AME 309 – Dynamics of Fluids
Units: 4
Fall 2021 - Mon & Wed 12:00-1:50pm

Location: SLH 100.

Instructor: Iván Bermejo-Moreno

Office: OHE 500M

Office Hours: Thu, 4-6pm, OHE 406 and Zoom (Blackboard)

Contact Info: bermejom@usc.edu

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

Teaching Assistant: Vanessa Rubien

Office: TBA

Office Hours: Wed, 5-7pm on Zoom (Blackboard) and Thu, 11am-12pm in VHE 202

Contact Info: vrubien@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/fall2021/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: 30% of final grade.
- Midterm exams: 2 × 20% of final grade.
- Final exam: 30% 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	Introduction to fluids; continuum hypothesis; dimensions	
	Aug 25	Kinematics	
2	Aug 30	Fluid statics	
	Sep 01		HW1 due
3	Sep 06	Analysis methods; systems and control volumes; fluxes	
	Sep 08	Reynolds' transport theorem; conservation of mass	HW2 due
4	Sep 13	Conservation of momentum	
	Sep 15		HW3 due
5	Sep 20	Bernoulli's equation	
	Sep 22	Conservation of energy	HW4 due
6	Sep 27	Differential analysis of fluid motion	
	Sep 29		
7	Oct 04	Stream function, vorticity, irrotationality, velocity potential	HW5 due
	Oct 06	**Midterm 1**	
8	Oct 11	Dimensional analysis and similarity	
	Oct 13		
9	Oct 18	Duct flow	
	Oct 20		
10	Oct 25	Boundary layers	HW6 due
	Oct 27		
11	Nov 01	Flow past immersed bodies	
	Nov 03	Potential flow	HW7 due
12	Nov 08	**Midterm 2**	
	Nov 10	Introduction to compressible flow of perfect gases	
13	Nov 15	Isentropic steady flow; smoothly varying cross-section	
	Nov 17	Normal shock waves	HW8 due
14	Nov 22	Nozzle flow	
15	Nov 29	Oblique shocks	
	Dec 01	Prandtl-Meyer expansions	HW9 due
16	**Dec 10**	**Final exam 11 a.m to 1 p.m.**	

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, http://policy.usc.edu/scientific-misconduct.

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

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

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

Sexual Assault Resource Center
For more information about how to get help or help a survivor, rights, reporting options, and additional resources, visit the website: sarc.usc.edu

Office of Equity and Diversity (OED)/Title IX Compliance – (213) 740-5086
Works with faculty, staff, visitors, applicants, and students around issues of protected class. equity.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

The Office of Disability Services and Programs
Provides certification for students with disabilities and helps arrange relevant accommodations. dsp.usc.edu

Student Support and Advocacy – (213) 821-4710
Assists students and families in resolving complex issues adversely affecting their success as a student EX: personal, financial, and academic. studentaffairs.usc.edu/ssa

Diversity 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

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. 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