Aerodynamics I - AE 305

CHAPTER 0

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Course Objectives and Syllabus

by

Dr. Emre Kara , Univ. of Gaziantep, TURKEY

Instructor

Asst. Prof. Dr. Emre Kara

Office: Z04

Email: emrekara@gantep.edu.tr

Lecture webpage:

http://www1.gantep.edu.tr/~emrekara/index.php/ae305/

Lecture assistant: Enes Coşkun

For his office hours and lab groups, check announcements:

https://akbis.gantep.edu.tr/detay/?A_ID=324662_arastirma-gorevlisi_enes-coskun

Course Information

Lectures: Monday – 14:25-16:55 (A03)

Thursday – 11:15-13:00 (AEROLAB)

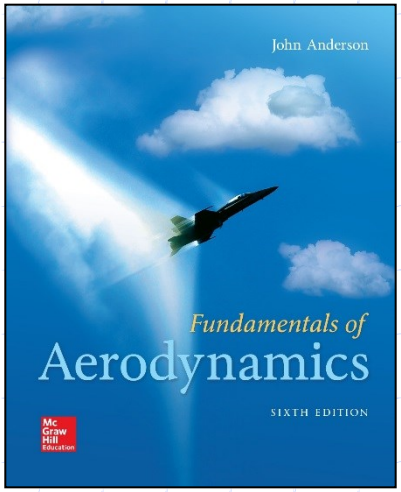
Credits: 3 (Theory) + 2 (Pratice)

Compulsory Text

Fundamentals of Aerodynamics

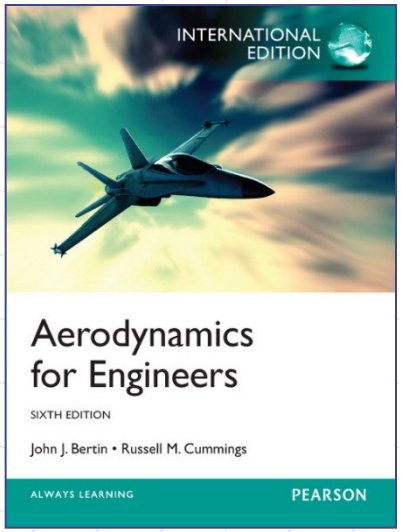
6th Edition or newer

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,
- to gain experience and develop skills in the experimental and analytical investigation of aerodynamic systems, as well as in the design of basic aerodynamic components and systems.

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

1. Late attendances to lecture hours **in class** and **in lab quizzes** are not encouraged.
2. Students must maintain a minimum of 70% attendance, strictly for total lecture (5 hours per week – 70 total hours) and must maintain a minimum of 80% attendance, strictly for lab sessions (11 labs in total). For example, a student attending 49 hours total lecture and 8 labs, can pass. However, a student attending lower than 49 hours total lecture 7 labs, fails (NA) or a student attending 48 hours total lecture and 8 labs, fails (NA) or a student attending 48 hours and 7 labs, also fails (NA). **In short, a student should have at least 49 hours total lecture and at least 8 lab attended to pass the lecture.**
3. 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.

Assessment (LOOK OUT !)

- Labs:

Regular attendance to lab works is **strictly required**

(at least 80 %).

Eleven laboratory sessions will be comprised, dates of which can be found at the end of these slides in the schedule. Prior to each laboratory session, a quiz will be conducted for a period of **five minutes at 11.15 AM** in the UM CLASSES in the «Aircraft Assembly Workshop» building. The total lab grade will be distributed as follows: 24% for the laboratories (18% for the reports, and 6% for the quizzes)

It is expected that students will attend the laboratory sessions punctually. A student who do not attend the quiz of the corresponding lab session, cannot attend the laboratory.

Groups of **five** will be announced by lecture assistant, Enes Coşkun. You can suggest your lab group to him till the end of Friday (26.09.2025) or you will randomly be grouped in five. The lab groups will be announced in lecture assistant's site on (29.09.2025), LAST YEAR'S ATTENDEES CAN SEND THEIR NAMES TO THE LECTURE ASSISTANT FOR EXEMPTION FROM THIS SEMESTER'S LAB SESSIONS.

Assessment (LOOK OUT !)

- Labs:

The following regulations shall be observed in the laboratory:

- It is required that each group submit a single report.
- Each group is required to write each part independently and then convene with their fellow group members to consolidate their findings.
- All reports are to be submitted **the next day (Friday) by 17.00** to the corresponding assistant in his office.

Assessment (LOOK OUT !)

- Labs:

LAB REPORT FORMAT

DO NOT COPY/PASTE FROM OTHER GROUPS OR INTERNET SITES. OTHERWISE YOU WILL NOT BE GRADED!

The lab report (no longer than 15 pages – all included –) should include the followings (unless otherwise specified):

1. Objective
2. Theory
3. Procedure
4. Results
5. Sample calculation
6. Necessary plots
7. Discussion on results, errors and graphs
8. Conclusion

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:

Midterm 1	18 %
Midterm 2	18 %
Labs	24 %
Final Comprehensive Exam	40 %
Total	100 %

Contents

Tentative* Schedule

Week -1: Chapter 0: Introduction (Monday) & Lab introduction (Thursday)

Week-2: Chapter 1: Aerodynamics: Some Introductory Thoughts • Aerodynamics Classifications and Objectives (Monday) & Lab-1 (Thursday)

Week-3: • Fundamental Aerodynamics Variables • Aerodynamics Forces and Moments • Center of Pressure • Dimensional Analysis: The Buckingham Pi Theorem • Flow Similarity (Monday) & Lab-2 (Thursday)

Week-4: • Types of Flow - Chapter 2: Aerodynamics: Some Fundamental Principles and Equations • Review of vector relations • Control volumes and fluid elements (Monday) & Lab-3 (Thursday)

Week-5: • Continuity equation • Momentum equation • Pathlines and streamline • Angular velocity, vorticity (Monday) & Lab-4 (Thursday)

Week-6: • Circulation • Stream function and velocity potential - Chapter 3: Fundamentals of Inviscid, Incompressible Flow • Bernoulli's equation and its application (Monday) & PROBLEM HOUR-1 (Thursday)

Week-7: **MIDTERM 1 - November 3rd 2025, Monday at 15.30, classroom A11** & Lab-5 (Thursday)

Week-8: • Pitot tube – Pitotstatic tube • Pressure coefficient • Laplace's equation for irrotational, incompressible flow • Elementary flows • Combination of elementary flows • Nonlifting flow over a circular cylinder (Monday) & Lab-6 (Thursday)

Week-9: • Lifting flow over a circular cylinder • Kutta Joukowski Theorem - Chapter 4: Incompressible Flows Over Airfoils • Introduction • Airfoil Nomenclature Airfoil Characteristics • The Vortex Sheet Model • The Kutta Condition • Kelvin's Circulation Theorem and the Starting Vortex (Monday) & Lab-7 (Thursday)

Week-10: • Classical Thin Airfoil Theory • The Cambered Airfoil • The Vortex Panel Method • Viscous Flow (Monday) & Lab-8 (Thursday)

Week-11: Chapter 5: Incompressible Flow Over Finite Wings • Downwash and Induced Drag (Monday) & Lab-9 (Thursday)

Week-12: • The Vortex Filament, The Biot-Savart Law, The Helmholtz Theory • Prandtl's Classical Lifting-Line Theory • Elliptical lift distribution • General lift distribution (Monday) & PROBLEM HOUR-2 (Thursday)

Week-13: **MIDTERM 2 – December 15th 2025, Monday at 15.30, classroom A11** & Lab-10 (Thursday)

Week-14: Chapter 6: Three-Dimensional Incompressible Flow • Three-Dimensional Source, Three-Dimensional Doublet • Flow over a Sphere, Comment on the 3D Relieving Effect • General 3D Flows: Panel Techniques, Applied Aerodynamics (Monday) & Lab-11 (Thursday)

Schedule can be re-organized because of uncertain conditions. Follow the announcements from lecture assistant.

Next Lecture

⟹ LAB INTRODUCTION

ON THURSDAY AT 11.15, THE LAB INTRODUCTION WILL BE GIVEN IN THE «AERODYNAMICS LABORATORY - AEROLAB» IN THE «AIRCRAFT ASSEMBLY WORKSHOP» BUILDING.