COURSE DATA

Data Subject	
Code	34753
Name	Fluid Mechanics
Cycle	Grade
ECTS Credits	6.0
Academic year	2019 - 2020

Study (s)

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

Subject-matter

Degree	Subject-matter	Character
1401 - Degree in Chemical Engineering	8 - Fluid mechanics	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 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.

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 El 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. 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 by the teacher or the students. (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 in time 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.

The requirements to be qualified by the model A) are: deliver more than 75% of activities, getting an average score equal or greater than 5 in them and to get in each of the individual exams a mark equal or greater than 4.5. The final mark for this mode will be calculated using the following criteria:

5% From student participation (G3, G4, R2)

5% On-time delivery (G3, G4, G6, G11, R2)

30% From class, homework and laboratory grading (G3, G4, G5, G6, G11, R2)

60% From 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 on the first round by the model B), or go to the second call if a mark equal or greater than 4.5 is not achieved in the exam of block II.

In model B) the student has to do a final exam on the date scheduled of the whole of the subject which will only count up to 75% of the final mark (G3, G4, R2), whereas the remaining 25% of the mark will be obtained from class, homework and laboratory grading activities (G3, G4, G5, G6, G11, R2). In the final exam a mark equal or greater than 4.5 must be obtained and in order 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 up to 85% whereas the remaining 15% will be obtained from the non-recoverable activities made along the course. The exam will allow the evaluation of the acquisition of learning outcomes and recoverable activities. For those non-recoverable activities (on-time delivery, class grading activities and laboratory report) the mark obtained in the first round will be maintained. In the final exam a mark equal or greater than 4.5 must be obtained and in order to pass the course the final mark must be equal 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

- Mecànica de Fluids A. V. Orchillés, M. Sanchotello (Publicacions Universitat de València, 2007). ebook en UV
- Mecánica de Fluidos. 3ª Ed. M. C. Potter, D. C. Wiggert (Thomson, 2002)
- Fluid Flow for Chemical Engineers. 2nd Ed. F. A. Holland, R. Bragg (Edward Arnold, 1995). ebook en UV

Additional

- Mecánica de Fluidos R. L. Mott (Pearson, 2006)
- Chemical Engineering Fluid Mechanics. 2nd Ed. R. Darby (Marcel Dekker, 2001)
- Pipeline Rules of Thumb Handbook : A manual of quick, accurate solutions to everyday pipeline engineering problems 8th Ed, E.W. McAllister (Gulf Professional Publishing, 2014). ebook en UV
- Ingeniería Química. Tomos I y II J. M. Coulson, J. F. Richardson (Reverté, 1979)
- Flujo de fluidos e intercambio de calor O. Levenspiel (Reverté, 1993)
- Flujo estacionario de fluidos incompresibles en tuberías R. Pérez y otros (Universidad Politécnica de Valencia, 2005)
- Mixing in the Process Industries. 2nd Ed. N. Harby y otros (Butterworth, 1992)

ADDENDUM COVID-19

This addendum will only be activated if the health situation requires so and with the prior agreement of the Governing Council

1. Contenidos

Se reducen los contenidos inicialmente recogidos en la guía docente seleccionando los conceptos indispensables para adquirir las competencias. Concretamente se eliminan los contenidos del tema 7 ya que son los que menos utiliza un ingeniero químico en el ejercicio de su profesión.

2. Volumen de trabajo y planificación temporal de la docencia

En la guía docente se preveían 20 horas de clase de teoría y 35 de prácticas en el aula de las que ya se habían ejecutado 30 en el momento de comienzo de la docencia no presencial.

Se reducen en 25 horas las clases de teoría y prácticas y se aumenta en 8 horas la preparación de las clases de teoría, en 12 la preparación de las clases prácticas y de problemas y en 5 horas el trabajo autónomo. Se ha dado libertad al estudiantado con los horarios ya que disponen de todo el material on-line que pueden visualizar en cualquier momento y de las tareas propuestas a su disposición en Aula Virtual.

3. Metodología docente

Además del material que ya se encontraba en el Aula Virtual, se sustituye la clase presencial por transparencias con locución para las clases de teoría y por videos explicativos de problemas resueltos para las prácticas de problemas, localizadas en la plataforma mmedia de la UV con enlaces desde el Aula Virtual. Los problemas se explican con la hoja de cálculo Excel y de forma opcional se propone a cada estudiante la generación y envío vía Aula Virtual de esas hojas de cálculo para que cuenten en el apartado de Participación. Las actividades a realizar presencialmente en clase se sustituyen por “Tareas” de Aula Virtual cuya propuesta y ejecución podrá realizarse durante un período de tiempo prolongado, o durante un tiempo acotado de unas 2 horas. Se mantienen los cuestionarios que se realizan por Aula Virtual.

Se mantienen las prácticas de laboratorio que se hicieron antes de la entrada en vigor del estado de alarma.

Sistema de tutorías: Los dos profesores participan en el programa de tutorías electrónicas. Se contestarán las dudas que vengan por correo electrónico o vía Aula Virtual (máximo 48 horas laborables).

4. Evaluación

Primera convocatoria

Mantenimiento de las notas resultantes de la evaluación continua obtenidas antes de la entrada en vigor del estado de alarma aunque su peso cambia.

La evaluación se llevará a cabo mediante las actividades de evaluación continua y un examen final. La aportación de cada parte a la calificación se detalla a continuación.

Incremento del peso de la evaluación continua del 40% en la guía docente al 60%. Se mantienen las actividades evaluables de manera continua de la guía original: resolución de problemas, cuestionarios y laboratorio.

Reducción del peso del examen final del 60 al 40%. Se elimina el mínimo en la nota del examen para superar la asignatura.

No obstante, se aplicará a cada estudiante los porcentajes de ponderación que aparecen en todas las modalidades contempladas en la guía docente y se mantendrá la calificación que resulte más favorable.

Prueba de evaluación final: Se basará en un examen con una parte de teoría y otra de problemas con una duración total de 3 horas. La parte de teoría será un cuestionario tipo test a realizar en aula virtual a la fecha y hora oficial prevista para el inicio del examen. Tras finalizar el cuestionario, se resolverán dos problemas, uno a continuación del otro, que se subirán al aula virtual como “Tarea” (resolución y hoja de cálculo). Se generarán múltiples versiones distintas de los problemas. Será la hora que figure en la actividad “Tarea” del aula virtual como hora de entrega la que se tenga en cuenta para entender que se ha entregado en plazo. En su momento se darán instrucciones por si cada estudiante tiene que estar conectado mediante videoconferencia BBC con la cámara activada y el micrófono silenciado.

Si una persona no dispone de los medios para establecer esta conexión y acceder al aula virtual, deberá contactar con el profesorado por correo electrónico en el momento de publicación de este anexo a la guía docente

Segunda convocatoria

La evaluación global de la asignatura se cuantificará mediante una media ponderada de dos partes, con un peso relativo del 15% de las actividades no recuperables y del 85% del examen.

La estructura del examen será idéntica a la especificada en la primera evaluación. Se elimina el mínimo en la nota del examen para superar la asignatura.

5. Bibliografía

No hay cambios en la bibliografía. Aunque no toda es accesible, con la que sí lo es y el material de apoyo en aula virtual es suficiente para preparar la asignatura.