Centre	**University College of Engineering of Vitoria-Gasteiz**
Name of subject	**25979 - Fluid Mechanics**
Qualification	**Degree in Mechanical Engineering**
Type	**Compulsory**
Credits	**6 ECTS**
Year	**2**
Term(s)	**2nd**
Department	**Nuclear Engineering and Fluid Mechanics**
Language	**English, Spanish and Basque**

Outcomes / Objectives

The learning outcomes for the subject are the following:
- Know, understand and apply the basic concepts of Fluid Mechanics to carry out professional engineering activities in the field of fluids.
- Apply scientific method strategies to fluid mechanics: analyse qualitatively and quantitatively the problem situation, propose hypotheses and solutions.
- Use specific vocabulary and terminology and the appropriate means to effectively communicate knowledge, procedures, results, skills and aspects inherent to fluid mechanics.
- Work efficiently in a group, integrating skills and knowledge to make decisions in the performance of fluid mechanics tasks, adopting a responsible and organised attitude to work and a willingness to learn.
- Plan and carry out designs and processes in the field of fluid mechanics in accordance with the relevant specific technology, applying the quality principles and methods and analysing and assessing the social and environmental impact of the technical solutions adopted.

The following degree programme competencies are developed: C3 (Knowledge of basic and technological subjects that enables students to learn new methods and theories, providing them with versatility to adapt to new situations), C4 (Capacity to solve problems using initiative, decision making, creativity, critical thinking, and to communicate and convey knowledge, abilities and skills in the field of Industrial Engineering), and the cross-curricular competencies C12 (Adopt a responsible and organised attitude towards work and a willingness to learn taking into account the challenge of the necessary continuous training), C13 (APPLY SCIENTIFIC METHOD STRATEGIES: ANALYSE QUALITATIVELY AND QUANTITATIVELY THE PROBLEM SITUATION, PROPOSE HYPOTHESES AND SOLUTIONS USING INDUSTRIAL ENGINEERING MODELS, SPECIALITY MECHANICS), and C14 (WORK EFFICIENTLY IN A GROUP, INTEGRATING SKILLS AND KNOWLEDGE TO MAKE DECISIONS IN THE FIELD OF INDUSTRIAL ENGINEERING, SPECIALITY MECHANICS).

Syllabus

Introduction to Fluid Mechanics. Prior concepts. Introduces the prior key concepts for the study of Fluid Mechanics.
Physical properties of fluids Definitions. Analyses the key physical properties of fluids.
General laws of Fluid Statics. Based on the classification of the forces acting on fluids and the principle of pressure isotropy, the key equation in fluid statics is derived.
Statics of an incompressible flow in the gravitational field. Hydrostatics. Based on the previous equation, the key equation in hydrostatics is derived, and its consequences and application to pressure measurement are analysed.
Statics of fluids in other force fields. Relative equilibrium. Studies uniformly rotating and uniformly moving liquids.

Statics of compressible flows in the gravitational field. Analyses pressure changes in compressible flows.
Forces on surfaces. Calculates the force and the point of application of fluids on plane and curved surfaces.
Forces on closed bodies. Presents the procedure for calculating the forces exerted by fluids on closed bodies.
Fundamentals of fluid motion. Introduces the key concepts for the study of fluid motion.
Mass conservation theorem. Continuity equation. The mass conservation theorem and the continuity equation are derived.
Key equations in fluid dynamics. Presents Euler's equations of motion through a trajectory, and Navier-Stokes equations.
Bernoulli's equation. The different forms of the energy equation or Bernoulli equation are derived, and the concepts of power and performance in pumps and turbines are introduced.
Applications of Bernoulli's equation. Measuring devices. Application of Bernoulli equation to determine the velocity and flow rate of a fluid.
Theorems of quantity of motion and of the momentum of the quantity of motion. The theorems of quantity of motion and of the momentum of the quantity of motion are derived.
Applications of the quantity of motion theorem. Several technical applications of the quantity of motion theorem are presented.
Dimensional analysis and dynamic similarity. Introduces the concepts of dimensional analysis and dynamic similarity, Buckingham's pi theorem, and its application to the design of hydraulic machines.
Effects of viscosity in flows. Studies external flows, focusing on the concepts of boundary layer, drag and lift.
Study of head losses in closed conduits. Introduces the key equations and diagrams for the calculation of primary and secondary head losses in closed conduits.
Permanent fluid flow in closed conduits. Practical piping calculations. Networks. Presents the method for calculating pipe systems in series, in parallel, branched and in mesh networks.
Variable flow regime in pipes. Studies the method for calculating the water hammer and protections against it.
Permanent open channel flow. Channels. Studies the method for calculating head losses in open conduits.
Hydraulic machines. Key principles. Turbomachines. Introduces the key concepts related to hydraulic machines, focusing on turbomachines and on the phenomenon of cavitation.
Water turbines. Hydroelectric power stations. Analyses the key types of water turbines, fields of application, their components and their application to hydroelectric power stations.
Hydraulic pumps. Describes the main types of hydraulic pumps, their principle of operation and the field of use for each type.
Pumping facilities. Components, characteristic curves and pump selection for a pumping facility.
Dispersion of pollutants in the atmosphere and in water bodies and watercourses. The principles of fluid mechanics studied are applied to the analysis of the atmospheric dispersion of pollutants and their discharge into watercourses.

Methodology

Teaching Method

Face-to-Face Teaching Hours								
Lectures	**Seminars**	**Classroom practice**	**Lab. practice**	**Computer sessions**	**Clinical practice**	**Workshops**	**Industrial workshops**	**Field practice**
48			**12**					
Student Hours of Non Face-To-Face Activities								
Lectures	**Seminars**	**Classroom practice**	**Lab. practice**	**Computer sessions**	**Clinical practice**	**Workshops**	**Industrial workshops**	**Field practice**
72			**18**					

Assessment System

General criteria

Written essay exam

Oral exam

Practical activities (exercises, case studies or problems)

Individual assignments

Group assignments

Presentation of assignments, reading...

Clarification regarding assessment

Subject assessment will be continuous, based on the following components:

20% Submission and assessment of course deliverables (tasks assigned for the different topics). Where students submit less than 80% of deliverables, they will receive the grade Not submitted. The quality of the group assignment will also be taken into account.

15% Report on laboratory practice, carried out in group. Completion of lab practice and corresponding report is compulsory in order to pass the subject. The quality of team work will also be taken into account.

30% Students must take two exams prior to carrying out the project. Students who do not pass both exams will fail the subject.

35% Project. Oral presentation of the project and quality of team work will be taken into account.

Rubrics or assessment matrices will be used to assess:

- the quality of the deliverables
- the quality of the team work
- oral presentations.
- problem solving tasks.
- the quality of the report on laboratory practice.

The deliverables will be assessed by the lecturer, and some of them also by the students.

Bibliography

Basic Bibliography

All the bibliography listed for the subject and more can be found under call number 532 in the Biblioteca de las Nieves library.

White, Frank M. Mecánica de Fluidos. McGraw-Hill, 2008.

Agüera Soriano, José. Mecánica de Fluidos Incompresibles y Turbomáquinas Hidráulicas. Ciencias, 1992.

Streeter, V.L. y Wylie, E.B. Mecánica de los fluidos. McGraw-Hill, 1988.

Cengel, Yunus A. y Cimbala, John M. Mecánica de Fluidos. Fundamentos y Aplicaciones. Mc Graw-Hill, 2006.

In-depth Bibliography

Fox, R.W. McDonald, A.T. Introducción a la Mecánica de Fluidos. McGraw-Hill, 1989.

Shames, Irving H. Mecánica de Fluidos. Mc Graw-Hill, 1995.

Potter, Merle C., Wiggert, David C. Mecánica de Fluidos. Thomson, 2002.

Finnemore, E.J.. y Franzini, J.B. Fluid Mechanics with engineering applications. 2002

Journals:

- Ingeniería del agua - Journal of fluid mechanics
- Tecnología del agua - Journal of hydraulic engineering.
- El instalador. - World pumps.
- Montajes e instalaciones. - Pump industry analyst
- Fluidos. - Environmental fluid mechanics

Websites

- Hydraulic Institute. www.pumps.org
- Pump-Flo Co. www.pump-flo.com/manulist.asp
- Animated software company, www.animatedsoftware.com
- www.pump-zone.com.
- http://www.sc.ehu.es/sbweb/fisica/fluidos/estatica/introduccion/Introduccion.htm