Universitat Autònoma de Barcelona

**2022/2023**

# Fluid Dynamics

Code: 102414
ECTS Credits: 6

| Degree | Type | Year | Semester |
|---|---|---|---|
| 2500897 Chemical Engineering | OB | 2 | 2 |

## Contact

Name: Montserrat Sarra Adroguer
Email: montserrat.sarra@uab.cat

## Use of Languages

Principal working language: catalan (cat)
Some groups entirely in English: No
Some groups entirely in Catalan: Yes
Some groups entirely in Spanish: No

## Prerequisites

Convenient to have studied the subject 102405 Mass and energy balance in chemical engineering.

## Objectives and Contextualisation

The main objective is to select and design equipment based on the circulation of fluids existing in any industrial plant.

Other more specific objectives:
• Apply the mechanical energy balance to the study of the fluid flow.
• Study and dimension the equipment for the transport of incompressible fluids.
• Know the necessary instrumentation or based on the fluid flow.
• Expand the application of the mechanical energy balance to the circulation of compressible fluids.
• Understand the foundation of unit operations based on the fluid flow.
• Design the equipment of the most relevant unit operations.

## Competences

- Communication
- Demonstrate knowledge of the different reaction, separation and processing operations for materials, and transport and circulation of fluids involved in the industrial processes of chemical engineering.
- Develop personal attitude.
- Develop personal work habits.
- Develop thinking habits.
- Objectively compare and select different technical options for chemical processes.
- Understand and apply the basic principles on which chemical engineering is founded, and more precisely: balances of matter, energy and thermodynamic momentum, phase equilibrium and kinetic chemical equilibrium of the physical processes of matter, energy and momentum transfer, and kinetics of chemical reactions

## Learning Outcomes

1. Communicate efficiently, orally and in writing, knowledge, results and skills, both professionally and to non-expert audiences.
2. Describe the operations for the transport and circulation of fluids involved in the industrial processes of chemical engineering.
3. Develop a capacity for analysis, synthesis and prospection.
4. Develop curiosity and creativity.
5. Develop independent learning strategies.
6. Efficiently use ICT for the communication and transmission of ideas and results.
7. Identify, analyse and resolve mechanical energy and matter balances.
8. Manage available time and resources. Work in an organised manner.
9. Objectively compare and select different technical alternatives for fluid circulation systems.
10. Work autonomously.

## Content

1.- Introduction
2.- Incompressible fluids
2.1.- Installations for the transport of fluids
2.1.1.- Pipe fittings and valves
2.1.2.- Materials
2.2.- Balance of mechanical energy
2.2.1.- Simplified forms
2.2.2.- Evaluation of the mechanical energy loss
2.2.3.- Applications of the mechanical energy balance
2.3.- Transportation of incompressible fluids: pumps
2.3.1.- Head and NPSH
2.3.2.- Classification and description of pumps
2.3.3.- Characteristic curve of a centrifugal pump
2.4. Measurers of flow rate and pressure

3.- Compressible fluids
3.1.- Balance of mechanical energy
3.1.1.- Isotherm circulation
3.1.2.- Adiabatic circulation
3.2.- Measurers of gas flow rate
3.3.- Transport of compressible fluids
3.3.1.-Classification of equipment: fans, blowers and compressors
3.3.2.- Calculation of the compressor power
4.-Operations based on the flow of fluids
4.1.- Circulation of a fluid around a solid
4.2.- Fixed beds
4.3.- Fluidised beds
4.4.- Filtration
4.5.- Sedimentation

## Methodology

The fundamentals will be introduced by videos and teaching material.

Class will be dedicated to apply concepts to case studies and to solve questions.

Concepts will be applied also to solve selected problems.

Search of information related to the description of equipment by the students.
During lectures students will complete a numerical project of fluid flow installation.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

## Activities

| Title | Hours | ECTS | Learning Outcomes |
|---|---|---|---|
| Type: Directed | | | |
| Equipment calculation | 15 | 0.6 | 9 |
| Theoretical foundations | 30 | 1.2 | |
| Type: Supervised | | | |
| Equipment selection | 10 | 0.4 | 9 |
| Type: Autonomous | | | |
| Problem solving | 45 | 1.8 | 9, 1, 8 |
| Study | 25 | 1 | 9 |
| To find information | 10 | 0.4 | 9, 2 |

## Assessment

The subject is divided into two parts: part A (topics 1 and 2) and part B (topics 3 and 4).

a) Students will have all the material on the virtual campus (videos, notes

1) test-type questions (multiple choice) about equipment description works

2) Seminar every 2-3 weeks where a problem related to the proposed se

3) Carrying out a numerical work autonomously or with a tutorial

4) Block A theory exam and numerical work (1st part) and block B theory

The final grade will be calculated according to the expression:

Final grade = 15% theory exams + 60% problems + 10% test tests + 20% numerical work.

To pass block A and block B you must take 50% between theory exam and problems, otherwise you will have to

To calculate the final grade, a minimum of 30% must be obtained in each

b) Scheduling of evaluation activities

The calendar of assessment activities will be published on the Virtual Ca

c) Recovery procedure

Without requirements.

d) Procedure for reviewing grades

For each test the day, hour and place will be indicated when the grades a

e) Qualifications

UAB regulations state that MHs can only be awarded to students who ha
To obtain an MH it is essential to obtain a good qualification in the 1st ve

f) Irregularities on the part of the student, copying and plagiarism.

Without prejudice to other disciplinary measures deemed appropriate, irr
The copy can be detected during the test, but especially during the corre
In cooperative work, it is recommended to denounce "jets" and "blanket"

h) Evaluation of repeaters.

No grades are saved from any evaluation activity of previous courses.

## Assessment Activities

| Title | Weighting | Hours | ECTS | Learning Outcomes |
|---|---|---|---|---|
| Block A theory exam | 7.5% | 0.5 | 0.02 | 9, 2 |
| Block B theory exam | 7.5 % | 0.5 | 0.02 | 9, 2 |
| Multiple choise exams about equipments | 10% | 1 | 0.04 | 9, 5, 8 |
| Numerical project | 20 % | 1 | 0.04 | 9, 1, 5, 3, 4, 6, 8, 7, 10 |
| Recovery Exam A (theory + problems) | 37.5 % | 3 | 0.12 | 9, 2 |
| Recovery Exam B (theory + problems) | 37.5 % | 3 | 0.12 | 2, 7 |
| Solving problems in class | 60% | 6 | 0.24 | 2, 3, 8, 7, 10 |

## Bibliography

J.M. Coulson, J.F. Richardson Chemical Engineering, V. 1 (1991), V. 6 (1983) Pergamon Press

W.L. Mc Cabe, J.C. Smith, P. Harriot Unit Operations of Chemical Engineering, 4th edition.McGraw-Hill Book Company, New York (1985)

E. Costa Novella Ingeniería Química 3. Flujo de fluidos. Alhambra Universidad, Madrid (1985)

R.H. Perry, D. Green Perry's Chemical Engineers' Handbook, 6th edition McGraw-hill, New York (1984)

O. Levenspiel Flujo de Fluidos. Intercambio de Calor Ed. Reverté, Barcelona (1993)

F.M. White Fluid Mechanics, 3th edition. McGraw-Hill, New York (1994)

N. de Nevers Fluid Mechanics for Chemical Engineers, 2nd edition. McGraw-Hill, New York (1991)

R. Darby Chemical Engineering Fluid Mechanics. Marcel Dekker, New York (1996)

Robert L. Mott Mecànica de fluidos aplicada, 4ª edición, Prentice Hall, Mèxico (1996)

Through the library, electronic versión is available.

Ch. J. Geankoplis Transport Processes and Unit Operations, 3ª edición, Prentice Hall, New Jersey (1993)

## Software

No special software