

Aerodynamics I - AE 305



CHAPTER 0

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Course Objectives and Syllabus

by

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Instructor



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Lecture assistant: Burak Çiftçiöğlü

Course Information



Class Hour:

TUESDAY – 09:25-12:00 (A11)

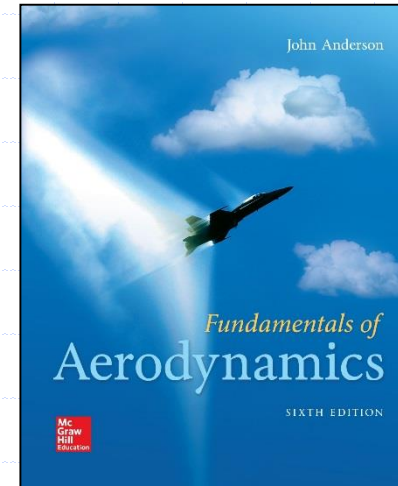
WEDNESDAY – 13.30-15.10 (A11)

3-2 Credit

Compulsory Text



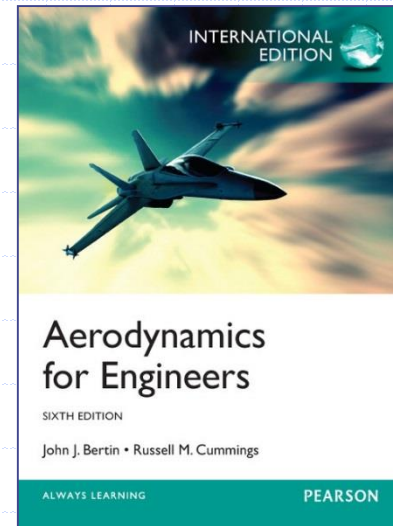
Fundamentals of Aerodynamics 6th Edition or newer by John Anderson



Recommended Texts



- Aerodynamics for Engineers
International Edition
by John J. Bertin,
Russell M. Cummings



- Kuethe, A. M. and Chow, C. Y., “Fundamentals of Aerodynamics: Bases of Aerodynamic Design” 5th edition, Wiley, 1998.
- Houghton E. L. and Carpenter P. W., “Aerodynamics for Engineering Students” 2003
- Flandro, G., McMahon, H., and Roach, R., “Basic Aerodynamics: Incompressible Flow” 2011

Course Objectives



This course deals with the fundamentals of Aerodynamics including:

- fundamentals of incompressible aerodynamics
- basic aerodynamics problem solutions

Expected Learning Outcomes



After successful completion of this course the students will have:

- An ability to apply airfoil theory to predict airfoil performance.
- An ability to analyze and optimize wing performance.
- An exposure to recent developments in aerodynamics, with application to aerospace systems
- An ability to apply the concepts of aerodynamics to the design of aerospace systems.

Assessment (LOOK OUT !)



- Attendance
- Labs
- Examinations
- Final Grades

Assessment (LOOK OUT !)



- Attendance:

Late attendances to lecture hours in class are not encouraged.

In case you have to miss a class, **you are responsible for keeping up** with the class work and being informed of all announcements made in the class concerning midterms, labs, etc.

If you encounter difficulties of any kind, feel free to send me e-mail. I can answer them during my spare time.

Assessment (LOOK OUT !)



- Labs:

There will be three lab sessions regarding to aerodynamics-based problems. Lab reports will be evaluated.

Assessment (LOOK OUT !)



- Examinations:

Two term tests are scheduled. A final comprehensive examination will be given according to the school schedules based on the same format as the term tests.

They will consist of a section on concepts, definitions, and short exercises plus section with numerical problems. **Both will be closed-book, closed-notes, no formula sheet (you need to memorize the equations needed, if it is not given in the exam paper).**

Make-up exams may be given for legitimate excuses if you contact the instructor as soon as you return to the school. It will be given for excused absences only and must be scheduled immediately upon returning to class. Excused absences require a medical excuse or notice of official school business by the V.P. of Academic Affairs.

Assessment (LOOK OUT !)



- Final Grades:

Three Labs	20 %
Class Tests (Midterms)	(2x20) %
Final Comprehensive Exam	40 %
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Total	100 %

Letter grades will be given relative to the average of the class !



Contents

1. Introduction - Aerodynamics: Some Introductory Thoughts
2. Aerodynamics: Some Fundamental Principles and Equations
3. Fundamentals of Inviscid, Incompressible Flow
4. Incompressible Flows Over Airfoils
5. Incompressible Flows Over Finite Wings
6. Three-Dimensional Incompressible Flow



Tentative* Schedule

Chapter 1: Introduction - Aerodynamics: Some Introductory Thoughts (Weeks 1-2-3)

- Aerodynamics Classifications and Objectives
- Fundamental Aerodynamics Variables
- Aerodynamics Forces and Moments
- Center of Pressure
- Dimensional Analysis: The Buckingham Pi Theorem
- Flow Similarity
- Types of Flow

Chapter 2: Aerodynamics: Some Fundamental Principles and Equations (Weeks 3-4)

- Review of vector relations
- Control volumes and fluid elements
- Continuity equation
- Momentum equation
- Pathlines and streamlines
- Angular velocity, vorticity and circulation
- Stream function and velocity potential

Chapter 3: Fundamentals of Inviscid, Incompressible Flow (Weeks 5-6)

- Bernoulli's equation and its application
- Pressure coefficient
- Laplace's equation for irrotational, incompressible flow
- Elementary flows
- Combination of elementary flows
- Kutta Joukowski Theorem
- Nonlifting flow over a circular cylinder

PROBLEM HOUR I (Week 6)

**MIDTERM 1 (Week 7) November 8th 2022,
Tuesday at 09.25, classroom A11**

Chapter 4: Incompressible Flows Over Airfoils (Weeks 7-8-9)

- Introduction
- Airfoil Nomenclature
- Airfoil Characteristics
- The Vortex Sheet Model
- The Kutta Condition
- Kelvin's Circulation Theorem and the Starting Vortex
- Classical Thin Airfoil Theory
- The Cambered Airfoil
- The Vortex Panel Method

Lab-1 (WEEK 9): 2D XFLR5 – ALL STUDENTS SHOULD ATTEND

Chapter 5: Incompressible Flow Over Finite Wings (Week 10-11)

- Downwash and Induced Drag
- The Vortex Filament, The Biot-Savart Law, The Helmholtz Theorem
- Prandtl's Classical Lifting-Line Theory
- Elliptical lift distribution
- General lift distribution

PROBLEM HOUR II (Week 11)

**MIDTERM 2 (Week 12) December 13th 2022,
Tuesday at 09.25, classroom A11**

Lab-2 (WEEK 12): 2D AVL – ALL STUDENTS SHOULD ATTEND

Chapter 6: Three-Dimensional Incompressible Flow (Week 13)

- Three-Dimensional Source, Three-Dimensional Doublet
- Flow over a Sphere, Comment on the 3D Relieving Effect
- General 3D Flows: Panel Techniques, Applied Aerodynamics

Lab-3 (WEEK 13): 3D XFLR5 & AVL – ALL STUDENTS SHOULD ATTEND

Schedule can be re-organized because of uncertain pandemic conditions. Follow the announcements from @dremrekara twitter page

LECTURE REVIEW (Week 14)
PROBLEM HOUR III (Week 14)

E. Kara, Preparation date:
04.07.2022

Aerodynamics I - Chapter 0



Next Lecture → Chapter 1

Aerodynamics: Some Introductory Thoughts



NEXT CHAPTER'S OUTLINE

- Classification and practical objectives
- Some fundamental aerodynamic variables
- Aerodynamic forces and moments
- Center of pressure
- Dimensional analysis
- Flow similarity
- Types of flow

We will continue in the next lecture.