Course Syllabus

1. COURSE DESCRIPTION

Degree:	**Biotechnology**
Double Degree:	
Course:	**Physics**
Module:	**Physics, Mathematics and Computing for the Molecular Biosciences**
Department:	**Physical, Chemical and Natural Systems**
Term:	**First Term**
Total credits:	**6**
Year:	**First Year**
Type of Course:	**Basic**
Course language:	**English**

Teaching model:	**B1**
a. General/background:	**60%**
a. Theory-into-practice/developmental b. knowledge-building:	**40%**
c. Guided Academic Activities:	**0**

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2. COURSE COORDINATOR

Course coordinator	
Name:	**María Carmen Gordillo Bargueño**
Faculty:	**Faculty of Experimental Sciences**
Department:	**Physical, Chemical and Natural Systems**
Academic area:	**Applied Physics**
Category:	**Tenured Lecturer**
Office Hours:	**Mondays and Wednesdays 15:00-18:00 or by appointment.**
Office:	**22.2.14**
Email:	**cgorbar@upo.es**
Telephone:	**+34 954 97 79 37**

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3. ACADEMIC CONTEXT

3.1. Course Description and Objectives

This basic course collects all the physical concepts that will be needed throughout the degree in Biotechnology. In addition, students will be provided with the basic mathematical tools to interpret and report the experimental results obtained in the laboratory. By the end of the semester, they should

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

b) Have an adequate knowledge of Mechanics and of the Physics of Fluids, 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. Recommendations or Prerequisites

Students should have a working knowledge of basic mathematics. In particular, they should know how to solve linear and quadratic equations and simple sets 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.

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4. SKILLS

4.1 Degree skills to be developed during this course

1. A basic understanding of the Scientific Method. The student should learn to implement the Physics laboratory protocols properly and acquire the necessary mathematical skills to report the results obtained.

2. An awareness of the importance of 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 experimental errors.

4.3 Course-specific skills

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: Kinematics and dynamics.
Fluid Mechanics.
Electric and magnetic fields.
Waves.
Optics.
Principles of Nuclear Physics. Radioactivity.

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5. COURSE TOPICS

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. Projectile motion. Uniform circular motion. Newton's laws. Gravitation. Definition of weight. Friction. Work. Power. The work-energy theorem. Conservative forces: potential energy. Law of 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.

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6. METHODOLOGY AND RESOURCES

Of the 45 hours of face-to-face class time, 27 will be devoted to the background concepts outlined in the previous section. These classes shall be attended by the entire group of 60 students, and will consist of presentations 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 WebCT. 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.

These background classes will be complemented by six three-hour practice 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 schedule for these theory-into-practice classes is:

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 in order to have at least two sets of data. Thus, we will be able to address questions of reproducibility.

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

3rd week. How to estimate errors in indirect measurements will be explained.

4th week and 5th week. Each group will work autonomously under the teacher supervision. They will have to prove if their experimental data are compatible with the laws they are testing. The fundamentals 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. This session will end with an individual test designed to assess if all the students know how to perform error calculations.

All the course material would be available from WebCT. The professor will be available via WebCT both for electronic tutoring or to set up appointments during her office hours.

7. ASSESMENT

There will be several contributions to the final grade:

a) Practical session's grade. It has also two parts.
   1. The assessment of the Power Point presentation described in the previous section. The corresponding grade will be in the range 0-10, and it will be shared equally by all the members of the group. Since **attending the practical sessions is mandatory**, if a student does not show up in one or several of them, his/her grade will be multiplied by the ratio of the attended ones to the total number of practical sessions. The weight of this part in the final grade is 30%
   2. The grade of the individual test described above to check if the students know how to calculate errors. This grade will be also in the range 0-10, and its weight in the final mark is 10%.

Assessed skills. Degree skills 1 and 2. Module skill 2 and all the course-specific skills.

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

Assessed skills. Module skill 1 and all the course-specific skills.

To pass the course, 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 practical session's grade obtained during the first semester. The student will also have the right to repeat **individually** the Power Point to improve his/her grade. (S)he could also repeat the error test.

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8. BIBLIOGRAPHY

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