



Introduction to Aerospace Engineering 20243_ame_105_28706

Units: 4

Fall 2024—Tue/Thu—S1: 9:30 – 10:50 THH 212, S2: 11:00 – 12:20 VHE 210

Instructor: Geoffrey Spedding

Office: OHE 500L

Office Hours: 1-2:30 pm Tue,Thu in OHE 500L, 11:30 – 1 pm Wed, (e-quad or office)

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TA for Mon lab: TBD

Office/Hours: TBD

Lab Hours: Section 28708
Mon 2 – 4:50 pm, SAL 109

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TA for Thu lab: TBD

Office/Hours: TBD

Lab Hours: Section 28707
Thu 2 – 4:50 pm, SAL 127

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Course Description

The “Intro. to Aero.” class is the first taste of Aerospace Engineering for AE majors and anyone else who is interested, or curious. It provides an example of the application of the principles of mathematics and physics to an engineering topic of great societal impact. It is an illustration of the art of engineering, and we also examine the politics and business of aerospace engineering, again from the perspective of basic quantitative analysis and prediction. We aim to provide the background and basis for further exploration of fluid mechanics, structures and aerodynamics, and for emerging into the world of professional engineering and/or academia. The background is in the form of analysis, synthesis and design, numerical computation and computer-aided drawing. Each of these 4 skill-sets lays the foundation for further progress over the next 3.5 years.

Learning objectives

Students who successfully complete the course will be able to:

- 1) place aerospace engineering in societal context
- 2) formulate and manipulate equations for transport efficiency
- 3) apply the fundamental equations for the physics of fluids to canonical problems
- 4) understand and use International Standard Atmospheric tables
- 5) calculate lift and drag for wings and bodies for varying Reynolds numbers, Mach number
- 6) estimate drag, thrust and power curves for aircraft as a function of flight speed
- 7) design a basic aircraft for a mission defined by weight, speed and distance
- 8) read, interpret and apply lift-drag polars for design
- 9) construct a basic flight mechanics model for simulating drag and power requirements
- 10) make detailed Re-dependent drag estimates for an entire aircraft, predicting range and endurance
- 11) design a vehicle that is passively stable in pitch and yaw
- 12) design and describe parts in a Computer Aided Drawing (CAD) program

- 13) produce parts assemblies
- 14) generate simple Matlab scripts to calculate and render data
- 15) make clear, concise and quantitative statements about engineering data

Course Notes

This class is taught in standard lecture mode. There are 2 80-minute lectures per week. Each week, one homework will be assigned, due the following week. The homework will be based on material discussed in class. Most weeks there will also be a 10-15 minute class quiz, with simple questions designed to check your working knowledge. The class is not broadcast simultaneously, but all lecture materials can be found in movies that are posted online, week-by-week. In-class attendance is very strongly recommended. This is where we form our learning community. Attendance at mid-term, and at finals is mandatory, and non-changeable. Attendance at Glider Day is also mandatory, since the glider report forms a significant part of the class grade.

Communication & technology

The class is hosted on BrightSpace (BS). BS hosts also the weekly assignments. Assignments are due one week following their release online. All general and technical questions should be addressed to the Discussions section (DS) on BS. All electronic communications will be answered within 24 hours, except at weekends. Usually, the response time is under 2 hours. Students are encouraged to hold themselves to this standard so that group work can be efficient. Groups are defined and enabled on BB. **In most assignments, group participation is encouraged.**

Technological Proficiency and Hardware/Software Required

We assume that every student has access to Microsoft Office (which is provided free by the University) and/or a Google equivalent, or Overleaf (for LaTeX), so that typeset documents and spreadsheets can be generated and submitted. We will also assume the ability to scan documents (usually containing hand-written equations), for which a standard smartphone is sufficient.

Required Readings

Every student must have a copy of the textbook 'Introduction to Flight' by J. Anderson. There are numerous editions, each one more expensive than the last. The course materials and references to this text are organized so that any edition from the 4th onwards will suffice. Any online edition is also acceptable.

Optional Readings

There is an optional textbook, 'The Simple Science of Flight' by H. Tennekes. No course material depends on it, but it is highly encouraged because it expands the scope of the class, while being completely in line with the main themes of the course. It also costs about \$15.

Description and Assessment of Assignments

Assignments are aligned with the learning objectives, meaning that each assignment serves to measure student performance on at least one learning objective. The following is a complete list of expected assignments. hw denotes a homework assignment, *en* an exam. Lab1-3 are the main assignments for the graphics/CAD lab.

- 1) hw1: cost of transport and real aircraft specifications
- 2) hw2: computing the standard atmosphere
- 3) hw3: interim summary -- online
- 4) hw4: 2D airfoils and aircraft applications
- 5) hw5: airfoil geometry and Reynolds number
- 6) hw6: a simple computer model of flight vs. speed
- 7) hw7: flight performance analysis
- 8) hw8: model predictions for a model glider
- 9) hw9: practical glider flight tests and a scientific report

- 10) e1 - mid-term exam: from basic aerodynamics to viscous boundary layers
- 11) e2 - final exam: everything, including stability and high-speed flight

Here is how the assignments map onto the course outcomes:

Student learning outcome	Graded assignments
1	hw1, 4
2	hw1, e1,2
3	hw2, 3, e1,2
4	hw2, e1,2
5	hw5, 8, 9, e1,2
6	hw6, 9, e1,2
7	hw6, 7, e1,2
8	hw5, 9, e1,2
9	hw6
10	hw8, 9
11	e2
12	lab1
13	lab2
14	lab3
15	hw1, 4, 6, 8, 9, e1, 2

Every homework is accompanied at the time of its publication with a detailed grading template, which is then used to score the result. For every homework there is a dedicated BlackBoard discussion section, which is monitored by the Instructor.

Grading Breakdown

This is an estimate of how the grade for the class is distributed amongst the various assignments. It is an initial estimate only, as the actual weights will depend slightly on adaptations to the class progress during the semester. There will also be a balance between in class quizzes and homework assignments. The in-class quizzes will count towards the HW totals below. Hw8 & 9 are important, and act as capstones projects for the class as a whole. Hw8 is a theoretical/numerical model which is then combined with flight tests in hw9.

Assignment	% of Grade
Hw1-7	25
Hw8, 9	25
Graphics lab	10
Mid-term	20
Final	20
Total	100

Assignment Submission

Assignments are published on BrightSpace at 9am every Thursday. Submissions themselves will be on paper and are handed in before class.

Grading Timeline

Every homework will be graded within one week of submission. A review of the grading will typically be given on the Tuesday Discussion Session.

Late work

Each homework score is reduced by 10% for every day late. 1 µsec late counts as one day. There are no exceptions to this rule.

Academic integrity

The University of Southern California is foremost a learning community committed to fostering successful scholars and researchers dedicated to the pursuit of knowledge and the transmission of ideas. Academic misconduct is in contrast to the university's mission to educate students through a broad array of first-rank academic, professional, and extracurricular programs and includes any act of dishonesty in the submission of academic work (either in draft or final form).

This course will follow the expectations for academic integrity as stated in the [USC Student Handbook](#). All students are expected to submit assignments that are original work and prepared specifically for the course/section in this academic term. You may not submit work written by others or "recycle" work prepared for other courses without obtaining written permission from the instructor(s). Students suspected of engaging in academic misconduct will be reported to the Office of Academic Integrity.

Other violations of academic misconduct include, but are not limited to, cheating, plagiarism, fabrication (e.g., falsifying data), knowingly assisting others in acts of academic dishonesty, and any act that gains or is intended to gain an unfair academic advantage.

Academic dishonesty has a far-reaching impact and is considered a serious offense against the university. Violations will result in a grade penalty, such as a failing grade on the assignment or in the course, and disciplinary action from the university itself, such as suspension or even expulsion.

For more information about academic integrity see the [student handbook](#) or the [Office of Academic Integrity's website](#), and university policies on [Research and Scholarship Misconduct](#).

Please ask your instructor if you are unsure what constitutes unauthorized assistance on an exam or assignment or what information requires citation and/or attribution.

Specifically for AME 105:

Take-home homeworks put an extra emphasis on honesty and academic integrity. In homeworks, the default is that collaboration is allowed, and encouraged, provided the names of all collaborators are clearly noted at the time of homework submission. Class quizzes and exams are solo efforts.

Course Content Distribution and Synchronous Session Recordings Policies

USC has policies that prohibit recording and distribution of any synchronous and asynchronous course content outside of the learning environment.

Recording a university class without the express permission of the instructor and announcement to the class, or unless conducted pursuant to an Office of Student Accessibility Services (OSAS) accommodation. Recording can inhibit free discussion in the future, and thus infringe on the academic freedom of other students as well as the instructor. (Living our Unifying Values: The USC Student Handbook, page 13).

Distribution or use of notes, recordings, exams, or other intellectual property, based on university classes or lectures without the express permission of the instructor for purposes other than individual or group study. This includes but is not limited to providing materials for distribution by services publishing course materials. This restriction on unauthorized use also applies to all information, which had been distributed to students or in any way had been displayed for use in relation to the class, whether obtained in class, via email, on the internet, or via any other media. Distributing course material without the instructor's permission will be presumed to be an intentional act to facilitate or enable academic dishonesty and is strictly prohibited. (Living our Unifying Values: The USC Student Handbook, page 13).

Course Schedule

Week	Dates	Discussion Topic	notes & movies
1	Aug 27, 29	Introduction/Engineering Fundamentals begin Graphics Lab	M0-Introduction M1-Physics of Fluids
2	Sep 2 Sep 03, 05	Labor Day Aerostatics/Standard Atmosphere	M2-Aerostatics M3-ISA
3	Sep 10, 12	Basic & practical Aero.	M4-Aerodynamics
4	Sep 17, 19	Airfoils	M5-Applied Aerodynamics M6-Airfoils
5	Sep 24, 26	Wings	M7-Wings
6	Oct 01, 03	Real wings, real drag last week of Graphics Lab	M8-AeroDesign
7	Oct 08	Viscosity/Boundary Layers Fall recess (Oct 10,11)	M9-Viscous Flows
8	Oct 15, 17	Separation/turbulence first week of Glider Build	M10-Turbulence
9	Oct 22, 24	Turbulence, MT MidTerm	MT prep
10	Oct 29, 31	Flight Mechanics 1 Flight Mechanics 2	M11-Flight Mechanics M12-Gliding
11	Nov 05, 07	Stability & control	M14-StabilityControl
12	Nov 12, 14	High-speed flight 1	M15-HighSpeed
13	Nov 19 Nov 21	High-speed flight 2 Glider Flight Tests (6 am)	
14	Nov 26, 28	Thanksgiving Break	no class
15	Dec 03, 05	Summary and review	Glider report due 12/01
	Thu, Dec 12 Tue, Dec 17	Final Exam S1 (11 am – 1 pm) Final Exam S2 (8 – 10 am)	THH 212 (inperson) VHE 210 (in person)

Statement on University Academic and Support Systems

Students and Disability Accommodations:

USC welcomes students with disabilities into all of the University's educational programs. [The Office of Student Accessibility Services](#) (OSAS) is responsible for the determination of appropriate accommodations for students who encounter disability-related barriers. Once a student has completed the OSAS process (registration, initial appointment, and submitted documentation) and accommodations are determined to be reasonable and appropriate, a Letter of Accommodation (LOA) will be available to generate for each course. The LOA must be given to each course instructor by the student and followed up with a discussion. This should be done as early in the semester as possible as accommodations are not retroactive. More information can be found at osas.usc.edu. You may contact OSAS at (213) 740-0776 or via email at osasfrontdesk@usc.edu.

Student Financial Aid and Satisfactory Academic Progress:

To be eligible for certain kinds of financial aid, students are required to maintain Satisfactory Academic Progress (SAP) toward their degree objectives. Visit the [Financial Aid Office webpage](#) for [undergraduate](#)- and [graduate-level](#) SAP eligibility requirements and the appeals process.

Support Systems:

[Counseling and Mental Health](#) - (213) 740-9355 – 24/7 on call

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

[988 Suicide and Crisis Lifeline](#) - 988 for both calls and text messages – 24/7 on call

The 988 Suicide and Crisis Lifeline (formerly known as the National Suicide Prevention Lifeline) provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week, across the United States. The Lifeline consists of a national network of over 200 local crisis centers, combining custom local care and resources with national standards and best practices. The new, shorter phone number makes it easier for people to remember and access mental health crisis services (though the previous 1 (800) 273-8255 number will continue to function indefinitely) and represents a continued commitment to those in crisis.

[Relationship and Sexual Violence Prevention Services \(RSVP\)](#) - (213) 740-9355(WELL) – 24/7 on call

Free and confidential therapy services, workshops, and training for situations related to gender- and power-based harm (including sexual assault, intimate partner violence, and stalking).

[Office for Equity, Equal Opportunity, and Title IX \(EEO-TIX\)](#) - (213) 740-5086

Information about how to get help or help someone affected by harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants.

[Reporting Incidents of Bias or Harassment](#) - (213) 740-2500

Avenue to report incidents of bias, hate crimes, and microaggressions to the Office for Equity, Equal Opportunity, and Title for appropriate investigation, supportive measures, and response.

[The Office of Student Accessibility Services \(OSAS\)](#) - (213) 740-0776

OSAS ensures equal access for students with disabilities through providing academic accommodations and auxiliary aids in accordance with federal laws and university policy.

[USC Campus Support and Intervention](#) - (213) 740-0411

Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

[Diversity, Equity and Inclusion](#) - (213) 740-2101

Information on events, programs and training, the Provost's Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

[USC Emergency](#) - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call

Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

[USC Department of Public Safety](#) - UPC: (213) 740-6000, HSC: (323) 442-1200 – 24/7 on call

Non-emergency assistance or information.

[Office of the Ombuds](#) - (213) 821-9556 (UPC) / (323-442-0382 (HSC)

A safe and confidential place to share your USC-related issues with a University Ombuds who will work with you to explore options or paths to manage your concern.

[Occupational Therapy Faculty Practice](#) - (323) 442-2850 or otfp@med.usc.edu

Confidential Lifestyle Redesign services for USC students to support health promoting habits and routines that enhance quality of life and academic performance.