Universidad Zaragoza

30013 - Fluid Mechanics

Información del Plan Docente

Academic Year	2017/18
Faculty / School	110 - Escuela de Ingeniería y Arquitectura
Degree	436 - Bachelor's Degree in Industrial Engineering Technology
ECTS	6.0
Year	2
Semester	First semester
Subject Type	Compulsory
Module	---

1.General information

1.1.Introduction

The purpose of the Fluid Mechanics course, in the first term of the second year, is to provide the graduate in Industrial Technology Engineering with knowledge and skills related to the fundamentals of Fluid Mechanics. Given the general nature of the subject, the program is extensive and devoted mostly to basic aspects.

1.2.Recommendations to take this course

Previous knowledge of physics and mathematics is necessary. In particular: the origin and meaning of forces and moments; properties and operations with vectors and matrices; derivative calculation (total and partial) and integral (definite and indefinite, over surfaces and volumes); differential operators such as the vector operator nabla in its different forms; physical meaning and handling of differential and integral equations.

The continued study and individual work are fundamental for structured and effective learning in this module. The student has the advice of the teacher, both during class and, especially, in the tutorials to guide him/her in learning. The labs are designed to provide observation about the most important aspects of the module.

1.3.Context and importance of this course in the degree

1.4.Activities and key dates

Important dates and specific delivery times can be found on the academic website.

At the beginning of the semester the detailed schedule of activities, corresponding to the main milestones of the subject, such as global testing and delivery of work will be provided to the students.

2.Learning goals

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2.2.Importance of learning goals

3.Aims of the course and competences

3.1.Aims of the course

3.2.Competences

4.Assessment (1st and 2nd call)

4.1.Assessment tasks (description of tasks, marking system and assessment criteria)

Students can choose between continuous assessment or global assessment test.

Continuous assessment, voluntary, is designed to encourage students to follow consistently a subject that by its nature and position in the curriculum, requires a continued attention. It consists of short controls along the course, in which students must answer questions about theory and / or solve problems. In general, to pass the student must pass each of the controls, and also obtain more than 5/10 when controls are averaged with lab exam global test indicated below (respective weights: 90 % and 10%).

The global examination is a test with three parts: a part of theoretical issues, with a weight of 30%; two exercises, with a weight of 60%; an examination of lab issues, with a weight of 10%.

5.Methodology, learning tasks, syllabus and resources

5.1.Methodological overview

The learning process designed for this subject is based on the following:

* Lectures, given to the entire group, in which the teacher will explain the basic principles of the subject and solve a few selected problems. These problems are mainly drawn from the collection that the teacher provides to the student at the beginning of the semester. The participation of students in this activity will be encouraged by identifying in advance the problems that are to be discussed in the classroom so that the student can reflect on them and intervene in their resolution. They will be developed throughout the semester in the 50 hours in schedule assigned by the University. It is, therefore, a classroom activity, and attendance is highly recommended for good use.

* Laboratory practices, which are distributed throughout the semester and whose assessment will form part of the final grade for the course. They are taught in small groups of students to work on each laboratory assembly, counting with a script previously delivered by teachers and a questionnaire that collects data from the activity. About 5 sessions of two hours will be proposed. The labs are classroom activities, and their learning outcome is required to pass the course. The time planning will be conducted by the center and communicated at the beginning of the course.

* Activities in small groups and student participation aimed at: Explain in more detail aspects of the theory and / or solving problems and case studies.

* Self-employment, studying the matter and applying it to solve exercises. This activity is essential in the process of student learning and overcoming evaluation activities. This is the non-contact part of the course, which is valued at about

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85 hours necessary for the study of theory, problem solving and laboratory reviewing scripts.

* Tutorials, related to any part of the subject are welcome but emphasizing that the student use them with clear and mulled conveniently approaches. Professors will publish a schedule of attention to students so they can attend to queries in an orderly manner throughout the semester.

5.2.Learning tasks

The course is divided in the following activities:

1: Lectures (50 hours). They will be developed throughout the semester on schedule assigned by the center covering the following topics:

2 Laboratory lessons (10 hours). Two-hour sessions are conducted in the laboratory with subgroups of group theory. The program is as follows:

1. Density and surface tension.

2. Viscosity.

3. Forces in a fluid.

4. Flow in an open channel.

5. Measure in wind tunnel.

5.3.Syllabus

* 1: Introduction - Definition of fluid; continuum hypothesis. Physical properties of fluids. Study techniques of fluid flow. Classification of fluid flow.

* 2: Kinematics - Eulerian and Lagrangian descriptions. Derived substantial. Lines flow characteristics. The velocity gradient tensor.

* 3: Forces and fluidostatics - Forces of surface and volume. The stress tensor. Fundamental equation of fluidostatics. Pressure and its measurement. Forces and torques on submerged surfaces. Fluidostatics in non-inertial systems. Surface tension.

* 4: Fundamental Equations of Fluid Mechanics - fluid volume and volume control. Reynolds Transport Theorems. Continuity equation. Momentum equation. Equation of angular momentum. Bernoulli equation. Equations of energy. Ideal flow. Turbulence

* 5: Dimensional analysis and similarity - Principle of dimensional homogeneity. Vaschy theorem Pi-Buckingham.

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Important dimensionless numbers in fluid mechanics. Adimensionalization of the fundamental equations. Similitude and modelling.

* 6: Unidirectional viscous flow - Introduction and equations. Couette flow. Hagen-Poiseuille flow. Hagen-Poiseuille flow axisymmetric. Flow in closed conduits. Flow in channels

* 7: Flow in thin sheets - equations, boundary conditions and orders of magnitude. Velocities and flow rates. Reynolds equation. Linear wedge. Theory of lubrication. Crushing Reed

* 8: Boundary layer and aerodynamics - boundary layer equations. Parameters of the viscous boundary layer. Flat plate laminar flow: similarity solution. von Karman integral equation. Turbulent boundary layer. Detachment of the boundary layer. Aerodynamics

5.4.Course planning and calendar

It is determined at the beginning of the course, according to schedules provided by the Centre.

5.5.Bibliography and recommended resources

- Crespo A. "Mecánica de Fluidos", Pub. De la ETSIIM, 1986
- White F.M., "Mecánica de Fluidos", McGraw-Hill, 2004
- Brun, Matinot-Lagrade y Mathieu, "Mecánica de Fluidos", Ed. Labor, 1980
- Spurk, Fluid Mechanics
- Streeter y Wylie, "Mecánica de los Fluidos", McGraw-Hill, 1990