General Information

Prerequisite: AP Calculus AB, AP Calculus BC or teacher recommendation
Length: Full Year
Format: meets daily for one period

Course Description

This college level course is designed to prepare the student for eventual courses in multivariable calculus and modern algebra. Students will study systems of equations, vectors and vector spaces, linear transformations and matrix representations, determinants, eigenvectors and eigenvalues and a variety of applications. Linear algebra is used in abstract algebra, functional analysis and has extensive applications to both natural sciences and social sciences. *This course is an alternate year course. It will run in 2011-12, but not in 2012-13. This decision is subject to change based on interest and potential enrollment.*

This course is intended for the highly motivated math students and designed to challenge the most mathematically capable students. The courses will involve rigorous pacing and workload with teacher expectations intended to challenge the student. The course will require more independent and self guided learning (with an emphasis on writing explanations) than all other courses.

Course Objectives:

At the end of the year, student should be able to:
- Solve a system of linear equations using Gaussian elimination
- Add, subtract and multiply two matrices and perform scalar multiplication
- Transpose a matrix and use properties of transposes
- Find elementary matrices
- Find the inverse of invertible matrices
- Find the determinant of square matrices by cofactor expansion and row reduction
- Use the properties of determinant
- Perform operations on vectors in 2 and 3-spaces
- Perform dot and cross products on vectors
- Find the projection of a vector onto another vector
- Write equation of lines and planes in 3-space
- Perform operations on vectors in the Euclidean n-space
- Perform linear transformations from R^n to R^m
- Determine if a set is a vector space
- Determine if a set is a subspace
- Determine if vectors are linearly independent
- Find the basis and dimension of a vector space
- Find the row space, column space and nullspace of a matrix
- Find the rank and nullity of a matrix
- Determine if a vector space is an inner product space
- Find the inner product of elements in an inner product space
- Find the angle between two vectors in an inner product space
- Find the orthogonal complement of a subspace
- Find the orthonormal basis using Gram-Schmidt process
- Perform QR-decomposition
- Find the new basis from an old basis

- Determine if a matrix is orthogonal
- Find the eigenvalues and eigenvector of square matrices
- Diagonalize a square matrix
- Find the power of a square matrix
- Perform orthogonal diagonalization on a square matrix
- Perform linear transformations
- Determine the linear transformations for different vector spaces
- Find the kernel and range of a linear transformation
- Find the inverse of a linear transformation
- Find the matrix of a general linear transformation
- Determine if two matrices are similar
- Determine the isomorphism between two vector spaces
- Perform the LU-decomposition
- Use mathematical induction to prove identities, inequalities and divisibility
- Use the division algorithm and the Euclidean algorithm to find the greatest common divisor of two integers
- Perform modulo operations
- Use the properties of linear congruences
- Use Fermat's Little Theorem

Common Assessments:

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The assessments for this course include:
- Test at the end of every chapter.
- Departmental midterm exam
- Departmental final exam

Major Units of Study:

Chapter 1: Sytems of Linear Equations and Matrices
Chapter 2: Determinant
Chapter 3: Vectors in 2-Space and 3-Space
Chapter 4: Euclidean Vector Spaces
Chapter 5: General Vector Spaces
Chapter 6: Inner Product Spaces
Chapter 7: Eigenvalues and Eigenvectors
Chapter 8: Linear Transformations
Chapter 11: Applications of Linear Algebra (selected topics will be presented by students)

Materials & Texts

Common Text and Resources:

Elementary Linear Algebra (Applications Version), 9th Ed. – Anton, H. & Rorres, C.

Supplemental Text and Resources:

Elementary Number Theory, 5th Ed. – Burton, D

Summer Assignment

There is no summer assignment for this course.