Fluid installations and hydraulic machinery

Academic Year: (2019 / 2020) **Review date: 16-12-2019**

Department assigned to the subject: Thermal and Fluids Engineering Department

Coordinating teacher: SEVILLA SANTIAGO, ALEJANDRO

Type: Compulsory ECTS Credits : 6.0

Year : 3 Semester : 1

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

- All the courses in mathematics (calculus, algebra, etc.)
- 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 hydraulic machines and systems.
2. The ability to apply their knowledge and understanding to identify, formulate and solve problems of hydraulic machines and systems using established methods.
3. The ability to select and apply relevant analytic and modelling methods in hydraulic machines and systems.
4. An understanding of design methodologies in fluid mechancis, and an ability to use them.
5. The ability to combine theory and practice to solve problem of hydraulics.
6. An understanding of applicable techniques and methods in hydraulic machines and systems, and of their limitations.
7. Function effectively as an individual and as a member of a team.

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 to the lab sessions and elaborate the lab reports.

ASSESSMENT SYSTEM

The continuous assesment 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 assesment grade. To pass the course it is required that TC>=5.

- The first partial exam (EP1) covers chapters 1 to 3, and contributes to 40% of the continuous assesment grade. Provided that EP>=5 and TC>=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 assesment grade. Provided that EP2>=5, this part of the course can be disregarded by the student in the ordinary final exam.

- The continuous assesment 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 assesment.

- 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.

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

BASIC BIBLIOGRAPHY

- Antonio Crespo y Julio Hernández Problemas de Mecánica de Fluidos y Máquinas Hidráulicas, Cuadernos de la UNED, 1996
- Crespo Martínez, Antonio Mecánica de fluidos, Thomson Paraninfo, 2006
- 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