ME 540 Advanced Aerodynamics
Spring 2012

Professor: Sheryl Grace

Course Description
This course will cover the basics of both steady and unsteady aerodynamics. The course topics relevant to steady aerodynamics will include: derivation and use of partial differential and integral equations of incompressible and compressible flow; introduction to and use of complex variables and conformal mapping techniques for obtaining analytical solutions to two-dimensional problems; implementation of lifting line theory and panel methods to obtain the flow around three dimensional bodies. The course will cover the classical unsteady aerodynamic problems underlying the field of aeroelasticity through the analysis of airfoil pitching, heaving, and airfoil-gust interaction and aeroelastic stability.

Textbook will be chosen from

- *Low-speed Aerodynamics; From Wing Theory to Panel Methods*, Joseph Katz and Allen Plotkin, San Diego St. Bookstore, 1999.
- *Aeroelasticity*, Raymond Bisplinghoff, Holt Ashely, and Robert Halfman, Addison-Wesley, 1955 (Dover now)
- *An Introduction to the Theory of Aeroelasticity*, Y. C. Fung, Dover, 2002.

Prereqs: Vector calc, differential equations, some familiarity with complex variables, fluid mechanics.

This course will require the students to perform many computational assignments in MATLAB. The students are also encouraged to utilize a package such as Mathematica or Maple throughout the class. Students will also review two journal articles (one classic, one recent).

Topics:

Basics of fluid motion, equations of fluid dynamics, flow parameters
Inviscid, Incompressible flow
Potential flow solutions
Flow over 2D airfoils (exact – conformal mapping, numerical – panel methods)
Flow over 3D wings (lifting line, complex variable methods, panel methods)
Unsteady aerodynamics – 2D airfoils, incompressible
Unsteady aerodynamics – 2D airfoils, compressible
Aeroelasticity – flutter boundaries, stability

Approximate grading scale
Homework – 25%
Computer project(s) –15%
Article reviews – 10%
Midterm Exam – 25%
Final Exam – 25%