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

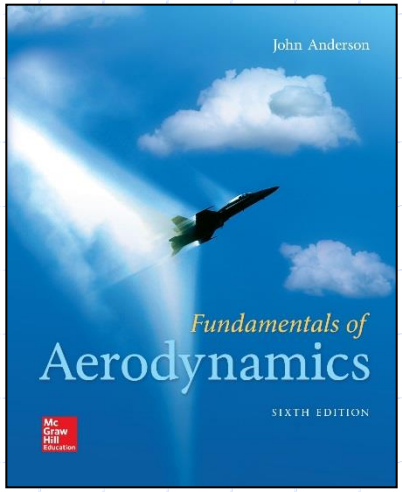
Class Hours: MONDAY – 09:25-12:00 (A03)

THURSDAY – 08:30-10:10 (A01)

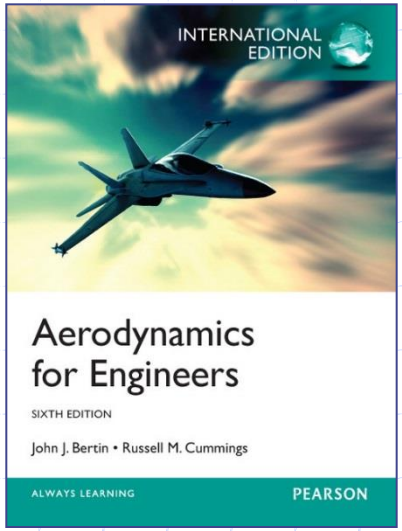
Number of Credit Hours: 5 hr credit

Compulsory Texts

1. Fundamentals of Aerodynamics
   6th Edition
   by John Anderson



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



Recommended Texts

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 !)

- Homeworks
- Quizzes
- Labs
- Attendance
- Examinations
- Final Grades

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.

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, particularly before the tests.

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 !)

- Quizzes:

Announced or **unannounced** quizzes may be given whenever it is found necessary.

Assessment (LOOK OUT !)

- Labs:

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

Assessment (LOOK OUT !)

- Attendance:

Regular attendance is **strictly required (at least 70 %).**

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 homework, quizzes, tests, etc.

If you encounter difficulties of any kind, feel free to come and see me in my office.

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.**

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:

Homeworks and Quizzes	10	%
Labs	2×5	%
Class Tests (Midterms)	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 3-4-5)
- 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

PROBLEM HOUR I (Week 5)

MIDTERM 1 (Week 6) – October 21st, Monday, 09:25

Chapter 3: Fundamentals of Inviscid, Incompressible Flow (Weeks 6-7-8)
- Bernoulli's equation and its application
- Pressure coefficient
- Laplace's equation for irrotational, incompressible flow
- Elementary flows
- Combination of elementary flows

Chapter 4: Incompressible Flows Over Airfoils (Weeks 9-10-11)
- 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 12)

PROBLEM HOUR II (Week 12)

MIDTERM 2 (Week 13) – December 9th, Monday, 09:25

Chapter 5: Incompressible Flow Over Finite Wings (Weeks 14)
- 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

Lab-2 (WEEK 15)

PROBLEM HOUR III (Week 15)

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