Universidad Zaragoza

Academic Year/course: 2022/23

28838 - Structures Analysis and Design

Syllabus Information

Academic Year: 2022/23
Subject: 28838 - Structures Analysis and Design
Faculty / School: 175 - Escuela Universitaria Politécnica de La Almunia
Degree: 424 - Bachelor's Degree in Mechatronic Engineering
ECTS: 6.0
Year: 4
Semester: Second semester
Subject Type: Optional
Module:

1. General information

1.1. Aims of the course

The main goals of the subject "Design and Calculation of structures" are that the students get the skills to choose a structural model appropriate to each situation, and then, to carry out the structural analysis to get the stresses and displacements and finally, to validate an adequate structural element section (predominantly in steel).

These approaches and objectives are in line with the following Sustainable Development Goals (SDGs) of the United Nations 2030 Agenda (https://www.un.org/sustainabledevelopment/es/), in such a way that the acquisition of the course learning outcomes provides training and competence to contribute to their achievement to some degree.

- Goal 4: Quality Education
- Goal 9: Build resilient infrastructure, promote sustainable industrialization and foster innovation

1.2. Context and importance of this course in the degree

The subject "Design and Calculation of Structures" is an optional subject that is framed within the module of mechanics - design and calculation of the curriculum of the **BEng in Mechatronic Engineering**. It is a subject of 6 ECTS credits that it is taught in the second semester of the fourth year, or eighth semester of the race.

The subject is the continuation of the subject Strength of Materials, which gives the basics this new subject. From this point, in this subject the student is provided with the necessary technological tools for the design, calculation, analysis and size of the most frequent types of structures in industrial plants and facilities.

The student will end up knowing:

- Structuring calculation methods
- Advanced constructive solutions
- Industrial constructions

1.3. Recommendations to take this course

We recommend that the student that take this course will know how to:

- To solve reactions and forces on statically determinate structures.
- To determine displacements and angular rotation in structures.
- To get normal and tangential stresses from forces.
- To calculate simple articulated structures.
- Differential, Integral, Matrix and Vector calculus

2. Learning goals

2.1. Competences

GENERAL SKILLS (ITI)

- GI03 Knowledge of basic and technological subjects, which enables them to learn new methods and theories, and equips them with versatility to adapt to new situations.
- GI04 Ability to solve problems with initiative, decision making, creativity, critical reasoning and to communicate and transmit knowledge, abilities and skills in the field of Industrial Engineering and in particular in the field of industrial electronics.
- GI06 Ability to manage specifications, regulations and mandatory standards.
- GI10 Ability to work in a multilingual and multidisciplinary environment.

GENERAL SKILLS (UNIVERSITY CENTRE)

- GC02. Interpret experimental data, contrast them with theoretical ones and draw conclusions.
- GC03. Ability for abstraction and logical reasoning.
- GC04. Ability to learn continuously, self-directed and autonomously.
- GC05. Ability to evaluate alternatives.
- GC06. Ability to change to the rapid evolution of technologies.
- GC07. Ability to lead a team as well as be a committed member of it.
- GC08. Ability to locate technical information, as well as its understanding and evaluation.
- GC09. Positive attitude towards technological innovations.
- GC10. Ability to write technical documentation and present it with the help of appropriate computer tools.
- GC11. Ability to communicate their reasoning and designs clearly to specialized and non-specialized audiences.
- GC14. Ability to understand the operation and develop the maintenance of mechanical, electrical and electronic equipment and installations.
- GC15. Ability to analyze and apply simplified models to technological equipment and applications that require forecasting of their behavior.
- GC16. Ability to configure, simulate, build and verify prototypes of electronic and mechanical systems.
- GC17. Ability to correctly interpret plans and technical documentation.

SPECIFIC SKILLS (MECHANICAL ENGINEERING)

- EM01. Knowledge and skills for the calculation, design and testing of machines (in this case of structures)
- EM02. Knowledge and capacity for modeling and simulation of systems (in this case of structures)
- EM05. Knowledge and skills for the design and maintenance of mechatronic systems (structural, in this case).

2.2. Learning goals

The student, to pass this subject, must demonstrate the following results ...

- The constructive arrangement of the different systems that make up an industrial structure dominates.
- It is capable of pre-sizing the most common structural typologies.
- Master and know how to apply different methods of calculation and analysis of articulated structures.
- Master and know how to apply different methods of calculation and analysis of rigid knot structures.
- Master and know how to solve the problem of global stability of structures.
- Master and know how to apply the general regulations on structures and buildings contained in the Technical Building Code.

2.3. Importance of learning goals

The learning results of this subject are very important for an engineer or mechatronic engineer since they provide him with a deep knowledge of the behavior of structures, which are present as a resistant element supporting any type of machine, building, installation, robot, etc.

3. Assessment (1st and 2nd call)

3.1. Assessment tasks (description of tasks, marking system and assessment criteria)

The student must demonstrate that they have achieved the expected learning outcomes through the following assessment systems

CONTINUOUS ASSESSMENT

A continuous follow-up evaluation system for the subject is proposed, consisting of the following sections:

Practice of design and calculation of industrial building: Throughout the course the student will develop a particular case of design and calculation of industrial building in which he will capture in a report all the development from the genesis to the dimensioning of the structure, according to the content of the syllabus taught in the classes. This case study will have a weight on the note of 50%.
Theoretical - practical exam, whose weight on the note is 50%
Those students whose average grade for the case study and the theoretical-practical exam is at least 5 points will pass the subject in continuous evaluation.

It is an essential condition to pass the subject in continuous assessment, attending 80% of the face-to-face activities: classes, technical visits, practices, etc.

GLOBAL ASSESSMENT (FINAL EXAMINATION ONLY)

The student who does not pass the continuous monitoring evaluation system or does not wish to do so, will opt for a global evaluation, which is described below.

Theoretical-practical content exam (100% of the final grade). In this exam theoretical-practical questions will be formulated and several problems of similar difficulty to those carried out in class will be carried out. The estimated duration of this test is three hours.

On the first day of class, there will be a presentation of the subject where the evaluation models will be explained.

4. Methodology, learning tasks, syllabus and resources

4.1. Methodological overview

The learning process designed for this subject is based on the following:

Strong interaction between the teacher/student. This interaction is brought into being through a division of work and responsibilities between the students and the teacher. Nevertheless, it must be taken into account that, to a certain degree, students can set their learning pace based on their own needs and availability, following the guidelines set by the teacher.

The current subject is conceived as a stand-alone combination of contents, yet organized into three fundamental and complementary forms, which are: the theoretical concepts of each teaching unit, the solving of problems or resolution of questions and laboratory work, at the same time supported by other activities

The organization of teaching will be carried out using the following steps:

- **Lectures**: Theoretical activities carried out mainly through exposition by the teacher, where the theoretical supports of the subject are displayed, highlighting the fundamentals, structuring them into topics and or sections, interrelating them.
- **Practice Sessions**: The teacher resolves practical problems or cases for demonstrative purposes. This type of teaching complements the theory shown in the lectures with practical aspects.
- **Individual Tutorials**: Those carried out giving individual, personalized attention with a teacher from the department. Said tutorials may be in person or online.

The approach, methodology and assessment of this guide are intended to be the same for any teaching scenarios. They will be adapted to the social-health situation at any particular time, as well as to the instructions given by the authorities concerned.

4.2. Learning tasks

The program offered to the student to help them achieve their target results is made up of the following activities. Involves the active participation of the student, in a way that the results achieved in the learning process are developed, not taking away from those already set out, the activities are the following:

Face-to-face generic activities:

- **Lectures**: The theoretical concepts of the subject are explained and illustrative examples are developed as support to the theory when necessary.
- **Practice Session**: Problems and practical cases are carried out, complementary to the theoretical concepts studied.

Generic non-class activities:

- Study and understanding of the theory taught in the lectures.
- Understanding and assimilation of the problems and practical cases solved in the practical classes.

- Preparation of seminars, solutions to proposed problems, etc.
- Preparation of the written tests for continuous assessment and final exams.

The subject has 6 ECTS credits, which represents 150 hours of student work in the subject during the trimester, in other words, 10 hours per week for 15 weeks of class.

A summary of a weekly timetable guide can be seen in the following table. These figures are obtained from the subject file in the Accreditation Report of the degree, taking into account the level of experimentation considered for the said subject is moderate.

Activity / Weekly school hours

Lectures / 4

Other Activities / 6

4.3. Syllabus

The course will address the following topics:

1. Actions and Structural Reliability Theory
2. Structural analysis: reticular structures
3. Structural analysis: articulated structures
4. Introduction to matrix structural analysis
5. Introduction to finite element analysis
6. Steel Structural Design: elements and connections
7. Foundations

4.4. Course planning and calendar

Further information concerning the timetable, classroom, office hours, assessment dates and other details regarding this course will be provided on the first day of class or please refer to the EUPLA website:

- https://eupla.unizar.es/
- https://eupla.unizar.es/asuntos-academicos/calendario-y-horarios
- https://eupla.unizar.es/asuntos-academicos/examenes

4.5. Bibliography and recommended resources

http://psfunizar10.unizar.es/br13/egAsignaturas.php?codigo=28838