AME 309 – Dynamics of Fluids
Units: 4
Fall 2024 - Tue & Thu 12:00-1:50pm

Location: SLH 100.

Instructor: Iván Bermejo-Moreno
Office: OHE 500M
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- Allow 48 hours during weekdays for email replies.
- Use your USC email account for email communications.

Teaching Assistant: Weyie Wang
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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 layers, 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 Brightspace online services (https://brightspace.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 https://piazza.com/usc/fall2024/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 or newer), 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 Brightspace course website. If you have a paper-based version of your homework assignment, you can use a scanner or any existing smart phone app that utilize 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 within every subsequent 24-hour period late, unless the late submission is due to an emergency 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 27	Introduction to fluids; continuum hypothesis; dimensions and units.	
	Aug 29	Fluid properties	
2	Sep 03	Kinematics	
	Sep 05	Fluid statics	HW1 due
3	Sep 10	Hydrostatic forces and buoyancy	
	Sep 12	Analysis methods; systems and control volumes	HW2 due
4	Sep 17	Fluxes and Reynolds' transport theorem	
	Sep 19	Conservation of mass	HW3 due
5	Sep 24	Conservation of momentum	
	Sep 26	Bernoulli's equation	HW4 due
6	Oct 01	Conservation of energy	
	Oct 03		
7	Oct 08	Differential analysis of fluid motion	HW5 due
8	Oct 15	Stream function, vorticity, irrotationality, velocity potential	
	Oct 17	**Midterm (in class)**	
9	Oct 22	Dimensional analysis: Vaschy-Buckingham / Pi theorem	
	Oct 24	Dimensionless parameters and fluid flow equations; Similarity	
10	Oct 29	Duct /pipe flow	HW6 due
	Oct 31		
11	Nov 05	Boundary layers	
	Nov 07	Flow past immersed bodies	HW7 due
12	Nov 12	Potential flow	
	Nov 14		
13	Nov 19	Introduction to compressible flow of calorically perfect gases	
	Nov 21	Isentropic steady flow; smoothly varying cross-section	HW8 due
14	Nov 26	Normal shock waves	
15	Dec 03	Nozzle flow	
	Dec 05	Oblique shocks, Prandtl-Meyer expansions	HW9 due
16	**Dec 17**	**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 the USC Student Handbook, page 11: https://policy.usc.edu/studenthandbook/ .
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.
https://safety.usc.edu/resources/counseling/
https://sites.usc.edu/counselingandmentalhealth/

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://sites.usc.edu/clientservices/

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/

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. https://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. https://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. https://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