Advanced concepts of Fluid Mechanics

Academic Year: (2020 / 2021) **Review date: 21-12-2020**

Department assigned to the subject: Thermal and Fluids Engineering Department

Coordinating teacher: SEVILLA SANTIAGO, ALEJANDRO

Type: Electives ECTS Credits : 3.0

Year : 4 Semester :

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Linear Algebra, Calculus I, Physics I, Calculus II, Physics II, Thermal Engineering, Engineering Fluid Mechanics

OBJECTIVES

By the end of this subject, students will be able to have:

1. A systematic understanding of the key aspects and concepts of fluid mechanics for its rigorous application to egineering problems.
2. The ability to apply their knowledge and understanding to identify, formulate and solve problems of fluid mechanics using established methods.
3. The ability to select and apply relevant analytic and modelling methods in fluid mechanics.
4. An understanding of approximation methods in fluid mechanics, and the ability to use them to solve engineering problems.
5. Skills to effectively find and use appropriate bibliographical sources of scientific and technical nature in the different fields of fundamental and applied fluid mechanics.
6. Ability to combine theory and practice to solve fluid mechanics problems.
7. An understanding of applicable techniques and methods in fluids engineering and of their limitations.

DESCRIPTION OF CONTENTS: PROGRAMME

CHAPTER 1. Kinematics. Motion around a point. Vorticity. Rate-of-strain tensor. Divergence.
CHAPTER 2. Conservation equations in differential form. The mass conservation equation. Stream function. Volume and surface forces. The stress tensor. Navier-Poisson law. The momentum equation. Perfect liquids. Heat conduction and Fourier's law. Total energy, kinetic energy and internal energy equations. Enthalpy and entropy equations. The Navier-Stokes equations. Initial and boundary conditions.
CHAPTER 3. Unidirectional motion. Steady flow: Couette, Hagen-Poiseuille and Poiseuille flows. Transient flow: Rayleigh and Stokes flows. Quasi-steady flow.
CHAPTER 4. Lubrication theory. Flow in slender channels and thin films dominated by viscous forces. The Reynolds equation. Applications.
CHAPTER 5. Flow at high Reynolds numbers. Internal and external ideal flow. Boundary layer theory. Separation. Integral methods.

LEARNING ACTIVITIES AND METHODOLOGY

The teaching methodology will incluye: 1. Lectures: The students will be provided with lecture notes and recommended bibliography. 2. Problem solving sessions, related with the course topics. 3. Homework problems aiming at student self-evaluation. 4. Development and interactive presentation of guided works, including four lab session as direct application of theory.

ASSESSMENT SYSTEM

The continuous evaluation will be based on:

- 3 take-home quizzes will be proposed during the semester (40% of continuous evaluation grade).
- 2 presential quizzes will take place during the semester (40% of continuous evaluation grade).
- Laboratory work: 4 computing room sessions. Reports are due after each session (20% of continuous evaluation grade).

It is possible to pass the course without final exam.

For those students who failed in the continuous evaluation:

- Ordinary examination: 60% of the total grade, remaining 40% coming from continuous evaluation.
- Extraordinary examination: 100% of the total grade, or 60%+40% coming from continuous evaluation (the best option for each student).

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

BASIC BIBLIOGRAPHY

- A. Crespo y J. Hernández Problemas de mecánica de fluidos y máquinas hidráulicas, Cuadernos de la UNED, 1996
- Antonio Crespo Martínez Mecánica de Fluidos, Thomson, 2006
- D. J. Acheson Elementary fluid dynamics, 1990, Clarendon Press
- J. H. Spurk Fluid mechanics: Problems and Solutions, Springer Verlag, 1997
- J.M. Gordillo, G. Riboux, J.M. Fernández Introducción a la mecánica de fluidos, Paraninfo, 2017
- M. Vera, I. Iglesias, A.L. Sánchez y C. Martínez Igeniería Fluidomecánica, Paraninfo, 2012