Last update: 04-12-2018

250142 - OBRHID - Hydraulic Constructions

Coordinating unit: 250 - ETSECCPB - Barcelona School of Civil Engineering

Teaching unit: 751 - DECA - Department of Civil and Environmental Engineering

Academic year: 2018

Degree: BACHELOR'S DEGREE IN CIVIL ENGINEERING (Syllabus 2010). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN CIVIL ENGINEERING (Syllabus 2017). (Teaching unit Compulsory)

ECTS credits: 4,5 Teaching languages: Catalan

Teaching staff

Coordinator: JUAN PEDRO MARTÍN VIDE

Others: MARC BERENGUER FERRER, JOSE MIGUEL DIEGUEZ GARCIA, CARLES FERRER BOIX, JUAN PEDRO MARTÍN VIDE

Opening hours

Timetable: Every Tuesday from 15 to 15.50.(prof. Juan P. Martín Vide)

Degree competences to which the subject contributes

Specific:

3033. Knowledge of hydrostatics and fluid mechanics and dynamics, and their application to hydraulics and hydrology. Knowledge of the concepts and technical aspects of both pressure and free surface conduction systems.

3034. Students will acquire knowledge of hydrostatics and fluid mechanics and dynamics and the ability to design and dimension hydraulic works and plan and manage hydraulic resources.

3061. Knowledge of and ability to design and dimension hydraulic works and facilities, energy systems and the harnessing of hydroelectric energy, and plan and manage surface and underground hydraulic resources.

Generical:

3104. Students will learn to identify, formulate and solve a range of engineering problems. They will be expected to show initiative in interpreting and solving specific civil engineering problems and to demonstrate creativity and decision-making skills. Finally, students will develop creative and systematic strategies for analysing and solving problems.

3106. Students will learn to assess the complexity of the problems examined in the different subject areas, identify the key elements of the problem statement, and select the appropriate strategy for solving it. Once they have chosen a strategy, they will apply it and, if the desired solution is not reached, determine whether modifications are required. Students will use a range of methods and tools to determine whether their solution is correct or, at the very least, appropriate to the problem in question. More generally, students will be encouraged to consider the importance of creativity in science and technology.

3107. Students will learn to identify, model and analyse problems from open situations, consider alternative strategies for solving them, select the most appropriate solution on the basis of reasoned criteria, and consider a range of methods for validating their results. More generally, students will learn to work confidently with complex systems and to identify the interactions between their components.

3110. Students will learn to plan, design, manage and maintain systems suitable for use in civil engineering. They will develop a systematic approach to the complete life-cycle of a civil engineering infrastructure, system or service, which includes drafting and finalising project plans, identifying the basic materials and technologies required, making decisions, managing the different project activities, performing measurements, calculations and assessments, ensuring compliance with specifications, regulations and compulsory standards, evaluating the social and environmental impact of the processes and techniques used, and conducting economic analyses of human and material resources.

3112. Students will develop an understanding of the different functions of engineering, the processes involved in the life-cycle of a construction project, process or service, and the importance of systematising the design process. They

250142 - OBRHID - Hydraulic Constructions

will learn to identify and interpret the stages in preparing a product design specification (PDS), draft and optimise specifications and planning documents, and apply a systematic design process to the implementation and operation phases. Students will learn to write progress reports for a design process, use a range of project management tools and prepare final reports, and will be expected to show an awareness of the basic economic concepts associated with the product, process or service in question.
3113. Students will learn to identify user requirements, to draft definitions and specifications of the product, process or service in question, including a product design specification (PDS) document, and to follow industry-standard design management models. Students will be expected to show advanced knowledge of the steps involved in the design, execution and operation phases and to use the knowledge and tools covered in each subject area to the design and execution of their own projects. Finally, students will assess the impact of national, European and international legislation applicable to engineering projects.

Transversal:

585. ENTREPRENEURSHIP AND INNOVATION - Level 1. Showing enterprise, acquiring basic knowledge about organizations and becoming familiar with the tools and techniques for generating ideas and managing organizations that make it possible to solve known problems and create opportunities.
586. ENTREPRENEURSHIP AND INNOVATION - Level 2. Taking initiatives that give rise to opportunities and to new products and solutions, doing so with a vision of process implementation and market understanding, and involving others in projects that have to be carried out.
589. SUSTAINABILITY AND SOCIAL COMMITMENT - Level 2. Applying sustainability criteria and professional codes of conduct in the design and assessment of technological solutions.
594. TEAMWORK - Level 3. Managing and making work groups effective. Resolving possible conflicts, valuing working with others, assessing the effectiveness of a team and presenting the final results.
584. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.

Teaching methodology

The course consists of 3 hours per week of classroom activity, which are devoted to theoretical lectures, in which the teacher presents the basic concepts and topics of the subject and practical lectures in which the teacher shows examples and solves exercises.

Learning objectives of the subject

Students will acquire the knowledge and skills to plan and design hydraulic works and facilities, energy systems and hydroelectric power plants, and to plan and manage surface and groundwater resources.

Upon completion of the course, students will have acquired the ability to: 1. Plan a basic irrigation infrastructure. 2. Analyse river behaviour in terms of flooding, transport of solids, and restoration. 3. Carry out an energy and hydraulic study of a hydroelectric power plant. 4. Design a dam, taking into account both structural and technological considerations.

Open channel flow systems such as irrigation canals and sanitary sewers; River engineering, including river morphology and transport of solids, the study of flooding and flood-protection measures, and riverbank protection; Environmental aspects of river areas and river restoration; Erosion and scour; Bridge hydraulics; Hydroelectric power plants; Hydrological, hydraulic and production-related analysis of a river elevation drop; Reversible turbines and mini-hydroelectric plants; Water hammer and mass oscillation; Classification of dams; Stability analysis; Selecting a type of dam considering the geological determining factors; Spillways, floodgates and valves; Gravity dams, earth-fill dams, rock-fill dams, arch dams and buttress dams

Last update: 04-12-2018

250142 - OBRHID - Hydraulic Constructions

Study load

Total learning time: 112h 30m	Hours large group:	28h 30m	25.33%
	Hours medium group:	11h 30m	10.22%
	Hours small group:	5h	4.44%
	Guided activities:	4h 30m	4.00%
	Self study:	63h	56.00%

Last update: 04-12-2018

250142 - OBRHID - Hydraulic Constructions

Content

Canals

Learning time: 10h 48m

Theory classes: 3h 30m
Laboratory classes: 1h
Self study : 6h 18m

Description:
Comparison between rivers and canals
Irrigation systems. Irrigation canals and ditches.
Irrigation channels. Diversion network.

Specific objectives:
To establish the differences with the channels, which are the students' prior knowledge.

Last update: 04-12-2018

250142 - OBRHID - Hydraulic Constructions

River Engineering	Learning time: 58h 48m Theory classes: 15h Practical classes: 7h 30m Laboratory classes: 2h Self study : 34h 18m

Description:

Planform of rivers. Braided and meandering rivers. Hydraulic geometry of planforms and cross sections.
Exploration of the dominant discharge of a river. Equilibrium analysis using the Lane's analogy. Understanding of the river bathymetry using the Fargue's laws.
Application of knowledge of river morphology to a qualitative issue.
Grain size distribution, concepts of threshold and Shields diagram. Classification of sediment transport.
Measurements of sediment transport. Bedforms in sand and gravelbed rivers. Empirical equations of bedload and Exner equation. Profile of suspended sediment concentration.
Apply the knowledge of transport solid.
Definition of river training, objectives and effects. Perched rivers.
Criteria to design a environmentally acceptable river training. Sinuosity and cutoffs. Criteria for main channel and floodway.
Application of knowledge on river training.
Concepts about flooding. Non-structural measures. Risk. Height of levees. Legislation of flood areas. Floodway determination. Effects of levees.
Methods of river bank protection. Special features of torrential rivers and types of works in them. River restoration.
An exercise on flloding an another on bank protection.
Computation of shear stresses at the bed and banks. Flow capacity as a function of grain size and vegetation. Compound sections. Scouring assessment.
Causes of failure of bridges. Hydraulic design. Hydraulic effects. Scouring, pathology and evaluation. Countermeasures.
Calculation of scour and afflux of bridges.
Rip-rap. Gavions. Earth materials for levees. Vegetation as a material.

Specific objectives:

Understanding the nature of the rivers in planform and cross section
Understanding what determines the river forms and why.
Exercise
Reminder about the grain size distribution. Understanding the phenomenon of the initiation of movement.
Understanding the nature of sediment transport.
Ability to calculate partial and total solid transport.
Exercise
Understanding the effects of river training. Understanding when it is correct. Ability to draw the planform of a river training.
Exercise of implementation in river training: drawing a plant or setting of a cross section.
Understanding and capacity of computation..
Understanding phenomena (bank erosion and torrential flows). Understanding the kind of engineering in torrential rivers and for restoration.
Exercise
Ability to calculate, or at least assess approximately the most important variables in river engineering.
Understand and know how to evaluate the hydraulic and scour issues of the bridges.
Application of the previous sessions.
Understanding the utility and applicability of different materials.

Last update: 04-12-2018

250142 - OBRHID - Hydraulic Constructions

Dams

Learning time: 16h 48m

Theory classes: 6h
Practical classes: 1h
Self study : 9h 48m

Description:
Purpose and goals of the dams. Technical and environmental implications.
Gravity dams, earth and rock dams and arch dams. Reasons for each type of dam.
Hydrostatic force, weight, underpressure and other actions. Stability against sliding and overturning. Tensions.
Means to improve stability. Drainage.
Spillways. Types and Characteristics. Design Flood.
Management of Dams. Exploitation of ordinary and extraordinary situations (floods). Droughts. Dam safety.
Problems on stability and strength of dams

Specific objectives:
Introduction to the study of the dams

Hydropower plants

Learning time: 21h 36m

Theory classes: 5h
Practical classes: 2h
Laboratory classes: 2h
Self study : 12h 36m

Description:
Comparison with other forms of energy generation
Hydropower dams, with diversion channels (run-of-the-river) and with all the pipes under pressure.
Intakes, diversion channels, forebays, penstocks, surge tanks, powerhouses ...
Hydraulic design criteria. Hydraulic calculation of pipelines and mechanical calculation (appurtenances).
Problems

Last update: 04-12-2018

250142 - OBRHID - Hydraulic Constructions

Qualification system

The mark of the course is obtained from the ratings of

4 practical exercises, which are compulsory, distributed along the course (1 exercise per every 3 weeks in average): T1... T4.

1 optional examination at the end of the course: E

The final mark is the arithmetic mean of (T1 + T2 + T3 + T4 + T5)/5 on one hand with a weight of 50% plus the mark of E with a weight of 50%.

Criteria for re-evaluation qualification and eligibility: Students that failed the ordinary evaluation and have regularly attended all evaluation tests will have the opportunity of carrying out a re-evaluation test during the period specified in the academic calendar. Students who have already passed the test or were qualified as non-attending will not be admitted to the re-evaluation test. The maximum mark for the re-evaluation exam will be five over ten (5.0). The non-attendance of a student to the re-evaluation test, in the date specified will not grant access to further re-evaluation tests. Students unable to attend any of the continuous assessment tests due to certifiable force majeure will be ensured extraordinary evaluation periods.

These tests must be authorized by the corresponding Head of Studies, at the request of the professor responsible for the course, and will be carried out within the corresponding academic period.

Regulations for carrying out activities

Failure to perform a continuous assessment (exercises) in the scheduled period will result in a mark of zero. To be entitled to re-evaluation, it is necessary to have done all excercises of the continuous assessment.

Bibliography

Basic:

Martín 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.

Complementary:

Novak, P ... [et al.]. Hydraulic structures. 4th ed. London: Unwin Hyman, 2007. ISBN 9780415386265.

Garcia, M. Sedimentation engineering : processes, measurements, modeling and practice [on line]. ASCE, 2007 [Consultation: 03/04/2019]. Available on: <https://ebookcentral.proquest.com/lib/upcatalunya-ebooks/detail.action?docID=3115359>. ISBN 9780784471289.

Cardoso, A.H. Hidráulica fluvial. Lisboa: Fundaçao Calouste Gulbenkian, 1998.

López Alonso, R.. Problemas resueltos de ingeniería hidráulica forestal. Lleida: Universitat de Lleida, 2004. ISBN 8484099423.

Calvo Gabás, R. Obras hidráulicas : ejercicios resueltos. Madrid: Revista de Obras Públicas, 1983. ISBN 8474930685.