Course Syllabus

Term
Spring 2019 (Jan. 7 – May 8, 2019)

Lectures
Tuesdays and Thursdays, 9:30 – 10:50am, in VKC 260

Instructor
Alejandra URANGA • Email: auranga@usc.edu
Office Hours: Tue. and Thurs. 11:00am – 12:00pm in RRB 218

Teaching Assistant
Arturo CAJAL • Email: cajal@usc.edu
Office Hours: Mon. 8:00 – 9:30am and Wed. 4:30 – 6:00pm in VHE 202

Course Description
The goal of the course is to teach the fundamental concepts and techniques used in aerodynamics—the study of the flow of air about a body—as applied to subsonic, transonic, and supersonic regimes. Topics covered include conservation principles, incompressible flows, potential flows, thin airfoil and lifting line theories, quasi-one-dimensional compressible flows and shocks, small disturbance approximation, and an introduction to viscous flows and boundary layer theory.

Textbook
John D. Anderson Jr., Fundamentals of Aerodynamics, 6th edition, 2016, McGraw-Hill (Note: an older edition can also be used)

Required Preparation
- AME 309 Dynamics of Fluids, or equivalent course in fluid mechanics
- Basic physics, vector calculus, and differential equations, at a level common to 1st year college

Grading
- Homework: 30% of final grade (two lowest grades dropped)
- Exam 1: 35% of final grade (in-class and take-home parts equally weighted)
- Exam 2: 35% of final grade (in-class and take-home parts equally weighted)

Resources

Blackboard course management system
https://blackboard.usc.edu
Course material will be posted on Blackboard. This includes homework assignments, but graded homework and exams will only be available on gradescope (see below).

Piazza Discussion Forum
https://piazza.com/usc/spring2019/20191_ame_460/home
You are strongly encouraged to use the Piazza discussion forum (integrated within Blackboard) to ask questions, make comments, and answer questions from your peers. When discussing homework assignments, do not give out the answers to questions! That would be a violation of the Collaboration Policy. Public posts related to graded assignments should only be for clarification purposes. No posts are allowed while a take-home exam is out.

Homework and Exam Grading on gradescope
https://gradescope.com
Assignments will be graded on gradescope. You will submit your homeworks and exams on paper, and see your grade and comments online on gradescope once they are graded.

You will receive an email to your USC email address with instructions on how to log in after the first homework is graded.
References

We will be following Anderson’s textbook closely, but there are a number of other good books on aerodynamics. The following references are good complements for those students who want to get another perspective or go in more depth on the material.

Fundamentals:
- J. Katz and A. Plotkin *Low-Speed Aerodynamics*, Cambridge University Press
- J.D. McLean, *Understanding Aerodynamics*, Wiley

Advanced Topics:

Course Policies

These course policies are designed to help students learn the material effectively, and the course assessment system is designed to best test students on what they really know, and can effectively use, in a real-world context. To ensure fairness, the rules will be strictly enforced.

Collaboration

- Collaboration of any sort on all matters that are not graded is strongly encouraged.
- Students may discuss the homework problems with one another, but no written or digital material can be part of such exchanges. *If it’s not in your head, it isn’t yours.* The corollary is that you must develop and write your own solutions.
- **Absolutely no collaboration is allowed on take-home exams:** these are individual efforts, and you are not allowed to discuss them with anyone else than the instructor.
- We will be very strict about academic integrity violations and report them as appropriate.

Homework Assignments

- Weekly homework will be assigned on Thursdays and due the following Thursday most weeks (except before exams). It is due before class begins on the due date. To be fair to everyone, late submissions will incur a 20% penalty after the due time (9:30am) and for each 24h delay.
- Homework must be submitted in class to the instructor on paper on the assignment pages provided (hard-copies). If you are not able to make the lecture on a due date, email your submission to the instructor by the due time.
- The two lowest homework grades will be dropped when computing the homework portion of the final grade.
- In order to receive full credit, solutions must be presented in a clear manner, and show evidence of work: magical one-line answers do not make the cut. The reasoning is as important as the solution. *This also applies to the exams.*

Office Hours

Office hours are held by both instructor and teaching assistant, and provide a good opportunity for you to get clarifications and better understand the course material. This time is best utilized when students come with clear questions and at least an attempt at a solution. The goal is for us to help you clarify the concepts and guide you through your thought process. *It is not meant as a way for you to effortlessly obtain the solutions.* So come often but prepared.
# Topics and Tentative Schedule

*You are responsible for reading the chapter(s) in the textbook before the corresponding lecture.*

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Topics</th>
<th>Reading</th>
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| 1    | JAN 8, 10| **I.** Introduction  
> Forces and moments  
> Flow similarity  
> Aerodynamic performance | Ch. 1     |
| 2    | JAN 15, 17| **II.** Conservation laws  
> Conservation of mass, momentum  
> Intrinsic coordinates, streamlines, stream function | Ch. 2     |
| 3    | JAN 22, 24| **III.** Incompressible potential flows  
> Equations, flow modeling  
> Non-lifting and lifting flow models | Ch. 3, 6  |
| 4    | JAN 29, 31| **IV.** Shock-expansion theory  
> Gas dynamics, energy equation  
> Normal shocks  
> Oblique shocks, expansion waves | Ch. 7     |
| 5    | FEB 5, 7  | **V.** Inviscid compressible aero  
> Full potential flow  
> Small disturbances, perturbation potential  
> Linearized compressible potential flow  
> Subsonic linearized potential flow, Prandtl-Glauert  
> Supersonic linearized potential flow  
> Transonic flows | Ch. 8     |
| 6    | FEB 12, 14| **Exam 1 take-home part due: Thursday March 7**  
> Quasi 1D flows and applications | Ch. 9     |
| 7    | FEB 19, 21| **Exam 1: Thursday February 28**  
> Normal shocks  
> Oblique shocks, expansion waves | Ch. 10    |
| 8    | MAR 5     | **Exam 1: Thursday February 28**  
> Normal shocks  
> Oblique shocks, expansion waves | Ch. 11, 12|
| 9    | MAR 12, 14| **Exam 2: Thursday April 4**  
> Normal shocks  
> Oblique shocks, expansion waves | Ch. 15    |
| 10   | MAR 19    | **VI.** Viscous flows and boundary layer theory  
> Viscous flows fundamentals  
> Boundary layer equations  
> Boundary layer parameters | Ch. 17    |
| 11   | MAR 26, 28| **Exam 2 take-home part due: Thursday April 11**  
> Viscous flows fundamentals  
> Boundary layer equations  
> Boundary layer parameters | Ch. 18    |
| 12   | APR 9, 11 | **Exam 2: Thursday April 4**  
> Viscous flows fundamentals  
> Boundary layer equations  
> Boundary layer parameters | Ch. 19    |
| 13   | APR 2     | **Exam 2 take-home part due: Thursday April 11**  
> Viscous flows fundamentals  
> Boundary layer equations  
> Boundary layer parameters | Ch. 18    |
| 14   | APR 23    | **Exam 2 take-home part due: Thursday April 11**  
> Viscous flows fundamentals  
> Boundary layer equations  
> Boundary layer parameters | Ch. 19    |
| 15   | APR 25    | Summary of aerodynamics tools | Ch. 15    |
| 16   | APR 28    | Summary of aerodynamics tools | Ch. 17    |
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” http://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, http://policy.usc.edu/scientific-misconduct.

Support Systems:

Student Health Counseling Services - (213) 740-7711 24/7 on call
http://engemannshc.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
http://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) 740-4900 24/7 on call
http://engemannshc.usc.edu/rsvp
Free and confidential therapy services, workshops, and training for situations related to gender-based harm.

Office of Equity and Diversity (OED) / Title IX - (213) 740-5086
http://equity.usc.edu, http://titleix.usc.edu
Information about how to get help or help a survivor of harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants. The university prohibits discrimination or harassment based on the following protected characteristics: race, color, national origin, ancestry, religion, sex, gender, gender identity, gender expression, sexual orientation, age, physical disability, medical condition, mental disability, marital status, pregnancy, veteran status, genetic information, and any other characteristic which may be specified in applicable laws and governmental regulations.

Bias Assessment Response and Support - (213) 740-2421
http://studentaffairs.usc.edu/bias-incident-report-statement/
Avenue to report incidents of bias, hate crimes, and microaggressions for appropriate investigation and response.

The Office of Disability Services and Programs - (213) 740-0776
http://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 Support and Advocacy - (213) 821-4710
http://studentaffairs.usc.edu/ssa
Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.