AE 6080 Dynamics of Turbulence

Catalog description: AE 6080 - Dynamics of Turbulence 3-0-3.

Fundamental physics of turbulent flows. Vorticity dynamics, Kolmogorov similarity hypotheses and nonlinear interactions. Mixing and dispersion. Direct and large-eddy simulations, Reynolds stress modeling. Advanced topics.

Prerequisite: AE 6010 (Shear Flows) or equivalent.

Coordinator: P. K. Yeung, Professor

Learning objectives

- Learn about advanced concepts in the study of turbulence and turbulent mixing
- Learn about different approaches in turbulence simulation and modeling
- Gain exposure to the research literature and advanced topics of current interest.

Textbook: Pope 1997, Turbulent Flows.

Additional References

- Tennekes& Lumley 1972, McComb 1990.
- Selected research papers from the literature.

Lecture Topics

1. Introduction
2. Vorticity transport equation
3. Analysis of enstrophy budget, role of vortex stretching
4. Kolmogorov (1941) similarity hypotheses
5. Intermittency and the refined similarity hypotheses
6. Fourier-spectral description: evolution equation for energy spectrum
7. Interscale energy transfer, triadic interactions
8. Lagrangian description and fluid particle dispersion
9. Mixing of passive scalars, including similarity theory
10. Direct and large-eddy simulations of turbulence: survey of important results, subgrid scale modeling
11. Reynolds stress modeling: exact equations and model constraints
12. Reynolds stress modeling: pressure-strain correlations, lower order models
13. Introduction to the probability density function approach
14. Rotating turbulence
15. Compressible turbulence