(3-0-0; ——) **Applications of Matrix Algebra** MATH-405*

The course is concerned with various topics in matrix theory, and their applications. Topics include matrix decompositions (e.g. LU, SVD), canonical forms (e.g. Jordan, Smith), functions of a matrix (e.g. exponential), eigenvalue calculations, generalized inverses, non-negative matrices. The course was offered in the Fall of 2003, and will be offered in the Fall of 2005, and is expected to be offered in alternate years.

**Textbook:** *Class Notes*

**Prerequisite:** One of MATH-211, 212*, 217*, 312* *and* MATH-280*/281*.

**Instructor:** N. M. Rice

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| **Evaluation:** | Weekly Assignments | 10% |
| | Midterm Test | 20% |
| | Final Examination | 70% (or 100%) |

**Outline:**

Block arithmetic of matrices; elementary matrices; row-column reduction; solutions of linear equations.

Diagonalization; similarity by row-column operations; unitary triangularization; symmetric and normal matrices; Jordan form; real Jordan form; Cayley-Hamilton Theorem and minimal polynomial; applications of the Jordan form, including powers and limits of matrices, functions of a matrix, spectral decomposition.

LU and QR decompositions; Singular Value Decomposition; various applications, such as dynamical systems, efficient solution of linear systems, eigenvalue calculations, least-squares optimizations, low-rank approximations, data mining.

Diagonalization and eigenvalue estimation; Gerschgorin circles;

Smith normal form for integer matrices, with application to linear Diophantine systems; Smith normal form for polynomial matrices, with application to Jordan forms; invariant factors.

Non-negative matrices; Perron-Frobenius theory; eigenvalue estimation; applications to Markov chains, Leslie matrices, population dynamics.

Generalized matrix inverses, including the Moore-Penrose pseudo-inverse; applications to solutions of linear equations, including linear Diophantine equations; other applications, including least-square type optimization.