ME/AE 435 Turbulent Flows – Theory, Measurements & Modeling - Fall 2011
Mechanical & Aerospace Engineering Department, Missouri S&T

Instructor: **Prof. Arindam Banerjee** (E-mail: **banerjeea@mst.edu**, ☏ **573-341-4494**)
184 Toomey Hall, Missouri S&T, Rolla, MO 65409.

Class schedule: Tuesday-Thursday: 8.00 a.m. - 9.15 a.m.
Office hours: Tuesday-Wednesday: 2.00 p.m.– 3.00 p.m.
(other time by prior appointment only)

Class Location: **Toomey 250**

Grading Outline: **Homework: 20%, Mid-term Exams (2): 40%,**
Final Exam: 20%, CFD/Lab Assignment: 20%.

Prerequisites: **ME/AE 331 or ME/AE339 + co-enrollment in MATH 325**

Textbook: **Turbulence Modeling for CFD – D. Wilcox-3rd Edition – DCW Industries**

Supplemental Reading: **Pope, S.B. Turbulent Flows – Cambridge University Press**
Notes/handouts by instructor

Programming Skills: Knowledge of Fortran/Matlab and CFD packages (Fluent, CFX, etc).

Course objectives: This course is designed to give the students an overview of various aspects of turbulent flows – the course is highly mathematical and will involve rigorous derivations using PDEs. The course is divided into 3 parts and will cover:
(a) ***Turbulence theory*** (i.e. where does turbulence come from and what are its universal features, to what extent is it deterministic?)
(b) ***Turbulence modeling*** (i.e. derive semi-empirical models to parameterize the influence of turbulence on various flows)
(c) ***Turbulence measurements*** (discuss state of the art techniques to measure and quantify various parameters discussed in (a) and (b) above)
The topics are meant to provide graduate students a sound theoretical foundation regarding analyzing turbulent flows.

Topics to be covered

Part 1: Fundamentals & Turbulence Theory
(Introduction to Tensors, Statistical Properties, Equations of Fluid Mechanics – mean flow equations, Origin and nature of turbulence, Statistical description of turbulent flows, Phenomenology of Taylor, Richardson and Kolmogorov, Understanding some simple flows)

Part 2: Modeling of Turbulent Flows
(RANS averaging, RANS models – algebraic models, one and two equations models, effects of compressibility – FAVRE averaging, basics of LES and DNS techniques)

Part 3: Turbulence Measurements
(Data acquisition and analysis, signal processing techniques, hot-wire/hot-film anemometry, Laser Velocimetry including PIV)

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