Course guides
280641 - 280641 - Electricity and Electrotechnics

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). (Compulsory subject).
BACHELOR’S DEGREE IN NAVAL SYSTEMS AND TECHNOLOGY ENGINEERING (Syllabus 2010). (Compulsory subject).
Academic year: 2021  ECTS Credits: 6.0  Languages: Catalan, Spanish

LECTURER

Coordinating lecturer: CARLES BOU

Others:
- Primer quadrimestre:
  - CARLES BOU - DT, GESTN, GTM
  - JAVIER CORCUERA GIMENO - DT, GESTN, GTM
  - VICTOR FUSES NAVARRA - DT, GESTN, GTM
  - SAMUEL GALCERAN ARELLANO - DT, GESTN, GTM
  - PEDRO IGNACIO MUÑOZ HERNANDEZ - DT, GESTN, GTM
  - VICENÇ RODRIGUEZ BARRAGUER - DT, GESTN, GTM

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
GTM.CE7. Knowledge of circuit theory and electrical characteristics of marine machinery and capacity to implement the operation and operation of the ship of this knowledge.
GESTN.CE9. Knowledge of circuit theory and the characteristics of electrical machines and ability to perform calculations for systems involving these elements.

Transversal:
TEQ N2. TEAMWORK - Level 2. Contributing to the consolidation of a team by planning targets and working efficiently to favor communication, task assignment and cohesion.
STCW:
ME.1. A-III/1-2. Function: Electrical, electronic and control engineering at the operational level
ME.2. A-III/1-2.1 Operate electrical, electronic and control systems
ME.3. A-III/1-KUP 2.1.1.1 Basic configuration and operation principles of the following electrical, electronic and control equipment: .1 electrical equipment: .a) generator and distribution systems, .b) preparing, starting, paralleling and changing over generators, .c) electrical motors including starting methodologies,.d) highvoltage Installations, .e) sequential control circuits and associated system devices
ME.4. A-III/1-2.2 Maintenance and repair of electrical and electronic equipment
ME.5. A-III/1-KUP 2.2.1 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
ME.6. A-III/1-KUP 2.2.2 Maintenance and repair of electrical System equipment, switchboards, electric motors, generator and DC electrical systems and equipment
ME.7. A-III/1-KUP 2.2.3 Detection of electric malfunction, location of faults and measures to prevent damage
ME.8. A-III/1-KUP 2.2.4 Construction and operation of electrical testing and measuring equipment
ME.9. A-III/1-KUP 2.2.5.1 Function and performance tests of the following equipment and their configuration: .1 monitoring systems
ME.10. A-III/1-KUP 2.2.5.2 Function and performance tests of the following equipment and their configuration: .2 automatic control devices
ME.11. A-III/1-KUP 2.2.5.3 Function and performance tests of the following equipment and their configuration: .3 protective devices
ME.12. A-III/1-KUP 2.2.6 The interpretation of electrical and simple electronic diagrams
ETO.1. A-III/6-1. Function: Electrical, electronic and control engineering at the operational level
ETO.2. A-III/6-1.1 Monitor the operation of electrical, electronic and control systems
ETO.3. A-III/6-KUP 1.1.3 Knowledge of Electrotechnology and electrical machines theory
ETO.4. A-III/6-KUP 1.1.5 Knowledge of: Electrical power distribution boards and electrical equipment
ETO.5. A-III/6-KUP 1.1.8 Knowledge of: Electrical drives
ETO.6. A-III/6-KUP 1.1.9 Knowledge of: Technology of electrical materials

TEACHING METHODOLOGY
- Receive, understand and synthesize knowledge.
- Define and solve problems.
- Develop critical thinking and reasoning and defend it both in oral and in writing.
- Perform work individually.

LEARNING OBJECTIVES OF THE SUBJECT
- Understand the circuit theory fundamentals.
- Introduction to different types of electric machines and applications.
- Introduction to electrical installations of the ship.
- Be able to compute and solve basic electrical circuits and use equivalent schemes of electrical machines for problem solving and troubleshooting.
- Understand electrical systems and be able to explain them through plans and instructions
- Select tools, measuring instruments and devices for testing. Interpret the results correctly
- Work in line with manuals and good practices

STUDY LOAD

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<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
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<tr>
<td>Self study</td>
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<td>Guided activities</td>
<td>5,0</td>
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</tr>
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</table>

Total learning time: 150 h
## CONTENTS

### 1. Characteristics and laws of electrical circuits

**Description:**

**Related competencies:**
- A36-1.1.9. A-III/6-KUP 1.1.9 Knowledge of: Technology of electrical materials
- A36-1.1.3. A-III/6-KUP 1.1.3 Knowledge of Electrotechnology and electrical machines theory
- A31-2.2.6. A-III/1-KUP 2.2.6 The interpretation of electrical and simple electronic diagrams
- A31-2.1.1a. A-III/1-KUP 2.1.1.1 Basic configuration and operation principles of the following electrical, electronic and control equipment: .1 electrical equipment: .a) generator and distribution systems, .b) preparing, starting, paralleling and changing over generators , .c) electrical motors including starting methodologies,.d) highvoltage Installations, .e) sequential control circuits and associated system devices

**Full-or-part-time:** 15h  
Theory classes: 2h  
Laboratory classes: 2h  
Guided activities: 1h  
Self study : 10h

### 2. Circuit analysis

**Description:**

**Related competencies:**
- A36-1.1.5. A-III/6-KUP 1.1.5 Knowledge of: Electrical power distribution boards and electrical equipment
- A36-1.1.9. A-III/6-KUP 1.1.9 Knowledge of: Technology of electrical materials
- A36-1.1.3. A-III/6-KUP 1.1.3 Knowledge of Electrotechnology and electrical machines theory
- A31-2.2.3. A-III/1-KUP 2.2.3 Detection of electric malfunction, location of faults and measures to prevent damage
- A31-2.1.1a. A-III/1-KUP 2.1.1.1 Basic configuration and operation principles of the following electrical, electronic and control equipment: .1 electrical equipment: .a) generator and distribution systems, .b) preparing, starting, paralleling and changing over generators , .c) electrical motors including starting methodologies,.d) highvoltage Installations, .e) sequential control circuits and associated system devices
- A36-1.1.8. A-III/6-KUP 1.1.8 Knowledge of: Electrical drives
- A31-2.2.1. A-III/1-KUP 2.2.1 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

**Full-or-part-time:** 16h  
Theory classes: 2h  
Laboratory classes: 2h  
Guided activities: 2h  
Self study : 10h
3. Dynamic elements

**Description:**

**Related competencies:**
A36-1.1.5. A-III/6-KUP 1.1.5 Knowledge of: Electrical power distribution boards and electrical equipment
A36-1.1.9. A-III/6-KUP 1.1.9 Knowledge of: Technology of electrical materials
A36-1.1.3. A-III/6-KUP 1.1.3 Knowledge of Electrotechnology and electrical machines theory
A31-2.2.5b. A-III/1-KUP 2.2.5.2 Function and performance tests of the following equipment and their configuration: .2 automatic control devices
A31-2.2.5a. A-III/1-KUP 2.2.5.1 Function and performance tests of the following equipment and their configuration: .1 monitoring systems
A31-2.2.5c. A-III/1-KUP 2.2.5.3 Function and performance tests of the following equipment and their configuration: .3 protective devices
A31-2.2.1. A-III/1-KUP 2.2.1.1 Basic configuration and operation principles of the following electrical, electronic and control equipment: .1 electrical equipment: .a) generator and distribution systems, .b) preparing, starting, paralleling and changing over generators, .c) electrical motors including starting methodologies,.d) highvoltage Installations, .e) sequential control circuits and associated system devices
A31-2.2.4. A-III/1-KUP 2.2.4 Construction and operation of electrical testing and measuring equipment
A31-2.2.1. A-III/1-KUP 2.2.1 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

**Full-or-part-time:** 14h
Theory classes: 2h
Guided activities: 2h
Self study : 10h

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4. AC circuits analysis

**Description:**
Knowledge about electrical distribution systems, their components and protection devices:

**Related competencies:**
A36-1.1.3. A-III/6-KUP 1.1.3 Knowledge of Electrotechnology and electrical machines theory
A31-2.2.5b. A-III/1-KUP 2.2.5.2 Function and performance tests of the following equipment and their configuration: .2 automatic control devices
A31-2.2.5a. A-III/1-KUP 2.2.5.1 Function and performance tests of the following equipment and their configuration: .1 monitoring systems
A31-2.2.3. A-III/1-KUP 2.2.3 Detection of electric malfunction, location of faults and measures to prevent damage
A31-2.2.1. A-III/1-KUP 2.2.1.1 Basic configuration and operation principles of the following electrical, electronic and control equipment: .1 electrical equipment: .a) generator and distribution systems, .b) preparing, starting, paralleling and changing over generators, .c) electrical motors including starting methodologies,.d) highvoltage Installations, .e) sequential control circuits and associated system devices
A31-2.2.5c. A-III/1-KUP 2.2.5.3 Function and performance tests of the following equipment and their configuration: .3 protective devices
A31-2.2.4. A-III/1-KUP 2.2.4 Construction and operation of electrical testing and measuring equipment
A31-2.2.1. A-III/1-KUP 2.2.1 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

**Full-or-part-time:** 20h
Theory classes: 6h
Laboratory classes: 2h
Guided activities: 2h
Self study : 10h
5. Three-phase circuits

**Description:**
Knowledge about electrical distribution systems, their components and protection devices (these knowledge are necessary according to STCW code):
Three-phase generation systems, load connection star (Y) and delta (D), three-phase relationships, monophasic equivalences, star-delta transformation, balanced and unbalanced loads, power measurements.

**Related competencies:**
A36-1.1.5. A-III/6-KUP 1.1.5 Knowledge of: Electrical power distribution boards and electrical equipment
A36-1.1.9. A-III/6-KUP 1.1.9 Knowledge of: Technology of electrical materials
A36-1.1.3. A-III/6-KUP 1.1.3 Knowledge of Electrotechnology and electrical machines theory
A31-2.2.5b. A-III/1-KUP 2.2.5.2 Function and performance tests of the following equipment and their configuration: .2 automatic control devices
A31-2.2.5a. A-III/1-KUP 2.2.5.1 Function and performance tests of the following equipment and their configuration: .1 monitoring systems
A31-2.2.3. A-III/1-KUP 2.2.3 Detection of electric malfunction, location of faults and measures to prevent damage
A31-2.1.1a. A-III/1-KUP 2.1.1.1 Basic configuration and operation principles of the following electrical, electronic and control equipment: .1 electrical equipment: .a) generator and distribution systems, .b) preparing, starting, paralleling and changing over generators, .c) electrical motors including starting methodologies,.d) highvoltage Installations, .e) sequential control circuits and associated system devices
A31-2.2.5c. A-III/1-KUP 2.2.5.3 Function and performance tests of the following equipment and their configuration: .3 protective devices
A31-2.2.4. A-III/1-KUP 2.2.4 Construction and operation of electrical testing and measuring equipment
A31-2.2.1. A-III/1-KUP 2.2.1 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

**Full-or-part-time:** 20h
Theory classes: 6h
Laboratory classes: 3h
Guided activities: 1h
Self study: 10h
6. Electrical installations

Description:
Knowledge about electrical distribution systems, their components and protection devices (these knowledge are necessary according to STCW code):
Calculation of electrical installations. Shortcircuits.

Related competencies:
A36-1.1.5. A-III/6-KUP 1.1.5 Knowledge of: Electrical power distribution boards and electrical equipment
A31-2.2.5b. A-III/1-KUP 2.2.5.2 Function and performance tests of the following equipment and their configuration: .2 automatic control devices
A31-2.2.5a. A-III/1-KUP 2.2.5.1 Function and performance tests of the following equipment and their configuration: .1 monitoring systems
A31-2.2.3. A-III/1-KUP 2.2.3 Detection of electric malfunction, location of faults and measures to prevent damage
A31-2.1.1a. A-III/1-KUP 2.1.1.1 Basic configuration and operation principles of the following electrical, electronic and control equipment: .1 electrical equipment: .a) generator and distribution systems, .b) preparing, starting, paralleling and changing over generators, .c) electrical motors including starting methodologies, .d) highvoltage Installations, .e) sequential control circuits and associated system devices
A31-2.2.2. A-III/1-KUP 2.2.2 Maintenance and repair of electrical System equipment, switchboards, electric motors, generator and DC electrical systems and equipment
A31-2.2.5c. A-III/1-KUP 2.2.5.3 Function and performance tests of the following equipment and their configuration: .3 protective devices
A31-2.2.4. A-III/1-KUP 2.2.4 Construction and operation of electrical testing and measuring equipment
A31-2.2.1. A-III/1-KUP 2.2.1 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

Full-or-part-time: 14h
Theory classes: 3h
Guided activities: 1h
Self study: 10h

7. Protections

Description:
Knowledge about electrical distribution systems, their components and protection devices.

Related competencies:
A36-1.1.5. A-III/6-KUP 1.1.5 Knowledge of: Electrical power distribution boards and electrical equipment
A36-1.1.9. A-III/6-KUP 1.1.9 Knowledge of: Technology of electrical materials
A31-2.2.5b. A-III/1-KUP 2.2.5.2 Function and performance tests of the following equipment and their configuration: .2 automatic control devices
A31-2.2.5a. A-III/1-KUP 2.2.5.1 Function and performance tests of the following equipment and their configuration: .1 monitoring systems
A31-2.2.3. A-III/1-KUP 2.2.3 Detection of electric malfunction, location of faults and measures to prevent damage
A31-2.2.5c. A-III/1-KUP 2.2.5.3 Function and performance tests of the following equipment and their configuration: .3 protective devices

Full-or-part-time: 16h
Theory classes: 4h
Laboratory classes: 1h
Guided activities: 1h
Self study: 10h
8. Transformers

Description:
Knowledge about electrical distribution systems, their components and protection devices (these knowledge are necessary according to STCW code):

Related competencies:
A36-1.1.9. A-III/6-KUP 1.1.9 Knowledge of: Technology of electrical materials
A36-1.1.3. A-III/6-KUP 1.1.3 Knowledge of Electrotechnology and electrical machines theory
A31-2.1.1a. A-III/1-KUP 2.1.1.1 Basic configuration and operation principles of the following electrical, electronic and control equipment: .1 electrical equipment: .a) generator and distribution systems, .b) preparing, starting, paralleling and changing over generators, .c) electrical motors including starting methodologies,.d) highvoltage Installations, .e) sequential control circuits and associated system devices
A31-2.2.2. A-III/1-KUP 2.2.2 Maintenance and repair of electrical System equipment, switchboards, electric motors, generator and DC electrical systems and equipment
A31-2.2.1. A-III/1-KUP 2.2.1 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

Full-or-part-time: 19h
Theory classes: 6h
Laboratory classes: 2h
Guided activities: 1h
Self study : 10h

9. Electrical Machines

Description:
Knowledge about electrical distribution systems, their components and protection devices.
Introduction to different types: DC Machines, Synchronous Machine, Asynchronous Machine (Induction). Interpretation of data plate ratings.
DC Machines: Equivalent circuits, changing direction of rotation, variation of motor speed.

Related competencies:
A36-1.1.5. A-III/6-KUP 1.1.5 Knowledge of: Electrical power distribution boards and electrical equipment
A36-1.1.3. A-III/6-KUP 1.1.3 Knowledge of Electrotechnology and electrical machines theory
A31-2.1.1a. A-III/1-KUP 2.1.1.1 Basic configuration and operation principles of the following electrical, electronic and control equipment: .1 electrical equipment: .a) generator and distribution systems, .b) preparing, starting, paralleling and changing over generators, .c) electrical motors including starting methodologies,.d) highvoltage Installations, .e) sequential control circuits and associated system devices
A31-2.2.2. A-III/1-KUP 2.2.2 Maintenance and repair of electrical System equipment, switchboards, electric motors, generator and DC electrical systems and equipment
A36-1.1.8. A-III/6-KUP 1.1.8 Knowledge of: Electrical drives
A31-2.2.1. A-III/1-KUP 2.2.1 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

Full-or-part-time: 16h
Theory classes: 4h
Laboratory classes: 1h
Guided activities: 1h
Self study : 10h
**GRADING SYSTEM**

The final mark is the sum of the following qualifications:

\[ N_{\text{final}} = 0.4 \times N_{\text{pf}} + 0.4 \times N_{\text{ac}} + 0.2 \times N_{\text{L}} \]

- **N\text{final}**: final mark.
- **N\text{pf}**: final test grade.
- **N\text{ac}**: continuous assessment grade.
- **N\text{L}**: laboratory grade.

The final test includes the concepts associated with the learning objectives of the subject with respect to knowledge or understanding of application exercises. Continuous assessment is cumulative to different activities, both individual and group, with a training goal conducted during the year (in the classroom and outside it).

The rating of laboratory practices is the sum of the following three laboratory activities:

\[ N_{\text{L}} = 0.4 \times N_{\text{pfL}} + 0.4 \times N_{\text{acL}} + 0.2 \times N_{\text{pL}} \]

- **N\text{pfL}**: final lab grade.
- **N\text{acL}**: lab continuous assessment.
- **N\text{pL}**: attendance and lab participation grade.

**Reevaluation**: Test that includes the concepts and objectives set for the final test.

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

**EXAMINATION RULES.**

- Attendance and completion of the hands-on labs, is a compulsory requirement.
- If not done any of the lab activities or continuous assessment, the student will be considered as non-rated.
- Will be considered "not present" the one who has not been in the exam or have an overall grade of less than 0.5 points.
- Under no circumstances a student can have any support formular in the tests.

**BIBLIOGRAPHY**

**Basic:**

**Complementary:**
RESOURCES

Other resources:
Course notes to ATENEA