COMILLAS
UNIVERSIDAD PONTIFICIA
ICAI ICADE CIHS

Syllabus
2025 - 2026

GENERAL INFORMATION

Data of the subject	
Subject name	Mechanics
Subject code	DIM-GITI-202
Mainprogram	Bachelor's Degree in Engineering for Industrial Technologies
Involved programs	Grado en Ingeniería en Tecnologías Industriales y Grado en Administración y Dirección de Empresas [Second year] Grado en Ingeniería en Tecnologías Industriales [Second year]
Level	Reglada Grado Europeo
Quarter	Anual
Credits	9,0 ECTS
Type	Obligatoria (Grado)
Department	Department of Mechanical Engineering
Coordinator	Antonio Fernández Cardador
Office hours	To be defined at the beginning of the course

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DESCRIPTION OF THE SUBJECT

Contextualization of the subject

Prerequisites

There are no prerequisites that formally prevent the course from being taken. However, it does rely on concepts seen in previous subjects: Physics.

- Particle kinematics and dynamics
- Kinematics and dynamics of a rigid solid in plane motion.

Course contents

Contents

2D Mechanics Analysis of Flat Mechanisms

Lesson 1. Introduction to 2D Kinematics of the Rigid Solid

1. Background and purpose. Classification of Rigid Solid movements.
2. Basic equations of velocity and acceleration distribution.
3. Instantaneous center of rotation
4. Rolling

Lesson 2. Introduction to Flat Mechanisms

1. Terminology. Definition of Mechanism and Machine
2. Classification of the elements and joints or kinematic pairs.
3. Degrees of freedom. Grubler's formula. Structures

Lesson 3. Kinematic Analysis of Flat Mechanisms

1. Analytical method
2. Cinema of velocities and accelerations

Lesson 4. Mobile Reference Systems. Sliding Contacts

1. Rotational reference systems.
2. Relative velocity and acceleration. Coriolis. Inertia forces
3. Analysis of mechanisms with sliding contacts

Lesson 5

1. Moment of a force and Torque. Calculation methods
2. Force systems. Equivalent systems. Reduction to Torque-Force
3. Equilibrium conditions. Equations
4. Equilibrium of a solid subjected to 2 and 3 forces. Graphical methods of resolution

Lesson 6. Dynamic Analysis of Mechanisms Plane

1. Newton's Laws. Basic equations
2. Moment of Inertia and Radius of Gyration.
3. Solving the direct and inverse problem.
4. Dynamic analysis with friction

Lesson 7. Work and Energy in Flat Mechanisms

1. Mechanical Energy. Variation and conservation theorems.
2. Methods of resolution

Lesson 8. Linear and kinetic momentum in Flat Mechanisms

1. Linear and kinetic momentum. Conservation theorems.
2. Impulsive forces. Shocks
3. Resolution methods

Lesson 9. Virtual Work and Inertia Forces Methods

1. Introduction to the method of virtual works.
2. Dynamic resolution by means of inertia forces

3D Mechanics

Lesson 10. 3D Kinematics of the Rigid Solid

1. Rotation of a Rigid Solid around fixed axis.
2. Rotation of a Rigid Solid with fixed point. Finite and infinitesimal rotations. Euler's Theorem
3. General Motion of a Rigid Solid

Lesson 11. Rotation matrices. Euler angles

1. Rigid Solid rotation matrices. Base changes.
2. Euler angles. Euler matrix.
3. Euler velocities and accelerations
4. Kinematic analysis of a Rigid Solid using Euler angles.

Lesson 12. 3D Dynamics of Rigid Solids

1. Inertia Tensor. Euler equations. Steiner's theorem.
2. Dynamic analysis of a Rigid Solid with fixed axis. Balancing
3. General 3D dynamics of a Rigid Solid. Gyroscopic effect.
4. Work and Energy. Conservation of kinetic momentum

Technological applications

Lesson 13. Gears

1. Basic concepts. Law of gearing. Classification of gears
2. The spur gear. Basic quantities.
3. Kinematics and dynamics of flat mechanisms with gears.
4. Technological applications of gears

EVALUATION AND CRITERIA

The use of AI to produce full assignments or substantial parts thereof, without proper citation of the source or tool used, or without explicit permission in the assignment instructions, will be considered plagiarism and therefore subject to the University's General Regulations.

Evaluation activities	Evaluation criteria	Weight
Examinations (2 examinations, at the end of each semester)	• Understanding of concepts. • Application of concepts to the resolution of practical problems. Chosen resolution procedure. • Analysis, numerical results, and their interpretation in problem solving. • Presentation and written communication.	60
Tests taken in class at the end of some topics (2 tests). Intersemester follow-up tests (2 tests)	• Understanding of concepts. • Application of concepts to solve practical problems.	40

Grading

There will be two follow-up tests in the first semester, a test during class hours and an inter-semester test, with weighting factors of 5% and 15% on the ordinary grade of the subject, respectively.

There will be two follow-up tests in the second semester, a class test and an inter-semester test, with weighting factors of 5% and 15% on the ordinary grade of the course, respectively.

There will be a partial exam at the end of the first semester, and a final exam at the end of the second semester. The latter will be divided into two parts: contents of the first semester and contents of the second semester.

Students whose grade is equal to or higher than 5 points in the partial exam of the first semester may not take the first semester part of

the final exam. In this case, the weighting factor on the ordinary grade of the first semester midterm will be 30%.

Students whose grade is lower than 5 points in the first semester midterm exam must take both parts of the final exam. In this case, the weighting factor for the first semester midterm will be 10%, and for the first semester part of the final exam will be 20%. The same rule applies for students with a grade in the first semester midterm equal to or higher than 5 points who choose to take the first semester portion of the final exam with the intention of earning a higher grade.

The second semester part of the final exam has a weighting factor on the ordinary grade of the course of 30% in any of the cases.

The grade in the extraordinary exam will be obtained exclusively from the exam taken in the extraordinary exam, evaluating the whole course.

Failure to attend more than 15% of the classroom hours of this subject may result in the impossibility to attend the ordinary and extraordinary exams.

WORK PLAN AND SCHEDULE

Activities	Date of realization	Delivery date
Reading of the slides presented in class.	Before each class	
Study of the transparencies presented in class	After each class	
Complement the study of the slides with the rest of the course material.	After each class	
Attempt to solve the problems to be performed in class.	Before each class	
Review and study of the problems solved in class.	After each class	
Attempt to solve the problems not done in class. Consultation of the solution published in the Resources Portal and request for tutoring if necessary.	At the end of each lesson	
Preparation of tests to be taken during class time	Week prior to the scheduling of each test	
Preparation of exams of the first semester. We will work especially on the recapitulation of the corresponding topics made by the teacher in class.	Early October and late November	
Preparation for second semester exams. Special attention will be paid to the recapitulation of the corresponding topics made by the teacher in class.	Mid-February to mid-April	

BIBLIOGRAPHY AND RESOURCES

Basic References

Textbooks

- A. Bedford, W. Fowler. Engineering Mechanics. Dynamics (Fifth edition). Pearson. 2008.

Notes and Slides

- Notes and Slides (available in Moodle).
- Proposed problems (available in Moodle).