28921 - Hydraulics

Información del Plan Docente

Academic Year	2016/17
Academic center	201 - Escuela Politécnica Superior
Degree	437 - Degree in Rural and Agri-Food Engineering
ECTS	6.0
Course	3
Period	First semester
Subject Type	Compulsory
Module	---

1.Basic info

1.1.Recommendations to take this course

You are strongly recommended to have acquired the Fluid Mechanics skills taught in Physics I, and all the skills in Mathematics I and Mathematics II.

Students who want to pass the subject with continuous assessment must spend an estimated six hours a week on coursework and personal study over the term, as well as attending scheduled classroom sessions (theory, problems, laboratory work, computer work, etc.).

In all cases, attending classroom activities is strongly recommended.

1.2.Activities and key dates for the course

The subject content is divided into two major blocks: free surface flow and pressurised flow. When each block is completed there will be a continuous assessment test. That means that about halfway through the term there will be an assessment test on free surface flow, and at the end of the course there will be an assessment test on pressurised flow, as shown in more detail in the Assessment section.

Each block will combine different types of classroom-based activities in order to achieve the desired learning results.

2.Initiation

2.1.Learning outcomes that define the subject

Understanding and applying the basic principles of Hydraulics in both free surface flow and pressurised flow.

Designing and analysing basic hydraulic installations, in both free surface flow and pressurised flow.

Basic use of hydraulic simulation software.

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2.2.Introduction

In 1636, Galileo Galilei wrote in his work *Two New Sciences* : "it is easier to study the motion of infinitely distant celestial bodies than that of a brook that runs at our feet."

Despite the relative complexity of Hydraulics to which Galileo refers, graduates of agricultural engineering and the rural environment should understand the basic laws and principles governing the movement of water, whether for agricultural irrigation (capture, storage, transport, application, drainage) or for applications relating to the agro-food industry.

Until quite recently the study of the behaviour of liquids (Hydraulics) was empirical, based on trial and error and on the cultural transmission of practical knowledge from generation to generation.

The development of a scientific understanding of hydraulics began in the 18th century and continues today. Thanks to this discipline, it is now possible to predict "on paper" the behaviour of liquids in general and water in particular, and the evolution of the variables characterising its state (pressure, depth, flow rate, velocity, etc.). So the design, analysis, evaluation and management of irrigation systems and hydraulic installations in agro-food industries now require an understanding of the basic laws governing the movement of water, whether in a free surface flow (canals, irrigation ditches, surface irrigation, etc.) or in a pressurised flow (pipes, sprinklers, drip irrigation, hydraulic installations, etc.).

The behaviour of liquids is complex, but in broad terms, predictable. It obeys fixed laws relating to the principles of physics, and these principles are an essential part of the toolbox for graduates in agricultural engineering and the rural environment. The Hydraulics course is simply designed to help students understand and know how to apply the rules governing the behaviour of liquids in general and water in particular.

3.Context and competences

3.1.Goals

The overall goal of the Hydraulics course is simply to give students a sound foundation in hydraulics, a discipline which is absolutely essential for certain areas of the work of graduates in agricultural engineering and the rural environment.

3.2.Context and meaning of the subject in the degree

This course, which takes place in the first term of the third year of the degree, makes use of what students have learned in Physics I and Mathematics I and II to ensure students have a good understanding of free surface flow hydraulics and pressurised flow hydraulics, which will prepare them for more in-depth studies of irrigation and drainage (in the special subjects of Farming or Horticulture and Gardening) or for designing and managing hydraulic installations (a specialisation in Agro-Food Industries).

3.3.Competences

Knowing, understanding and using the principles of engineering in the rural environment: hydraulics.

Understanding the basis of hydraulics in irrigation and drainage.

Applying in practice the foundations of hydraulics for irrigation and drainage.

Making basic use of hydraulics software for irrigation and drainage.

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Basic management of hydraulic installations.

Applying this knowledge to their work in a professional manner and having skills that can be demonstrated by preparing and defending an argument and resolving problems within their area of study.

Compiling and interpreting relevant information (normally in their area of study) in order to express opinions that include a consideration of relevant social, scientific and ethical subjects.

3.4.Importance of learning outcomes

The planned learning results serve as a foundation for more in-depth studies of irrigation and drainage (in the special subjects of Farming or Horticulture and Gardening) or for designing and managing hydraulic installations (a specialisation in Agro-Food Industries).

In particular, the study of hydraulics must enable graduates to perform their professional work relating to capturing and transporting water, its application to a field or crop (irrigation), and drainage. Also, graduates can use the skills they have acquired to design and manage hydraulic installations in the agro-food industry.

4.Evaluation

This course can be taken in **continuous assessment** mode, basically consisting of two objective assessment tests at the end of each of the two blocks of study (free surface flow and pressurised flow). Both continuous assessment tests consist of a theory and practice test and a second part with written practical exercises.

There will also be **overall tests** corresponding to the two main exam periods of the academic year. An overall test will be in two parts: one relating to the free surface flow block and the other relating to the pressurised flow block. Each of them will consist of a theory and practice test and a second part with written practical exercises.

The content to be evaluated in the assessments will be all the content taught and indicated in all the classroom-based activities in the subject: theory, problems, computer work, laboratory work and special practical work.

Assessment Criteria.

To pass either of the two subject blocks students will need a mark of five points or more in the corresponding assessment test.

To pass the subject they must pass each of the two blocks. In this case the mark will be the average of the marks obtained in each block.

Otherwise the subject will be considered not to have been passed, and the mark will be the average of the marks obtained for each block, unless that value is higher than the pass mark, in which case the mark given will be the lower of the two blocks.

In an overall exam, when students have previously passed the assessment for a single block, they may take the exam for the other block only, always in the same academic year. They can also take an overall exam after passing both blocks in continuous assessment, in order to improve their marks.

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As indicated above, the test for each of the two subject blocks, whether in continuous assessment or the overall exam, will consist of a theory and practice test and a second part with written practical exercises.

The **theory and practice test** will be taken without study material and with a non-programmable calculator, and is a qualifying exam: it must be passed for the written practical exercises to be marked. Wrong answers in the test may lower the mark. The test questions are designed to evaluate the level of understanding of the theoretical and practical content of the subject, not the students' memorising skills.

The **written practical exercise** will consist of a set of practical problems which can be resolved with the study materials the student considers appropriate. When a problem or one of its sections requires a numerical answer, the student must include the working out. A problem or section will be considered to be passed if the value is within a margin of ±5% of the correct result, and the mark will be adjusted according to the clarity of the explanations and the scientific rigour used to obtain the result.

The mark for the block will be that of the theory and practice test if failed, and the the weighted average of the theory and practice test (40%) and the written practical exercises (60%) if passed.

5.Activities and resources

5.1.General methodological presentation

This is a foundational course. The skills acquired in the course will form the basis for later studies relating to irrigation and drainage, or to hydraulics in the agro-food industry.

For this reason, the learning process is based on theoretical content accompanied by written practical exercises, which will serve as a starting point for later, more specific skills: the design and analysis of irrigation systems and hydraulic installations in general.

The learning process is completed by laboratory work with basic hydraulic installations (hydrodynamic channel, valve bank, pump bank), and computer work, where students will familiarise themselves with some of the leading hydraulic simulation software for irrigation and the rural environment (Gestar, HecRas and WinSRFR).

5.2.Learning activities

Lectures on theory and problems (28 classroom hours).

Problem-solving and case studies (15 classroom hours).

Laboratory and computer work (12 classroom hours).

Special practical work (5 classroom hours).

Study (78 non-classroom hours).

Assessment (12 classroom hours).

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5.3.Program

Theory

Block 0. Introduction and preliminary concepts

Block 1. Free surface flow

Hydrostatics.

Steady flow.

Transient flow.

Block 2. Pressurised flow.

Flow in pipes.

Head losses.

Pipes with en-route service.

Hydraulic pumping.

Water hammer.

Practical Work

Block 1. Free surface flow.

Practical work with HecRas.

Practical work with WinSRFR.

Practical work with hydrodynamic channels.

Block 2. Pressurised flow.

Practical work with Gestar.

Practical work with valve banks.

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Practical work with pumps.

5.4.Planning and scheduling

The following table shows the suggested weekly organisation *for this subject. B1 means Block 1 (free surface flow) and* B2 means Block 2 (pressurised flow). You will see that in the middle of the term there is an assessment test for block 1, and at the end of the term, an assessment test for block 2.

The last column shows the total hours students should spend on each activity.

Please note: this outline is subject to changes, which will be announced in a timely manner.

5.5.Bibliography and recomended resources

Basic bibliography:

- Losada Villasante, Alberto. El riego : fundamentos hidráulicos / A. Losada Villasante . 4ª ed. corr. Madrid [etc.] : Mundi-Prensa, 2009

Complementary bibliography:

- Arviza Valverde, Jaime. Ingeniería rural : hidráulica / Jaime Arviza Valverde, Cristina Santamarina Siurana . Valencia : Universidad Politécnica, Servicio de Publicaciones, D.L.1995
- Paco López-Sánchez, José Luis de. Fundamentos del cálculo hidraúlico en los sistemas de riego y drenaje / José Luis de Paco López-Sánchez . Madrid : Mundi-Prensa : MAPA-IRYDA, D.L. 1993
- Problemas de hidráulica para riegos / José Roldán ... [et al.] . 2ª ed. corr. Córdoba : Servicio de Publicaciones de la Universidad de Córdoba, D.L. 2004
- Arviza Valverde, Jaime. Problemas de hidráulica / Jaime Arviza Valverde, Iban Balbestre Peralta . Valencia : Editorial de la UPV, D. L. 2008