2011-12 Academic Year

Physics for Health Sciences (20407)

Qualification/course: Bachelor's Degree in Medicine
Year: 1
Term: 1
Number of ECTS credits: 5
Number of study hours: 125
Course Language(s):
Teaching staff: Martí Lacruz

1. Presentation of the course

Physics for Health Sciences is one of the basic first-year subjects of the first year of the degree course in Medicine at the Pompeu Fabra University. It consists of 5 ECTS credits, of which 3 are theoretical and 2 are practical.

The subject is broken down into two parts: a theoretical part and practical/experimental part. Lecturers from the Medical and Radiophysics Departments of the Radiotherapeutical Oncology Service at the Esperança Hospital in Barcelona will be responsible for teaching this module. The subject coordinator is Martí Lacruz, the Head of the Physics Section, who will be responsible for teaching the theoretical course together with Jaume Quera, the assistant radiographer. The practical parts will be taught by the Head of Service, Dr. Manel Algara, and his assistant doctors Palmira Foro, Xavier Sanz and Nuria Rodríguez.

2. Competences to be achieved

The basic aims of this course, and consequently the teaching staff's aims for the students, can be summarised as the following:

- To provide students with the fundamental concepts that will help them realise that any phenomenon that they observe during their professional careers will have an implicit cause that can be explained in terms of physics.
- To collaborate with the rest of the teaching staff in transmitting a scientific learning methodology that will give students a tool with which to undertake their research efforts.
- To transmit to students a passionate interest in the cause-effect relationship and encourage them to take pleasure in their research.

3. Course content

THEORY SYLLABUS
The training programme can be broken down into five thematic areas:

Topic 1. The primordial universe
The first three minutes. Formation of matter. Elementary particles. Space, time and relativity. Development towards complex structures.

Topic 2. Atomic and nuclear physics
Quantum nature of the atomic nucleus. Radioactivity. Interaction between radiation and matter. The electromagnetic spectrum. Previous knowledge required of the student: non quantum nature of the atom; electronic configuration of the atomic shell; basic molecular chemistry.

Topic 3. Mechanics of physical bodies
Statics of fluids: gravity on fluids, equilibrium of bodies, surface tension. Fluid dynamics: circulation through narrow pipes. Laminar flow and turbulent flow. Acoustics: longitudinal and transverse waves. Sound. Doppler Effect. Previous knowledge required of the student: nature of fluids; wave theory (mathematics and physics).

Topic 4. Electromagnetism
Electricity: electric dipole. Electric potential. Bioelectricity. Electric current: electrical networks. Nerve impulse. Nernst potential. Magnetism: magnetic fields and induced fields. Magnetic properties of matter. Biomagnetism. Previous knowledge required of student: Coulomb's law, electrical field and electrical force; insulators and conductors; Ohm's law, direct current and alternating current; vector calculus.

Topic 5. Optics
Nature of light. Reflection and refraction on flat surfaces. Lenses and their aberrations. Polarization of light. Previous knowledge required of the student: electromagnetic nature of light. Laws of reflection and refraction. Basic geometry.

PRACTICAL SYLLABUS

Practical Session 1. Application of physics to medicine. Objective: practical application of atomic and nuclear physics, electromagnetism and acoustics to medicine. This practical session will be held in the lecture-rooms at the Faculty of Life and Health Sciences, and will consist of four parts: a first part in which will be explained the concept of three-dimensional space; a second part dedicated to the specialisation of Medical Physics; a third part in which we will examine the physical basis for obtaining images for radiology, and a fourth and final part in which will be explained the effects of total body irradiation (TBI) of a living being. Assessment: examination.

Practical Session 2. Interaction of radiation with matter. Practical application to living beings via a computer simulation program. Preparation of three-dimensional dosimetry. Objective: practical observation of the behaviour of radiation in the interaction with human body organs of differing electronic densities. The session will be held at the Radiotherapy Department of the Esperança Hospital. Assessment: examination and presentation of dosimetry.

Practical Session 3. The physics of life. Objective: all the phenomena that occur in nature, even everyday situations which we have never paused to think about, have an explanation based on a law of physics. The objective of the session is for students to find the law or explanation given by physics for certain everyday situations, i.e. to formulate the general rule on the basis of specific situations. The aim is to stimulate the skills of discovery, observation and abstraction. The session will be divided into two parts: preparation of a written report and presentation of the results in the classroom. Assessment: questions on the topics presented and evaluation of the written report, and of the oral presentation of the topics.

4. Assessment

Each module has its own assessment criteria, which will be made available to students in the specific course syllabuses. The subject mark will be proportional to the number of credits for the two modules. In order to attain the average mark between the two modules a minimum mark of 4 is required in each. If students do not pass one of the modules at the first attempt, they will be required to re-sit the examination exclusively for the module concerned at the second examination session.

Assessment of progress
THEORY (70%) OF THE FINAL MARK

PRACTICAL WORK (30%) OF THE FINAL MARK

ASSESSMENT CONTROL FACTOR (summative mark)

5. Bibliography and teaching resources

5.1. Basic bibliography

Textbooks:
CROMER, A. H. *Física para las ciencias de la vida*. 3a ed. Barcelona: Reverté, 1992.
CUSSÓ, F.; LÓPEZ, C.; VILLA, R. *Física de los procesos biológicos*. Ed. Ariel.

5.2. Complementary bibliography

Reference books:
BOGDANOV, K. *El físico visita al biólogo*. Moscou: Editorial Mir.
GASS. *Introducción a las ciencias de la tierra*. Ed. Reverté.
GUILLET, J. P. *Manual de física de radioterapia.* 1a. ed. Barcelona: Masson, 1996.
HAWKING, S. *Historia del tiempo.* Ed. Crítica.
HOYLE, F. *El universo inteligente*. Ed. Grijalbo.
HEWIT, PAUL G. *Conceptos de física*. Limusa Noriega Editores.
ORTUÑO, M. *Física para biología, medicina, farmacia y veterinaria*. Ed. Crítica.
RESNICK. *Conceptos de relatividad y teoría cuántica*. Limusa Noriega Editores.

SEARS-ZEMANSKY. *Física general*.
VALLS, A.; ALGARA, M. *Radiobiología básica*. Madrid: Eurobook, SL, 1994.

6. Methodology

7. Activities schedule