



## Teaching Guide

| Teaching Guide           |                                                                                                                                                                                                                                                                                      |        |                        |           |
|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|------------------------|-----------|
| Identifying Data         |                                                                                                                                                                                                                                                                                      |        |                        | 2023/24   |
| Subject (*)              | Electrical Systems of Marine Propulsion                                                                                                                                                                                                                                              |        | Code                   | 631480103 |
| Study programme          | Mestrado Universitario en Enxeñaría Mariña                                                                                                                                                                                                                                           |        |                        |           |
| Descriptors              |                                                                                                                                                                                                                                                                                      |        |                        |           |
| Cycle                    | Period                                                                                                                                                                                                                                                                               | Year   | Type                   | Credits   |
| Official Master's Degree | 1st four-month period                                                                                                                                                                                                                                                                | First  | Obligatory             | 6         |
| Language                 | Spanish                                                                                                                                                                                                                                                                              |        |                        |           |
| Teaching method          | Face-to-face                                                                                                                                                                                                                                                                         |        |                        |           |
| Prerequisites            |                                                                                                                                                                                                                                                                                      |        |                        |           |
| Department               | Enxeñaría Industrial                                                                                                                                                                                                                                                                 |        |                        |           |
| Coordinador              | Masdias y Bonome, Antonio                                                                                                                                                                                                                                                            | E-mail | antonio.masdias@udc.es |           |
| Lecturers                | Masdias y Bonome, Antonio                                                                                                                                                                                                                                                            | E-mail | antonio.masdias@udc.es |           |
| Web                      |                                                                                                                                                                                                                                                                                      |        |                        |           |
| General description      | O obxectivo é impartir formación de posgrao a estudantes que xa teñen coñecemento xeral das máquinas eléctricas empregadas a bordo e cada vez máis empregadas na propulsión, así como das instalacións eléctricas asociadas, integrando estes coñecementos e centrándoos na xestión. |        |                        |           |

## 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.                                                                                                                                                                                         |
| A5   | Garantir que se observan as prácticas de seguridade no traballo, a nivel de xestión.                                                                                                                                                                                                           |
| A6   | Facer arrancar e parar a máquina propulsora principal e a maquinaria auxiliar, incluídos os sistemas correspondentes, a nivel de xestión.                                                                                                                                                      |
| A7   | Facer funcionar o equipo eléctrico e electrónico, a nivel de xestión.                                                                                                                                                                                                                          |
| A9   | Manter a seguridade dos equipos, sistemas e servizos da maquinaria, a nivel de xestión.                                                                                                                                                                                                        |
| A13  | Planificar e programar as operacións, a nivel de xestión.                                                                                                                                                                                                                                      |
| A14  | Probar o equipo eléctrico e electrónico, detectar avarías e mantelo en condicións de funcionamento o reparalo, a nivel de xestión.                                                                                                                                                             |
| B2   | Resolver problemas de forma efectiva.                                                                                                                                                                                                                                                          |
| B4   | Traballar de forma autónoma con iniciativa.                                                                                                                                                                                                                                                    |
| B5   | Traballar de forma colaborativa.                                                                                                                                                                                                                                                               |
| B7   | Capacidade para interpretar, seleccionar e valorar conceptos adquiridos noutras disciplinas do ámbito marítimo, mediante fundamentos físico-matemáticos.                                                                                                                                       |
| B9   | Capacidade para a aprendizaxe de novos métodos e teorías, que lle doten dunha gran versatilidade para adaptarse a novas situacións.                                                                                                                                                            |
| 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.                                                                                                                                                                                       |
| C3   | Utilizar as ferramentas básicas das tecnoloxías da información e as comunicacións (TIC) necesarias para o exercicio da súa profesión e para a aprendizaxe ao longo da súa vida.                                                                                                                |
| C6   | Valorar criticamente o coñecemento, a tecnoloxía e a información dispoñible para resolver os problemas cos que deben enfrontarse.                                                                                                                                                              |
| 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 |         |
| Management of maintenance and repair of electrical machines.                                                                            |  | AC2                         | BC2 CC1 |
| Management of the operation of the main and auxiliary machinery                                                                         |  | AC5                         | BC4 CC3 |
| Test management, fault detection, repair and maintenance of electrical equipment.                                                       |  | AC6                         | BC5 CC6 |
| Management of safety practices at work.                                                                                                 |  | AC7                         | BC7 CC8 |
| Management of electronic power devices                                                                                                  |  | AC9                         | BC9 CC9 |
| Detect and define the cause of the malfunctions of the machines and repair them, at the management level.                               |  | AC13                        | BC12    |
| Ensure that occupational safety practices are observed at the management level.                                                         |  | AC14                        | BC13    |
| Start and stop the main propulsion machinery and the auxiliary machinery, including the corresponding systems, at the management level. |  |                             | BC14    |
| Operate electrical and electronic equipment, at the management level.                                                                   |  |                             | BC15    |
| Operate the machine, control, monitor and evaluate its performance and capacity, at the management level.                               |  |                             | BC16    |

| Contents                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Topic                                     | Sub-topic                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| INTRODUCTION TO ELECTRIC PROPULSION       | <ul style="list-style-type: none"> <li>- Management function in a naval electric propulsion plant.</li> <li>- Selection of solid state components according to ease of command, switching speed and power range.</li> <li>- Analysis of the types of naval installations of electric propulsion. Evolution. Current facilities in use. New constructions.</li> <li>-Azimuth thrusters. Characteristics. Analysis of the different types by their drive motor and power range.</li> <li>- Study of power plant alternatives. Technical, economic and operational implications. Current trends depending on the type of ship.</li> <li>- High Tension in propulsion and distribution.</li> <li>- Management of a naval propulsion power plant.</li> </ul> |
| ELECTRICAL INSTALLATIONS                  | <ul style="list-style-type: none"> <li>- Interpretation of technical documentation on electrical machines and systems.</li> <li>- Calculation of lines and protections.</li> <li>- Naval electric propulsion type plants.</li> <li>- PODs</li> <li>- Technical-economic justification. Fields of application.</li> <li>- New designs.</li> <li>- Management of a naval propulsion power plant.</li> <li>- Power Management System.</li> </ul>                                                                                                                                                                                                                                                                                                           |
| POWER ELECTRONICS AND ELECTRICAL MACHINES | <ul style="list-style-type: none"> <li>- Power electronic devices, power control circuits, rectifier circuits and converters. Applications.</li> <li>- Assembly, testing, maintenance and repair of electrical machines and electrical installations.</li> <li>- Marine electrotechnology, electronics, power electronics, automatic control machines and control devices</li> <li>safety</li> <li>- Direct and indirect electrical energy converters.</li> <li>- Power electronic components.</li> <li>- Project characteristics of high voltage installations.</li> <li>- Pieces of Respect</li> </ul>                                                                                                                                                |
| ELECTRICAL HAZARDS                        | Prevention of occupational hazards and environmental protection. Risks evaluation.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |



| Planning                                                                                                                        |                                                        |                      |                               |             |
|---------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|----------------------|-------------------------------|-------------|
| Methodologies / tests                                                                                                           | Competencies                                           | Ordinary class hours | Student?s personal work hours | Total hours |
| ICT practicals                                                                                                                  | A2 B4 C3                                               | 5                    | 1                             | 6           |
| Laboratory practice                                                                                                             | A6 A7 A9 A13 A14 B5<br>B7 B12 B13 B14 B15<br>B16 C1 C9 | 4                    | 1                             | 5           |
| Problem solving                                                                                                                 | B9 C6                                                  | 4                    | 1                             | 5           |
| Directed discussion                                                                                                             | A5 B2 B5 B7 C8                                         | 2                    | 0                             | 2           |
| Oral presentation                                                                                                               | A2 A5 B5                                               | 97                   | 1                             | 98          |
| Objective test                                                                                                                  | B2 C3 C6                                               | 2                    | 1                             | 3           |
| Workbook                                                                                                                        | A5                                                     | 1                    | 1                             | 2           |
| Document analysis                                                                                                               | C8                                                     | 4                    | 1                             | 5           |
| Seminar                                                                                                                         | B9 C3 C8                                               | 21                   | 1                             | 22          |
| 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                                                          |
| ICT practicals      | De acuerdo con el interés individual o del grupo                     |
| Laboratory practice | Complementarias a los realizadas en los cursos anteriores            |
| Problem solving     | Resolución razonada a los problemas propuestos                       |
| Directed discussion | Ante cuestiones planteadas, discusión de las distintas alternativas. |
| Oral presentation   | Exposición de los conceptos teóricos                                 |
| Objective test      | acorde a los conceptos a desarrollar                                 |
| Workbook            | De la amplia bibliografía proporcionada                              |
| Document analysis   | De acuerdo con el contenido                                          |
| Seminar             | Inciendo en aspectos de interés particular                           |

| Personalized attention |                                                                                                                                                                                                             |
|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Methodologies          | Description                                                                                                                                                                                                 |
| Seminar                | Practices with electrical panels that implement the assembly of circuits after the design.                                                                                                                  |
| ICT practicals         | After the delivery of the bulletins of the problem, giving time to the resolution on the part of the students, they will be solved in the classroom, clarifying the doubts.                                 |
| Laboratory practice    | Directed discussion seeks to raise issues whose solution involves knowledge of the topic discussed above.                                                                                                   |
| Problem solving        | The oral presentation will consist of the explanatory development of the subjects of the subject, by the teacher, using various educational resources.                                                      |
| Directed discussion    |                                                                                                                                                                                                             |
| Oral presentation      |                                                                                                                                                                                                             |
| Objective test         | The objective test will usually include the development of theoretical questions, problems, and the elaboration of electrical diagrams.                                                                     |
| Workbook               | The reading will be about technical articles in English on the content of the subject.<br>The seminars will be held with small groups that will address a topic and encourage participation and group work. |

| Assessment     |              |                                                                            |               |
|----------------|--------------|----------------------------------------------------------------------------|---------------|
| Methodologies  | Competencies | Description                                                                | Qualification |
| Seminar        | B9 C3 C8     | Seminario Inciando en aspectos de interés particular                       | 5             |
| ICT practicals | A2 B4 C3     | Prácticas a través de TIC De acuerdo con el interés individual o del grupo | 10            |



|                     |                                                        |                                                                                         |    |
|---------------------|--------------------------------------------------------|-----------------------------------------------------------------------------------------|----|
| Laboratory practice | A6 A7 A9 A13 A14 B5<br>B7 B12 B13 B14 B15<br>B16 C1 C9 | Prácticas de laboratorio Complementarias a los realizadas en los cursos anteriores      | 5  |
| Problem solving     | B9 C6                                                  | Solución de problemas Resolución razonada a los problemas propuestos                    | 5  |
| Directed discussion | A5 B2 B5 B7 C8                                         | Discusión dirixida Ante cuestiones planteadas, discusión de las distintas alternativas. | 5  |
| Oral presentation   | A2 A5 B5                                               | Presentación oral: Exposición de los conceptos teóricos                                 | 5  |
| Objective test      | B2 C3 C6                                               | Proba obxectiva : acorde a los conceptos a desarrollar                                  | 60 |
| Workbook            | A5                                                     | Lecturas De la amplia bibliografía proporcionada                                        | 5  |

## Assessment comments

The percentages are only a first approximation. The evaluation criteria set out in Table A-III / 2 of the STCW Code and included in the Quality Assurance System will be taken into account when designing and conducting the evaluation. The assessment is to verify the specific competencies A2-A5-A6-A7-A14 and the transversal type B: B2-B4-B5

The evaluation criteria set out in Tables A-III / 1 and A-III / 3 of the STCW, and included in the quality assurance system, are taken into account so that students with recognition of part-time dedication and academic exemption exemption from attendance , as established by the "RULE THAT REGULATES OR RULES OF DEDICATION TO STUDY TWO UNDERGRADUATE STUDENTS IN THE UDC (Art. 2.3; 3. b; 4.3 and 7.5) (05/04/2017): possibility to get a 100% grade.

The student is reminded of the importance of deadlines when submitting work, as well as the importance of complying with the rules and regulations of the UDC, and referencing all documentation and content not prepared by the student. Specifically, the fraudulent performance of the tests or evaluation activities, once verified, will directly imply the qualification of failing "0" in the subject, in the corresponding call, thus invalidating any qualification obtained in all the evaluation activities for the extraordinary summons

## Sources of information

|                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Basic</b>         | <ul style="list-style-type: none"> <li>- Alf Kare Adnanes (2003). Maritime Electrical Installations and Diesel Electric Propulsion. Oslo. ABB AS Marine</li> <li>- Damir Radan (). Power Electronic Converters for ships propulsion electric motors.</li> <li>- Faure Benito, Roberto (2000). Máquinas y accionamientos eléctricos. Madrid. FEIN</li> <li>- Borrás Formoso (2011). Apuntes de Propulsión eléctrica naval.</li> <li>- Lena Bergh (2007). Electrical systems in pod propulsion. Goteborg-Chalmers University</li> <li>- AENOR (). UNE21-135-501.Instalaciones Eléctricas en Buques.Planta de propulsión Eléctrica. Madrid</li> <li>- Fraile Mora, J. (2008). Máquinas eléctricas. 6a ed. Madrid: McGraw-Hill, 2008.. Madrid: McGraw-Hill</li> </ul> <p>Se proyectarán los videos elaborados por "Videotel Marine International" relacionados con el contenido de la materia.Se subirán a Moodle los contenidos complementarios necesarios para el correcto seguimiento de la asignatura</p> |
| <b>Complementary</b> | <ul style="list-style-type: none"> <li>- Lena Bergh (2007). Electrical systems in pod propulsion. Goteborg. Suecia. Chalmers University of Tecnology</li> <li>- Bobby A. Bassham (2003). Evaluation of electric motors for ship propulsion. Monterey.California.Naval Postgraduate School.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

## Recommendations

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

Electrotechnology, Electrical Machinery and Electronic Systems for Vessels/631G02253

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### Subjects that are recommended to be taken simultaneously



|                                                                                                                                                                                                                                                                                                               |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                                                                                                                                               |
| Subjects that continue the syllabus                                                                                                                                                                                                                                                                           |
|                                                                                                                                                                                                                                                                                                               |
| Other comments                                                                                                                                                                                                                                                                                                |
| <p>Complemento a las asignaturas previamente cursadas</p> <p>Sería conveniente tener conocimientos de la hoja de cálculo Excel.</p> <p>Se propondrá la elaboración de una aplicación simulando la evolución de parámetros según distintos modos de operación de una planta de propulsión eléctrica naval.</p> |

(\*)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.