FISICA INFORMATICA E STATISTICA MEDICA - channel 2

10 CFU - 1° Semester

Teaching Staff

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LEARNING OBJECTIVES

- **Physics**
  The aim of the course is the achievement by the student of descriptive and predictive ability of physics applied to biological systems. The review, in the medical field, of the scientific method in terms of language, models and representation of the mechanical, thermal, electromagnetic phenomena represents a specific objective as well as the knowledge of basic physical principles of the diagnostic and therapeutic techniques used in modern medicine.

  The subjects that will be covered are: fluid mechanics and its implications in hemodynamic; wave mechanics with specific developments relating to sound and hearing; the use of ultrasounds in medicine; vision and optical instruments; interaction of radiation with matter; generation, use and biological effects of ionizing radiation; dosimetry and radiation protection.

The scientific field of reference is Applied Physics (FIS/07).

- **Bioinformatics**
  Objective of the course is the acquisition of methods for the analysis of biological sequences and structures and the capability of searching in in biological databases (eg. Genes, sequences, functional domains). Starting from primary sequences of nucleic acids or proteins can hypothesize the function, evolutionary history and structure. The tools used to achieve these objectives are the public databases and the tools for the analysis and visualization of such kind of data.

  Knowledge and understanding: Students will gain knowledge on methods for the analysis of biological sequences and for searching in biological databases. In particular students will be able to search on database of sequences and domains. Also, public databases available on NCBI will be presented together with software for the and the analysis and visualization of biological data. Finally, students will acquire the basic tools for the analysis of the transcriptome.
  Applying knowledge and understanding: identify the appropriate tools to manipulate data and extract knowledge underlying; solve problems through the use of appropriate software in bioinformatics.
  Making judgments: Through guided exercises, the students will acquire the basic skills necessary to deal with the analysis of new biological sequences, hypothesizing the function, study the transcriptome.
  Communication skills: the student will acquire the necessary communication skills and expressive appropriateness in the use of technical language within the general framework of the analysis of biological data.
  Learning skills: The course aims, as the goal, to provide students with the necessary basic theoretical methods and practices in order to address and solve problems concerning the analysis of biological data.

- **Medical Statistics**
  The course will provide basic elements to let the student be able to describe individual and population based biological events through syntetic indeces. Moreover, the student should be able to identify and use elementary metodologies of analysis of numerical data.

COURSE STRUCTURE

- **Physics**
  Lectures and tests (entrance, on going and end-of-course verification).

- **Bioinformatics**
  Lectures

- **Medical Statistics**
  Classroom lecturers using blackboard and tracing papers

DETAILED COURSE CONTENT

- **Physics**
  Physical quantities and their measurement - Physical quantities, units and systems of

measurement, dimensional analysis. Measurements and uncertainties. Instrument characteristics of instrument. Analytical and graphical representations. Scalar and vector quantities.

Elements of mechanics and concepts of Biomechanics - Kinematics. Circular and harmonic motion. Momentum. Principles of dynamics. Work. Energy. Power and efficiency. Statics. Elasticity. Physiological statics. Bone fractures.

Basics of fluids and applications in biological systems – Density. Viscosity. Hydrostatic pressure. Fluid statics. Drip. Dynamics of ideal fluids. Bernoulli's theorem. Aneurysm and stenosis. Real liquids. Poiseuille's relation. Hydraulic resistance. Sphygmomanometry.

Waves and radiations – Wave phenomena. Period and frequency. Amplitude and energy. Mechanical waves. Sound. Decibel. Isophonic curves. Phonendoscope. Ultrasonic wavers. Electromagnetic waves. Electromagnetic spectrum. Eye and vision. Radiation for diagnostics and therapy. X ray imaging. Radioisotopes and nuclear medicine. Radiotherapy. Biological effects of ionizing radiation. Introduction to radiation protection dosimetry.

- **Bioinformatics**
  The course is organized into lectures that provide a theoretical basis coupled with exercises for learning the use of bioinformatics tools in the field of medicine.

  PROGRAM

  1. Introduction
  2. Pairwise and Multiple alignment
  3. Biological Databases: General Databases (NCBI, EMBL), Specialized Databases (OMIM, CIVIC, Drugbank, KEGG Pathway)
  4. Tools for the analysis of the transcriptome: Microarray, Next Generation Sequencing, Analysis of the transcriptome: Biomarkers

- **Medical Statistics**
  1. Measurers: numerical, ordinal and nominal

  2. Descriptive measurers: central tendency and variability

  3. Probability and Bayes Theorem

  4. Probability distributions: binomial, Poisson and gaussian

  5. Hypothesis tests and their meaning

  6. Student t test, chi square

  7: Correlation and regression

  8. Epidemiology: sensitivity, specificity, predictive values, incidence and prevalence rates

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TEXTBOOK INFORMATION

- **Physics**

Scannicchio D., Fisica Biomedica, EdiSES, 2013
Davidson R.C., Metodi Matematici per un Corso introduttivo di Fisica - EdiSes, 2013
Lecture notes provided during the course

- **Bioinformatics**
  - Jambeck, Gibas “Developing Bioinformatics Computer Skills", O'Reilly
- **Medical Statistics**
  BIOSTATISTICA

  M. Pagano, K. Gavreau

  Editor: Idelson Gnocchi

  Alternatively

  BIOSTATISTICA

  Wayne W. Daniel, Chad L. Cross

  Edizioni EdiSES