Universidad Zaragoza

Academic Year/course: 2022/23

29729 - Fluid Machines and Installations

Syllabus Information

Academic Year: 2022/23
Subject: 29729 - Fluid Machines and Installations
Faculty / School: 110 - Escuela de Ingeniería y Arquitectura
Degree: 434 - Bachelor's Degree in Mechanical Engineering
ECTS: 6.0
Year: 3
Semester: First semester
Subject Type: Compulsory
Module:

1. General information

1.1. Aims of the course

The subject and its expected results meet the following approaches and objectives:

The Hydraulic Machinery and Systems subject focuses on the calculation and design of fluid systems and its active elements: pumps and turbines.

The hydraulic design of a fluid machine consists in determining the best shape it must have to provide to / receive from the fluid the specified power. To this end the influence of the internal geometry of the machine in the fluid energy / machine interaction is described in a simplified one-dimensional theory.

The calculation of facilities requires the use of optimization with respect to specified criteria for the design of an energy-efficient installation. The optimization process will focus on pumping facilities that are the most common in industrial engineering practice.

These approaches and objectives are aligned with the following Sustainable Development Goals (SDGs) of the United Nations 2030 Agenda (https://www.un.org/sustainabledevelopment/), in such a way that the results of learning this subject provides training and competence to contribute to some extent to their achievement:

Goal 2: Zero Hunger.

- Target 2.3 By 2030, double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists and fishers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and non-farm employment.

Goal 6: Ensure access to water and sanitation for all.

- Target 6.4 By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity.

Goal 11: Make cities inclusive, safe, resilient and sustainable

- Target 11.1 By 2030, ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums.
- Target 11.6 By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management

1.2. Context and importance of this course in the degree

The subject of ?Hydraulic Machinery and Systems? is an integral part of the group of compulsory subjects within the industrial branch. It is a subject of 6 credits ETCS taught in the second semester of the second year. It is a constituent material of a fundamental part of industrial engineering such as fluid transport and distribution, as well as the interaction of these with mobile and fixed elements in power generating machines.

1.3. Recommendations to take this course

It is advisable to have studied and understood properly the basic subject of Fluid Mechanics. There are concepts of this

subject used extensively in the development of this one. It is desirable that students adopt a system of continuous study and frequently using tutorials with the teacher to resolve any doubts that will surely arise in the learning of the subject.

2. Learning goals

2.1. Competences

After taking the course, students will be more competent to ...

Apply the knowledge of fluid mechanics and the calculation, design and testing of systems and turbomachines.

Solve problems and make decisions with initiative, creativity and critical thinking.

Use the techniques, skills and tools of industrial engineering required in its practice.

Continuously learn and develop independent learning strategies.

2.2. Learning goals

The student, in order to pass this subject, should demonstrate the following

He/She understands the operation and applications of fluid machinery

She/He is capable of sizing a fluid machine subject to general technical specifications.

He/She has the ability to size a fluid installation.

He/She is able to apply efficiency criteria in the design of a facility.

She/he can design operating protocols of facilities based on criteria of efficiency, economy and reliability.

2.3. Importance of learning goals

Graduates in Industrial Engineering Technologies will face in their professional life many situations in which in one way or another will have to work with facilities using fluids. This subject is the key for them to be designed with basic criteria of energy efficiency.

3. Assessment (1st and 2nd call)

3.1. Assessment tasks (description of tasks, marking system and assessment criteria)

The evaluation will be carried out by means of a global written test in the two official calls established for this purpose by EINA.

The exam is made up of four sections:

- Problem #1 (30% of the final grade)
- Problem #2 (30%)
- Theory (20%)
- Questions about laboratory work (20%)

A minimum of 3 points out of 10 will be required in each of the parts of the exam mentioned above (Problem 1, Problem 2, Theory and Laboratory Work) in order to pass.

The student has the option of doing a project assignment. If he decides to do so, the weight of the global exam in the final grade will be scaled down to 95% (the exam grade will be multiplied by 0.95) and the remaining 5% will come from the evaluation of the assignment.

4. Methodology, learning tasks, syllabus and resources

4.1. Methodological overview

For the subject a learning process is designed based on the following:

1. Lectures, given to the entire group, in which the teacher will explain the theory of the subject and resolve problems relevant to the calculation of duct systems and the geometry of pumps/turbines.

2. Lab. These practices are highly recommended for a better understanding of the subject because elements described and calculated on the blackboard are seen in actual operation.

3. Tutorials related to any topic of the subject.

Further information regarding the course will be provided on the first day of class.

4.2. Learning tasks

The course includes 6 ECTS organized according to:

- Lectures (2 ECTS): 50 hours.
- Laboratory sessions (0.4 ECTS): 10 hours.
- Guided assignments (0.2 ECTS): 5 hours.
- Autonomous work (3.32 ECTS): 83 hours.
- Tutorials (0.08 ECTS): 2 hours.

Lectures. They are developed at the rate of four hours per week, to complete the 50 hours that we consider appropriate to complete the syllabus.

Lab practices. Five sessions will be held at two hours per session with groups of three / four students. Initially scheduled practices are:

1. Disassembling and selection of centrifugal pumps
2. Pump tests. Cavitation.
3. Fan tests
4. Measurement of losses in pipelines and other elements
5. Simulation of pumping facilities.

Study and personal work. This off-site part is valued at about 90 hours, necessary for the study of theory, problem-solving and reviewing of lab work.

Tutorship. Each teacher will publish a scheduled timetable to attend the students throughout the semester.

4.3. Syllabus

The course will address the following topics:

- Module 0. Introduction. Types and operation of fluid machines. Classification of fluid machines.
- Module 1. Review of principles. Energy exchange in turbomachinery. Powers, losses and efficiencies.
- Module 2. Fundamental Theory of turbomachinery. Geometric and kinematic aspects of flow impeller.
- Module 3. Theory 1-D of radial turbomachinery. Characteristic curves. Aerodynamic theory of axial machines and turbines.
- Module 4. Dimensional analysis of turbomachinery. Modeling. Scale effects.
- Module 5. Specific parameters.
- Module 6. Operation of pumping and ventilation lines. Fluid distribution networks.
- Module 7. Flow control in lines, pumping and ventilation.
- Module 8. Cavitation. Effects of cavitation in turbomachinery. Dimensional analysis of cavitation.

4.4. Course planning and calendar

Lectures of theory and problems are given in the timetable established by the center, as well as the hours assigned to the lab work.

The dates and times of lectures will be found on the degree website, which can be found at:

http://titulaciones.unizar.es/

At the beginning of the course, students will also know the dates and locations of the necessary examinations in order to pass this subject

4.5. Bibliography and recommended resources

Link: http://**psfunizar10.unizar.es/br13/egAsignaturas.php?codigo=29729**