Course guide
2500013 - GECMECANI2 - Mechanics II

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, NARGES DIALAMI SHABANKAREH

Others: GABRIEL BARBAT VLAD, MICHELE CHIUMENTI, NARGES DIALAMI SHABANKAREH, ALESSANDRO FRANCI

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)
14401. Ability to analyze and understand how the characteristics of structures influence their behavior. Ability to apply knowledge about the resistant operation of structures to size them according to existing regulations and using analytical and numerical calculation methods. (Common module to the Civil branch)

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 on kinematics of a particle and a particle system. Particle dynamics and a particle system. Kinematics of rigid solids. Rigid solids dynamics. Working methods and energy. Impulse and momentum

1 Ability to apply the conservation equations of mass, momentum and energy to both the material and the solid point.
2 Ability to apply the concepts of mechanics (kinematic, static and dynamic) to the calculation of elementary structures.

Knowledge of energy, work and power. Application to particle systems and to systems of variable mass. Knowledge of particle statics, solids and fluids. Stress matrix. Solid balance: isostatic and hyperstatic problems. Knowledge of the statics of structures, including moments of inertia and centers of mass. Kinematics of a particle and particle systems. Kinematics of rigid solids. Rigid solids dynamics.

The objective of the Mechanics course is to introduce the basic principles of Statics. The concept of balance and its application for the study of isostatic structures (articulated and reticulated). Calculation methodologies for trusses, continuous beams and gantries will be introduced.
The course is complemented by an introduction to the use of calculation software.

STUDY LOAD

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

Total learning time: 150 h

CONTENTS

Momentos de inercia

Description:
Mixed sections, definition and calculation of mechanical center, definition and calculation of moments of mechanical inertia
Rotation of reference axes, definition and calculation of moment and principal axes of inertia
Class problems on calculation of mechanical moments of inertia and principal moments of inertia in mixed sections

Full-or-part-time: 9h 36m
Theory classes: 2h
Practical classes: 2h
Self study : 5h 36m

Cálculo vectorial

Description:
Vector fijo, vector deslizante, vector libre
Vector unitario
Componentes cartesianas
Módulo de un vector

Full-or-part-time: 2h 24m
Theory classes: 1h
Self study : 1h 24m

Fuerzas y momentos

Description:
Fuerza concentrada
Carga distribuida
Momento
Par

Full-or-part-time: 4h 48m
Theory classes: 2h
Self study : 2h 48m

Principios básicos de la estática

Description:
Ecuaciones de equilibrio: formulación vectorial
Ecuaciones de equilibrio: formulación escalar
Diagrama de cuerpo libre
Tipos de conexión
Reacciones generadas en los soportes
Restricciones redundantes
Restricciones impropias

Resueltos problemas en clase

Full-or-part-time: 9h 36m
Theory classes: 2h
Practical classes: 2h
Self study : 5h 36m

Introducción a la análisis de estructuras

Description:
Idealización de la geometría de la estructura
Identificación de las cargas aplicadas
Identificación del tipo de soportes y enlaces
Identificación del grado de hiperestaticidad de la estructura
Hiperestatismo interno
Hiperestatismo externo
Problems resolts a classe

Full-or-part-time: 12h
Theory classes: 2h
Practical classes: 3h
Self study : 7h

Análisis de estructuras articuladas isostáticas

Description:
Tipología de estructura articuladas
Hipótesis de diseño y cálculo
Identificación del grado de hiperestatismo interno y externo de la estructura
Cálculo de las reacciones en los apoyos
Solución de estructuras articuladas planas mediante el método del equilibrio en los nudos
Problems solved in class
Introduction to the use of software for the analysis and calculation of articulated structures
Problems solved in class
Specific workshop for the preparation of the first part

Full-or-part-time: 33h 36m
Theory classes: 3h
Practical classes: 8h
Laboratory classes: 3h
Self study : 19h 36m

Análisis de estructuras reticuladas isostáticas

Description:
Hipótesis de diseño y cálculo
Identificación de los soportes, enlaces y cargas externas
Identificación del grado de hiperestatismo interno y esterno de la estructura
Ecuaciones de equilibrio para la estructura
Diagrama de cuerpo libre
Cálculo de las reacciones en los apoyos
Problems solved in class
Definición de esfuerzo axil, cortante y momento flector
Convención de signos
Acciones internas en una sección de la estructura
Ecuaciones y diagramas de las acciones internas
Resueltos problemas en clase
Analysis and calculation of continuous beams
Analysis and calculation of gantries
Problems solved in class
Introduction to the use of software
Specific workshop for the preparation of the second part

Full-or-part-time: 72h
Theory classes: 15h
Practical classes: 12h
Laboratory classes: 3h
Self study : 42h

GRADING SYSTEM

To pass the subject, it is MANDATORY to carry out the different Continuous Assessment Practices that will be proposed throughout the course in the classroom and at home. These practices will give rise to an average grade of practices (PR).

In addition, there are 2 exams planned in the semester:

EX_1. Continuous beams and frames
EX_2. Articulated and reticulated structures

Students must also carry out two completed projects throughout the course on the design of articulated and reticulated structures. These two projects will be evaluated at the end of the course and will give rise to the average grade of the projects (PY).

The final grade for the course will be calculated as a weighted average of the grade for practices, exams and projects as follows

NOTE = 0.05*PY + 0.15*PR + 0.40*EX_1 + 0.40*EX_2

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

Criteria for qualification and admission to the REEVALUATION: Students suspended in the ordinary evaluation who have regularly taken the evaluation tests of the suspended subject will have the option to take a re-evaluation test in the period established in the academic calendar. Students who have already passed it or students qualified as not present will not be able to take the re-assessment test for 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-assessment test, held in the established period, may not give rise 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 academic period.

The final grade obtained as well as the grades of the Continuous Assessments will not be saved for the academic year of the following year.

EXAMINATION RULES.

Las pruebas de evaluación continua son OBLIGATORIAS. Si no se realizan todas las pruebas de evaluación continua en el periodo programado, la nota final será de NP (No Presentado).

BIBLIOGRAPHY

Basic:
- Chiumenti M.; Cervera, M. Estática de estructuras: problemas resueltos. Barcelona: Centro Internacional de Métodos Numéricos en la Ingeniería (CIMNE), 2007. ISBN 978-84-96736-20-7.
- 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.
- Hibbeler, R.C. Ingeniería mecánica: estática. 12a ed. México: Prentice-Hall Interamericana, 2010. ISBN 9786074426618.

Complementary:
- Hibbeler, R.C. Mecánica vectorial para ingenieros: estática. 10a ed. México: Pearson Educación, 2004. ISBN 970-26-0501-6.