Aerodynamics I - AE 305

CHAPTER 0

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Course Objectives and Syllabus

by

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Instructor

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Course Information

Class Hour:

THURSDAY	–	13:30-16:05 (A11)
FRIDAY	–	08.30-10.10 (A11)

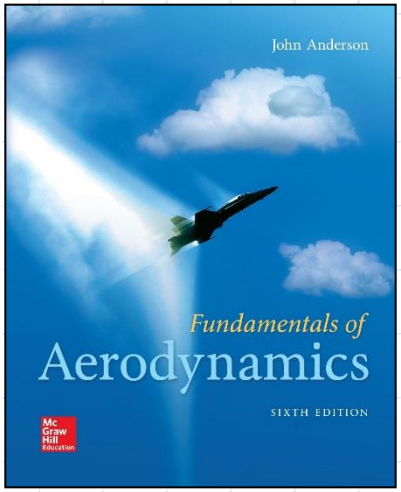
3-2 Credit

Compulsory Text

Fundamentals of Aerodynamics

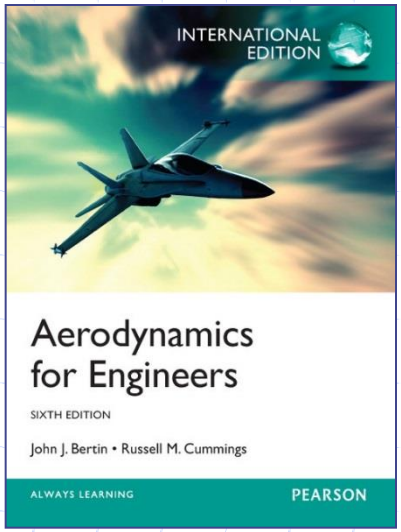
6th Edition or newer

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
- Homeworks
- Pop quizzes
- 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 **two** lab sessions regarding to aerodynamics-based problems. Lab reports will be evaluated.

Assessment (LOOK OUT !)

- Homeworks

In order to encourage you to closely follow the material covered in the lectures and provide you with opportunities to practice the concepts taught in the class through problem solving, some problems will be assigned as homework assignments; some in the form of handouts or continuation of the class examples.
It is strongly recommended that the assignments are completed independently.
Homeworks will start after first midterm.
All assignments are due the next session unless another due date is announced by the instructor.
The assignments will be collected, graded, and returned as soon as possible.
Half the homework points will be given for each problem seriously attempted; the other half will be based on successful solution of the problem.
Late homework will be accepted with 20% penalty per day unless there is a legitimate excuse.

Assessment (LOOK OUT !)

- Pop quizzes

Unannounced quizzes may be given whenever it is found necessary.

Quizzes will start after the first midterm

There will be NO makeups for quizzes.

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:

Labs	10 %
Pop Quizzes and Homeworks	10 %
Midterm 1	20 %
Midterm 2	20 %
Final Comprehensive Exam	40 %
Total	100 %

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

Contents

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 16th 2023, Thursday at 13.30, 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 10): 2D XFLR5 – ALL STUDENTS SHOULD ATTEND

Chapter 5: Incompressible Flow Over Finite Wings (Week 10-11-12)
- Downwash and Induced Drag
- The Vortex Filament, The Biot-Savart Law, The Helmholtz Theory
- Prandtl's Classical Lifting-Line Theory
- Elliptical lift distribution
- General lift distribution

PROBLEM HOUR II (Week 12)

MIDTERM 2 (Week 13) December 28th 2023, Thursday at 13.30, classroom A11

Lab-2 (WEEK 13): 3D XFLR5 – ALL STUDENTS SHOULD ATTEND

Chapter 6: Three-Dimensional Incompressible Flow (Week 14)
- Three-Dimensional Source, Three-Dimensional Doublet
- Flow over a Sphere, Comment on the 3D Relieving Effect
- General 3D Flows: Panel Techniques, Applied Aerodynamics

PROBLEM HOUR III (Week 14)

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

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.