

Academic Year: (2022 / 2023)

Review date: 28/07/2022 12:38:36

Department assigned to the subject: Thermal and Fluids Engineering Department

Coordinating teacher: SEVILLA SANTIAGO, ALEJANDRO

Type: Electives ECTS Credits : 6.0

Year : 4 Semester :

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

- All the courses in mathematics (calculus, algebra, etc.)
- Engineering fluid mechanics

OBJECTIVES

The goal of this course is make the student familiar with the application of Fluid Mechanics to industry-related problems, chiefly the transport and distribution of fluids.

At the end of the course, the student must be able to:

- Understand the physical problems associated to the transport and distribution of fluids through networks.
- Make the necessary hypotheses to apply, in a rigorous way, the fluid mechanics conservation laws to real problems.
- Identify the role of the different elements existing in a transport network.
- Define the necessary steps to design and analyze a fluid transport installation.

DESCRIPTION OF CONTENTS: PROGRAMME

This is an eminently practical course, so the student must master the necessary fundamental knowledges at the time on enrollment.

CHAPTER 1: Steady flow of liquids in ducts

- 1.1 Primary head losses. Colebrook correlation and Moody's chart.
- 1.2 Non-circular cross-section ducts. Hydraulic diameter.
- 1.3 Localized head losses: Valves, Elbows, curves, expansions, contractions, etc.
- 1.4 Coupling of turbomachinery to hydraulic facilities.

CHAPTER 2: Steady flow of liquids in pipe networks.

- 2.1 Pipes in series and in parallel.
- 2.2 Analysis of branched ducts: the three-reservoirs problem.
- 2.3 Analysis of closed-loop pipe networks. Matrix algorithm and its numerical implementation.

CHAPTER 3: Unsteady phenomena in pipe flow.

- 3.1 Theory of unsteady incompressible flow in ducts.
- 3.2 Characteristic acceleration and discharge times. Quasi-steady flow.
- 3.3 Order-of-magnitude analysis of characteristic variables in unsteady pipenetworks flow. Non-dimensionalization of the equations.
- 3.4 Applications. Surge tanks.
- 3.5 Compressibility effects. Basic theory of water hammer. Reflection and transmission of waves. Applications.

CHAPTER 4: Introduction to turbomachinery.

- 4.1 Definitions. Classification of incompressible fluid machines.
- 4.2 Characteristic curves of pumps and turbines.
- 4.3 Cavitation in turbomachinery.

- 4.4 Similarity in pumps.
- 4.5 Similarity in turbines.
- 4.6 Coupling of pumps and turbines to a hydraulic network.

LEARNING ACTIVITIES AND METHODOLOGY

The methodology will include:

- (1) Lectures, where the basic knowledges will be exposed.
- (2) Resolution of problems.
- (3) Resolution of problems by the student, that will be useful to self-assess his/her knowledge and develop the necessary skills.
- (4) The students will attend to the lab sessions and elaborate the lab reports.

ASSESSMENT SYSTEM

% end-of-term-examination/test: 50

% of continuous assessment (assignments, laboratory, practicals...): 50

The continuous assessment grading is based on two partial exams and one numerical lab.

- The numerical lab consists in developing a numerical code to solve a given pipe network. It contributes to 20% of the continuous assessment grade. To pass the course it is required that $TC \geq 5$.

- The first partial exam (EP1) covers chapters 1 to 3, and contributes to 40% of the continuous assessment grade. Provided that $EP \geq 5$ and $TC \geq 5$, this part of the course can be disregarded by the student in the ordinary final exam.

- The second partial exam (EP2) covers chapters 4 and 5, and contributes 40% to the continuous assessment grade. Provided that $EP2 \geq 5$, this part of the course can be disregarded by the student in the ordinary final exam.

- The continuous assessment grade (EC) is obtained according to $EC = 0.2 \cdot TC + 0.4 \cdot EP1 + 0.4 \cdot EP2$. If $EC \geq 5$, provided that $EP1 \geq 4$ and $EP2 \geq 4$, the student does not need to do the Final exam.

- The ordinary final exam is divided into two parts, corresponding to chapters 1 to 3 (EFO1) and to chapters 4 and 5 (EFO2). The grade of this exam is calculated with the equation $EFO = 0.5 \cdot \text{MAX}(EP1, EFO1) + 0.5 \cdot \text{MAX}(EP2, EFO2)$, in order to pass it is required that $EFO1 \geq 4$ and that $EFO2 \geq 4$, except in the case that the course has already been passed by continuous assessment.

- The extraordinary final exam (EE) contemplates all the topics of the course.

The final grade of the course (NF) is given by the following formulae:

ORDINARY:

$$NF = 0.2 \cdot TC + 0.15 \cdot EP1 + 0.15 \cdot EP2 + 0.5 \cdot EFO$$

EXTRAORDINARY:

$$NF = \text{MAX}(0.2 \cdot TC + 0.8 \cdot EFE, EFE)$$

The course is passed if $NF \geq 5$.

During the examinations the student is not allowed to use any material in addition to that provided by the teacher, with the exception of a scientific calculator.

BASIC BIBLIOGRAPHY

- Antonio Crespo Martínez Mecánica de Fluidos, Thomson, 2006

- Antonio Crespo y Julio Hernández Problemas de Mecánica de Fluidos y Máquinas Hidráulicas, Cuadernos de la UNED, 1996

- Frank M. White Fluid Mechanics, McGraw-Hill, 2003

- M. Vera, I. Iglesias, A.L. Sánchez y C. Martínez Ingeniería Fluidomecánica, Paraninfo, 2012

ADDITIONAL BIBLIOGRAPHY

- Antonio Barrero y Miguel Pérez-Saborid Fundamentos y Aplicaciones de la Mecánica de Fluidos, McGraw-Hill, 2005

- G.F. Round Incompressible Flow Turbomachines: Design, Selection, Applications, and Theory, Butterworth-Heinemann, 2004

- M Hanif Chaudhry Applied Hydraulic Transients, Springer, 2014