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Coordinating unit: 390 - ESAB - Barcelona School of Agricultural Engineering

Teaching unit: 748 - FIS - Department of Physics

Academic year: 2019

Degree: BACHELOR'S DEGREE IN BIOSYSTEMS ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN AGRICULTURAL, ENVIRONMENTAL AND LANDSCAPE ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN FOOD ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN AGRICULTURAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN FOOD ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR ' S DEGREE IN AGRONOMIC SCIENCE ENGINEERING (Syllabus 2018). (Teaching unit Compulsory)

ECTS credits: 6 Teaching languages: Catalan

Teaching staff

Coordinator: Lopez Codina, Daniel

Others: Giró Roca, Antoni
Pineda Soler, Eloi
Pradell Cara, Trinitat
Prats Soler, Clara
Valls Ribas, Joaquim

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

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and checking the results and they must acquire expertise in the diverse calculation techniques introduced in the subject.

Study load

Total learning time: 150h	Hours large group:	40h	26.67%
	Hours medium group:	0h	0.00%
	Hours small group:	20h	13.33%
	Guided activities:	0h	0.00%
	Self study:	90h	60.00%

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Content

Introduction to Biophysics

Learning time: 3h

Theory classes: 1h
Self study : 2h

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
Exercices and questions homework

Materials properties

Learning time: 13h

Theory classes: 3h
Laboratory classes: 2h
Self study : 8h

Description:
2.1 Materials properties
2.2 Biological materials and biomaterials

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

Fluid statics

Learning time: 14h

Theory classes: 4h
Laboratory classes: 2h
Self study : 8h

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 exercices and questions

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Fluid dynamics	Learning time: 19h Theory classes: 6h Laboratory classes: 2h Self study : 11h

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 exercices and questions

Introduction to thermodynamics	Learning time: 15h Theory classes: 5h Laboratory classes: 2h Self study : 8h

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

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Energy and First law of thermodynamics

Learning time: 15h

Theory classes: 4h
Laboratory classes: 2h
Self study : 9h

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

Information theory and Second law of thermodynamics

Learning time: 12h

Theory classes: 3h
Laboratory classes: 2h
Self study : 7h

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

Heat transfer

Learning time: 14h

Theory classes: 4h
Laboratory classes: 2h
Self study : 8h

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

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Introduction to the thermodynamics of irreversible processes

Learning time: 16h

Theory classes: 4h
Laboratory classes: 2h
Self study : 10h

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 exercices and questions
Exercises and questions homework

Waves

Learning time: 14h

Theory classes: 3h
Laboratory classes: 2h
Self study : 9h

Description:
10.1 Oscillatory motion
10.2 Sound. Ears
10.3 Light. Eyes

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

Ionizing radiation

Learning time: 11h

Self study : 11h

Description:
11.1 Fundamentals
11.2 Ionizing radiation and living systems

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

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Planning of activities

Theory lessons	Hours: 34h Theory classes: 34h
Problems solving sessions	Hours: 6h Theory classes: 6h
Practical sessions of exercises and questions	Hours: 20h Laboratory classes: 20h
Online theory lessons	Hours: 5h Self study: 5h
Exercises and questions homework	Hours: 8h Self study: 8h
Autonomous learning	Hours: 77h Self study: 77h

Qualification 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:

Nfinal= 0.4N1 + 0.4N2 + 0,15N3 + 0.05CG

In case of Nfinal<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:

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Villar, Raúl; López, Cayetano; Cussó Pérez, Fernando. Fundamentos físicos de los procesos biológicos. San Vicente [del Raspeig], Alicante: Club Universitario, 2012. ISBN 9788499485096.

Guyton, Arthur C. Fisiologia 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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