BASIC DETAILS:

Subject:	ESTRUCTURAS I		
Id.:	30200		
Programme:	GRADUADO EN ARQUITECTURA. PLAN 2009 (BOE 21/03/2015)		
Module:	TECNICO		
Subject type:	OBLIGATORIA		
Year:	2	**Teaching period:**	Primer Cuatrimestre
Credits:	3	**Total hours:**	75
Classroom activities:	34	**Individual study:**	41
Main teaching language:	Inglés	**Secondary teaching language:**	Castellano
Lecturer:	BERTOL GROS, ANA (T)	**Email:**	abertol@usj.es

PRESENTATION:

This course is about mechanics of materials.

Mechanics of materials is one of the first application-based engineering classes students face in their educational career. It's part of the branch of physics known as mechanics, which includes other fields of study such as rigid solid body statics and dynamics. Mechanics is an area of physics that allows you to study the behaviour and motion of objects in the world around you. mechanics of materials uses basic statics and dynamics principles but allows you to look even more closely an object to see how it deforms under load.

The main goal of mechanics of materials is to provide the designer with the means to analyse and design structures capable of supporting loads and actions to which they are or may be subjected during their useful life. The course is proposed as a transition from architectural to structural concepts. The course's main goal is for the student to acquire the fundamental concepts of equilibrium, rigidity and strength, the three concepts needed to design a structure.

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.
	G06	Demonstrate critical and analytical ability to conventional approaches of the discipline.
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).
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.
	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.
Learning outcomes	R01	Resolve structural problems applying fundamentals of statics and strength of materials.
	R02	Understand the concept of tension, compression and bending, as well as the effect on structural systems used in buildings.
	R03	Understand the concept of shear and axial bending and torque, as well as the effect on structural systems used in buildings.
	R04	Resolve structural problems relating to the static degree of the structure and understand know how to use knots systems and structural links between the different elements that make up a structure.
	R05	Predict and analyse qualitative and quantitative diagrams of shear and bending moments.

	R06	Calculate deformations of structural elements subjected to simple loads using different methods.

PRE-REQUISITES:

It is advisory that every student that enrols in this course is at least familiar with basic statics and computation of internal forces, taught in the previous physics course. She/ he 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.

It is also advisory that students have some upper intermediate level of English.

SUBJECT PROGRAMME:

Observations:

As this course is the student's first attempt to understand building structures, the course will first teach students to appreciate what a structure is, the way the forces travel through each structural element and the geometries and materials used to build structures.

Once the basic knowledge is presented, the course will take on to teach about structural forces. External forces and internal forces. While studying external forces, we'll investigate supports systems, types of beams and pillars and we will learn to estimate and calculate efforts diagrams. While studying internal forces, we'll learn about Hooke's law and stress and strain operations.

The course will end with some basic knowledge and tips for the student to understand a structure's behaviour and even attempt to design them.

Subject contents:

1 - Introduction
1.1 - Structural vocabulary
2 - What is a structure?
2.1 - Physics review
2.2 - Basic concepts
2.3 - Equilibrium / Rigidity / Strength
3 - Structural geometry (equilibrium)
3.1 - Building geometry
3.2 - Section geometry
4 - Structural materials (rigidity)
4.1 - Types of materials
4.2 - Elasticity and materials behaviour
4.2.1 - Hooke's law
5 - Structural forces (strength)
5.1 - External forces
5.1.1 - Building loads
5.1.2 - Efforts diagrams
5.2 - Internal forces
5.2.1 - Axial stress
5.2.2 - Bending stress
5.2.3 - Shear stress
5.2.4 - Trosion stress
6 - Stress and strain
6.1 - Calculating stress
6.2 - Understanding deformation
7 - Practice makes perfect

7.1 - Designing for required section properties
7.2 - Tips to solving mechanic of materials problems

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.

At midterm there will be a **practical written test** to check the evaluating competences are being met. Students will have to solve some exercises similar to the ones solved at the practical sessions, using the knowledge from the theory sessions.

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.

Student work load:

Teaching mode	Teaching methods	Estimated hours
Classroom activities	Master classes	10
	Practical exercises	10
	Practical work, exercises, problem-solving etc.	4
	Debates	2
	Films, videos, documentaries etc.	4
	Workshops	2
	Assessment activities	2
Individual study	Tutorials	2
	Individual study	15
	Individual coursework preparation	10
	Group cousework preparation	2

	Research work	5
	Recommended reading	2
	Other individual study activities	5
	Total hours:	75

ASSESSMENT SCHEME:

Calculation of final mark:

Written tests:	10	%
Individual coursework:	30	%
Final exam:	20	%
Course project:	40	%
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:

J.M.GERE. Timoshenko: Resistencia de Materiales. Thomson, 2006.
R.C.HIBBELER. Mechanics of materials. Pearson, USA 2011.
J.E.GORDON. Estructuras o por qué las cosas no se caen (Structures: Or why whigs don't fall down). Calamar Ediciones, 2006.
M.C.RUIZ, E.B.DÍAZ. Resistencia de Materiales. CIMNE, Barcelona, 2015.

Recommended bibliography:

SALVADORI, Mario. Why Buildings Stand Up: Strength of Architecture from the Pyramids to the Skyscraper. Norton, 2002.
MATTHYS, Levy. Why buildings fall down. Norton, 2002.
NASH, William A. Teoría y Problemas de Resistencia de Materiales. Schaum, Mc. Graw-Hill, 1992
JAMES H. Mechanics of materials for dummies. Willey publishing. Indiana, 2011.

Recommended websites:

Estructurando	http://estructurando.net/
Civil geeks	https://civilgeeks.com/
Ingemecánica	https://ingemecanica.com/index.html
Beam Calculator Online	https://beamguru.com/online/beam-calculator/