



# UNIVERSIDAD DE CASTILLA - LA MANCHA

## GUÍA DOCENTE

### 1. General information

**Course:** HYDRAULIC ENGINEERING

**Type:** CORE COURSE

**Degree:** 345 - UNDERGRADUATE DEGREE PROGRAMME IN CIVIL ENGINEERING

**Center:** 603 - E.T.S. CIVIL ENGINEERS OF CR

**Year:** 2

**Main language:** Spanish

**Use of additional languages:**

**Web site:**

**Code:** 38315

**ECTS credits:** 6

**Academic year:** 2023-24

**Group(s):** 20

**Duration:** C2

**Second language:**

**English Friendly:** Y

**Bilingual:** N

| Lecturer: <b>M<sup>a</sup> DEL CARMEN CASTILLO SANCHEZ</b> - Group(s): 20 |                                      |              |                              |   |
|---|--------------------------------------|--------------|------------------------------|---|
| Building/Office   | Department                           | Phone number | Email                        | Office hours  |
| A-44  | INGENIERÍA CIVIL Y DE LA EDIFICACIÓN | 926052560    | mariacarmen.castillo@uclm.es | These hours are not final: Monday: from 15:00 to 17:00<br>Tuesday: from 12:30 to 14:30 Wednesday: from 12:30 to 14:30     |
| Lecturer: <b>ALVARO GALAN ALGUACIL</b> - Group(s): 20                     |                                      |              |                              |   |
| Building/Office   | Department                           | Phone number | Email                        | Office hours  |
| A43   | INGENIERÍA CIVIL Y DE LA EDIFICACIÓN | 926051927    | alvaro.galan@uclm.es         | Tentative: Wednesday: 08:30 to 10:00 and 16:30-17:30 hours<br>Thursday: 08:30 to 10:00 hours Friday: 12:00 to 14:00 hours |
| Lecturer: <b>JAVIER GONZALEZ PEREZ</b> - Group(s): 20                     |                                      |              |                              |   |
| Building/Office   | Department                           | Phone number | Email                        | Office hours  |
| A38   | INGENIERÍA CIVIL Y DE LA EDIFICACIÓN | 926295422    | javier.gonzalez@uclm.es      | Tentative: Monday from 15:00 to 18:00 hours, Thursday from 15:00 to 18:00 hours   |

### 2. Pre-Requisites

Not established

### 3. Justification in the curriculum, relation to other subjects and to the profession

First subject related to Hydraulic Engineering and Hydrology.

It focusses on Fluid Mechanics and on both Open Channel and Pipes Networks Flow.

### 4. Degree competences achieved in this course

#### Course competences

| Code | Description  |
|------|--|
| CB01 | Prove that they have acquired and understood knowledge in a subject area that derives from general secondary education and is appropriate to a level based on advanced course books, and includes updated and cutting-edge aspects of their field of knowledge.  |
| CE01 | Students can apply their knowledge in the practical solution of civil engineering problems, with capacity for the analysis and definition of the problem, the proposal of alternatives and their critical evaluation, choosing the optimal solution with technical arguments and with capacity of defense against third parties. |
| CE16 | Students have knowledge of the concepts and technical aspects related to pipeline systems, both in pressurized flow and in free surface conditions.  |
| CG01 | Students achieve general knowledge of Information and Communication Technologies (ICT).  |

### 5. Objectives or Learning Outcomes

#### Course learning outcomes

Description

Ability to calculate the hydrostatic thrust on flat and curved surfaces.

Capacity of dimensioning and operation of canals and pressured pipelines under permanent regime conditions, knowing the fundamental equations of governance of the problems and the limitations of the approaches.

Knowledge of the equations that govern non-permanent hydraulic problems.

Knowledge of the fundamental properties of fluids.

### 6. Units / Contents

#### Unit 1: Properties of a fluid

#### Unit 2: Hydrostatics

**Unit 2.1** Pascal Principle

**Unit 2.2** General equations

**Unit 2.3** Hydrostatic forces on flat and curved surfaces

**Unit 2.4** Buoyancy and stability

**Unit 3: Basic concepts and laws in fluid motion****Unit 3.1** Preliminary concepts, flux**Unit 3.2** Fundamental equations**Unit 3.3** Permanent regime: integrated equations**Unit 4: Incompressible flow: general description****Unit 4.1** Perfect fluids**Unit 4.2** Real fluids: hypothesis and equations; dimensional analysis; laminar and turbulent flow**Unit 4.3** Boundary layer**Unit 5: Steady State Pipes Networks Flow****Unit 5.1** Fluids in ducts**Unit 5.2** Head loss**Unit 5.3** Local losses in pipe systems**Unit 5.4** Multiple pipe systems**Unit 5.5** Hydraulic pumps**Unit 6: Steady State Open Chanel Flow****Unit 6.1** Uniform flow**Unit 6.2** Specific energy**Unit 6.3** Gradually varied flow and**Unit 6.4** Aforo de caudal**7. Activities, Units/Modules and Methodology**

| Training Activity   | Methodology                      | Related Competences (only degrees before RD 822/2021) | ECTS  | Hours      | As | Com | Description   |
|---|----------------------------------|---|---|------------|----|-----|---|
| Class Attendance (theory) [ON-SITE]   | Lectures                         | CB01 CE01 CE16  | 1.24  | 31         | N  | -   |   |
| Problem solving and/or case studies [ON-SITE]                               | Problem solving and exercises    | CB01 CE01 CE16  | 0.88  | 22         | Y  | N   | This part cannot be retaken   |
| Laboratory practice or sessions [ON-SITE]                                   | Practical or hands-on activities | CB01 CE01 CE16  | 0.12  | 3          | Y  | Y   | Lab sessions are compulsory and cannot be retaken   |
| Computer room practice [ON-SITE]  | Practical or hands-on activities | CB01 CE01 CE16  | 0.16  | 4          | Y  | Y   | Numerical tests reports can be retaken.   |
| Practicum and practical activities report writing or preparation [OFF-SITE] | Group Work                       | CB01 CE01 CE16  | 0.36  | 9          | Y  | Y   | Reports for laboratory tests are compulsory and must be due on date regardless of any decision about taking (or not) the progress test exam. If the mark is less than 45, it can be retaken once on an oral exam with a maximum grade of 4 over 10 unless plagiarism has been detected. |
| Study and Exam Preparation [OFF-SITE]                                       | Self-study                       | CB01 CE01 CE16  | 3.04  | 76         | N  | -   |   |
| Other off-site activity [OFF-SITE]  | Combination of methods           | CB01 CE01 CE16 CG01                                   | 0.2   | 5          | Y  | N   | Problem solving and/or presentation and/or online activities  |
| Mid-term test [ON-SITE]   | Assessment tests                 | CB01 CE01 CE16  | 0   | 0          | Y  | Y   | Partial and final exams will take place outside of class hours  |
| <b>Total:</b>   |                                  |   | <b>6</b>                                    | <b>150</b> |    |     |   |
| <b>Total credits of in-class work: 2.4</b>                                  |                                  |   | <b>Total class time hours: 60</b>           |            |    |     |   |
| <b>Total credits of out of class work: 3.6</b>                              |                                  |   | <b>Total hours of out of class work: 90</b> |            |    |     |   |

As: Assessable training activity

Com: Training activity of compulsory overcoming (It will be essential to overcome both continuous and non-continuous assessment).

**8. Evaluation criteria and Grading System**

| Evaluation System                                     | Continuous assessment | Non-continuous evaluation* | Description   |
|---|-----------------------|----------------------------|---|
| Mid-term tests  | 30.00%                | 0.00%                      | Written exam (Unit 1/Tema 1) (P1). It can be re-evaluated in the final exam. It can be retaken with another exam  |
| Mid-term tests  | 30.00%                | 0.00%                      | Written exam (Unit 2/Tema 2) (P2). It can be re-evaluated in the final exam. It can be retaken with another exam  |
| Practicum and practical activities reports assessment | 10.00%                | 10.00%                     | Laboratory tests and reports (L1, L2, L3). They cannot be retaken   |
| Assessment of activities done in the computer labs    | 10.00%                | 10.00%                     | Numerical assignments and reports (N1, N2). They can be retaken with another report   |
| Assessment of active participation                    | 10.00%                | 0.00%                      | During class hours (C1, C2). It cannot be retaken   |
| Other methods of assessment                           | 10.00%                | 0.00%                      | Problem solving and/or presentation and/or online activities (O1, O2). It can be retaken with another report if there is a final deadline at the end of the semester. Continuous evaluation with quizzes cannot be retaken. |
| Final test  | 0.00%                 | 60.00%                     | Written exam (All units) (NC1). It can be retaken with another exam   |
|   |                       |                            | Oral presentation of a scientific paper related with the subject  |

|                               |                |                |                             |
|-------------------------------|----------------|----------------|-----------------------------|
| Oral presentations assessment | 0.00%          | 20.00%         | (NC2). It cannot be retaken |
| <b>Total:</b>                 | <b>100.00%</b> | <b>100.00%</b> |                             |

According to art. 4 of the UCLM Student Evaluation Regulations, it must be provided to students who cannot regularly attend face-to-face training activities the passing of the subject, having the right (art. 12.2) to be globally graded, in 2 annual calls per subject, an ordinary and an extraordinary one (evaluating 100% of the competences).

#### Evaluation criteria for the final exam:

##### Continuous assessment:

All numerical and laboratory tests (sessions and reports) are compulsory.

Reports for laboratory tests must be due on date regardless of any decision about taking (or not) the mid-term tests. Each day of delay in delivery is a penalty of 2 points out of 10.

Every unit includes a mid-term test (P1, P2), laboratory tests (L1, L2, L3) and numerical assignments (N1, N2).

Any details on content, extension and requirements of written exercises will be indicated on virtual campus at the beginning of the semester.

In order to pass the subject, the following requirements must be satisfied: (at any time: mid-term tests, final exam or retake exam dates)

- L1, L2, L3, N1, N2 ≥ 4;
- P1, P2 ≥ 3;
- $(30 \cdot P1 + 3.33 \cdot L1 + 3.33 \cdot L2) / 36.66 \geq 4$ ;
- $(30 \cdot P2 + 3.33 \cdot L3 + 5 \cdot N1 + 5 \cdot N2) / 43.33 \geq 4$ ;
- Global mark:  $[30 \cdot (P1 + P2) + 3.33 \cdot (L1 + L2 + L3) + 5 \cdot (N1 + N2 + C1 + C2 + O1 + O2)] / 99.99 \geq 5$ ;

All minimum marks on this guide refer to (a maximum of) 10 points.

##### Non-continuous evaluation:

Unless stated otherwise, continuous evaluation criteria will be applied to all students.

Anyone choosing non-continuous assessment must notify it to the lecturer within the class period of the subject. The option is only available if the student's participation in evaluation activities (from the continuous assessment) has not reached 50% of the total evaluation for the subject.

For the retake exam, the assessment type used for the final exam will remain valid.

All numerical and laboratory tests (sessions and reports) are compulsory.

Reports for laboratory tests must be due on date regardless of any decision about taking (or not) the progress test exam. Each day of delay in delivery is a penalty of 2 points out of 10.

In order to pass the subject, the following requirements must be satisfied: (at any time: final exam or retake exam dates)

- L1, L2, L3, N1, N2 ≥ 4;
- NC1 ≥ 3;
- Global mark  $[60 \cdot (NC1) + 3.33 \cdot (L1 + L2 + L3) + 5 \cdot (N1 + N2) + 20 \cdot (NC2)] / 99.99 \geq 5$

##### Specifications for the resit/retake exam:

All numerical and laboratory tests (sessions and reports) are compulsory.

Reports for laboratory tests must be due on date regardless of any decision about taking (or not) the progress test exam. Each day of delay in delivery is a penalty of 2 points out of 10.

Every unit includes a progress test (P1, P2), laboratory tests (L1, L2, L3) and numerical assignments (N1, N2).

In order to pass the subject, the following requirements must be satisfied:

- L1, L2, L3, N1, N2 ≥ 4;
- P1, P2 ≥ 3;
- $(30 \cdot P1 + 3.33 \cdot L1 + 3.33 \cdot L2 + 5 \cdot N1) / 41.66 \geq 4$ ;
- $(30 \cdot P2 + 3.33 \cdot L3 + 5 \cdot N2) / 38.33 \geq 4$ ;
- Global mark:  $[30 \cdot (P1 + P2) + 3.33 \cdot (L1 + L2 + L3) + 5 \cdot (N1 + N2 + C1 + C2 + O1 + O2)] / 99.99 \geq 5$ ;

L1, L2, L3, C1, C2 cannot be retaken.

##### Specifications for the second resit / retake exam:

Just a final progress test. L1, L2, L3, N1, N2 ≥ 4

- L1, L2, L3, N1, N2 ≥ 4;
- PF ≥ 3;
- Nota global:  $[60 \cdot PF + 3.33 \cdot (L1 + L2 + L3) + 5 \cdot (N1 + N2 + C1 + C2 + O1 + O2)] / 99.99 \geq 5$ ;

for continuous assessment or

- L1, L2, L3, N1, N2 ≥ 4;
- PF ≥ 3;
- Nota global  $[60 \cdot (PF) + 3.33 \cdot (L1 + L2 + L3) + 5 \cdot (N1 + N2) + 20 \cdot (NC2)] / 99.99 \geq 5$

for non-continuous evaluation

| 9. Assignments, course calendar and important dates                             |              |
|---|--------------|
| Not related to the syllabus/contents  |              |
| Hours   | hours        |
| <b>Unit 1 (de 6): Properties of a fluid</b>                                     |              |
| <b>Activities</b>   | <b>Hours</b> |
| Class Attendance (theory) [PRESENCIAL][Lectures]                                | 16           |
| Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises] | 12           |
| Laboratory practice or sessions [PRESENCIAL][Practical or hands-on activities]  | 1            |

|   |              |
|---|--------------|
| Computer room practice [PRESENCIAL][Practical or hands-on activities]                   | 2            |
| Practicum and practical activities report writing or preparation [AUTÓNOMA][Group Work] | 3            |
| Study and Exam Preparation [AUTÓNOMA][Self-study]                                       | 38           |
| Other off-site activity [AUTÓNOMA][Combination of methods]                              | 2.5          |
| <b>Unit 2 (de 6): Hydrostatics</b>  |              |
| <b>Activities</b>   | <b>Hours</b> |
| Class Attendance (theory) [PRESENCIAL][Lectures]  | 15           |
| Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]         | 10           |
| Laboratory practice or sessions [PRESENCIAL][Practical or hands-on activities]          | 2            |
| Computer room practice [PRESENCIAL][Practical or hands-on activities]                   | 2            |
| Practicum and practical activities report writing or preparation [AUTÓNOMA][Group Work] | 6            |
| Study and Exam Preparation [AUTÓNOMA][Self-study]                                       | 38           |
| Other off-site activity [AUTÓNOMA][Combination of methods]                              | 2.5          |
| <b>Global activity</b>  |              |
| <b>Activities</b>   | <b>hours</b> |
| Laboratory practice or sessions [PRESENCIAL][Practical or hands-on activities]          | 3            |
| Computer room practice [PRESENCIAL][Practical or hands-on activities]                   | 4            |
| Practicum and practical activities report writing or preparation [AUTÓNOMA][Group Work] | 9            |
| Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]         | 22           |
| Other off-site activity [AUTÓNOMA][Combination of methods]                              | 5            |
| Class Attendance (theory) [PRESENCIAL][Lectures]  | 31           |
| Study and Exam Preparation [AUTÓNOMA][Self-study]                                       | 76           |
| <b>Total horas: 150</b>   |              |

| 10. Bibliography and Sources   |   |                                |      |                   |      |             |
|--------------------------------|---|--------------------------------|------|-------------------|------|-------------|
| Author(s)                      | Title/Link  | Publishing house               | City | ISBN              | Year | Description |
| BERTIN, John J.                | Mecánica de fluidos para ingenieros               | Prentice-Hall-Hispanoamericana |      | 968-880-071-6     | 1986 |             |
| Batchelor, G. K.               | An introduction to fluid dynamics                 | Cambridge University Press     |      | 978-0-521-66396-0 | 2009 |             |
| Chow, Ven Te                   | Hidráulica de canales abiertos / Ven Te Chow      | Diana                          |      | 968-13-1327-5     | 1993 |             |
| Crespo, AntonioCrespo Martínez | Mecánica de fluidos                               | Thomson                        |      | 978-84-9732-292-8 | 2006 |             |
| Daugherty, Robert L.           | Fluid mechanics : (with engineering applications) | McGraw-Hill                    |      | 0-07-015427-9     | 1977 |             |
| Giles, Ranald V.               | Mecánica de los fluidos e hidráulica              | McGraw-Hill                    |      | 978-84-481-1898-3 | 2003 |             |
| Kundu, Pijush K.1941-1994      | Fluid mechanics                                   | Academic Press                 |      | 978-0-12-373735-9 | 2008 |             |
| Mays, L. W.                    | Water resources engineering                       | John Wiley and Sons            |      |                   | 2001 |             |
| Streeter, Victor L.            | Mecánica de los fluidos                           | McGraw-Hill                    |      | 958-600-987-4     | 2001 |             |
| White, Frank M.                | Fluid Mechanics                                   | McGraw-Hill Higher Education   |      | 0-07-128645-4     | 2008 |             |
| Wurbs, R. A. y James, W. P.    | Water resources engineering                       | Prentice Hall                  |      |                   | 2002 |             |