

## Course guide

### 390103 - FF1 - Physics I

**Last modified:** 21/06/2024

**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:** 2024    **ECTS Credits:** 6.0    **Languages:** Catalan

#### LECTURER

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**Coordinating lecturer:** Prats Soler, Clara

**Others:** Alvarez Lacalle, Enrique  
Rubio Maturana, Carles  
Prat Pou, Arnau  
Mazon Bueso, Jordi  
Ye, Qiaoling  
Perramon Malavez, Aida

#### DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

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**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

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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 some notes of the course and problems lists. These materials will be available at ATENEA.

#### LEARNING OBJECTIVES OF THE SUBJECT

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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

Type	Hours	Percentage
Self study	90,0	60.00
Hours large group	40,0	26.67
Hours small group	20,0	13.33

**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

## GRADING SYSTEM

There are two written tests N1 and N2, in the middle and end of the semester. If the subject is suspended and the final grade is higher than Not Presented, the N1 and N2 written tests can be reassessed in the extraordinary period of reassessment exams. Students who have already passed or those classified as not presented will not be able to take part in the re-evaluation of a subject. These tests will count for 80% of the final grade of the subject (40% each). The remaining 20%, corresponding to N3, will correspond to continuous assessment through deliverables.

$$N_{\text{final}} = 0.40 N1 + 0.40 N2 + 0.20 N3$$

## 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]. Available on: [https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB\\_BooksVis?cod\\_primaria=1000187&codigo\\_libro=10372](https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=10372). ISBN 8429144102.
- Villar, Raúl; López, Cayetano; Cussó Pérez, Fernando. Fundamentos físicos de los procesos biológicos [on line]. San Vicente [del Raspeig], Alicante: Club Universitario, 2012 [Consultation: 22/11/2023]. Available on: <https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=3216262>. ISBN 9788499485096.
- Guyton, Arthur C. Fisiología humana. [6ª ed.]. México, D.F. [etc.]: Nueva Editorial Interamericana, 1987. ISBN 9682510163.
- Solomon, Eldra Pearl; Berg, Linda R; Martin, Diana W. Biología. Novena edición. México: Cengage Learning Editores, 2013. ISBN 9786074819335.
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