Course guide
250404 - INFRAHID - Hydraulic Infrastructure

Last modified: 11/06/2025

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

Degree: MASTER'S DEGREE IN CIVIL ENGINEERING (PROFESSIONAL TRACK) (Syllabus 2012). (Compulsory subject).

Academic year: 2025 **ECTS Credits:** 4.5 **Languages:** Catalan, Spanish, English

LECTURER

Coordinating lecturer: Ferrer Boix, Carles

Others: Gironella I Cobos, Francesc Xavier
Nuñez González, Francisco
Gracia Garcia, Vicente
Ferrer Boix, Carles
Martín Vide, Juan Pedro

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
8230. The ability to plan, dimension, construct and maintain hydraulic works.
8231. The ability to plan, evaluate and regulate the use of surface water and groundwater resources.
8233. Knowledge of and the ability to understand dynamic phenomena of the coastal ocean and atmosphere and respond to problems encountered in port and coastal areas, including the environmental impact of coastal interventions. The ability to analyse and plan maritime works.

Transversal:
8562. EFFECTIVE USE OF INFORMATION RESOURCES: Managing the acquisition, structuring, analysis and display of data and information in the chosen area of specialisation and critically assessing the results obtained.

8563. FOREIGN LANGUAGE: Achieving a level of spoken and written proficiency in a foreign language, preferably English, that meets the needs of the profession and the labour market.

TEACHING METHODOLOGY

The course consists of 3 hours per week that are dedicated to lectures where the professor explains the concepts and basic materials of the matter and practical and laboratory lessons with examples and exercises. The first forth month period, the lectures will be teaching mostly in Catalan. The second forth month period, the lectures will be teaching in Spanish or English.

LEARNING OBJECTIVES OF THE SUBJECT

Students will learn to design and dimension hydraulic works and installations and hydroelectric installations and to plan and manage surface and underground hydraulic resources. Basic knowledge of maritime engineering as well as capacity for the contrucción and conservation of maritime works.
Upon completion of the course, students will be able to:
Analyse fluvial sediment transport, flooding and different concepts of restoration;
Conduct a hydraulic power analysis of a hydroelectric installation;
Plan hydraulic works.Realize a project of a hydraulic work. Realize a study of surge from royal measures proceeding from a buoy. To realize the project of a port including basic elements. To do a study of dynamics of coasts, including the interaction between port - coast.
Open channel flow and pressurised flow; Aspects of river engineering, including morphology, sediment transport and flooding; Environmental aspects of floodplains and river restoration; Hydroelectric installations; Dams, canals, pressurised pipes and pump systems; Hydraulic studies of water treatment infrastructure; Water hammer and mass oscillation. Wave motion. Sediment transport and dispersion. Crown wall. Overtopping. Introduction to probabilistic design.

STUDY LOAD

Type	Hours	Percentage
Self study	72,0	63.94
Hours medium group	9,8	8.70
Hours small group	9,8	8.70
Hours large group	21,0	18.65

Total learning time: 112.6 h

CONTENTS

HYDRAULIC ENGINEERING

Description:
Rivers:
Comparison between rivers and canals. Fluvial morphology: planform and cross-section. Dominant discharge and the balance analogy. Initiation of motion, sediment transport: classification, measurement, and calculation. Mesoforms. Grain size distribution of alluvial beds. River training works: effects and design criteria. Floods: levees. Bank protection. River restoration. Materials in fluvial engineering. Bridge hydraulics.
Hydroelectric dams:
Power and energy. Classification of hydroelectric dams from a functional point of view: dams with regulation, run-of-river dams. Classification of hydroelectric dams from the point of view of their conduits: dams with diversion channels, dams with all pressurized conduits, reversible dams. Hydraulic operating schemes, losses. Turbines, efficiencies.
Dams:
Classification of dams according to material: embankment dams, concrete dams. Classification of dams according to structural behavior: gravity dams, arch and arch-gravity dams. Stability calculation of dams. Cutoffs, drains.

Specific objectives:
Establish the differences with the channels. Understanding the nature of rivers in plan and section. Understanding what determines the river forms and why.
Knowledge to design and introduce the study of locks
Show students the knowledge and criteria for designing and calculating hydraulic infrastructure for energy generation.

Full-or-part-time: 57h 35m
Theory classes: 17h
Practical classes: 7h
Self study : 33h 35m

Maritime Engineering

Description:
Extension for the design of seawalls with the presentation of more formulations and their applicability to the calculation of sections of seawalls. New types of dikes.
Practical application to real cases of seawalls in port works.
Working with students to apply a spreadsheet (excel) formulations for the design of seawalls.
Description of Levels I, II and III. Comparison with deterministic design. Concepts of modes of breakdown and breakdown of equations.
Practical application to real cases of seawalls in port works.
Working with students to apply a spreadsheet (excel) Levels I, II and III of probabilistic design in a seawall.

Specific objectives:
To intensify the acknowledgement of students in the design of seawalls port.
Helping students to understand the issue and applicability of the theory.
Understand the foundations of probabilistic design concepts applied to maritime engineering.
Helping students to understand the issue and applicability of the theory.

Full-or-part-time: 34h 48m
Theory classes: 4h
Practical classes: 3h 30m
Laboratory classes: 7h
Self study : 20h 18m

EXAM

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

GRADING SYSTEM

The course will be assessed through two exams corresponding to the hydraulics syllabus and one exam of the maritime syllabus. Each exam consists of a theoretical part and a problem-solving part. The final grade for the course is the weighted average of the exams (2/3 from Hydraulics and 1/3 from Maritime).

BIBLIOGRAPHY

Basic:
- Martin Vide, J.P. Ingeniería de ríos. 2a ed. Barcelona: Edicions UPC, 2006. ISBN 9788483019009.
- Vallarino, E. Tratado básico de presas. 6a ed. corr. i ampl. Madrid: Colegio de Ingenieros de Caminos, Canales y Puertos, 2006. ISBN 8438003141.
- Vallarino, E. Obras hidráulicas. Madrid: Escuela Técnica Superior de Ingenieros de Caminos, Canales y Puertos, 1980. ISBN 8460064611.
- Negro, V [et al.]. Diseño de diques verticales. 2a ed. Madrid: Colegio de Ingenieros de Caminos, Canales y Puertos., 2008. ISBN 9788438003749.
- Negro, V.; Varela O. Diseño de diques rompeolas. 2a ed. Madrid: Colegio de Ingenieros de Caminos, Canales y Puertos., 2008. ISBN 9788438004029.

Complementary:
- Puertos del Estado. ROM 0.0: procedimiento general y bases de cálculo en el proyecto de obras marítimas y portuarias: parte I [on line]. Salamanca: Puertos del Estado, 2001 [Consultation: 30/05/2012]. Available on: http://www.puertos.es/programa_rom/ROM_00_espa.html. ISBN 8488975309.
- Morang, A. [et al.]. Coastal engineering manual [on line]. Washington: US Army Corps of Engineers, 2003 [Consultation:

02/02/2021]. Available on: http://www.a-jacks.com/Coastal/GeneralInfo/CEM/CEM.aspx.