

BASIC DETAILS:

Subject:	ESTRUCTURAS III		
Id.:	30214		
Programme:	GRADUADO EN ARQUITECTURA. PLAN 2009 (BOE 21/03/2015)		
Module:	TECNICO		
Subject type:	OBLIGATORIA		
Year:	3	Teaching period:	Primer Cuatrimestre
Credits:	3	Total hours:	75
Classroom activities:	30	Individual study:	45
Main teaching language:	Inglés	Secondary teaching language:	Castellano
Lecturer:		Email:	

PRESENTATION:

This course is about Steel and Timber Structures.

Steel structures are a very widespread construction system, its utilization tends to grow depending on the industrialization achieved in the region or country where it is used. They have a great resistant capacity due to its main material, the steel, which gives the structure the possibility of achieving large-scale solutions, with low weight. As its elements and connections are prefabricated and standardized, construction times are significantly shortened.

Wooden structures are a construction system that is not as widespread as steel or reinforced concrete structures can be, but they are becoming popular in the construction sector thanks to its ecological benefit. Wood is a material with a mechanical behavior similar to steel, much lighter, and much less resistant.

This course will follow the rules established by the Technical Building Code (CTE). It will be complemented with structural rules defined in the Structural Steel Instruction (EAE) and some timber calculation guides from the Timber Eurocode (EN-1995).

PROFESSIONAL COMPETENCES ACQUIRED IN THE SUBJECT:

General programme competences	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.
Specific programme competences	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.
Regulated profession competences	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.
Learning outcomes	R01	Elaborar el proyecto de ejecución de una estructura de edificación de Hormigón Armado
	R02	Comprender y resolver cuestiones de carácter estructural relativas a la estabilidad de las construcciones arquitectónicas con referencia a los Estados Límite de Servicio y Último
	R03	Llevar a cabo el estudio pormenorizado de resolución estructural y puesta constructiva de distintas tipologías de forjados empleados en edificación
	R04	Diseñar, predimensionar, calcular y realizar el armado de una estructura de edificación de hormigón armado, analizando los resultados obtenidos y teniendo en cuenta el cumplimiento de la normativa vigente
	R05	Aplicar los conocimientos necesarios de los programas informáticos de cálculo de estructuras de hormigón armado, para contrastar con el empleo de los mismos los resultados obtenidos manualmente
	R06	Analizar, comprender y resolver problemas referidos a sistemas de cimentación superficial
	R07	Analizar, comprender y resolver problemas referidos a sistemas de cimentación profunda

PRE-REQUISITES:

It is advisory that every student that enrolls 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 is divided into two identical units: the first one Steel Structures, the second one Wooden Structures. It has been divided this way to ensure a better development of the course project. Both units will be measured with a practical project and exam.

The Steel Structures unit will start with some basic concepts about the conception of these structures, digging deeper into its mechanical properties and basis design calculations. There will be practical lessons on how to calculate the structure under failure ULS and buckling ULS. To end the unit with several global concepts about the conception of steel buildings and how it affects the structural calculations.

The Wooden Structures unit will start with some basic concepts about the conception of these structures, digging deeper into its mechanical properties and basis design calculations. There will be practical lessons on how to calculate the structure under ULS and SLS. To end the unit with several global concepts about the conception of timber buildings and how it affects the structural calculations.

Subject contents:

1 - STEEL STRUCTURES
1.1 - The material: Structural Steel
1.1.1 - Structural Steel Shapes
1.1.2 - Mechanical properties
1.2 - Basis of design
1.2.1 - Classification of cross-sections
1.2.2 - Calculation process
2 - ULS CALCULATIONS: RESISTANCE OF CROSS-SECTIONS
2.1 - Calculation with bending moment
2.2 - Calculation with compression
2.3 - Calculation with tension

2.4 - Calculation with shear
3 - ULS CALCULATION: BUCKLING RESISTANCE OF MEMBERS
3.1 - Instability concept
3.2 - Euler's formula: Buckling
3.3 - Calculation with compression
3.4 - Calculation with bending and axial compression
4 - BOLTED CONNECTIONS CALCULATION
4.1 - Types of connections
4.2 - Efforts affecting the connection
4.3 - Connection strength resistance
5 - WELDED CONNECTIONS CALCULATION
5.1 - Welding methods
5.2 - Welding types
5.3 - Quality control
5.4 - Efforts affecting the connection
5.5 - Connection strength resistance
6 - STEEL STRUCTURES CONSTRUCTION
6.1 - Composite slabs
6.2 - Cross bracing
6.3 - Steel Structure design
7 - WOODEN STRUCTURES
7.1 - The material: Structural wood
7.1.1 - Structural Wooden Shapes
7.1.2 - Mechanical properties
7.2 - Basis of design
7.2.1 - Kmod calculation
7.2.2 - Calculation process
8 - ULS CALCULATION FOR WOODEN STRUCTURES
8.1 - Design of cross-sections subjected to stress in one principal direction
8.2 - Design of cross-section subjected to combined stresses
8.3 - System strength
9 - SLS CALCULATION FOR WOODEN STRUCTURES
9.1 - Joint slip
9.2 - Limiting values for deflections of beams
10 - WOODEN STRUCTURES CONSTRUCTION
10.1 - Wooden roofs
10.2 - Wooden Structure design
11 - JORGENTINE PAVILION

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 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 -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 lectures, 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 in person. Students must prepare the practical activities prior to the realization of the session and study every concept needed to solve exercises. At the end of each unit there will be a **partial practical exam** 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 two **course projects**: one for each unit. The project will evaluate every concept of the unit. The first one will be done **individually**, the second one will be done in **interdisciplinary groups**. 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.

Student work load:

Teaching mode	Teaching methods	Estimated hours
Classroom activities	Master classes	4
	Other theory activities	5
	Practical exercises	5
	Practical work, exercises, problem-solving etc.	10
	Coursework presentations	2
	Participation in seminars, conferences etc.	4
Individual study	Tutorials	2
	Individual study	10
	Individual coursework preparation	8
	Group coursework preparation	15
	Research work	2
	Recommended reading	2
	Extra-curricular activities (visits, conferences, etc.)	3
	Other individual study activities	3
Total hours:		75

ASSESSMENT SCHEME:

Calculation of final mark:

Written tests:	40	%
Individual coursework:	15	%
Group coursework:	15	%
Final exam:	15	%
Individual project:	15	%
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:

GOBIERNO DE ESPAÑA. Código Técnico de la Edificación. 2006
GOBIERNO DE ESPAÑA. Instrucción de acero estructural. 2011
VARIOS, Conceptos básicos de la construcción con madera. Madrid: CcM, 2010.

Recommended bibliography:

AENOR; Eurocódigo 3: Proyecto de estructuras de acero; Madrid 2012.
AENOR; Eurocódigo 5: Proyecto de estructuras de madera; Madrid 2016.
ARGUELLES ÁLVAREZ, R. Estructuras de acero, cálculo. Madrid: Bellisco, 2013.

Recommended websites:

Código Técnico de la Edificación	https://www.codigotecnico.org/index.php/menu-seguridad-estructural.html
Estructurando	http://estructurando.net/
Ingeniería y construcción	https://civilgeeks.com/

* Guía Docente sujeta a modificaciones