BSc in Physiotherapy

INTEGRADED COURSE TITLE: PHYSICS, STATISTICS AND INFORMATION TECHNOLOGY
NUMBER OF ECTS CREDITS: 8
SSD: FIS/07, INF/01, MED/01, ING-INF/05
MODULE CONVENOR: PROF. ANDREA DIMITRI
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MODULE: APPLIED PHYSICS
NUMBER OF ECTS CREDITS: 2
SSD: FIS/07
PROFESSOR: Alessandra Filabozzi e-mail: alessandra.filabozzi@unicamillus.org

MODULE: INFORMATION TECHNOLOGY
NUMBER OF ECTS CREDITS: 2
SSD: INF/01
PROFESSOR: Andrea Dimitri e-mail: andrea.dimitri@unicamillus.org

MODULE: DATA PROCESSING SYSTEMS
NUMBER OF ECTS CREDITS: 2
SSD: ING-INF/05
PROFESSOR: Andrea Dimitri e-mail: andrea.dimitri@unicamillus.org

MODULE: MEDICAL STATISTICS
NUMBER OF ECTS CREDITS: 2
SSD: MED/01
PROFESSOR: Daniele Di Giovanni e-mail: daniele.digiovanni@unicamillus.org

PREREQUISITES

A prior knowledge (high school level) of basic mathematics, physics and statistics and a confidence in basic IT tools is required.
For Data processing systems module, the knowledge obtained in the Information Technology module is a prerequisite.

LEARNING OBJECTIVES

The IT module aims to provide students with the basic knowledge to understand the essential role of Information Technology (IT) in our society, and specifically in the context of health-related technical professions. In the Data Processing Systems module the attention will be in the understanding of the role of Information Systems and their lifecycle, specifically focusing on database management systems. Data collection and efficient storing is a prerequisite for data analysis. The course aims to provide the student with the necessary statistical bases to set up a research and collect and analyze relationships in data. The student must acquire a correct statistical terminology and be able to understand and interpret a scientific study.

Medical Physics introduces a specific field of application of acquired tools. Aim of the Medical Physics module is to provide students with knowledge on the fundamentals of applied physics necessary to the performance of their future activity. In particular, the comprehension of physical principles at the base of medical physics and of functioning of medical instrumentation will be addressed.
At the end of the course, the students will know the fundamental concepts of application of the Scientific Method to the study of biomedical phenomena (data collection, choice and measure of parameters, evaluation of errors), they will be able to describe physical phenomena of complex systems using suitable mathematical tools, they will know the scientific basis of medical procedures and principles of functioning of the equipment commonly used for diagnostics and therapeutics.

LEARNING OUTCOMES

The specific learning outcomes of the program are coherent with the general provisions of the Bologna Process and the specific provisions of EC Directive 2005/36/EC. They lie within the European Qualifications Framework (Dublin Descriptors) as follows:

Knowledge and Understanding

- *Understand the experimental method and learn the use and transformation of measure units.*
- *Know and understand the proper terminology of physics.*
- *Know and understand the main physical principles and laws concerning kinetics, dynamics, electricity and magnetism, vibration and waves, radiation, balance regulating principles and fluids.*
- *Apply these concepts to biological and physiological phenomena in living organisms.*
- *Identify and recognize the physical principles which govern the function of the specific human organs.*
- *Knowledge of basic statistical tools and ability to understand statistical studies and analysis.*
- *Understand the elements that contribute to define the architecture of an IT system in terms of the relevant hardware and software components.*
- *Understand the elements that contribute to define the architecture of an Information System in terms of the relevant components, with specific application to Database Management Systems*

Applying knowledge and understanding

- *Apply the principles of physics to selected problems and to a variable range of situations.*
- *Use the tools, methodologies, language and conventions of physics to test and communicate ideas and explanations.*
- *Possess the knowledge and skills to use basic statistical tools necessary to describe and analyze data sets.*
- *Use of tools and information languages for data collection and data retrieving*

Communication skills

- Present the topics orally in an organized and consistent manner.
- Utilize a proper scientific language coherent with the topic of discussion.

Making judgements

- Recognize the importance of an in-depth knowledge of the topics consistent with a proper medical education.
- Identify the fundamental role of a proper theoretical knowledge of the topic in the clinical practice.

COURSE SYLLABUS

Syllabus INFORMATION TECHNOLOGY :

- Introduction to IT systems
- Notes on the hardware part of IT systems (CPU, memory, input/output). File system management.
- The system software: operating systems and associate utility programs
- Application software: basic tools for medical practice

Syllabus DATA PROCESSING SYSTEMS :

- Introduction to Information Systems
- Standards and languages (xml, hl7, etc.)
- The lifecycle of Information Systems
- Database and Database Management System (DBMS)

Syllabus MEDICAL STATISTICS:

- Introduction to statistics: randomness and causality
- Observation of reality
- Descriptive statistics and inferential statistics
- Quantitative and qualitative variables
- Absolute, relative and percentage frequency
- Tables, diagrams and graphs
- Statistical indices: measures of central tendency and dispersion
- Central limit theorem
- The normal (Gaussian) curve and its properties
- Statistical inference: null and alternative hypotheses, p-value, statistical association
- Association and causality
- Hypothesis testing and introduction to statistical significance tests
- Correlation
- Univariate and multivariate linear regression
- Differences between proportions: observed and expected values

Syllabus PHYSICS:

Mechanics

Introduction, Measurement, Estimating Measurement and Uncertainty; Significant Figures. Units of measure systems. Converting Units. Dimensions and Dimensional Analysis. (OFA debt lectures)

Describing Motion: Kinematics in One Dimension

References Frames. Displacement. Velocity and Acceleration. Motion at Constant Acceleration. (OFA debt lectures)

Kinematics in Two Dimensions; Vectors

Vectors and Scalars. Addition of Vectors-Graphical Methods. Subtraction of Vectors and Multiplication of a Vector by a Scalar. Adding Vectors by Components.

Dynamics: Newton's Laws of Motion

Force. Newton's First Law of Motion. Mass. Newton's Second Law of Motion. Newton's Third Law of Motion. Weight-The Force of Gravity. The Normal Force. Solving Problems with Newton's Laws: Free-Body Diagrams. Problems Involving Friction, Inclines. Problem Solving : A General Approach.

Circular Motion; Gravitation

Kinematics of Uniform Circular Motion. Dynamics of Uniform Circular Motion. Newton's Law of Universal Gravitation.

Work and Energy

Work Done by a Constant Force. Kinetic Energy and the Kinetic Energy Theorem. Potential Energy. Conservative and Nonconservative Forces. Mechanical Energy and its Conservation. Problem Solving Using Conservation of Mechanical Energy. Other Forms of Energy: Energy Transformations and the Law of Conservation of Energy. Power.

Linear Momentum

Momentum and Its Relation to Force. Conservation of Momentum. Center of Mass (CM). Center of Mass and Translational Motion.

Static Equilibrium; Elasticity and Fracture

The Conditions for Equilibrium. Solving Statics Problems. Applications to Muscles and Joints. Stability and Balance. Elasticity; Stress and Strain. Fracture.

Thermology

Heat as Energy Transfer. Internal Energy. Specific Heat. Calorimetry. Latent Heat. Heat Transfer.

Fluids

Phases of Matter. Density. Pressure in Fluids. Relative Pressure. Pascal's Principle. Measurement of Pressure. Archimede's Principle.

Vibrations and Waves

Wave Motion. Types of Waves: Transverse and Longitudinal. Energy Transported by Waves. Intensity Related to Amplitude and Frequency.

Sound

Characteristics of Sound. Intensity of Sound: Decibels. Doppler Effect.

Electricity and Magnetism

Electric Charge and Electric Field

Static Electricity. Electric Charge and its Conservation. Electric Charge in the Atom. Insulators and Conductors. Induced Charge. Coulomb's Law. Solving Problems Involving Coulomb's Law. The Electric Field. Field Lines. Electric Fields and Conductors.

Electric Potential

Electric Potential Energy and Potential Differences. Relation between Electric Potential and Electric Field. Equipotential Lines. The Electron Volt, a Unit of Energy. Electric Potential Due to Point Charges. Capacitance. Dielectrics. Storage of Electric Energy.

Electric Currents

The Electric Current. Ohm's Laws: Resistance and Resistors. Resistivity. Electric Power.

DC Circuits

The Electromotive Force (EMF). Resistors in Series and in Parallel. Kirchhoff's Laws. Circuits Containing Capacitors in Series and in Parallel. RC Circuits-Resistor and Capacitor in Series.

Electromagnetic Waves

Changing Electric Fields Produce Magnetic Fields; Maxwell's Equations. Production of Electromagnetic Waves (EM). Light as an Electromagnetic Wave and the Electromagnetic Spectrum. Energy in EM Waves. The Wave Nature of Light.

Optical Instruments

X-Rays and X-Ray Diffraction. X-rays and their production. X-rays in medical diagnostics and therapy.

COURSE STRUCTURE

The teaching is structured in 80 hours of frontal teaching on both theoretical and applicative topics, divided into lessons based on the academic calendar. Attendance is compulsory for at least 75% of the hours, added to all the courses of the integrated course.

COURSE GRADE DETERMINATION

Students' learning will be evaluated through a written test in which all the contents covered in the Integrated Course are subject to evaluation.
The verification method includes a questionnaire consisting of multiple choice questions for each of the 4 modules, aimed at assessing both the theoretical knowledge and the student's ability to solve problems.
The test is passed with a vote from 18 to 30, in each module. The final mark will be determined by the average of the marks obtained in each module.
If the sufficiency is not obtained in all the modules, the test is not considered passed.
If the sufficiency is not reached in just one module but at the same time the average on the 4 modules is higher than 18/30, it is possible to take an oral test on the insufficient module. If the oral test gives a positive outcome and the sufficiency is reached, the test is passed, and the average is determined with the new vote.

OPTIONAL ACTIVITIES

If necessary, the students can have an appointment for solving doubts or deepen topics on the teaching program.

RECOMMENDED READING

INFORMATION TECHNOLOGY:
Deborah Morley and Charles S. Parker, *Understanding Computers: Today and Tomorrow (16th edition)* - Cengage Learning

DATA PROCESSING SYSTEMS:
Deborah Morley and Charles S. Parker, *Understanding Computers: Today and Tomorrow (16th edition)* - Cengage Learning

MEDICAL STATISTICS
MATERIALI AUTENTICI DEL DOCENTE (diapositive)
Harvey Motulsky *Biostatistica essenziale – Una guida non matematica*
Casa editrice Piccin Nuova Libraria, Padova
Geoffrey R. Norman, David L. Streiner *Biostatistica. Quello che avreste volute sapere…*
Casa Editrice Ambrosiana, Rozzano (MI)

PHYSICS
D. C. Giancoli, Fisica (principi e applicazioni), Casa Editrice Ambrosiana

D. Halliday, R. Resnik, J. Walker, Fondamenti di Fisica, Casa Editrice Ambrosiana

D. Scannicchio, E. Giroletti - Elementi di Fisica Biomedica - EdiSES
https://www.edisesuniversita.it/default/scannicchio-elementi-di-fisica-biomedica.html