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250130 - HIDHID - Hydraulics and Hydrology

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: 9 Teaching languages: Catalan, Spanish

Teaching staff

Coordinator: ERNEST BLADE CASTELLET, JOSE DOLZ RIPOLLES

Others: ERNEST BLADE CASTELLET, JOSE DOLZ RIPOLLES, MARIA SOLEDAD ESTRELLA TORAL, MARTI SANCHEZ JUNY

Opening hours

Timetable: Tuesday and Thursday from 12 to 13:30 h.
Also in hours to be arranged.

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.

Transversal:

592. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 2. Using strategies for preparing and giving oral presentations. Writing texts and documents whose content is coherent, well structured and free of spelling and grammatical errors.

596. TEAMWORK - Level 1. Working in a team and making positive contributions once the aims and group and individual responsibilities have been defined. Reaching joint decisions on the strategy to be followed.

599. EFFECTIVE USE OF INFORMATION RESOURCES - Level 3. Planning and using the information necessary for an academic assignment (a final thesis, for example) based on a critical appraisal of the information resources used.

602. SELF-DIRECTED LEARNING - Level 3. Applying the knowledge gained in completing a task according to its relevance and importance. Deciding how to carry out a task, the amount of time to be devoted to it and the most suitable information sources.

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.

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Teaching methodology

The course consists of 3 hours per week of classroom activity (large size group) and 2 hours weekly with half the students (medium size group).

The 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 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.

Learning objectives of the subject

Students will acquire knowledge of concepts and technical aspects related to both pressurised and open channel flow systems. They will also learn to solve hydraulic engineering problems.

Upon completion of the course, students will have acquired the ability to: 1. Apply equations of fluid motion to engineering cases related to pressurised or open channel flow systems. 2. Solve problems related to pipe networks, including support elements such as fittings and valves. 3. Analyse open channel water flow in basic geometries or conditions.

History of hydraulic works; Characteristics of fluids: compressibility, viscosity, phase transitions and surface tension; Fluid statics; Equations of fluid motion and their application to ducted flow; Continuity, momentum and Bernoulli's trinomial; Turbulent motion and the Reynolds number; Permanent and variable flow in pipes, including the conservation of energy and pressure-drop analysis, as well as pumping systems; Permanent and variable flow in open channel flow systems and its application to the functioning of channels; Erodible channels; Dimensional analysis; Similarity law; Models; Basic concepts of surface hydrology; Basic concepts of aerodynamics

Knowledge of the concepts and technical aspects related to piping systems in both pressure and free sheet. Ability to solve hydraulic problems in engineering. At the end of the course, the student will have acquired the ability to: 1. Apply the fluid movement equations to engineering cases related to pressurized and free-flowing films. 2. Solve pipe network problems including auxiliary elements such as elbows and valves. 3. Ability to analyze the flow of water in open channels in geometries or basic conditions. History of hydraulic works. Understand the characteristics of fluids: comprehensibility, viscosity, phase change and surface tension. Static of liquids. Knowledge of the fluid movement equations to apply them to flow in ducts. Continuity, amount of movement, trinomy of Bernoulli. Turbulent movement and Reynolds name. Knowledge of the permanent and variable movement in pipes, including the conservation of energy and the analysis of load losses, as well as pumping systems. Knowledge of the permanent and variable movement in a free sheet and application to the operation of channels. Eroded plots. Dimensional analysis Laws of similarity. Models. Basic knowledge of surface hydrology.

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Study load

Total learning time: 225h	Theory classes:	42h	18.67%
	Practical classes:	34h	15.11%
	Laboratory classes:	14h	6.22%
	Guided activities:	9h	4.00%
	Self study:	126h	56.00%

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Content

I. Introduction to the subject

Learning time: 12h

Theory classes: 2h
Practical classes: 2h
Laboratory classes: 1h
Self study : 7h

Description:
Course objectives. Relationship with other subjects.
Fluid concept. Fluid as continuum. Mass and weight. Elasticity. Viscosity. Vapor pressure. Cavitation. Surface tension, capillarity.

Solving practical exercises previously proposed to students

II. Hydrostatic

Learning time: 19h 12m

Theory classes: 4h
Practical classes: 4h
Self study : 11h 12m

Description:
General equation. Statics of liquids under gravitational field. Push on flat walls. Push on curved walls. Equilibrium of a fully submerged solid. Uplift. Equilibrium of a solid partially submerged. Relative equilibrium.
Solving practical exercises previously proposed to students

III. Concepts and fundamental equations of fluid motion

Learning time: 16h 48m

Theory classes: 4h
Practical classes: 2h
Laboratory classes: 1h
Self study : 9h 48m

Description:
Perfect fluids and real fluids. Flow around contours. Boundary layer: separation.
Description of the movement. Variations of a property: local variation and material. Continuity equation applied to a flow tube. Flow equation of momentum: application to a flow tube. Bernoulli trinomial average values: variations along flow. Experience of Reynolds tube and number. Turbulent motion in ducts.
Resolution of previously proposed practical exercises to students.

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IV. Steady flow in pipes	Learning time: 26h 24m Theory classes: 6h Practical classes: 5h Self study : 15h 24m

Description:
Steady and variable flow. Basic concepts and equations of steady flow: continuity and energy conservation equations. Energy line: piezometric head. Energy losses. Moody Abacus: discussion and analysis of the influence of turbulence.
Schematic description of a turbomachine. Characteristic curve. Pumps in series and in parallel. NPSH. Elements of a impulsion. Measures of pressure, velocity and flow rate.
Resolution of previously proposed practical exercises to students.

Exam 1	Learning time: 7h 11m Laboratory classes: 3h Self study : 4h 11m

V. Steady free surface flow	Learning time: 74h 24m Theory classes: 16h Practical classes: 13h Laboratory classes: 2h Self study : 43h 24m

Description:
Pressure distribution. Types of movement. Steady and variable motion. Equations of continuity and conservation of energy. Energy losses. Uniform motion.
Uniform flow
Resolution of previously proposed practical exercises to students.
Backwater curves: classification, boundary conditions and integration.
Solving practical exercises previously proposed to students
Transitions.Outlets and spillways. Gauges. Channel design.
Solving practical exercises previously proposed to students
Analysis of a flow event by means of HECRAS model
General concepts. Threshold of movement: critical stress, Shields curve. Bedload. Suspension transport. Riverbed morphology (qualitative description). Local scour.

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VI. Introduction to physical models	Learning time: 7h 11m Theory classes: 3h Self study : 4h 11m

Description:
Numerical and physical models. Hydraulic and mechanical similarities. Froude similarity. Scale effects in the study of hydraulic structures in free surface flow

VII. Introduction to surface hydrology	Learning time: 24h Theory classes: 6h Practical classes: 2h Laboratory classes: 2h Self study : 14h

Description:
The hydrological cycle. Global water balance. Water vapour in the atmosphere. Creation of the precipitation. Rainfall data. Return periods. Extreme values of precipitation. Temporal and spatial description of the rainfall. Duration-frequency-intensity curve.
Physical description of a basin: river system. Surface runoff. Concentration time. Curve area / time. Hydrogram analysis. The rational method. Runoff coefficient and threshold runoff.
Introduction to the analysis of the spatial and temporal evolution of floods
Practical exercises

Exam 2	Learning time: 4h 48m Laboratory classes: 2h Self study : 2h 48m

Directed activities	Learning time: 24h Practical classes: 10h Self study : 14h

Description:
Direction directed activities

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Qualification system

Approved if:

0,06 (T1+T2+T3+T4+P)+0,2E1+0,2E2+0,3MG is equal or higher than 5
where:

- T1 is the qualification of test 1 (basic concepts and item I)
- T2 is the qualification of test 2 (items II and III)
- T3 is the qualification of test 3 (first part of item IV)
- T4 is the qualification of test 4 (HECRAS theory)
- E1 is the qualification of exam 1 (items I, II, III and IV)
- E2 is the qualification of exam 2 (items V, VI and VII)
- P is the qualification of the practical exercise of flow in canals
- MG is the geometric mean of E1 and E2

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 laboratory or continuous assessment activity in the scheduled period will result in a mark of zero in that activity.

Bibliography

Basic:

Nanía, Leonardo S.; Gómez Valentín, Manuel. Ingeniería hidrológica. 2a ed. [Granada]: Grupo Editorial Universitario, 2006. ISBN 8484916367.

Puertas, Jerónimo ... [et al]. Apuntes de ingeniería hidráulica. A Coruña: Fundación Ingeniería Civil de Galicia, 2016. ISBN 9788461746644.

Gutiérrez, C. Apuntes de Hidráulica. Barcelona: Atenea, 2017?.