



## Teaching Guide

| Teaching Guide           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |        |                       |           |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|-----------------------|-----------|
| Identifying Data         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |        |                       | 2018/19   |
| Subject (*)              | Energy Use of Regasification of Liquefied Natural Gas                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Code   |                       | 770523017 |
| Study programme          | Mestrado Universitario en Eficiencia e Aproveitamento Enerxético                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |        |                       |           |
| Descriptors              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |        |                       |           |
| Cycle                    | Period                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Year   | Type                  | Credits   |
| Official Master's Degree | 2nd four-month period                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | First  | Optional              | 3         |
| Language                 | SpanishGalicianEnglish                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |        |                       |           |
| Teaching method          | Face-to-face                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |        |                       |           |
| Prerequisites            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |        |                       |           |
| Department               | Ciencias da Navegación e Enxeñaría MariñaEnxeñaría Naval e Industrial                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |        |                       |           |
| Coordinador              | Romero Gómez, Manuel                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | E-mail | m.romero.gomez@udc.es |           |
| Lecturers                | Carbia Carril, Jose                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | E-mail | jose.carbia@udc.es    |           |
|                          | Romero Gómez, Manuel                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |        | m.romero.gomez@udc.es |           |
| Web                      | moodle.udc.es/                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |        |                       |           |
| General description      | <p>Natural gas is the fossil fuel with less environmental impact. It is the fuel of the present and the future to help reduce emissions. The natural gas passes through various processes from extraction to final consumption by users. One of these processes is the storage and regasification of LNG.</p> <p>In this sujet the regasification process is studied from the thermodynamic point of view to establish strategies to exploiting the energy released in this process. Software tools to optimize the process are used.</p> |        |                       |           |

## Study programme competences

| Code | Study programme competences                                                                                                                                                                                                              |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A13  | Capacidad para analizar, aplicar y optimizar los sistemas de aprovechamiento energético.                                                                                                                                                 |
| B1   | Que los estudiantes sepan aplicar los conocimientos adquiridos y su capacidad de resolución de problemas en entornos nuevos o poco conocidos dentro de contextos más amplios (o multidisciplinares) relacionados con su área de estudio. |
| B3   | Poseer y comprender conocimientos que aporten una base u oportunidad de ser originales en el desarrollo y/o aplicación de ideas, a menudo en un contexto de investigación.                                                               |
| B6   | Buscar y seleccionar alternativas considerando las mejores soluciones posibles.                                                                                                                                                          |
| B7   | Desarrollar las capacidades de análisis y síntesis; fomentar la discusión crítica, la defensa de argumentos y la toma de conclusiones.                                                                                                   |
| B9   | Extraer, interpretar y procesar información, procedente de diferentes fuentes, para su empleo en el estudio y análisis.                                                                                                                  |
| B11  | Adquirir nuevos conocimientos y capacidades relacionados con el ámbito profesional del máster.                                                                                                                                           |
| B13  | Aplicar los conocimientos teóricos a la práctica                                                                                                                                                                                         |
| B14  | Aplicar conocimientos de ciencias y tecnologías avanzadas a la práctica profesional o investigadora de la eficiencia                                                                                                                     |
| B16  | Valorar la aplicación de tecnologías emergentes en el ámbito de la energía y el medio ambiente.                                                                                                                                          |
| B18  | Plantear y resolver problemas, interpretar un conjunto de datos y analizar los resultados obtenidos; en el ámbito de la eficiencia energética y la sostenibilidad.                                                                       |
| C2   | Fomentar la sensibilidad hacia temas medioambientales.                                                                                                                                                                                   |
| C3   | Aplicar una metodología que fomente el aprendizaje y el trabajo autónomo.                                                                                                                                                                |

## Learning outcomes

| Learning outcomes                                                                                                                                                                              | Study programme competences |     |  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|-----|--|
| Ability to analyze, implement and optimize energy utilization systems.                                                                                                                         | AJ13                        |     |  |
| That the students can apply their knowledge and their ability to solve problems in new or unknown environments within broader (or multidisciplinary) contexts related to their field of study. |                             | BC1 |  |
| Knowledge and understanding that provides a basis or opportunity to be original in the development and / or implementation of ideas.                                                           |                             | BC3 |  |
| Find and select the best alternative considering possible solutions.                                                                                                                           |                             | BC6 |  |



|                                                                                                                                 |  |      |     |
|---------------------------------------------------------------------------------------------------------------------------------|--|------|-----|
| Develop the capacities of analysis and synthesis; encourage critical discussion, arguments and making conclusions.              |  | BC7  |     |
| Extract, interpret and process information from different sources, for use in the study and analysis.                           |  | BC9  |     |
| Acquire new knowledge and skills related to the professional field of the master.                                               |  | BC11 |     |
| Apply theoretical knowledge into practice                                                                                       |  | BC13 |     |
| Apply knowledge of science and advanced technologies to professional practice or research efficiency                            |  | BC14 |     |
| Assess the application of emerging technologies in the field of energy and the environment.                                     |  | BC16 |     |
| Solve problems, interpret a set of data and analyze the results obtained; in the field of energy efficiency and sustainability. |  | BC18 |     |
| Foster sensitivity to environmental issues.                                                                                     |  |      | CC2 |
| Apply a methodology that fosters learning and self-employment.                                                                  |  |      | CC3 |

| Contents                                                       |                                                                                                                                                                                                                                                                       |
|----------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Topic                                                          | Sub-topic                                                                                                                                                                                                                                                             |
| 1. Introduction to natural gas                                 | 1.1 Chain of natural gas<br>1.2 Uses of natural gas<br>1.3 Iberian and European gas network                                                                                                                                                                           |
| 2. Onshore regasification terminals                            | 2.1 Equipment<br>2.2 LNG regasification process<br>2.3 regasification terminals: Features                                                                                                                                                                             |
| 3. Offshore regasification terminals                           | 3.1 Vessels FSRU (Floating Storage and Regasification Unit)<br>3.2 Description of operation<br>3.3 Equipment                                                                                                                                                          |
| 4. Energetic and exergetic analysis LNG regasification process | 4.1 Thermodynamic Fundamentals<br>4.2 Energy and Exergy Analysis<br>4.3 Recovery of LNG exergy regasification process<br>4.4 Analysis of power plants with utilization of LNG exergy.<br>4.5 Case study to solve with the software EES (Engineering Equation Solver). |

| Planning                                                                                                                        |                            |                      |                               |             |
|---------------------------------------------------------------------------------------------------------------------------------|----------------------------|----------------------|-------------------------------|-------------|
| Methodologies / tests                                                                                                           | Competencies               | Ordinary class hours | Student's personal work hours | Total hours |
| Problem solving                                                                                                                 | A13 B1 B6 B13 B14<br>C3    | 7                    | 14                            | 21          |
| Supervised projects                                                                                                             | A13 B1 B6 B7 B9 B13        | 8                    | 8                             | 16          |
| Objective test                                                                                                                  | B1 B6 B7 B9 B13 B14<br>B16 | 2                    | 6                             | 8           |
| Guest lecture / keynote speech                                                                                                  | B3 B7 B9 B11 B16<br>B18 C2 | 15                   | 15                            | 30          |
| Personalized attention                                                                                                          |                            | 0                    |                               | 0           |
| (*)The information in the planning table is for guidance only and does not take into account the heterogeneity of the students. |                            |                      |                               |             |

| Methodologies       |                                                                                                                                                                                                                                                                                                                                                 |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Methodologies       | Description                                                                                                                                                                                                                                                                                                                                     |
| Problem solving     | Collections of exercises proposed for each issue will be resolved, allowing the application of the most appropriate mathematical models to each case, including management software, application of the most appropriate assumptions, regarding the theoretical contents developed in lectures and relationship with the professional exercise. |
| Supervised projects | Troubleshooting greater demands that the exercises solved in class or issues of particular relevance.                                                                                                                                                                                                                                           |



|                                |                                                                                                                                                                                                                                                        |
|--------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Objective test                 | The degree of acquired knowledge on the subject in question is valued, taking into account both the theoretical part as problems.                                                                                                                      |
| Guest lecture / keynote speech | The detailed explanation of the contents of the subject will be made. The student will have a copy of the topic in each session master. Class participation is encouraged through comments linking the theoretical content with real-life experiences. |

| Personalized attention                 |                                                                                                                                                                                                                             |
|----------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Methodologies                          | Description                                                                                                                                                                                                                 |
| Supervised projects<br>Problem solving | The student is guided on those issues that are imparted and special difficulty understanding matter. Channels and contact information will be the Virtual Faculty and individualized tutoring that develop during the week. |

| Assessment                     |                            |                                                                                                                                                                                                                                                                                                                                                                 |               |
|--------------------------------|----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| Methodologies                  | Competencies               | Description                                                                                                                                                                                                                                                                                                                                                     | Qualification |
| Supervised projects            | A13 B1 B6 B7 B9 B13        | Presentation and defense of the work performed. The structure, neatness, content and originality expository will be evaluated.                                                                                                                                                                                                                                  | 10            |
| Guest lecture / keynote speech | B3 B7 B9 B11 B16<br>B18 C2 | Attendance at the sessions will be counted in the final mark.                                                                                                                                                                                                                                                                                                   | 10            |
| Problem solving                | A13 B1 B6 B13 B14<br>C3    | Troubleshooting, if possible, with appropriate software                                                                                                                                                                                                                                                                                                         | 10            |
| Objective test                 | B1 B6 B7 B9 B13 B14<br>B16 | Assessment of Knowledge and understanding of the basic contents of the subject, considering the student's abilities and skills, strategies and approaches to problem solving.<br><br>The degree of development of students and their ability to analyze and solve specific problems will be evaluated, requiring a balanced theoretical and practical training. | 70            |

| Assessment comments                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A final exam for those students who do not participate in the continuous assessment of the subject throughout the course will be proposed. It allows to evaluate and verify the expected results in terms of global content of matter and verify the degree of achievement of the objectives. The overall final exam will consist of a test composed of 2 parts: a) theoretical (50%); b) practice (50%); with independent valuation, which is necessary to obtain a minimum of 3 points in each part purposed. |

| Sources of information |                                                                                                                                                                                                                                                                                                                |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Basic                  | - Saeid Mokhatab, John Y. Mark (). Handbook of Liquefied Natural Gas. Elsevier<br>- Michael J. Moran, Howard N. Shapiro (). Fundamentos de Termodinámica Técnica. Reverté<br>- Saeid Mokhatab, William A. Poe and James G. Speight (). Handbook of Natural Gas Transmission and Processing. Elsevier<br><br /> |
| Complementary          |                                                                                                                                                                                                                                                                                                                |

| Recommendations                                          |
|----------------------------------------------------------|
| Subjects that it is recommended to have taken before     |
| Subjects that are recommended to be taken simultaneously |
| Subjects that continue the syllabus                      |
| Other comments                                           |



(\*)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.