science**

Instructor's Information:

Instructor: <Professor John Smith>
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Course Information:

Course: MAT 243 Linear Algebra – Section ##
Meets on: <Mondays, Wednesdays, Fridays from 8:00am – 8:50am>
Credits: 3 credit hours

Course Description:

This course covers systems of linear equations, matrices, reduced echelon forms, vectors in R^n , linear independence and transformations, matrix operations, inverse of a matrix, determinants, vector space, rank, subspaces, bases, eigen vectors and eigen values, the characteristic equations, diagonalization, complex eigen values, numerical methods for solving linear systems, and orthogonality. Students learn to use linear algebra to solve problems in differential equations, statistics, and engineering design. Students also use mathematical software to solve higher order systems of equations and matrices.

Corequisite:

MAT 238

Required Textbook/Materials/Website:

Textbook: *Linear Algebra and Its Applications*, by David Lay, Pearson Publishing, 5th edition, © 2016
Website: Access to www.mymathlab.com

Student Learning Outcomes & Instructional Objectives:

This course is designed to achieve the following student outcomes and objectives:

- Solve systems of linear equations.
- Determine if a system is consistent.
- Determine if the solution is unique.
- Row reduce a matrix to echelon form and reduced row echelon form.
- Write a system of linear equations as a vector equation.
- Define a linear combination of vectors.
- View a linear combination of vectors as the product of a matrix and a vector.
- Describe solutions to homogeneous and nonhomogeneous systems.
- Determine if a set of vectors is linearly independent.
- Define a linear transformation and find the images of vectors under a linear transformation.
- Find the standard matrix of a linear transformation.

- Compute the product of matrices by using properties of matrix multiplication.
- Find the inverse of a matrix by using the algorithm for finding the inverse of a matrix.
- Use the Invertible Matrix Theorem to decide if a given matrix is invertible.
- Find an LU factorization of a matrix.
- Define a subspace of \mathbf{R}^n and use it to determine the column space and the null space of a matrix.
- Find basis for subspaces.
- Determine the dimension of a subspace and the rank of a matrix.
- Compute the determinant of an $n \times n$ matrix using row operations.
- Use Cramer's Rule to solve a system of linear equations.
- Use the definition of vector space to determine if a given set is a vector space.
- Find a subspace of a vector space by using the definition.
- Determine the kernel and range of a linear transformation.
- Use the definition and determine if a set of vectors is a linearly independent set.
- Determine bases for the null space and column space of a matrix.
- Find the coordinate vector of a given vector relative to a basis.
- Determine the dimension of a vector space.
- Find the row space of a matrix.
- Determine the change-of-coordinates matrix from one basis to another.
- Find the eigenvectors and eigenvalues of a square matrix and basis for the corresponding eigenspace.
- Diagonalize a matrix using the Diagonalization Theorem.
- Find complex eigenvalues of a matrix when they exist.
- Define length, distance, and perpendicularity in terms of the Inner Product.
- Show that a set of vectors is an Orthogonal Set using the definition.
- Calculate orthogonal projections.
- Use the Gram-Schmidt Process to construct an orthogonal basis for a given subspace.
- Determine if a vector space is an inner product space.
- Orthogonally diagonalize a symmetric matrix.
- Make a change of variable that transforms a quadratic form into a quadratic form with no cross-product term.

Teaching Procedures:

Most classes will be a combination of lecture, and in-class assignments. You will be given homework assignments to be completed outside of class, with due dates/times. There will occasionally be a quiz or exam given in class.

Course Topics & Required Assignments/Readings:

Linear Equations in Linear Algebra

- System of Linear Equations
- Row Reduction and Echelon Forms
- Vector Equations
- The Matrix Equation $A\mathbf{x} = \mathbf{b}$

- Solution Sets of Linear Systems
- Applications of Linear Systems
- Linear Independence
- Introduction to Linear Transformations
- The Matrix of a Linear Transformation

Matrix Algebra

- Matrix Operations
- The inverse of a Matrix
- Characterizations of Invertible Matrices
- Partitioned Matrices
- Matrix Factorizations
- Subspaces of \mathbf{R}^n
- Dimension and Rank

Determinants

- Introduction to Determinants
- Properties of Determinants
- Cramer's Rule, Volume, and Linear Transformations

Vector Spaces

- Vector Spaces and Subspaces
- Null Spaces, Column Spaces, and Linear Transformations
- Linearly Independent Sets; Bases
- Coordinate Systems
- The Dimension of a Vector Space
- Rank
- Change of Basis

Eigenvalues and Eigenvectors

- Eigenvectors and Eigenvalues
- The Characteristic Equation
- Diagonalization
- Eigenvectors and Linear Transformations
- Complex Eigenvalues
- Discrete Dynamical Systems
- Application to Differential Equations
- Iterative Estimates for Eigenvalues

Orthogonality and Least Squares

- Inner Product, Length, and Orthogonality
- Orthogonal Sets
- Orthogonal Projections
- The Gram-Schmidt Process
- Least-Squares Problems
- Inner Product Spaces
- Applications of Inner Product Spaces

Symmetric Matrices and Quadratic Forms

- Diagonalization of Symmetric Matrices

- Quadratic Forms

Assignment & Test Schedule:

<list all assignments, quizzes, & exam dates>

Grading Breakdown:

25% Homework
 15% Quizzes
 10% Attendance
 20% Exams
 30% Final Exam/ Final Project

A	95 – 100	B –	80 – 82	D +	67 – 69
A –	90 – 94	C +	77 – 79	D	63 – 66
B +	87 – 89	C	73 – 76	D –	60 – 62
B	83 – 86	C –	70 – 72	F	0 – 59

Attendance Policy:

Students are expected to attend all classes, for the entire period. Attendance will be taken during every class, and counts towards your final course grade. If you are absent from class, a doctor's note will excuse your absence.

Disability Statement:

If you have a disability which may require an accommodation, please notify me as soon as possible. You are responsible for forwarding your Accommodation Letter to me and discussing arrangements for this course. Your accommodations for this course begin upon my receipt of your Accommodation Letter; accommodations are not retroactive. You may request accommodations at any time during the semester, but instructors must be provided with reasonable notice prior to exams or deadlines.

Disability Services works to promote access to ensure an accessible college experience for students. If you have further questions, contact Disability Services. All discussions are confidential.

Contact Information for Disability Services & Assistive Technology:

Call: 508-854-4471
 Sorenson Video Phone: 508-502-7647
 Email: disabilityservices@qcc.mass.edu

Services for Veterans:

If you are a veteran of the armed forces, please visit the Veteran Affairs Office located in 258A (Administration Building) or contact them at veteranaffairs@qcc.mass.edu

Academic Honesty and Plagiarism:

Our purpose in the classroom is to seek the truth; this work requires trust and honesty between teacher and student. If we are not honest about what we know and don't know, our learning will

always be impaired. Because our teaching and learning depends on this honest communication, we expect all students to understand what plagiarism is and why it is unacceptable.

Plagiarism means taking someone else's ideas or words and presenting them as one's own. The offense can take many forms including cheating on a test, passing in a paper taken from the Internet or from another student, or failing to properly use and credit sources in an essay. Sometimes the issue is subtle, involving getting too much help on an assignment from someone else. In every instance, plagiarism means cheating both oneself and the owner of the source. Since the cheating sabotages a student's learning experience, consequences range from no credit for the assignment to failure for the course and possible expulsion from the college.

For further information concerning plagiarism, refer to the QCC Student Handbook.