

# Analysis and Design of Steel Structures (250472)

## General information

<b>School:</b>	ETSECCPB
<b>Departments:</b>	751 - Departament d'Enginyeria Civil i Ambiental
<b>Credits:</b>	5.0 ECTS
<b>Programs:</b>	1161 - MÀSTER UNIVERSITARI EN ENGINYERIA DE CAMINS, CANALS I PORTS (pla 2012), 872 - MÀSTER UNIVERSITARI EN ENGINYERIA DE CAMINS, CANALS I PORTS (pla 2012), 1140 - MÀSTER UNIVERSITARI EN ENGINYERIA ESTRUCTURAL I DE LA CONSTRUCCIÓ (pla 2015)
<b>Course:</b>	2015/2016
<b>Course language:</b>	Castellano

## Faculty

Responsible faculty: Alfredo Bernardo Arnedo Pena, Enrique Mirambell Arrizabalaga

Teachers: Alfredo Bernardo Arnedo Pena, Enrique Mirambell Arrizabalaga

## Generic objectives

Specialization subject in which knowledge on specific competences is intensified.

Knowledge and skills at specialization level that permit the development and application of techniques and methodologies at advanced level.

Contents of specialization at master level related to research or innovation in the field of engineering.

## Skills

### *Specific skills*

Knowledge of all kinds of structures and materials and the ability to design, execute and maintain structures and buildings for civil works.

Knowledge of and competence in the application of advanced structural design and calculations for structural analysis, based on knowledge and understanding of forces and their application to civil engineering structures. The ability to assess structural integrity.

### *Generic skills of subject*

INNOVATION, EMPLOYABILITY, DEVELOPMENT AND RESEARCH: The ability to develop one's creative and innovative tendencies with the ultimate aim of serving the development and

progress of society. The ability to work on a research topic. Employability in managerial posts in all types of companies and public authorities, coupled with initiative and decision-making abilities. The ability to develop one's creative and innovative tendencies with the ultimate aim of serving the development and progress of society. The ability to work on a research topic. Employability in managerial posts in all types of companies and public authorities, coupled with initiative and decision-making abilities.

**SUSTAINABILITY AND THE ENVIRONMENT:** The capacity for engineering development in the framework of globalisation, sustainability and environmental protection. The ability to analyse the entire life cycle of an engineering project.

**KNOWLEDGE DEVELOPMENT:** The ability to develop new analytical methods and processes at all levels: conception, design and development. The ability to propose and develop specifications, regulations and rules in engineering following safety and efficiency criteria and using sustainable resources.

### ECTS credits: total hours of student work

		Dedication	
		Hours	Percent
<b>Supervised Learning</b>	<b>Theory</b>	21.00	46.7%
	<b>Assignments</b>	12.00	26.7%
	<b>Laboratory</b>	6.00	13.3%
	<b>Supervised activities</b>	6.00	13.3%
<b>Self-Learning</b>		80.00	

### Contents

#### **1.The steel material.**

***Dedication***

3.0h. Theory

***Description***

Steel properties. Stress-strain relationship. Temperature effects. Strain rate. Plasticity. Ductility. Toughness. Fatigue.

#### **2.Design os structural elements in front of brittle fracture and fatigue.**

***Dedication***

3.0h. Theory + 3.0h. Assignments

***Description***

Treatment in Instrucción EAE and Eurocode. Exercises and problems.

Exercises

## **Ultimate Limit States**

### ***Dedication***

6.0h. Theory + 3.0h. Assignments

### ***Description***

Resistance of the cross sections. Cross section classification. Interacción. Plastic design. Buckling design. Cross sections class 4.

Column buckling theory. Beam-column behaviour. Effective lengths. Design rules of EAE, Eurocode and AISC.

Exercises and problems.

## **Assessment 2**

### ***Dedication***

3.0h. Laboratory

## **Joints**

### ***Dedication***

3.0h. Theory + 3.0h. Assignments

### ***Description***

Joints.

Welding properties. Calculation of welded joints.

Bolted joints. Base plates .

Joint exercises

## **Built-up elements**

### ***Dedication***

3.0h. Theory

### ***Description***

Built-up columns, lattice girders and trusses.

## **Structural types**

### ***Dedication***

3.0h. Assignments

### ***Description***

Design of multi-storey buildings and industrial buildings.

## **Accidental actions**

### ***Dedication***

3.0h. Theory

**Description**

Fire resistance. Simplified Method.

Seismic design based on ductility.

Blast and impact.

**Assessment 3**

**Dedication**

3.0h. Laboratory

**Activities**

**Steel column**

**Dedication**

3.0 h. Supervised activities

**Description**

Design of a steel column of a building.

**Design of a steel beam subjected to fire**

**Dedication**

3.0 h. Supervised activities

**Description**

Design of a steel beam under fire

**Grading rules (\*)**

**(\*) The evaluation calendar and grading rules will be approved before the start of the course.**

The mark of the course is obtained from the ratings of continuous assessment.

The first assessment is 35 % and the second 65% of the total.

**Test rules**

Any exercise with conceptual errors in determining the internal forces will be assessed with 0.

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

**Teaching methodology**

The course consists of 1,8 hours per week of classroom activity (large size group) and 0,8 hours weekly with half the students (medium size group).

The 1,8 hours in the large size groups are devoted to theoretical lectures, in which the teacher presents the basic concepts and topics of the subject, shows examples and solves exercises.

The 0,8 hours in the medium size groups is devoted to solving practical problems with greater interaction with the students. The objective of these practical exercises is to consolidate the general and specific learning objectives.

The rest of weekly hours devoted to laboratory practice.

Support material in the form of a detailed teaching plan is provided using the virtual campus ATENEA: content, program of learning and assessment activities conducted and literature.

### **Office hours**

### **Basic bibliography**

- Comisión Permanente de Estructuras de Acero. **EAE: instrucción de acero estructural: con comentarios de los miembros de la Comisión Permanente de Estructuras de Acero.** Ministerio de Fomento. Secretaría General Técnica. Madrid. 2011. ISBN 978-84-498-0904-0.
- CEN. **UNE-EN 1993-1-1:2008 Eurocódigo 3: Proyecto de estructuras de acero. Parte 1-1: Reglas generales y reglas para edificios.** AENOR. 2008.
- CEN. **UNE-EN 1993-1-3:2009 Eurocódigo 3: Proyecto de estructuras de acero. Parte 1-3: Reglas generales. Reglas adicionales para perfiles y chapas de paredes delgadas conformadas en frío.** AENOR. 2009.
- CEN. **UNE-EN 1993-1-8:2011 Eurocódigo 3: Proyecto de estructuras de acero. Parte 1-8: Uniones.** AENOR. 2011.
- Alfredo Arnedo Pena. **Naves industriales con acero.** Publicaciones APTA. 2009. ISBN 978-84-692-2274-4.