USC Viterbi School of Engineering

AME 309 – Dynamics of Fluids

Units: 4
Fall 2022 - Tue & Thu 12:00-1:50pm

Location: SLH 100.

Instructor: Iván Bermejo-Moreno
Office: OHE 500M
Office Hours: Tuesdays, 4-6pm, in OHE 406 (conference room)
Contact Info: bermejom@usc.edu

- Allow 48 hours during weekdays for email replies.
- Use your USC email account for email communications.

Teaching Assistant: Morgan Jones
Office: TBA
Office Hours: Mon 10-11am, Wed 5:30-7:30pm
Contact Info: morganrj@usc.edu

IT Help: https://viterbigrad.usc.edu/technical-support/

Course Description

This course provides an introduction to fluid mechanics. The first part of the course focuses on a description of fluids, the continuum hypothesis, revisiting dimensions and units, kinematics, fluid statics, followed by the statement of conservation laws of mass, momentum and total energy in integral and differential forms. Kinematics. Dimensional analysis is then introduced. The second part of the course is devoted to specific flow types of engineering relevance, including flow in ducts/pipes, boundary layes, flow past immersed bodies, potential flow, and compressible flow.

Learning Objectives

- Introduce the fundamental analytical treatment of fluids as a continuum medium.
- Provide a first exposure to three approaches of analysis of fluid flows: control volume (integral) analysis, differential analysis and dimensional analysis.
- Teach problem-solving strategies in engineering applications of fluids, including fluid systems in static equilibrium and in motion, and applying the most suitable methodology in each case.
- Solve practical problems in incompressible and compressible flow types using differential and integral fluid motion formulations.

Prerequisite(s): AME 201 **Co-Requisite(s):** MATH 245 **Concurrent Enrollment:** N/A

Recommended Preparation: introductory courses in fluid- and thermo-dynamics, vectorial and tensorial calculus, and partial differential equations.

Course Notes

- The course uses Blackboard online services (https://blackboard.usc.edu/). All course material, including lecture videos, instructor's notes, slide-show presentations, formula sheets, tables and graphs, and announcements will be posted online in the course website.
- A Microsoft OneNote Class Notebook is available to students with the handwritten part of the lectures and office hours. The notebook is shared with all students. Contact the instructor if you have not been granted access (e.g., if you enrolled after the first day of instruction).
- An online discussion forum will be used through the Piazza platform (http://www.piazza.com/). Please submit all questions related to homework, logistics, midterm and final exams to the discussion forum, so that other students can also benefit from the answers. You can submit questions anonymously if you so desire. If you are not automatically enrolled in Piazza, please contact the instructor. The course Piazza website is http://piazza.com/usc/fall2022/ame309
- Classes will be in-person with live Zoom broadcasting and recording, accessible from the Blackboard course website.

Technological Proficiency and Hardware/Software Required

- Basic use of plotting software will be required for some homework assignments. Any plotting software can be used (e.g., Python's matplotlib, gnuplot, Matlab, Microsoft Excel, etc.)

Recommended textbooks

- Frank White, Fluid Mechanics, 8th Ed, McGraw-Hill, Inc.

Paper-based copies of this book are available at USC's Science Library, physically located at 910 Bloom Walk, Los Angeles, CA 90089.

Grading Breakdown

- Homework: 35% of final grade.
- Midterm exam: 30% of final grade.
- Final exam: 35% of final grade.

Grading Scale

Course letter grades will be determined using the following scale from the final numerical grade:

A	91.5-100.0%
A-	82.5-91.5%
B+	75.0-82.5%
B	66.5-75.0%
B-	57.5-66.5%
C+	50.0-57.5%
C	41.5-50.0%
C-	32.5-41.5%
D+	25.0-32.5%
D	16.5-25.0%
D-	8.5-16.5%
F	0.0-8.5%

Assignment Submission Policy

- Each homework assignment should be **submitted electronically as a single PDF file** via the course Gradescope course page, accessible through the Blackboard course website at https://blackboard.usc.edu/). If you have a paper-based version of your homework assignment, you can use a scanner or any existing smart phone apps that use the phone camera as a scanner. Please make sure to append all pages into a single PDF document before submitting. **Also, please make sure to assign the pages corresponding to each problem on the Gradescope interface.**
- Ensure that you provide legible and logically organized solutions that explicitly include all necessary steps and assumptions (if any) made. Both hand-written or typed solutions are acceptable.
- Discussion of homework assignments with your classmates is allowed but each student should develop and write their own original solution.
- Late submission of homework assignments will be penalized by a 25% deduction in the assignment grade every 24 hours late, unless due to an emergency situation excused by the instructor. Email the instructor as soon as possible to discuss alternate arrangements due to an emergency.

Grading Timeline

- Graded annotated homework assignments and respective numerical grades will be available online through the Gradescope course website (accessible from Blackboard course website) within approximately 10 days after the submission deadline.

Additional Policies

- Students who require a laptop to complete any of their work can check one out through the Laptop Loaner Program https://itservices.usc.edu/spaces/laptoploaner/

Course Schedule: A Weekly Breakdown (W = week, HW = homework)

W	Date	Topics	Assignment
1	Aug 23 Aug 25	Introduction to fluids; continuum hypothesis; dimensions and units. Fluid properties	
2	Aug 30 Sep 01	Kinematics Fluid statics	 HW1 due
3	Sep 06 Sep 08	Hydrostatic forces and buoyancy Analysis methods; systems and control volumes	 HW2 due
4	Sep 13 Sep 15	Fluxes and Reynolds' transport theorem Conservation of mass	 HW3 due
5	Sep 20 Sep 22	Conservation of momentum Bernoulli's equation	 HW4 due
6	Sep 27 Sep 29	Conservation of energy	
7	Oct 04 Oct 06	Differential analysis of fluid motion Stream function, vorticity, irrotationality, velocity potential	 HW5 due
8	Oct 11	**Midterm**	
9	Oct 18 Oct 20	Dimensional analysis: Vaschy-Buckingham / Pi theorem Dimensionless parameters and fluid flow equations; Similarity	
10	Oct 25 Oct 27	Duct /pipe flow	HW6 due
11	Nov 01 Nov 03	Boundary layers Flow past immersed bodies	 HW7 due
12	Nov 08 Nov 10	Potential flow	
13	Nov 15 Nov 17	Introduction to compressible flow of calorically perfect gases Isentropic steady flow; smoothly varying cross-section	 HW8 due
14	Nov 22	Normal shock waves	
15	Nov 29 Dec 01	Nozzle flow Oblique shocks, Prandtl-Meyer expansions	 HW9 due
16	**Dec 13**	**Final exam: 11 am – 1 pm**	

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" https://scampus.usc.edu/1100-behavior-violating-university-standards-and-appropriate-sanctions.
Other forms of academic dishonesty are equally unacceptable. See additional information in *SCampus* and university policies on scientific misconduct, https://ooc.usc.edu/research-compliance/scientific-integrity/.

Support Systems:

Student Counseling Services (SCS) – (213) 740-7711 – 24/7 on call
Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention. engemannshc.usc.edu/counseling

The Office of Student Accessibility Services
Provides certification for students with accessibility requirements and helps arrange relevant accommodations.
https://osas.usc.edu/

Relationship and Sexual Violence Prevention and Services (RSVP) – (213) 740-4900 – 24/7 on call
Free and confidential therapy services, workshops, and training for situations related to gender-based harm.
https://studenthealth.usc.edu/sexual-assault

Office of Equity, Equal Opportunity, and Title IX (EEO-TIX) – (213) 740-5086
Works with faculty, staff, visitors, applicants, and students around issues of protected class. https://eeotix.usc.edu/

Bias Assessment Response and Support
Incidents of bias, hate crimes and microaggressions need to be reported allowing for appropriate investigation and response. studentaffairs.usc.edu/bias-assessment-response-support

Campus Support and Integration
Assists students and families in resolving complex issues adversely affecting their success as a student EX: personal, financial, and academic. https://campussupport.usc.edu/

Diversity, Equity, and Inclusion at USC
Information on events, programs and training, the Diversity Task Force (including representatives for each school), chronology, participation, and various resources for students. diversity.usc.edu

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

USC Emergency Information
Provides safety and other updates, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible. emergency.usc.edu

USC Department of Public Safety – UPC: (213) 740-4321 – HSC: (323) 442-1000 – 24-hour emergency or to report a crime.
Provides overall safety to USC community. https://dps.usc.edu/

Academic Dishonesty Sanction Guidelines

Violation	USC – Recommended sanction	AME – Recommended sanction
Copying answers from other students on any course work **	F for course	First offense: F on assignment Second offense: F for course
One person allowing another to cheat from his/her exam or assignment	F for course for both persons	If assignment: First offense: F on assignment Second offense: F for course If exam: F for course
Possessing or using material during exam (crib sheets, notes, books, etc.) which is not expressly permitted by the instructor.	F for course.	First offense: F on exam. Second offense: F for course.
Continuing to write after exam has ended.	F for course.	F on exam
Taking exam from room and later claiming that the instructor lost it.	F for course and recommendation for further disciplinary action (possible suspension).	F for course
Changing answers after exam has been returned.	F for course and recommendation for further disciplinary action (possible suspension).	F for course
Fraudulent possession of exam prior to administration.	F for course and recommendation for suspension.	F for course
Obtaining a copy of an exam or answer key prior to administration.	Suspension or expulsion from the university; F for course.	F for course
Having someone else complete course work for oneself.	Suspension or expulsion from the university for both students; F for course.	F for course
Plagiarism — Submitting other's work as one's own or giving an improper citation.	F for course.	First offense: F on assignment. Second offense: F for course.
Submission of purchased term papers or papers done by others.	F for course and recommendation for further disciplinary action (possible suspension).	F for course
Submission of the same assignment to more than one instructor, where no previous approval has been given.	F for both courses.	F for both courses
Unauthorized collaboration on an assignment.	F for the course for both students.	First offense: F on assignment. Second offense: F for course.
Falsification of information in admission applications (including supporting documentation).	Revocation of university admission without opportunity to reapply.	Revocation of university admission without opportunity to reapply.
Documentary falsification (e.g., petitions and supporting materials; medical documentation.)	Suspension or expulsion from the university; F for course when related to a specific course.	Suspension or expulsion from the university; F for course when related to a specific course.
Plagiarism in a graduate thesis or dissertation.	Expulsion from the university when discovered prior to graduation; revocation of degree when discovered subsequent to graduation.***	Expulsion from the university when discovered prior to graduation; revocation of degree when discovered subsequent to graduation.***

*Assuming first offense; **Exam, quiz, tests, assignments or other course work; ***Applies to graduate students