

Course guide

390103 - FF1 - Physics I

Last modified: 06/06/2023

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: 2023 **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

| 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

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:

$$N_{\text{final}} = 0.4N1 + 0.4N2 + 0.15N3 + 0.05CG$$

In case of Nfinal

BIBLIOGRAPHY

Basic:

- Solomon, Eldra Pearl; Berg, Linda R.; Martin, Diana W. Biología. Novena edición. México: Cengage Learning Editores, 2013. ISBN 9786074819335.

- 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.

- 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. ISBN 8429144102.