

Mathematical methods play an exceptionally important role in geosciences and are essential for understanding advanced geophysics. This course is a tour of mathematics beyond calculus. We will visit mathematical topics that are of particular relevance to geophysics in order to develop familiarity with the key concepts through lectures, exercises, and examples. The exercises involve Sage, an open-source mathematical software environment.

This course carries the *Quantitative Reasoning* flag. Quantitative Reasoning courses at UT Austin are designed to equip you with skills that are necessary for understanding the types of quantitative arguments that you will regularly encounter in your professional life.

Class objectives:

1. To familiarize students with key concepts in mathematical methods.
2. To explain relevance of mathematical methods to geosciences.
3. To motivate further studies.

Key Topics:

Infinite Series, Power Series

convergent and divergent series, Taylor series expansions

Complex Numbers

complex plane, complex algebra, functions of complex numbers, analytic functions

Linear Algebra

matrices, linear vector spaces, eigenvalues and eigenvectors

Partial Differentiation, Vector Analysis

partial derivatives, gradient, divergence, curl, Green's theorem

Multiple Integrals

double and triple integrals, surface integrals

Fourier Series and Transforms

wave motion and periodic functions, Fourier series and Fourier transform

Ordinary Differential Equations

linear and non-linear equations, Dirac delta function, Green functions

Calculus of Variations

Euler-Lagrange equations, Eulerian and Lagrangian mechanics

Tensor Analysis

Tensor notation, Cartesian and curvilinear coordinates

Special Functions

Gamma function, Legendre polynomials, Bessel functions

Partial Differential Equations

Laplace's equation, wave equation, diffusion equation

Probability and Statistics

Probability theorems, random variables, Gaussian distribution

Lectures: Tuesdays and Thursdays, 11:00–12:30, Room EPS 1.126.

Instructor:

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Prerequisites: Math 427L or equivalent.

Textbook:

Mathematical Methods in the Physical Sciences by Mary L. Boas: John Wiley & Sons, 3rd Edition, 2006, ISBN 0471198269.

Additional Materials: Sage webpage

Course Web Page:

- **Blackboard**
- **Sage notebooks**

Homework: Weekly assignments.

Grading:

75% homework assignments

25% final exam

100%

Homework assignments policy:

Assignments are due in class. Your two lowest homework grades will be dropped to allow for two missed assignments.

No lectures:

November 6 and November 8: SEG Annual Meeting.

November 22: Thanksgiving Day.

Students with disabilities:

The University of Texas at Austin provides upon request appropriate academic accommodations for qualified students with disabilities. For more information, contact Services for Students with Disabilities at 471-6259 (voice) or 232-2937 (video phone).