26935 - Fluid Physics

Información del Plan Docente

Academic Year	2016/17
Academic center	100 - Facultad de Ciencias
Degree	447 - Degree in Physics
ECTS	5.0
Course	
Period	First semester
Subject Type	Optional
Module	---

1.Basic info

1.1.Recommendations to take this course

Schedule sessions and presentation of works.
Distribution, depending on the credit of the various activities scheduled as follows:
Theoretical and practical classes: lectures and case-based learning classes (3.5 ECTS), and problem solving in small group (0.5 ECTS). The days, hours and classroom will be assigned by the Faculty of Science.
Laboratory Practice: 1 ECTS. The dates will be set at the beginning of the semester according to the number of enrolled students and availability of laboratory and instrumentation.
Practical work: Workload: 20 hours, with a classroom presentation included.
Exams: The written exam will last for 4 hours. It will be held at the end of the term, on the date assigned by the Faculty of Science. For the practical laboratory exam, 1 hour, the call will be published in due time for students who must do it.

1.2.Activities and key dates for the course

The key dates in the subject and the tiem schedule of all the activities will be displayed in the web page:

http://titulaciones.unizar.es/

On the other hand, the students can find a detailed calendar in moodle2.unizar.es

- Personal work deadline

- Laboratory final examination

- Theory and problems examination

2.Initiation

2.1.Learning outcomes that define the subject

On completion of this module, students should be able to

1. Manage the differential and integral formulation of the laws governing the dynamic and thermal processes of fluids.

2. Understand the description of the flow field and its properties.

3. Formulate and interpret the forces acting on the fluid and its consequences in situations of steady flow both static and dynamic.

4. Use together the fundamentals of theoretical, experimental and computational fluid dynamics.

2.2.Introduction

The aim of Physics of Fluids, in 3rd year, is to provide the graduate in Physics and general knowledge skills related to fluid physics. This module provides a careful, thorough treatment of the foundational principles, and offers students extensive opportunities for practising.

3.Context and competences

3.1.Goals

The module Physics of Fluids is part of the optional block grade curriculum. It is a subject of 5 ECTS.

3.2.Context and meaning of the subject in the degree

The course presents the conceptual foundations of Physics of Fluids and its contents are necessary to complement and consolidate the various compulsory and optional subjects of the degree.

3.3.Competences

Generic competences:

1. Understand the physical and mathematical foundations of fluid mechanics and the equations that determine the dynamics of fluids.

2. Be familiar with fundamental models of fluid flow: ideal, viscous, turbulent, compressible and free surface.

3. Manage the main techniques for solving practical questions and problems in the study of the physics of fluids.

5. Familiarize with the basic experimental techniques in fluid mechanics.

6. Know and use the techniques and instruments used in fluid handling technology.

Specific skills:

1. Knowledge of the basic principles of fluid physics

2. Application to solving problems in this field.

3.4.Importance of learning outcomes

Learning outcomes of the course are essential because they provide the student with a basic knowledge and skills needed to interpret and solve problems involving fluid mechanics plays a role methodological tools. In turn, they are the starting point for other subjects of the degree.

4.Evaluation

The student must demonstrate the achievement of learning outcomes through:

1. Reports of laboratory practical lessons. This constitutes 25% of the final grade.

2. Conducting exercises in class. This constitutes 20% of the final grade.

3. Individual work. This constitutes 25% of the final grade.

At the end of the semester, according to the examination timetable center, there will be a comprehensive written test of the subject. It will consist of short questions and will constitute 30% of the final grade. On the same day, for those students who do not complete the tasks proposed in paragraphs 1, 2 and 3, another exercise that will constitute 45% of the note will be proposed and other laboratory examination will constitute 25% of the final grade.

5.Activities and resources

5.1.General methodological presentation

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5.2.Learning activities

The learning process that is designed for this subject is based on:

* Lectures, given to the entire group, in which the teacher will explain the basic principles of the subject and solve some problems selected application subject to the degree. These problems are mainly drawn from the collection that the teacher provides the student at the beginning of the semester. the participation of students in this activity by planning sorts of problems will be strengthened. That is, be indicated prior 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 by 3 hours of weekly classes on schedule assigned by the center. It is, therefore, a classroom activity, and highly recommended assistance to good use.

* Laboratory practical lessons that are distributed throughout the semester and whose assessment will be part of the final grade for the course. Groups of three students will work on each laboratory setup, using a script previously delivered by teachers and a questionnaire that collects data and analysis. 6 two-hour sessions will be conducted at the laboratory.

* Personal work, studying the matter and applying that knowledge to solve exercises. This activity is essential in the process of student learning and to complete the evaluation activities.

* Tutorials, related to any part of the module.

The teacher will publish a schedule of tutorial times to students so they can attend in an orderly manner throughout the semester

5.3.Program

1. Physical properties of fluids. The continuum hypothesis. Concept of fluid element. Local thermodynamic equilibrium. Forces acting on a fluid. The stress tensor. Form of stress tensor for a fluid at rest. Surface tension.

2: Description of Lagrangian and Eulerian flow field. Material derivative. Paths, streamlines and streaklines. Movement around a point. The strain rate tensor. Rotation and deformation. Vorticity circulation. fluids and control volumes. Reynolds Transport Theorem

3: Basic equations. Conservation of mass, momentum and energy. Transport phenomena. Flows of energy and momentum. Transport equation of vorticity. Equation of internal energy and entropy. Dissipation of mechanical energy.

4: Dimensional Analysis. Interest of dimensional analysis in fluid physics. Vaschy theorem Pi-Buckingham. Adimensionalización of the general equations. dimensionless parameters. physical interpretation. Full and partial physical likeness. Similarity solutions.

5: Ideal flow. Ideal fluid condition. Euler equations. Bernoulli equation for gases and liquids. irrotational movement. Two-dimensional and axisymmetric movements. Current function. elementary solutions. Superposition principle. complex potential. Lift and drag . Motion of an ideal fluid with vorticity.

6: Viscous flow. Steady two-dimensional movements. Couette flow and Hagen-Poiseuille. Unsteady two-dimensional movements: Stokes flow and Rayleigh problem. Motion of thin liquid films. Movements at low Reynolds numbers. Flow around a sphere.

7: Viscous boundary layer moving at high Reynolds numbers. Concept of boundary layer. Analysis of orders of magnitude and approximations. Equations of two-dimensional boundary layer and boundary conditions. Similarity solutions. Influence of the pressure gradient. Detachment.

8: Compressible gas flow regime. Normal discontinuities: shock waves and contact discontinuities. Mach waves. Gas flow ducts slowly variable section.

5.4.Planning and scheduling

5.5.Bibliography and recomended resources