240NU012 - Systems, Components and Materials

Degree competences to which the subject contributes

Specific:
4. Ability to select the most appropriate components and materials for the nuclear island systems of a plant as well as to analyze its degradation as a result of the conditions (thermal, chemical, mechanical and radiation) to which they are subjected.
5. Ability to write the main systems of a nuclear power plant and identify the main features of such systems.
6. Knowledge of different reactor designs and nuclear plants, including proposals for future reactors, and will be able to assess their strengths and weaknesses.

Transversal:
1. EFFECTIVE USE OF INFORMATION RESOURCES: Managing the acquisition, structuring, analysis and display of data and information in the chosen area of specialisation and critically assessing the results obtained.
2. FOREIGN LANGUAGE: Achieving a level of spoken and written proficiency in a foreign language, preferably English, that meets the needs of the profession and the labour market.
3. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.

Teaching methodology

The course on Systems, Components and Materials is mainly based on theory sessions, complemented by cooperative learning (students work in reduced groups) and autonomous learning.

Learning objectives of the subject

- Provide an overview of the different reactor designs and their most important characteristics
- Describe the systems of a light water nuclear reactor: nuclear steam supply system, safety systems, auxiliary systems, instrumentation and control systems and balance of plant, understanding their main characteristics, functions and requirements.
- Provide information about the different materials that can be used in a nuclear power plant and the relation with the
functional requirements of the components
- Provide an overview of the effects of radiation on materials and the reasons for the components degradation

<table>
<thead>
<tr>
<th>Study load</th>
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<tbody>
<tr>
<td><strong>Total learning time</strong>: 150h</td>
<td></td>
</tr>
<tr>
<td>Hours large group:</td>
<td>0h</td>
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<tr>
<td>Hours medium group:</td>
<td>36h</td>
</tr>
<tr>
<td>Hours small group:</td>
<td>18h</td>
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<tr>
<td>Guided activities:</td>
<td>0h</td>
</tr>
<tr>
<td>Self study:</td>
<td>96h</td>
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## Content

### 1. Introduction to nuclear reactors

**Description:** During the first sessions an overview of the nuclear energy will be provided. Several basic concepts related to nuclear reactor will be also explained, as well as the organization of the course.

**Related activities:**
- Independent learning: reading of related material.

**Specific objectives:**
- CE7

**Learning time:** 6h
- Theory classes: 4h
- Self study : 2h

### 2. Types of reactors: classification of elements and design. Base designs and advanced designs

**Description:** The most important designs of present and advanced nuclear reactors are described, specifying the main differences among them.

**Related activities:**
- Independent learning: reading of related material.
- Short reports.
- Validation tests.

**Specific objectives:**
- CE8

**Learning time:** 10h
- Theory classes: 4h
- Self study : 6h

### 3. The nuclear steam supply system of a light water reactor

**Description:** The nuclear steam supply system of a light water reactor (PWR and BWR) is described.

**Related activities:**
- Independent learning: reading of related material.
- Short tests.

**Specific objectives:**
- CE9

**Learning time:** 16h
- Theory classes: 6h
- Self study : 10h
### 4. Safety systems

**Learning time:** 16h  
Theory classes: 6h  
Self study: 10h

**Description:**
The most important safety systems of a nuclear power plant (PWR) are described.

**Related activities:**
- Independent learning: reading of related material.
- Tutored activities and short tests.

**Specific objectives:**
CE9

### 5. Balance of plant

**Learning time:** 8h  
Theory classes: 2h  
Self study: 6h

**Description:**
The most important systems of the balance of plant of an NPP (PWR) are described.

**Related activities:**
- Independent learning: reading of related material.
- Short tests.

**Specific objectives:**
CE9

### 6. Control and Protection systems and instrumentation

**Learning time:** 10h  
Theory classes: 4h  
Self study: 6h

**Description:**
The philosophy of the instrumentation and control and protection systems of a PWR plant is described and justified. The main control and instrumentation systems of a nuclear plant (PWR) are described.

**Related activities:**
- Independent learning: reading of related material.
- Tutored activities and short tests.

**Specific objectives:**
CE9
7. Auxiliary cooling systems

**Description:**
The main auxiliary cooling systems of a nuclear plant (PWR) are described.

**Related activities:**
Independent learning: reading of related material.
Short tests.

**Specific objectives:**
CE9

<table>
<thead>
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<th>Learning time:</th>
<th>12h</th>
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<tr>
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<td>4h</td>
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<td>Self study:</td>
<td>8h</td>
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8. Materials

**Description:**
Nuclear materials. Types.
Properties and functions of materials
Radiation effects in different components of the nuclear reactor
Degradation phenomena in the materials of a nuclear power plant
Materials for new reactor designs

**Related activities:**
Independent learning: reading of related material.
Formal report about a topic presented in class.
Short test and validation test.

**Specific objectives:**
CE9

<table>
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<tr>
<th>Learning time:</th>
<th>64h</th>
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<td>Theory classes:</td>
<td>24h</td>
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<td>Self study:</td>
<td>40h</td>
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**Qualification system**

\[ FQ = \text{SUM} (P_i \times Q_i) \]

FQ: Final Qualification

This qualification is obtained weighting the qualification obtained in the different activities and written tests performed (Qi) using the proportion of hours of each topic related to the total amount of hours of the course (Pi). As some marks take into account activities performed in group, individual validation tests can be established.

The detection of plagiarism or copying in any learning activity or exam will cause the automatic suspension of qualification of the whole course.