ISEL
INSTITUTO SUPERIOR DE ENGENHARIA DE LISBOA

DEC
ÁREA DEPARTAMENTAL DE ENGENHARIA CIVIL

Course file

Study cycle	BACHELOR IN CIVIL ENGINEERING		
Course	HYDRAULICS II	Mandatory	☒
		Optional	☐
Course scientific area	CIVIL ENGINEERING	Category	C

Course category: B - Basic; C - Core Engineering; E - Specialization; P - Complementary.

Year: 2nd	Semester: 4th		ECTS: 5,5		Total: 149
Contact time	T:	TP: 67,5	PL:	S:	OT:

T - Lectures; TP - Theory and practice; PL - Lab Work; S - Seminar; OT - Tutorial Guidance.

Course Director	Title	Position
Luís Carlos Pais Vaz Tecedeiro	Licenciado	Professor Adjunto

Learning objectives (knowledge, skills and competences to be developed by students)

(max. 1000 characters)

1 To recognise and characterise a) different types of open channel flows; b) flow through orifices and weirs; c) ground water flows
2 Open-channel hydraulics calculations (steady uniform and non-uniform flows) in open and closed sections
2.1 Designing channel sections – uniform flow depth and critical depth in geometrically simple sections, geometrically composite sections and sections with variable roughness
2.2 Hydraulic profile calculations of steady non uniform flow with constant discharge
2.3 Hydraulic jump calculations (upstream and downstream flow depths, energy loss and length of the roller)
3 Discharge through orifices calculations
4 To recognise the various fluid measurement methods
5 Calculation of the groundwater flow-level drawdown relations
6 Describe the different hydraulic machines (pumps and turbines) and characterize their working conditions
6.1 Determination of the operating point of a) a pump; b) parallel-series pump association
6.2 NPSH determination

Syllabus

(max. 1000 characters)

1. Open-Channel Hydraulics: Uniform flow (Geometrically simple sections. Geometrically composite sections. Sections with variable roughness. Closed sections.). Critical, supercritical and subcritical flow. Steady non uniform flow: (Hydraulic profile - constant discharge.). Hydraulic jump.
2. Discharge Through Orifices (Thin-plate orifices. Broad-plate orifices. Submerged orifices. Large orifices.) and Weirs (Sharp-crested weirs. Broad-crested weirs.). Fluid Measurement: Orifices. Weirs.

3. Fluid measurement (level, pressure, velocity and discharge measurement.).
4. Ground Water Hydraulics: Darcy's equation. Determination of the permeability. Radial and one-direction flows (Galleries and trenches. Water-table wells. Artesian wells.).
5. Hydraulic Machines. Pumps and turbines. Power curves and characteristic curves. Pump Association. Cavitation and NPSH.

Demonstration of the consistency between the syllabus and the course objectives

(max. 1000 characters)

Relation between Syllabus and Learning Objectives:
Learning Objective #1 attained with Syllabus #1;
Learning Objective #2 attained with Syllabus #1;
Learning Objective #2.1 attained with Syllabus #1;
Learning Objective #2.2 attained with Syllabus #1;
Learning Objective #2.3 attained with Syllabus #1;
Learning Objective #3 attained with Syllabus #2;
Learning Objective #4 attained with Syllabus #3;
Learning Objective #5 attained with do Syllabus #4;
Learning Objective #6 attained with do Syllabus #5;
Learning Objective #6.1 attained with do Syllabus #5;
Learning Objective #6.2 attained with do Syllabus #5.

Teaching methodology (evaluation included)

(max. 1000 characters)

1 Theoretical and practical lessons, with the exposition of the syllabus matters, completed with the presentation of examples, questions and practical cases to be answered and solved by the students
2 Laboratorial assignments:
A Open-channel flow
-Uniform depth
-Manning coefficient
-Flow and channel roughness
-Using the Chézy formula
-Cross section design
-Flow rate – uniform depth relation
-Flow through a sluice gate
-Supercritical and subcritical flow
-Hydraulic jump
B Weirs
-Sharp-crested weirs, rectangular and V-shaped
-Circular
- Bazin weir
-Broad-crested weirs
C Flow rate measurement- Venturi flume

D Characteristic curves and work conditions of
-a centrífugal pump
-paralell-series pump association
3 Assessment
-Laboratorial assessment, including writen report - 10% of the final grade.
-Final examination (graded over 50%) or two mid-term tests (each one graded over 40%) - 90% of the final grade.

Demonstration of the consistency between teaching methodology and the course learning objectives

(max. 3000 characters)

The teoretical lessons, supported by the presentation of slides (later made available to students via the Internet), allows the transmission to the students of the theoretical information of the syllabus. Points 1, 4 and 6 of the learning objectives are attained this way and evaluated in the mid-term tests or final examination.

In addition, case studies and problems resolution in theoretical and TP lessons reinforce the theoretical information transmitted. Thus, the remaining points 2, 2.1, 2.2, 2.3, 3, 6.1 and 6.2 of the learning objectives will be attained this way and also evaluated in the mid-term tests or at the final examination.

The whole learning process is subject to ongoing qualitative assessment throughout the semester by means of questions and problems posed to students, and a quantitative assessment in the two mid-term tests and at the written examination.

The practical laboratory work to be undertaken by students covers a large part of the syllabus, allowing students to consolidate their learning process, observing the hydraulic phenomena and, without the teacher's presence, gaining experimentation skills. Their final reports are graded and constitute a percentage (10%) of the final grade.

Main Bibliography

(max. 1000 characters)

CHANSON, Hubert - The Hydraulics of Open Channel Flow: An Introduction. Oxford: Elsevier, 2004. ISBN 0-7506-5978-5
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ISI IMPIANTI - Manual de Trabalhos Práticos Laboratoriais. Génova: Isi Impianti, 1980.
LENCASTRE, Armando - Hidráulica Geral. Lisboa : ed. do autor, 1996. ISBN 972-95-8590-3
NELIK, Lev - Centrifugal and Rotary Pumps: Fundamentals with Applications. Boca Raton : CRC Press, 1999. ISBN 0-849-30701-5
QUINTELA, António de Carvalho – Hidráulica. Lisboa : Fundação Calouste Gulbenkian, 2000. ISBN 972-31-0775-9

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