Differential Equations Qualifying Examination Syllabus

Elementary linear algebra

Vector spaces

Diagonalizability of matrices
Relationship to eigenvectors. Symmetric matrices, diagonalization of symmetric matrices and normal operators, quadratic forms. Minimal and characteristic polynomials, Jordan canonical form. Exponentiation of matrices and applications to differential equations.

Scalar ordinary differential equations

Linear vector ordinary differential equations

Nonlinear vector ordinary differential equations
Autonomous systems. The phase-plane. Elementary notions of stability, classification of critical points.

General ordinary differential equations
Conversion of higher order ODE problems to first-order systems. Laplace transform solutions. Nonlinear conservative systems.

Partial differential equations
Qualitative behaviour of solutions to the heat equation, wave equation, and Laplace’s equation. Separation of variables solutions. Laplace and Fourier transform solutions to the heat equation.

(continued)
**Suggested References** (note: not all topics in these sources are necessary for the qualifying examinations—refer to the above list of topics)

- Boyce and Diprima, Differential Equations
- Borrelli and Coleman, Differential Equations
- Friedberg, Insel, and Spence, Linear Algebra
- Haberman, Applied Partial Differential Equations
- Hoffman and Kunze, Linear Algebra
- Strang, Linear Algebra and its Applications
- Strauss, Partial Differential Equations