

# San José State University

## Mechanical and Aerospace Engineering

### ME111, Fluid Mechanics, Spring 2017

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<b>Office Hours:</b>	Monday, 8:45 – 9:30 AM, Wednesday, 8:45 – 9:30 AM
<b>Prerequisites:</b>	Math 32 (Calculus III) and CE 99 (Statics)

#### Online Course Resources

Electronic copies of the course materials such as the syllabus, assignments, handouts, grades, etc. may be found on my ME111 course shell in Canvas (<http://sjsu.instructure.com>, see [http://www.sjsu.edu/at/ec/canvas/student\\_resources/index.html](http://www.sjsu.edu/at/ec/canvas/student_resources/index.html) to get started). You will automatically receive an account when you are registered in the course. You will be able to contact your classmates and instructor here through email and the discussion board, which may be useful for collaborating on the homework and project.

Also, a google group can be created to make sure that everybody will receive updates.

#### Course Description

Fluid properties, statics, dynamics of fluids; continuity, linear and angular momentum and energy principles. Viscous and non-viscous flow. Pumps, turbines, flow in pipes and around submerged obstacles. <http://info.sjsu.edu/web-dbgen/catalog/courses/ME111.html>

#### Course Goals and Student Learning Objectives

The course goal is to teach the basic theory and mathematics describing fluid mechanics and their application to common and contemporary applications.

#### Course Content Learning Outcomes

Upon successful completion of this course, students will be able to:

##### *Fluid Mechanics and Properties*

- Describe fluid mechanics, and contrast gases and liquids by describing similarities and differences.
- Use primary dimensions to check equations for dimensional homogeneity.

- Define the various properties of fluids, such as density, specific weight, specific gravity, pressure, temperature, viscosity, and vapor pressure.

### ***Statics***

- Apply the hydrostatic equation and the manometer equations to predict pressure and the resulting forces on plane surfaces.

### ***Hydrodynamics – Bernoulli’s Equation***

- Apply the Bernoulli equation to pressure and velocity variations
- Calculate and interpret the pressure coefficient around ideal (fully attached) and real (separated) cylinders and blunt bodies.

### ***Hydrodynamics – Continuity***

- Calculate the volume and mass flow rates of applications such as draining tanks and variable-area ducts using the continuity equation.
- State the purpose of the Reynolds Transport Theorem
- Describe the idea underlying cavitation and predict its onset.

### ***Hydrodynamics – Momentum Equation***

- Interpret and apply the momentum equation to stationary and moving control volumes to calculate forces and moments on applications such as jets, vanes, nozzles and pipe sections.

### ***Hydrodynamics – Energy Equation***

- Apply the energy equation to predict pressure drop and head loss, or the power equation to find power required by a pump or power supplied by a turbine.
- Sketch and interpret an EGL or HGL for systems involving reservoirs, pipes, pumps, turbines, and nozzles, and identify locations of cavitation.

### ***Boundary Layers***

- Calculate boundary layer thickness and overall shear stress in laminar, combined laminar and turbulent, and turbulent boundary layer flows.

### ***Flow in Conduits – Internal Flows***

- Classify flow as laminar or turbulent, and developing or fully developed.
- Find values of the friction factor using the Moody diagram or equations
- Calculate pipe head loss, component head loss, and total head loss.
- Calculate minor losses (i.e., head losses in pipe inlets, outlets, valves, and other fittings).
- Select the right size pump for a given pipeline / system.

### ***Special Topics***

- Interpret and apply the drag coefficient to calculate drag force on a blunt body.
- Apply the Manning equation to predict velocity in an open channel flow.
- Determine and interpret the NPSH (Net Positive Suction Head) associated with the inlet of a centrifugal pump.

### ***Contemporary Problems Related to Fluid Mechanics***

- Demonstrate lifelong learning skills by using library databases and other reliable information sources to research a contemporary issue related to fluid mechanics with a regional, national, or global impact.
- Demonstrate an ability to identify, formulate, and solve engineering problems by articulating and testing a hypothesis to answer a question surrounding the contemporary issue using theory discussed in class. Critically evaluate and draw conclusions based on evidence.

Success in this course is based on the expectation that students will spend, for each unit of credit, a minimum of forty-five hours over the length of the course (normally 3 hours per unit per week with 1 of the hours used for lecture) for instruction or preparation/studying or course related activities including but not limited to internships, labs, clinical practica. Other course structures will have equivalent workload expectations as described in the syllabus.

## Required Texts/Readings

*Fluid Mechanics*, by Frank White

## Classroom Protocol

Please arrive to class on time. Most recent updates are presented at the very beginning of each class. Even if tardy or absent, each student is personally responsible for staying up-to-date with all instructions and relevant announcements. Please put away all cell phones and internet devices during the class period. All participation, including questions during lecture, volunteering solutions, and contributing in group activities, is highly encouraged. You must exhibit a respectful and professional attitude towards everyone in the classroom at all times.

## Dropping and Adding

Students are responsible for understanding the policies and procedures about add/drop, grade forgiveness, etc. Refer to the current semester's [Catalog Policies](http://info.sjsu.edu/static/catalog/policies.html) section at <http://info.sjsu.edu/static/catalog/policies.html>. Add/drop deadlines can be found on the [current academic calendar](http://www.sjsu.edu/academic_programs/calendars/academic_calendar/) web page located at [http://www.sjsu.edu/academic\\_programs/calendars/academic\\_calendar/](http://www.sjsu.edu/academic_programs/calendars/academic_calendar/). The [Late Drop Policy](http://www.sjsu.edu/aars/policies/latedrops/policy/) is available at <http://www.sjsu.edu/aars/policies/latedrops/policy/>. Students should be aware of the current deadlines and penalties for dropping classes.

Information about the latest changes and news is available at the [Advising Hub](http://www.sjsu.edu/advising/) at <http://www.sjsu.edu/advising/>.

## Assignments and Grading Policy

### Graded Work and Weight Distribution

Class Work/Home Work	10%
Exams	35% (2 exams)
Design Project	15%
Final Exam	40%

### Grading Scale

A+ = 99-100 | A = 92-98 | A- = 90-91 | B+ = 88-89 | B = 82-87 | B- = 80-81  
C+ = 78-79 | C = 72-77 | C- = 70-71 | D+ = 68-69 | D = 62-67 | D- = 60-61 | F < 60

## **Design Project**

You need to design a device that can measure airflow. You don't need to have a prototype but you need to show assumption, calculations, etc...

Each group should consist of five people. Group members should be decided within three weeks. At the end of the semester, you need to deliver a "word document" that describe the design, process of thinking, assumptions, and calculations in a clear and systematic way.

The project should start with introduction (where you state what you are trying to do), then literature review to say what other people has done and how can you build/improve what they did. Then, then there is the analysis part where you describe your device and do some derivation/analysis).

Finally, a conclusion that tells people what you deduce.

Report should be between 10-15 pages.  
12pts font (times new roman).

## **Exam Policy**

All students are expected to complete exams in class as scheduled. There are no make-up exams or quizzes. Alternative accommodations or extended time will be considered only in partnership with the Disability Resource Center (<http://www.drc.sjsu.edu/>).

## **Exception Handling**

Any grading exceptions or appeals must be resolved in writing. Late homework or exams will be recorded with zero credit in the grade roster. Special consideration of truly unavoidable and extenuating circumstances will depend on expeditious timing and supporting documentation (e.g. doctor's note, jury summons, military orders). In fairness to classmates who have more fully met requirements, any retroactive credit will be evaluated at the very end of the semester, in context with one's overall class performance and in relative comparison to all other cases class-wide.

## **University Policies**

### **Academic integrity**

Your commitment as a student to learning is evidenced by your enrollment at San Jose State University. The [University's Academic Integrity policy](http://www.sjsu.edu/senate/S07-2.htm), located at <http://www.sjsu.edu/senate/S07-2.htm>, requires you to be honest in all your academic course work. Faculty members are required to report all infractions to the office of Student Conduct and Ethical Development. The [Student Conduct and Ethical Development website](http://www.sa.sjsu.edu/judicial_affairs/index.html) is available at [http://www.sa.sjsu.edu/judicial\\_affairs/index.html](http://www.sa.sjsu.edu/judicial_affairs/index.html).

Instances of academic dishonesty will not be tolerated. Cheating on exams or plagiarism (presenting the work of another as your own, or the use of another person's ideas without giving proper credit) will result in a failing grade and sanctions by the University. For this class, all assignments are to be completed by the individual student unless otherwise specified. If you

would like to include your assignment or any material you have submitted, or plan to submit for another class, please note that SJSU's Academic Policy S07-2 requires approval of instructors.

### **Campus Policy in Compliance with the American Disabilities Act**

If you need course adaptations or accommodations because of a disability, or if you need to make special arrangements in case the building must be evacuated, please make an appointment with me as soon as possible, or see me during office hours. Presidential Directive 97-03 requires that students with disabilities requesting accommodations must register with the [Disability Resource Center](http://www.drc.sjsu.edu/) (DRC) at <http://www.drc.sjsu.edu/> to establish a record of their disability.

### **Student Technology Resources**

Computer labs for student use are available in the Academic Success Center located on the 1<sup>st</sup> floor of Clark Hall and on the 2<sup>nd</sup> floor of the Student Union. Additional computer labs may be available in your department/college. Computers are also available in the Martin Luther King Library.

### **SJSU Writing Center**

The SJSU Writing Center is located in Room 126 in Clark Hall. It is staffed by professional instructors and upper-division or graduate-level writing specialists from each of the seven SJSU colleges. Our writing specialists have met a rigorous GPA requirement, and they are well trained to assist all students at all levels within all disciplines to become better writers. The [Writing Center website](http://www.sjsu.edu/writingcenter/about/staff/) is located at <http://www.sjsu.edu/writingcenter/about/staff/>.

## ME111 / Fluid Mechanics, Spring 2017, Course Schedule

*Schedule is subject to change with fair notice via in-class announcements or email.*

Week	Topics, Readings, Assignments, Deadlines
1	Greensheet, Introduction Ch- Liquids/gases, dimensions/units
2	Fluid properties- Fluid statics
3	Fluid statics cont. (Hydrodynamic forces-Buoyancy)
4	Review EXAM 1:
5	Bernoulli's equation and pitot static tube; Bernoulli's equation cont.
6	Pressure coefficient, Separation
7	Rate of flow, control volume, Reynolds transport theorem Continuity
8	Cavitation; video Momentum equation;
9	Applications of momentum equation; Momentum applications cont.
10	Energy, energy equation; Pipe flow;
11	EXAM 2: Laminar boundary layer and transition
12	Turbulent boundary layer Pipe sizes and pipe head loss
13	Head loss and minor losses; Drag coefficient;
14	Review EXAM3 EXAM 3
15	Review; Research project due