Universidad Zaragoza

Year : 2020/21

30013 - Fluid Mechanics

Syllabus Information

Academic Year: 2020/21
Subject: 30013 - Fluid Mechanics
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.Aims of the course

1.2.Context and importance of this course in the degree

1.3.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.

2.Learning goals

2.1.Competences

2.2.Learning goals

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.

2.3.Importance of learning goals

3.Assessment (1st and 2nd call)

3.1.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%.

4.Methodology, learning tasks, syllabus and resources

4.1.Methodological overview

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

- 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 at the beginning of the semester. Student participation 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 partake in their solution. Lectures will be developed throughout the semester in the 50 hours in timetable assigned by the University. It is, therefore, a classroom activity, and attendance is highly recommended for sound and efficient learning.
- Laboratory sessions, which are distributed throughout the semester and the assessment of which is a fraction of the final grade for the course. They are taught in small groups of students who work on each laboratory rig. The course includes about five two-hour sessions. The scheduling of lab sessions is made by the School, and is available at the beginning of the course.
- Activities in small groups with student participation, aimed at explaining in greater detail some aspects of the theory, and to solving problems and cases.
- Students' use of their own time for: studying the theory, problem solving, and reviewing lab scripts and results. This activity estimated at about 85 hours.
- One-to-on tutorials, on any aspect of the subject. Please check the tutorial schedule with your teacher and ask for an appointment in advance.

4.2.Learning tasks

The course is made up of the following activities:

1 Lectures (50 hours). They will take place throughout the semester in the schedule assigned by the School.

2. Laboratory lessons (10 hours). Two-hour sessions take place in the lab in small groups in the laboratory with subgroups of group theory.

4.3.Syllabus

Theory and problems

1. Introduction - Definition of a fluid and continuum hypothesis. Physical properties of fluids. Study techniques of fluid flow. Classification of fluid flow.
2. Kinematics - Eulerian and Lagrangian descriptions. Substantial derivative. Characteristic lines. The velocity gradient tensor.
3. Forces and hydrostatics - Surface and volumetric forces. The stress tensor. The fundamental equation of hydrostatics. Pressure and its measurement. Force and torque on a submerged surface. Hydrostatics in non-inertial systems. Surface tension.
4. Fundamental Equations of Fluid Mechanics - fluid volume and control volume. 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. Pi theorem. Nondimensionalization of the fundamental equations. Important dimensionless numbers in Fluid Mechanics. Similarity and modeling.
6. Unidirectional viscous flow - Introduction and equations. Couette flow. Hagen-Poiseuille flow. Flow in closed ducts. Flow in channels
7. Flow in thin layers - Equations, boundary conditions and orders of magnitude. Velocities and volume flow rates. Reynolds equation. Analysis of typical configurations
8. Boundary layer and aerodynamics - Boundary layer equations. Parameters of the viscous boundary layer. Flat plate in laminar flow: similarity solution. Von Karman integral equation. Turbulent boundary layer. The detachment of the boundary layer. Aerodynamics.

Lab sessions

1. Density and surface tension.
2. Viscosity.
3. Forces in a fluid.
4. Similarity in aerodynamics and wind-tunnel testing
5. Open-channel flow.

4.4.Course planning and calendar

The course plan is released at the beginning of the course, and follows the schedule provided by the School.

Important dates and deadlines can be found on the *Anillo Digital Docente*.

4.5.Bibliography and recommended resources

Link:
http://biblos.unizar.es/br/br_citas.php?codigo=30013&year=2019