

## Course guide

### 240NU012 - 240NU012 - Systems, Components and Materials

**Last modified:** 27/05/2025

**Unit in charge:** Barcelona School of Industrial Engineering  
**Teaching unit:** 748 - FIS - Department of Physics.

**Degree:** MASTER'S DEGREE IN NUCLEAR ENGINEERING (Syllabus 2012). (Compulsory subject).  
MASTER'S DEGREE IN INDUSTRIAL ENGINEERING (Syllabus 2025). (Optional subject).

**Academic year:** 2025    **ECTS Credits:** 6.0    **Languages:** English

#### LECTURER

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**Coordinating lecturer:** Carme Pretel Sánchez

**Others:** Carme Pretel Sánchez  
Suarez Cambra, Daniel  
Different speakers from Tecnatom, CIEMAT, ... to be determined

#### DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

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##### Specific:

CEN7. Ability to write the main systems of a nuclear power plant and identify the main features of such systems.  
CEN8. Knowledge of different reactor designs and nuclear plants, including proposals for future reactors, and will be able to assess their strengths and weaknesses.  
CEN9. 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.

##### Generical:

CGN1. Have adequate knowledge of mathematical aspects, analytical, scientific, instrumental, technological and management.  
CGN9. Ability to reason and act based on the so-called safety culture

##### Transversal:

CTN4. 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.

CTN5. 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.

CTN7. 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.

##### Basic:

CB9. (ENG) Que els estudiants sàpiguen comunicar les seves conclusions i coneixements (i darrers raonaments que els sustentin), a públics especialitzats i no especialitzats de manera clara i sense ambigüitats.

#### TEACHING METHODOLOGY

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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

## STUDY LOAD

Type	Hours	Percentage
Hours large group	48,0	32.00
Hours small group	6,0	4.00
Self study	96,0	64.00

**Total learning time:** 150 h

## CONTENTS

### 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.

#### Specific objectives:

CE7

#### Related activities:

Independent learning: reading of related material.

#### Full-or-part-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.

#### Specific objectives:

CE8

#### Related activities:

Independent learning: reading of related material.

Short reports.

Validation tests.

#### Full-or-part-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.

**Specific objectives:**

CE9

**Related activities:**

Independent learning: reading of related material.

Short tests.

**Full-or-part-time:** 16h

Theory classes: 6h

Self study : 10h

### 4. Safety systems

**Description:**

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

**Specific objectives:**

CE9

**Related activities:**

Independent learning: reading of related material.

Tutored activities and short tests.

**Full-or-part-time:** 16h

Theory classes: 6h

Self study : 10h

### 5. Balance of plant

**Description:**

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

**Specific objectives:**

CE9

**Related activities:**

Independent learning: reading of related material.

Short tests.

**Full-or-part-time:** 8h

Theory classes: 2h

Self study : 6h

## 6. Control and Protection systems and instrumentation

### 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.

### Specific objectives:

CE9

### Related activities:

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

### Full-or-part-time: 10h

Theory classes: 4h  
Self study : 6h

## 7. Auxiliary cooling systems

### Description:

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

### Specific objectives:

CE9

### Related activities:

Independent learning: reading of related material.  
Short tests.

### Full-or-part-time: 12h

Theory classes: 4h  
Self study : 8h

## 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

### Specific objectives:

CE9

### Related activities:

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

### Full-or-part-time: 64h

Theory classes: 24h  
Self study : 40h



### Simulator exercises

**Description:**

content english

**Full-or-part-time:** 10h

Laboratory classes: 10h

## GRADING SYSTEM

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$$FQ = 0,8 \cdot Q_{\text{curs}} + 0,2 \cdot Q_{\text{sim}}$$

$$Q_{\text{curs}} = \text{SUM} (P_i \cdot Q_i)$$

$Q_i$ : Qualification of the different tests performed during the course

$Q_{\text{curs}}$ : This qualification is obtained weighting the qualification obtained in the different activities and written tests performed ( $Q_i$ ) using the proportion of hours of each topic related to the total amount of hours of the course ( $P_i$ ).

$Q_{\text{sim}}$ : Qualification obtained in the simulator exercises

$FQ$ : Final Qualification

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.