DIM-SAP-353 Engineering Fluid Mechanics

SEMESTER: Spring

CREDITS: 6 ECTS (60 hours)

LANGUAGE: English

DEGREES: SAPIENS program

Course overview

This course provides an introduction to fluid mechanics. It examines the theoretical bases for fluid statics and dynamics including the conservation of mass, energy and momentum. It includes the governing integral and differential equations for viscous and inviscid fluids, in internal and external flows. Upon completion of this course, a good understanding of the theory and real applications of incompressible and compressible fluids will be achieved.

Prerequisites

Having passed a first year of bachelor's degree in engineering. Recommended: Thermodynamics.

Course contents

Theory:

1. Introduction to Fluid Mechanics. Concept of a Fluid. Properties of a fluid. Viscosity. Surface Tension.
2. Hydrostatics. Pressure Distribution in a Fluid. Pressure measurement. Plane and curved surfaces. Buoyancy and Stability.
3. Fluid dynamics I: Integral Relations for a Control Volume. The Reynolds Transport Theorem. Conservation of Mass. The Linear Momentum Equation. The Angular-Momentum Theorem. The Energy Equation. The Bernoulli's Equation.
4. Fluid dynamics II: Differential Relations for a Fluid Particle. The Acceleration Field of a Fluid. The Differential Equations of Mass Conservation, Linear and Angular Momentum; and Energy. Vorticity and Irrotationality.
5. Dimensional Analysis and Similarity. The Pi Theorem. Similitude.
6. Viscous Flow in Ducts. Reynolds-Number Regimes. Flow in circular and non- circular pipes. Losses.
7. Flow Past Immersed Bodies. Reynolds-Number and Geometry Effects. The Boundary-Layer Equations. Boundary Layers with Pressure Gradient. Experimental External Flows.
8. Compressible Flow. The Speed of Sound. Isentropic Flow with Area Changes. Shock Waves.
9. Open-Channel Flow. Uniform Flow. Chézy Formula. Efficient Uniform-Flow Channels. Hydraulic Jumps.

Laboratory

In addition to lectures, students will carry out 4 lab sessions, related to the theoretical concepts seen in class. Each session will be 2-hours-long. The students will be divided into groups of 3-4 people, and each group must deliver a report about the concepts reviewed during each session, at the end of each activity. These activities will lead to a better understanding of the theoretical concepts.

01. Hydraulic losses.

02. Flow rate and velocity measurement devices.

03. Pipe networks: EPANET.

04..Computational Fluid Dynamics (CFD).

Textbook

- White, F. M. Fluid Mechanics. McGraw Hill. 2008
- Çengel, Y. A., Cimbala, J. M., Fluid Mechanics: Fundamentals and Applications. McGraw Hill. 2012
- Munson, Y., Okiishi, Fundamentals of Fluid Mechanics. 8th edition, Wiley, 2016

Grading

The following conditions must be accomplished to pass the course:

- A minimum overall grade of at least 5 over 10.

The overall grade is obtained as follows:

- 50 %, Exams (20% March + 30% April)
- 20%, Lab Exam (10%) + Lab Sessions Reports (10%)
- 30 %, Homework Tasks (collection of exercises to be solved periodically)

-- Class attendance is mandatory. If you miss more than 15% of the classes, you lose the right to take the final ordinary exam.
-The lack of attendance to some of the activities is a 0 in that session.
-A delay in the delivery of reports/solutions means a 0 in that task.

The extraordinary call consists of an exam covering the whole subject.
The weight of this extraordinary exam ~~could~~ is 60% or 80%. The Lab contribution (20%) runs separately.
The exam will only count 60% if tasks and reports helps the student to get a better overall grade.
If these contributions do not improve overall grade, the extraordinary exam will value 80% of the final mark.

The final grade will include the 20% of the lab sessions.
If lab sessions were failed (<5), the extraordinary exam will also cover these contents.

Use of AI

The use of AI to create entire works or relevant parts, without citing the source or the tool, or without explicit permission in the assignment description, will be considered plagiarism and will be regulated in accordance with the University General Regulations.

The use of Artificial Intelligence is allowed exclusively in the performance of the HOMEWORK. Therefore, Level 1 of the Perkins et al. (2024) Assessment Scale is set: " The assessment is completed entirely without AI assistance in a controlled environment, ensuring that students rely solely on their existing knowledge, understanding, and skills."

You must not use AI at any point during the assessment. You must demonstrate your core skills and knowledge.