Fluid Mechanics

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

Department assigned to the subject: Department of Thermal and Fluids Engineering

Coordinating teacher: SEVILLA SANTIAGO, ALEJANDRO

Type: Electives ECTS Credits : 6.0

Year : 4 Semester :

STUDENTS ARE EXPECTED TO HAVE COMPLETED

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

COMPETENCES AND SKILLS THAT WILL BE ACQUIRED AND LEARNING RESULTS.

The objective of this course is to provide the student an understanding of fluid mechanics at an intermediate level. After attending this course, the student should be able to apply the mass, momentum and energy conservation laws in their differential form to study problems of relevance in engineering.

Knowledge mastered in this course:

- Understand the relative importance of the different terms in the conservation equations in differential form, and develop reduced models based on dominant balances.
- Determine the adequate methodology to obtain the required variables in an engineering problem (analysis, experiment, etc.).
- Present results in a rational manner, in terms of the minimum number of relevant parameters, by making use of dimensional analysis and nondimensionalization of the governing equations.
- Determine similarity solutions in fluid-dynamics problems.
- Comprehension of basic terminology to understand technical documentation and specific literature.

Specific capacities:

- Write the appropriate set of differential equations, as well as their initial and/or boundary conditions, whose integration determines the flow field.
- Write and solve unidireccional flow problems.
- Write and solve problems under conditions of dominant viscous forces.
- Apply hydrodynamic lubrication theory to solve relevant problems in engineering.
- Apply ideal flow theory to solve relevant problems in engineering.
- Apply boundary layer theory to solve relevant problems in engineering.

General capabilities:

- Analysis based on basic scientific principles.
- Multidisciplinar approach (use knowledge from several disciplines: Mechanics, Thermodynamics, Calculus, etc.)
- Capacity to locate and understand basic literature on the subject, needed in the solution of flow problems.

Attitudes:

- Analytical attitude when facing engineering problems.
- Critical attitude given the different choices available to tackle a given problem.
- Cooperative attitude to exchange information and knowledge.

DESCRIPTION OF CONTENTS: PROGRAMME

This is a course in Fluid Mechanics at an intermediate level. The Programme is divided in 6 parts:

FIRST PART: Introduction. Summary of conservation equations in integral form. Complementary concepts in kinematics. Conservation equations in differential form.
SECOND PART: Unidirectional flow of liquids.
THIRD PART: Quasi-unidirectional viscosity-dominated flows of liquids.
FOURTH PART: Hydrodynamic lubrication theory. The Reynolds equation.
FIFTH PART: Introduction to ideal flow theory.
SIXTH PART: Boundary layer theory.

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

- Antonio Barrero, Miguel Pérez-Saborid Fundamentos y Aplicaciones de la Mecánica de Fluidos, McGraw Hill, 2004
- Antonio Crespo Martínez Mecánica de Fluidos, Thomson, 2006
- Antonio Luis Sánchez Pérez Introduction to Fluid Mechanics, Área de Mecánica de Fluidos, 2011
- José Manuel Gordillo, Guillaume Riboux, Juan Fernández Introducción a la mecánica de fluidos, Paraninfo, 2017

ADDITIONAL BIBLIOGRAPHY

- Amable Liñán Martínez Mecánica de Fluidos (Volúmenes I y II), Publicaciones de la ETS de Ingenieros Aeronáuticos, Universidad Politécnica de Madrid, 2006
- D. J. Acheson Elementary Fluid Dynamics, Clarendon Press, 1990
- G. K. Batchelor An introduction to fluid dynamics, Cambridge University Press, 2000
- J. H. Spurk Fluid Mechanics: Problems and Solutions, Springer Verlag, 1997
- L. D. Landau, E. M. Lifshitz Mecánica de Fluidos, Reverté, 1985

BASIC ELECTRONIC RESOURCES

- National Commitee for Fluid Mechanics Films. A. Shapiro (editor) . Fluid Mechanics Films: http://web.mit.edu/hml/ncfmf.html