

2009-2010 SPRING TERM

AE 714

Aeroelastic Effects In Structures

INSTRUCTOR

Assist. Prof. Dr. Güçlü Seber

REQUIREMENTS

Proficiency in mechanical vibrations of discrete and continuous system, and aerodynamics/fluid mechanics is strongly recommended.

TEXT BOOK

There is no unique textbook available for this course.

REFERENCE BOOKS

- *Principles of Aeroelasticity*, R. L. Bisplinghoff, H. Ashley, Dover Edition
- *Introduction to Aircraft Aeroelasticity and Loads*, J. R. Wright and J. E. Cooper, Wiley
- *Introduction to Structural Dynamics and Aeroelasticity*, D. H. Hodges and G. A. Pierce, Cambridge Aerospace Series
- *A Modern Course in Aeroelasticity*, E. H. Dowell, et. al., Kluwer Academic Publishers
- *An Introduction to Theory of Aeroelasticity*, Y. C. Fung, John Wiley and Sons, Inc., Dover Edition
- *Aeroelasticity*, R. L. Bisplinghoff, H. Ashley, and R. L. Halfman, Dover Edition
- *Introduction to the Study of Aircraft Vibration and Flutter*, R. H., Scanlan, R. Rosembaum, The Macmillan Co.
- *Rotary Wing Structural Dynamics and Aeroelasticity*, R. L. Bielawa, American Institute of Aeronautics and Astronautics

GRADING

HWs 25%
Term Project 35%
Final Exam 40%

COURSE CONTENT

1. Formulation of Fluid-Structure Interaction Problems

- 1.1 Introduction to Aeroelasticity
- 1.2 Mathematical Preliminaries: Calculus of Variations
- 1.3 Hamilton's Principle
- 1.4 Lagrange's Equations
- 1.5 Approximate Methods: Galerkin and Rayleigh-Ritz
- 1.6 Aeroelastic Operators

2. Fundamental Aerodynamics and Introduction to Unsteady Flows

- 2.1 Fundamental Aerodynamic Principles and Governing Equations
- 2.2 Flows over Airfoils and Finite Wings
- 2.3 Unsteady Aerodynamics: Gust Effects (Wagner, Küssner and Sears Functions) and Harmonically Oscillating Airfoils (The Theodorsen Solution)

3. Static and Dynamic Aeroelasticity

- 3.1 Static Aeroelastic Phenomena: Divergence of Straight Slender Wings and Aileron Reversal
- 3.2 Dynamic Aeroelastic Response: Gust problem

4. Flutter of Aircraft Wings and Control Surfaces

- 4.1 Definition and Types of Flutter
- 4.2 Single Degree of Freedom Flutter
- 4.3 Bending-Torsion Flutter of a Typical Section Model
- 4.4 Exact Treatment of Bending-Torsion Flutter
- 4.5 Modal Methods in Flutter Calculations
- 4.6 Flutter Solution Methods: k and p-k methods

5. Coupling of Aerodynamic and Structural Models

- 5.1 Introduction
- 5.2 Coupling of Structural and Aerodynamic Models: Static and Dynamic Problems
- 5.3 CFD Based Methods in Aeroelasticity: Direct Simulation of Flutter
- 5.4 The Direct Eulerian-Lagrangian Approach

6. Control of Aeroelastic Instabilities

- 6.1 Introduction to Aeroservoelasticity
- 6.2 Formulation a Simple Aeroservoelastic System with a Control Surface
- 6.3 State-Space Representation of Aeroelastic Equations and Approximation of Unsteady Aerodynamics