

COURSE INFORMATION**MECH 3314:** Fluid Mechanics**CRN:** 10978**Term:** Fall 2024**Delivery Method:** In- person or as informed by the Instructor**Meeting Day and Time:** 10:30 – 11:50 am TR**Location:** Education Building, 311**INSTRUCTOR INFORMATION****Instructor:** Dr. Piyush Kumar**Email:** pkumar2@utep.edu**Phone Number:** (915)-747-7976**Office Location:** Engineering Building, Room E-330**Office Hours:**

- Face-to-Face: MW (15:00-16:30) at E-330 (Engineering Building) or by appointment through email
- Virtual: MW (11:00-12:30) on Teams by appointment through email

REQUIRED MATERIALS

Textbook: “Cengel, Y. A. and Cimbala, J. M., *Fluid Mechanics Fundamental and Applications, Fourth Edition, McGraw-Hill Inc. NY*”. Instructors may provide additional reading materials.

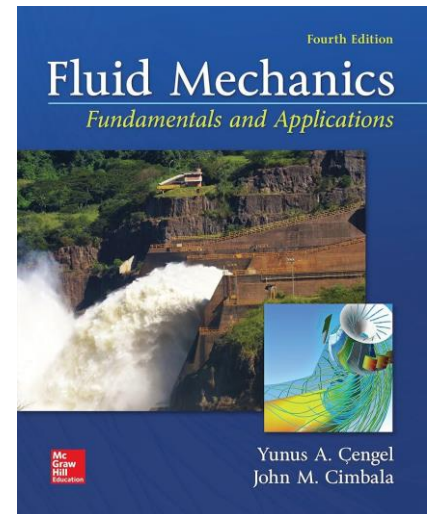
Prerequisite: MECH 2311 (Introduction to Thermal-Fluid Sciences/Mechanics of Materials) and all students taking the course must have a basic knowledge of engineering (Thermodynamics laws, Newtonian Mechanics/Laws) and differential and integral calculus.

COURSE DESCRIPTION:

Fluid Mechanics is an essential course for understanding the behavior and dynamics of fluids (liquids and gases) in various engineering contexts. This course provides a foundation in the principles of fluid statics, fluid dynamics, and their applications in real-world engineering problems. Students will learn to analyze and design systems involving fluid flow and understand how fluids interact with their surroundings.

COURSE OBJECTIVES:

- To understand the fundamental properties and behaviors of fluids.
- To apply the principles of fluid mechanics to solve real-world engineering problems.
- To analyze fluid flow in different contexts, such as pipes, channels, and around objects.
- To use dimensional analysis and similitude to model and predict fluid behavior.



LEARNING OUTCOMES:

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

- Describe and apply the fundamental concepts of fluid mechanics.
- Solve problems involving fluid statics and dynamics using relevant equations and principles.
- Analyze and design fluid systems, including pipes, channels, and hydraulic devices.
- Conduct dimensional analysis and apply similitude for modeling and scaling fluid systems.
- Use experimental and computational methods to investigate and validate fluid flow phenomena.

TOPICS

- Introduction and Basic Concepts
- Pressure and Fluid Statics
- Fluid Kinematics
- Bernoulli and Energy Equations
- Momentum Analysis of Flow Systems
- Dimensional Analysis
- Internal Flow
- External Flow: Drag and Lift
- Turbomachinery

ASSIGNMENT AND GRADING

There will be several Assignments/Homework at regular intervals during the semester. Students are required to submit the assigned work on or before the deadline. Late submission of the assigned work will not be allowed unless medical and emergency reasons exist. The following percentages of the assignments, exams, and projects will constitute the basis for the assigning of the final grade in the course:

Exam 1: 20%, Exam 2: 20%, Exam 3: 20%

Class performance & Quizzes: 20%

Homework and Assignments: 20%

Grading criterion:

- A ($\geq 90\%$)
- B ($<90\%$ & $\geq 80\%$)
- C ($<80\%$ & $\geq 70\%$)
- D ($<70\%$ & $\geq 60\%$)
- F ($<60\%$)

Note: Any outstanding issues related to grading of assigned work (quizzes, exams, homework or projects) must be resolved within two weeks from the day the graded work is returned.

Exams: There will be four exams. If you miss two exams, the instructor has the option to drop you from the class or assign an "F" grade. The exam grades will be calculated based on the average of the three highest test scores. A makeup exam will be provided in case of a documented emergency.



Assignment: The assignment will be uploaded on the blackboard as the pdf file or through the McGraw Hill Connect.

Quizzes: The quizzes will be given in class. No makeup quizzes.

TECHNOLOGY REQUIREMENTS

Some course content is delivered via the Internet through the Blackboard learning management system. Ensure your UTEP email account is working and you have access to the Web and a stable web browser. Google Chrome and Mozilla Firefox are the best browsers for Blackboard; other browsers may cause complications. When having technical difficulties, update your browser, clear your cache, or try switching to another browser.

You will need to have access to a computer/laptop. You will need to download or update the following software: Microsoft Office, Adobe Acrobat Reader, Windows Media Player, QuickTime, and MATLAB/Python. Check that your computer hardware and software are up-to-date and able to access all parts of the course.

If you do not have word-processing software, you can download Word and other Microsoft Office programs (including Excel, PowerPoint, Outlook, and more) for free via UTEP's Microsoft Office Portal. Click the following link for more information about [Microsoft Office 365](#) and follow the instructions.

IMPORTANT: If you encounter technical difficulties beyond your scope of troubleshooting, please contact the UTEP [Help Desk](#), as they are trained specifically in assisting with technological needs of students. Please do not contact me for this type of assistance. The Help Desk is much better equipped than I am to assist you!

ATTENDANCE AND PARTICIPATION

Students must attend at least 75% of all the classes in person.

ILLNESS PRECAUTIONS

Please stay home if you have symptoms of a communicable illness. If you are feeling unwell, please let me know as soon as possible so that we can work on appropriate accommodation.

EXAM INSTRUCTIONS

- Students are NOT allowed to go to restrooms during the test. Students with disabilities must have a letter of accommodation and coordinate this with the instructor.
- Students are NOT allowed access to any materials in their backpacks without permission.
- Students can NOT use devices during the exam (such as cell phones, iPads, iPods, and wristwatches).
- Late students are NOT allowed to take the exam 15 minutes after starting the test.



- No wearing hats is allowed during the test.

Allowed Calculators

- The following will be the only calculators allowed in exams:
- Casio: All fx-115 models. Any Casio calculator must contain fx-115 in its model name.
- Hewlett Packard: The HP 33s and HP 35s models, but no others.
- Texas Instruments: All TI-30X and TI-36X models. Any Texas Instruments calculator must contain either TI-30X or TI-36X in its model name.

EXCUSED ABSENCES AND/OR COURSE DROP POLICY

According to UTEP Catalog, "At the discretion of the instructor, a student can be dropped from a course because of excessive absences or lack of effort. A grade of "W" will be assigned before the course drop deadline and a grade of "F" after the course drop deadline." See Policies and Regulations in the UTEP Undergraduate Catalog for a list of excuse absences. Therefore, if I find that, due to non-performance in the course, you are at risk of failing, I will drop you from the course. I will provide 24-hour advance notice via email.

OR

I will not drop you from the course. However, if you feel that you are unable to complete the course successfully, please let me know and then contact the [Registrar's Office](#) to initiate the drop process. If you do not, you are at risk of receiving an "F" for the course.

MAKEUP WORK

Makeup work will be given *only* in the case of a *documented* emergency. Note that makeup work may be in a different format than the original work, may require more intensive preparation, and may be graded with penalty points. If you miss an assignment and the reason is not considered excusable, you will receive a zero. It is therefore important to reach out to me—in advance if at all possible—and explain with proper documentation why you missed a given course requirement. Once a deadline has been established for makeup work, no further extensions or exceptions will be granted.

ALTERNATIVE MEANS OF SUBMITTING WORK IN CASE OF TECHNICAL ISSUES

I strongly suggest that you submit your work with plenty of time to spare in the event that you have a technical issue with the course website, network, and/or your computer. I also suggest you save all your work (answers to discussion points, quizzes, exams, and essays) in a separate Word document as a backup. This way, you will have evidence that you completed the work and will not lose credit. If you are experiencing difficulties submitting your work through the course website, please contact the UTEP Help Desk. You can email me your backup document as a last resort.

INCOMPLETE GRADE POLICY

Incomplete grades may be requested only in exceptional circumstances after you have completed at least half of the course requirements. Talk to me immediately if you believe an incomplete is warranted. If granted, we will establish a contract of work to be completed with deadlines.



ACCOMMODATIONS POLICY

The University is committed to providing reasonable accommodations to students with documented disabilities. Students who become pregnant may also request reasonable accommodation, in accordance with state and federal laws and regulations and University policy. Accommodations that constitute undue hardship are not reasonable. To make a request, please register with the UTEP Center for Accommodations and Support Services (CASS). Contact CASS at 915-747-5148, email them at cass@utep.edu, or apply for accommodations online via the CASS portal.

SCHOLASTIC INTEGRITY

Academic dishonesty is prohibited and is considered a violation of the UTEP Handbook of Operating Procedures. It includes, but is not limited to, cheating, plagiarism, and collusion. Cheating may involve copying from or providing information to another student, possessing unauthorized materials during a test, or falsifying research data on laboratory reports. Plagiarism occurs when someone intentionally or knowingly represents the words or ideas of another as ones' own. Collusion involves collaborating with another person to commit any academically dishonest act. Any act of academic dishonesty attempted by a UTEP student is unacceptable and will not be tolerated. All suspected violations of academic integrity at The University of Texas at El Paso must be reported to the Office of Student Conduct and Conflict Resolution (OSCCR) for possible disciplinary action. To learn more, please visit [HOOP: Student Conduct and Discipline](#).

GUIDANCE ON ARTIFICIAL INTELLIGENCE

AI prohibited

Use of A.I. technologies or automated tools, particularly generative A.I. such as [ChatGPT](#) or [DALL-E](#), is ***not allowed*** for assignments in this class. Each student is expected to use critical and creative thinking skills to complete tasks and not rely on computer-generated ideas. Any direct use of AI-generated materials submitted as your own work will be treated as plagiarism and reported to the Office of Student Conduct and Conflict Resolution (OSCCR).

A.I. allowed with proper acknowledgement

Use of A.I. technologies or automated tools, particularly generative A.I. such as [ChatGPT](#) or [DALL-E](#), is ***only allowed with proper attribution given for its use***.

Students must properly cite and give full credit to the program used upon submission of every relevant assignment. For example, text generated using ChatGPT must be cited:

Chat-GPT(version). Date of query (year/month/day). "Text of your query."

Generated using OpenAI. <https://chat.openai.com/>

A short paragraph describing how the tool(s) was/were used for the assignment must be included.

COURSE RESOURCES: Where you can go for assistance

UTEP provides a variety of student services and support. Please refer to the Q.R. code below for a listing of campus resources or visit https://www.utep.edu/advising/student_resources/student-success-resource-hub.html.



ACES & Tutoring Center from the College of Engineering

Please note there are tutoring services available in the ACES center.

<https://www.utep.edu/engineering/student-resources/student-resources-aces-tutoring.html>

COURSE PLAN (Subject to Change)

Introduction and Basic Concepts



Week 1:

- Introduction
- The non-slip Conditions
- Classification of fluid flows
- System and Control Volume
- Properties of fluids

Pressure and Fluid Statics

Week 2 and 3:

- Pressure and Pressure measurement device
- Introduction to Fluid Statics
- Hydrostatic Forces on Submerged Plane Surfaces
- Hydrostatic Forces on Submerged Curved Surfaces
- Buoyancy and Stability

Fluid Kinematics

Week 4 and 5:

- Lagrangian and Eulerian Descriptions
- Flow patterns and Flow Visualization
- Vorticity and Rotationality
- The Reynolds Transport Theorem

Bernoulli and Energy Equations

Week 6 and 7:

- Introduction
- Conservation of Mass
- The Bernoulli Equation
- Derivation of the Bernoulli Equation
- Limitations on the Use of the Bernoulli Equation
- Applications of the Bernoulli Equation
- General Energy Equation
- Energy Transfer by Heat
- Energy Transfer by Work

Momentum Analysis of Flow Systems

Week 8 and 9:

- Newton's Laws
- Choosing a Control Volume
- Forces Acting on a Control Volume
- The Linear Momentum Equation
- The Angular Momentum Equation

Dimensional Analysis

Week 10:

- Dimensions and Units



Dimensional Homogeneity
Dimensional Analysis and Similarity
The Method of Repeating Variables and the Buckingham Pi Theorem

Internal Flow

Week 11 and 12:

Introduction
Laminar and Turbulent Flows
The Entrance Region
Laminar Flow in Pipes
Turbulent Flow in Pipes
Minor Losses
Piping Networks and Pump Selection

External Flow: Drag and Lift

Week 13 and 14:

Introduction
Drag and Lift
Parallel Flow over Flat Plates
Flow over Cylinders and Sphere

Turbomachinery

Self-Study:

Classifications and Terminology
Pumps
 Pump Performance Curves and Matching a Pump to a Piping System
 Pump Cavitation and Net Positive Suction Head
 Pumps in Series and Parallel
 Positive-Displacement Pumps
 Centrifugal Pumps
Turbines
 Positive-Displacement Turbines
 Impulse Turbines
 Reaction Turbines

The above schedule, policies, and assignments in this course are subject to change in the event of extenuating circumstances or by mutual agreement between the instructor and the students.