



| Teaching Guide           |                                                                                                                                                                                                                                                                                                                                                                                                                               |        |                                                                                                                                            |         |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|--------------------------------------------------------------------------------------------------------------------------------------------|---------|
| Identifying Data         |                                                                                                                                                                                                                                                                                                                                                                                                                               |        |                                                                                                                                            | 2023/24 |
| Subject (*)              | Industrial Internet of Things (IIoT)                                                                                                                                                                                                                                                                                                                                                                                          | Code   | 730542015                                                                                                                                  |         |
| Study programme          | Master Universitario Erasmus Mundus en Sostibilidade e Industria 4.0 aplicada ao Sector Marítimo                                                                                                                                                                                                                                                                                                                              |        |                                                                                                                                            |         |
| Descriptors              |                                                                                                                                                                                                                                                                                                                                                                                                                               |        |                                                                                                                                            |         |
| Cycle                    | Period                                                                                                                                                                                                                                                                                                                                                                                                                        | Year   | Type                                                                                                                                       | Credits |
| Official Master's Degree | 2nd four-month period                                                                                                                                                                                                                                                                                                                                                                                                         | First  | Optional                                                                                                                                   | 6       |
| Language                 | English                                                                                                                                                                                                                                                                                                                                                                                                                       |        |                                                                                                                                            |         |
| Teaching method          | Face-to-face                                                                                                                                                                                                                                                                                                                                                                                                                  |        |                                                                                                                                            |         |
| Prerequisites            |                                                                                                                                                                                                                                                                                                                                                                                                                               |        |                                                                                                                                            |         |
| Department               | Ciencias da Computación e Tecnoloxías da InformaciónEnxeñaría Industrial                                                                                                                                                                                                                                                                                                                                                      |        |                                                                                                                                            |         |
| Coordinador              | Becerra Permuy, Jose Antonio                                                                                                                                                                                                                                                                                                                                                                                                  | E-mail | jose.antonio.becerra.permuy@udc.es                                                                                                         |         |
| Lecturers                | Becerra Permuy, Jose Antonio<br>Guerreiro Santalla, Sara<br>Naya Varela , Martín<br>Quintían Pardo, Héctor<br>Timiraos Díaz, Miriam                                                                                                                                                                                                                                                                                           | E-mail | jose.antonio.becerra.permuy@udc.es<br>sara.guerreiro@udc.es<br>martin.naya@udc.es<br>hector.quintian@udc.es<br>miriam.timiraos.diaz@udc.es |         |
| Web                      |                                                                                                                                                                                                                                                                                                                                                                                                                               |        |                                                                                                                                            |         |
| General description      | This course is focused on providing the students with practical knowledge in the Internet of Things (IoT) and, specifically, regarding its application to industrial environments (Industrial Internet of Things, IIoT). The theoretical lessons will cover a broad view of all relevant aspects of IoT, while practical lessons will prepare the students for carrying out the implementation of those theoretical concepts. |        |                                                                                                                                            |         |

| Study programme competences |                                                                                                                                                                                                                                                                                     |
|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Code                        | Study programme competences                                                                                                                                                                                                                                                         |
| B2                          | CB6 - Acquire and understand knowledge that provides a basis or opportunity to be original in the development and / or application of ideas, usually in a research context.                                                                                                         |
| B3                          | CB7 - That students know how to apply the acquired knowledge and their ability to solve problems in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their area of study.                                                                   |
| B4                          | CB8 - That students are able to integrate knowledge and face the complexity of making judgments based on information that, being incomplete or limited, includes reflections on the social and ethical responsibilities linked to the application of their knowledge and judgments. |
| B5                          | CB9 ? That students are able to communicate their conclusions -and the knowledge and ultimate reasons that sustain them- to specialized and non-specialized publics in a clear and unambiguous way.                                                                                 |
| B6                          | CB10 - That students have the learning skills that allow them to continue studying in a way that will be largely self-directed or autonomous.                                                                                                                                       |
| B7                          | CG1 ? To display the adequate intercultural competence to successfully navigating within multicultural learning environments and to implement basic management principles suitable for a multicultural working environment.                                                         |
| B8                          | CG2 ? To express an attitude of intellectual inquisitiveness and open-mindedness.                                                                                                                                                                                                   |
| B11                         | CG5 ? To have the capability to identify, formulate and solve engineering problems within realistic constraints.                                                                                                                                                                    |
| B13                         | CG7 ? To have the capability to critically analyse, synthesise, interpret and summarise complex scientific processes.                                                                                                                                                               |
| C2                          | CT2 - Mastering oral and written expression in a foreign language.                                                                                                                                                                                                                  |
| C3                          | CT3 - Using ICT in working contexts and lifelong learning.                                                                                                                                                                                                                          |
| C4                          | CT4 - Acting as a respectful citizen according to democratic cultures and human rights and with a gender perspective.                                                                                                                                                               |
| C6                          | CT6 - Acquiring skills for healthy lifestyles, and healthy habits and routines.                                                                                                                                                                                                     |
| C7                          | CT7 -Developing the ability to work in interdisciplinary or transdisciplinary teams in order to offer proposals that can contribute to a sustainable environmental, economic, political and social development.                                                                     |

| Learning outcomes |                             |
|-------------------|-----------------------------|
| Learning outcomes | Study programme competences |
|                   |                             |



|                                                                                                                                       |      |     |
|---------------------------------------------------------------------------------------------------------------------------------------|------|-----|
| The students will be able to understand and implement the basic theoretical concept of Internet of Things in industrial environments. | BC1  | CC2 |
|                                                                                                                                       | BC2  | CC3 |
|                                                                                                                                       | BC3  | CC4 |
|                                                                                                                                       | BC4  | CC6 |
|                                                                                                                                       | BC5  | CC7 |
|                                                                                                                                       | BC6  |     |
|                                                                                                                                       | BC7  |     |
|                                                                                                                                       | BC10 |     |
|                                                                                                                                       | BC12 |     |

| Contents                |                                                                                                                                                                                       |
|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Topic                   | Sub-topic                                                                                                                                                                             |
| Introduction.           | <ul style="list-style-type: none"> <li>- Background and definitions.</li> <li>- Involved technologies.</li> <li>- IoT vs. IIoT.</li> <li>- Relationship with Industry 4.0.</li> </ul> |
| Devices.                | <ul style="list-style-type: none"> <li>- Sensors and endpoints.</li> <li>- Actuators.</li> <li>- Hardware platforms.</li> <li>- Low level communication.</li> </ul>                   |
| Communication networks. | <ul style="list-style-type: none"> <li>- Types of networks.</li> <li>- Gateways.</li> <li>- Protocols.</li> </ul>                                                                     |
| Data processing.        | <ul style="list-style-type: none"> <li>- Edge, fog, and cloud computing.</li> <li>- Data analytics and machine learning application.</li> <li>- Software platforms.</li> </ul>        |
| User interfaces.        | <ul style="list-style-type: none"> <li>- Standalone.</li> <li>- Cloud-based.</li> </ul>                                                                                               |
| Security.               | <ul style="list-style-type: none"> <li>- Firewalls.</li> <li>- Encryption.</li> <li>- Authentication.</li> </ul>                                                                      |

| Planning                        |                                                |                      |                               |             |
|---------------------------------|------------------------------------------------|----------------------|-------------------------------|-------------|
| Methodologies / tests           | Competencies                                   | Ordinary class hours | Student?s personal work hours | Total hours |
| Mixed objective/subjective test | B4 B11 B13 C2                                  | 2.5                  | 0                             | 2.5         |
| Guest lecture / keynote speech  | B2 B6 B8 C2 C3 C4                              | 21                   | 21                            | 42          |
| Laboratory practice             | B3 B6 B8 C2 C3 C4                              | 21                   | 21                            | 42          |
| Supervised projects             | B3 B4 B5 B6 B7 B8<br>B11 B13 C2 C3 C4<br>C6 C7 | 0                    | 61.5                          | 61.5        |
| Personalized attention          |                                                | 2                    | 0                             | 2           |

(\* )The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

| Methodologies                   |                                                                                                                                                                                      |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Methodologies                   | Description                                                                                                                                                                          |
| Mixed objective/subjective test | It will consist of a written test with short and / or multiple choice questions, in order to check the consolidation of the most important theoretical concepts seen in the subject. |



|                                |                                                                                                                                                                                                                                                                                                                                                                      |
|--------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Guest lecture / keynote speech | Activity in the classroom that serves to establish the fundamental concepts of the subject. It consists of oral presentation making profuse use of audiovisual media and seeking the participation of students by posing practical cases and asking questions, in order to facilitate learning and foster a critical spirit.                                         |
| Laboratory practice            | Through this activity, students will implement small systems in the laboratory that will exemplify the concepts seen in the lectures, so that they can test some of the methods and techniques in the real world, and assess the problems (and their implications) that arise in the implementation of IoT systems.                                                  |
| Supervised projects            | Completion of one or more assignments throughout the term, carried out autonomously and supervised by the teachers, which will involve putting into practice the concepts seen in the lectures. At least the final work will be done in groups and students will submit a report and they will also have to make a presentation to the teacher and their classmates. |

### Personalized attention

| Methodologies                              | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|--------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Supervised projects<br>Laboratory practice | <p>Laboratory practice: personalized attention in laboratory practices will consist of solving conceptual or procedural doubts that may arise during students' work.</p> <p>Supervised projects: it will be necessary to show the progress that is being made to offer the appropriate guidance, resolve doubts and ensure the quality of the work. These tutorials will be carried out in groups and in person in the teacher's office or using Teams.</p> |

### Assessment

| Methodologies                   | Competencies                                   | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Qualification |
|---------------------------------|------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| Supervised projects             | B3 B4 B5 B6 B7 B8<br>B11 B13 C2 C3 C4<br>C6 C7 | <p>Development of one or more individual projects or in small groups. It will be necessary to deliver the materials (document and presentation) in a timely manner following the instructions. At least the final work will require oral presentation by all members of the working group. Not to perform the presentation will result in a score of zero in this activity.</p> <p>Nomenclature used in the observations section for this activity:<br/>P: mark obtained in the supervised project (70% of the final mark).</p> | 70            |
| Mixed objective/subjective test | B4 B11 B13 C2                                  | <p>It will consist of a written exam with short and / or multiple choice questions, in order to check the consolidation of the most important theoretical concepts seen in the subject.</p> <p>General evaluation criteria:<br/>* Correct answers.</p> <p>Nomenclature used in the observations section for this activity:<br/>E: mark obtained in this test (30% of the final mark).</p>                                                                                                                                       | 30            |

### Assessment comments

In order to pass the subject, the student must meet the following requirements (score between 0 and 10 in all activities):<sup>1</sup> P> = 5.2) E> = 5. If all the above requirements are not met, the maximum qualification mark that can be obtained, in the corresponding opportunity, will be 4.5 points. If the required requirements are met, the final mark will be calculated as follows: FINAL MARK = 0.7 × P + 0.3 × E

General EMJMD Sustainable Ship and Shipping SEAS 4.0 evaluation rules:

- Students will have only two opportunities to pass a course. If failing to do so, they may be forced to leave the degree.
- No part time or lecture attendance exemption are allowed in this degree.

Fraudulent performance of tests or evaluation activities, once verified, will directly imply the qualification of failing in the opportunity in which it is committed: the student will be graded with "fail" (numerical grade 0) in the corresponding opportunity, whether the commission of the offense occurs on the first opportunity or on the second. For this, their qualification will be modified in the first opportunity certificate, if necessary.



## Sources of information

|                      |                                                                                                                                                                                                                                                |
|----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Basic</b>         | <ul style="list-style-type: none"><li>- Veneri, G., &amp; Capasso, A. (2018). Hands-On Industrial Internet of Things. Packt Publishing Ltd.</li><li>- Dow, C. (2018). Internet of Things Programming Projects. Packt Publishing Ltd.</li></ul> |
| <b>Complementary</b> | <ul style="list-style-type: none"><li>- Lea, P. (2018). Internet of Things for Architects. Packt Publishing Ltd.</li><li>- Ravulavaru, A. (2018). Enterprise Internet of Things Handbook. Packt Publishing Ltd.</li></ul>                      |

## Recommendations

### Subjects that it is recommended to have taken before

### Subjects that are recommended to be taken simultaneously

Industry 4.0 Enabling Technologies/730542010

### Subjects that continue the syllabus

Digital Twin in Marine System/730542022

### Other comments

To help in achieving a sustainable environment and to get the objective of number 5 action of the "Ferrol Green Campus Action Plan" (Healthy and environmentally and socially sustainable research and teaching): The assignments to be done in this course: - Will be required in digital format. - Will be delivered using Moodle, with no need to print them. In case it is necessary to print them: - Plastics won't be used. - Two side printing will be used. - Recycled paper will be used. - Printing drafts will be avoided. A sustainable use of the resources should be done, together with the prevention of negative impacts on the environment. In this course, an effort will be pursued towards the incorporation of gender inclusion aspects: no sexist language will be allowed, bibliography from authors of both genders will be used, and the participation of students of both gender in class will be promoted. The situations of gender discrimination will be detected, and actions will be implemented to correct them. The full integration of students who for physical, sensorial, psychic, or socio-cultural reasons may have difficulties in their academic life will be promoted.

(\*)The teaching guide is the document in which the URV publishes the information about all its courses. It is a public document and cannot be modified. Only in exceptional cases can it be revised by the competent agent or duly revised so that it is in line with current legislation.