Course guide
2500002 - GECFISAPLI - Applied Physics

Unit in charge: Barcelona School of Civil Engineering
Teaching unit: 748 - FIS - Department of Physics.
Degree: BACHELOR'S DEGREE IN CIVIL ENGINEERING (Syllabus 2020). (Compulsory subject).
Academic year: 2021 ECTS Credits: 6.0 Languages: Catalan, Spanish

LECTURER

Coordinating lecturer: FRANCISCO MARQUES TRUYOL

Others: DANIEL CALVETE MANRIQUE, ALBERTO FALQUES SERRA, JOSE MANUEL LOPEZ ALONSO, FRANCISCO MARQUES TRUYOL, ALVARO MESEGUER SERRANO, JUAN JOSE SANCHEZ UMBRIA

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 course consists of 2 hours per week of classroom activity (large size group) and 1.6 hours weekly with half the students (medium size group).

The 2 hours in the large size groups are devoted to theoretical lectures, in which the teacher presents the basic concepts and topics of the subject, shows examples and solves exercises.

The 1.6 hours in the medium size groups is devoted to solving practical problems with greater interaction with the students. The objective of these practical exercises is to consolidate the general and specific learning objectives.

The rest of weekly hours devoted to laboratory practice.

Support material in the form of a detailed teaching plan is provided using the virtual campus ATENEA: content, program of learning and assessment activities conducted and literature.
LEARNING OBJECTIVES OF THE SUBJECT

Knowledge of heat and thermodynamics; Oscillations and waves; Electricity and Magnetism.

1. Ability to apply the general principles of thermodynamics to basic engineering problems.
2. Ability to apply the concepts of fields and waves in engineering.
3. Ability to solve simple electromagnetism problems.

Understanding and mastering the basic concepts of physics on the general laws of thermodynamics, fields and waves, and electromagnetism and their application to the resolution of engineering problems. Knowledge of thermodynamics including the first and second principles, heat transfer, and the foundations of kinetic theory. Knowledge of wave propagation, and in particular acoustic problems. Knowledge of electromagnetism, including engineering-type applications. Basic knowledge about continuum mechanics.

To acquire physical skills necessary for basic scientific education of a civil engineer which it is based on other scientific and technical knowledge developed in subjects in later grades. We introduce the principles of fluid mechanics, heat, thermodynamics, oscillations and waves, and electromagnetism.

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<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>Hours large group</td>
<td>30,0</td>
<td>20.00</td>
</tr>
<tr>
<td>Guided activities</td>
<td>6,0</td>
<td>4.00</td>
</tr>
</tbody>
</table>

**Total learning time:** 150 h

CONTENTS

**Introduction**

**Description:**
Resolution error and accidental. Calculation of errors in indirect measurements. Rounding and number of significant figures. Graphic representation and interpretation of experimental data. Adjustment of a line to the experimental data.

**Specific objectives:**
Identify and calculate errors in measurements. Express and represent measures. Fit measurements to a straight line.

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

Description:
Examples and problem solving.
Examples and problem solving.
Density. Measuring instruments.

Specific objectives:
Know the elastic properties of materials. Acquire the concepts of stress, deformation and modulus of elasticity. Know the validity ranges of Hooke's law.
Practical exercises to consolidate learning.
Know the properties of fluids. Acquire the concepts of density, pressure and surface tension. Know how to use the Archimedean principle.
Practical exercises to consolidate learning.
Familiarize yourself with various laboratory instruments: balance, flexometer, kingfoot and micrometer screw. Calculate and represent measures and their errors.

Full-or-part-time: 19h 12m
Theory classes: 2h 30m
Practical classes: 2h 30m
Laboratory classes: 3h
Self study: 11h 12m
Heat and Thermodynamics

Description:
Heat capacity. Phase changes and latent heat.
Examples and problem solving.
Examples and problem solving.
Examples and problem solving.
Examples and problem solving.
Entropy Microscopic interpretation of entropy. Irreversibility.
Exemples and problem solving.
Examples and problem solving.
Specific heat and heat transfer.

Specific objectives:
Acquire the Concepts of temperature and heat, and add microscopic significance. Know the different temperature scales. Know the thermal properties and phases of matter. Acquire the concepts of phase, phase change, heat capacity and latent heat.
Practical exercises to consolidate learning.
Know the thermal properties and phases of matter. Acquire the concepts of thermal expansion and thermal stress. Acquire the concepts of phase and phase change.
Practical exercises to consolidate learning.
Acquire the concept of heat transfer. Know the heat transfer mechanisms. Acquire the concepts of thermal resistance, emissivity and radiant power.
Practical exercises to consolidate learning.
Acquire the concept of internal energy. Know the relationship between work, internal energy and heat. Know how to use the first principle of thermodynamics. Acquire the concept of internal energy and its microscopic meaning. Know the relationship between work, internal energy and heat. Know how to use the first principle of thermodynamics.
Practical exercises to consolidate learning.
Acquire the concept of entropy. Acquire the concepts of entropy and irreversibility, as well as their microscopic meaning.
Calculate the change of entropy in a thermodynamic system.
Exercicis pràctics per tal de consolidar l'aprenentatge.
Acquire the concept of thermal machine and thermal performance. Know the energy balances in a thermal machine.
Practical exercises to consolidate learning.
Familiarize yourself with various laboratory instruments: balance and thermometer. Calculate and represent measures and their errors.

Full-or-part-time: 48h
Theory classes: 8h 30m
Practical classes: 8h 30m
Laboratory classes: 3h
Self study : 28h
Oscillations and Waves

Description:
Examples and problem solving.
Examples and problem solving.
Examples and problem solving.
Reflection and refraction. Propagation by non-homogeneous means.
Examples and problem solving.
Interference. Standing waves and normal modes.
Examples and problem solving.
Examples and problem solving.
Acoustic waves, wavelength, frequency and speed of sound.

Specific objectives:
Acquire the concepts of balance, restoring strength and periodic movement. Know the terms to characterize a periodic movement. Acquire the concept of simple harmonic motion. Acquire the concepts of damped oscillation, forced oscillation and resonance.
Practical exercises to consolidate learning.
Acquire the concept of mechanical wave. Know the different types of mechanical waves. Acquire the concept of wave function, sine wave function, propagation speed, wavelength and period. Know the wave equation. Know the principle of superposition and harmonic analysis. Know how to describe different types of waves in different media in the wave equation.
Practical exercises to consolidate learning.
Know the properties of wave energy.
Practical exercises to consolidate learning.
Know the phenomena of reflection and refraction.
Practical exercises to consolidate learning.
Know the phenomenon of interference. Acquire the concept of standing wave, normal mode and resonance.
Practical exercises to consolidate learning.
Acquire the concept of wave packet, group, group speed and dispersive medium. Know the phenomenon of the Doppler effect.
Practical exercises to consolidate learning.
Familiarize yourself with various laboratory instruments: function generator, multimeter and oscilloscope. Calculate and represent measures and their errors.

Full-or-part-time: 72h
Theory classes: 13h
Practical classes: 13h
Laboratory classes: 4h
Self study : 42h

GRADING SYSTEM
The mark of the course is obtained from the ratings of continuous assessment and their corresponding laboratories and/or classroom computers.
Continuous assessment consist in several activities, both individually and in group, of additive and training characteristics, carried out during the year (both in and out of the classroom).
The teachings of the laboratory grade is the average in such activities.
The evaluation tests consist of a part with questions about concepts associated with the learning objectives of the course with regard to knowledge or understanding, and a part with a set of application exercises.
EXAMINATION RULES.

Failure to perform a laboratory or continuous assessment activity in the scheduled period will result in a mark of zero in that activity. At the end of semester examinations are scheduled for those who have not made any final exams due to a number of reasons verifiable.

BIBLIOGRAPHY

Basic:

Complementary: