Computational Aerodynamics

Academic Year: (2023 / 2024) **Review date: 04/11/2022 17:21:49**

Department assigned to the subject: Aerospace Engineering Department

Coordinating teacher: FLORES ARIAS, OSCAR

Type: Compulsory ECTS Credits : 6.0

Year : 1 Semester : 1

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Fluid mechanics
Aerodynamics
Numerical methods

OBJECTIVES

To acquire an advanced and applied knowledge in numerical methods and computational fluid mechanics, with application to internal and external aerodynamics.
To acquire a basic knowledge of turbulence modeling techniques.

DESCRIPTION OF CONTENTS: PROGRAMME

1 Introduction to Computational Aerodynamics
2 The mathematical models for fluid flow simulations
  2.1 The equations of fluid dynamics
  2.2 The mathematical nature of the flow equations and boundary conditions
3 Discretization Techniques
  3.1 Finite Difference Methods
  3.2 Finite Volume Methods
  3.3 Structured and Unstructured Grids
4 The analysis of numerical schemes
  4.1 Consistency, Stability and Error Analysis
5 The resolution of numerical schemes
  5.1 Time integration methods
  5.2 Iterative methods for the resolution of algebraic systems
6 Applications to inviscid and/or viscous flows
7 Introduction to Turbulence and its modeling
  7.1 Direct numerical simulation (DNS)
  7.2 Large Eddy simulation (LES)
  7.3 Reynolds-averaged Navier-Stokes (RANS)

LEARNING ACTIVITIES AND METHODOLOGY

LEARNING ACTIVITIES

- Theory sessions.
- Problem sessions working individually and in groups.
- Lab-sessions with mathematical software.
- Individual work by the student

METHODOLOGY

- Teacher's presentations in class with the support of audiovisual media, in which the main concepts of

the subject are explained. The corresponding bibliography is provided to complement the student's learning.
- Critical reading of texts recommended by the professor of the subject: reports, manuals, and/or academic articles, either for subsequent discussion in class, or to expand and consolidate knowledge of the subject.
- Resolution (individually or in groups) of practical cases, problems, etc.
- Work on projects and reports, individually or in groups

ASSESSMENT SYSTEM

% end-of-term-examination/test:	25
% of continuous assessment (assigments, laboratory, practicals…):	75

End-of-term exam (25%)
Continuous evaluation (75%)

The continuous evaluation may include lab sessions, group projects, exams in the computer room, etc.

The end-of-term exam may consist of a written part and/or exercises in the computer room.

In order to pass the subject, two requirements need to be met:

1) to have a minimum grade of 4.0/10 in the end-of-term exam;
2) to have a minimum overall grade of 5.0/10 (weighing 25% the end-of-term exam and 75% the continuous evaluation).

In the extraordinary call only, it will be possible to pass the subject either by meeting the previous two requirements or by having a minimum grade of 5.0/10 in the final exam.

BASIC BIBLIOGRAPHY

- C. Hirsch Numerical Computation of Internal and External Flows, Elsevier, 2007

- Robert W. MacCormack Numerical Computation of Compressible and Viscous Flow, AIAA Education Series, 2014

ADDITIONAL BIBLIOGRAPHY

- J.D. Anderson Computational Fluid Dynamics. The Basics with applications, McGraw Hill, 1995

- J.H. Ferziger & M. Peric Computational Methods for Fluid Dynamics, Springer, 2013

- S. Pope Turbulent flows , Cam. Univ. Press, 2000