

Course guides

250307 - MECÀNICA - Mechanics

Last modified: 04/12/2018

Unit in charge: Barcelona School of Civil Engineering
Teaching unit: 748 - FIS - Department of Physics.

Degree: BACHELOR'S DEGREE IN GEOLOGICAL ENGINEERING (Syllabus 2010). (Compulsory subject).

Academic year: 2018 **ECTS Credits:** 7.5 **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer: MARCEL HURLIMANN ZIEGLER

Others: MARCEL HURLIMANN ZIEGLER

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

4051. Understanding and mastery of the basic concepts of the general laws of mechanics, thermodynamics and electromagnetic fields and waves, and their application in solving engineering problems

4057. Understanding and mastery of the basic concepts of the general laws of mechanics and thermodynamics, and their application in solving engineering problems. Heat transfer and thermal matter and machines

Transversal:

591. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 1. Planning oral communication, answering questions properly and writing straightforward texts that are spelt correctly and are grammatically coherent.

598. EFFECTIVE USE OF INFORMATION RESOURCES - Level 2. Designing and executing a good strategy for advanced searches using specialized information resources, once the various parts of an academic document have been identified and bibliographical references provided. Choosing suitable information based on its relevance and quality.

601. SELF-DIRECTED LEARNING - Level 2: Completing set tasks based on the guidelines set by lecturers. Devoting the time needed to complete each task, including personal contributions and expanding on the recommended information sources.

TEACHING METHODOLOGY

The course consists of 4.3 hours per week of classroom activity (large size group).

The 4.3 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 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.

LEARNING OBJECTIVES OF THE SUBJECT

Students will acquire a general understanding of classical mechanics, statics, dynamics and kinematics. They will also learn to apply this knowledge to specific scientific and technical problems and to geological engineering in general.

Upon completion of the course, students will be able to:

1. Solve kinematics problems of material points and solids;
2. Applying the conservation equations of mass, momentum and energy both as the solid material point. Application to problems of heat transfer and thermal analysis equipment
3. Apply mechanical concepts (kinematics, statics and dynamics) to the calculation of basic structures.

Vector algebra, including systems of sliding vectors; Kinematics of material points, trajectories, velocity and acceleration; Newton's laws in inertial and non-inertial systems; Dimensional analysis; Reference systems; Kinematics of solids; Linear and angular momentum; Conservation of momentum; Energy, work and power; Conservation of energy and heat transfer; Application to systems of particles and variable mass systems; Particle, solid and fluid statics; Stress; Equilibrium of solids: Isostatic and hyperstatic problems; Structural statics, including moments of inertia and centres of mass; Three-dimensional solid dynamics

The laws of physics, its principles and methods for applying them to practical problems are the main objectives of this course. The engineers used directly or indirectly to the principles of classical mechanics. Therefore, our goal is to develop and apply knowledge of classical mechanics, statics, dynamics and kinematics in subjects scientific-technological and engineering in general.

At the end of the course students will have acquired the ability to:

1. Troubleshooting and kinematics of rigid point.
2. Applying the equations of conservation of mass, momentum and energy to the point and the solid material.
3. Applying the concepts of mechanics (kinematics, static and dynamic) to the calculation of basic structures.

STUDY LOAD

Type	Hours	Percentage
Hours small group	18,0	9.60
Self study	105,0	56.00
Hours medium group	27,0	14.40
Guided activities	7,5	4.00
Hours large group	30,0	16.00

Total learning time: 187.5 h

CONTENTS

Particle Kinematics

Description:

Vector position, trajectory, velocity and acceleration. Intrinsic components of the acceleration. Circular motion. Motion with constant acceleration. Integration of the equations of motion in simple cases. Traslació axes of reference. Problems of the particle kinematics

Full-or-part-time: 12h

Theory classes: 3h

Practical classes: 1h

Laboratory classes: 1h

Self study : 7h



Dynamics of the particle

Description:

Strength and mass. Inertial reference systems and Newton's first law. Second and third laws of Newton. Forces distance and contact forces. Forces ligation. Dry friction between solids. Forces of inertia.

Problems of the particle dynamics

Full-or-part-time: 16h 48m

Theory classes: 3h

Practical classes: 1h

Laboratory classes: 3h

Self study : 9h 48m

Forces Systems

Description:

Equilibrium of a particle. Equilibrium of rigid bodies: moment of a force about a point. Resulting time and resulting in a system of forces. Definition of equivalence and reduction systems. Invariant and central trinomial. Classification systems and codes.

Systems plans.

Exercices of forces systems

Full-or-part-time: 9h 36m

Theory classes: 1h

Practical classes: 2h

Laboratory classes: 1h

Self study : 5h 36m

Statics

Description:

Statics of solids. Balance of articulated structures. Simple flat structures. Analysis by the Method of knots. Analysis by the method of sections. Diagrams of shear forces and bending moments in a beam.

Problems of static solid

Lab error

Full-or-part-time: 26h 24m

Theory classes: 2h

Practical classes: 4h

Laboratory classes: 5h

Self study : 15h 24m

Change of Coordinate Reference System

Description:

Rotation axes in space. Derivative of a vector function. Transformation of velocities and accelerations. Centripetal and Coriolis accelerations. Inertia forces: centrifugal force and Coriolis force. Effects of Earth rotation.

Problems of reference systems in rotation

Full-or-part-time: 12h

Theory classes: 3h

Practical classes: 2h

Self study : 7h



Rigid Body Kinematics

Description:

Degrees of freedom of a solid. Velocity field. Pure translation and pure rotation. Field acceleration. Instant Axis of rotation and sliding. Classification of movement. Movement plan.

Problems 2D kinematics of rigid

Full-or-part-time: 12h

Theory classes: 3h

Practical classes: 2h

Self study : 7h

Particle System and Rigid Solid Dynamics

Description:

Center of mass and momentum. Law of balance and dynamic center of mass. Angular momentum. Central forces. Moment of inertia. Moment of a force about an axis. Dynamics of plane rotation.

Problems and angular momentum. Problems of calculating centers of mass and moments of inertia. 2D dynamic problems of solid.

Working in small groups on problems of 2D rigid body dynamics.

Lab on moment of inertia

Full-or-part-time: 45h 36m

Theory classes: 5h

Practical classes: 6h

Laboratory classes: 8h

Self study : 26h 36m

Work and Energy

Description:

Kinetic energy, power and work for a particle. Forces and dissipative forces conservatives. Golf conservative and potential energy. Potential energy gradient. Theorem mechanical energy. Gravitational potential energy and elastic potential energy. Kinetic energy of a particle system. Orbital energies and intrinsic. Theorem living forces: external work and internal work of deformation. Potential energy of a particle system. External and internal potential energy. Energy and work in a rigid body. Problems for a particle energy and labor. Problems of work and energy for particle systems. Problems of work and energy for the rigid

Lab on inclined plane

Full-or-part-time: 21h 36m

Theory classes: 4h

Practical classes: 3h

Laboratory classes: 2h

Self study : 12h 36m



Gravitation

Description:

Law of universal gravitation. Gravitational field. Equivalence principle. Effective gravity. Potential land. Elliptical orbits
Problems of Gravitation
Problems compendium
Global evaluation

Full-or-part-time: 24h

Theory classes: 3h
Practical classes: 4h
Laboratory classes: 3h
Self study : 14h

GRADING SYSTEM

The final grade is the sum of the subsequent partial qualifications:

Nat: continuous assessment mark

Nel: laboratory teaching qualification and / or computer classroom

NPG: qualifying test or global exams

$$N_{\text{final}} = 0.5 * NPG + 0.35 * Nac. + 0.15 * Nel$$

Continuous assessment is to make different individual activities, which are additive and training, carried out during the year (in the classroom and outside it).

The classification of subjects in the laboratory is the average of the activities of this type.

The global test consists of a part with questions on concepts associated with learning objectives in terms of subject knowledge or understanding, application and a set of exercises.

Criteria for re-evaluation qualification and eligibility: Students that failed the ordinary evaluation and have regularly attended all evaluation tests will have the opportunity of carrying out a re-evaluation test during the period specified in the academic calendar. Students who have already passed the test or were qualified as non-attending will not be admitted to the re-evaluation test. The maximum mark for the re-evaluation exam will be five over ten (5.0). The non-attendance of a student to the re-evaluation test, in the date specified will not grant access to further re-evaluation tests. Students unable to attend any of the continuous assessment tests due to certifiable force majeure will be ensured extraordinary evaluation periods.

These tests must be authorized by the corresponding Head of Studies, at the request of the professor responsible for the course, and will be carried out within the corresponding academic period.

EXAMINATION RULES.

If not performed any of the activities in the continuous lab od'avaluació scheduled period will be considered as a zero score.

During the tests, tests or exams is forbidden to exchange information with other students. In the same way that the use of other materials, unless they are authorized. Not allowed to use calculators that girdles the simple arithmetic functions. Those who violate these guidelines is to evaluate the grade of zero.

BIBLIOGRAPHY

Basic:

- Martínez Benjamín, J.J. Mecánica Newtoniana. Barcelona: Edicions UPC, 2001. ISBN 8483014351.

- Bedford, A.; Fowler, W. Mecánica para ingeniería: vol. 1: estática. 5a ed. México: Pearson Educación, 2008. ISBN 9789702612155.