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230459 - BIOF1 - Biophysics 1

Coordinating unit: 230 - ETSETB - Barcelona School of Telecommunications Engineering
Teaching unit: 748 - FIS - Department of Physics
Academic year: 2019
Degree: BACHELOR'S DEGREE IN ENGINEERING PHYSICS (Syllabus 2011). (Teaching unit Compulsory)
ECTS credits: 6 Teaching languages: Catalan

Teaching staff

Coordinator: DANIEL LÓPEZ CODINA

Others:

Alonso Muñoz, Sergio

Degree competences to which the subject contributes

Specific:

1. Ability to describe in general the structure of living things, from cellular to systemic level. Ability to analyze the constraints imposed by the physics laws to the development of biological systems, and the biological solutions to engineering problems.
2. Ability to analyze biological systems as complex systems.

Generical:

4. ABILITY TO IDENTIFY, FORMULATE, AND SOLVE PHYSICAL ENGINEERING PROBLEMS. Planning and solving physical engineering problems with initiative, making decisions and with creativity. Developing methods of analysis and problem solving in a systematic and creative way.

Transversal:

2. TEAMWORK - Level 1. Working in a team and making positive contributions once the aims and group and individual responsibilities have been defined. Reaching joint decisions on the strategy to be followed.
3. SELF-DIRECTED LEARNING - Level 1. Completing set tasks within established deadlines. Working with recommended information sources according to the guidelines set by lecturers.
1. SUSTAINABILITY AND SOCIAL COMMITMENT - Level 2. Applying sustainability criteria and professional codes of conduct in the design and assessment of technological solutions.

Teaching methodology

Classes (2.6 ECTS): contents' exposition (theory and problems) with the participation of students. Practical activities and problems solving either individually or in groups.

Learning objectives of the subject

- Students will be able to understand the basic concepts about biological systems behaviour.
- Students will be able to use basic principles of physics in solving problems in biophysics.

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Study load

Total learning time: 150h	Hours large group:	65h	43.33%
	Self study:	85h	56.67%

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Content

1. Introduction

Learning time: 1h

Theory classes: 1h

Description:
1.1 Presentation of the course.

Related activities:
Activity 1: Theory classes.

2. Biomechanics

Learning time: 14h

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

Description:
2.1 Scaling laws.
2.2 Stresses and work.
2.3 Biological materials.

Related activities:
Activity 1: Theory classes.
Activity 3: Guided problems sessions.

3. Fluid mechanics and biological systems

Learning time: 23h

Theory classes: 7h
Practical classes: 4h
Self study : 12h

Description:
3.1 Introduction. Biological basis, example: respiration.
3.2 Hydrostatics. From physical basis to surface energy in alveoli.
3.3 Fluid dynamics. Fundamentals, blood circulation, respiration, xylem.

Related activities:
Activity 1: Theory classes.
Activity 3: Guided problems sessions.

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4. Thermodynamics of living systems (I)	Learning time: 19h Theory classes: 6h Practical classes: 3h Self study : 10h

Description:
4.1 Introduction. Biological basis, examples: enzime kinetics, microbial growth.
4.2 Temperature and living systems. Life and temperature ranges, temperature and metabolic activity, temperature control in living systems.
4.3 First law. Conservation principles, energetic balance of living systems, calorimetry.
4.4 Second law. Second law and living systems, energetic yield, entropy, MAXENT.

Related activities:
Activity 1: Theory classes.
Activity 3: Guided problems sessions.

5. Thermodynamics of living systems (II). Thermodynamics of irreversible processes	Learning time: 22h Theory classes: 6h Practical classes: 5h Self study : 11h

Description:
5.1 Introduction. Biological basis, example: the cell.
5.2 Basis.
5.3 Transport phenomena. Diffusion. Osmotic flow (alveoli, blood capillaries, transport in plants,...).
5.4 Cell membrane.
5.5 Action potential.

Related activities:
Activity 1: Theory classes.
Activity 3: Guided problems sessions.
Activity 4: Seminars.

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6. Wave phenomena and living systems

Learning time: 18h

Theory classes: 5h
Practical classes: 3h
Self study : 10h

Description:
6.1 Waves. Introduction. Biological basis, example: solar radiation and photosyntesis.
6.2 Basis.
6.3 Sound.
6.4 Electromagnetic waves. Wave-matter interaction. Eyes.
6.5 Electromagnetic waves. Energy.

Related activities:
Activity 1: Theory classes.
Activity 3: Guided problems sessions.
Activity 4: Seminars.

7. Biological effects of ionizing radiation

Learning time: 13h

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

Description:
7.1 Introduction. Biological basis, example: genetic material and cancer.
7.2 Nuclear reactions, radiation alpha, beta and gamma. Doses. Measures. Biological effects.

Related activities:
Activity 1: Theory classes.
Activity 3: Guided problems sessions.

8. Physics and mathematics of ecosystems

Learning time: 20h

Theory classes: 5h
Practical classes: 5h
Self study : 10h

Description:
8.1 The concept of ecosystem. Physical and mathematical basis of ecology.
8.2 Mathematical models and ecosystems.

Related activities:
Activity 1: Theory classes.
Activity 3: Guided problems sessions.
Activity 4: Seminars.

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9. Modelling and simulation of biological systems	Learning time: 20h Theory classes: 2h Practical classes: 2h Guided activities: 10h Self study : 6h

Description:
9.1 Methodology for modelling in biology.
9.2 Methods for simulation of biological systems.

Related activities:
Activity 1: Theory classes.
Activity 3: Guided problems sessions.
Activity 5: Guided activity on modelling and simulation of biological systems.

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Planning of activities

ACTIVITY 1: THEORY CLASSES

Hours: 39h
Theory classes: 39h

Description:
Contents' exposition with the participation of students.

Specific objectives:
Students will be able to understand the basic concepts about biological systems behaviour.

ACTIVITY 2: INDIVIDUAL EVALUATION TESTS

Description:
Students will solve theoretical questions and problems individually. There will be two tests along the course: a mid-semester partial exam and an end-semester global exam.

Specific objectives:
Assessment of the students' achievment of learning objectives.

ACTIVITY 3: GUIDED PROBLEMS SESSIONS

Hours: 23h
Practical classes: 23h

Description:
The lecturer will solve some problems as examples and will propose different problems to students to be solved either individually or in groups.

Specific objectives:
Students will be able to use basic principles of physics in solving problems in biophysics.

ACTIVITY 4: SEMINARS

Hours: 3h
Practical classes: 3h

Description:
Lectures on research and technological applications of topics related to the subject that will be given by experts.

Specific objectives:
Students will be able to understand the basic concepts about biological systems behaviour.
Students will be able to use basic principles of physics in solving problems in biophysics.

ACTIVITY 5: GUIDED ACTIVITY ON MODELLING AND SIMULATION OF BIOLOGICAL SYSTEMS

Hours: 10h
Guided activities: 10h

Description:
Guided activity that involves either the use of an existing program or the building of a simulator in order to study the behaviour of a specific biological system.

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Support materials:
Guide for the execution of the activity.

Descriptions of the assignments due and their relation to the assessment:
Students will hand in a report according to the established format and deadlines. This report will be assessed by the lecturer.

Specific objectives:
Students will be able to understand the basic concepts about biological systems behaviour.
Students will be able to use basic principles of physics in solving problems in biophysics.

Qualification system

The evaluation consists of a final exam (EF) and an evaluation during the course that considers both a mid-semester partial exam (EP) and the practical activities (P). The final grade is be given by:
Max{EF, 0.60 x EF + 0.30 x EP + 0.10 x P}

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Complementary:

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