

**Aerospace/ME 525: Inhomogeneous Turbulence
Spring Semester 2004**

Time: TR, 9:45 –11:00am

Location: 119 EES Building

Instructor: **Philip J. Morris**, Boeing/A. D. Welliver Professor of Aerospace Engineering, 233C Hammond Building, 863-0157, pjm@psu.edu

Goal: *To introduce the student to a broad range of modeling techniques for the prediction of the development and structure of turbulent shear flows. These techniques include methods that are used widely in industry as well as more sophisticated techniques that have yet to enter common usage.*

Course Topics:

- Stability and Transition - a review
- Turbulence Models:
 - Algebraic closure schemes
 - One- and two-equation models: $k - \epsilon$ models, algebraic Reynolds-stress models, and Spalart-Allmaras model
 - Reynolds-stress closures
 - Weakly nonlinear models
 - Additional topics:
 - Realizability, Large Eddy Simulation, Direct Numerical Simulations, Experimental methods, Reacting Flows, Rotation Effects, Compressible Turbulence,

Textbook: There is no assigned textbook for this course.

Course Conduct:

The course will be in two parts. The first, and longer part, will be a traditional lecture format that will introduce closure schemes and their assumptions and limitations. A wide range of methods for steady and unsteady flow will be introduced. The second, and shorter, part of the course will involve readings, presentations and discussions by the class. Assignments will be made to students who will be responsible for making the presentations and leading the discussion. All students will write a term paper on their presentation topic. In addition, there will be a computer project in which each student will write a boundary layer code and implement more than one turbulence model.

Grading:

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| • Presentation | 25% |
| • Class discussion | 5% |
| • Term paper | 35% |

- Computer project

35%

Presentation:

Assignments, schedules and topics will be made by the beginning of February 2004. Assignments will also be made to students to lead the class discussion and criticism of the presentations. Each student will submit a two-page progress report on their topic, to be made available to the class, on March 15, 2004 (immediately following Spring break).