PETERS TOWNSHIP SCHOOL DISTRICT

CORE BODY OF KNOWLEDGE

LINEAR ALGEBRA HONORS

GRADE 12

For each of the sections that follow, students may be required to analyze, recall, explain, interpret, apply, or evaluate the particular concept being taught.

Course Description

This college level mathematics course will cover linear algebra and matrix theory emphasizing topics useful in other disciplines such as physics and engineering. Key topics include solving systems of equations, evaluating vector spaces, performing linear transformations and matrix representations. Linear Algebra Honors is designed for the extremely capable student who has completed one year of calculus.

Systems of Linear Equations

- Categorize a linear equation in n variables
- Formulate a parametric representation of solution set
- Assess a system of linear equations to determine if it is consistent or inconsistent
- Apply concepts to use back-substitution and Guassian elimination to solve a system of linear equations
- Investigate the size of a matrix and write an augmented or coefficient matrix from a system of linear equations
- Apply concepts to use matrices and Guass-Jordan elimination to solve a system of linear equations
- Solve a homogenous system of linear equations
- Design, setup and solve a system of equations to fit a polynomial function to a set of data points
- Design, set up and solve a system of equations to represent a network

Matrices

- Categorize matrices as equal
- Construct a sum matrix
- Construct a product matrix
- Assess two matrices as compatible
- Apply matrix multiplication to solve a linear system
- Investigate a matrix to determine if it has an identity matrix
- Apply the algebra of matrices to determine if it is an elementary matrix
- Solve a matrix equation using matrix algebra
- Design, setup and solve an input-out matrix
- Design, set up and solve a matrix equation to find the line of best fit

Determinants

- Identity if a matrix has a determinant
- Find the determinant of a matrix
- Use cofactors and minors to find the determinant of a matrix
- Find the determinant of a triangular matrix
- Use Cramer's rule to solve a system of linear equations
- Create solutions using determinants to solve analytic geometry problems
- Create solutions using determinants to formulate equations for lines and planes
- Create solutions using determinants to calculate areas and volumes
- Advocate for themselves when they miss content or are struggling

Vector Spaces

- Add and subtract vectors
- Scale vectors
- Use an ordered pair to represent a vector
- Create a vector from a linear combination of other vectors
- Prove the properties of the additive identity and additive inverse
- Create a linear combination of vectors
- Prove sets are vector spaces
- Prove sets are a subset of a vector space
- Find linear combinations of vectors
- Prove sets are a span of a set
- Analyze a set as linearly dependent or independent
- Determine if a set is a standard or nonstandard
- Find the dimension of a subspace
- Find the rank of a matrix
- Find the nullspace of a matrix
- Find a coordinate matrix relative to a standard and nonstandard basis
- Find a transition matrix
- Find the Wronskian of a set of functions
- Test a set of solutions for linear independence
- Create a rotation of a conic section

Inner Product Spaces

- Calculate the length of a vector
- Calculate the distance between two vectors
- Calculate the dot product of two vectors
- Calculate the angle between two vectors
- Formulate an orthogonal projection of a vector
- Analyze sets to determine if the set is orthogonal or orthonormal
- Utilize the Gram-Schmidt process
- Solve the least squares problem using orthonormalization
- Find the cross product of two vectors

Linear Transformations

- Calculate the image of a vector space
- Calculate the pre-image of a vector space
- Verify linear transformations
- Calculate the kernel of a vector space
- Determine the nullity and rank of a vector space
- Analyze a vector space to determine the standard matrix
- Prove that a linear transformation is invertible
- Prove that a square matrix is similar
- Utilize elementary matrices in R^2 and R^3 to perform linear transformations

Eigenvalues and Eigenvectors

- Calculate eigenvalues and eigenvectors
- Prove that a set is a subspace
- Calculate the eigenvalues of a triangular matrix
- Create a diagonalization from a square matrix
- Prove that a square matrix is orthogonal
- Solve population growth problems using eigenvalues

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