HONORS ALGEBRA 1-2

1. Honors Algebra 1

- Theory and examples of vector spaces and linear transformations.
- Systems of linear equations and methods of their solution, bases, change of basis.
- Theory and applications of determinants.
- Intro to spectral theory: eigenvalues and eigenvector, diagonalization. Linear algebraic proof of the fundamental theory of algebra.
- Real and complex inner product spaces, orthogonality, orthonormal bases, Gram-Schmidt orthonormalization.
- Classes of operators: symmetric, skew-symmetric, orthogonal, unitary.

2. Honors Algebra 2

- Spectral theory for self-adjoint and normal operators.
- Singular value decomposition and its applications, structure of orthogonal matrices
- Bilinear and quadratic forms, diagonalization, positive definite forms, Sylvester's cryterion.
- Dual spaces and tensors.
- Jordan normal form.

Applications (Sample).
- Basic notions of ordinary differential equations.
- Classification of first order ODEs.
- Linear differential equations and first order systems of differential equations.
- Totally positive matrices.
- Jacobi matrices and orthogonal polynomials.
- Dehn invariant and re-cutting of polyhedra (application of tensor products)
- Perron-Frobenius theorem and Google algorithm.
- Elementary introduction to integrable Hamiltonian systems.