



## Teaching Guide

| Teaching Guide           |                                            |        |                    |           |
|--------------------------|--------------------------------------------|--------|--------------------|-----------|
| Identifying Data         |                                            |        |                    | 2018/19   |
| Subject (*)              | Combustion                                 |        | Code               | 631480208 |
| Study programme          | Mestrado Universitario en Enxeñaría Mariña |        |                    |           |
| 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 Mariña  |        |                    |           |
| Coordinador              | Carbia Carril, Jose                        | E-mail | jose.carbia@udc.es |           |
| Lecturers                | Carbia Carril, Jose                        | E-mail | jose.carbia@udc.es |           |
| Web                      |                                            |        |                    |           |
| General description      |                                            |        |                    |           |

## Study programme competences

| Code | Study programme competences                                                                                                                                                                                                                                                                    |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A2   | Detectar e definir a causa dos defectos de funcionamento das máquinas e reparalas, a nivel de xestión.                                                                                                                                                                                         |
| A8   | Facer funcionar a máquina, controlar, vixiar e avaliar o seu rendemento e capacidade, a nivel de xestión.                                                                                                                                                                                      |
| A9   | Manter a seguridade dos equipos, sistemas e servizos da maquinaria, a nivel de xestión.                                                                                                                                                                                                        |
| A16  | Vixiar e controlar o cumprimento das prescricións lexislativas e das medidas para garantir a seguridade da vida humana no mar e a protección do medio mariño, a nivel de xestión.                                                                                                              |
| A19  | Regular, controlar, diagnosticar e supervisar sistemas, procesos e máquinas para a toma de decisións en condución e operación.                                                                                                                                                                 |
| A20  | Capacidade para desenrolar tarefas de análise e síntese de problemas teórico-prácticos en base a conceptos adquiridos noutras disciplinas do ámbito marítimo, mediante fundamentos físico-matemáticos.                                                                                         |
| B1   | Aprender a aprender.                                                                                                                                                                                                                                                                           |
| B2   | Resolver problemas de forma efectiva.                                                                                                                                                                                                                                                          |
| B3   | Comunicarse de maneira efectiva nun entorno de traballo.                                                                                                                                                                                                                                       |
| B4   | Traballar de forma autónoma con iniciativa.                                                                                                                                                                                                                                                    |
| B5   | Traballar de forma colaborativa.                                                                                                                                                                                                                                                               |
| B6   | Comportarse con ética e responsabilidade social como cidadán e como profesional.                                                                                                                                                                                                               |
| B7   | Capacidade para interpretar, seleccionar e valorar conceptos adquiridos noutras disciplinas do ámbito marítimo, mediante fundamentos físico-matemáticos.                                                                                                                                       |
| B10  | Comunicar por escrito e oralmente os coñecementos procedentes da linguaxe científica.                                                                                                                                                                                                          |
| B11  | Capacidade para resolver problemas con iniciativa, toma de decisións, creatividade, razoamento crítico e de comunicar e transmitir coñecementos, habilidades e destrezas.                                                                                                                      |
| B12  | Posuír e comprender coñecementos que aporten unha base ou oportunidade de ser orixinais no desenvolvemento e/ou aplicación de ideas, a miúdo nun contexto de investigación                                                                                                                     |
| B13  | Que os estudantes saiban aplicar os coñecementos adquiridos e a súa capacidade de resolución de problemas en contornas novas ou pouco coñecidas dentro de contextos máis amplos (ou multidisciplinares) relacionados coa súa área de estudo                                                    |
| B14  | Que os estudantes sexan capaces de integrar coñecementos e enfrontarse á complexidade de formular xuízos a partires dunha información que, sendo incompleta ou limitada, inclúa reflexións sobre as responsabilidades sociais e éticas vencelladas á aplicación dos seus coñecementos e xuízos |
| B15  | Que os estudantes saiban comunicar as súas conclusións e os coñecementos e razóns últimas que as sustentan a públicos especializados e non especializados dun xeito claro e sin ambigüidades                                                                                                   |
| B16  | Que os estudantes posúan as habilidades de aprendizaxe que lles permitan continuar estudando dun xeito que haberá de ser en grande medida autodirixido ou autónomo.                                                                                                                            |
| C1   | Expresarse correctamente, tanto de forma oral coma escrita, nas linguas oficiais da comunidade autónoma.                                                                                                                                                                                       |
| C2   | Dominar a expresión e a comprensión de forma oral e escrita dun idioma estranxeiro.                                                                                                                                                                                                            |



|    |                                                                                                                                                                                                                                                        |
|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| C4 | Desenvolverse para o exercicio dunha cidadanía aberta, culta, crítica, comprometida, democrática e solidaria, capaz de analizar a realidade, diagnosticar problemas, formular e implantar solucións baseadas no coñecemento e orientadas ao ben común. |
| C6 | Valorar criticamente o coñecemento, a tecnoloxía e a información dispoñible para resolver os problemas cos que deben enfrontarse.                                                                                                                      |
| C7 | Asumir como profesional e cidadán a importancia da aprendizaxe ao longo da vida.                                                                                                                                                                       |
| C8 | Valorar a importancia que ten a investigación, a innovación e o desenvolvemento tecnolóxico no avance socioeconómico e cultural da sociedade.                                                                                                          |
| C9 | Falar ben en público                                                                                                                                                                                                                                   |

| Learning outcomes                                                                                                                                                                         |      |                             |     |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-----------------------------|-----|
| Learning outcomes                                                                                                                                                                         |      | Study programme competences |     |
| Knowledge of basic combustion processes, which are key to the proper management of propulsion equipment and auxiliary services.                                                           | AC2  | BC1                         | CC1 |
|                                                                                                                                                                                           | AC8  | BC2                         | CC2 |
|                                                                                                                                                                                           | AC9  | BC3                         | CC4 |
|                                                                                                                                                                                           | AC16 | BC5                         | CC9 |
|                                                                                                                                                                                           | AC19 | BC12                        |     |
|                                                                                                                                                                                           | AC20 | BC13                        |     |
|                                                                                                                                                                                           |      | BC14                        |     |
| Be able to evaluate the operation of combustion equipment, respond to technological advances in this field and provide solutions in a multidisciplinary field such as Marine Engineering. |      | BC15                        |     |
|                                                                                                                                                                                           |      | BC16                        |     |
|                                                                                                                                                                                           | AC9  | BC4                         | CC6 |
|                                                                                                                                                                                           | AC19 | BC6                         | CC7 |
|                                                                                                                                                                                           | AC20 | BC7                         | CC8 |
|                                                                                                                                                                                           |      | BC10                        | CC9 |
|                                                                                                                                                                                           |      | BC11                        |     |
|                                                                                                                                                                                           |      | BC12                        |     |
|                                                                                                                                                                                           |      | BC13                        |     |
|                                                                                                                                                                                           |      | BC14                        |     |
|                                                                                                                                                                                           |      | BC15                        |     |
|                                                                                                                                                                                           |      | BC16                        |     |

| Contents   |                                                                                                                                                                                                                                                                                                                                                                            |
|------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Topic      | Sub-topic                                                                                                                                                                                                                                                                                                                                                                  |
| Combustión | 1. Introduction to combustion<br>2. Classification of combustion processes. General approach to the problem.<br>3. Stoichiometry of the combustion of solid, liquid and gaseous fuels.<br>4. Composition of polluting gases. Polluting load.<br>5. Combustion modes. Premix, diffusion.<br>6. Atomization and combustion of drops.<br>7. Formation of polluting emissions. |

| Planning              |                                    |                      |                               |             |
|-----------------------|------------------------------------|----------------------|-------------------------------|-------------|
| Methodologies / tests | Competencies                       | Ordinary class hours | Student?s personal work hours | Total hours |
| Document analysis     | B1 B4 B7 C2 C6 C8                  | 1                    | 1                             | 2           |
| Case study            | A2 A20 B1 B2 B3 B4<br>B5 B7 C7     | 5                    | 15                            | 20          |
| Objective test        | A8 A9 A16 A19 A20<br>B2 B10 B11 C1 | 3                    | 0                             | 3           |



|                                |                                                                               |   |    |    |
|--------------------------------|-------------------------------------------------------------------------------|---|----|----|
| Problem solving                | A2 A9 A16 A20 B2 B3<br>B4 B5 B6 B7 B10 B11<br>B12 B13 B14 C4 C6<br>C8         | 6 | 18 | 24 |
| Supervised projects            | A2 A9 A16 A20 B2 B3<br>B4 B5 B7 B10 B11<br>B12 B13 B14 B15<br>B16 C1 C6 C8 C9 | 1 | 7  | 8  |
| Guest lecture / keynote speech | A2 A8 A9 A16 A19 C8                                                           | 7 | 7  | 14 |
| Personalized attention         |                                                                               | 4 | 0  | 4  |

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

| Methodologies                  |                                                                                                                                                                                                                                                                                                               |
|--------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Methodologies                  | Description                                                                                                                                                                                                                                                                                                   |
| Document analysis              | An analysis and selection of the most up-to-date documentation sources will be carried out, with the help of new technologies, to achieve the proposed objectives.                                                                                                                                            |
| Case study                     | Proposal of practical cases, resolution and criticism.                                                                                                                                                                                                                                                        |
| Objective test                 | Oral and/or written tests will be carried out that will consist of theoretical and practical questions.                                                                                                                                                                                                       |
| Problem solving                | Solve problems in terms of design and real behavior.                                                                                                                                                                                                                                                          |
| Supervised projects            | It will be proposed the realization of works for the resolution of cases of real processes, making consequent follow-up.                                                                                                                                                                                      |
| Guest lecture / keynote speech | The detailed explanation of the contents of the subject will be made. The student will have bibliographic material of the subject to be treated in each master session. Student participation in class will be encouraged, through comments that try to relate the theoretical contents with real experience. |

| Personalized attention         |                                                                                                                                                                                                                                                                                                                               |
|--------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Methodologies                  | Description                                                                                                                                                                                                                                                                                                                   |
| Guest lecture / keynote speech | ANALYSIS OF DOCUMENTARY SOURCES. Personal attention will be given to the selection of bibliographic sources and specialized publications.                                                                                                                                                                                     |
| Document analysis              | STUDY OF CASES. Preferably, cases for which there is inefficient exploitation documentation will be chosen for analysis, making a follow-up of the development of them individually.                                                                                                                                          |
| Case study                     | OBJECTIVE PROOF Oral and / or written tests will be carried out that will consist of theoretical and practical questions.                                                                                                                                                                                                     |
| Objective test                 | PROBLEM SOLVING. The proposed problems will be solved by the student, making a permanent follow-up.                                                                                                                                                                                                                           |
| Problem solving                | WORK PROTECTED. Attention in office or classroom for the resolution of analysis and research work.                                                                                                                                                                                                                            |
| Supervised projects            | Resolution of difficulties at work.                                                                                                                                                                                                                                                                                           |
|                                | MASTER SESSION. The detailed explanation of the contents of the subject will be made. The student will have bibliographic material of the subject to be treated in each master session. Student participation in class will be encouraged, through comments that try to relate the theoretical contents with real experience. |
|                                | PERSONAL ATTENTION. They will be carried out during tutorials established at the beginning of the course and on the board of the office. This personalized attention is essential for sel the work done by the student eminently oriented to research.                                                                        |

| Assessment                     |                     |                                                                                                                                                               |               |
|--------------------------------|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| Methodologies                  | Competencies        | Description                                                                                                                                                   | Qualification |
| Guest lecture / keynote speech | A2 A8 A9 A16 A19 C8 | With the participative attendance to the expository classes.                                                                                                  | 5             |
| Document analysis              | B1 B4 B7 C2 C6 C8   | An analysis and selection of the most updated sources of documentation will be carried out, with the help of new technologies, to achieve the objectives set. | 5             |



|                     |                                                                               |                                                                              |    |
|---------------------|-------------------------------------------------------------------------------|------------------------------------------------------------------------------|----|
| Case study          | A2 A20 B1 B2 B3 B4<br>B5 B7 C7                                                | Proposal of practical cases, analysis, resolution, validation and criticism. | 10 |
| Objective test      | A8 A9 A16 A19 A20<br>B2 B10 B11 C1                                            | Resolution of theoretical and practical proposals.                           | 50 |
| Problem solving     | A2 A9 A16 A20 B2 B3<br>B4 B5 B6 B7 B10 B11<br>B12 B13 B14 C4 C6<br>C8         | Solve problems in terms of design and real behavior.                         | 10 |
| Supervised projects | A2 A9 A16 A20 B2 B3<br>B4 B5 B7 B10 B11<br>B12 B13 B14 B15<br>B16 C1 C6 C8 C9 | Presentation in time and form of the proposed works.                         | 20 |

## Assessment comments

Evaluation criteria contemplated in tables A-III/1 and A-III/2 of the STCW Code and its amendments related to this matter will be taken into account when designing and carrying out its evaluation.

Students with recognition of part-time dedication and academic exemption of attendance exemption, according to the "NORM THAT REGULATES THE REGIME OF DEDICATION TO THE STUDY OF GRADUATE STUDENTS IN THE UDC (Arts 2.3, 3.b; 4.3 e 7.5 ) (04/05/2017):

- Attendance / participation in the minimum class activities: 80% to be considered by the teacher, considering that in these cases it can be compensated with specific jobs, assistance to tutorials ... For example, in some subjects this 80% could be the corresponding to the hours of practices in laboratory / workshop, and allow the exemption to attend the lectures.

- Qualification:

a) Elaboration of works: up to 80%

c) Problem solving: up to 80%

b) Written exam on the contents of the subject: up to 100%

d) Other methodologies considered: up to 100%

## Sources of information

|                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Basic</b>         | <ul style="list-style-type: none"> <li>- Ernest J. Henley (2002). Cálculo de Balances de Materia y Energía . Barcelona: Edit. Reverté. S.A.</li> <li>- Manuel Marquez (2005). Combustión y Quemadores. España. Marcombo</li> <li>- David M. Himmelblau (2002). Principios básicos y cálculos en ingeniería química. México. Pearson Educación</li> <li>- Sánchez Naranjo, Consuelo (2008). Teoría de la combustión. UNED</li> </ul>                                                                               |
| <b>Complementary</b> | <ul style="list-style-type: none"> <li>- J. L. Gómez Ribelles (2002). Termodinámica técnica. Valencia. UPV</li> <li>- M. J. Moran; H. N. Shapiro (1999). Fundamentos de termodinámica técnica. Barcelona. Ed. Reverte, S.A</li> <li>- Yunus A. Çengel; Michael A. Boles (2002). Termodinámica. México. McGraw-Hill</li> <li>- D. B. Spalding (1979). Combustion and Mass Transfer. Pergamon</li> <li>- TURNS, S. R. (2000). An Introduction to Combustions: Concepts and Applications. Ed. McGraw-Hill</li> </ul> |

## 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

Because it is an optional Master's subject, which implies having completed a Degree, no additional prerequisite is required.



(\*)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.