USC University of Southern California

Introduction to Aerospace Engineering
20213_ame_105_ 28706

Units: 4
Fall 2021—Tue/Thu—9:30 am – 10:50 am PST
Location: VHE 206
Instructor: Geoffrey Spedding
Office: OHE 500L
Office Hours: 1-3 pm Tue,Thu
Contact Info: geoff@usc.edu

Teaching Assistant: Shilpa Vijay
Office/Hours: VHE 202, Mon, Thu 12 – 1 pm
Lab Hours: 28707 Mon 2 – 4:50 pm, SAL 109
28708 Thu 2 – 4:50 pm, SAL 127
Contact Info: shilpavi@usc.edu

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.

Course Outcomes

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 flipped, and there are no lectures in the traditional sense. The course is divided into 15 course modules, each corresponding to an identified topic (e.g. flight mechanics, high-speed flight). Covering the course modules m1-15, there are about 70 short movie segments, each one concentrating on one important idea. The movie segments are called 'nuggets' – bite-sized presentations of core concepts in the course. Each topic also has hand-written notes, as if compiled by the perfect student consuming the nuggets. The movies and notes comprise the main course material, and the students watch and read these before the live class session, which is now turned into a discussion on the material. In most Discussion Sessions, there will be an in-class short quiz, which will be based on the previously-viewed material. Depending on the depth of this quiz (some will be 10 minutes, other may be 40 minutes), it may somewhat, or completely replace a proposed take-home assignment.

Communication & technology

The class is hosted on Blackboard (BB). BB hosts also the online assignments. Assignments are due one week following their release online. All general and technical questions should be addressed to the Discussion Board (DB) on BB. 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.

USC technology rental program

We realize that attending classes online and completing coursework remotely requires access to technology that not all students possess. If you need resources to successfully participate in your classes, such as a laptop or internet hotspot, you may be eligible for the university's equipment rental program. To apply, please submit an application. The Student Basic Needs team will contact all applicants in early August and distribute equipment to eligible applicants prior to the start of the fall semester.

USC Technology Support Links

Zoom information for students
Blackboard help for students
Software available to USC Campus

Required Materials

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 Materials

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, e*n* 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. 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 Blackboard at 9am every Thursday. Submission must be by PDF, properly scanned and formatted as necessary. Raw images and photos will not be accepted. Multiple submissions can be posted during the week the homework is live, and only the last one will be read and graded. Submissions are through BlackBoard, which also maintains the live Gradebook.

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. I μsec late counts as one day. There are no exceptions to this rule.

Academic integrity

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 in person.

Synchronous session recording notice

Discussion sessions (class) will be recorded and provided to all students asynchronously. This happens automatically through BlackBoard-hosted zoom meetings.

Sharing of course materials outside of the learning environment

USC has a policy that prohibits sharing of any synchronous and asynchronous course content outside of the learning environment.

SCampus Section 11.12(B)

Distribution or use of notes or recordings based on university classes or lectures without the express permission of the instructor for purposes other than individual or group study is a violation of the USC Student Conduct Code. This includes, but is not limited to, providing materials for distribution by services publishing class notes. 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 relationship to the class, whether obtained in class, via email, on the Internet or via any other media. (SeeSection C.1 Class Notes Policy).

Course Schedule

Week	Dates	Discussion Topic	notes & movies
1	Aug 24, 26	Introduction/Engineering Fundamentals	M0-Introduction M1-Physics of Fluids
2	Aug 31, Sep 2	Aerostatics/Standard Atmosphere **begin Graphics Lab**	M2-Aerostatics M3-ISA
3	**Sep 6** Sep 7, 9	**Labor Day** Basic & practical Aero.	 M4-Aerodynamics
4	Sep 14, 16	Airfoils	M5-Applied Aerodynamics M6-Airfoils
5	Sep 21, 23	Wings	M7-Wings
6	Sep 28, 30	Real wings, real drag **last week of Graphics Lab**	M8-AeroDesign
7	Oct 5, 7	Viscosity/Boundary Layers **first week of Glider Build**	M9-Viscous Flows
8	Oct 12	Separation/turbulence **Fall recess (Oct 14,15)**	M10-Turbulence
9	Oct 19, 21	Turbulence, MT **MidTerm**	MT prep
10	Oct 26, 28	Flight Mechanics 1 Flight Mechanics 2	M11-Flight Mechanics M12-Gliding
11	Nov 2, 4	Range and Endurance	M13-RangeEndurance
12	Nov 9, 11 **Nov 12**	Stability and Control **Glider Flight Tests (6 am)**	M14-StabilityControl
13	Nov 16, 18	High-speed flight	M15-HighSpeed
14	Nov 23, 25	**Thanksgiving Break**	no class
15	Nov 30, Dec 2	Summary and review	**Glider report due 12/02**
	Thu, Dec 9	**Final Exam (11 am – 1 pm)**	VHE 206 (in person)

Course evaluation

Course evaluation occurs at the end of the semester university-wide. It is an important review of your class experience. The instructor reads all the compiled statistical data, and every personal (but anonymous) comment. We We work hard, months in advance, to design this course to be both challenging and fun. Help us make continuous improvements by thinking about the class and giving evaluations and comments about its various components.

Statement on Academic Conduct and Support Systems

Academic Conduct:

Plagiarism – presenting someone else's ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in SCampus in Part B, Section 11, "Behavior Violating University Standards" policy.usc.edu/scampus-part-b. Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on scientific misconduct, policy.usc.edu/scientific-misconduct.

Support Systems:

Counseling and Mental Health - (213) 740-9355 – 24/7 on call
studenthealth.usc.edu/counseling
Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

National Suicide Prevention Lifeline - 1 (800) 273-8255 – 24/7 on call
suicidepreventionlifeline.org
Free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week.

Relationship and Sexual Violence Prevention Services (RSVP) - (213) 740-9355(WELL), press "0" after hours – 24/7 on call
studenthealth.usc.edu/sexual-assault
Free and confidential therapy services, workshops, and training for situations related to gender-based harm.

Office of Equity and Diversity (OED) - (213) 740-5086 | Title IX – (213) 821-8298
equity.usc.edu, titleix.usc.edu
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) 740-5086 or (213) 821-8298
usc-advocate.symplicity.com/care_report
Avenue to report incidents of bias, hate crimes, and microaggressions to the Office of Equity and Diversity |Title IX for appropriate investigation, supportive measures, and response.

The Office of Disability Services and Programs - (213) 740-0776
dsp.usc.edu
Support and accommodations for students with disabilities. Services include assistance in providing readers/notetakers/interpreters, special accommodations for test taking needs, assistance with architectural barriers, assistive technology, and support for individual needs.

USC Campus Support and Intervention - (213) 821-4710
campussupport.usc.edu
Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

Diversity at USC - (213) 740-2101
diversity.usc.edu
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
dps.usc.edu, emergency.usc.edu
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) 442-120 – 24/7 on call
dps.usc.edu
Non-emergency assistance or information.