



Course guide

2500007 - GECMECAN1 - Mechanics I

Last modified: 01/10/2023

Unit in charge: Barcelona School of Civil Engineering
Teaching unit: 751 - DECA - Department of Civil and Environmental Engineering.

Degree: BACHELOR'S DEGREE IN CIVIL ENGINEERING (Syllabus 2020). (Compulsory subject).

Academic year: 2023 **ECTS Credits:** 6.0 **Languages:** Spanish, English

LECTURER

Coordinating lecturer: MICHELE CHIUMENTI, ALESSANDRO FRANCI

Others: GABRIEL BARBAT VLAD, LUCIA GRATIELA BARBU, MICHELE CHIUMENTI, ALESSANDRO FRANCI, SERGIO JIMÉNEZ REYES

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

14395. 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)

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.

Although most of the sessions will be given in the language indicated, sessions supported by other occasional guest experts may be held in other languages.

LEARNING OBJECTIVES OF THE SUBJECT

Knowledge of vector calculus. Strengths and Times. Centroids and mass centers. Basic principles of static. Introduction to structural analysis. Analysis of isostatic articulated structures. Analysis of isostatic reticulated structures. Moments of inertia.

- 1 Ability to solve kinematics problems for both point and solid.
- 2 Ability to apply Newton's laws, dimensional analysis and linear and angular momentum.

Knowledge of vector algebra including sliding vector systems. Knowledge of point kinematics, trajectories, speed and acceleration. Knowledge of Newton's laws. Dimensional analysis. Knowledge of reference systems. Solid kinematics knowledge. Knowledge linear momentum and angular momentum. Conservation of the moment. Basic principles of statics. Introduction to structural analysis. Analysis of isostatic articulated structures. Analysis of isostatic reticulated structures.

The objective of the Mechanics course is to introduce Newton's laws for the analysis of motion in terms of Kinematics and Dynamics. The concepts will be applied to the particle, to a system of particles, as well as to the rigid solid. The concept of equilibrium and its application to the statics of elementary structures will be introduced.



STUDY LOAD

Type	Hours	Percentage
Hours large group	30,0	20.00
Hours medium group	24,0	16.00
Hours small group	6,0	4.00
Self study	84,0	56.00
Guided activities	6,0	4.00

Total learning time: 150 h

CONTENTS

Cálculo vectorial

Description:

Vector fijo, vector deslizante, vector libre

Vector unitario

Componentes cartesianas

Módulo de un vector

Suma

Resta

Producto escalar

Producto vectorial

Problems solved in class

Full-or-part-time: 12h

Theory classes: 3h

Practical classes: 2h

Self study : 7h

Centroides y centros de masa

Description:

Definición de área y masa

Definición de momentos estaticos de primer orden

Definición de centroide (centro geométrico) y centro de masa (centro de gravedad)

Simetría

Método de cálculo por integración

Método de cálculo para secciones compuestas

Método de cálculo para secciones mixtas

Método de cálculo para secciones de pared delgada

Problems solved in class

Full-or-part-time: 12h

Theory classes: 3h

Practical classes: 2h

Self study : 7h



Momentos de inercia

Description:

Momentos de inercia de área
Producto de inercia
Radios de giro
Teorema de los ejes paralelos
Momentos principales de inercia
Círculo de Mohr
Método de cálculo por integración
Método de cálculo para secciones compuestas
Método de cálculo para secciones mixtas
Método de cálculo para secciones de pared delgada
Problems solved in class
Definición
Teorema de los ejes paralelos
Métodos de calculo

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

Theory classes: 7h
Practical classes: 2h
Self study : 12h 36m

Cinemática de una partícula

Description:

Posición, desplazamiento, velocidad y aceleración
Posición, desplazamiento, velocidad y aceleración
Componentes rectangulares
Componentes normal y tangencial
Movimiento circular
Componentes polares
Velocidad angular
Problems resolts a classe
Movimiento relativo usando ejes en traslación
Posición relativa
Velocidad relativa
Aceleración relativa
Sistema inercial
Problems solved in class

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

Theory classes: 5h
Practical classes: 2h
Self study : 9h 48m



Cinemática plana de sólido rígido

Description:

Movimiento de traslación

Rotación con respecto a un eje fijo

Movimiento general de sólido rígido

Velocidad relativa

Centro de instantánea rotación

Aceleración relativa

Movimiento relativo usando ejes en rotación: sistemas no inerciales

Problems solved in class

Full-or-part-time: 19h 12m

Theory classes: 3h

Practical classes: 2h

Laboratory classes: 3h

Self study : 11h 12m

Dinámica plana de sólido rígido

Description:

Ecuaciones de movimiento translacional rectilíneo

Ecuaciones de movimiento translacional curvilíneo

Ecuaciones de movimiento rotacional con respecto a un eje fijo

Movimiento plano general

Problems solved in class

Fuerzas de rozamiento: Teoría de la fricción seca o fricción de Coulomb

Problems solved in class

Full-or-part-time: 24h

Theory classes: 4h

Practical classes: 6h

Self study : 14h



Métodos de trabajo y energía

Description:

Energía cinética en un movimiento de traslación
Energía cinética en un movimiento de rotación con respecto de un eje fijo
Energía cinética en un movimiento plano general
Energía potencial gravitatoria
Energía potencial elástica
Trabajo de una fuerza variable
Trabajo de una fuerza constante
Trabajo de una fuerza peso
Trabajo de una fuerza de resorte
Trabajo de un par
Fuerzas que no trabajan
Principio del trabajo y la energía
Principio de la conservación de la energía
Problems solved in class

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

Theory classes: 4h

Practical classes: 3h

Self study : 9h 48m

Impulso y momentum

Description:

Impulso de una fuerza
Momentum lineal y angular: movimiento de traslación
Momentum lineal y angular: movimiento de rotación respecto de un eje fijo
Momentum lineal y angular: movimiento plano general
Principio del impulso y momentum
Problems solved in class

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

Theory classes: 3h

Practical classes: 3h

Laboratory classes: 3h

Self study : 12h 36m



GRADING SYSTEM

To pass the course it is MANDATORY to carry out the different Continuous Assessment Practices that will be proposed throughout the course in classrooms and at home. These practices will give an average grade of practices PR_1.

There are also 2 exams planned in the semester:

EX_1. Kinematics

EX_2. Dynamic

The final mark of the course will be calculated as the following weighted average of the mark of practices and exams:

$$\text{NOTA} = 0,2*\text{PR}_1 + 0,3*\text{EX}_1 + 0,5*\text{EX}_2$$

ALL the Evaluation Tests are MANDATORY and can be recovered only in case of justification (medical justification, etc.). In the case of not having one or more Assessment notes, the final grade will be a NP (not presented).

Criteria for qualification and admission to RE-EVALUATION: Students suspended in the ordinary evaluation who have regularly submitted to the evaluation tests of the suspended subject will have the option to take a re-evaluation test in the period set in the academic calendar . Students who have already passed it or students qualified as not presented may not take the re-evaluation test of a subject. The maximum grade in the case of taking the re-evaluation exam will be five (5.0). The non-attendance of a student summoned to the re-evaluation test, held in the established period, may not lead to another test with a later date. Extraordinary evaluations will be carried out for those students who, due to accredited force majeure, have not been able to take any of the continuous evaluation tests.

These tests must be authorized by the corresponding head of studies, at the request of the professor responsible for the subject, and will be carried out within the corresponding school period.

The final mark obtained as well as the marks of the continuous evaluations will not be saved for the academic year of the following year.

EXAMINATION 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).

BIBLIOGRAPHY

Basic:

- Hibbeler, R.C. Ingeniería mecánica: dinámica. 14a ed. Ciutat de Mèxic: Pearson, 2016. ISBN 9786073236973.
- Nelson, E.W.; Best, C.L.; McLean W.G. Mecánica vectorial: estática y dinámica. 5a ed. Madrid: Mc Graw Hill, 2004. ISBN 84-481-2950-4.

Complementary:

- Hibbeler, R.C. Mecánica vectorial para ingenieros: dinámica. 10a ed. México: Pearson Educación, 2004. ISBN 970-26-0500-8.