

Physics of Turbulence

PHY672

Instructor: Mahendra K. Verma, Physics Dept.

Units: 3 lectures, 9 credits

Prerequisite: None, yet basic knowledge of Navier-Stokes equation and programming is required.

Who can take the course: Ph. D., M. Sc., M. Tech., Advanced UG (final year) students.

Course Contents: Review of Navier-Stokes equations, Spectral descriptions, Homogeneity and isotropy in turbulence, Kolmogorov's theory of turbulence, Two-dimensional turbulence, Higher-order structure functions and intermittency, Application of renormalization groups to turbulence and renormalized (eddy) viscosity. Large-eddy simulations.

Magnetohydrodynamic Turbulence, Magnetic field generation in turbulent flows (Dynamo), Liquid metal flows, Astrophysical applications, Buoyancy-driven turbulence, Rotating turbulence, Instabilities and pattern formation

Direct numerical simulation of turbulence. Hands on experience with some of the codes

Selected Readings: (1) S. B. Pope, Turbulent Flows, Cambridge University Press (2000).

(2) M. Lesieur, Turbulence in Fluids, Springer (2008).

(3) P. A. Davidson, Turbulence, Oxford University Press (2004).

(4) P. Sagaut and C. Cambon, Homogeneous Turbulence Dynamics, Cambridge University Press (2008).

(5) Course notes