Course guide
390103 - FF1 - Physics I

Unit in charge: Barcelona School of Agri-Food and Biosystems Engineering
Teaching unit: 748 - FIS - Department of Physics.

Degree: BACHELOR’S DEGREE IN BIOSYSTEMS ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR’S DEGREE IN FOOD ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR’S DEGREE IN AGRONOMIC SCIENCE ENGINEERING (Syllabus 2018). (Compulsory subject).

Academic year: 2022 ECTS Credits: 6.0 Languages: Catalan

LECTURER

Coordinating lecturer: Lopez Codina, Daniel
Others: Alonso Muñoz, Sergio
Valls Ribas, Joaquim
Català Sabaté, Martí
Pedros Barnils, Nuria
Requena Pozo, Borja

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
2. Knowledge of the basic concepts of mechanics, thermodynamics, electromagnetic fields and waves, and ability to apply them in engineering problems.

Generical:
1. Ability to solve problems.

TEACHING METHODOLOGY

The theory classes will consist of an introduction of the concepts required to achieve the course objectives. This will be done by the lecturer that will also show the use of these concepts on problems solving. The practical classes will be divided into problems sessions and laboratory practices. These sessions will be guided by the lecturer, and the students will work in groups. The teamwork capacity of students will be fostered, as well as their problem solving capacity. The support materials include the practices guides, problems lists and some notes of the course. These materials will be available at ATENEA.

LEARNING OBJECTIVES OF THE SUBJECT

Students will discover the importance of physics to understand the living systems. Through this course it is intended that students achieve the knowledge of mechanics, fluid mechanics, thermodynamics and waves needed for understanding the behavior of biological systems. The students should be able to solve problems and answer questions related to all these topics, as well as to apply this knowledge in the following subjects of the degree. The students must also attain an overview of science and the scientific method, they must be able to apply the dimensional analysis to solving problems and checking the results and they must acquire expertise in the diverse calculation techniques introduced in the subject.
**STUDY LOAD**

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours large group</td>
<td>40,0</td>
<td>26.67</td>
</tr>
<tr>
<td>Hours small group</td>
<td>20,0</td>
<td>13.33</td>
</tr>
<tr>
<td>Self study</td>
<td>90,0</td>
<td>60.00</td>
</tr>
</tbody>
</table>

Total learning time: 150 h

**CONTENTS**

**Introduction to Biophysics**

**Description:**
1.1 What is Biophysics?
1.2 Subject program
1.3 Method of learning
1.4 Review of elementary fundamentals of mathematics and physics

**Related activities:**
Theory lessons
Exercises and questions homework

**Full-or-part-time:** 3h
Theory classes: 1h
Self study : 2h

**Materials properties**

**Description:**
2.1 Materials properties
2.2 Biological materials and biomaterials

**Related activities:**
Theory lessons
Problems solving lesson
Practical session of exercises and questions

**Full-or-part-time:** 13h
Theory classes: 3h
Laboratory classes: 2h
Self study : 8h
### Fluid statics

**Description:**
- 3.1 Density, pressure, the effect of gravity
- 3.2 Pascal's Law. Archimedes Principle
- 3.3 The air bladder of fishes
- 3.4 Surface tension. Alveoli. Cell membrane

**Related activities:**
- Theory lessons
- Practical session of exercises and questions

**Full-or-part-time:** 14h
- Theory classes: 4h
- Laboratory classes: 2h
- Self study: 8h

### Fluid dynamics

**Description:**
- 4.1 Continuity equation
- 4.2 Bronchial system. Circulatory system
- 4.3 Bernoulli's equation
- 4.4 Viscosity. Poiseuille's Law
- 4.5 Bernoulli's equation in real fluids. Reynolds number. Turbulent regime
- 4.6 Distribution of pressure in the circulatory system

**Related activities:**
- Theory lessons
- Theory online lessons
- Problems solving lesson
- Practical session of exercises and questions

**Full-or-part-time:** 19h
- Theory classes: 6h
- Laboratory classes: 2h
- Self study: 11h

### Introduction to thermodynamics

**Description:**
- 5.1 What is thermodynamics?
- 5.2 Temperature and the zeroth law of thermodynamics
- 5.3 Microscopic interpretation of temperature. Heat capacity. Physical effects of temperature
- 5.4 Properties of pure substances. Phase changes
- 5.5 Humidity
- 5.6 Biological effects of temperature

**Related activities:**
- Theory lessons
- Problems solving lessons
- Practical session of exercises and questions

**Full-or-part-time:** 15h
- Theory classes: 5h
- Laboratory classes: 2h
- Self study: 8h
Energy and First law of thermodynamics

**Description:**
6.1 First law of thermodynamics
6.2 Heat and mechanical work in an ideal gas
6.3 Carnot cycle. Biological systems as a heat engine
6.4 First law and metabolism

**Related activities:**
Theory lessons
Online theory lesson
Practical session of exercises and questions

**Full-or-part-time:** 15h
Theory classes: 4h
Laboratory classes: 2h
Self study : 9h

Information theory and Second law of thermodynamics

**Description:**
7.1 Information theory. Second law of thermodynamics
7.2 Biodiversity. Ecological succession
7.3 Second law and energy. Energy in ecological systems. Human ecosystems

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

Heat transfer

**Description:**
8.1 Conduction and convection
8.2 Electromagnetic radiation. Thermal radiation
8.3 Temperature control in living organisms

**Related activities:**
Theory lessons
Problems solving lesson
Practical session of exercises and questions

**Full-or-part-time:** 14h
Theory classes: 4h
Laboratory classes: 2h
Self study : 8h
Introduction to the thermodynamics of irreversible processes

Description:
9.1 Transport phenomena
9.2 Osmotic flux
9.3 Gibbs free energy. Chemical potential
9.4 Xylem. Starling mechanism. Cell membrane

Related activities:
Theory lessons
Practical session of exercises and questions
Exercises and questions homework

Full-or-part-time: 16h
Theory classes: 4h
Laboratory classes: 2h
Self study: 10h

ACTIVITIES

Theory lessons

Full-or-part-time: 34h
Theory classes: 34h

Problems solving sessions

Full-or-part-time: 6h
Theory classes: 6h

Practical sessions of exercises and questions

Full-or-part-time: 20h
Laboratory classes: 20h

Online theory lessons

Full-or-part-time: 5h
Self study: 5h

Exercises and questions homework

Full-or-part-time: 8h
Self study: 8h
Autonomous learning

**Full-or-part-time:** 77h  
Self study: 77h

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**GRADING SYSTEM**

N1 and N2: the individual evaluation tests N1 and N2 will be performed at the mid-semester and end-semester examination periods, respectively. The test N1 can be repeated at the end of the semester. N1+N2 will represent the 80% of the final mark.  
N3: the 10 guided problems sessions and laboratory practices, together with the optional laboratory practice represent the 15% of the final mark.  
CG: the first level of the generic competence will be evaluated as a part of the problems sessions.  
The final mark (Nfinal) will be:

\[ N_{\text{final}} = 0.4N_1 + 0.4N_2 + 0.15N_3 + 0.05CG \]

In case of \( N_{\text{final}} < 5 \), N1 and N2 tests can be repeated in the extraordinary examination period only if the final mark of the course is higher than \( NP \).

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**BIBLIOGRAPHY**

**Basic:**
- Tipler, Paul Allen; Mosca, Gene. Física para la ciencia y la tecnología [on line]. 5a ed. Barcelona [etc.]: Reverté, 2005 [Consultation: 26/07/2022].  
  ISBN 8429144102.