Fluid Dynamics

Academic Year: (2024 / 2025) **Review date: 04-09-2024**

Department assigned to the subject: Physics Department

Coordinating teacher: SANCHEZ FERNANDEZ, LUIS RAUL

Type: Compulsory ECTS Credits : 6.0

Year : 1 Semester : 1

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

No prior knowledge is mandatory

OBJECTIVES

The students are expected to acquire a basic knowledge of the fundamental laws of the mechanics of fluids in both incompressible and compressible regimes, and of their application.

DESCRIPTION OF CONTENTS: PROGRAMME

The continuum hypothesis. Definition of thermodynamic properties. Gas models.

Fluid kinematics. Eulerian and Lagrangian coordinates. Local and material derivative. The Reynolds transport theorem.

Continuity equation. Momentum equation and definition of the stress tensor. Energy equation. First thermodynamic principle. The Bernoulli¿s principle.

Fluid statics. Stevino's law. Hydrostatics. Forces on immersed bodies.

Non-dimensional version of the Navier-Stokes equations. The Buckingham PI theorem. Relevant non-dimensional numbers in fluid mechanics.

Boundary Layers

Irrotational motion. Velocity potential. Stream function. Plane potential flow. The complex potential. Superposition of elementary solutions. Flow over a cylinder.

The Mach number. Flow regimes. Total thermofluiddynamic properties.

Steady and unsteady normal shock waves. Oblique shock waves. Expansion waves: the Prandtl-Meyer relation.

Introduction to fluid dynamic stability. Kelvin-Helmholtz, Rayleigh-Taylor and Richtmyer-Meshkov instability.

Introduction to fluid turbulence.

LEARNING ACTIVITIES AND METHODOLOGY

Theory sessions.
Problem sessions working individually and in groups.
Lab-sessions.

ASSESSMENT SYSTEM

% end-of-term-examination:	60
% of continuous assessment (assigments, laboratory, practicals…):	40

Continuous evaluation: 40%
The continuous assessment will consist of homework, tests or problems to be solved at home or in class. Students will be advised about the type of each assessment in advance.

The final exam will evaluate all the concepts explained during the course and will add up to the total final grade (remaining 60%).

It is necessary to obtain a grade of at least 4 in the final in order to complete the course.

BASIC BIBLIOGRAPHY

- Anderson, J. D Modern compressible flow, McGraw-Hill, 1990

- Shapiro, A. H The Dynamics and Thermodynamics of Compressible Fluid Flow, Vol I and II, John Wiley & Sons, 1953

ADDITIONAL BIBLIOGRAPHY

- Hodge B. K. & Koenig E K. Compressible Fluid Dynamics: With Personal Computer Applications, Prentice Hall College Div, 1995