ES205 Aug 3:0

Mathematics for Geophysicists

Instructor

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Department: Centre for Earth Sciences

Course Time: Tue, Thu, 8:30-10 AM

Lecture venue: Earth Sciences Seminar Hall

Detailed Course Page:

Announcements

Brief description of the course

This course covers the essentials of mathematical modelling of geophysical phenomena. Topics that require computational modelling are also introduced. Presently, this course is compulsory for M.Tech students in Earth Sciences; graduate students in Earth/Atmospheric Sciences and Engineering also find this course useful. As emphasis is laid on first principles, students in Earth Sciences who are not formally exposed to mathematical methods as part of their UG/PG degrees will benefit from this course.

Prerequisites

Plus two level mathematics.

Syllabus

Vector fields: basic vector algebra, line, surface and volume integrals, potential, conservative fields, gradient, divergence, curl, circulation, Stokes's theorem, Gauss's theorem, applications in fluid mechanics and electromagnetism, Kelvin's theorem, Helmholtz's theorem. Linear algebra:

Matrices, operations, eigen components, systems of linear differential equations, examples. Partial differential equations: The diffusion equation, wave equation, Laplace's equation, Poisson's equation, similarity solutions,

numerical solutions (simple examples with MATLAB), series solutions, spherical harmonic expansions.

Dimensional analysis: Pi theorem, similarity,

non-dimensional formulation of geophysical problems, examples.

Course outcomes

Vector notation and calculus, construction of partial differential equations (PDEs) in vector form that describe geophysical phenomena, elementary fluid mechanics, basic electromagnetism, basic solutions to PDEs, construction of dimensionless parameters and equations, hands-on experience in problem solving through 3 assignments.

Grading policy

30% for assignments, 30% for mid-term, 40% for final.

Assignments

Resources

Riley, K.F., Hobson, M.P., and Bence, S.J., Mathematical methods for physics and engineering, Cambridge University Press, 2006.

Panton, R.L., Incompressible flows, John Wiley & Sons, 2006.

Lecture notes.