COURSE DATA

Data Subject	
Code	34753
Name	Fluid mechanics
Cycle	Grade
ECTS Credits	6.0
Academic year	2023 - 2024

Study (s)

Degree	Center	Acad. year	Period
1401 - Degree in Chemical Engineering	School of Engineering	2	Second term
1934 - D.D. in Chemistry-Chemical Engineering	Faculty of Chemistry	2	Second term

Subject-matter

Degree	Subject-matter	Character
1401 - Degree in Chemical Engineering	8 - Fluid mechanics	Obligatory
1934 - D.D. in Chemistry-Chemical Engineering	2 - Segundo curso	Obligatory

Coordination

Name	Department
ALVAREZ HORNOS, FRANCISCO JAVIER	245 - Chemical Engineering
ORCHILLES BALBASTRE, ANTONI VICENT	245 - Chemical Engineering

SUMMARY

This subject is the basis to solve practical problems, from an engineering point of view, in which fluid flow is involved. Its aim is that the students achieve the background related to fluids in movement so that it can be used in the design of pumps, compressors and agitators.

This is a basic subject which emphasizes the systematic application of fundamental principles to the analysis of a variety of fluid problems of practical nature where dissipation of mechanical energy is produced.

The subject contents are: **Kinematic and dynamic of fluids. Fluid flow. Hydraulic machines. Pumps. Compressors**, which are structured in the units showed in section 6.

The general objectives of the course are:

- To expand, in a practical context, the vision that the student has of the fluid behavior in other subjects such as Physics or Transport Phenomena.
- To present mechanical energy as an useful energy as well as the interchange ability of their components.
- To develop in students the ability to propose and solve numerical problems which occur with mechanical energy and pressure losses, as well as to interpret the results.
- Enhance students' skills in reasoning and systematic work.
- Promote and encourage those values and attitudes that must be inherent to engineers.

The theory classes will be taught in Catalan and the practical activities and laboratory sessions as stated in the assignment form on the web of the degree.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

To successfully pass the subject is advisable that students possess a series of prior knowledge at the level demanded in subjects studied previously. This knowledge comprises:
International system of units. Change of units.
Fluid knowledge.
Balances of property.
Transport phenomena

OUTCOMES

1401 - Degree in Chemical Engineering

- G3 - Knowledge of basic and technological subjects that allows students to learn new methods and theories and provides them with versatility to adapt to new situations.
- G4 - Ability to solve problems with initiative, decision-making skills, creativity and critical reasoning and to communicate and transmit knowledge, abilities and skills in the field of industrial engineering.
- G5 - Knowledge to carry out measurements, calculations, assessments, appraisals, surveys, studies, reports, work plans and analogous work.

- G6 - Ability to deal with specifications, regulations and mandatory standards.
- G11 - Knowledge, understanding and ability to apply the necessary legislation for practising professionally as a qualified industrial technical engineer.
- R2 - Understanding of the basics of fluid mechanics and their application to solving problems in the field of engineering. Design of piping, channels and fluid systems.

LEARNING OUTCOMES

1. To understand the basic principles of fluid mechanics and be able to use them to identify, formulate and solve problems of his field of work. (G3, G4, R2)
2. Being able to plan and carry out pilot studies on fluid mechanics, and to measure experimentally the technical parameters of fluid systems and hydraulic machines, and to explain and report on their results. (G5, R2)
3. Knowing the types of pipes, valves, fittings, agitators, pumps and compressors available on the market, and know how to choose the most appropriate one for each operation. (G3, R2)
4. Being able to calculate the size and power of an agitator, pump or compressor, according to standards and specifications. (G6, R2)
5. To be able to design flow systems for which fluids circulate, according to standards and specifications. (G3, G4, G6, G11, R2)
6. To be able to run pumping, agitation and fluid circulation equipments in systems of process industry, according to standards and specifications. (G4, G6, R2)
7. To be able to analyse processes, equipment and systems of circulation, agitation and pumping of fluids, to assess their suitability and propose alternatives. (G3, G5, R2)
8. To know how to use specific software tools for the analysis and design of pipelines in which fluids circulate, pumps and compressors that drive them and processes in which agitators are needed. (G3, G4, R2)

After completing this course the students will be able to:

- Discuss the fundamental equations for fluid flow.
- Get the balance of mechanical energy in a volume control from an energy balance.
- Calculate the force that pipes undergo when changes in diameter or direction are considered.
- Obtain the mechanical energy losses in a flow system through which a liquid circulates.
- Solve problems where you have to calculate the energy supplied by a pump or obtained in a turbine.
- Calculate the mechanical energy losses in pipes.
- Define the concept of hydraulic diameter of a pipe with a non-circular section.
- Calculate the flow rate of a fluid through a pipe.
- Calculate the diameter for a fluid flow rate.
- Calculate the distribution of flows in pipe networks.
- Calculate the flow rate provided by a pump in a system.
- Apply the affinity laws to determine how the flow rate in a fluid system is changed when you change the speed or impeller pump.
- Calculate how the impeller diameter or speed of the pump must be changed so that the flow rate provided in an installation is modified in the desired amount.
- Indicate the conditions of cavitation of a pump.

- Obtain the characteristic curves of pump connections.
- Explain the flow control with valves and when the speed of the pump is adjusted.
- Compute valve loss coefficients from their flow coefficients.
- Calculate the mechanical energy losses in a pipeline through which gas flows.
- Calculate the gas flow passing through a fluid system.
- Calculate the power required for compressing a gas and its compressor exit temperature.
- Describe the different types of flow in open channels.
- Calculate the normal discharge of an open channel.
- Design an open channel to produce a given discharge with uniform flow.
- Describe the term hydraulic jump.
- Calculate the power dissipated in a hydraulic jump.
- Calculate changes in depth in for the fast transitions in open channels of different geometries.
- Choose the most appropriate procedure and equipment for a mixing operation.
- Calculate the power consumed by an agitator.

In addition to what has been said before, the course will encourage students to develop several generic skills, among which the following are noteworthy:

- Capacity for analysis and synthesis.
- Ability to argue from rational and logical criteria.
- Ability to communicate in a properly and organized manner.
- Ability to develop a problem in a systematic and organized manner.
- Ability to work and distribute the personal time.
- Ability to work in groups by encouraging diversity respect, equity and gender equality.

DESCRIPTION OF CONTENTS

1. BASIC CONCEPTS

The aim of Fluid Mechanics. Concept of pressure: in static systems and in fluids in movement. Fluid Velocity.

2. FUNDAMENTAL EQUATIONS FOR FLUID FLOW

Conservation of mass. Conservation of energy. Mechanical energy balance. Conservation of momentum. Transport equation for mechanical energy loss.

3. CIRCULACIÓN DE FLUIDOS POR EI INTERIOR DE CONDUCCIONES

Velocity profile in a circular conduit: Laminar and turbulent flows. Universal profile of velocity for smooth tubes. Velocity profile for rough tubes. Estimation of friction factor in conduits of circular section.

4. LIQUID FLOW IN PIPES

Design equations: - Mechanical energy balance; - Calculation of the losses of mechanical energy. Practical cases in the design of pipes for liquids: - Calculation of the pump power; - Calculation of the discharge flow; - Calculation of pipe diameter. Networks of pipes: Resolution of problems.

5. PUMPS FOR LIQUID DRIVING

The system. The pump: Types of pumps. Turbopumps: - Specific speed of a turbopump; - Laws of affinity; - Connexions of turbopumps. Interaction pump-system: - Installation point of a pump; - Discharge and head supplied by a pump; - Flow control.

6. COMPRESSIBLE FLOW IN PIPES. COMPRESSORS

Design Equations. Combination of mechanical energy balance and the rate equation: - Isothermal flow; - Adiabatic flow; - Polytropic flow. Equipment for the movement of gases. Work of compression. Staged operation.

7. OPEN CHANNEL FLOW

Flow in open channels: - Classification of open channel flow; - Classes of flow in open channels. Uniform flow: - Channel geometry; - Equations; - The most efficient section. Mechanical energy balance: - Specific head; - Using the mechanical energy balance in transitions; - Flow measurement. Momentum in open channel flow: Hydraulic jump.

8. FLUID MIXING SYSTEMS. AGITATORS

Types of mixture. Mixing mechanisms. Types of agitators for liquid mixing. Homogenization of miscible liquids in stirred tanks: - Power consumption in a stirred tank; - Agitator capacity pumping; - Mixing time.

9. LAB OF FLUID MECHANICS

Simulation of hydraulic systems with EPANET2

WORKLOAD

ACTIVITY	Hours	% To be attended
Classroom practices	35,00	100
Theory classes	20,00	100
Laboratory practices	5,00	100
Development of group work	5,00	0
Study and independent work	20,00	0
Preparation of evaluation activities	15,00	0
Preparing lectures	18,50	0
Preparation of practical classes and problem	20,00	0
Resolution of case studies	10,00	0
Resolution of online questionnaires	1,50	0
TOTAL	**150,00**	

TEACHING METHODOLOGY

The development of the course is structured around the theory classes, practical activities and laboratory sessions. Some of these activities will be evaluated and will contribute to the final mark.

In the theory classes lecture model will be used to explain the most complex or difficult notions, and always during periods of less than 30 minutes, as well as flipped classrooms. Students will get an insight into many of the theoretical concepts by working with the material provided to them. (G3, G11, R2)

Problems will be developed in practical class sessions following two models. Some problems will be solved by the teacher so that students find out the way to address them, while others will be solved by students, individually or in groups under the supervision of the teacher. After the work, the problems will be collected, analyzed and corrected. (G3, G4, G5, R2)

The proposed work for the students will be of several types: Questions or short exercises, problems similar in complexity to those of exams and self-correcting tests performed in the e-learning platform. All of these activities will be done in class or at home, and their contribution to the final mark will be established. After correction, the students will be informed of their results and will be given with a summary of the most common mistakes.

These activities are non-recoverable (G4, G5, G6, R2)

For laboratory practice sessions, a practical guide will be supplied to the students and the experimentation will be carried out entirely by them under the supervision of the teacher (R2, G6). Attendance at laboratory is a non-recoverable activity and mandatory to pass the course.

EVALUATION

In a first round, the assessment of student learning will be carried out using two models:
1. Through continuous assessment where activities delivered by students and the marks obtained in 2 individual exams will be taken into account (Model A).
2. From the mark of a final exam to be held on the scheduled date and the activities delivered along the course (Model B).
In model A the student evaluation will be carried out considering two blocks: Block I: issues 1 to 5; and Block II: issues 6 to 8. The exam of Block I will be carried out after finishing the subject of this block, whereas the exam of Block II will be on the date of the first call. People who choose model A and takes the block I test will be evaluated by model A and will not be able to access model B. In model A it is a requirement to get an average mark equal or greater than 4.5 in the individual exams.
The final mark for this model will be calculated using the following criteria:

- 5% For attendance (G3, G4, R2)
- 5% For on-time deliveries (G3, G4, G6, G11, R2)
- 30% For class, homework and laboratory grading (G3, G4, G5, G6, G11, R2)
- 60% For individual exams (G3, G4, R2)

To pass the course with this model a final mark equal to or greater than 5 must be obtained. Any student who does not meet any of the mentioned requirements will have to pass the course by the second call and will be graded with the lowest grade between the final mark and the average mark of the individual exams.
In model B, the students have to do a final exam of the whole of the subject on the date scheduled, which will count up to 75% of the final mark (G3, G4, R2), whereas the remaining 25% of the mark will be obtained from grading activities (G3, G4, G5, G6, G11, R2). In the final exam a mark equal or greater than 4.5 must be obtained. Otherwise, the final mark will be that of the exam. To pass the course the final mark must be equal or greater than 5.
The students who have not passed the course on the first round will have a second one in which the exam will count for 85% whereas the qualifying problems carried out in the classroom and the laboratory report count for 15%. In the final exam you have to obtain a grade equal to or higher than 4.5. Otherwise, the final mark will be that of the exam. To pass the subject, the final grade must be equal to or greater than 5.
For the advancement of the assessment, it is essential to assist the laboratory in a previous year. Finally, to pass the subject attendance to the lab is mandatory.
In any case, the assessment system will be governed by that established in the Evaluation and Qualification Regulations of the University of Valencia for Degrees and Masters (http://links.uv.es/7S40pjF)

REFERENCES

Basic

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Additional

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