Computational fluid dynamics

Academic Year: (2023 / 2024) **Review date: 28-03-2023**

Department assigned to the subject: Thermal and Fluids Engineering Department

Coordinating teacher: IGLESIAS ESTRADE, MARIA IMMACULADA

Type: Electives ECTS Credits : 6.0

Year : Semester : 2

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Basic knowledge in Fluid Mechanics.

SKILLS AND LEARNING OUTCOMES

CB1. Students have demonstrated possession and understanding of knowledge in an area of study that builds on the foundation of general secondary education, and is usually at a level that, while relying on advanced textbooks, also includes some aspects that involve knowledge from the cutting edge of their field of study
CB2. Students are able to apply their knowledge to their work or vocation in a professional manner and possess the competences usually demonstrated through the development and defence of arguments and problem solving within their field of study.
CB3. Students have the ability to gather and interpret relevant data (usually within their field of study) in order to make judgements which include reflection on relevant social, scientific or ethical issues.
CB5. Students will have developed the learning skills necessary to undertake further study with a high degree of autonomy.
CG1. Ability to solve problems with initiative, decision-making, creativity, critical reasoning and to communicate and transmit knowledge, skills and abilities in the field of Industrial Engineering.
CG3. Ability to design a system, component or process in the field of Industrial Technologies to meet the required specifications
CG4. Knowledge and ability to apply current legislation as well as the specifications, regulations and mandatory standards in the field of Industrial Engineering.
CG5. Adequate knowledge of the concept of company, institutional and legal framework of the company. Organisation and management of companies.
CG6. Applied knowledge of company organisation.
CG8. Knowledge and ability to apply quality principles and methods.
CG9. Knowledge and ability to apply computational and experimental tools for the analysis and quantification of Industrial Engineering problems.
RA1. Knowledge and understanding: Have basic knowledge and understanding of science, mathematics and engineering within the industrial field, as well as knowledge and understanding of Mechanics, Solid and Structural Mechanics, Thermal Engineering, Fluid Mechanics, Production Systems, Electronics and Automation, Industrial Organisation and Electrical Engineering.
RA2. Engineering Analysis: To be able to identify engineering problems within the industrial field, recognise specifications, establish different resolution methods and select the most appropriate one for their solution
RA3. Engineering Design: To be able to design industrial products that comply with the required specifications, collaborating with professionals in related technologies within multidisciplinary teams.
RA4. Research and Innovation: To be able to use appropriate methods to carry out research and make innovative contributions in the field of Industrial Engineering.
RA5. Engineering Applications: To be able to apply their knowledge and understanding to solve problems and design devices or processes in the field of industrial engineering in accordance with criteria of cost, quality, safety, efficiency and respect for the environment.
RA6. Transversal Skills: To have the necessary skills for the practice of engineering in today's society.

OBJECTIVES

This subject is intended for students to acquire, on a reasonable level,
-Knowledge and understanding of the fundamental concepts and basic techniques of Computational Fluid Mechanics (CFD).
-Ability to develop their own code for simulating simple flows.
-Ability to choose a mathematical model suitable for numerical simulation of industrial flows of interest, with possible application to design problems.

-Ability to use the commercial CFD software chosen for the subject and to read and understand the program guide.
-Awareness of the need to (and ability to) critically verify, validate and interpret results obtained from a CFD simulation.
-Ability to collaborate as a team and effectively present the results of the work carried out.

DESCRIPTION OF CONTENTS: PROGRAMME

- Introduction to CFD.
- The basic equations of fluid mechanics.
- Levels of approximation.
- Mathematical nature of the equations and their boundary conditions.
- Discretization techniques.
- Numerical mesh generation.
- Finite difference method for model equations.
- Finite difference and finite volume method for the Navier-Stokes equations.
- Turbulence modeling.
- Applications: programming a finite differences code to solve a simple problem, and using a commercial code (ANSYS FLUENT) to solve a real-life industrial problem.

LEARNING ACTIVITIES AND METHODOLOGY

The development of the course includes lectures where the theoretical concepts are exposed, combined with practical application classes in a computer room.

ASSESSMENT SYSTEM

- Final exam (30%)
- Attendance and participation in class (10%)
- Programming of a finite differences code to solve a simple flow problem (30%)
- Implementation of a problem of industrial interest in a general purpose commercial CFD code (30%)

% end-of-term-examination:	30
% of continuous assessment (assigments, laboratory, practicals…):	70

BASIC BIBLIOGRAPHY

- Hirsch, C. Numerical Computation of Internal and External Flows (Second Edition) , Elsevier, 2007

ADDITIONAL BIBLIOGRAPHY

- null ANSYS FLUENT Theory Guide, ANSYS.

- null ANSYS FLUENT User's guide, ANSYS.

BASIC ELECTRONIC RESOURCES

- Hirsch, C. . Numerical Computation of Internal and External Flows (Second Edition) : http://www.sciencedirect.com/science/book/9780750665940#ancPR4