

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.

### **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, minimum and maximum problems, change of variables, 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*

**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.

**Lectures:** Tuesdays and Thursdays, 9:30–11:00, Room EPS 1.126.

**Instructor:**

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Office hours: TTh 2:30-3:30 or by appointment.

**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

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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:**

September 20 and September 22: SEG Annual Meeting.

November 24: 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 the Office of the Dean of Students at 471-6259, 471-6441 TTY.