



**AME 309: Dynamics of Fluids**

**Units: 4.0**

**Spring 2019—Mon, Wed—Time: 12.00-1.50pm**

**Location: KDC 240**

**Instructor: Mitul Luhar**

**Office: RRB 220**

**Office Hours: Mon, 2.00pm-4.00pm, or by appointment.**

**Contact: [luhar@usc.edu](mailto:luhar@usc.edu)**

**Teaching Assistant:**

**Office: Michael Kruger**

**Office Hours: Tue, 10.00am-12.00pm; Fri, 12.00pm-2.00pm**

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## Course Description

This course aims to provide junior-level aerospace and mechanical engineering students with an in-depth introduction to fluid dynamics. Topics covered will include: fluid statics; conservation of mass, momentum, and energy (in both differential and integral form); laminar and turbulent flows; potential (ideal) flows; compressible flows; as well as several applications

## Learning Objectives and Outcomes

This course will:

- Introduce the concept of fluids as a continuum media
- Provide exposure to three different analytical approaches when considering fluids problems, i.e., the use of
  - o Dimensional analysis
  - o Control volume (integral) balances of mass, momentum, and energy
  - o Differential equations governing fluid flow
- Teach problem-solving strategies in engineering applications of fluid dynamics, including fluid systems in motion and in static equilibrium
- Enable students to identify the most appropriate methodology for solving engineering problems
- Integrate fluid flow analysis, basic numerical methods, design, experimental testing, data collection and post-processing in a team design project for a fluid system of engineering relevance.

**Prerequisite(s):** AME 201

**Co-Requisite(s):** MATH 245

## Textbook and Other Resources

There will be no required textbook for this class. All course notes will be provided in electronic format via Blackboard. However, **F. M. White, Fluid Mechanics, 8th Ed, McGraw-Hill** is recommended. It is a great resource for fluid dynamics in engineering systems. Readings will be suggested from the book to supplement course notes. Other good resources:

- *R. L. Panton, Incompressible Flow, Wiley*
- *M. Van Dyke, An Album of Fluid Motion, Parabolic Press (a beautiful book – check it out in the library!)*

There is a series of 39 videos developed by the National Committee for Fluid Mechanics Films (NCFMF) that I would highly recommend for anyone interested in the subject:

<http://web.mit.edu/hml/ncfmf.html>

## Grading Breakdown

Assignment	% of Grade
Homeworks (8 total)	20
Midterm 1	20
Midterm 2	20
Project	10
Final	30
<b>TOTAL</b>	

## Discussion board

Either Piazza (<https://piazza.com>) OR the Blackboard discussion forums will be used for all electronic discussions. Please post your questions (regarding homework assignments, class logistics, exams, etc.) on these forums instead of using email. You can access these through the Blackboard page for this course.

## Assignment Submission Policy

There will be a total of 8 homework assignments. You will generally have one week to work on each assignment.

- No late homework will be accepted.
- Discussion of homework assignments with your classmates is allowed (and encouraged!) but each student should develop and write their own original solution.
- Assignments should be submitted in stapled US letter-sized paper, with legible and logically organized solutions that explicitly include all necessary steps and assumptions (if any) made.
- Course grading policy and letter grade equivalence:

<http://arr.usc.edu/services/grades/gradinghandbook/gradingpolicies.html>

## Course Schedule: A Weekly Breakdown

	Topics/Daily Activities	Notes
Week 1 01/07	M: Introduction, Continuum Hypothesis, Applications W: Fluid Statics I	
Week 2 01/14	M: Fluid Statics II W: Kinematics	HW 1 Due
Week 3 01/21	M: <i>Martin Luther King's Birthday (no class)</i> W: Control Volume Analysis	
Week 4 01/28	M: Conservation of Mass W: Conservation of Momentum I	HW 2 Due
Week 5 02/04	M: Conservation of Momentum II W: Conservation of Energy	HW 3 Due
Week 6 02/11	M: Bernoulli's Equation W: <b>Midterm 1 (in class)</b>	
Week 7 02/18	M: <i>President's Day (no class)</i> W: Differential Equations for Fluid Flow	
Week 8 02/25	M: Streamfunction, Velocity Potential W: Vorticity and Irrotationality	HW 4 Due
Week 9 03/04	M: Dimensional Analysis W: Project Introduction	HW 5 Due
Week 10 03/18	M: Pipe, Channel, and Duct Flows W: Boundary Layers I	
Week 11 03/25	M: Boundary Layers II W: <b>Midterm 2 (in class)</b>	HW 6 Due
Week 12 04/01	M: Jets and Wakes W: Project Day	HW 7 Due
Week 13 04/08	M: Introduction to Compressible Flows W: Isentropic Flows	
Week 14 04/15	M: Normal Shockwaves W: Nozzle Flow	Project Report Due
Week 15 04/22	M: Oblique Shocks and Prandtl Meyer Expansions W: Introduction to Turbulence	HW 8 Due
FINAL	Friday, May 3 11.00am to 1.00pm	

## Academic Dishonesty: Sanction Guidelines

<b>Violation</b>	<b>USC – Recommended sanction</b>	<b>AME – Recommended sanction</b>
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.***

## 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](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, [policy.usc.edu/scientific-misconduct](http://policy.usc.edu/scientific-misconduct).

### Support Systems

*Student Health Counseling Services - (213) 740-7711 – 24/7 on call*  
[engemannshc.usc.edu/counseling](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*  
[suicidepreventionlifeline.org](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*  
[engemannshc.usc.edu/rsvp](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*  
[equity.usc.edu](http://equity.usc.edu), [titleix.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*  
[studentaffairs.usc.edu/bias-assessment-response-support](http://studentaffairs.usc.edu/bias-assessment-response-support)

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*  
[dsp.usc.edu](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*  
[studentaffairs.usc.edu/ssa](http://studentaffairs.usc.edu/ssa)

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](http://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](http://dps.usc.edu), [emergency.usc.edu](http://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](http://dps.usc.edu)

Non-emergency assistance or information.