

## Course guide

### 250709 - 250709 - Nanotechnology in Construction

**Last modified:** 28/03/2024

<b>Unit in charge:</b>	Barcelona School of Civil Engineering	
<b>Teaching unit:</b>	751 - DECA - Department of Civil and Environmental Engineering.	
<b>Degree:</b>	MASTER'S DEGREE IN STRUCTURAL AND CONSTRUCTION ENGINEERING (Syllabus 2015). (Optional subject).	
<b>Academic year:</b> 2023	<b>ECTS Credits:</b> 5.0	<b>Languages:</b> Spanish

#### LECTURER

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<b>Coordinating lecturer:</b>	LUCIA FERNANDEZ CARRASCO
<b>Others:</b>	LUCIA FERNANDEZ CARRASCO, DAVID TORRENS MARTÍN

#### DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

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##### Specific:

- 13364. To conceive and design civil and building structures that are safe, durable, functional and integrated into its surroundings.
- 13365. Designing and building using traditional materials (reinforced concrete, prestressed concrete, structural steel, masonry, wood) and new materials (composites, stainless steel, aluminum, shape memory alloys?).
- 13366. To evaluate, maintain, repair and strengthen existing structures, including the historic and artistic heritage.
- 13368. Mathematically modelling structural engineering problems.
- 13369. To apply methods and advanced design software and structural calculations, based on knowledge and understanding of forces and their application to the structural types of civil engineering.

##### Generical:

- 13360. To conceive, design, analyze and manage structures or structural elements of civil engineering or building, encouraging innovation and the advance of knowledge.
- 13361. To develop, improve and use conventional materials and new construction techniques to ensure the safety requirements, functionality, durability and sustainability.

#### TEACHING METHODOLOGY

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The course consists of 3 hours per week of classroom sessions in a classroom (large group).

They are dedicated to lectures 1.5 hours in a large group: the teachers exposed the basic concepts and materials of matter, presents examples and exercising.

The rest of weekly hours dedicated to tutorials and individual monitoring of the work commissioned.

Support material is used in the form of detailed teaching plan using the virtual campus ATENEA: content, programming and evaluation activities directed learning and literature.

## LEARNING OBJECTIVES OF THE SUBJECT

Subject to identify the main nanotechnology applications in the construction sector

Identification capability nanotechnologies major application in the field of construction and use techniques of nanometric

Study techniques at the nanoscale level. Nanotechnology of Cement. Nanotechnology of Additives. Nanotechnology of mineral additions. Nanotechnology of mortars and concretes . Nanotechnology of Asphalt Mixture. Energy efficiency and environmental applications. Economic impact of nanotechnology in the construction sector.

Technological advances lead us towards a continuous evolution of products. The application of nanotechnology to various construction products and materials is producing a continuous modification in the construction industry, new products and property modification. In the theme of this subject we introduce ourselves in the analysis of products that are presented with nanometric scale dimensions and in how existing systems are modified. Our main focus now is to study how these features can contribute to building construction and addressing a sustainability aspect.

## STUDY LOAD

Type	Hours	Percentage
Self study	80,0	63.95
Hours small group	9,8	7.83
Hours large group	25,5	20.38
Hours medium group	9,8	7.83

**Total learning time:** 125.1 h

## CONTENTS

### Introductory concepts

#### Description:

The evolution and technological advances have advanced towards the development of products with dimensions in nanometric scales. These products under construction are analyzed.

An introduction is made to the products to be built on a nanometric scale and their compatibility with current systems: employment methodologies.

Microscopy electronics, interferometry and atomic force. X-ray diffraction synchrotron radiation. Synthesis techniques. Surface chemistry studies: photoelectron spectroscopy X-ray characterization mechanics: nanoindentation

A series of practical cases will be carried out to strengthen the theoretical sessions.

Visit to the laboratories of the UPC Nanoengineering Research Center. Realization of nano models for analysis.

**Full-or-part-time:** 40h 48m

Theory classes: 6h

Practical classes: 6h

Laboratory classes: 5h

Self study : 23h 48m

## Nanomaterials

### Description:

The different products that are currently used for the manufacture of mortars and concretes with nanomaterials will be reviewed. A constructive system model will be prepared and properties and applications will be analyzed.

The use of nanotechnological products in protection against corrosion is a current trend. Systems will be analyzed, in these materials and others such as ceramics and glass.

The use of nanomaterials in restoration and conservation is increasingly common: a series of real cases will be presented. Starch-based coatings, nanofiber mats, hydrogels, and polyetherimide nanocomposite foams are used to modify the fire resistance of materials. Different systems will be analyzed.

At present, a large number of products are incorporated to provide differentiated functionalities. The different systems and applications will be analyzed.

**Full-or-part-time:** 67h 12m

Theory classes: 28h

Self study : 39h 12m

## GRADING SYSTEM

Ordinary Assessment (EO) The continuous assessment grade is obtained from the weighted arithmetic mean of the exercises/problems (Pr) delivered during the course, of the activities directed as assignments or reports (Tr). The final grade will be:  $EO = 0.5(\text{Pr average}) + 0.5(\text{Tr average})$ . To pass, the grade of the EO must be greater than or equal to 5.0. Re-evaluation (RE) The criteria for qualification and admission to the RE are as follows: students suspended in the ordinary assessment and who have appeared regularly in the assessment tests of the suspended subject will have the option to take an RE test in the period set in the academic calendar. Students who have already passed the EO will not be able to take the RE of a subject. The RE test will consist of a single exam covering all course content. The maximum mark for the reassessment will be five (5.0). The non-attendance of a student called to the re-evaluation test, held in the fixed period, cannot give rise to the completion of another test with a later date. Extraordinary assessments will be carried out for those students who, due to accredited force majeure, have not been able to take any of the continuous assessment tests. These tests must be authorized by the corresponding head of studies, at the request of the teacher responsible for the subject, and will be carried out within the corresponding teaching period.

## EXAMINATION RULES.

Failure to perform a laboratory or continuous assessment activity in the scheduled period, this will result in a mark of zero in that activity.

## BIBLIOGRAPHY

### Basic:

- F. Pacheco-Torgal, S. Jalali. Nanotechnology: Advantages and drawbacks in the field of construction and building materials. Constr. Build. Mater. 25, 2011.
- Transportation Research Record: Journal of the Transportation Research Board [on line]. 2010 [Consultation: 24/04/2020]. Available on: <https://journals.sagepub.com/home/trr>.
- W. Zhu, P.J.M. Bartos, A. Porro. Application of nanotechnology in construction - Summary of a state-of-the-art report. Mater. Struct. 37, 2004.
- T. Brockmann, P. Fontana, B. Meng, U. Mueller. Nanotechnology in construction engineering. Beton- Und Stahlbetonbau. 103, 2008.

### Complementary:

- Y. Yang, X. Liu, H. Jia, B. Xu. How do vapor grown carbon nanofibers nucleate and grow from deoiled asphalt?. Mater. Chem. Phys. 126, 2011.
- Nanostructure and irreversible colloidal behavior of  $\text{Ca}(\text{OH})_2$ : Implications in cultural heritage conservation [on line]. [Consultation: 24/04/2020]. Available on: <http://pubs.acs.org/journal/langd5>.