Course guide
2500052 - GECEDIANEH - Design and Analysis Tools in Hydraulic Engineering

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 CIVIL ENGINEERING (Syllabus 2020). (Optional subject).

Academic year: 2023 **ECTS Credits:** 4.5 **Languages:** Catalan

LECTURER

Coordinating lecturer: CARLES FERRER BOIX

Others: CARLES FERRER BOIX, GONZALO JAVIER OLIVARES CERPA, MARTI SANCHEZ JUNY, JACKSON DAVID TELLEZ ALVAREZ

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
14417. Knowledge and understanding of the supply and sanitation systems, as well as their sizing, construction and conservation. (Specific technology module: Civil Construction)
14418. Knowledge and ability to project and size hydraulic works and installations, energy systems, hydroelectric uses and planning and management of surface and underground hydraulic resources. (Specific technology module: Hydrology)

Generical:
14380. Scientific-technical training for the exercise of the profession of Technical Engineer of Public Works and knowledge of the functions of advice, analysis, design, calculation, project, construction, maintenance, conservation and exploitation.
14383. Ability to project, inspect and direct works, in their field.
14384. Capacity for the maintenance and conservation of hydraulic and energy resources, in its field.
14386. Capacity for maintenance, conservation and exploitation of infrastructure, in its field.
14389. Knowledge of the history of civil engineering and training to analyze and assess public works in particular and construction in general.
14390. Identify, formulate and solve engineering problems. Pose and solve construction engineering problems with initiative, decision-making skills and creativity. Develop a systematic and creative method of analysis and problem solving. (Additional school competition).
14391. Conceive, project, manage and maintain systems in the field of construction engineering. Cover the entire life cycle of an infrastructure or system or service in the field of construction engineering. (Additional school competition).

TEACHING METHODOLOGY

The course consists of 1.5 hours per week of classroom activity (large size group) and 1.5 hours weekly with half the students (medium size group).

The 1.5 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 1.5 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.

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

Knowledge of the main tools used both for the design of hydraulic structures and hydrodynamic analysis. Study of the theoretical models and laws of similarity. Knowledge of the measuring instrumentation usually used in field and laboratory. Main design and experimental analysis techniques. Knowledge and application of the main commercial models of hydraulic simulation in openflow (IBER, HECRAS) and water pressure (EPANET) and hydrological (HMS).

1 Ability to design a simple experimental campaign in hydraulic infrastructures, either in the field or in the laboratory.
2 Ability to properly select the objectives and calculation tools to carry out a hydraulic / hydrological analysis.

Knowledge of the main tools used both for the design of hydraulic structures and hydrodynamic analysis. Study of the theory of models and laws of similarity. Knowledge of the measurement instrumentation commonly used in the field and laboratory. Main design techniques and experimental analysis. Knowledge and application of the main commercial models of hydraulic simulation both in free sheet (IBER, HECRAS) and pressure (EPANET) and hydrological (HMS). Study of practical cases.

STUDY LOAD

Type	Hours	Percentage
Guided activities	4,5	4.00
Self study	63,0	56.00
Hours medium group	22,5	20.00
Hours large group	22,5	20.00

Total learning time: 112.5 h

CONTENTS

I. Introduction to experimental hydraulics

Description:
Introduction to dimensional analysis and reduced models
Measurement techniques in the laboratory
Risk prevention in the laboratory and field

Full-or-part-time: 12h
Theory classes: 4h
Practical classes: 1h
Self study : 7h

II. Lab work on gradually and rapidly varied flow

Description:
Objectives of the Lab work
Lab work
Data processing and analysis

Full-or-part-time: 24h
Theory classes: 1h
Practical classes: 5h
Laboratory classes: 4h
Self study : 14h

III. Lab work on velocity and flow rate measurement

Description:
Objectives of the Lab work
Lab work
Data processing and analysis

Full-or-part-time: 24h
Theory classes: 1h
Practical classes: 5h
Laboratory classes: 4h
Self study : 14h

IV. Numerical modeling with HECRAS

Description:
Introduction to HECRAS
Modeling of Lab work

Full-or-part-time: 19h 12m
Theory classes: 2h
Practical classes: 6h
Self study : 11h 12m

V. Numerical modeling with IBER

Description:
Introduction to IBER
Modeling of Lab work

Full-or-part-time: 28h 47m
Theory classes: 4h
Practical classes: 6h
Laboratory classes: 2h
Self study : 16h 47m

GRADING SYSTEM

Each student must do the following tasks:
I. Lab work (groups of 3 or 4 students)
II. Individual Report of Lab work
III Numerical simulation work in HECRAS and IBER
IV. Individual Report on numerical work
V. Oral presentation of all the tasks

The course consists of two different parts, each of which corresponds to 50% of the semester.

a) Lab work:
There will be a previous session in the classroom in which the objectives, the methodology to be followed and the risk prevention mechanisms to be considered will be explained. Specifically, two Lab works are proposed to address different aspects of open channel flow (gradually varied flow, rapidly varied flow, flow capacity, 1D and 2D flow).
There will be two or three sessions in the classroom to analyze the data taken in the laboratory and raise the main doubts that arise from the treatment of those data.
In all sessions the professor will assess the student's participation during it.
Each student must prepare an individual report for each of the Lab works following the script that will be provided for its elaboration.
b) Numerical simulation work
The two works performed in the laboratory will be reproduced numerically. With the 1D HECRAS model and later with the 2D IBER model.
The sessions will take place in the computer room. The professor will indicate the steps to follow to achieve each goal.
In all sessions the professor will assess the student's participation during it.
Each student must prepare an individual report for each of the practices following the script that will be provided for its elaboration.

The global assessment of the subject will be done following the following weighting:

Final Grade = 0.9 · (Average of the 4 individual reports) +0.10 · (Individual assessment of class participation)

Criteria of qualification and of admission to the re-evaluation: The students suspended in the ordinary evaluation that have presented regularly to the proofs of evaluation of the asignatura suspended will have option to realize a proof of reevaluation in the period fixed in the academic calendar. Students who have already passed it or the students qualified as not presented will not be able to take the re-evaluation test of 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 re-evaluation test, held in the fixed period may not result in another test being held at a later date. Extraordinary evaluations will be performed for those students who due to accredited force majeure have not been able to perform any of the continuous evaluation tests.

BIBLIOGRAPHY

Basic:
- Puertas, Jerónimo ... [et al]. Apuntes de ingeniería hidráulica. A Coruña: Fundación Ingeniería Civil de Galicia, 2016. ISBN 9788461746644.
- Puertas, J.; Sánchez-Juny, M. Hidráulica. Madrid: Colegio de Ingenieros de Caminos, Canales y Puertos, 2001. ISBN 84-380-0206-4.
- 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.
- 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.