Universidad Zaragoza

Academic Year/course: 2021/22

28815 - Fluid Mechanics

Syllabus Information

Academic Year: 2021/22
Subject: 28815 - Fluid Mechanics
Faculty / School: 175 - Escuela Universitaria Politécnica de La Almunia
Degree: 424 - Bachelor's Degree in Mechatronic Engineering
ECTS: 6.0
Year: 2
Semester: Second semester
Subject Type: Compulsory
Module:

1. General information

1.1. Aims of the course

The principal aim of the subject is to get our students to acquire sufficient knowledge concerning both the concepts and those technical aspects linked to hydrostatic systems and systems of pressure piping.

1.2. Context and importance of this course in the degree

The subject of Engineering of Fluids is part of the present curriculum of Mechatronics Engineering at the EUPLA. This subject lasts a semester and is taught in the second year and consists of 6 ECTS credits. This subject is compulsory.

1.3. Recommendations to take this course

The subject Engineering of Fluids has no prior compulsory requirements. However, students taking the degree in Mechatronics are advised to have passed, or at least have taken, Mathematics I and II as well as Physics I and II.

2. Learning goals

2.1. Competences

Furthermore, as generic and specific competences, the student will acquire:
GI03: Knowledge of basic and technological subjects, enabling them to learn new methods and theories, and equip them with versatility to adapt to new situations.
GI04: Ability to solve problems with initiative, decision making, creativity, critical reasoning and to communicate and transmit knowledge, abilities and skills in the field of Industrial Engineering Industrial and Electronics.
GI06: Ability to manage specifications, regulations and mandatory standards.
GC02: Interpret experimental data, contrast them with the theoretical ones and draw conclusions.
GC03: Ability for abstraction and logical reasoning.
GC04: Ability to learn continuously, self-directed and autonomously.
GC05: Ability to evaluate alternatives.
GC06: Ability to adapt to the rapid evolution of technologies.
GC07: Ability to lead a team as well as to be a committed member of it.
GC08: Ability to locate technical information, as well as its understanding and evaluation.
GC09: Positive attitude towards technological innovations.
GC10: Ability to write technical documentation and present it with the help of adequate IT tools.
GC11: Ability to communicate your reasoning and designs clearly to specialized and not specialized audiences.
GC14: Ability to understand the operation and develop maintenance of equipment and mechanical, electrical and electronic installations.
GC15: Ability to analyze and apply simplified models to technological equipment and applications that allow making forecasts about their behavior.
GC16: Ability to configure, simulate, build and test prototypes of electronic and mechanical systems.
GC17: Ability to correctly interpret plans and technical documentation. EIO2: Knowledge of the basic principles of fluid mechanics and their application to problem solving in the field of engineering. Calculation of pipes, channels and fluid systems.

2.2. Learning goals

Knowledge of the general properties of fluids.
Knowledge of the principles and calculation methods of hydrostatics.
Knowledge of the principles of hydrodynamics and the technical aspects related to calculation regarding pipes systems and application of hydraulic machines.

2.3. Importance of learning goals

The subject of Fluid Engineering has a marked engineering character with direct and immediate application in the labor and professional market. In particular the student will acquire knowledge of the general properties of fluids, the principles related to hydrostatics and hydrodynamics concerning calculation of pressured pipes systems, free flow channels and hydraulic machines.

3. Assessment (1st and 2nd call)

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

Assessment tasks are the basic elements in the entire teaching-learning process since it is the only mechanism that allows, at any time during an educational period, to evaluate the degree of achievement of the proposed learning results and, if appropriate, apply the necessary corrections.

At the beginning of the course the student will choose one of the following two assessment methodologies:
Continuous assessment system: it is an assessment system characterized by the obligation to participate in face-to-face activities of the subject and to take and pass practical tests, partial exams and academic works within the established deadlines. In the case the students passes all the continuousassessment tests, they will be exempt from the global exam.
Global final evaluation exam: it is a final and global exam on all the theoretical and practical content of the subject.

Continuous evaluation system:
Following the spirit of the reform of the European Higher Education Area (EHEA), the evaluation of the subject contemplates a continuous evaluation system as the most consistent to be in line with the guidelines set by this new framework. In the continuous assessment model, the professor will assess the student's participation in face-to-face activities and their ability to solve problems and laboratory practices. Finally, the student should take and pass two partial exams ("continuous assessment exams") throughout the course.
The evaluation criteria to be followed for the activities of the continuous evaluation system are:
Laboratory tasks: In each one of the laboratory activity, its development, results and conclusions will be evaluated. Once the practice is done, a report will be delivered by Moodle platform. This activity is valued from 0 to 10 points with a minimum score of 5 to be considered as approved. These activities will be carried out in groups of 2/3 students, while the report delivery will be individually. The final score will be the arithmetic average of the partial scores.
Proposed exercises and theoretical questions: Responsible professors of the subject will propose exercises, problems, practical cases, theoretical questions, etc. to be solved individually. Report about these activities should be delivered according to specific scheduling and will be valued between 0 and 10 points. The final score will be the arithmetic average of the marks obtained in the partial deliveries.
2 written evaluation tests: They will consist of the typical written exam scored from 0 to 10 points. The final score of this activity will be given by the arithmetic mean of the two tests. In case one the two partial scores will not reach the minimum score of 4, in this case the activity will be considered as not approved.
The weights of the above mentioned activities are following summarized:

Individual works	5%
Laboratory activities	15%
Partial written exam 1	40%
Partial written exam 2	40%

Global final evaluation test:
The students must choose this modality when, due to their personal situation, they cannot adapt to the rhythm of work required in the continuous assessment system, have failed any assessment test of the continuous evaluation process or would like to improve their score.
As in the continuous evaluation system, the global final evaluation test must be aimed at check if the learning results have been achieved, as well as contribute to the acquisition of various competencies.
The global final evaluation test will have the following group of qualifying activities:
Laboratory practices: The student will deliver a report of all the laboratory activities carried out during the course before the beginning of the global assessment written exam. test, as a sine qua non condition to pass the course. This activity will be valued from 0 to 10 points.
Written exam: It will consist of a test that will contain questions and problems related to the topics explained throughout the course. This test will be valued between 0 and 10 points.
The weights of the above mentioned activities are following summarized:

Laboratory activity	15%
Written exam	85%

4. Methodology, learning tasks, syllabus and resources

4.1. Methodological overview

The methodology followed in this course is oriented towards the achievement of the learning objectives. A wide range of teaching and learning tasks are implemented, such as:

Strong interaction between the teacher/student. This interaction is brought into being through a division of work and responsibilities between the students and the teacher. Nevertheless, it must be taken into account that, to a certain degree, students can set their learning pace based on their own needs and availability, following the guidelines set by the teacher.

The current subject Materials Engineering is conceived as a stand-alone combination of contents, yet organized into three fundamental and complementary forms, which are: the theoretical concepts of each teaching unit, the solving of problems or resolution of questions and laboratory work, at the same time supported by other activities.

The organization of teaching will be carried out using the following steps:

1. Face-to-face generic activities:

- **Lectures**: The theoretical concepts of the subject are explained.
- **Practice Sessions**: Problems and practical cases are carried out.
- **Monitored Practices**: Exercises and practical cases are carried out, complementary to the theoretical concepts studied.

2. *Supervised Autonomous Activities*: These activities are carried out independently by students under the supervision of the teachers of the subject. The student will have questionnaires available per unit and suggested exercises and will be allowed to attend face-to-face or group tutorials to focus on solving them.

3. *Reinforcement activities*: Through the virtual learning portal (Moodle) or email of the University of Zaragoza, teachers of the subject will develop, for particular cases for which conventional tutoring cannot be applied, support and help activities for students who need it solving doubts or providing solutions to problems connected with the units covered.

If classroom teaching were not posssible due to health reasons, it would be carried out on-line.

4.2. Learning tasks

The course includes the following learning tasks:

- **Theory/Practice Lectures:** Theoretical activities or problems carried out mainly through exposition by the teacher.
- **Practical classes:** Theoretical discussion activities or exercises and practical cases presented by students.
- **Practical laboratory testing:** This work is tutored by a teacher in the laboratory. These activities will continue with autonomous student work.
- **Individual tutorials:** These tutorials may be face-to-face or virtual (Moodle or email).
- **Group tutorials:** Scheduled tracking learning activities in which the teacher meets with a group of students to answer questions, exams or problems.

The subject has 6 ECTS credits, which represents 150 hours of student work in the subject during the trimester, in other words, 10 hours per week for 15 weeks of class. 40% of this work (60h) will be held in the classroom and or lab and the rest will be autonomous.

A summary of a weekly timetable guide can be seen in the following table.

Activity	**Weekly school hours**
Lectures	2-3
Practical laboratory testing	1-2
Other Activities	6

There is a tutorial calendar timetable set by the teacher that can be requested by the students who want a tutorial.

4.3. Syllabus

The course will address the following topics:

CONTENTS

- **THEORETICAL CONTENT**

1. Introduction to Hydraulic engineering

Definition. Measurement units. Fluids properties (weight and mass, specific weight, specific or absolute density, relative density. Pressure. Manometers. Liquids and gases compressibility. Surface tension. Capillarity. Viscosity.

2. Hydrostatics

Definition. Properties of hydrostatic pressure: direction and intensity. Pascal principle. General equation. Law of pressure variation. Archimedes principle. Hydrostatic forces on flat and curved surfaces.

3. Fluids Kinematics

Definition. Kinematic parameters. Trajectory, tracer line, current line, flow line pipe. Classification of fluid.

4. Fluids Dynamics.

Definition. Basic principles. The theorem of Bernouilli for ideal fluids, applications. Theoretical power of a hydraulic machine.

Equation of motion. Dynamics of real fluids. Loss of charge. The real power of the hydraulic pump. The motion of real liquids in pipes.

5. Hydraulic pumps, valves and water hammer

Hydraulic pumps and liquid pumping. Pump efficiency. Classification of hydraulic pumps. Valves and water hammer. Valve typology. Cavitation.

6. Pressurized pipes and channels

Pressurized long pipe system. Design of a pressurized pipe system. Checking how a pressurized pipe system works. Practical formulae for hydraulic calculation of pressurized pipes. Open channel flow. Channels and parameters characteristic of flow. Equations.

PRACTICAL CONTENTS

Problems

1.1 Compressibility of fluids.

1.2 Hydrostatic systems, calculation of intensity, etc.

1.3 Fluids dynamics, the equation for conservation of energy, charge loss, etc.

1.4 Hydraulic pumps, water hammer, etc.

1.5 Pressurized pipe systems.

Practice

2.1 Manometers.

2.2 Viscosity.

2.3 Hydrostatic thrust.

2.4 Osborne Reynolds apparatus.

2.5 Venturi meter.

4.4. Course planning and calendar

For the students in the continuous evaluation system, the written test will be held at the end of each section. The final dates will be announced during the scholar year in the Moodle. The weekly schedule of the subject will be published at http://www.eupla.unizar.es/asuntos-academicos/calendario-y-horarios

The dates of the global evaluation test (official calls) will be published at http://eupla.unizar.es/asuntos-academicos/examenes

4.5. Bibliography and recommended resources

http://psfunizar10.unizar.es/br13/egAsignaturas.php?codigo=28815