

Aerodynamics I - AE 305



CHAPTER 0

—

Course Objectives and Syllabus

by

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Instructor



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You can find lecture syllabus (this slides) and the password-protected lecture notes in my akbis announcement.

Lecture assistant: Burak Çiftçioğlu

Email: aero.ciftcioglu@gmail.com

For his office hours and lab groups, check announcements of his webpage.

Course Information



Lectures: Tuesday – 14:25-16:55 (A03)
Friday – 13:30-15:10 (AEROLAB in experiments & COMLAB in virtual labs)

Credits: 3 (Theory) + 2 (Pratice)

EVERY AE STUDENT SHOULD FOLLOW THIS PATH FOR SUCCESS (IMHO)



→ means next semester.

— means same semester.

AE 209 — THERMODYNAMICS

Fundamental energy & thermodynamic principles

AE 204 — FLUID MECHANICS

Fluid properties, flow, continuity, momentum & energy equations

AE 427 — INTRODUCTION TO CFD

Numerical methods, discretization, meshing & computational flow analysis

AE 305 — AERODYNAMICS I

Incompressible flow, airfoils, lift, drag & basic aerodynamic theory

AE 306 — AERODYNAMICS II

Compressible flow, shocks, expansions, high-speed aerodynamic flows

AE 443 — EXPERIMENTAL AERODYNAMICS

Wind-tunnel testing, measurements, instrumentation & experimental data

AE 428 — APPLIED CFD

Advanced CFD modeling, simulations, validation & engineering applications

- SUCCESSFUL AEROSPACE ENGINEERING UNDERGRADUATE
- AERODYNAMICS + CFD + EXPERIMENTAL ENGINEERING COMPETENCE

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AE 204 — FLUID MECHANICS

Fluid properties, flow, continuity, momentum & energy equations

You are here now ↓

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AE 427 — INTRODUCTION TO CFD

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AE 306 — AERODYNAMICS II

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AE 209 — THERMODYNAMICS

Fundamental energy & thermodynamic principles

Closest lecture

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CFD Numerical methods, discretization, meshing & computational flow analysis

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AERODYNAMICS Wind-tunnel testing, measurements, instrumentation & experimental data

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Students that have selected AE427 (old name AE433) in 2020, What are they doing now?

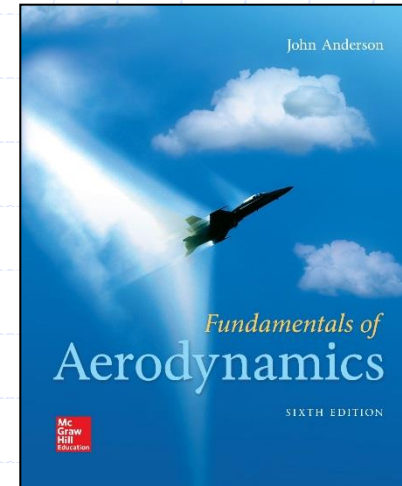
				Ders Yoklama Listesi (BAHAR 2019/2020)	
F				AE 433	Der
a				1	Öğr
#	A dı Soyadı			Where is he/she now?	
1	M*****	S*****	A****	Living Abroad	
2	E***	A*****		Avionics Systems Design Engineer · Türk Havacılık ve Uzay Sanayii	
3	M*****	A***	A*****	TEITECH şirketinde Lead Mechanical Design Engineer	
4	M*****	C**	A*****	· Project Management Specialist · Tezmaksan Robot Technologies	
5	S*****	Ç****		Aircraft Maintenance Coordinator at Turkish Technic	
6	M*****	C**	E***	Aircraft Maintenance Coordinator · Turkish Technic	
7	A***	G****	E****	TAAC Havacılık Teknolojileri - Yıldız Teknik Üniversitesi	
8	B****	G****		Design Engineer · Türk Havacılık ve Uzay Sanayii	
9	S****	C****	G****	Modeling and Simulation Engineer · Turkish Aerospace	
10	H****	Ö*		Southwind Airlines	
12	S****	T****	T*****	Mechanical Design Engineer · TCI Aircraft Interiors	
13	M*****	E****	T*****	ARGE Mühendisi · Kucukpazari Aerospace	
14	H*****	M*****	Ü****	Senior System Engineering · ONUR Airlines	
15	F*****	E*****	Y*****	Sales, contracts and customer support · Turkish Engine Center Pratt & Whitney Turkish Technic	

- SUCCESSFUL AEROSPACE ENGINEERING UNDERGRADUATE
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Compulsory Text



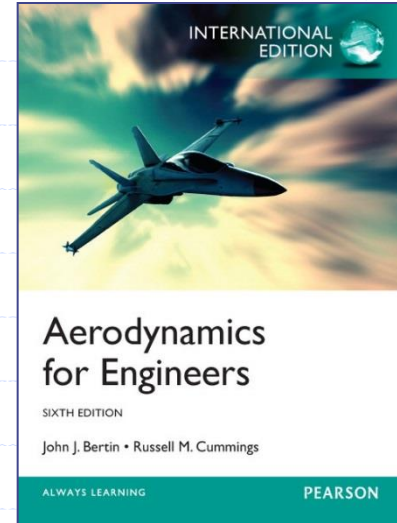
Fundamentals of Aerodynamics 6th Edition or newer by John Anderson



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 (10 labs in total). **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 %)**.

Ten laboratory sessions (three of them are virtual labs) 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 to ten minutes at 13.30 PM on Fridays** 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-to-six** will be announced by lecture assistant. You can suggest your lab group to him till the end of Monday (28.09.2026) or you will randomly be grouped. The lab groups will be announced in lecture assistant's site on Tuesday (29.09.2026), **LAST TWO YEARS' ATTENDEES CAN SEND THEIR NAMES TO THE LECTURE ASSISTANT FOR EXEMPTION FROM THIS SEMESTER'S LAB SESSIONS, OTHERWISE THEY SHOULD FOLLOW THE CODES ABOVE..**

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 **Mondays before 17.00** to the corresponding assistant in his office.

Assessment (LOOK OUT !)



- Labs: **(USE OF AI)**

- Students are expected to adhere to the principles of academic integrity throughout the course. All reports must represent the student's own work, and all sources must be properly acknowledged.
- Artificial intelligence (AI) tools (e.g., ChatGPT, Copilot, Gemini) are **not permitted other than plots/graphics/tables generation**. However, any use of AI tools should be appropriately disclosed in **acknowledgements section**, and students remain fully responsible for the accuracy, originality, and integrity of all submitted work.
- AI-generated content must not replace the student's own understanding, analysis, or original work.
- Violations of academic integrity will be handled in accordance with the University's academic regulations.

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 10 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
9. Acknowledgements (USE of AI in plot/graph/table generation, if any)

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

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

Week -1: Chapter 0: Introduction (Tuesday) & Lab introduction (Friday)

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

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

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

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

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

**Week-7: MIDTERM 1 - November 3rd 2026,
Tuesday at 14.30, classrooms A02-A03 & Lab-5 (Friday)**

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 (Tuesday) & Lab-6 (Friday)

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 (Tuesday) & Lab-7 (Friday)

Week-10: • Classical Thin Airfoil Theory • The Cambered Airfoil • The Vortex Panel Method • Viscous Flow (Tuesday) & Virtual Lab-1 (Friday)

Week-11: Chapter 5: Incompressible Flow Over Finite Wings • Downwash and Induced Drag (Tuesday) & Virtual Lab-2 (Friday)

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

**Week-13: MIDTERM 2 – December 15th 2026,
Tuesday at 14.30, classrooms A02-A03 & Virtual Lab-3 (Friday)**

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 (Tuesday) & PROBLEM HOUR-3 (Friday)

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



Next Lecture

→ LAB INTRODUCTION

ON FRIDAY AT 13.30, THE LAB
INTRODUCTION WILL BE GIVEN
IN THE «AERODYNAMICS
LABORATORY - **AEROLAB**» IN
THE «AIRCRAFT ASSEMBLY
WORKSHOP» BUILDING.