Universidad Zaragoza

Academic Year/course: 2022/23

39616 - Elasticity and Resistance of Materials

Syllabus Information

Academic Year: 2022/23
Subject: 39616 - Elasticity and Resistance of Materials
Faculty / School: 175 - Escuela Universitaria Politécnica de La Almunia
Degree: 608 -
ECTS: 6.0
Year: 2
Semester: Second semester
Subject Type: Compulsory
Module:

1. General information

1.1. Aims of the course

Elasticity is a basic theory, essential to be able to understand the resistance of materials from which it is, therefore, essential foundation. The first four topics refer to the theory of elasticity where the concepts of deformations and tensions are exposed, and later to address, in general, the solution of the elastic problem: To obtain the deformations and tensions in the points of An elastic solid, subject to a set of external loads.
The resistance of materials is a discipline of compulsory study for all the students of technical careers, because their theory has an object to establish the criteria that will allow them to determine the material, the form and the dimensions to be given to Any structural element that they must design in a particular project in their future professional activity.
Another fundamental objective is that these graduates acquire a series of technical, systemic, participatory and personal transversal competencies that will be listed in the following section.

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 of "elasticity and material resistance " is obligatory and belongs to the Mechanics module within the degree of "Mechatronics Engineering ". It has in the current curriculum a workload load of 6 ECTS credits and is imparted in the second semester of the second year.

Brief presentation of the subject:

The theory of rigid solids was studied in the subject of "mechanical Engineering" based on the hypothesis that when a solid is subjected to a system of loads, it remains perfectly rigid, ie the distances between its points do not vary, the solid does not Experience any kind of deformation.
In this subject "elasticity and resistance of materials" The mechanics of the deformable solids will be studied since all the structures and real machines are deformed under the loads to which they are subjected.
The theory of elasticity is considered as that part of the mechanics that studies the elastically deformable solids of engineering interest; That is, those solids that recover their primitive form when they stop acting on them the mechanical or thermal actions that deformed them. Its field is very extensive being the resistance of materials apart, more applied, of this theory.
Thus, the resistance of materials can be defined as the whole of those techniques that allow studying the mechanical behaviour of elastic solids formed by a small number of prismatic pieces, interconnected with each other, and supporting actions Mechanical and thermal.

1.3. Recommendations to take this course

This subject requires to have studied the subjects related to fundamentals of physics I and mathematics of the first year of the qualification.

2. Learning goals

2.1. Competences

GI03.- Knowledge in basic and technological matters, which enables them to learn new methods and theories, and provides them with versatility to adapt to new situations
GI04.- Ability to solve problems with initiative, decision making, creativity, critical thinking and to communicate and convey knowledge, skills and abilities in the field of Industrial Engineering.
GI06.- Capacity to deal with specifications, regulations and mandatory rules.
GC03.- Capacity for abstraction and logical thinking.
GC04.- Ability to learn in a continuous, self-directed and autonomous way.
GC05.- Capacity to evaluate options.
GC06.- Ability to adapt to the rapid evolution of technologies.
GC07.- Ability to lead a team as well as being a committed member of it.
GC08.- Ability to locate technical information, as well as its understanding and assessment.
GC09.- Positive attitude towards technological innovations.
GC10.- Ability to write technical documentation and to present it with the help of appropriate computer tools.
GC11.- Ability to convey their ideas and designs clearly to specialized and non-specialized audiences.
GC14.- Ability to understand the operation and deal with the maintenance of mechanical, electrical and electronic equipment and installations.
GC15.- Ability to analyze and apply simplified models to equipment and applications.
GC16: Ability to set up, simulate, build and test prototypes of electronic and mechanical systems.
GC17.- Capacity for correct interpretation of plans and technical documentation.
IE08: Knowledge and use of the principles of mechanics of materials.

2.2. Learning goals

To pass this subject, the students must demonstrate the following competences ...

Know how to interpret the concepts of stress and deformation and know how to relate them through behavioral equations, to solve simple three-dimensional elastic solids problems.

Know how to calculate and represent the internal stress diagrams in rigid knot and articulated knot structures.
Know how to dimension simple structural elements in rigid knot and articulated knot structures.
Know how to interpret the phenomenon of buckling in structures working under compression.

Know how to distinguish between isostatic and hyperstatic problems and know different methods of solving the latter.
Obtain knowledge of at least one computer program for calculation and design of structures.

2.3. Importance of learning goals

This subject offers training with content for application and immediate development in today's job and professional market. Through the achievement of the relevant learning results, the necessary capacity is obtained to understand the behavior of the different structural systems, which will be absolutely essential for the design of any set of interconnected elements that fulfill a resistant function against a state of loads that request it.

3. Assessment (1st and 2nd call)

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

The assessment must be understood as a continuous and individualized process throughout the entire teaching-learning period, prioritizing the capacities and abilities of each student, as well as their performance.

At the beginning of the course, the student will choose one of the following two assessment methodologies:

A) A continuous assessment system, which is carried out throughout the entire learning period. Characterized by the obligation to take and pass the practical tests, partial exams and academic tasks proposed in the subject, within the deadlines established for this purpose. In this case, the student does not have to take a final exam.

B) A global assessment test, showing the achievement of learning results, at the end of the teaching period. Characterized by not taking or not passing the practical tests, partial exams or academic work proposed in the subject. In this case, the student must compulsorily take the final exam.

Breakdown and content of each assessment system:

The continuous assessment system consists of three blocks that are explained below. The first condition is that the student must attend at least 80% of the classroom activities.

1st Block: Continuous assessment exercises: The student will carry out a total of 5 continuous assessment exercises (one per chapter) on a compulsory basis in the continuous assessment system, which will be distributed throughout the course. Each exercise will be delivered to the student once the corresponding theory topics and exercises have been completed. The student will have a week to do it and deliver it to the teacher, since this activity is continuous and should not be delayed in time. The continuous assessment exercise will be very similar to the exercises carried out in class. In addition, the student will have tutorials to answer any questions about it. This activity will globally account for 30% of the final grade for the course. To take this grade into account the student must meet two requeriments:

- 1st They will have to deliver all the exercises within the period given by the teacher. Otherwise, this activity will be considered as a fail (except for properly justified major cause).
- 2nd They will have to obtain a minimum of 3.0 in each exercise. And you must obtain a minimum grade of 4.0 with all the exercises included. If not, this activity will be considered as a fail.

2nd Block: Written tests for continuous assessment. The student will take a total of four compulsory written tests in the continuous assessment system, which will be distributed throughout the course. These tests will include theoretical questions and exercises on the corresponding topics. The duration of the test will be a minimum of two hours of classes and a maximum of three, depending on the case. This activity will globally account for 50% of the final grade of the course, to take this mark into account, the student must fulfill two requirements:

- 1st They will have to turn up in all the tests in the date given by the professor. Otherwise, this activity will be considered as a fail (except for properly justified major cause).
- 2nd They will have to obtain a minimum of 3.0 in each test. And they must obtain, including all the tests, a minimum grade of 4.0. If not, this activity will be considered as a fail.

3rd Block: Computer-Assisted Practices. The student will carry out two compulsory practice sessions in the continuous assessment system, which will be distributed throughout the course, according to the planning chart. This activity will globally account for 20% of the final grade for the course, to take this grade into account the student must meet two requirements:

- 1st They will have to attend all practice sessions on the date given by the teacher. Otherwise, this activity will be considered as a fail (except for properly justified major cause).
- 2nd They will have to obtain a minimum of 3.0 in each practice. And they must obtain a minimum grade of 4.0 including all the practices. If not, this activity will be considered as a fail.

Prior to the first call, the teacher will notify each student whether or not they have passed the subject depending on the use of the continuous assessment system, based on the sum of the scores obtained in the different activities carried out throughout it. according to the formulation:

- Final mark of the subject in THE first call = 50% A + 30% B + 20% C

A = Average grade of written tests
B = Average grade of exercises
C = Average mark of practice task

Thus, they must obtain a minimum grade of 5.0 to pass the course, fulfilling all the above mentioned and explained requirements. The students who have passed the subject in this way, will be allowed to increase their grade on the first call (never to lower it).

Global Test: In case of not passing with the previous system, the student will have two additional calls (June and September) with a global assessment test. This test will be unique with theory and exercises representative of the entire syllabus of the subject contributing 100% to the final grade of the course.

4. Methodology, learning tasks, syllabus and resources

4.1. Methodological overview

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

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 (Elasticity and Strength of Materials) 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 fundamental, structuring them in 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.

? **Laboratory Workshop**: Practical activities will be implemented in the computer room 1.1 simulation software structures (Wineva 7.0 and Abaqus.cae) with the presence and teacher mentoring.

? **Individual Tutorials**: Those carried out giving individual, personalized attention with a teacher from the department. Said tutorials may be in person or online.

4.2. Learning tasks

Programmed learning activities	The programme offered to the student to help them achieve their target results is made following activities... Involves the active participation of the student, in a way that the results achieved in the learnir 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 exa developed as a support to the theory when necessary. ?**Practice Sessions**: Problems and practical cases are carried out, complementary to the concepts studied. ? **Laboratory Workshop**: This work is tutored by a teacher, in groups of no more than 20 stud ? **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 cl ? Preparation of seminars, solutions to proposed problems, etc. ? Preparation of laboratory workshops, preparation of summaries and reports. ? 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 dur 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 o 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	3
Laboratory Workshop	1
Other Activities	6

4.3. Syllabus

The course will address the following topics:

- **Topic 1: Introduction to Strength of Materials**
    - Types of Structures, links and loads
    - Balance and GDH a Structure
    - Definition and types of internal efforts
    - Calculation and Representation Efforts diagrams
- **Topic 2: Structure Design Rigid Knots**
    - Laminating criteria: voltage Von- Mises
    - Normal stress distribution in a section
    - Distribution of shear stress one section
    - Bending and Twisting problems in structures
- **Topic 3: Structure Design Articulated Knots**
    - Method for calculating knots structures
    - PTV method to calculate displacements
    - Buckling phenomenon
    - Calculation of the truss structure
- **Topic 4: Calculation of displacements in structures**
    - Theorems Mohr (Gyre y Displacements)
    - Virtual work (Gyre y Displacements)
    - Flexibility Method for Structural Analysis Hyperstatic
- **Topic 5: Deformable Solid Mechanics: Stress-Strain**
    - Deformable Solid Mechanics
    - Kinematics of Solid Deformable
    - Dynamics of Deformable Solid
    - Ratio behaviour
    - Thermoelastic behaviour

4.4. Course planning and calendar

weeks	WEEKLY PLANNING SEMESTER	
1ª 2ª	Topic 1	Exercise No. 1 Continuous Assessment
3ª 4ª 5ª 6ª	Topic 2	Exercise No. 2 Continuous Assessment 1st Practice with Wineva software (Topic 1 and 2) 1st Written Test (Topic 1 and 2)
7ª 8ª 9ª	Topic 3	Exercise No. 3 Continuous Assessment 2nd Practice with software Wineva (Topic 3) 2nd Written Test (Topic 3)

10ª 11ª 12ª	Topic 4	Exercise No. 4 Continuous Assessment 3rd practice with software Wineva (Topic 4) 3rd Written Test (Topic 4)
13ª 14ª 15ª	Topic 5	Exercise No. 5 Continuous Assessment 4th Practice with Abaqus software (Topic 5) 4th Written Test (Topic 5)

The weekly schedule of the subject will be published at http://www.eupla.unizar.es/asuntos-academicos/calendario-y-horarios

The dates of the global evaluation test (**official calls**) will be published at http://www.eupla.unizar.es/asuntos-academicos/examenes

4.5. Bibliography and recommended resources

http://psfunizar10.unizar.es/br13/egAsignaturas.php?codigo=39616

Recommended Resources:

Material	Format
Topic theory notes Topic problems	Paper/repository
Topic theory notes Topic presentations Topic problems Related links	Digital/Moodle E-Mail
Educational software Wineva.7.0	Web page: wineva.upc.edu/esp/Download.php