

ME 303: Fluid Mechanics

This is a cooperative course taught by WSU, open to University of Idaho students.

- Course description:* Fluid statics, laminar and turbulent flow, similitude, pipe flow, boundary layers, lift and drag, and measurement techniques.
- Number of credits:* 3. This course is required.
- Course Coordinator:* J. Liu
- Prerequisites by course:* ME 212
- Prerequisites by topic:*
1. Differentiation and integration.
 2. Simple vector operations.
 3. Concepts of velocity, acceleration, force and energy.
 4. Newton's laws of motion.
 5. Basic thermodynamic concepts such as systems and properties.
 6. Resolution of forces and moments from free body diagrams in statics and dynamics.
- Postrequisites:* ME 304, ME 306, ME 407, ME 439
- Textbooks/other required materials:* D.F. Elger, B.A. LeBret, C.T. Crowe, and J.A. Roberson. *Engineering Fluid Mechanics*. 12/e, 2019.
- Course objectives:*
1. Understanding the properties of fluids.
 2. Calculating forces on a submerged structure in a static fluid.
 3. Applying the mass conservation principle, using the control volume approach, to engineering problems.
 4. Using Euler's and Bernoulli's equations to calculate pressure variations in accelerating fluids.
 5. Applying the momentum and energy equations to engineering problems.
 6. Using dimensional analysis for scaling and data reduction.
 7. Calculating surface resistance in laminar and turbulent flows.
 8. Evaluating head loss in pipes and conduits.
 9. Calculating lift and drag on moving bodies.
- Topics covered:*
1. Fluid properties
 2. Fluid statics
 3. Fluids in motion
 4. Pressure variation in flowing fluids
 5. Momentum principle
 6. Energy principle
 7. Dimensional analysis and similitude
 8. Surface resistance
 9. Flow in conduits

10. Drag and lift
11. Flow measurements

Expected learning outcomes:

1. Ability to solve manometer problems, and calculate forces on submerged and floating bodies.
2. Ability to use conservation of mass principle to calculate flow rates through control volumes.
3. Ability to calculate accelerations and associated pressure variations in moving fluids using Euler's and Bernoulli's equations.
4. Ability to analyze momentum fluxes through a control volume and calculate forces in moving fluids.
5. Ability to apply conservation laws for mass, momentum and mechanical energy in combination to control volumes in ideal fluids and hence calculate hydraulic and energy grade lines.
6. Ability to calculate local and overall skin friction drag in laminar and turbulent flat plate boundary layers using approximate empirical formula.
7. Ability to solve hydraulic pipe flow problems using Moody's diagram for skin friction to calculate flow rate/ pressure loss / pipe diameter.
8. Ability to use dimensional analysis and similarity considerations in the design and interpretation of scale model experiments.
9. Ability to calculate lift and drag forces for simple aerodynamic shapes such as airfoils, cylinders and spheres using published charts of aerodynamic coefficients.

Class schedule:

Three 50-minute lecture sessions per week or two 75-minute lecture sessions per week for one semester.

Laboratory schedule:

None

Contribution to meeting the professional component:

Engineering Topics

Relationship of course to student outcomes:

Meets:

1. School of MME ME educational objectives: 1, 2
2. School of MME ME program outcomes: 1
3. ABET EC2019, Criterion 3 program outcomes: 1

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POLICIES

A. **Reasonable Accommodation** (the nature of the particular course determines which one applies):

- Pullman Campus. Reasonable accommodations are available for students with a documented disability. If you have a disability and need accommodations to fully participate in this class, please either visit or call the Access Center (Washington Building 217; 509-335-3417) to schedule an appointment with an Access Advisor. All accommodations MUST be approved through the Access Center.
- WSU Online Course. Reasonable accommodations are available in online classes for students with a documented disability. All accommodations must be approved through your WSU Disability Services office. If you have a disability and need accommodations, we recommend you begin the

process as soon as possible. For more information contact a Disability Specialist on your home campus: Pullman or WSU Online (<http://accesscenter.wsu.edu>), Spokane (<http://spokane.wsu.edu/students/current/studentaffairs/disability/>), Tri-Cities (<http://www.tricity.wsu.edu/disability>), Vancouver (<http://studentaffairs.vancouver.wsu.edu/student-resource-center/disability-services>).

B. Academic Integrity

WSU expects all students to behave in a manner consistent with its high standards of scholarship and conduct. Students are expected to uphold these standards both on and off campus and acknowledge the university's authority to take disciplinary action. The Standards of Conduct for Students can be found at <http://conduct.wsu.edu>.

C. WSU Safety

WSU is committed to maintaining a safe environment for its faculty, staff, and students. Safety is the responsibility of every member of the campus community and individuals should know the appropriate actions to take when an emergency arises. In support of our commitment to the safety of the campus community the University has developed a Campus Safety Plan, <http://safetyplan.wsu.edu>. It is highly recommended that you visit this web site as well as the University emergency management web site at <http://oem.wsu.edu/> to become familiar with the information provided.