Course Syllabus

2012-2013

1. COURSE DESCRIPTION

Undergraduate Degree:	**Biotechnology**
Combined Undergraduate Degree:	
Subject:	**Physics**
Module:	**Physics, Mathematics and Computing for the Molecular Biosciences**
Department:	**Physical, Chemical and Natural Systems**
Academic Year:	**2012-2013**
Semester:	**First Semester**
ETCS:	**6**
Year:	**First Year**
Typology:	**Core Subject**
Language:	**Spanish**

Typology of teaching:	**B1**
a. EB:	**60%**
b. EPD:	**40%**
c. AD:	**0**

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2. TEACHING TEAM

2.1. Person responsible for the subject	**María Carmen Gordillo Bargueño**

2.2. Lecturers	
Name:	**María Carmen Gordillo Bargueño**
Centre:	**Faculty of Experimental Sciences**
Department:	**Physical, Chemical and Natural Systems**
Area:	**Applied Physics**
Category:	**Tenured Lecturer**
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Name:	**Carmen Carbonell Coronado**
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3. SITUATION WITHIN THE TRAINING PLAN

3.1. Course Objectives

This subject is eminently basic and aims to collect the physical concepts that will be needed in more specific subjects of the degree in Biotechnology. Students will be also provided with the basic mathematical tools to interpret and report the experimental results obtained in the laboratory. By the end of the semester, students should

a) Know how to use correctly the different systems of units, and how to assess the result of an experiment from the analysis of the error bars of the measurements.

b) Have an adequate knowledge of Mechanics in general and Fluid Mechanics in particular, in order to understand the engineering problems related to Biotechnology.

c) Know enough of the basic principles of Electricity, Magnetism, Optics and Radioactivity to grasp the fundamentals of the analytical techniques used in Biotechnology.

3.2. Contributions to the Training Plan

This course aims to provide the student with the necessary basic knowledge to understand and identify the physical processes involved in any context related to Biotechnology, especially in applications related to engineering and analytical techniques.

3.3. Necessary Previous Knowledge

Students should have a working knowledge of basic mathematics. In particular, they should know how to solve linear and quadratic equations and simple systems of linear equations. Trigonometry and the properties of logarithms and determinants are also included in this necessary previous knowledge. This material will not be covered in class, but the students will be able to work autonomously on the material at their disposition on the University website.

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4. SKILLS

4.1 General skills to be developed during this course

1. A basic understanding of the scientific method. The student should learn to use properly the experimental protocols in the laboratory (in this case, in the Physics Laboratory) and acquire the necessary skills to interpret and report the results obtained.

2. An awareness of the importance of the teamwork and of critical discussion in the pursuing of common goals.

4.2. Module skills to be developed during this course

The student should, by the end of the semester

1. Be able to identify the physical processes involved in any biological phenomenon, together with the basics of various analytical tools, and the fundamentals of the engineering processes related to Biotechnology.

2. Have an adequate understanding of the concept of measurement in science, including the correct use of the systems of units and the correct handling of errors.

4.3 Specific skills of this course

The student must acquire a working knowledge of the following topics,

Measurement in science: systems of units and interpretation of experimental data.
Principles of Mechanics: Cinematics and dynamics.
Fluid Mechanics.
Electric and magnetic fields.
Waves.
Optics.
Principles of Nuclear Physics. Radioactivity.

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5. COURSE OUTLINE

Unit 0. Basic mathematical tools

Scalars and vectors. Vector algebra. Dot product. Cross product. Determinants. Derivatives and Integrals.

Unit 1: Introduction and basic concepts

Methodology of the course. Definition of Physics and its relation to other sciences. Scientific method.

Unit 2: Mechanics

Straight-line motion: displacement, velocity and acceleration. Motion with constant acceleration: free fall. Motion in a plane. Projectile motion. Uniform circular motion. Newton's laws. Gravitation. Definition of weight. Friction. Work. Power. The work-energy theorem. Conservative forces. Potential energy. Conservation of energy.

Unit 3: Fluids

Ideal fluids. Pressure. Archimedes' Principle. The equation of continuity. Bernoulli's equation. Real fluids: viscosity. Poiseuille's law. Reynolds number. Surface tension.

Unit 4: Electric and magnetic fields

Electric charges: history, types and conservation. Coulomb's law. Principle of superposition. Electric Field. Electric dipoles. Electric field lines. Electric potential. Electric current. Current intensity. Ohm's law. Resistivity. DC circuits: Kirchhoff's rules. Magnetic phenomena. Lorentz force. Fundamentals of mass spectrometry.

Unit 5. Waves. Optics.

Waves. Wave types. Wave equation. Interference. Standing waves. Power and intensity of waves. Sound. Sound intensity: decibels. Light waves. Reflection and refraction. Mirrors and lenses. Thin lens formula. Magnification. Lensmaker's equation.

Unit 6. Nuclear physics. Radioactivity.

The atomic nucleus. Radioactivity. Nuclear reactions. Radioactive dating.

6. METHODOLOGY AND RESOURCES FOR TEACHING

Of the 45 hours of face-to-face class time, 27 will be devoted to the basic concepts outlined in the previous section. These classes will consist of presentations (PowerPoint or otherwise) by the teacher followed by practical sessions in which some applications of the concepts will be done, mainly in the form of problems to solve. To have a copy of the teacher presentations is highly recommended, but not mandatory. Those copies can be downloaded at no cost from the University website. Problem collections will be given to students in advance to be solved in class, either individually or in small groups. These classes shall be attended by the entire group of 60 students.

The Basic Concepts classes will be complemented by six three-hour practical sessions (18 hours in total), with at most a session per week. The goal of these classes will be to complete a project on the subject of the comparison of experimental data to the pertinent physical laws. To do so, the class will be divided in groups of 4-6 students who will work together throughout the semester. The scheme of the work is as follows:

1st week. Measurement of experimental data designed to test the laws of motion and some properties of fluids. Each group of students will be split as to have two sets of data in order to being able to address questions of reproducibility.

2nd week. The fundamentals of error theory and of statistical inference will be explained. The mathematical operations and the graphical representations will be done with the Excel program, so its use will be explained with a standard set of data.

3rd week. The estimation of experimental errors of indirect measurements will be explained.

4th week and 5th week. Each student group will work autonomously under the teacher supervision. They will have to prove if their experimental data are statistically compatible with the laws they are testing (straight-line motion and Bernoulli's equation). The fundamentals of the use of the Power Point program will be also explained.

6th week. A student of each group will deliver a brief talk of about 20' on the main findings of their project, using a Power Point presentation as a support. The speaker will be chosen at random between the members of the group at the beginning of the corresponding session. At the end of the talk, the professor will ask some questions to check if every member of the

group has a working knowledge of the task that has been done. The grade awarded for this assignment will be in the range 0-10.

7. GRADING

An individual exam to be performed at the end of the semester will evaluate the concepts taught in the Basic Concept classes. The grade awarded for this exam will be in the range 0-10 and its weight in the final grade will be 60%.

The Power Point presentation described in the previous section will make up the remaining 40% of the final grade, and will be shared equally by all the members of the group.

To pass the subject, the final grade should be at least of 5.

If the student does not pass the subject, a new individual exam will take place in July, with the same format and with the same weight as in the February exam. The course final grade in July will be the weighted sum of the grade of the final exam in July and the grade of the corresponding PowerPoint delivered during the first semester. The student will also have the right to repeat **individually** that Power Point to improve his/her grade.

8. GENERAL BIBLIOGRAPHY

Giancoli, D.C. Physics: Principles with Applications with MasteringPhysics with Get Ready for Physics (6th Edition) Addison-Wesley (2010)