Course guides
280685 - 280685 - Maintenance and Repair of Equipment and Electric Systems on Board

Unit in charge: Barcelona School of Nautical Studies
Teaching unit: 709 - DEE - Department of Electrical Engineering.
Degree: BACHELOR'S DEGREE IN MARINE TECHNOLOGIES (Syllabus 2010). (Optional subject).
Academic year: 2021  ECTS Credits: 6.0  Languages: Catalan, Spanish

LECTURER
Coordinating lecturer: VICTOR FUSES NAVARRA
Others: Segon quadrimestre:
        VICTOR FUSES NAVARRA - GTMDT

REQUIREMENTS
To register this subject, it must be approved:
280641 Electricity and electrical engineering
280660 Electric propulsion and power electronics, or, 280665 Vessel Power Plant.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
GTM.CE24. Knowledge of the organization and project management of repair, installation, modification, redesign and maintenance of machines and systems of ships, within the scope of its special ad, ie, operation and exploitation.

General:  
CG8. IDENTIFY I resoldre Capacitat PER L'Ambit problemes IN MARINA DE L'ENGINYERIA. Capacitat per the plantejament i resolució of problemes de l'ambi enginyeria assumint marina iniciatives, prenent decisions i aplicant solucions creatives in the marc d'a systematic methodology.

Transversal:  
AAT N2. SELF-DIRECTED LEARNING - Level 2: Completing set tasks based on the guidelines set by lecturers. Devoting the time needed to complete each task, including personal contributions and expanding on the recommended information sources.
STCW:
ETO.1. A-III/6-1.1 Monitor the operation of electrical, electronic and control systems
ETO.2. A-III/6-KUP 1.1.1.6 Basic understanding of the operation of mechanical engineering systems, including: .6 hotel systems
ETO.3. A-III/6-KUP 1.1.2 Basic knowledge of heat transmission, mechanics and hydromechanics
ETO.4. A-III/6-KUP 1.1.3 Knowledge of Electrotechnology and electrical machines theory
ETO.5. A-III/6-KUP 1.1.4 Knowledge of Fundamentals of electronics and power electronics
ETO.6. A-III/6-KUP 1.1.5 Knowledge of: Electrical power distribution boards and electrical equipment
ETO.7. A-III/6-KUP 1.1.6 Knowledge of: Fundamentals of automation, automatic control systems and technology
ETO.8. A-III/6-KUP 1.1.7 Knowledge of: Instrumentation, alarm and monitoring systems
ETO.9. A-III/6-KUP 1.1.8 Knowledge of: Electrical drives
ETO.10. A-III/6-KUP 1.1.9 Knowledge of: Technology of electrical materials
ETO.11. A-III/6-KUP 1.1.10 Knowledge of: Electrohydraulic and electro-pneumatic control systems
ETO.12. A-III/6-KUP 1.1.11 Knowledge of: Appreciation of the hazards and precautions required for the operation of power systems above 1,000 volts
ETO.13. A-III/6- 1.3 Operate generators and distribution systems
ETO.14. A-III/6-KUP 1.3.1 Coupling, load sharing and changing over generators
ETO.15. A-III/6-KUP 1.3.2 Coupling and breaking connection between switchboards and distribution
ETO.16. A-III/6-2.1 Maintenance and repair of electrical and electronic equipment
ETO.17. A-III/6-KUP 2.1.1 Safety requirements for working on shipboard electrical systems, including the safe isolation of electrical equipment required before personnel are permitted to work on such equipment
ETO.18. A-III/6-CCS 2.1.2 Maintenance and repair of electrical system equipment, switchboards, electric motors, generators and DC electrical systems and equipment
ETO.19. A-III/6-CCS 2.1.3 Detection of electric malfunction, location of faults and measures to prevent damage
ETO.20. A-III/6-CCS 2.1.4 Construction and operation of electrical testing and measuring equipment
ETO.21. A-III/6-CCS 2.1.5.1 Function and performance tests of the following equipment and their configuration: .1 monitoring systems
ETO.22. A-III/6-CCS 2.1.5.2 Function and performance tests of the following equipment and their configuration: .2 automatic control devices
ETO.23. A-III/6-CCS 2.1.5.3 Function and performance tests of the following equipment and their configuration: .3 protective devices
ETO.24. A-III/6-CCS 2.1.5.4 Function and performance tests of the following equipment and their configuration: .4 The interpretation of electrical and electronic diagrams
ETO.25. A-III/6-2.2 Maintenance and repair of automation and control systems of main propulsion and auxiliary machinery
ETO.26. A-III/6-CCS 2.2.1 Appropriate electrical and mechanical knowledge and skills
ETO.27. A-III/6-CCS 2.2.2 Safety and emergency procedures: Safe isolation of equipment and associated systems required before personnel are permitted to work on such plant or equipment
ETO.28. A-III/6-CCS 2.2.3 Safety and emergency procedures: Practical knowledge for the testing, maintenance, fault finding and repair
ETO.29. A-III/6-CCS 2.2.4 Safety and emergency procedures: Test, detect faults and maintain and restore electrical and electronic control equipment to operating condition
ETO.30. A-III/6-CCS 2.3.2 Theoretical knowledge: Electrical and electronic systems operating in flammable areas
ETO.31. A-III/6-2.4 Maintenance and repair of electrical, electronic and control
ETO.32. systems of deck machinery and cargohandling equipment
ETO.33. A-III/6-CCS 2.4.1 Appropriate electrical and mechanical knowledge and skills
ETO.34. A-III/6-CCS 2.4.2 Safety and emergency procedures: Safe isolation of equipment and associated systems required before personnel are permitted to work on such plant or equipment
ETO.35. A-III/6-CCS 2.4.3 Safety and emergency procedures: Practical knowledge for the testing, maintenance, fault finding and repair
ETO.36. A-III/6-CCS 2.4.4 Safety and emergency procedures: Test, detect faults and maintain and restore electrical and electronic control equipment to operating condition
ETO.37. A-III/6-2.5 Maintenance and repair of control and safety systems of hotel equipment
ETO.38. A-III/6-CCS 2.5.1 Theoretical knowledge: Electrical and electronic systems operating in flammable areas
ETO.39. A-III/6-CCS 2.5.2 Practical knowledge: Carrying out safe maintenance and repair procedures
TEACHING METHODOLOGY

- Receive, understand and synthesize knowledge.
- Analysis of real applications.
- Define and solve problems.
- Application of theoretical knowledge to the maintenance of electrical systems.
- Perform work individually.

LEARNING OBJECTIVES OF THE SUBJECT

- Understand and apply the norms or technical regulations.
- Use the electrical diagrams as an inspection and maintenance tool.
- Know the different types of maintenance applicable.
- Apply procedures for early detection of breakdowns.
- Know the security procedures.
- Understand the properties of the materials and the electrical installations in case of fire.

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Hours large group</td>
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<td>Hours medium group</td>
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<td>Hours small group</td>
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<tr>
<td>Self study</td>
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<tr>
<td>Guided activities</td>
<td>5.0</td>
<td>3.33</td>
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Total learning time: 150 h

CONTENTS

1. Electric Technical Regulations. Electrical testing and measuring equipment

Description:
UNE, IEC, etc. Standardization committees, classification societies. Safety requirements. Electrical working authorisations. Safe isolation equipment. Examples of test regulations: power switches, insulators, conductors, generators, etc. Electrical testing and measuring equipment.

Specific objectives:
Use of basic measuring instruments: voltmeter, clamp ammeter, shunt resistor, megahmmeter, ohmmeter, continuity, millimeter, Kelvin connection, oscilloscope.

Related activities:
Use the laboratory of measuring equipment. Research work on commercial measuring equipment.

Related competencies:
A36-2.1.4. A-III/6-CCS 2.1.4 Construction and operation of electrical testing and measuring equipment
A36-1.1.7. A-III/6-KUP 1.1.7 Knowledge of: Instrumentation, alarm and monitoring systems
A36-1.1.5. A-III/6-KUP 1.1.5 Knowledge of: Electrical power distribution boards and electrical equipment

Full-or-part-time: 4h
Theory classes: 2h
Laboratory classes: 1h
Guided activities: 1h

Description:

Specific objectives:
Identification of neutral regime and its implications for electrical safety and adequate protections.

Related activities:
Elaboration of the electrical scheme of a simple installation.
Directed work on electrical protections and neutral regimes.
Electrical protection laboratory test.

Related competencies:
A36-2.4.4. A-III/6-CCS 2.4.3 Safety and emergency procedures: Practical knowledge for the testing, maintenance, fault finding and repair
A36-2.1.5d. A-III/6-CCS 2.1.5.4 Function and performance tests of the following equipment and their configuration: .4 The interpretation of electrical and electronic diagrams
A36-1.1.7. A-III/6-KUP 1.1.7 Knowledge of: Instrumentation, alarm and monitoring systems
A36-2.1.5c. A-III/6-CCS 2.1.5.3 Function and performance tests of the following equipment and their configuration: .3 protective devices
A36-2.1.5a. A-III/6-CCS 2.1.5.1 Function and performance tests of the following equipment and their configuration: .1 monitoring systems
A36-2.1.5b. A-III/6-CCS 2.1.5.2 Function and performance tests of the following equipment and their configuration: .2 automatic control devices
A36-2.2.4. A-III/6-CCS 2.2.4 Safety and emergency procedures: Test, detect faults and maintain and restore electrical and electronic control equipment to operating condition

Full-or-part-time: 6h
Theory classes: 3h
Laboratory classes: 1h
Guided activities: 2h
## 3- Maintenance

**Description:**


**Related activities:**
Analysis work on some electrical equipment or installations.
First outline of maintenance plan.

**Related competencies:**
A36-2.5.1. A-III/6-2.5 Maintenance and repair of control and safety systems of hotel equipment
A36-2.1.2. A-III/6-CCS 2.1.2 Maintenance and repair of electrical system equipment, switchboards, electric motors, generators and DC electrical systems and equipment
A36-2.2.1. A-III/6-CCS 2.2.1 Appropriate electrical and mechanical knowledge and skills
A36-2.4.1. systems of deck machinery and cargohandling equipment
A36-1.1.0. A-III/6-1.1 Monitor the operation of electrical, electronic and control systems

**Full-or-part-time:** 6h
Theory classes: 4h
Guided activities: 2h
4. Premature fault detection

Description:

Related activities:
Tests for fault detection.
Writing an inspection report, or breakdown, or accident.

Related competencies:
A36-2-5.3. A-III/6-CCS 2.5.2 Practical knowledge: Carrying out safe maintenance and repair procedures
A36-2.4.4. A-III/6-CCS 2.4.3 Safety and emergency procedures: Practical knowledge for the testing, maintenance, fault finding and repair
A36-2.1.4. A-III/6-CCS 2.1.4 Construction and operation of electrical testing and measuring equipment
A36-2.1.5d. A-III/6-CCS 2.1.5.4 Function and performance tests of the following equipment and their configuration: the interpretation of electrical and electronic diagrams
A36-2.4.3. A-III/6-CCS 2.4.2 Safety and emergency procedures: Safe isolation of equipment and associated systems required before personnel are permitted to work on such plant or equipment
A36-2.5.2. A-III/6-CCS 2.5.1 Theoretical knowledge: Electrical and electronic systems operating in flammable areas
A36-2.1.5c. A-III/6-CCS 2.1.5.3 Function and performance tests of the following equipment and their configuration: protective devices
A36-2.1.5a. A-III/6-CCS 2.1.5.1 Function and performance tests of the following equipment and their configuration: monitoring systems
A36-2.1.5b. A-III/6-CCS 2.1.5.2 Function and performance tests of the following equipment and their configuration: automatic control devices
A36-2.2.4. A-III/6-CCS 2.2.4 Safety and emergency procedures: Test, detect faults and maintain and restore electrical and electronic control equipment to operating condition
A36-2.2.3. A-III/6-CCS 2.2.3 Safety and emergency procedures: Practical knowledge for the testing, maintenance, fault finding and repair
A36-2.1.3. A-III/6-CCS 2.1.3 Detection of electric malfunction, location of faults and measures to prevent damage
A36-1.1.0. A-III/6-1.1 Monitor the operation of electrical, electronic and control systems

Full-or-part-time: 8h
Theory classes: 4h
Laboratory classes: 4h

5. Knowledge and behaviour of materials.

Description:

Related activities:
Research work on devices and market elements on corrosion, ATEX equipment, roofing materials, inn equipment materials.

Related competencies:
A36-2-5.3. A-III/6-CCS 2.5.2 Practical knowledge: Carrying out safe maintenance and repair procedures
A36-2.1.4. A-III/6-CCS 2.1.4 Construction and operation of electrical testing and measuring equipment
A36-2.1.2. A-III/6-CCS 2.1.2 Maintenance and repair of electrical system equipment, switchboards, electric motors, generators and DC electrical systems and equipment
A36-2.3.2. A-III/6-CCS 2.3.2 Theoretical knowledge: Electrical and electronic systems operating in flammable areas
A36-1.1.0. A-III/6-1.1 Monitor the operation of electrical, electronic and control systems

Full-or-part-time: 4h
Theory classes: 4h
#### 6. Operation in degraded modes

**Description:**
Study of cases:
- Recovery of a "electric lock out".
- Management of large electrical collapses.
- Load sharing, coupling and breaking.

**Related activities:**
- 50 kW plant start-up laboratory test, mains synchronization, frequency and voltage stability, protection tripping, load transfer.

**Related competencies:**
- A36-1.3.1. A-III/6-KUP 1.3.1 Coupling, load sharing and changing over generators
- A36-1.3.0. A-III/6- 1.3 Operate generators and distribution systems
- A36-1.3.2. A-III/6-KUP 1.3.2 Coupling and breaking connection between switchboards and distribution
- A36-1.1.0. A-III/6-1.1 Monitor the operation of electrical, electronic and control systems

**Full-or-part-time:** 10h
- Laboratory classes: 8h
- Guided activities: 2h

#### 7. Repairs

**Description:**

**Related activities:**
- Laboratory test on electrical panel with motor and drives. Capacitor refurbishment. Batteries.

**Related competencies:**
- A36-2-5.3. A-III/6-CCS 2.5.2 Practical knowledge: Carrying out safe maintenance and repair procedures
- A36-2.4.4. A-III/6-CCS 2.4.3 Safety and emergency procedures: Practical knowledge for the testing, maintenance, fault finding and repair
- A36-2.1.4. A-III/6-CCS 2.1.4 Construction and operation of electrical testing and measuring equipment
- A36-2.1.5d. A-III/6-CCS 2.1.5.4 Function and performance tests of the following equipment and their configuration: .4 The interpretation of electrical and electronic diagrams
- A36-2.1.2. A-III/6-CCS 2.1.2 Maintenance and repair of electrical system equipment, switchboards, electric motors, generators and DC electrical systems and equipment
- A36-2.4.3. A-III/6-CCS 2.4.2 Safety and emergency procedures: Safe isolation of equipment and associated systems required before personnel are permitted to work on such plant or equipment
- A36-2.5.2. A-III/6-CCS 2.5.1 Theoretical knowledge: Electrical and electronic systems operating in flammable areas
- A36-2.2.1. A-III/6-CCS 2.2.1 Appropriate electrical and mechanical knowledge and skills
- A36-2.4.1. systems of deck machinery and cargohandling equipment
- A36-2.2.4. A-III/6-CCS 2.2.4 Safety and emergency procedures: Test, detect faults and maintain and restore electrical and electronic control equipment to operating condition
- A36-2.2.3. A-III/6-CCS 2.2.3 Safety and emergency procedures: Practical knowledge for the testing, maintenance, fault finding and repair
- A36-1.1.0. A-III/6-1.1 Monitor the operation of electrical, electronic and control systems

**Full-or-part-time:** 10h
- Theory classes: 8h
- Laboratory classes: 2h
8. Safety procedures

Description:

Specific objectives:
Writing electrically safe work procedures.

Related activities:
Risk identification activity.
Case study on the development of safe work procedures.
Manipulation, verification and use of the most important PPE

Related competencies:
A36-2.4.2. A-III/6-CCS 2.4.1 Appropriate electrical and mechanical knowledge and skills
A36-2.5.2. A-III/6-CCS 2.5.1 Theoretical knowledge: Electrical and electronic systems operating in flammable areas
A36-2.2.1. A-III/6-CCS 2.2.1 Appropriate electrical and mechanical knowledge and skills
A36-2.1.1. A-III/6-KUP 2.1.1 Safety requirements for working on shipboard electrical systems, including the safe isolation of electrical equipment required before personnel are permitted to work on such equipment
A36-2.2.2. A-III/6-CCS 2.2.2 Safety and emergency procedures: Safe isolation of equipment and associated systems required before personnel are permitted to work on such plant or equipment
A36-2.4.1. systems of deck machinery and cargo handling equipment

Full-or-part-time: 6h
Theory classes: 2h
Laboratory classes: 2h
Guided activities: 2h

9. Fires of electrical origin

Description:

Related activities:
Exercise to identify ignition mechanisms and propose corrective measures.
Fire case assessment.
Laboratory: Inspection of materials involved in fires

Related competencies:
A36-2.5.1. A-III/6-2.5 Maintenance and repair of control and safety systems of hotel equipment
A36-2.4.2. A-III/6-CCS 2.4.1 Appropriate electrical and mechanical knowledge and skills
A36-1.1.7. A-III/6-KUP 1.1.7 Knowledge of: Instrumentation, alarm and monitoring systems
A36-2.1.1. A-III/6-KUP 2.1.1 Safety requirements for working on shipboard electrical systems, including the safe isolation of electrical equipment required before personnel are permitted to work on such equipment
A36-2.2.2. A-III/6-CCS 2.2.2 Safety and emergency procedures: Safe isolation of equipment and associated systems required before personnel are permitted to work on such plant or equipment
A36-1.1.9. A-III/6-KUP 1.1.9 Knowledge of: Technology of electrical materials

Full-or-part-time: 6h
Theory classes: 4h
Laboratory classes: 2h
GRADING SYSTEM

The final grade is the sum of the following partial grades:
\[ N_{\text{final}} = 0.2 \times N_{\text{pf}} + 0.8 \times N_{\text{ac}} \]

\( N_{\text{final}} \): final grade.
\( N_{\text{pf}} \): final evaluation grade.
\( N_{\text{ac}} \): grade for continuous evaluation and directed activities.

The continuous evaluation consists of different cumulative activities, both individual and group, of a formative nature, carried out during the course (in the classroom and outside of it), exams, work, practical and laboratory activities, etc.

Demonstration criteria for STCW competence: approved training in the electricity laboratory

EXAMINATION RULES.

- Assistance and completion of laboratory practices is mandatory.
- If any of the laboratory activities or continuous evaluation is not carried out, it will be considered as not punctuated.
- Will be considered Not Submitted: Who has not attended or has a global grade lower than 0.5 points.
- In no case you can have forms in the learning controls or exams.
- In exams only calculator and pens are allowed.
- The use of mobile phones is not allowed.

BIBLIOGRAPHY

Basic:

Complementary:

RESOURCES

Other resources:
Notes and technical articles contributed by the professor.
Regulations of the Classification Societies.
Dossiers of manufacturers: Electra Molins, ABB, Siemens, Schneider Electric.