280641 - Electricity and Electrotechnics

**Coordinating unit:** 280 - FNB - Barcelona School of Nautical Studies  
**Teaching unit:** 709 - EE - Department of Electrical Engineering  
**Academic year:** 2019  
**Degree:**  
- BACHELOR'S DEGREE IN MARINE TECHNOLOGIES (Syllabus 2010). (Teaching unit Compulsory)  
- BACHELOR'S DEGREE IN NAVAL SYSTEMS AND TECHNOLOGY ENGINEERING (Syllabus 2010). (Teaching unit Compulsory)  
- BACHELOR'S DEGREE IN MARINE TECHNOLOGIES/BACHELOR'S DEGREE IN NAVAL SYSTEMS AND TECHNOLOGY ENGINEERING (Syllabus 2016). (Teaching unit Compulsory)  
**ECTS credits:** 6  
**Teaching languages:** Catalan, Spanish

**Teaching staff**

**Coordinator:** FRANCISCO DÍAZ GONZÁLEZ  
**Others:**  
- Primer quadrimestre:  
  - FRANCISCO DÍAZ GONZÁLEZ - 1, 2, 3  
  - VICTOR FUSES NAVARRA - 1, 2, 3  
  - JOAN NICOLAS APRUZZESE - 1, 2, 3  
- Segon quadrimestre:  
  - FRANCISCO DÍAZ GONZÁLEZ - 1, 2, 3, 4  
  - VICTOR FUSES NAVARRA - 1, 2, 3, 4

**Degree competences to which the subject contributes**

**Specific:**
- 2. Knowledge of circuit theory and electrical characteristics of marine machinery and capacity to implement the operation and operation of the ship of this knowledge.  
- 3. Knowledge of circuit theory and the characteristics of electrical machines and ability to perform calculations for systems involving these elements.

**Transversal:**
- 1. TEAMWORK - Level 2. Contributing to the consolidation of a team by planning targets and working efficiently to favor communication, task assignment and cohesion.

**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.

Moreover, one objective of this course is to provide knowledge, understanding and proficiency of skills STCW A-III/1:

1. Having a basic understanding of the operation of electrical distribution systems, their components and their protection.
2. Understand the use of electrical equipment for measurement and troubleshooting and maintenance and repair test.

Competencies required and defined in Section A-III/1 (Minimum requirements for certification of officers in charge of the watch in unattended machinery or service engineers designated camera unattended machinery (propulsion power of 750 kW or more) of the International Convention on Standards of Training, Certification and Watchkeeping for seafarers.

Also, this course will evaluate the following STCW competences:
6. Operate electrical, electronic and control systems
7. Maintenance and repair of electrical and electronic equipment

Les competencies STCW abans indicades tenen associades les KUPs següents:
6.1. Electrical equipment.
7.1. 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.
7.2. Maintenance and repair of electrical system equipment, switchboards, electric motors, generator and DC electrical systems and equipment.
7.3. Detection of electric malfunction, location of faults and measures to prevent damage.
7.4. Construction and operation of electrical testing and measuring equipment.
7.5. Function and performance tests of the following equipment and their configuration.
E1.1. Knowledge of electro-technology and electrical machines theory.
E1.2. Fundamentals of automation, automatic control systems and technology.

This competence is assessed according to the section "Evaluation " of this record.

<table>
<thead>
<tr>
<th>Study load</th>
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<tbody>
<tr>
<td><strong>Total learning time</strong></td>
<td>150h</td>
<td></td>
</tr>
<tr>
<td>Hours large group:</td>
<td>40h</td>
<td>26.67%</td>
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<tr>
<td>Hours medium group:</td>
<td>0h</td>
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<tr>
<td>Hours small group:</td>
<td>15h</td>
<td>10.00%</td>
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<tr>
<td>Guided activities:</td>
<td>5h</td>
<td>3.33%</td>
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<tr>
<td>Self study:</td>
<td>90h</td>
<td>60.00%</td>
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</tbody>
</table>
# Content

<table>
<thead>
<tr>
<th>Characteristics and laws of electrical circuits</th>
<th>Learning time: 4h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description:</td>
<td>Theory classes: 2h</td>
</tr>
<tr>
<td>Basic knowledge about electrical distribution systems, their components and protection devices (these knowledge are necessary according to STCW Code):</td>
<td>Laboratory classes: 2h</td>
</tr>
<tr>
<td>Topic related with the following KUPs according to STCW: A-III/1-6.1, A-III/1-7.1 and A-III/6-E.1.1</td>
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<table>
<thead>
<tr>
<th>Circuit analysis</th>
<th>Learning time: 4h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description:</td>
<td>Theory classes: 2h</td>
</tr>
<tr>
<td>Knowledge about electrical distribution systems, their components and protection devices. Learn about measure and test devices to detect failures and maintenance and repair operation. (These knowledge are necessary according to STCW Code):</td>
<td>Laboratory classes: 2h</td>
</tr>
<tr>
<td>Topic related with the following KUPs according to STCW: A-III/1-6.1, A-III/1-7.1, A-III/1-7.3 and A-III/6-E.1.1</td>
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<table>
<thead>
<tr>
<th>Dynamic elements</th>
<th>Learning time: 2h</th>
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<tbody>
<tr>
<td>Description:</td>
<td>Theory classes: 2h</td>
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<tr>
<td>Topic related with the following KUPs according to STCW: A-III/1-6.1, A-III/1-7.1, A-III/1-7.5 and A-III/6-E.1.1</td>
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<table>
<thead>
<tr>
<th>Subject</th>
<th>Learning time</th>
<th>Description</th>
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<tbody>
<tr>
<td><strong>AC circuits analysis</strong></td>
<td>8h</td>
<td>Knowledge about electrical distribution systems, their components and protection devices (these knowledge are necessary according to STCW Code): &lt;br&gt; Properties of sinusoidal magnitudes. Phasors. Relationship of current-voltage phasors. Impedance and admittance. Application of methods and theorems for circuits solving and network theorems for steady state. Complex power. Power factor and compensation. &lt;br&gt; Topic related with the following KUPs according to STCW: A-III/1-6.1, A-III/1-7.1, A-III/1-7.3, A-III/1-7.4, A-III/1-7.5 and A-III/6-E.1.1</td>
</tr>
<tr>
<td><strong>Three-phase circuits</strong></td>
<td>9h</td>
<td>Knowledge about electrical distribution systems, their components and protection devices (these knowledge are necessary according to STCW code): &lt;br&gt; 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. &lt;br&gt; Topic related with the following KUPs according to STCW: A-III/1-6.1, A-III/1-7.1, A-III/1-7.3, A-III/1-7.4, A-III/1-7.5 and A-III/6-E.1.1</td>
</tr>
<tr>
<td><strong>Electrical installations</strong></td>
<td>3h</td>
<td>Knowledge about electrical distribution systems, their components and protection devices (these knowledge are necessary according to STCW code): &lt;br&gt; Calculation of electrical installations. Shortcircuits. &lt;br&gt; Topic related with the following KUPs according to STCW: A-III/1-6.1, A-III/1-7.1, A-III/1-7.2, A-III/1-7.3, A-III/1-7.4, A-III/1-7.5, A-III/6-E.1.1 and A-III/6-E.1.2</td>
</tr>
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### Protection

**Learning time:** 5h  
Theory classes: 4h  
Laboratory classes: 1h

**Description:**  
Knowledge about electrical distribution systems, their components and protection devices (these knowledge are necessary according to STCW code):  
- Electric current danger. Direct and indirect contact. Continuity defects and insulation defects.  
- The differential switch. The breaker switch. Protection curves and coordination.

Topic related with the following KUPs according to STCW: A-III/1-7.3, A-III/1-7.5, A-III/6-E.1.1 and A-III/6-E.1.2

### Transformers

**Learning time:** 8h  
Theory classes: 6h  
Laboratory classes: 2h

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

Topic related with the following KUPs according to STCW: A-III/1-6.1, A-III/1-7.1, A-III/1-7.2 and A-III/6-E.1.1

### Electrical Machines

**Learning time:** 5h  
Theory classes: 4h  
Laboratory classes: 1h

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

Topic related with the following KUPs according to STCW: A-III/1-6.1, A-III/1-7.1, A-III/1-7.2 and A-III/6-E.1.1
Example:
The final mark is the sum of the following qualifications:

\[ N_{final} = 0.4 \times Npf + 0.4 \times Nac + 0.2 \times NeL \]

- **Nfinal**: final mark.
- **Npf**: final test grade.
- **Nac**: continuous assessment grade.
- **NeL**: 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:

\[ NeL = 0.4 \times NpfL + 0.4 \times NacL + 0.2 \times NpL \]

- **NpfL**: final lab grade.
- **NacL**: lab continuous assessment.
- **NpL**: attendance and lab participation grade.

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

### Regulations for carrying out activities

- 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.
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**Bibliography**

**Basic:**


**Complementary:**


**Others resources:**

Course notes to ATENEA