Universidad Zaragoza

Academic Year/course: 2023/24

28707 - Mechanics

Syllabus Information

Academic year: 2023/24
Subject: 28707 - Mechanics
Faculty / School: 175 - Escuela Universitaria Politécnica de La Almunia
Degree: 423 - Bachelor's Degree in Civil Engineering
ECTS: 6.0
Year: 1
Semester: Second semester
Subject type: Basic Education
Module:

1. General information

This subject studies the mechanics of rigid bodies and is centered on statics, which studies bodies at rest. Mechanics is the science that describes and predicts the conditions of rest and motion of bodies under the action of forces, being a physical science base of most of the sciences of Engineering and Architecture, and prerequisite essential for other subjects. Its purpose is to explain and predict the physical phenomena underlying the equilibrium conditions of structures and to lay the foundations for its application in Architecture and Engineering.

These approaches and objectives are aligned with the Sustainable Development Goals (SDGs) of the 2030 Agenda of United Nations (https://www.un.org/sustainabledevelopment/es/) and certain specific targets, such that the acquisition of the learning results of the subject will contribute to some extent to the achievement of targets 9.1, 9.4, 9.5, 9.a and 9.b of Goal 9.

Mechanics entails a series of difficulties and objectives that only work and progress based on previously elaborated knowledge can overcome. This is why students should start the subject with a series of knowledge and tools well established during the first semester of the first year of this degree. In order to successfully take this subject students must have a good knowledge of "Physics I: General Mechanics" and "Mathematics Applied to Building I", both taught during the first semester of the first year of this degree.

2. Learning results

- Mastery and understanding of the fundamental concepts of structural statics applied to the theory of structures and beams.
- Demonstrate the ability to analyze, hypothesize, and apply concepts to resolve issues related to the theory of structures and beams.
- Ability to calculate stresses, reactions and forces acting on particles and rigid bodies in equilibrium.
- Make decisions taking into account the different technical issues involved.
- Demonstrate ability to solve structures by the methods of nodes and sections.
- Demonstrate computational skills in solving problems of reactions and stresses in beams and cables.
- Understanding and ability to calculate the different types of quantities involved in the problems of elasticity and structures .

3. Syllabus

1. -Mechanics: basic concepts and principles governing it. Systems of Units of Measurement: the International System and the English system, other systems of units. Uses of SI multiples and submultiples, significant figures, rounding and dimensional analysis. Error propagation. The Greek alphabet.

2. -Particle statics: Concepts of particle and extended body. Equilibrium conditions of a particle. Principles of Dynamics. Resultant force. Forces in the plane and space (Vector Statics).

3. -Systems of forces and moments: Concept of Momentum of a force with respect to a point. Moment of a force with respect to an axis. Moment of a pair of forces. Pair composition. Resultant of a system of forces. The simplest resultant of a system of forces. Different cases and torsor.

4. -Equilibrium and reactions, friction: Degrees of freedom. Links or ligatures. Equilibrium conditions of extensive bodies . Calculation of reactions. Determinacy, indeterminacy and static instability. Problems of friction. Imminent rollover and wedges.

5. -Centroids and center of gravity, distributed forces: Distributed forces. Centroids. Pappus and Guldin theorem. Forces on submerged surfaces.

6. -Analysis of planar structures: Introduction to Structures. Articulated structures or trusses. Method of the knots. Method of sections. Analysis of composite reinforcement. Complex armors. Frames and machines.

7. -Beams and cables: Introduction to Beams and Cables. Shear force and bending moment. Shear force diagrams and of bending moment. Isostatic and hyperstatic beams. Cables and suspension bridges. Catenary (application of the Bolzáno's method in the solution of transcendental hyperbolic equations).

8. -Moment of Inertia of areas: Moment of inertia of body area. Determination of the moment of inertia of area by integration.

Polar moment of inertia. Parallel axes theorem. Moment of inertia of composite areas.Area inertia product. Main axes of inertia. Mohr's circle.

9. -Elasticity: Concept. Shear stress and normal stress. Safety factor. Unit deformation. Diagrams of stress-strain diagrams. Fatigue. Tensile or compressive elasticity. Thermal deformation. Poisson's ratio.Multiaxial load and generalized Hooke's law. Volume elasticity. Volumetric modulus. Shearing or shearing.

Stress-strain relationship for fiber composite materials. Torsional elasticity (shear stress and angle of rotation). Torsional elasticity of non-circular elements and non-thin-walled hollow shafts. Elasticity by bending (neutral axis, unit strain, normal stress, elastic modulus of the section, radius of curvature, equation of the elastic curve and particle cases). Use of profile table for its application in the calculation of normal stress.

General applications of Elasticity to Structural Analysis problems.

4. Academic activities

Group of proposed activities:

- **Theory classes (2 ECTS: 20 h)**: presentation of objectives and contents. Development of Physics Theories and interpretation of equations (formulas) and their implications. Use of basic didactic resources such as the blackboard and complements with slides and other technological means. The active participation of the studentwill be encouraged through questions and short exercises.
- **Problem classes (2 ECTS: 20 h)**: approach and resolution of theoretical and practical questions with different levels of difficulty, in increasing order to facilitate the assimilation and familiarization with formulas, magnitudes, approximations and calculation methods. The active participation of the students will be encouraged by proposing them to solve the selected problems on the blackboardthemselves.
- **Laboratory practices (1.75 ECTS:** 17.**5 h)**: approach and development of experimental activities based on experiments proposed and described in practice guides. Preparation of technical reports including objectives, methodology and experimental devices used, data processing and analysis of the results obtained.
- **Seminar classes (0.25 ECTS:** 2.**5 h)**: lectures and laboratory activities given by professors from other subjects of the course with the aim of introducing students to the different applications of structural statics in Architecture and Engineering.
- **Tutorials**: individualized, with personalized attention from the teacher. An attempt will be made to offer an appropriate timetable to students and its use will be encouraged on a continuous basis throughout the subject (and not only on the eve of exams). Resolution of some complex problems proposed and clarification of doubts.
- **Autonomous work and study (90 hours)**:

Study and understanding of the theory of the lectures.understanding and assimilation of the practical problems developed in class.

Preparation of the proposed problems and assignments.

Preparation of laboratory sessions and preparation of reports.

Preparation of written tests.

- **Examinations**: All proposed exams will be written and will take place within the time frame of the theory and problem sessions.

5. Assessment system

There will be two types of evaluation: the **Continuous Assessment** and the **Final Global Assessment**.

The **Continuous Assessment** will be composed of 3 partial test to be held throughout the academic year, which will be comprised of only 3 thematic units each each one; while, the **Final Global** Assessment is the Call Examination set by the center .

Students will be able to pass the subject by **Continuous Assessment** if they obtain an average of 5.0 or higher in the 3 midterm exams taken and have completed, analyzed and handed in all the corresponding reports to the laboratory practices carried out during the respective development of the subject.