Physics of Turbulence
PHY672

Instructor: Mahendra K. Verma, Physics Dept.

Units: 3 lectures, 9 credits

Prequisite: 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;, Instability and route to turbulence.

Kolmogorov's theory of turbulence in spectral space; Two-dimensional turbulence; Enstrophy and kinetic helicity. Direct numerical simulation of turbulent flows; Large-eddy simulations.

Kolmogorov's theory of turbulence in real space; Higher-order structure functions and intermittency;

Scalar turbulence; Buoyancy-driven turbulence: stably stratified flows and thermal convection.

Magnetohydrodynamic Turbulence, Magnetic field generation in turbulent flows (Dynamo), Liquid metal flows, Astrophysical applications

Hands on experience with some of the turbulence codes

Selected References:

1. M. K. Verma, Energy transfers in Fluid Flows, Cambridge University Press (2019).
2. M. K. Verma, Physics of Buoyant Flows, World Scientific (2018).
3. S. B. Pope, Turbulent Flows, Cambridge University Press (2000).