Computational Aerodynamics

Academic Year: (2019 / 2020) **Review date: 07-10-2019**

Department assigned to the subject: Bioengineering and Aeroespace Engineering Department

Coordinating teacher: GARCIA-VILLALBA NAVARIDAS, MANUEL

Type: Compulsory ECTS Credits : 6.0

Year : 1 Semester : 1

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Fluid mechanics
Aerodynamics
Numerical methods

OBJECTIVES

Good knowledge of advanced fluid mechanics, with special emphasis on computational fluid mechanics and turbulence

Good knowledge of internal and external aerodynamics, and in particular numerical aerodynamics.

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 Basic 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 modelling
  7.1 Direct numerical simulation (DNS)
  7.2 Large Eddy simulation (LES)
  7.3 Reynolds-averaged Navier-Stokes (RANS)

LEARNING ACTIVITIES AND METHODOLOGY

Theory sessions.

Problem sessions working individually and in groups.

Lab-sessions with mathematical software.

ASSESSMENT SYSTEM

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

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

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