(3-1-0; 3-1-0) **Linear Algebra** MATH-110

This course is intended for students planning to do an honours degree with a concentration in Mathematics or Statistics. It is also recommended for students in other disciplines who want to understand the foundations of linear algebra and matrix theory. The course introduces the basic material that is likely to be needed in any application of linear algebra to fields outside mathematics. It also lays a foundation for further courses in linear algebra as well as in the wide range of mathematical subjects that use vector spaces or similar algebraic structures.

The class material is complemented by labs, some of which are oriented towards learning to use computer-based tools for problem-solving and exploration, others towards exploring methods and foundations of mathematical proof. The lab work can be done jointly, and some labs are multi–week, guided, independent-study projects.

Course materials: *Elementary Linear Algebra*
by R.E. Larson and B.H. Edwards (D.C. Heath)
Interactive Notes and Workbook
by M. Orzech
MatrixPad (software); *Maple* (software)

Prerequisite: OAC Algebra and Geometry.

Instructor: M. Orzech

Evaluation:		
	Final exam	30%
	Midyear exam	20%
	Class tests	15%
	Homework and homework quizzes	15%
	Labs and projects	20%

Topics:

Solving linear systems by Gauss-Jordan elimination, row equivalence, systems of homogeneous equations.

Algebra of matrices, matrix representation of linear systems, inverse matrices, determinants and their uses.

Vector spaces and subspaces, connection of subspaces of $\mathbb{R}^n$ to linear systems, linear combinations and spans, linear independence, basis, dimension, row-space, rank and nullity, coordinates with respect to a basis, change of basis.

Inner product spaces, orthogonal and orthonormal bases, projections, least squares.

Linear transformations and their matrix representations, nullspace and kernel, eigenvectors and eigenvalues, diagonalizable operators and matrices, orthogonal operators and matrices, isomorphisms.

Complex numbers and complex vector spaces.

Other applications (e.g. vector spaces over finite fields, error-correcting codes) will be covered in the labs and projects, and in class as time permits.