Fluid Dynamics

Academic Year: (2019 / 2020) **Review date: 28-03-2019**

Department assigned to the subject:

Coordinating teacher: MARTIN SOLIS, JOSE RAMON

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.

Quasi-steady quasi-1D flow. Propagation speed of small pressure disturbs. Steady isentropic flow in ducts with slowly variable area.

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

Flow in converging nozzles and in converging-diverging nozzles.

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

LEARNING ACTIVITIES AND METHODOLOGY

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

ASSESSMENT SYSTEM

Continuous evaluation: 100%
In order to pass the subject it is required to have a MINIMUM mark of 5.0/10 in the continuous evaluation.
- partial exam 1 on incompressible flow regime (50%)

- partial exam 2 on compressible flow regime (50%)

% end-of-term-examination:	0
% of continuous assessment (assigments, laboratory, practicals…):	100

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