

Course guide

2500213 - GEA0213 - Fluid Mechanics

Last modified: 01/10/2023

Unit in charge: Barcelona School of Civil Engineering
Teaching unit: 751 - DECA - Department of Civil and Environmental Engineering.

Degree: BACHELOR'S DEGREE IN ENVIRONMENTAL ENGINEERING (Syllabus 2020). (Compulsory subject).

Academic year: 2023 **ECTS Credits:** 6.0 **Languages:** Catalan

LECTURER

Coordinating lecturer: ORIOL LLOBERAS VALLS

Others: RAMON CODINA ROVIRA, ORIOL LLOBERAS VALLS

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

14445. Recognize the biological bases and foundations of the plant and animal field in engineering: notions of genetics, biochemistry and metabolism, physiology, organisms and environment, population dynamics, flows of matter and energy and changes in ecosystems, biodiversity, principles of the kinetics of microbial growth and reactor theory.

14447. Obtain basic knowledge about the use and programming of computers, operating systems, databases and basic numerical calculation and applied to engineering.

14451. Apply the fundamental concepts of statistics and randomness of physical, social and economic phenomena, as well as uncertainty and decision-making techniques.

14452. Enhance the capacity of spatial vision and identify the techniques of graphic representation, topography, photogrammetry, cartography, remote sensing and Geographic Information systems.

14453. Describe and apply the techniques of analysis of physical, chemical and biological parameters; Integrate the experimental evidence found in field and / or laboratory data with the theoretical knowledge and interpret its results.

14454. Formulate the principles of fluid mechanics and the fundamentals of continuous medium mechanics.

14455. Identify the concepts and technical aspects linked to the conduit systems, both in pressure and in free sheet and apply them to the water supply transport networks; pumping systems; unit networks; separative networks; Avenues prevention systems in urban areas and analysis of tools for the recovery of altered river and coastal spaces.

14456. Describe the processes linked to the water cycle: atmospheric circulation and rain formation; rain transformation into runoff; and apply them to surface and underground hydrology associated with avenues risk, surface water pollution, aquifer management and groundwater pollution.

Generical:

14440. Identify, formulate and solve problems related to environmental engineering.

14441. Apply the functions of consulting, analysis, design, calculation, project, construction, maintenance, conservation and exploitation of any action in the territory in the field of environmental engineering.

14442. To use in any action in the territory proven methods and accredited technologies, in order to achieve the greatest efficiency respect for the environment and the protection of the safety and health of workers and users.



TEACHING METHODOLOGY

The course consists of 2.3 hours per week of classroom activity (large size group) and 1.2 hours weekly with half the students (medium size group).

The 2.3 hours in the large size groups are devoted to theoretical lectures, in which the teacher presents the basic concepts and topics of the subject, shows examples and solves exercises.

The 1.2 hours in the medium size groups is devoted to solving practical problems with greater interaction with the students. The objective of these practical exercises is to consolidate the general and specific learning objectives.

The rest of weekly hours devoted to laboratory practice.

Support material in the form of a detailed teaching plan is provided using the virtual campus ATENEA: content, program of learning and assessment activities conducted and literature.

Although most of the sessions will be given in the language indicated, sessions supported by other occasional guest experts may be held in other languages.

LEARNING OBJECTIVES OF THE SUBJECT

In this subject, the basic physical principles that occur in the aquatic physical environment are reviewed. Emphasis is placed on the concepts of oscillatory movement and on the physics of fluids (kinematics, conservation equations, constituent equations in fluids, and fluid mechanics).

1. Know the bases of continuous media and understand the conservation and balance equations to finally obtain the main equations of fluid mechanics in hydrostatics and hydrodynamics (Euler, Navier-Stokes, Reynolds, Bernoulli).
2. Study the laminar and turbulent regime, and the concepts of boundary layer, diffusion, and stratification.
3. Relate the concepts learned to the solids mechanics equations from the conservation and balance equations.

Fluid mechanics. In this subject the equations that define the behavior of fluids in natural environments are covered. A brief introduction is made to the continuous media, to continue with the conservation and balance equations, finally presenting the main equations of mechanics

of fluids in hydrostatics and hydrodynamics (Euler, Navier-Stokes, Reynolds, Bernoulli). The laminar and turbulent regime is studied, and the concepts of boundary layer, transported and diffusion, and layering. Finally, the concepts learned are related to the solids mechanics equations from the equations conservation and balance.

STUDY LOAD

Type	Hours	Percentage
Hours small group	15,0	10.00
Self study	90,0	60.00
Hours large group	30,0	20.00
Hours medium group	15,0	10.00

Total learning time: 150 h



CONTENTS

Introduction to Tensor Algebra

Description:

Introduction to tensor algebra
Problems Thesaurus Algebra

Specific objectives:

Introduce the basic notions of tensor algebra that allow a complete follow-up of the subject.

Full-or-part-time: 12h

Theory classes: 4h
Practical classes: 1h
Self study : 7h

Properties of fluids

Description:

Introduction to the basic properties of fluids and their units.
Fluid property problems

Full-or-part-time: 9h 36m

Theory classes: 3h
Practical classes: 1h
Self study : 5h 36m

Fluid statics

Description:

Fluid statics.
Fluid statics problems I

Full-or-part-time: 21h 36m

Theory classes: 5h
Practical classes: 4h
Self study : 12h 36m

Motion of Fluids

Description:

Eulerian and Lagrangian description, concepts of speed and acceleration,
Fluid movement problems

Specific objectives:

Adquirir els coneixements matemàtics bàsics en la descripció del moviment dels fluids.

Full-or-part-time: 9h 36m

Theory classes: 3h
Practical classes: 1h
Self study : 5h 36m



Control volume and conservation equations

Description:

Control volume and balance sheets
Control volume and balance sheet issues

Full-or-part-time: 19h 12m

Theory classes: 3h
Practical classes: 1h
Laboratory classes: 4h
Self study : 11h 12m

Differential forms of fundamental equations

Description:

Continuity equation, momentum equation, energy equation.
Conservation of the amount of movement

Full-or-part-time: 14h 23m

Theory classes: 4h
Practical classes: 2h
Self study : 8h 23m

Dimensional analysis.

Description:

Dimensional analysis
Problems of Dimensional Analysis

Full-or-part-time: 14h 23m

Theory classes: 4h
Practical classes: 2h
Self study : 8h 23m

Internal flow

Description:

Flow developed, flow in tube, flow in
Flow in free-sheet ducts

Full-or-part-time: 14h 23m

Theory classes: 4h
Practical classes: 2h
Self study : 8h 23m



External flow

Description:

Flow of a fluid around a body.
Load problems caused by a fluid

Full-or-part-time: 28h 47m

Theory classes: 2h

Practical classes: 2h

Laboratory classes: 8h

Self study : 16h 47m

GRADING SYSTEM

The qualification of the subject is done by means of:

- Two partial exams. Its average weighs 70% of the final grade.
- Two course assignments. Its average weighs 30% of the final grade.

EXAMINATION RULES.

- The exams consist of two parts, a theoretical one (50%) in which no material can be consulted and a practical one (50%) in which you can consult what the student deems appropriate.
- The homeworks must be delivered by email to the responsible teacher on the same day that the corresponding exam is taken.

BIBLIOGRAPHY

Basic:

- Streeter, V.; Wylie, E. B.; Bedford, K. Mecánica de fluidos. 9a ed. Publicació México [etc.]: McGrawHill, 2000. ISBN 9586009874.
- Giles. R. V. Mecánica de los fluidos e hidráulica. 2a ed. Madrid: McGrawHill, 1994. ISBN 8448118987.

Complementary:

- Oliver Olivella, X.; Agelet de Saracíbar, C. Mecànica de medis continus per a enginyers [on line]. Barcelona: Edicions UPC, 2003 [Consultation: 29/04/2020]. Available on: <http://hdl.handle.net/2117/97013>. ISBN 8483017199.