MATH M31: Introduction to Linear Algebra

Course Objectives (COR)

- Solve systems of linear equations using various methods including Gaussian and Gauss-Jordan elimination and inverse matrices.
- Perform matrix algebra, invertibility, and the transpose and understand vector algebra in $\mathbf{R}^n$.
- Determine relationship between coefficient matrix invertibility and solutions to a system of linear equations and the inverse matrices.
- Define special matrices: diagonal, triangular, and symmetric
- Understand determinants and their properties.
- Understand real vector spaces and subspaces and apply their properties.
- Understand linear independence and dependence.
- Find basis and dimension of a vector space,and understand change of basis.
- Find a basis for the row space, column space and null space of a matrix and find the rank and nullity of a matrix.
- Compute linear transformations, kernel and range, and inverse linear transformations, and find matrices of general linear transformations.
- Find the dimension of spaces such as those associated with matrices and linear transformations.
- Find eigenvalues and eigenvectors and use them in applications.
- Diagonalize, and orthogonally diagonalize symmetric matrices
- Evaluate the dot product, norm, angle between vectors, and orthogonality of two vectors in $\mathbf{R}^n$.
- Compute inner products on a real vector space and compute angle and orthogonality in inner product spaces.
- Create orthogonal and orthonormal bases: Gram-Schmidt process and use bases and orthonormal bases to solve application problems.
- Prove basic results in linear algebra using appropriate proof-writing techniques such as linear independence of vectors; properties of subspaces; linearity, injectivity and surjectivity of functions; and properties of eigenvectors and eigenvalues

Course Learning Outcomes (CLO)

- Students completing this course will be able to compute the inverse of an invertible matrix.
- Students completing this course will be able to find the null space of a matrix and represent it as the span of independent vectors.
- Students completing this course will be able to find the matrix representation of a linear transformation given bases of the relevant vector spaces.