Mechanics I (2500007)

General Information

School	ETSECCPB
Departments	Departament d'Enginyeria Civil i Ambiental (DECA)
Credits	6.0 ECTS
Programs	GRAU EN ENGINYERIA CIVIL (pla 2020) PARS: ENGINYER/A DE CAMINS, CANALS I PORTS (pla 2022)
Course	2025/26

Main teaching language at each group

- Group 10 Spanish (Q2)
- Group 20 Spanish (Q2)
- Group 30 English (Q2)
- Group 40 Spanish (Q2)

Faculty

Responsible Faculty: Michele Chiumenti
Faculty: Gabriel Barbat Vlad, Lucia Gratiela Barbu, Michele Chiumenti, Alessandro Franci, Sergio Jiménez Reyes

Objectives of Education

1. Dimensional analysis
2. Vector calculus
3. Calculation of resultant forces and torques
4. Calculation of centroid, center of mass, and moments of inertia
5. Basic principles of statics
6. Analysis of equilibrium for isostatic structures
7. Kinematics of the Particle and the Rigid Solid
8. Newton's laws for solving dynamic problems
9. Solution of dynamic problems through the concepts of energy and work
10. Solution of dynamic problems through the concepts of impulse and momentum

These concepts will allow students to understand and apply the fundamental principles of mechanics in various contexts, facilitating their ability to analyze and solve problems related to the movement and balance of bodies.

Competencies

Especific

Understanding and mastery of the basic concepts about the general laws of mechanics, thermodynamics, fields and waves and electromagnetism and their application for solving engineering problems. (Basic training module)

Total hours of student work

		Hours	Percentage
Supervised Learning	Large group	30.0 h	50.00 %
	Medium group	24.0 h	40.00 %
	Laboratory classes	6.0 h	10.00 %
	Guided Activities	0.0 h	0.00 %
Self Study		90.0 h	

Contents

Vector calculus

Fixed vector, sliding vector, free vector
Unit vector
Cartesian components
Module of a vector
Sum of vectors
Dot product
Cross product
Problems solved in class

Centroids and centers of mass

Definition of area and mass
Definition of first order static moments
Definition of centroid (geometric center) and center of mass (center of gravity)
Symmetries
Integration calculation method
Calculation method for assembled sections
Calculation method for mixed sections
Problems solved in class

Moments of inertia

Moments of inertia of area
Turning radii
Parallel axes theorem
Integration calculation method
Calculation method for assembled sections
Calculation method for mixed sections
Problems solved in the classroom

Kinematics of a particle

Definition of position, displacement, velocity and acceleration
Cartesian Components
Tangential and normal components
Circular motion
Polar coordinates
Angular velocity and acceleration
Relative position
Relative velocity and acceleration
Problems solved in class

Planar kinematics of rigid solid

Translation movement
Rotational movement with respect to a fixed axis
Instant Center Rotation
General motion of rigid solid
Problems solved in class

Planar dynamics of rigid solid

Statics equations
Friction forces: Coulomb friction law
Dynamic equilibrium: Newton and d'Alambert equations
Problems solved in class

Work and energy methods

Kinetic energy in a translational movement
Kinetic energy in a rotation movement with respect to a fixed axis
Kinetic energy in general plane motion
gravitational potential energy
elastic potential energy
Work of a force
Work of a spring force
Work of a torque
Forces that do not work
Principle of work and energy
Principle of energy conservation
Problems solved in class

Impulse and momentum

Impulse of a force
Linear and angular momentum
Principle of impulse and momentum
Problems solved in class

Activities

Class test evaluation (vectors)

Assessment class test (vectors)

Dedication

1h

Class test evaluation (inertia)

Class test evaluation (inertia)

Dedication

1h

Class test evaluation (particle motion)

Class test evaluation (particle motion)

Dedication

1h

Class test evaluation (rigid solid kinematics)

Class test evaluation (rigid solid kinematics)

Dedication

1h

Test in class evaluation (rigid solid dynamics)

Assessment class test (rigid solid dynamics)

Dedication

1h

Assessment class test (energy)

Assessment class test (energy)

Dedication

1h

Teaching Methodology

The teaching methodology is based on 3 points:
1. Preliminary study through videos and recommended readings, before the classroom class.
2. Development of basic concepts through specific directed activities in class, with the help and full support of the teaching staff.
3. Autonomous activities at home: resolution of small practices to internalize the concepts acquired. Deeper and more critical study for a broader development of the topic covered in class using the subject reference books. Preparation for the next class.
This pedagogical model requires the active participation of the student at all times, inside and outside the classrooms, encouraging questions, discussions and the application of concepts in practical activities. Personal learning is encouraged by making the most of the student-teacher relationship inside and outside the classroom.

Grading Rules

(*) The evaluation calendar and grading rules will be approved before the start of the course.

To pass the course, it is MANDATORY to take the various Examinations scheduled throughout the course: 2 Controls (CX_1 and CX_2) and 2 Exams (EX_1 and EX_2).
In addition, various Assignments will be conducted throughout the course in the classroom and at home. These Assignments will result in an average Assignments grade of PR.
The final course grade will be calculated based on the grades from the Exams (EX), the Controls (CX), and the average Assignments grade (PR) according to the following formula:
GRADE = (0.1*CX_1 + 0.2*EX_1) + (0.1*CX_2 + 0.5*EX_2) + 0.1*PR
ALL Examinations are MANDATORY and may only be retaken with a justified reason (medical certificate, etc.). If one or more Examination grades are missed, the final grade will be NP (Not Presented).
Grading and Re-Evaluation Admission Criteria: Students who have failed the regular evaluation and have taken ALL the Examinations will have the option to take a re-evaluation exam during the period established in the academic calendar. Students who have already passed the subject or students marked as NP may not take the re-evaluation test for a subject. The maximum grade for taking the re-evaluation exam will be five (5.0). Failure to attend the re-evaluation exam during the scheduled period will not result in the student taking another exam at a later date. Extraordinary evaluations will be given to students who, due to a proven force majeure, have been unable to take any of the continuous Evaluations. These tests must be authorized by the corresponding head of studies, at the request of the professor responsible for the subject, and will be taken within the corresponding academic period.
The final grade obtained, as well as the grades from the Assignments, will not be saved to the following academic year.

Test Rules

Continuous assessment tests are MANDATORY. If not all continuous assessment tests are performed in the scheduled period, the final grade will be NP (Not Presented).

Office Hours

The consultations will be carried out according to the schedules established by each teacher of the subject. The review of the exams will be done by email indicating Name, Surname and ID.

Bibliography

Basic

- Hibbeler, R.C. Ingeniería mecánica: dinámica. 14a ed. Ciutat de Mèxic: Pearson, 2016. ISBN 9786073236973.
- Hibbeler, R.C. Ingeniería mecánica: estática. 14a ed. Ciutat de Mèxic: Pearson, 2016. ISBN 9786073237079.
- Nelson, E.W.; Best, C.L.; Mc Lean, W.G. Mecánica vectorial: estática y dinámica. 5a ed. Madrid: McGraw-Hill, 2004. ISBN 9788448129507.