Course guide
2500216 - GEA0216 - Hydraulics

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: MARTI SANCHEZ JUNY

Others: MARTI SANCHEZ JUNY

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 hours per week of classroom activity (large size group) and 2 hours weekly with half the students (medium size group).

The 2 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 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

This course will provide knowledge of hydraulics and its application to pressure conduction and open channel systems and the ability to apply it to the solving of engineering problems. The applications of the fluid equations of motion to engineering cases related to pressure and open channel conduits will be shown. It will show how to solve pressure flow problems (pipes) including auxiliary elements such as pumps, elbows and valves and the flow of open channel water will be analyzed, in natural (rivers) and artificial channels.

1. Understand and know how to apply the laws of hydrostatics and the equations of fluid motion to engineering cases.
2. Solve problems of piping systems including pumping and auxiliary elements such as elbows and valves.
3. Analyze the free sheet water flow in geometries or basic conditions.

Hydraulics. Students will be introduced to hydrostatics and then the main equations that govern water transport will be analyzed. Will apply these to pressure and free sheet conduction systems to solve problems in the field of environmental engineering.

STUDY LOAD

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

Total learning time: 150 h

CONTENTS

Mechanical characteristics of fluids

Description:
Mechanical characteristics of fluids

Full-or-part-time: 4h 48m
Theory classes: 2h
Self study : 2h 48m

Hydrostatics

Description:
Basic principles. Push on flat surfaces
Thrust on curved surfaces. Uplift
Exercises

Full-or-part-time: 12h
Theory classes: 3h
Practical classes: 2h
Self study : 7h

Fundamental equations in the motion of fluids

Description:
Mass conservation. Momentum equation
Bernoulli equation. Reynolds experiment
Exercises

Full-or-part-time: 16h 48m
Theory classes: 4h
Practical classes: 3h
Self study : 9h 48m

Pressure flow

Description:
Steady flow in pipelines
Exercises
Pumping systems
Exercises
Transients in pipelines. Water hammer
Exercises

Full-or-part-time: 33h 36m
Theory classes: 6h
Practical classes: 6h
Laboratory classes: 2h
Self study : 19h 36m

Open channel fliow

Description:
Uniform regime
Gradually varied flow
Exercises
Rapidly varied flow
Exercises
HECRAS in steady flow
Introduction to the variable regime in open channel flow
Introduction to HECRAS in variable regime
Evaluation

Full-or-part-time: 76h 48m
Theory classes: 16h
Practical classes: 8h
Laboratory classes: 8h
Self study : 44h 48m

GRADING SYSTEM

The grade of the subject is obtained from the grades of continuous assessment. The continuous assessment consists of doing different activities, both individual and group, of an additive and formative nature, carried out during the course (inside the classroom and outside it).

Assessment tests consist of questions about concepts associated with the learning objectives of the subject in terms of knowledge or understanding, and a set of application exercises.

The final grade (NF) is obtained from the application of the following expression:

$NF = 0.62 \cdot NA + 0.38 \cdot NC$

Where
-NA: arithmetic average of ordinary assessment tests
-NC: arithmetic average of the activities proposed by the teachers throughout the course.

The student may give up the continuous assessment process either by notifying the responsible teacher in writing at the beginning of the course or by not attending 20% of the NC activities. In such case the NF of the subject will be obtained doing:

$NF = NA$

Criteria of qualification and of admission to the re-evaluation: The students suspended to the ordinary evaluation that have presented regularly in the proofs of evaluation of the suspended subject will have the option to take a re-assessment test in the period set in the academic calendar. Students who have already passed it or students qualified as not presented will not be able to take the re-assessment test for a subject. The maximum grade in the case of taking the re-assessment exam will be five (5.0). The non-attendance of a student summoned to the test of re-evaluation, celebrated in the fixed period will not be able to give rise to the realization of another test with later date. Extraordinary assessments will be carried out for those students who, due to force majeure, have not been able to take any of the continuous assessment tests. These tests must be authorized by the corresponding head of studies, at the request of the teacher responsible for the subject, and will be carried out within the corresponding teaching period.

EXAMINATION RULES.

If any of the laboratory or continuous assessment activities are not performed in the scheduled period, it will be considered as a zero score.

BIBLIOGRAPHY

Basic:
- Sanchez,M.; Bladé,E.; Puertas,G. Hidráulica [on line]. Barcelona: Edicions UPC, 2005 [Consultation: 04/03/2021]. Available on: http://hdl.handle.net/2099.3/36802. ISBN 8483018217.
- Puertas, Jerónimo ... [et al]. Apuntes de ingeniería hidráulica. A Coruña: Fundación Ingeniería Civil de Galicia, 2016. ISBN 9788461746644.
- Sotelo, G. Hidráulica general: vol. 1: fundamentos. México: Limusa, 1974. ISBN 968-18-0503-8.
- Streeter, V.; Wylie, E. B.; Bedford, K. Mecánica de fluidos. 9a ed. Publicació México [etc.]: McGrawHill, 2000. ISBN 9586009874.
- Chanson, H. The Hydraulics of open channel flow : an introduction : basic principles, sediment motion, hydraulic modelling, design of hydraulic structures. 2nd ed. Oxford [etc.]: Butterworth Heinemann, 2004. ISBN 9780750659789.