FLUID FACILITIES AND MACHINERY

GUIDE TO LABORATORY PRACTICALS

University of the Basque Country (UPV/EHU)

Energy Engineering Department

SYLLABUS

INTRODUCTION

The course "FLUID FACILITIES AND MACHINERY – Gide to laboratory practicals" aims to acquire the necessary knowledge related to fluid installations and the machines that constitute them, directly related to those containing turbines, pumps and fans.

The development of the course includes three different parts:

- The first one, of a theoretical nature, concisely describes the subjects under study in each practical, as well as a detailed description of the hydraulic machines under study.
- The second, proposed as a laboratory practice, contemplates the experimental procedure to be carried out with each hydraulic machine, in order to achieve the desired learning objectives. As this course is not face-to face, individual videos for each practical are offered in order to facilitate the comprehension about how to handle these machines.
- The third part of the course is related to the interpretation of the results acquired in the laboratory (given in the course) that adequately justifies the behavior of hydraulic machines under the operating conditions studied. This last is complemented with a self-evaluation option.

AUDIENCE AND PREREQUISITES

It is essential to have previously completed a degree corresponding to the field of engineering. In addition, it is also necessary to have previously studied the subject of Fluid Mechanics, which is taught in various degrees in the field of engineering. Finally, it is recommended, but not essential, to have studied any of the subjects related to the Hydraulics specialty.

OBJECTIVES

The purpose of this course is for students to acquire the necessary knowledge related to fluid facilities and the machines that constitute them. The different fluid facilities containing turbines, pumps and fans will be specifically analyzed.

It is about knowing the operation of the machines that interact with fluids, as well as their control and maintenance, in addition to the efficient management of the facility as a whole.

The development of the corresponding syllabus allows acquiring competencies not only from the module corresponding to Industrial Technology, but also from facilities, Plants and Complementary Constructions, since the necessary knowledge for the project and design of fluid installations is acquired.

COMPETENCIES

MEC COMPETENCES FOR MASTER'S DEGREES

MEC2. That student know how to apply the knowledge acquired and their ability to solve problems in new or little-known environments within broader (or multidisciplinary) contexts related to their area of study.

MEC3. That student are able to integrate knowledge and face the complexity of formulating judgments based on information that, being incomplete or limited, includes reflections on the social and ethical responsibilities linked to the application of their knowledge and judgments.

MEC4. That students know how to communicate their conclusions – and the knowledge and ultimate reasons that support them – to specialized and non-specialized audiences in a clear and unambiguous way.

DEGREE COMPETENCES

T1. Have adequate knowledge of the scientific and technological aspects of: mathematical, analytical and numerical methods in engineering, electrical engineering, energy engineering, chemical engineering, mechanical engineering, mechanics of continuums, industrial electronics, automation, manufacturing, materials, quantitative methods of management, industrial computing, urban planning, infrastructure, etc. (MEC2).

T2. Project, calculate and design products, processes, installations and plants. (MEC2).

T8. Apply the knowledge acquired and solve problems in new or little-known environments within broader and multidisciplinary contexts. (MEC3).

T10. Know how to communicate the conclusions – and the knowledge and ultimate reasons that support them – to specialized and non-specialized audiences in a clear and unambiguous way. (MEC4).

INDUSTRIAL TECHNOLOGIES

TI3. Ability to design and test machines. (T1)

TI5. Knowledge and skills for the design and analysis of thermal machines and engines, hydraulic machines and industrial heating and cooling installations. (T2, T8, T10)

IPCC4. Knowledge and skills to project and design electrical and fluid installations, lighting, air conditioning and ventilation, energy saving and efficiency, acoustics, communications, home automation and intelligent buildings and security installations. (T2, T8)

LEARNING RESULTS OF THE COURSE

Students will acquire knowledge about the different fluid installations and the machines that constitute them, so that they will be able to identify, project and design this type of installation efficiently.

The students will know the main and operating characteristics of the hydraulic machines under study. You will learn to acquire and interpret the necessary information based on its operation in different conditions, to be able to detail its behavior.

The students will make their own the corresponding knowledge to achieve training that gives them sufficient criteria when working with these hydraulic machines in the industry.

Theme 1 Pumps Connections

Calculate and demonstrate the operation of pumps individually, coupled in series and coupled in parallel.

- Visual observation of the operation of a pump.
- Experimental determination of the characteristic pump operating curves for each of the cases under study.
- Understanding and comparison of the H-Q characteristic curves obtained in the laboratory.

Theme 2 Pumps Rotation Speeds

Calculate and demonstrate the operation of a pump at different speeds of rotation. - Visual observation of the operation of a pump.

- Experimental determination of the characteristic operating curves of a pump at different speeds of rotation.
- Understanding and comparison of the H-Q characteristic curves obtained experimentally in the laboratory, with those obtained through the laws of similarity. Understanding and comparison of experimentally obtained mechanical power and performance curves.

Theme 3 Pelton Turbine

Calculate and demonstrate the operation of the Pelton action turbine.

- Visual observation of the operation of the Pelton action turbine.
- Experimental determination of the performance curves of the turbine.
- Reading and understanding of the parameters that must be taken into account when selecting, designing or optimizing the operation of a Pelton turbine.

Theme 4 Francis Turbine

Calculate and demonstrate the operation of the Francis reaction turbine.

- Visual observation of the operation of the Francis reaction turbine.
- Experimental determination of the performance curves of the turbine.
- Reading, understanding of the parameters that must be taken into account when selecting, designing or optimizing the operation of a Francis turbine.

Theme 5 Kaplan Turbine

Calculate and demonstrate the operation of the Kaplan reaction turbine.

- Visual observation of the operation of the Kaplan reaction turbine.
- Experimental determination of the turbine performance curves for each of the available runners.
- Reading, understanding of the parameters that must be taken into account when selecting, designing or optimizing the operation of a Kaplan turbine.

Theme 6 Propeller Turbine

Calculate and demonstrate the operation of the propeller-type reaction turbine.

- Visual observation of the operation of the propeller-type reaction turbine.
- Reading, understanding of the parameters that must be taken into account when selecting, designing or optimizing the operation of a propeller-type turbine.
- Turbine characteristic curves for different distributor openings working at constant H and Q.

Theme 7 Axial Fan

Study of the characteristics of an axial fan.

- Visual observation of the operation of an axial fan.
- Use of the Pitot tube for flow measurement. Obtaining the flow velocity profile in the suction pipe.
- Experimental determination of the characteristic curves of an axial fan: static pressure, dynamic pressure, total pressure, power and performance versus flow.
- Study of the regulation of an axial fan by varying the speed of rotation. Obtaining characteristic curves at different revolutions. Laws of similarity applied to fans.

Theme 8 Radial Fan

Study of the characteristics of a centrifugal or radial fan.

- Visual observation of the operation of a centrifugal fan.
- How to use a Prandtl tube; flow measurement and obtaining the flow velocity profile in the suction pipe.
- Experimental determination of the characteristic curves of the centrifugal fan.
- Study of the regulation of a centrifugal fan by varying the speed of rotation. Obtaining characteristic curves at different revolutions. Laws of similarity applied to fans.

METHODOLOGY

The methodology is based on learning through carrying out the corresponding laboratory practices with real hydraulic machines. The theoretical foundation is presented to acquire the necessary knowledge that enables students to understand the concepts of a theoretical nature to work and demonstrate in laboratory practices. The main characteristics of the hydraulic machines under study are detailed, in order to know and understand their operation. The experimental procedure to be carried out to properly carry out each laboratory practice is described, and thus be able to satisfactorily achieve the objectives of the subject and the learning results. Different interpretations are proposed in the form of graphic representations of the results obtained in the laboratory in order to obtain a clearer and more concise interpretation of them. A specific self-assessment exercise is provided in the form of a questionnaire for each topic of the course, thus being able to know the degree of learning acquired, without prejudice to the fact that the students have had the opportunity to work with the hydraulic machine in question.

CHRONOGRAM

THEMES	NUMBER OF HOURS			
	THEORY	PRACTICALS	RESULTS	TOTAL
1. PUMPS CONNECTIONS	2,5	2,5	2,5	7,5
2. PUMPS ROTATION SPEEDS	2,5	2,5	2,5	7,5
3. PELTONTURBINE	2,5	2,5	2,5	7,5
4. FRANCIS TURBINE	2,5	2,5	2,5	7,5
5. KAPLAN TURBINE	2,5	2,5	2,5	7,5
6. PROPELLER TURBINE	2,5	2,5	2,5	7,5
7. AXIAL FAN	2,5	2,5	2,5	7,5
8. RADIAL FAN	2,5	2,5	2,5	7,5
		TOTAL		60