

AME 533 Multiphase Flows, Spring 2019

OHE132 (TTh 2-3:20)

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Office hours: Available after class on request.
Feel free to email anytime.

This is largely a survey course. There will be no regular homework. Students are required to attend the lectures and will be graded on attendance. The major part of the grade is based on an individual project and a presentation to be given at the end of the semester and during final exam week. With luck the project can be related to a student's work or research. Note this should be much less work than a regular class, but I expect the student to put significant effort into the project.

There is no textbook for the course but a good survey is available free at <http://resolver.caltech.edu/CaltechBOOK:2005.001>

Topics:

Motion of single particles and bubbles in fluids.

Bubble growth and collapse, cavitation

Multiphase Flow Patterns

Interphasial Forces

Multiphase Flow Modeling

Homogeneous Flows

Separated Flows

Drift Flux Models

Kinematic Waves

Traffic Flow

Soil Liquefaction

Fluidization and Fluidized Beds

Granular Flows

Grading

Project: (See below) 60%
Attendance: 40%

Project Schedule:

Thursday Jan 31, Third Week of Class: (Student should decide on topic. (Students may change their mind later but should hand a page stating their topic on this date)

Thursday Feb 28, 7th Week of Class, Students should hand in a list of at least 15 references on their chosen topic.

March 10-17 Spring Break

Thursday April 4th, 12th Week, of Class, hand in a 1 page outline or summary of talk.

Student presentations will be made on the Last Week of Class, TTh April 23 and 25 and if necessary during the scheduled final exam period, Thursday May 2 2-4pm

At least one week before their presentation, students must make a one hour appointment with me to give me a practice run-through of their presentation. This is to help the students prepare the presentation. I will make suggestions and provide helpful hints to improve the final presentation. Students will not be graded on the run-through, only on the final presentation.

Report due by 2pm on May 2, the final exam date.

Projects for ME533: Multiphase Flows

The major course requirement for AME533 is an individual research project which is to be presented in the form of (1) a 15 page report (with at least 10 single spaced pages of text) and (2) a short (20min) presentation to the class; both students and I are permitted to answer questions during the presentation which will function as a kind of oral exam. In all cases the engineering relevance of the project must be clearly shown. The projects may fall into three categories:

(1) A survey or review of a general area concerning multiphase flows.

(2) A presentation of one particular piece of work in detail, such as a mathematical derivation. (A "piece of work" may consist of one or more papers.) In this case, the introduction should detail the relevance of the work and include a review of previous work.

(3) An original piece of research. Once again, the introduction should detail the relevance of the work and include a review of previous work.

I recommend that (2) and (3) be limited to those who have a current research or business interest in the subject. I also require that some of the presentation should include some work which is done explicitly for this class, and not be just a rehash of some previous project.

Grading will be based on the degree of understanding of the subject balanced with the difficulty of the task undertaken and the quality of the presentation. I prefer that you emphasize the basics of the problem rather than give a lot of disjointed problems.

PREVIOUSLY PRESENTED TITLES

The following are title of presentations that were previously given in this course or in a similar course given at Caltech. They are presented here to inspire ideas of your own. Only the more general topics should be considered as possible subject. I prefer some originality in the final choice. The final decision should be made in discussions with me and should be made within a month. Please email and make an appointment. My email address is campbell@usc.edu.

To get you started, I have the list of references used in all of the following. Each report must contain a similar reference list.

A Survey of Coagulation

Acoustic Cavitation and the Subharmonic mode

Spherical Instability During the Explosive Growth of a Liquid at the Superheat Limit

An Introduction to Two-phase Flow in Turbomachinery

Instrumentation in Two-phase Flow

The Rayleigh Taylor and Landau Instabilities

Flow of Dusty Gases

Analytical Methods in Two-phase Flows

The Effective Thermal Conductivity of Dilute Suspensions

The Sedimentation of Solid Spheres in a Quiescent Viscous Fluid

Some Aspects of Cavitation

Bubble Formation at an Orifice

Stability of Dusty Gases

The Viscosity of Suspension of Rigid Particles

The Dynamic Performance of Cavitating Pumps

Bubble Collapse and Microjets

Flow of Electrostatically Charged Suspensions

Cavitation Inception in Turbulent Shear Flows

Constitutive Relations for Fluid-solid mixtures

An Introduction to the Rayleigh-Taylor Instability

Ultrasonic Cavitation

Heat Transfer in the three Different Regimes of Pool Boiling

Aggregative and Particulate Fluidization

Performance Limitations in Heat Pipes

Stability of Fluidized Beds

The description of Particle Motions in Turbulent Flows

The Hydrodynamics of Hydrofoil Craft

Drag on Spherical Particles

The Viscosity of Concentrated Suspensions

Vapor Explosions: A survey of Models and Experimental Results

Departure from Nucleate Boiling in Pressurized Water Reactors

Radiation Attenuation Measurements for Two-phase Flow Measurements

Free Streamline theory Applied to a Cascade

The Spherical Droplet in a Gaseous Carrier: A Dimensional Analysis

Techniques for the Measurement of Cavitation Nucleation

Models of Heat Transfer in Fluidized Beds

Condensation Heat Transfer

A Model of the Maximum Flow Rate of a Two-phase Mixture

Secondary Atomization (Micro-Explosion) of the Fuel Droplet in Liquid Hydrocarbon-Fuel Combustion Systems

Spray Atomization

Flow Regime Transition in Horizontal Liquid-Gas Flow

Instabilities at a Two-phase Interface

Simultaneous Heat and Moisture Transfer in Porous Media

Drag on Small Particles and Drops in Stokes Flow

Two-phase Flow Instabilities in Heated Channels

Heat Transfer Phenomena during Quenching

Cavitation in Turbopumps

Microlayer in Nucleate Boiling

Two-phase Critical Flow

The Stress Tensor in Rapid Granular Flows

Transition and Film Boiling Phenomena

Acceleration of Burst Particles by an Exploding Vapor Field

Formation Mechanism of Ripples and Dunes on a Horizontal Erodeable Bed

Sonoluminescence

Atomization of a Liquid Jet

A Survey of Current Cavitation Inception Study and Testing

A Theory of Bubble Coalescence

Gas to Particle Heat Transfer

Bubbles in Gas Fluidized Beds

The Effective Thermal Conductivity of Sheared Suspensions

Drop Size Distributions and Geometries of Atomizer Sprays

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/ssaa

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