60828 - Modeling and simulation of flows and facilities

Información del Plan Docente

Academic Year	2016/17
Academic center	110 - Escuela de Ingeniería y Arquitectura
Degree	532 - Master's in Industrial Engineering
ECTS	6.0
Course	2
Period	Second semester
Subject Type	Optional
Module	---

1.Basic info

1.1.Recommendations to take this course

It is advisable to have studied and understood the subject Fluid Engineering of the first course. There are concepts of this subject used extensively. It is desirable that students adopt a system of ongoing study and frequently using tutorials with the teacher to resolve any doubts that surely will arise in the learning of the subject.

1.2.Activities and key dates for the course

At the beginning of each course the key dates and schedule will be published at the center's website http://eina.unizar.es
Also students will have at the beginning of course dates and locations of the necessary examinations to pass this subject.
Teaching material will be uploaded at the moodle2 platform and this will be the essential mechanism of communication with students.

2.Initiation

2.1.Learning outcomes that define the subject

The student should demonstrate the following results:

Meet the most suitable numerical methods for various problems of interest in Fluid Mechanics
Be able to interpret the results generated by a computer model of a fluid problem
Know the basics of modeling of incompressible and compressible flows of practical interest
Be able to apply the knowledge gained to flow analysis and facilities in the industry.

2.2.Introduction

Brief presentation of the subject

Itl includes the necessary skills to analyze, design and use computer simulation models of various flows.
Based on previous knowledge of fluid mechanics and hydraulic machines, methods best suited to each type of equation calculation are analyzed. The aim is to provide students with the capabilities to design and / or use complex flow simulation models.

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3.Context and competences

3.1.Goals

The subject and its expected results meet the following approaches and objectives:

Computational Fluid Mechanics (CFD) is an inherently interdisciplinary branch of science that has a very wide range of applications. Fluid Mechanics uses numerical methods and algorithms to solve and analyze problems that involve realistic fluid flows. Sectors such as aviation, space, automotive, medicine and the environment are just some of the industries that have in common fluid flows.

3.2.Context and meaning of the subject in the degree

The module on Models and flow simulation is part of the block of optional sibjects. This is a subject of 6 credits ETCS taught in the second semester of the second year. Equipped with numerical techniques of this subject, and with a good previous training in Fluid Mechanics, students will be prepared to understand and address more sophisticated design challenges in CFD utility in Industrial Engineering.

3.3.Competences

To pass the course, the students will be more competent at:

Applying the most suitable numerical methods for various problems of interest in Fluid Mechanics.
Interpreting the results generated by a computer model of a fluid problem.
Knowing the basics of modeling incompressible and compressible flows of practical interest.
Applying the knowledge gained to flow analysis and facilities in the industry.

3.4.Importance of learning outcomes

There has been considerable growth in development and application of CFD in all aspects of fluid dynamics. CFD has become a standard modeling tool widely used in industry. As a result there is considerable demand for specialists in the subject that is not covered in sufficient detail at the undergraduate level. This subject is looking to lay the foundations for an industrial or research career in the rapidly growing field of computational fluid dynamics. It provides a solid foundation for the student to be able to apply CFD methods as a tool for design, analysis and engineering applications. With a strong emphasis on understanding and applying the underlying methods, enthusiastic students can write their own CFD codes during the course.

4.Evaluation

The student must demonstrate the achievement of the learning outcome through the following evaluation activities

I: Group work. Reports generated from various computer cases raised in the practical and and computational exercises will be evaluated. They may be carried out in groups of two. (fifty%)
II: Presentation and discussion of individual work (50%)
Students who choose not to perform the progressive evaluation will be evaluated by a single global test at the end of the course, consisting of a theoretical and practical examination to be performed on the date indicated by the academic calendar of the School of Engineering and Architecture.

5.Activities and resources

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5.1.General methodological presentation

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

1. Lectures, given to the entire group, in which the teacher will explain the theory of the subject, illustrate and solve relevant cases. These sessions will use interactive simulation tools and familiarize students with some advanced simulation tools.
2. Computational Practices. These practices are altísimamente recommended for a better understanding of the subject because they are running real-elements described in theory class.
3. Tutorials related to any topic of the subject.

5.2.Learning activities

The program that the student is offered to help to achieve the expected results includes the following activities:

Lectures. They will be developed at a rate of four hours a week, up to 45 hours to complete the agenda.
Lab sessions. 4 sessions will be held at 3 hours per session with subgroups of two people.
Study and personal work. This non-contact portion is valued at about 93 hours necessary for the study of theory, case resolution and preparation of material.
Tutorials. The teacher will publish a schedule of attention to students throughout the semester.

5.3.Program

Proposed topics
0. Introduction.
1. governing equations and their properties in relation to CFD
2. Discretization of the equations and meshes schemes.
3. incompressible viscous flow models with and without turbulence
4. Models for free surface flow: hydraulic processes and environmental interest
5. Models for compressible flow: pressure gas installations and models of interest in aeronautics.
6 cases of interest in the industry.

5.4.Planning and scheduling

Lectures are scheduled by the center as well as the hours assigned to practical lessons. The presentation of individual work will be held in special sessions during class.

5.5.Bibliography and recomended resources

- Ch. Hirsch. Numerical computation of internal and external flows, John Wiley & Sons, New York, 1990.
- R.J. Leveque. Finite Volume Methods fot Hyperbolic Problems. Cambridge University Press, New York, 2002.
- E.F. Toro. Riemann solvers and Numerical Methods for fluid dynamics: A practical introduction. Springer-Verlag, Berlin, 1997.
- J.D. Anderson. Computational Fluid Dynamics. Mc-Graw Hill. 1995.

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