San José State University
Mechanical Engineering Department
ME 111 Fluid Mechanics Section 01, Fall 2022

Course and Contact Information

Instructor:	Crystal Han
Office Location:	E217B
Telephone:	408-924-6040
Email:	crystal.m.han@sjsu.edu Please always have your email title start with [ME111-01]
Office Hours:	Online during our scheduled class time 9:00 – 10:00 AM (link on Canvas) In-person on Wednesdays after class at 10:30 – 11:30 AM (E217B)
Class Meeting Days/Time:	Monday 9:00 AM -10:15 AM (independent study session) Wednesday 9:00 AM -10:15 AM (regular in-person class meeting)
Classroom:	E340
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 in-person flipped classroom format where the self-paced independent learning via online lecture videos will be followed by in-person in-class problem solving activities to consolidate the learning. 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 **individual worksheet** by the end of the class meeting day.
5) Before midterms and the final, submit your hand-written solution to **practice problems sets**.
6) Earn **extra credits** by solving 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, and announcements. It will also be used to submit the scanned copy of your assignments. 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. 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. 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, 4th 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 2**, 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-f22-me111-sec-01-fluid-mechanics
Opting Out of First Day for your eTextbook: https://vimeo.com/304674616

Technology Requirements
Students need to be able to scan their assignments and upload them on Canvas. Students are responsible for ensuring that they have access to reliable Wi-Fi to watch lecture videos as well. SJSU has a free equipment loan program available for students (https://www.sjsu.edu/learnanywhere/equipment/index.php). See Learn Anywhere website (https://www.sjsu.edu/learnanywhere/) for current Wi-Fi options on campus.

Adobe scan app
All assignments except for group worksheet write-ups 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.

Contact of the SJSU technical support for Canvas
Email: ecampus@sjsu.edu
Phone: (408) 924-2337
https://www.sjsu.edu/ecampus/support/

Engineering Library Liaison

Krista Anandakuttan
Email: 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 the corresponding Canvas assignment by **August 24** 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 videos

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 broken into clips topic by topic. 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. Three to five Video Quizzes are assigned weekly and are due at 11:59 pm of the day before classes.

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.

Group worksheet report

During class meetings, you will solve worksheet problems in group and submit your hard copy write-up as a group at the end of the class. As a group of 2-3 people, you will discuss the core parts of the analysis and fill in blanks in a group worksheet. I will provide any help you need during the worksheet time and answer any questions except for the direct answers to the problems. The same points will be assigned to the group members who participated in the group worksheet session. Group worksheet write-up will determine the 50% of the worksheet score.

Individual worksheet

Individual submission of full analysis to all worksheet problems are due at 11:59 pm of the day of classes. It will be submitted online as a PDF file on Canvas. The group discussion during the class meeting is supposed to provide clear plan for completing the worksheet problems. You are highly encouraged to resolve any doubts towards completing your individual worksheet during the class meeting. Your individual worksheet submission will be graded for accuracy in both answer and analysis steps, and will determine 50% of the worksheet score.

Practice problems (PPs) in McGraw Hill Connect

Practice problem sets will be posted at least 3-weeks ahead of the exam dates, and will be due at 11:59 pm of the next day of exams. There will be only three practice problem sets throughout the semester, so make sure you do not miss the due. You can access these problems in Connect and submit your final answers there. 50% of the score will be determined by your final answer on Connect, and the other 50% of the score will be determined by the PDF submission of your hand-written analysis on Canvas. Purpose of these problems is to help you get prepared for exams by giving additional problem-solving practices. And thus, you are encouraged to start working on these problems sufficiently ahead of the exam date so you can review other materials and problems (examples, homework, worksheet problems) near the exam.

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 attempt these but still want to get practice, you can choose to 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 135-minute 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, which will comprise 10% of your score.

Exam Protocols

Exams (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. The use of internet or communication with others (via talking, cell phones, tablets, laptop etc.) are NOT allowed during the exams. Earbuds, headphones, or headsets are not allowed during exams and quizzes.

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 82.9
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.

Late submission of assignments

The score **deduction of 2% for each hour late** submission will apply to the video-quizzes, homework, individual submission of worksheet, practice problem sets, and Connect extra credit problems. These are the assignments that you will submit on Canvas. Roughly speaking, you will receive 50% of your earned points

after 1 day, and after 2 days, no point. Late submission is **not applicable for quizzes and group worksheet write-ups** because you will submit the hard copies during classes.

Make-ups

There will be **no make-ups** in this course. However, **the two lowest scores of homework and worksheet assignments, and the lowest quiz score will be dropped from your final grade** to mitigate effects of the unexpected circumstances including absences.

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 email me with an explanation 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.

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 (https://www.sjsu.edu/studentconduct/docs/SJSU-Academic-Integrity-Policy-F15-7.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-22	Syllabus, Introduction, Basic Concepts (Ch1.1-1.5)
Aug-24	Dimensions and Unit (Ch1.6), Density (2.1-2.2), Viscosity (2.6)
Aug-31	Cavitation (2.3), Pressure (3.1-3.2), Buoyancy (3.6)
Sep-7	Fluid Statics (3.3-3.5), **Quiz 1**
Sep-14	Fluids in Motion (3.7)
Sep-21	**Midterm 1: Chapters 1-3**
Sep-28	Fluid kinematics (4.1-4.6), Conservation of Mass (5.1-5.2)
Oct-5	Bernoulli's Equation (5.3-5.4), Energy Analysis (5.5-5.6)
Oct-12	Linear Momentum Equation (6.1-6.4), **Quiz 2**
Oct-19	Angular Momentum Equation (6.5-6.6)
Oct-26	Laminar Internal Flow (8.1-8.4), **Quiz 3**
Nov-2	No class due to instructor's unavailability (date not finalized)
Nov-9	**Midterm 2: Chapters 4-6**
Nov-16	Turbulent Internal Flow and Piping Network (8.5-8.7)
Nov-23	Thanksgiving week: No class
Nov-30	Drag on common geometries (11.1-11.4), Flow over flat plate or cylinders (11.5-11.6) **Quiz 4**
Dec-13	**FINAL EXAM 7:15 am-9:30 am (Tuesday)**

Aug-31: Last day to drop without an entry on your permanent record
Sep-8: Last day to add a class and register late