

## ChE516: Turbulent Transport Processes

**Instructor:** R. Sureshkumar, Urbauer 314A, 5-4988, suresh@wuche.wustl.edu, Class meets *MW* 2:30-4 p.m. unless other special arrangements are made.

**Text:** Handouts, lecture notes and references

### Grading

Grading will be primarily based on a class project. Students are encouraged to choose a topic that is pertinent to their research area. Oral presentation and report are required. A few homework exercises will also be assigned—these will include reading material to be discussed later in class, running numerical simulations etc.

### Topics

1. Introductory lecture
2. Review of basic equations and concepts
3. Laminar vs. Turbulent flow, Flow transitions, Taylor vortices and Benard cells, Transition in plane shear flows
4. Turbulence: basic concepts. The turbulence syndrome, modeling, dimensional analysis
5. Reynolds averaging and related concepts
6. Turbulence dynamics—budgets of mechanical energy and vorticity
7. Turbulence modeling: first order closures, 0, 1 and 2 equation models (discussion of K- $\epsilon$  model and its variants), second order models, two-point closures, cascade models, EDQNM
8. Introduction to direct numerical simulations—use DNS code to evaluate average quantities in plane channel flow
9. Large eddy simulations, sub-grid-scale models
10. Scalar transport—reactive flows
11. Introduction to turbulent mixing
12. Turbulence as a dynamical system
13. Multiphase flows
14. Turbulent friction control—drag reduction by viscoelastic polymeric and surfactant additives, external fields, wall oscillations etc.