Fluid installations and hydraulic machinery

Academic Year: (2023 / 2024) **Review date: 09/05/2023 11:44:23**

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

LEARNING OUTCOMES

CB1. Students have demonstrated possession and understanding of knowledge in an area of study that builds on the foundation of general secondary education, and is usually at a level that, while relying on advanced textbooks, also includes some aspects that involve knowledge from the cutting edge of their field of study
CB2. Students are able to apply their knowledge to their work or vocation in a professional manner and possess the competences usually demonstrated through the development and defence of arguments and problem solving within their field of study.
CB3. Students have the ability to gather and interpret relevant data (usually within their field of study) in order to make judgements which include reflection on relevant social, scientific or ethical issues.
CB5. Students will have developed the learning skills necessary to undertake further study with a high degree of autonomy.
CG1. Ability to solve problems with initiative, decision-making, creativity, critical reasoning and to communicate and transmit knowledge, skills and abilities in the field of Industrial Engineering.
CG3. Ability to design a system, component or process in the field of Industrial Technologies to meet the required specifications
CG4. Knowledge and ability to apply current legislation as well as the specifications, regulations and mandatory standards in the field of Industrial Engineering.
CG5. Adequate knowledge of the concept of company, institutional and legal framework of the company. Organisation and management of companies.
CG6. Applied knowledge of company organisation.
CG8. Knowledge and ability to apply quality principles and methods.
CG9. Knowledge and ability to apply computational and experimental tools for the analysis and quantification of Industrial Engineering problems.
RA1. Knowledge and understanding: Have basic knowledge and understanding of science, mathematics and engineering within the industrial field, as well as knowledge and understanding of Mechanics, Solid and Structural Mechanics, Thermal Engineering, Fluid Mechanics, Production Systems, Electronics and Automation, Industrial Organisation and Electrical Engineering.
RA2. Engineering Analysis: To be able to identify engineering problems within the industrial field, recognise specifications, establish different resolution methods and select the most appropriate one for their solution
RA3. Engineering Design: To be able to design industrial products that comply with the required specifications, collaborating with professionals in related technologies within multidisciplinary teams.
RA4. Research and Innovation: To be able to use appropriate methods to carry out research and make innovative contributions in the field of Industrial Engineering.
RA5. Engineering Applications: To be able to apply their knowledge and understanding to solve problems and design devices or processes in the field of industrial engineering in accordance with criteria of cost, quality, safety, efficiency and respect for the environment.
RA6. Transversal Skills: To have the necessary skills for the practice of engineering in today's society.

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 ad 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 the lab sessions and elaborate the lab reports.

ASSESSMENT SYSTEM

% end-of-term-examination/test:	50
% of continuous assessment (assigments, laboratory, practicals…):	50

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

- The numerical lab consists in implementing a standard method to design and solve a given pipe network. It contributes to 20% of the continuous assessment grade.

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

% end-of-term-examination/test:	50
% of continuous assessment (assigments, laboratory, practicals…):	50

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>=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*TC+0.4*EP1+0.4*EP2. If EC >=5, provided that EP1>=4 and EP2>=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*MAX(EP1,EFO1)+0.5*MAX(EP2,EFO2), in order to pass it is required that EFO1>=4 and that EFO2>=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*TC+0.15*EP1+0.15*EP2+0.5*EFO

EXTRAORDINARY:
NF=MAX(0.2*TC+0.8*EFE,EFE)

The course is passed if NF >= 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