

**San José State University**  
**Mechanical Engineering Department**  
**ME 111 Fluid Mechanics Section 01, Fall 2021**

**Course and Contact Information**

Instructor:	Crystal Han
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Office Hours:	Tuesdays 9:00-10:00 AM and Wednesdays 12:00 – 1:00 PM
Class Meeting Days/Time:	Thursdays 9:00-10:15 AM + TBD (time allocated for watching lecture videos)
Classroom:	Zoom link provided on Canvas
Prerequisites:	MATH 032 and either CE 095 or 099 (with a grade of "C-" or better in each)

**Course Format**

The course will take the format of two meeting patterns; asynchronous online lectures (through recorded videos) and synchronous weekly meetings. Consider the videos as our lectures and meeting time as our group problem-solving time. Your learning of each topic in this course will take place in the sequence outlined below.

- 1) Watch lecture **videos** of the week up to 2 hours duration. Set aside a regular time for this.
- 2) Submit your **homework (HW)** by the day before the class.
- 3) Attend **class meetings** and actively participate in group worksheet activities.
- 4) Submit your **worksheet (WS)** write-ups by the next day of the class.
- 5) Before midterms and final, submit your hand-written solution to **practice problems (PP)**.
- 6) Earn **extra credits** by Connect problems (concept questions and additional problems)
- 7) **Test** your knowledge by quizzes, midterms, and final

Canvas will be extensively used for posting lecture videos, assignments, grades, zoom meeting links, and announcements. To use Canvas, use the link <https://sjsu.instructure.com/>, and login with your 9-digit SJSU ID and password. If you have any questions about using Canvas, please visit [http://www.sjsu.edu/at/ec/canvas/student\\_resources/index.html](http://www.sjsu.edu/at/ec/canvas/student_resources/index.html). You are responsible for checking the class page regularly to keep up to date on coursework. I strongly suggest having all announcements forwarded to an email address you check daily. **Modules tab** on the left sidebar will be the place you will follow through and accomplish week-by-week assignments. If you need to meet with me outside of office hours, please email me for an appointment and I can schedule an individual zoom meeting. Please do not forget to always include the course and section number in the title of your email. You can expect a reply to an email related to this course within 24 hours during weekdays.

## 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. Dimensional analysis and dynamic similitude.

## Course Learning Outcomes (CLO)

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

### *Fluid Properties*

1. Define a fluid and describe how it differs from a solid.
2. Describe the differences between liquids and gases.
3. Define the various properties of fluids, such as density, specific weight, specific gravity, pressure, temperature, viscosity, surface tension, and vapor pressure.
4. Distinguish between Newtonian and Non-Newtonian fluids.
5. Identify, formulate, and solve problems involving viscosity and vapor pressure.
6. Convert English and SI units involving fluid properties properly.

### *Fluid Statics*

7. Define and distinguish between absolute pressure, gage pressure, and vacuum.
8. Explain Blaise Pascal's law of pressure transmission.
9. Derive the basic differential equation of hydrostatics starting with the equilibrium of a fluid element.
10. Derive the equation for the pressure variation of a uniform-density fluid.
11. Identify, formulate and solve problems involving manometers and barometers.
12. Calculate forces and moments exerted by a fluid at rest on submerged plane and curved surfaces.
13. Analyze rigid-body motion of fluids in containers experiencing linear acceleration or rotation.

### *Fluid Flow – Continuity*

14. Explain the origin of the Reynolds Transport Theorem and how it can be used to develop important fluid mechanics equations.
15. Classify a flow as uniform or non-uniform, steady or unsteady, incompressible or compressible, 1-D, 2-D, or 3-D.
16. Calculate mass flow rate, volume flow rate, and mean velocity for a flow.
17. Derive the integral form of the continuity equation for a control volume.
18. Identify, formulate and solve problems involving the continuity equation for a variety of cases involving 1-D, uniform and non-uniform, incompressible, steady and unsteady flows.

### *Fluid Flow – Bernoulli's Equation*

19. Derive Bernoulli's equation and list the assumptions made in the derivation.
20. Apply Bernoulli's equation in a variety of problems including flow velocity measurements and pressure calculations.
21. Predict cavitation in enclosed pipes or hydraulic machines.

### *Fluid Flow – Momentum Equations*

22. Derive the linear momentum equation for a fluid, starting with Newton's 2nd law.
23. Identify, formulate, and solve problems involving the steady linear momentum equation in a variety of applications including stationary and moving vanes, nozzles, and pipes with bends.

24. Identify, formulate, and solve problems involving the steady angular momentum equation in a variety of applications including radial-flow devices and bending moments in piping networks.

### ***Fluid Flow – Energy Equation***

25. Derive the integral form of the energy equation starting with Reynolds transport theorem.
26. Identify, formulate, and solve problems involving the energy equation in a variety of applications including reservoirs, pipes with minor losses, pumps, turbines, and nozzles.
27. Identify, formulate, and solve problems involving the simultaneous application of continuity, momentum, and energy equations.
28. Plot the hydraulic and energy grade lines for a variety of flow systems involving reservoirs, pipes of varying diameters, pumps, turbines, and nozzles.
29. Choose a flowmeter for a particular application.

### ***Pipe Flow***

30. Describe qualitatively and quantitatively both laminar and turbulent flow in a pipe and predict transition from laminar to turbulent flow.
31. Explain how shear stress varies with distance from the entrance to a pipe. Calculate the entrance region for a pipe for both laminar and turbulent flow.
32. Use the Moody diagram or turbulent or laminar flow friction factor equations in a variety of problems involving head losses in pipes, including the design of pipes for certain discharge with a given head loss per unit length.
33. Calculate minor losses (i.e., head losses in pipe inlets, outlets, valves, and other fittings).

### ***External Flow***

34. Explain the difference between form (pressure) and friction drag. Predict which will dominate in different external flow situations. Explain the effect of flow regime on flow over cylinders and spheres.
35. Calculate the drag force over common 2-D and 3-D geometries.
36. Calculate skin friction coefficients and drag over flat plates experiencing laminar, all turbulent, and combined flows. Distinguish when to use skin friction coefficients and when to use drag coefficients to calculate drag.

### ***Pumps***

37. Calculate pump head and brake and water horsepower.
38. Place a pump at an elevation to prevent cavitation; determine if cavitation will happen in a given pump and system.

## **Textbook and technology requirements**

### **Textbook**

Cengel and Cimbala, Fluid Mechanics: Fundamentals and Applications, 4<sup>th</sup> ed., 2018 (E-book included in the Connect will be sufficient).

### **McGraw-Hill Connect**

Connect will be used for submitting practice problem assignments and for earning extra credits by solving concept questions and additional problems. Your access to McGraw-Hill Connect is included in your enrollment through First Day Solutions program. It is NOT recommended that you Opt-Out, as these materials are required to complete the course. You can choose to Opt-Out by **September 10**, but you will be responsible for purchasing your course materials at the full retail price and access to your materials may be suspended.

Accessing your Connect: <https://connect.mheducation.com/class/c-han-f21-me111-sec-01-fluid-mechanics>  
Opting Out of First Day for your eTextbook: <https://vimeo.com/304674616>

### Technology Requirements

Students are required to have an electronic device (laptop, desktop or tablet) with a camera and built-in microphone. SJSU has a free equipment loan program available for students (<https://www.sjsu.edu/learnanywhere/equipment/index.php>). Students are responsible for ensuring that they have access to reliable Wi-Fi to view lecture videos and to participate class meetings. On the exam days, students will need an additional device that has a camera and Wi-Fi connectivity. The first device will be used for accessing the exam problems (via Canvas using LockDown Browser), and the second device (typically a smartphone) will be used to provide zoom video for a proctoring purpose. This is because the LockDown Browser and zoom cannot run on the same device. If students are unable to have two devices connected to reliable Wi-Fi on exam dates, they must inform the instructor, as soon as possible or at the latest one week before the test date to determine an alternative. See Learn Anywhere website (<https://www.sjsu.edu/learnanywhere/>) for current Wi-Fi options on campus.

### Engineering Library Liaison

Krista Anandakuttan

Email: [krista.anandakuttan@sjsu.edu](mailto:krista.anandakuttan@sjsu.edu)

Subject guide: <http://libguides.sjsu.edu/me>

### Course Requirements and Assignments

“Success in this course is based on the expectation that students will spend, for each unit of credit, a minimum of 45 hours over the length of the course (normally three hours per unit per week) for instruction, preparation/studying, or course related activities, including but not limited to internships, labs, and clinical practica. Other course structures will have equivalent workload expectations as described in the syllabus.”

### Proof of Prerequisites

The most important task of the first week is to clear your prerequisites. Your unofficial transcript with the **prerequisite courses and your name highlighted** will serve as a proof of prerequisites. Submit your proof of prerequisites online as a file attachment on Canvas assignment by **August 25** in order to stay enrolled. If your courses are being evaluated for equivalency, please attach a course description in addition to your highlighted unofficial transcript.

### Lecture video-embedded quizzes

It is critical that you **allocate 2 hours in your weekly schedule to watch lecture videos**, which is the foundation for your homework and in-class worksheet. Videos are mostly broken into <30 min clips. Feel free to adjust playback speed to suit your needs. Undetermined number of questions asking about information delivered in the video clip will pop-up at undetermined time, which will comprise 5% of your final grade. Three to five Video Quizzes are assigned weekly and are **due at 11:59 pm of the day before classes**. The score deduction of 2% for each hour late submission will apply. Roughly after 1 day, you will receive 50% of your earned points, and after 2 days, no point.

### Homework

Homework will be assigned weekly, and it is **due at 11:59 pm of the day before classes**. Homework problems are closely related to the examples solved in the lecture videos, so it's highly encouraged that you attempt homework while or immediately after or while watching the assigned lecture videos of the week. You will submit a single PDF that includes scanned pages of your hand-written homework. Always combine multiple pages into a **single PDF file** before submission for smooth online grading. Information about a cell phone app

scanner and PDF combiner follows below. **No late homework will be accepted in any case; however, the 2 lowest homework scores will be dropped.** You may consider these assignments “freebies,” but use them wisely!

### **Worksheets**

During class meetings, you will solve worksheet problems in groups and submit your write-ups (as a group and as an individual) by the next day. Prepare your calculator, blank papers and any notes you have taken while watching the video lectures. Most importantly, do the homework before the class meeting so you are knowledgeable of the topic and are ready to solve the next-level problems. As a group of 3-4 people, you will fill in blanks in a worksheet on google slide through discussion in a ‘zoom breakout room.’ You call the instructor to your breakout room by pressing ‘Ask for help’ button. At the end of the discussion, your group will have write-ups that cover the key parts of the problem. Download the PDF of the completed google slide and submit it to earn points toward group activities (a half of the worksheet score). After the class meeting you will need to neatly write the entire analysis and answers to the problems and submit them individually (a half of the score). I will provide any help you need during the worksheet time and answer any questions except for the answers to the problems. You can check whether your answer is right or wrong using Canvas. Worksheet submissions are **due at 11:59 pm of the next day of classes**. The score deduction of 2% for each hour late submission will apply. Roughly after 1 day, you will receive 50% of your earned points, and after 2 days, no point.

If a person missed a group worksheet session, the default grade will be zero for that person who was absent. But I understand that there can be cases where you have a planned inevitable absence. If you plan ahead with your other members to arrange a way to contribute outside of the class meeting time (e.g. the person who missed the class takes care of polishing up the submission file and upload it, etc.), you can receive the same score as other members. For this arrangement, you will need to email me, cc-ing other group members, by the WS deadline. In the email, specify your contribution to the group worksheet.

### **Practice problems (PPs) in McGraw Hill Connect**

A set of problems from 2-3 chapters included in the scope of each exam (the midterm 1, 2 and final) will be posted ahead of time, and will be **due the day before exams**. Since there are only three sets of PPs, make sure you do not miss the due. The score deduction of 2% for each hour late submission will apply. Roughly after 1 day, you will receive 50% of your earned points, and after 2 days, no point. Purpose of these problems is to help you get prepared for exams by giving additional problem-solving practices. You can access these problems in Connect and submit your final answers there. A half of the score will be determined by your final answer on Connect, and the other half of the score will be determined by the PDF submission of your hand-written analysis on Canvas.

### **Concept questions and additional problems in McGraw Hill Connect (extra credit)**

Concept questions and additional problem sets will be posted chapter by chapter on Connect, and you can attempt them to earn extra credits. The concept questions can be useful for preparing for midterms and finals since those will include concept problems. A single attempt will be allowed to earn extra points. Once submitted, you can access the questions and detailed solutions throughout the semester. If you do not have time to solve but still want to get practice, you can just submit these with blank answers to reveal solutions so that you can use them as resources to prepare for your exams.

### **Quizzes**

There will be four short quizzes throughout the semester to test your understanding. Quizzes will start sharply in the beginning of the meeting time on dates shown on the tentative schedule below. There will be no make-up quizzes, but **the lowest quiz score will be dropped from your final grade**.

## Exams

There will be two 75-minute midterms and a final on the dates shown in the course schedule below. Exams are cumulative, so an exam will cover all chapters covered previously in this class. There will be questions testing your understanding on key concepts that comprise 10% of your score.

### Online Exam Protocols

All exams (quizzes, midterms, and final) will be **CLOSED BOOK and CLOSED NOTES with one single or double-sided 8.5 by 11 inch crib sheet and an engineering calculator allowed. No use of internet or communication with others** (via cell phones, tablets, laptop etc.) will be allowed during the exams. All exams require Canvas Lockdown Browser. Access code to exams will be given via zoom at the start time. After the exam is over, you will be given 10 minutes to upload a PDF file including scanned pages of your solution as a supporting document on canvas. No partial credits will be assigned without the supporting document.

### Proctoring Exams

Proctor will be conducted through zoom. Since the Canvas Lockdown Browser does not allow running zoom at the same time, you will need an additional device to provide a real-time video for the proctoring. Typically, people choose to a smartphone as their second device to provide a zoom video. You will be asked to have your zoom video 'on' with the correct viewing angle in which your face and hands (working surface) are visible on the zoom screen during the entire duration of the exam. Virtual background cannot be used during exams.

The zoom meeting during the exam will be recorded just in case there are irregular activities that require further investigation. Students are encouraged to contact the instructor if unexpected interruptions (from a parent or roommate, for example) occur during an exam. Only the instructor will have access to the recordings, and they will be deleted at the end of the semester. Please note it is the instructor's discretion to determine the method of proctoring. If cheating is suspected the proctoring videos may be used for further inspection and may become part of the student's disciplinary record.

### Online Exams Testing Environment

- No earbuds, headphones, or headsets visible.
- Only the resources allowed (a personal calculator and one sheet of equation sheet) can be used during the exam.
- The environment is free of other people besides the student taking the test.
- If students need scratch paper for the test, they should present the front and back of a blank scratch paper to the camera before the test.
- No other browser or windows besides Canvas opened.
- A workplace that is clear of clutter (i.e., reference materials, notes, textbooks, cellphone, tablets, smart watches, monitors, keyboards, gaming consoles, etc.)
- Well-lit environment. Can see the students' eyes and their whole face.
- Avoid having backlight from a window or other light source opposite the camera.
- Only one person is allowed to temporarily leave the desk at a time (e.g. to use restroom).

## Grading Information

### Grade Weighting

Lecture Video-embedded quiz	5%
Homework	8%
Worksheet	8%
Practice problems	4%
Quizzes	20%
Midterms (2@15% each)	30%
Final Exam	25%*
Connect problems	up to 2% extra

\*An exceptional final exam (10% higher than your average grade before the final) will result in the final exam being weighted at 35% of your final grade, with the weight of the other items being decreased proportionally.

### Determination of Grades

Letter Grade	Score
A plus	97.0 to 100
A	93.0 to 96.9
A minus	90.0 to 92.9
B plus	87.0 to 89.9
B	83.0 to 86.9
B minus	80.0 to 82.0
C plus	77.0 to 79.9
C	73.0 to 76.9
C minus	70.0 to 72.9
D plus	67.0 to 69.9
D	63.0 to 66.9
D minus	60.0 to 62.9

### Grading Philosophy

In engineering, getting the right answer is obviously important, but in this class, I am more concerned with helping you become good problem-solvers, not good answer-finders. This means that the process will be weighted more heavily than the getting the number right. If you attempt a problem correctly using relevant equations, I will try my best to give you partial credit. The more clearly you write your solution, the easier it is for me to do this.

### Grade Errors and Regrades

Clear grading errors (points added or recorded incorrectly) may be corrected at any time. Regrading (when you believe you deserve more points for something) may only be requested *within two weeks of the assignment due date*. To bring an error to my attention or request a regrade, please return the document to me in class with an attached note about why you believe you deserve more points.

### Extra credits

Extra credits of up to 2% to the overall grade is available for you by solving concept questions and additional problems in McGraw Hill Connect. No other extra credit will be made available.

## **Technologies for online learning**

### **Canvas**

Canvas will be the primary platform used for watching lecture videos, submitting assignments, and for all our communications. Connect can also be accessed from Canvas.

### **Zoom**

Zoom will be used for our class meetings and for exam proctoring. SJSU authentication will be required to join the zoom meeting. Log-in with your SJSU email and password before joining the zoom. This is to ensure that the pre-assigned breakout room works properly. See below for useful tips on zoom.

- You can use either tablet, laptop, desktop, or even a smartphone to join the zoom meeting.
- Use your SJSU login ID and password for using the app.
- When you first use, test your microphone and speakers following this instruction: <https://support.zoom.us/hc/en-us/articles/201362283-Testing-computer-or-device-audio>
- More information on zoom is provided here: <https://www.sjsu.edu/ecampus/teaching-tools/zoom/>
- The zoom features we will use include break-out room, annotation, shared screens, etc.

### **Adobe scan app**

All assignments are supposed to be submitted in a single PDF file format. To easily scan multiple pages and convert them into a single PDF, a mobile Adobe scanner app is recommended:

<https://acrobat.adobe.com/us/en/mobile/scanner-app.html>.

### **PDF merger**

In case you have several PDFs to combine into one, you can google search ‘merge PDF’ to find several websites that provides this service online.

### **Zoom Classroom Etiquette**

- **Mute Your Microphone:** To help keep background noise to a minimum, make sure you mute your microphone when you are not speaking.
- **Be Mindful of Background Noise and Distractions:** Find a quiet place to “attend” class, to the greatest extent possible.
- **Avoid video setups** where people may be walking behind you, people talking/making noise, etc.
- **Avoid activities** that could create additional noise, such as shuffling papers, listening to music in the background, etc.
- **Position Your Camera Properly:** Be sure your webcam is in a stable position and focused at eye level.
- **Limit Your Distractions/Avoid Multitasking:** You can make it easier to focus on the meeting by turning off notifications, closing or minimizing running apps, and putting your smartphone away (unless you are using it to access Zoom).
- **Use Appropriate Virtual Backgrounds:** If using a virtual background, it should be appropriate and professional and should NOT suggest or include content that is objectively offensive or demeaning.

### **Students are not allowed to record**

Students are prohibited from recording class activities (including class lectures, office hours, advising sessions, etc.), distributing class recordings, or posting class recordings. Materials created by the instructor for the course (syllabi, lectures and lecture notes, presentations, etc.) are copyrighted by the instructor. This university policy (S12-7) is in place to protect the privacy of students in the course, as well as to maintain academic integrity through reducing the instances of cheating. Students who record, distribute, or post these materials will be referred to the Student Conduct and Ethical Development office. Unauthorized recording may violate university

and state law. It is the responsibility of students that require special accommodations or assistive technology due to a disability to notify the instructor.

### **Technical difficulties**

#### **Internet connection issues**

Canvas autosaves responses a few times per minute as long as there is an internet connection. If your internet connection is lost, Canvas will warn you but allow you to continue working on your exam. A brief loss of internet connection is unlikely to cause you to lose your work. However, a longer loss of connectivity or weak/unstable connection may jeopardize your exam.

#### **Other technical difficulties**

Immediately email the instructor a current copy of the state of your exam and explain the problem you are facing. Your instructor may not be able to respond immediately or provide technical support. However, the copy of your exam and email will provide a record of the situation. If possible, complete your exam in the remaining allotted time, offline if necessary. Email your exam to your instructor within the allotted time or soon after.

#### **Contact the SJSU technical support for Canvas**

Email: [ecampus@sjsu.edu](mailto:ecampus@sjsu.edu)

Phone: (408) 924-2337

<https://www.sjsu.edu/ecampus/support/>

### **University Policies**

Per University Policy S16-9, university-wide policy information relevant to all courses, such as academic integrity, accommodations, etc. will be available on Office of Graduate and Undergraduate Programs' Syllabus Information page at <http://www.sjsu.edu/gup/syllabusinfo/>

### **Academic integrity**

Students who are suspected of cheating during an exam will be referred to the Student Conduct and Ethical Development office and depending on the severity of the conduct, will receive a zero on the assignment or a grade of F in the course. Grade Forgiveness does not apply to courses for which the original grade was the result of a finding of academic dishonesty. The University's Academic Integrity Policy (<http://www.sjsu.edu/studentconduct/docs/Academic%20Integrity%20Policy%20F15-7.pdf>), requires you to be honest in all your academic course work.

### **“SOS!”**

Sometimes, life happens. If you are really struggling with the course material, and/or if something is going on outside of class that may significantly disrupt your studies (financial concerns, upheaval in your home life, physical or mental health issues, etc.), I will do everything I can to help you succeed. If I am personally unable to help you, I will direct you to the appropriate resource. I will maintain a list on Canvas of all the resources available to you as an SJSU student. The earlier you ask for help with a problem, the easier it is to solve.

## ME 111 Fluid Mechanics Tentative Course Schedule

Meeting Dates	Topics (Textbook chapters)
Aug-19	Syllabus, Basic Concepts (Ch1.1-1.5)
Aug-26	Dimensions and Unit (Ch1.6), Density (2.1-2.2), Viscosity (2.6)
Sep-2	Cavitation (2.3), Pressure (3.1-3.2), Buoyancy (3.6)
Sep-9	Fluid Statics (3.3-3.5), <b>Quiz 1</b>
Sep-16	Fluids in Motion (3.7)
Sep-23	<b>Midterm 1: Chapters 1-3</b>
Sep-30	Fluid kinematics (4.1-4.6), Conservation of Mass (5.1-5.2)
Oct-7	Bernoulli's Equation (5.3-5.4), Energy Analysis (5.5-5.6)
Oct-14	Linear Momentum Equation (6.1-6.4), <b>Quiz 2</b>
Oct-21	Angular Momentum Equation (6.5-6.6)
Oct-28	Laminar Internal Flow (8.1-8.4), <b>Quiz 3</b>
Nov-4	<b>Midterm 2: Chapters 4-6</b>
Nov-11	Veterans day: No class
Nov-18	Turbulent Internal Flow and Piping Network (8.5-8.7)
Nov-25	Thanksgiving Day: No class
Dec-2	Drag on common geometries (11.1-11.4), Flow over flat plate or cylinders (11.5-11.6) <b>Quiz 4</b>
Dec-10	<b>FINAL EXAM 7:15-9:30 am (Friday)</b>

Aug-31: Last day to drop without an entry on your permanent record

Sep-8: Last day to add a class and register late