UNIVERSITAT POLITÈCNICA DE CATALUNYA
BARCELONATECH

Course guide
390459 - OSB - Waves and Biological Systems

Last modified: 03/07/2024

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). (Optional subject).

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

LECTURER

Coordinating lecturer:	Lopez Codina, Daniel
Others:	Alonso Muñoz, Sergio

TEACHING METHODOLOGY

Classes with the theory teacher: exposition of concepts, realization of problems, discussion, debate.
Classes with the teacher of problems and practical activities: completion of problems and practical activities by the students with the support of the teacher.
Visits.

LEARNING OBJECTIVES OF THE SUBJECT

"Waves and biological systems" is a natural continuation of the Physics 1-Biophysics subject.
Electromagnetic waves and density and pressure waves play a key role in biological systems, from the exchange of energy (photosynthesis, thermal radiation,...) to the transmission of information (vision, sounds, ultrasound, ...). We cannot understand the functioning of biological systems from the cell to ecosystems without understanding their interaction with waves.
The aim of the subject is to understand the nature of waves and how they interact with biological systems.
In the subject we hope that students can learn from real cases, enjoying learning about the operation of systems related to different types of waves. Mathematics necessarily appears but in an affordable way, where it is intended that the student can discover it while enjoying it. An important part of the syllabus will deal with specific biological systems, from the human eye or the eyes of insects to the human ear or the ear of bats. Issues at a planetary level, such as climate change or seismic waves, will also be discussed.

STUDY LOAD

Type	Hours	Percentage
Hours large group	44,0	29.33
Hours small group	22,0	14.67
Self study	84,0	56.00

Total learning time: 150 h

CONTENTS

1. Introduction to the subject

Description:
1.1 Objectives of the subject
1.2 Content
1.3 Basics

Related activities:
Theory classes
Problem sessions
Autonomous learning

Full-or-part-time: 24h
Theory classes: 8h
Practical classes: 4h
Self study : 12h

Electromagnetic radiations

Description:
2.1 Characteristics of electromagnetic waves
Electromagnetic spectrum
Polarized waves
Reflectance, absorbance, transmittance, diffraction, Doppler effect
Radiation-matter interaction
Light as a tool in technology, photonics.
Radio frequencies, environment and health

2.2 Solar radiation and terrestrial radiation. Climate change.

2.3 Eyes and vision
Human eye: anatomy and physiology
Radiometric and photometric quantities
Fundamentals of geometric optics
Color scales
other eyes
Light and natural systems (ecology, photosynthesis, phototaxis,...).

2.4 Ionizing radiation
Radioactivity Radiation sources
Biological effects of ionizing radiation
Radiation and health
Radiation and natural systems
Technological use of radiation

Related activities:
Theory classes
Problem sessions
Autonomous learning

Full-or-part-time: 48h
Theory classes: 16h
Practical classes: 8h
Self study : 24h

3. Density and pressure waves. Sound

Description:
3.1 Characteristics of density and pressure waves

3.2 The human ear: anatomy and physiology

3.3 Sound properties

3.4 Other ears, other vibration detection organs

3.5 Ultrasound and echolocation

3.6 Ultrasound and health

3.7 Sound and natural systems
noise Noise pollution.
Sonograms in the natural environment
The singing of the birds
The sounds in the aquatic environment

3.8 Technological use of sound waves

3.9 Seismic waves

Related activities:
Theory classes
Problem sessions
Autonomous learning

Full-or-part-time: 48h
Theory classes: 16h
Practical classes: 8h
Self study : 24h

GRADING SYSTEM

In the subject, continuous assessment will have a significant weight (problems, assignments, practices).

The grade N will be determined with the following algorithm:

N=maximum (average of exams; 0.7 x average of exams + 0.3 x continuous assessment).

BIBLIOGRAPHY

Basic:
- Tipler, Paul Allen; Mosca, Gene; Bramon Planas, Albert. Física para la ciencia y la tecnología . 5a ed. Barcelona [etc.] : Reverté, cop. 2005-. ISBN 8429144102.
- Villar, Raúl; López, Cayetano; Cussó Pérez, Fernando. Fundamentos físicos de los procesos biológicos . San Vicente [del Raspeig], Alicante : Club Universitario, DL 2012. ISBN 9788499485096.
- Guyton, Arthur C. Fisiología humana . 6ª ed. México [etc.] : Interamericana, 1987. ISBN 9682510163.
- Solomon, Eldra Pearl; Berg, Linda R; Martin, Diana W; García Hernández, Ana Elizabeth. Biología : novena edición. México, D.F. : Cengage Learning Editores, S.A. de C.V, [2013]. ISBN 9786074819335.