Course guide
250472 - ANPROESTAC - Analysis and Design of Steel Structures

Last modified: 22/05/2024

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

Degree: MASTER'S DEGREE IN CIVIL ENGINEERING (PROFESSIONAL TRACK) (Syllabus 2012). (Optional subject). MASTER'S DEGREE IN STRUCTURAL AND CONSTRUCTION ENGINEERING (Syllabus 2015). (Optional subject).

Academic year: 2024 **ECTS Credits:** 5.0 **Languages:** Spanish, English

LECTURER

Coordinating lecturer: ENRIQUE MIRAMBELL ARRIZABALAGA

Others: ITSASO ARRAYAGO LUQUIN, DIEGO COBO DEL ARCO, ENRIQUE MIRAMBELL ARRIZABALAGA, ESTHER REAL SALADRIGAS

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
8162. Knowledge of all kinds of structures and materials and the ability to design, execute and maintain structures and buildings for civil works.
8228. 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.

Transversal:
8559. ENTREPRENEURSHIP AND INNOVATION: Being aware of and understanding the mechanisms on which scientific research is based, as well as the mechanisms and instruments for transferring results among socio-economic agents involved in research, development and innovation processes.
8560. SUSTAINABILITY AND SOCIAL COMMITMENT: Being aware of and understanding the complexity of the economic and social phenomena typical of a welfare society, and being able to relate social welfare to globalisation and sustainability and to use technique, technology, economics and sustainability in a balanced and compatible manner.

8561. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.

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.

Although most of the sessions will be given in the language indicated, sessions supported by other occasional guest experts may be held in other languages.

LEARNING OBJECTIVES OF THE SUBJECT

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.

STUDY LOAD

Type	Hours	Percentage
Hours medium group	9,8	7.83
Hours small group	9,8	7.83
Hours large group	25,5	20.38
Self study	80,0	63.95

Total learning time: 125.1 h

CONTENTS

1. Presentation

Description:
Course brief description

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

2. Basic knowledge. Notions of structural analysis

Description:
Resistance of the cross sections. Cross section classification. Class 4 cross sections. Internal forces interaction.
Cross-section resistance ELU
Column buckling theory. Beam-column behaviour. Effective lengths. Design rules of EAE and Eurocode.
ELU of element instability
Basic notions of structural analysis considering the geometrical and material non-linearities. Global plastic analysis: Plastic hinges theory. Collapse mechanisms.
Basic notions of structural analysis. Global plastic analysis

Full-or-part-time: 19h 12m
Theory classes: 5h
Practical classes: 3h
Self study : 11h 12m

3. Brittle fracture

Description:
Fracture mechanics concepts. Fracture toughness. Resilience. Charpy test. Influence of temperature. Design against brittle fracture. EN 1993-1-10, Spanish Code EAE.
Design of elements against brittle fracture.

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

4. Fatigue

Description:
Basic concepts of fatigue. Mechanism of fatigue failure. Fatigue design methods. Safety partial factors. SN curve method (EN 1993-1-9, EAE). Recommendations
Fatigue design methods

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

Assessment 1

Full-or-part-time: 7h 11m
Laboratory classes: 3h
Self study : 4h 11m

5. Fire

Description:
General considerations. Properties of materials in front of fire. Fire resistance. Calculation of temperatures in steel.
Fire

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

6. Cold-formed structures

Description:
Cold-formed sheets and profiles. Material properties. Resistances verifications and deflection calculations. CUFSM.
Cold-formed structures

Full-or-part-time: 14h 23m
Theory classes: 3h
Practical classes: 3h
Self study : 8h 23m

7. Joints

Description:
Overview. Bolted joints. Category and check. Welded joints. Directional method.
Joint exercises

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

8. Structural analysis

Description:
Material nonlinearity. Geometric nonlinearity. Sway and non-sway frames. Consideration of second order effects.

Full-or-part-time: 7h 11m
Theory classes: 3h
Self study : 4h 11m

Assessment 2

Full-or-part-time: 7h 11m
Laboratory classes: 3h
Self study : 4h 11m

9. Tutorial design software

Description:
Commercial steel frame design software will be used to consolidate the concepts explained during the course through a practical application.

Full-or-part-time: 7h 11m
Laboratory classes: 3h
Self study : 4h 11m

GRADING SYSTEM

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

The first assessment is 50% and the second 50% of the total.

EXAMINATION RULES.

Any exercice with conceptuals 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.

BIBLIOGRAPHY

Basic:
- Comisión Permanente de Estructuras de Acero. EAE: instrucción de acero estructural: con comentarios de los miembros de la Comisión Permanente de Estructuras de Acero [on line]. Madrid: Ministerio de Fomento. Secretaría General Técnica, 2011 [Consultation: 08/02/2021]. Available on: https://www.mitma.es/recursos_mfom/1903100.pdf. ISBN 978-84-498-0904-0.
- CEN. UNE-EN 1993-1-1:2008/AC: Eurocódigo 3: proyecto de estructuras de acero: Parte 1-1: Reglas generales y reglas para edificios. Madrid: AENOR, 2010.
- 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.
- Arnedo, A. Naves industriales con acero. Madrid: Asociación para la Promoción Técnica del Acero, 2009. ISBN 9788469222744.