BASIC DETAILS:

Subject:	ESTRUCTURAS III		
Id.:	33792		
Programme:	DOBLE GRADO EN ARQUITECTURA Y DISEÑO DIGITAL Y TECNOLOGÍAS CREATIVAS		
Module:	TECNICO		
Subject type:	OBLIGATORIA		
Year:	3	**Teaching period:**	Primer Cuatrimestre
Credits:	3	**Total hours:**	75
Classroom activities:	34	**Individual study:**	41
Main teaching language:	Inglés	**Secondary teaching language:**	Castellano
Lecturer:		**Email:**	

PRESENTATION:

This course is about reinforced concrete structures.

Reinforced concrete is the most used building material for building structures. Its virtue is its ability to be moulded, so that it takes up the shapes required for every structural form. It is also very durable and fire resistant. Concrete can be used for all standard buildings both single storey and multi-storey and for containment and retaining structures and bridges.

The course will take students from initial basic concepts, that will allow them to make quick and easy pre-dimension; to the full calculation of a reinforced concrete structure, considering ultimate limit states and serviceability limit states. At the end of the course the student will be able to produce full detailed reinforced concrete projects.

This course will follow the rules stablished in the Spanish Building Code (CTE) and the Structural Concrete Norms (EHE-08).

PROFESSIONAL COMPETENCES ACQUIRED IN THE SUBJECT:

General programme competences	G01	Effectively use language skills to express views and formulate arguments both orally and in writing Ability to express opinions and propose arguments effectively both orally and in writing in student's native language and English.
	G02	Ability to resolve problems and make decisions throughout their lifetime and choose professional and educational pathways independently.
	G03	Ability for autonomous learning and self-criticism.
	G04	Ability to transfer the knowledge acquired in practical work and skills to the field of work.
	G05	Demonstrate creativity, independence of thought, autonomy.
	G06	Demonstrate critical and analytical ability to conventional approaches of the discipline.
	G07	Demonstrate capacity for innovation, creativity and initiative.
	G08	Incorporate social and humanistic knowledge to an all-encompassing university education.
	G09	Capacity of developing values such as solidarity, multiculturalism, equality, social commitment, respect, diversity, integrity, universal accessibility, among other values that are unique to a culture of peace and democratic values.
	G10	Formulate proposals for social transformation from a critical and constructive point of view.
	G11	Ability to act, make decisions and take initiatives based on their own convictions and ethical behaviour.
	G12	Knowledge of culture and society as a pillar of human reality.
	G13	Knowledge of ethical commitment that leads to respect for the dignity of persons.
	G14	Knowledge of the methods and procedures of democratic societies in the defence of fundamental rights of the person.
Specific programme competences	E01	Ability to: Apply the graphic procedures to the representation of spaces and objects (T); Design and represent the visual attributes of objects and master proportion and drawing techniques, including computer-based techniques (T).
	E02	Knowledge adapted and applied to architecture and urbanism of: The spatial representation systems; Analysis and theory of form and laws of visual perception; The metric and projective geometry; Graphic survey techniques in all its phases, from drawing notes to scientific

		restitution. The principles of general mechanics, statics, the geometry of masses and vector and tensor fields; The principles of thermodynamics, acoustics and optics; The principles of fluid, hydraulics, electricity and electromagnetism mechanics; the basis of topography and mapping and terrain modification techniques.
	E03	Knowledge applied to: Numeracy, analytical and differential geometry and algebraic methods.
	E04	Ability to conceive, calculate, design, integrate into buildings and urban units and execute: Building structures (T); Interior division systems, carpentry, stairways and other finished work (T); Locking systems, roof and other structural work (T); Foundation Solutions (T); Supply facilities, water treatment and disposal, heating and air conditioning (T).
	E05	Ability to: Apply technical and construction standards; Maintain building structures, foundation and civil works; Conserve the finished work; Evaluate the project.
	E06	Capacity to Preserve the structural work; Plan building and urban transformation facilities and power supply, audiovisual communication, acoustic conditioning and artificial lighting; Conserve facilities.
	E07	Adequate knowledge of: Solid mechanics of continuous media and soil, as well as plastic, elastic and strength of materials of heavy works; Conventional building systems and their pathology; The physical and chemical characteristics, production procedures, pathology and use of building materials; Industrialised building systems.
	E08	Knowledge of: Ethics, collegiate organisations, professional structure and civil liability; Administrative and professional management procedures; The organisation of professional offices; Measurement, expert and assessment methods; Health and safety at work; The management and real estate management.
	E09	Suitability for design, practice and development of: Basic execution projects, sketches and drafts (T); Urban Projects (T); Construction management (T).
	E10	Ability to: Develop functional programmes of buildings and urban spaces; Intervene in and conserve, restore and rehabilitate the built heritage (T); Remove architectural barriers (T); Undertake architectural criticism; Solve the passive environmental conditioning, including thermal and acoustic insulation, climate control, energy efficiency and natural lighting (T); Catalogue built and urban heritage and plan its protection.
	E11	Capacity to Perform safety projects, evacuation and protection properties (T); Compose civil engineering projects (T); Design and execute urban layouts and development projects, gardening and landscape (T); Apply standards and building regulations; Develop environmental, landscape and correction of environmental impacts studies(T).
	E12	Adequate knowledge of: General theories of form, composition and architectural types; The general history of architecture; The methods of studying the processes of symbolisation, practical functions and ergonomics; The methods to study social needs, quality of life, habitability and basic housing programmes; Ecology, sustainability and the principles of conservation of energy and environmental resources; Architectural, urban and landscape traditions of Western culture, as well as their technical, climatic, economic, social and ideological foundations; Aesthetics and theory and history of fine arts and applied arts; The relationship between cultural patterns and social responsibilities of the architect; The bases of vernacular architecture; Sociology, theory, economics and urban history; The methodological foundations of urban planning and territorial and metropolitan management; Drafting mechanisms and management of urban plans at any scale.
	E13	Knowledge of: Civil, administrative, urban laws of the building industry and the professional performance; Feasibility analysis and supervision and coordination of integrated projects; The real estate appraisal.
	E14	Once all the credits of the curriculum are obtained, the presentation and defence of an original project individually, before a university tribunal which will include at least one member suggested by the professional organisations. The assignment will consist of a comprehensive architectural project of a professional nature in which all the skills acquired in the degree are put into practice to the point of demonstrating proficiency to determine the complete execution of the construction project, in compliance with the applicable technical and administrative regulations.
Regulated profession competences	P01	Ability to create architectural designs that satisfy both aesthetic and technical requirements.
	P02	Adequate knowledge of the history and theories of architecture as well as the arts, technology and human sciences.
	P03	Knowledge of the fine arts as an influence on the quality of architectural design.
	P04	Adequate knowledge of urban design, planning and the skills involved in the planning process.
	P05	Ability to understand the relationships between people and buildings and between them and their environment, and the need to relate buildings and the spaces between them depending on the needs and the human scale.
	P06	Ability to understand the architectural profession and its role in society, in particular by developing projects that take social factors into account.
	P07	Knowledge of methods of investigation and preparation of construction projects.
	P08	Understand the problems of the structural design, construction and engineering associated with building projects.

	P09	Adequate knowledge of physical problems and the different technologies and of the function of buildings so as to provide them with internal conditions of comfort and protection against the climate conditions.
	P10	Design capacity to meet the requirements of building users within the limits imposed by budget factors and building regulations.
	P11	Adequate knowledge of the industries, organisations, regulations and procedures involved in translating design concepts into buildings and integrating plans into planning.

PRE-REQUISITES:

It is advisory that every student that enrols in this course has basic knowledge about mechanics of materials taught in “Estructuras I” and structural analysis taught in “Estructuras II”. It is also advisory that students have some upper intermediate level of English.

It will be supposed that every student remembers some basic math skills, including basic algebra and trigonometry, as well as some basic calculus topics (such as differentiation, simple integration, and how to find maximum and minimum values of functions). The student should be proficiency in geometry and trigonometry. Being familiar with the cartesian coordinate system and its terminology as well as knowing the basic rules governing sines, cosines and tangents of angles is invaluable as you work mechanics of materials problems.

SUBJECT PROGRAMME:

Observations:

The course will begin with some basic concepts about reinforced concrete structures. The materials and their properties, quick tools to design RC structures, and basic knowledge to understand the global concepts of the course.

Afterwards, the course will teach about structural calculations, following the ultimate limit state method. The student will learn to design and verify reinforced concrete beams and pillars, as well as draw the detailed section considering the spacing requisites stablished in the codes. Some basic concepts about design following the serviceability limit states will also be taught.

The course will conclude with some theory and exercises about foundation calculations. Students will learn to design both, shallow and deep foundations.

Subject contents:

1 - Introduction
1.1 - Reinforced concrete history
1.2 - Regulations and units of measurement
2 - Basic concepts
2.1 - Useful tips
2.2 - Quick calculations
2.3 - Understanding RC structures
3 - Reinforced concrete
3.1 - Concrete
3.1.1 - Components
3.1.2 - Properties
3.2 - Corrugated steel
3.2.1 - Reinforcing bars
3.2.2 - Properties
3.3 - Durability
3.4 - Shrinkage and creep
3.5 - Mechanical properties
4 - Calculation process
4.1 - Limit State Method
4.2 - Building loads CTE-DB-SE-AE

Subject planning could be modified due unforeseen circumstances (group performance, availability of resources, changes to academic calendar etc.) and should not, therefore, be considered to be definitive.

TEACHING AND LEARNING METHODOLOGIES AND ACTIVITIES:

Teaching and learning methodologies and activities applied:

To achieve the course competencies established in this guide, the activities are planned as follows:

There will be several **theory sessions** where the teacher will transmit the new information through oral and written exposition, conveniently using ICT as auxiliary means. The theory sessions will mainly be taught online, via Microsoft TEAMS. The exposition will be oriented to the course development; the new concepts will be structured in a coherent and logical way. The basic ideas and philosophy of the subject will be explained, avoiding extensive demonstrations that conspire against the understanding of the fundamental ideas of physics - which does not mean that mathematical demonstrations are less important. If circumstances require it, other theory activities not contemplated in the initial programming may be adopted. During the expositions questions or problematic situations may be asked. There will be some small practical activities. The teacher will solve any possible doubt or incomplete information, guiding and motivating students to search for answers, generating debates and creating an active class

environment.

There will be **practical sessions** related to the previous theory ones. The practical sessions will mainly be taught in the classroom, giving way to a more social interaction with the students to solve any practical doubt using the blackboard. Students must prepare the practical activities prior to the realization of the session and study every concept needed to solve exercises. There will be some **small written tests** to check the evaluating competences are being met.

After every theory session, to prepare for the following practical session, there will be some, mostly **individual, coursework** that each student must complete before the beginning of the next session. For this, the student must study each new concept and practice solving exercises on their own.

There will also be a **course project** that will be developed in an autonomous way. The project will evaluate every concept of the course and will be done **individually**. Each student will work on their project with the obligation to bring material to work in class, as well as doubts or questions that have arisen during the autonomous work to be able to solve them together in class. Students will be able to ask the professor their doubts in person during tutoring hours or via email.

To conclude with the course project, there will be a last task to be carried out in **groups**. And will evaluate the capacity of the students to explain a structural project to their classmates as well as building an actual reinforced concrete structural model.

Student work load:

Teaching mode	Teaching methods	Estimated hours
Classroom activities	Master classes	15
	Practical exercises	6
	Practical work, exercises, problem-solving etc.	7
	Debates	3
	Coursework presentations	1
	Films, videos, documentaries etc.	2
Individual study	Tutorials	3
	Individual study	15
	Individual coursework preparation	6
	Group cousework preparation	4
	Project work	7
	Research work	4
	Recommended reading	2
	Total hours:	75

ASSESSMENT SCHEME:

Calculation of final mark:

Written tests:	15	%
Individual coursework:	25	%
Group coursework:	10	%
Final exam:	20	%
Course project:	30	%
TOTAL	100	%

*Las observaciones específicas sobre el sistema de evaluación serán comunicadas por escrito a los alumnos al inicio de la materia.

BIBLIOGRAPHY AND DOCUMENTATION:

Basic bibliography:

Ministerio de Fomento. Código Técnico de la edificación (CTE) Seguridad estructural. 2006, Madrid.

Ministerio de Fomento. Instrucción de hormigón estructural (EHE-08). 2008, Madrid.
P. BHATT, T.J.MACGINLEY, B.S.CHOO. Reinforced concrete, design theory and examples. 3rd Edition. 2006, USA.
M.Y.H.BANGASH. Structural details in concrete. 1992, Hong Kong.
MONTOYA, Jiménez. Hormigón armado, 16º Edición basada en la EHE-08. 2018, Madrid.

Recommended bibliography:

Ministerio de Fomento. Guía de aplicación de la Instrucción de Hormigón Estructural (EHE-08)
AN/ UNE-EN 1992-1-1 Eurocode 2: Design of concrete structures.
CALAVERA, José. Proyecto y cálculo de estructuras de hormigón armado (tomos I y II). Madrid

Recommended websites:

Estructurando	http://estructurando.net/
Civil geeks	https://civilgeeks.com/

* Guía Docente sujeta a modificaciones