Universidad del País Vasco Euskal Herriko Unibertsitatea

COURSE GUIDE 2025/26

Faculty 363 - Faculty of Engineering - Bilbao **Cycle** .

Degree GMECAN30 - Bachelor`s Degree in Mechanical Engineering **Year** Third year

COURSE

27725 - Hydraulic Installations and Machines **Credits, ECTS:** 6

COURSE DESCRIPTION

The main objective of the Hydraulic Facilities and Machinery course is to provide students with the basic knowledge and fundamental principles of fluid-mechanical engineering applied to industrial installations and hydraulic machines of great importance in our society, with emphasis on those of state-of-the-art production and distribution of energy, necessary for the performance of the practical duties of mechanical engineering.
The course Hydraulic Facilities and Machinery is offered to the students of the Bachelor¿s Degree in Mechanical Engineering.
This course is a continuation of the Fluid Mechanics course based on the application of the principles of Fluid Mechanics to the design and calculation of the different types of hydraulic machines: centrifugal pumps, positive displacement pumps, hydraulic turbines, fans and wind turbines, as well as to the installations associated with them: pumping installations, ventilation installations and hydroelectric power plants.
Hydraulic machines have been used since historical times. The hydraulic paddle wheel, the Archimedes screw, the panemonas for the use of wind energy, have been used since several centuries B.C.. Hydraulic machines were one of the motors of the industrial revolution and their study continues to have great importance in the training of engineers, due to the great presence of this type of machines and installations in the industries.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

1. To know, understand and apply the concepts of science and technology of the different types of hydraulic machines and their corresponding facilities.
2. To apply the strategies of scientific methodology: to analyse the problematic situation qualitatively and quantitatively, to propose hypotheses and solutions to the calculation of hydraulic machines and their associated installations.
3. Communicate adequately the knowledge, procedures, results, skills and aspects of hydraulic machines and their installations using the vocabulary and specific terminology and the appropriate means.
4. To develop designs and processes of hydraulic installations in accordance with the specific technology of hydraulic machines applying the specifications and regulations of obligatory compliance.
5. To carry out measurements, calculations and studies on the operating parameters of the different types of hydraulic machines.

Theoretical and Practical Contents

Hydraulic turbomachines: generalities and fundamental principles. Definition and classification of hydraulic machines, as well as the fundamental parts of a turbomachine, their forms of representation and speed triangles. Nomenclature corresponding to heights, flows, powers, losses and performances, both in pumps and in turbines. Application of the fundamental theorem of turbomachines or Euler to turbines and pumps.
Similarity and dimensional analysis applied to turbomachines. Analysis of the similarities and analogies that must exist between two turbomachines in order to transfer their respective behaviour. Determination of the most important dimensional parameters in turbomachines using Buckingham's theorem, analysing the fundamental theorem of Combes-Bertrand-Rateau. Introduction to the concept of specific speed by presenting examples of homologous turbomachines.
Hydraulic turbopumps. Study of the elements, the constructive types, the characteristic curves, the regulation and the operation of the turbopumps.
Positive displacement machines. Analysis of the different types of positive displacement machines, their elements, their way of working and their characteristic curves.
Pumping installations. Study of the calculation and construction details of simple pumping installations, composite installations and overpressure installations.
Fans and ventilation installations. Analysis of the elements, construction types, characteristic curves, regulation and operation of fans, as well as their application to ventilation installations.
Hydroelectric power plants. Description of the layout of hydroelectric power plants. Analysis of the types of jumps to be considered, the types of hydroelectric power plants, as well as their fundamental constituent elements. Study of the different types of characteristic curves and regulation systems.
Hydraulic turbines. Analysis of the elements, construction types, characteristic curves, regulation and operation of hydraulic turbines.
Wind power plants. Study of the general theory of wind turbines and Betz's law and description of the different types of wind turbines available.
Water supply and sanitation networks. Study of the collection, regulation, conduction and distribution of water, as well as the collection and distribution of waste water.

TEACHING METHODS

In this course, various teaching methodologies are used, the most commonly used being problem solving and project

based learning. Autonomous work will be encouraged, through the use of bibliographic resources that help students to understand the different aspects of the subject.
In the master classes the topics established in the program of the subject will be exposed.
Classes will be given to explain the conceptual contents of the subject, with the participation of the students in occasional discussions about them.
Classroom practices will be a complement to the master classes, in which exercises, practical issues and projects will be developed.
The resolution of questions and problems in the classroom will be carried out in a participatory manner. Problems and exercises will be provided that will be developed individually or in groups, which will allow to deepen the theoretical knowledge of the subject and to relate the Hydraulic Facilities and Machinery, with other related areas. The formulation of questions and open discussion will be encouraged, so that students acquire skills related to oral communication, the capacity for synthesis and teamwork.
The projects will take place both in class and outside of it. Both knowledge and skills will be achieved. Students will learn to be more autonomous, will work in a collaborative environment, and will improve their communication skills.
Laboratory practices will be a practical complement to the course.
In the laboratory practices, experimental works will be developed in order to acquire knowledge and skills of experimental techniques used in Hydraulic Installations and Machinery, reflecting the advances in a final technical report.
Through the laboratory practices, it is expected to train the student in the following points:
- Review, deepen and use the theoretical concepts.
- Take practical experience in data measurement and experimental tests.
- To become familiar with teamwork, something very necessary in their future work as an engineer.

The laboratory practices will be carried out in groups, formed by a maximum of 6 students.
During the laboratory practices, attendance is checked.
In order to facilitate and ensure the students' learning, both classroom and laboratory practices will be monitored.
Feedback will be provided based on previously established evaluation criteria, so that students have the opportunity to become aware of their learning, as well as ways to improve it.

In the event that health conditions prevent the performance of a teaching activity and/or evaluation in person, a non-presential modality will be activated of which the students will be informed punctually.

If the student wants to achieve a clear knowledge of the subject, he/she will have to do a continuous work during the course, to assimilate and dominate the concepts.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	30		15	15					
Horas de Actividad No Presencial del Alumno/a	45		22,5	22,5					

Legend:
M: Lecture-based
S: Seminar
GA: Applied classroom-based groups
GL: Applied laboratory-based groups
GO: Applied computer-based groups
GCL: Applied clinical-based groups
TA: Workshop
TI: Industrial workshop
GCA: Applied fieldwork groups

Evaluation methods

- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 50%
- Exercises, cases or problem sets 20%
- Teamwork assignments (problem solving, Project design) 30%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

CONTINUOUS EVALUATION SYSTEM: Students will be qualified by the different tasks developed throughout the course in the following way:

1. Written exam to be developed: 50% (This exam may contain theory questions to be developed, questions, problems and / or multiple choice questions. A minimum mark of 3.5 out of 10 is required to add the result of this exam to the continuous evaluation system. The same final exam will be held in all subject groups.)
2. Completion of laboratory practices: 20%
3. Teamwork (Problem Solving, Project Design): 30%. The evaluation of each project developed throughout the course may include: detailed report of the project, presentation to the rest of the class and oral defense of the questions raised after the presentation.

FINAL ASSESSMENT SYSTEM: This system contemplates the possibility of evaluating learning results through a test (Article 8 of the Regulations governing the Evaluation of students in official Bachelor's degrees), consisting of one or more examinations and global evaluation activities of the subject . In any case, it will be a condition to be able to take advantage of this evaluation system to deliver, before the end of the teaching period, the projects corresponding to the themes raised in class to the rest of the students. In this case, the projects will be individual and their evaluation, in addition to being written, may include an oral defense.

In the event that health conditions prevent the performance of a teaching activity and/or evaluation in person, a non-presential modality will be activated of which the students will be informed punctually.

The same final test will be taken in all the groups of the subject.

If there is a discrepancy between the Spanish and English version guides, the Spanish version must be accepted.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The extraordinary call consists of a written test to be developed (50%). A minimum mark of 3.5 out of 10 is required to add the result of this exam to other grades (Laboratory practice sessions and Projects). The same final exam will be held in all subject groups.
The positive results obtained by the students during the course or exam of the ordinary call may be kept (Laboratory practices + Projects = 50%). In the event of having obtained a negative result through the continuous evaluation carried out during the course, said results may not be kept for the extraordinary call and the reports of those projects or laboratory practices must be re-delivered. The evaluation of these reports may also include an oral defense.

In case of not having participated in the Continuous Evaluation or not having any qualification of the projects, there will be the possibility of evaluating the learning results through a test consisting of one or more exams and global evaluation activities of the subject. In any case, it will be a condition to be able to take advantage of this evaluation system to deliver the projects corresponding to the topics raised in class to the rest of the students during their Continuous Evaluation. In this case, the projects will have an individual character and their evaluation, in addition to being written, may include an oral defense.

In the event that health conditions prevent the performance of a teaching activity and/or evaluation in person, a non-presential modality will be activated of which the students will be informed punctually.

If there is a discrepancy between the Spanish and English version guides, the Spanish version must be accepted.

MANDATORY MATERIALS

Lecture notes.
Collection of problems.
Laboratory practice guide.

BIBLIOGRAPHY

Basic bibliography

- Agüera Soriano, J "Mecánica de fluidos incompresibles y turbomáquinas hidráulicas". Ed. Ciencia 3, 1996
- Mataix, C "Turbomáquinas Hidráulicas". Ed. ICAI. 1975
- Cabrera, E. y otros. Ingeniería hidráulica aplicada a los sistemas de distribución de agua. Volúmenes I y II - Universidad Politécnica de Valencia. Grupo Mecánica de fluidos. - Valencia 1996
- Karassik, I.J. y otros. "Manual de Bombas". Ed. Mc. Graw-Hill
- Larreategui, A. "Elementos de Máquinas Hidraulicas". Ed. Escuela Superior de Ingenieros de Bilbao

Detailed bibliography

- Teoría y problemas de máquinas hidráulicas. Antonio Viedma Robles y Blas Zamora Parra. Horacio Escarabajal editores. 2008

Journals

- Ingeniería del agua.
- Tecnología del agua.

Web sites of interest

OBSERVATIONS