Course guide
250026 - GECCONSMET - Steel Structures

Unit in charge: Barcelona School of Civil Engineering
Teaching unit: 751 - DECA - Department of Civil and Environmental Engineering.

Degree: BACHELOR'S DEGREE IN CIVIL ENGINEERING (Syllabus 2020). (Compulsory subject).

Academic year: 2022 ECTS Credits: 6.0 Languages: Spanish, English

LECTURER
Coordinating lecturer: ROLANDO ANTONIO CHACÓN FLORES
Others: ROLANDO ANTONIO CHACÓN FLORES, SERGIO GALLEGUO URBANO, ENRIQUE MIRAMBELL ARRIZABALAGA, DAVID VERGES COLL

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
14401. Ability to analyze and understand how the characteristics of structures influence their behavior. Ability to apply knowledge about the resistant operation of structures to size them according to existing regulations and using analytical and numerical calculation methods. (Common module to the Civil branch)
14403. Knowledge of the fundamentals of the behavior of reinforced concrete structures and metal structures and ability to conceive, design, build and maintain these types of structures. (Common module to the Civil branch)

General:
14380. Scientific-technical training for the exercise of the profession of Technical Engineer of Public Works and knowledge of the functions of advice, analysis, design, calculation, project, construction, maintenance, conservation and exploitation.
14383. Ability to project, inspect and direct works, in their field.
14391. Conceive, project, manage and maintain systems in the field of construction engineering. Cover the entire life cycle of an infrastructure or system or service in the field of construction engineering. (Additional school competition).

TEACHING METHODOLOGY
The course consists of 2 hours per week of classroom activity (large size group) and 2 hours weekly with half the students (medium size group).

The 2 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 2 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.

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.
LEARNING OBJECTIVES OF THE SUBJECT

Producer of steel for the manufacture of profiles and plates used in construction, thus with the typical structural types in metal construction. Calculation bases. Limit states, actions, durability and materials. Stress-strain behavior of metal structures facing sectional forces such as axial forces, shear forces, bending and torsion moments, taking in account the possible interaction between the behavior of the elements in front of phenomena of instability: basic equations and design equations (flexural buckling and lateral buckling). Screwed joints and welded joints in steel structures.

1 Ability to define actions and combinations of actions to consider in the steel structures project. Capacity to design and/or check the strength of the sections against different types of forces and their interaction.
2. Ability to design and/or check the structural elements of concrete or metal against buckling phenomena.
3 Ability to design usual steel structural types.

Knowledge of the fundamentals of the behavior of steel structures and ability to conceive, project, build and maintain this type of structures. Knowledge of the production of steel for the manufacture of profiles and plates, as well as common structural types in metal construction. Knowledge of the stress-strain behavior of steel structures against sectional forces, axial forces, shear forces, bending moments and torsion moments, taking into account their possible interaction, and of the behavior of the elements against instability phenomena: basic equations and design equations (flexural buckling and lateral buckling). Knowledge of the behavior of bolted joints and welded joints in metal structures.

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
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</thead>
<tbody>
<tr>
<td>Self study</td>
<td>84,0</td>
<td>56.00</td>
</tr>
<tr>
<td>Hours medium group</td>
<td>30,0</td>
<td>20.00</td>
</tr>
<tr>
<td>Guided activities</td>
<td>6,0</td>
<td>4.00</td>
</tr>
<tr>
<td>Hours large group</td>
<td>30,0</td>
<td>20.00</td>
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Total learning time: 150 h

CONTENTS

**Topic 1. Introduction to steel structures**

**Description:**
Introduction to steel structures

**Full-or-part-time:** 2h 24m
- Theory classes: 1h
- Self study: 1h 24m

**Topic 2: The steel material**

**Description:**
2.1 Characteristics of steels 2.2 Types of steel 2.3 Steel products 2.4 Handbooks: ProfileCelsa 2.5 Steel production 2.6 Failure criteria

**Exercises**

**Full-or-part-time:** 7h 11m
- Theory classes: 2h
- Practical classes: 1h
- Self study: 4h 11m
### Topic 3: Project bases

**Description:**
3.1 Generalities. 3.2 The limit state method: Last limit states and service limit states. 3.3 Durability-oriented calculation bases. 3.4 Actions. Combination of actions. 3.5 Steel material. Partial coefficient for resistance.

**Exercises**

**Full-or-part-time:** 7h 11m  
Theory classes: 2h  
Practical classes: 1h  
Self study: 4h 11m

### Topic 4: Serviceability Limit States. Deflections

**Description:**
4.1 Deflections limits in buildings 4.2 Deflections limits in bridges

**Exercises**

**Full-or-part-time:** 4h 48m  
Theory classes: 1h  
Practical classes: 1h  
Self study: 2h 48m

### Topic 5: Ultimate Limit States. Cross-sectional resistance

**Description:**
5.1 General principles of calculation 5.1.1 Elastic analysis 5.1.2 Characteristics of cross sections 5.1.3 Effects of shear lag 5.2 Classification of cross sections 5.3 Tensile elements 5.4 Compression elements 5.5 Flexural elements 5.6 Shear stress 5.7 Bending-shear interaction 5.8 Bending-axial interaction 5.9 Bending-Axial-Shear interaction

**Exercises**

**Laboratories**

**Full-or-part-time:** 21h 36m  
Theory classes: 6h  
Practical classes: 2h  
Laboratory classes: 1h  
Self study: 12h 36m

### Topic 6: Sizing of structural elements subjected to bending

**Description:**
6.1 Global elastic analysis 6.2 Global plastic analysis 6.3 Structural types 6.3.1 Plate girders 6.3.2 Trusses and cantilever beams

**Exercises**

**Laboratories**

**Full-or-part-time:** 19h 12m  
Theory classes: 4h  
Practical classes: 2h  
Laboratory classes: 2h  
Self study: 11h 12m
Evaluation

Full-or-part-time: 14h 23m
Laboratory classes: 6h
Self study : 8h 23m

Topic 7: Structural elements subjected to torsion loads

Description:
7.1 General 7.2 Uniform torsion 7.3 Warping 7.4 Mixed torsion 7.5 Sizing of elements subjected to torsion 7.6 Shear-torsion interaction 7.7 Bending-torsion interaction

Exercises
Laboratories

Full-or-part-time: 16h 48m
Theory classes: 4h
Practical classes: 2h
Laboratory classes: 1h
Self study : 9h 48m

Topic 8: Ultimate limit state of instability. Bucklings

Description:
8.1 Ideal columns. Critical load. Equilibrium bifurcation 8.2 Real columns. Equilibrium divergence 8.3 European buckling curves 8.4 Sizing of compressed elements 8.5 Sizing of compressed elements for different buckling lengths 8.5.1 Canonical elements 8.5.2 Frames 8.5.3 Triangulated structures 8.5.4 Elements subjected to variable axial force. 8.5.5 Flexural torsional buckling and torsion and torsional buckling 8.6 Lateral Torsional Buckling 8.6.1 Ideal part. Critical moment of LTB 8.6.2 Sizing of elements subjected to bending in front of LTB 8.7 Sizing of elements subjected to compression and bending. 8.7.1 Simplified method 8.7.2 General method

Exercises
Laboratories

Full-or-part-time: 33h 36m
Theory classes: 9h
Practical classes: 4h
Laboratory classes: 1h
Self study : 19h 36m
Topic 9: Connections

Description:
10.1 Introduction 10.1.1 General considerations 10.1.2 Determination of stresses in the joints and distribution between the elements of the joint 10.1.3 Classification of the joints subjected to bending moment. Moment-rotation diagram. 10.2 Bolted joints 10.2.1 Types of bolts 10.2.2 Categories of bolted joints 10.2.3 Constructive provisions 10.2.4 Prestressed bolts 10.2.5 Strength of bolted joints 10.2.6 Distribution of forces between bolts 10.2.7 Types of bolted joints. Calculation 10.3 Welded joints 10.3.1 General 10.3.2 Types of joints and cords 10.3.3 Constructive arrangements for angled cords and butt cords 10.3.4 Strength of angled cords and butt cords 10.3.5 Casting of stresses between the cords of a joint 10.3.6 Types of welded joints.

Calculation
Exercises
Laboratories

Full-or-part-time: 16h 48m
Theory classes: 4h
Practical classes: 2h
Laboratory classes: 1h
Self study: 9h 48m

GRADING SYSTEM

The mark of the course is obtained from the ratings of continuous assessment and their corresponding laboratories and/or classroom computers.

Continuous assessment consist in several activities, both individually and in group, of additive and training characteristics, carried out during the year (both in and out of the classroom).

The teachings of the laboratory grade is the average in such activities.

The evaluation tests consist of a part with questions about concepts associated with the learning objectives of the course with regard to knowledge or understanding, and a part with a set of application exercises.

EXAMINATION RULES.

If any of the laboratory or continuous assessment activities are not performed in the scheduled period, it will be considered a zero score.

BIBLIOGRAPHY

Basic: