Course guide
2500007 - GECMECAN1 - Mechanics I

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: 2022 ECTS Credits: 6.0 Languages: Spanish, English

LECTURER
Coordinating lecturer: MICHELE CHIUMENTI, ALESSANDRO FRANTI
Others: GABRIEL BARBAT VLAD, LUCIA GRATIELA BARBU, MICHELE CHIUMENTI, ALESSANDRO FRANTI, 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

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.


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

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours large group</td>
<td>30,0</td>
<td>20.00</td>
</tr>
<tr>
<td>Hours medium group</td>
<td>24,0</td>
<td>16.00</td>
</tr>
<tr>
<td>Hours small group</td>
<td>6,0</td>
<td>4.00</td>
</tr>
<tr>
<td>Self study</td>
<td>84,0</td>
<td>56.00</td>
</tr>
<tr>
<td>Guided activities</td>
<td>6,0</td>
<td>4.00</td>
</tr>
</tbody>
</table>

**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
- Circulo 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 cálculo

**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
- Componentes rectangulares
- Componentes normal y tangencial
- Movimiento circular
- Componentes polares
- Velocidad angular
- Problems resolt a classe
- Movimento 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 traslacional rectilíneo
- Ecuaciones de movimiento traslacional 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:

\[ \text{NOTA} = 0.2 \times \text{PR}_1 + 0.3 \times \text{EX}_1 + 0.5 \times \text{EX}_2 \]

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:

Complementary: