

SYLLABUS AME 321

AIRCRAFT PERFORMANCE

Spring 2008

Class: 10-10:50, MWF, AME S338

Professor H. Fasel (AME N631), email: faselh@email.arizona.edu

Office hours: WF 11-12 and M 2-3 or by appointment

Teaching Assistant: Ivan Shalaev, email: shalaev@email.arizona.edu

Office hours: Tuesday 2-4 (AME 505)

Course Description:

This is a required course for the AE program. The purpose of the class is to learn how to predict aircraft performance based on the available aerodynamic data related to the aircraft. The main contents include understanding the forces and moments acting on an airplane, as well as the techniques to estimate aircraft performance under real flight conditions. Emphasis of this course is on developing a fundamental understanding of the properties of the atmosphere, the fundamental principles of fluid flow, lift and drag of airfoils and wings. The learning process includes lecturing, home work, a project, two mid-term exams and a final exam. The project is a required component for completion of this course. Students are expected to attend the class and to take notes. Late home work will not be accepted unless arranged otherwise in advance.

Text book: McCormick, Aerodynamics, Aeronautics and Flight Mechanics. 2nd Edition, Wiley.

Topics covered:

Chapter 1: Introduction

Chapter 2: Fluid mechanics (review)

Chapter 3: Lift:

Principles of lift production, thin-airfoil theory, aerodynamic center, practical airfoils, flaps, modern airfoil developments. Lifting line theory: effects of finite aspect ratio, induced angle of attack, elliptic wing, effect of taper, sweep, twist; aerodynamic center of finite wing, etc.; delta wing.

Chapter 4: Drag:

Types of Drag (induced, parasite, skin friction, form/pressure, interference, trim, profile cooling, base, wave), total drag, effect of wing loading, L/D, endurance

Chapter 6: Production of thrust:

Momentum theory, ideal efficiency, useful power, induced power, propeller theory, effect of blade angle on efficiency.

Chapter 9: Static Stability and Control:

Definition of static and dynamic stability;

Longitudinal Static Stability: criterion, neutral point of an airplane, static margin, effect of downwash on horizontal tail.

Longitudinal control: angle of incidence for horizontal tail, effect of elevator. Steady maneuvering, i.e. pull-up maneuver, load factor.

Directional Static Stability: criterion, effect of side slip role of vertical tail. Directional control: effect of rudder, vertical tail.

Lateral Static Stability: discuss dilemma

Lateral Control: Effect of steady rolling motion, aileron reversal.

Coupling Effects of Control: Rolling moment with rudder, rolling moment with yaw rate, yawing moment with roll rate, rolling moment with side slip, (dihedral effect), dihedral effect of swept wings.

Chapter 7: Airplane Performance

Takeoff : Definition of speeds, ground roll, effect of wind, climb, rate of climb, endurance.

Landing: Essential elements, factors.

Test 1: Friday, Feb. 22, (Chapter 1-3)

Test 2: Friday, Apr. 4, (Chapter 4-6)

Project due Friday, May 2:

Design and build 2 airplanes (max. 50 cm span, use paper, card board, balsa wood, etc.):

Plane 1: fly a specified distance as fast as possible;

Plane 2: fly a specified distance as slow as possible

Written Report required showing calculations for the design of the 2 airplanes and discussion of the design criteria employed.

Final Exam: As scheduled

Grading: Home work: 1/6

Midterm 1: 1/6

Midterm 2: 1/6

Project : 1/6 + Bonus

Final exam: 2/6