Bachelor's Degree in Biomedical Laboratory Techniques

INTEGRATED TEACHING : MATEMATICAL SCIENCES, PHYSICS, INFORMATIC
SSD : MED/01, FIS/07, NF/01
CFU: 8
RESPONSIBLE : LUCA PAOLO WELTERT
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MODULE : Medical Statistics
SSD : MED/01
Number of CFU : 3
Teacher name : Luca Paolo Weltert E-mail: lucapaolo.weltert@unicamillus.org

MODULO : Medical Physics
SSD : FIS/07
Number of CFU : 3
Teacher name: Iole Indovina E-mail: iole.indovina@unicamillus.org

Module: Computer technology
SSD: INF/01
Number of CFU: 2
Teacher name: Prof. Paolo Bocciarelli E-mail: paolo.bocciarelli@unicamillus.org

FREQUENCY MODALITY: A MINIMUM of 75% OF ATTENDED LESSONS IS REQUIRED

Prerequisites
Although there is no prerequisite, a previous knowledge of basic mathematics and a knowledge of basic computer tools as well as basic physics and statistics at secondary school level are required.

TRAINING GOALS
The Medical Statistics course aims to provide students with the basic notions of physics, statistics and computer science, the purpose of which is teaching the logic of statistical thinking and its application in real practice. The presentation of the topics will be oriented to concrete problems of analysis and research, starting from schematic examples and then confronting real situations taken from the medical literature.
The aim of the integrated course of Mathematical, Physical and Computer Science (Medical Physics, Medical Statistics and Computer Science) is to provide students with the knowledge on the foundations of applied physics necessary for the performance of their future activity, the principles of information technology and the principles of physical, applied to their professional profile. In particular, the understanding of the physical principles underlying medical physics and the functioning of medical instrumentation will be addressed.

At the end of the course, students will know the fundamental concepts of application of the scientific method to the study of biomedical phenomena (choice and measurement of parameters, evaluation of errors), they will be able to describe the physical phenomena of complex systems using appropriate mathematical tools, they will know the scientific

bases of medical procedures and the operating principles of the equipment commonly used for diagnostics and therapy, as well as to provide the student with the skills necessary to understand the key role that Information Technology (IT) plays for today's society and, in in particular, within the technical-health professions.

EXPECTED LEARNING RESULTS

The expected learning outcomes are consistent with the general provisions of the Bologna Process and the specific provisions of the 2005/36/EC Directive. They are located within the European Qualifications Framework (Dublin descriptors) as follows:

Knowledge and understanding

At the end of this course the student will have to know:

- o Understand the statistical tools needed to describe and analyze a data table
- o Understand the theoretical basis for extracting useful information from the data and making informed decisions
- o Know and memorize the most popular contemporary software suites
- o Know and understand firsthand the descriptive differential statistics
- o Know and understand first-hand the inferential inferential statistics
- o Compensate and apply the regression methods
- o Know the methods of control of confusion a posteriori
- o Know and describe the types of longitudinal statistical study and their implementation
- o Have understood the experimental method and have acquired the rigor in the use and transformations of the units of measurement.
- o Know and correctly understand the terminology of physics.
- o Know the fundamental principles and laws of physics concerning kinematics, dynamics, electricity and magnetism, vibrations and waves, radiation, nuclear physics and fluids.
- o Know and understand the concepts of biological and physiological phenomena in living organisms.
- o Know and understand the physical principles that regulate the function of specific human organs.
- o Basic knowledge of the characteristics of modern IT systems
- o Knowledge of the main applications of IT systems
- o Knowledge of the elements that contribute to defining the architecture of an IT system in terms of the related hardware and software components that compose them
- o Know the difference between basic software and application software
- o Know and know how to apply the use of software to specify the actions that a computer must perform
- o Know the social impact of computers and IT technologies.

Ability to apply knowledge and understanding

At the end of the course, the student will be able to:

- o Apply the knowledge acquired for the autonomous deepening of aspects related to the specific field to which the student will dedicate himself in the professional activity;
- o Particular emphasis will be given to statistical reasoning, interpretation and

decision-making, to this end more emphasis will be placed on conceptual understanding than mechanical calculation, also in light of the wide choice of software available for analysis
o Apply the principles of physics to selected problems and to a variable range of situations.
o Use the tools, methodologies, language and conventions of physics to test and communicate ideas and explanations.
or how to apply the knowledge and technologies learned during the course to real application contexts

Communication skills
At the end of the lesson, the student will need to know:

- Use specific scientific terminology appropriately.
- Understand methodological statements about computational paragraphs in scientific publications
- Expose topics orally in an organized and consistent manner.
- Use of a proper scientific language and conforms with the topic of discussion.
- how to appropriately use commonly used terminology in the IT world

Autonomy of judgment
At the end of the course, the student must know:
o Use specific scientific terminology appropriately.
o Understand the methodological declarations relating to the calculation paragraphs present in scientific publications
o Orally present the topics in an organized and coherent way.
o Use of adequate scientific language that conforms to the topic of the discussion.
or how to properly use the terminology commonly adopted in the IT world

<u>These expected learning outcomes are measurable with the final assessment</u>

PROGRAM

<u>Medical statistics</u>
The first part of the medical statistics module will introduce the logic of statistics and experimental design.
The concepts of probability and combinatorics will be introduced or recalled which, although in theory already in the possession of the student, are fundamental and will be useful in the following course. In this phase we will deal with the main probability distributions including the binomial distribution, the Poisson distribution and the Normal and Normal standard distributions, but even more than the single mathematical process we will want to transfer to the student the deep motivation for the existence of medical statistics in how much science and its application, as well as the risks of its incorrect understanding.
In the second part of the module the descriptive statistics and its methodology will be addressed. It will be shown how to recognize the type of data and how to summarize it in appropriate indices.

The student will learn how to calculate the measures of position (average, median, fashion), variability (variance, standard deviation), the coefficient of variation (CV), the percentiles and their use. SI will also make extensive use of practical examples to define good descriptive statistics and poor or misleading statistics.
In the final part of the course the general principles of statistical inference will be discussed.
Concepts of sample distribution, type I and type II error, test power and operating curve will be introduced.
We will therefore treat:
Parametric tests - Student's t test, ANOVA with 1 and 2 classification criteria.
nonparametric tests: - Wilcoxon test, Mann-Whitney test, Kruskal-Wallis test, Friedman test, median test, chi-square test, Fisher exact test. The basic concepts of regression and the analysis of time dependent variables will also be provided with a reference to Kaplann Meyer's functions, log rank and Cox regression.

Medical physics

Mechanical

Chapter 1: Introduction, Measurement, Estimate
1.4: Measurement and Uncertainty; Significant digits
1.5: Units, standards, and SI
1.6 units: Unit conversion
1.8: Size and size analysis
Chapter 2: Description of Motion: Cinematic in a Size
2.1: Reference Systems and Displacement
2.2: Average Speed
2.3: Instant Speed
2.4: Acceleration
2.5: Motion at Constant SpeedChapter
3: Cinematic in Two Dimensions; Vectors
3.1: Vectors and Scalers
3.2: Sum of Vectors - Graphic Methods
3.3: Subtracting Vectors and Multiplying a Vector with a Scale
3.4: Sum of Vectors for ComponentsChapter
4: Dynamics: Newton's Laws of Motion
4.1: Force
4.2:Newton'sPri m. Law of Motion
4.3: Mass
4.4: Newton's Second Law of Motion
4.5: Newton 4.6's Third Law of Motion:
Weight: Gravity; And the Normal Force
4.7: Troubleshooting with Newton's Laws: Freebody Diagrams
4.8: Problemi InvolvingFriction, Inclinations
4.9: Troubleshooting: A General ApproachChapter
5: Circular Motion; Gravity
5.1: Uniform Circular Motion Mechanics
5.2: Uniform Circular Motion Dynamics
5.6: Newton's Law ofUniversalGravity
Chapter 6: Work and Energy

6.1: Work Done by a Constant Force
6.3: Kinetic Energy and Work Energy Principle
6.4: Potential Energy
6.5: Conservative and Non Conservative Forces
6.6: Mechanical Energy and Its Preservation
6.7: Troubleshooting Using Mechanical
Energy Conservation6.8: Other Forms of Energy: Energy Transformations and Energy Conservation Law
6.10: PowerChapter
7: Linear Moment
7.1: Moment and Its Relationship withF.2:
Moment Storage
7.8: Center of Mass (CM)
7.10: Center of Mass and Translatory MotionChapter
9: Static Balance; Elasticity and Fracture
9.1: Conditions for Balance
9.2: Statica
Troubleshooting 9.3: Applications on Muscles and Joints
9.4: Stability and Balance
9.5: Elasticity; Stress and Tension
9.6:

Thermodynamic
Fracture Chapter13: Temperature and Kinetic Theory
13.1: Atomic Theory of Matter
13.2: Temperature and Thermometers
13.3: Balanceand Zeroth Lawof Thermodynamics
13.4: Thermal Expansion
13.6: The Laws of Gas and Absolute Temperature
13.7: The Ideal Gas Law
13.8: Troubleshooting with the Ideal Gas LawChapter
14: Heat
14.1 Heat as EnergyTransfer
14.2 Internal Energy
14.3: Specific Heat
14.4: Calorimetry
14.5: Latent Heat
14.6: Heat Transfer: Conduction
14.7: Convection
14.8: Heat Transfer: RadiationChapter
15: The Laws oftheAmicic
Heat 15.1: The First Law of Thermodynamics
15.2: Thermodynamic Processes and the First Law

Fluids
Chapter 10: Fluids
10.1: Stages of Matter

10.2: Specific Density and Severity
10.3: Pressure in Fluids
10.4: Pressure relative to Atmospheric Pressure
10.5: Pascal Principle
10.6: Pressure Measurement; Calibri and barometer
10.7: Float and Principle of Archimedes

Vibrations and Waves Chapter
11: Vibrations and Waves
11.7: Wave Motion
11.8: Wave Types: Transverse and Long-Wave
11.9: Energy Carried by Waves
11:10: Intensity relative to amplitude and frequencyChapter
12: Sound 12-1Sound characteristics
12-2 Sound intensity: decibels
12-7 Effect Doppler

Electricity and Magnetism
Chapter 16: Charge ele

16.1: static electricity; Electric charge and its storage
16.2: Electric charge in atom
16.3: insulators and conductors
16.4: Induced charge; The electroscope
16.5: Coulomb Law
16.6: Troubleshooting orCoulomb's Law and Carriers
16.7: The Electric Field
16.8: Field Lines
16.9: Electrical Fields and ConductorsChapter
17: Electrical Potential
17.1: Electricity Potential and Potential Differences
17.2: Ratio between electric potential and electric field
17.3: Equipotential lines
17.4: The Electronvolt, an energy unit
17.5: Electrical potential due to punctual charges
17.7: Capacity
17.8: Dielectric
17.9: Electricity storageChapter
18: Electrical currents
18.1: Lelectricbattery
18.2: Electricity
18.3: Ohm's Law: Resistance and Resistors
18.4: Resistance
18.5: ElectricityChapter
19: DC Circuits
19.1: EMF and Terminal Tension

19.2: Resistance shards in series and parallel
19.3: Kirchhoff
Rules19.4: EMF in series and in parallel; Battery Charge
19.5: Circuits containing capacitors in series and parallel
19.6: RC-Resistor and capacitor circuits in seriesChapter
20: Magnetism
20.1: Magnets and magnetic fields
20.2: Electric current produces magnetic fields
20.3: Force on an electric current in a magnetic field: definition of B
20.4: Force on an electric charge that moves in a magnetic field
20.5 magnetic due to a long and straight cable
20.8: Law of Ampere
Capitothe 21: Electromagnetic Induction and Faraday Law
21.1: EMF induced
21.2: Faraday Induction Law; LenzLaw
21.3: EMF induced in a mobile conductor
21.4: The change of magnetic flow produces an electric fieldChapter
22: Electric waves
22.1: the change of electric fields produces magnetic fields; Maxwell Equations
22.2: Electromagnetic Wave Production
22.3: Light as an Electromagnetic Wave and Electromagnetic Spectrum
22.5: Energy in Waves EM
Chapter 24: TheWave Nature ofLight
24.4: Visible Spectrum and Scatter Chapter
25: Optical Instruments
25-11: X-Rays and X-Ray Diffraction
25-12: X-ray Imaging and Tomography.

Technology

- Introduction to IT systems
- IT system hardware (CPU, memory, Input/Output)
- IT system software: system software (operating system and utilities), application software (word processing, spreadsheets, databases, etc.)

TEACHING MODE

The Medical Statistics module is structured in 30 hours of frontal teaching, divided into lessons of 2 or 4 hours according to the academic calendar. The frontal teaching includes frontal theoretical lessons, exercises and integrative seminars on the topics covered.
During the lectures the topics contained in the module program will be illustrated and commented. At the end of the theory relating to each topic, exercises will follow that will illustrate its application in practice. The procedure and step-by-step execution of the necessary calculations will be described. It will also show both the manual development and, in the most advanced phase of the course, the solution obtained through the use of special software, with particular reference to the MedCalc suite and to SPSS v22.0 (IBM Corp). In order to place what has been learned in each lesson in the scientific context and verify its practical usefulness, each lesson will be concluded by reading scientific

articles with particular attention to the statistical part and its relative importance in the study design.

Medical physics The module is structured in 30 hours of frontal teaching with practical exercises, divided into 2-hour lessons according to the academic calendar. Preliminary to the course, a recovery of the mathematical concepts and skills which are indispensable prerequisites for a successful course of the Integrated Course is carried out.

Information technology: the module is structured in 20 hours of frontal teaching and provides lectures on both theoretical and application topics, with reference to real case studies.

HOW LEARNING IS VERIFIED

The exam of the Integrated course of Mathematical, Physical and Computer Science (Medical Physics, Medical Statistics and Computer Science) consists of a PHYSICS assessment test, a STATISTICS assessment test, and an COMPUTER SCIENCE whose marks are an integral part of the assessment of integrated teaching.
The student can take the PHYSICS, STATISTICS or INFORMATICS test in a single session or in different sessions of the current academic year according to the methods listed below.

EVALUATION EVALUATION OF MEDICAL STATISTICS
The assessment of the achievement of the objectives set by the module requires a written test, consisting mainly of open-ended questions on topics covered in the course. In this way, the student's knowledge and understanding of both the theoretical principles and their consequences in the medical and biological field will be ascertained. The written test will also include the resolution of one or more problems, to verify the achievement of the objective of the ability to apply the knowledge acquired to a simulated situation of biological or medical interest. The collegial evaluation of the works will attribute the same weight to the answers to the open-ended questions and to the proposed problems. During the delivery of the papers and transcription of the mark, the student will be given the faculty, if there are doubts, to further externalize his knowledge in addition to the written test. The evaluation is expressed in thirtieths and the result will be communicated to the student after the correction of the task. In the evaluation, knowledge and comprehension skills have a weight equal to 40%, applied knowledge and comprehension skills of 40% and judgment autonomy of 20%

PHYSICAL ASSESSMENT TEST: The Physics test consists of a compulsory written test and an optional oral test. The written and oral tests are aimed at evaluating both the theoretical knowledge and the student's ability to solve problems. The written test consists of 15 multiple choice questions. Each correct answer gets a score of 2/30, while there is no penalty for the wrong answers. Only students who have obtained a written test of at least 12/30 are admitted to the oral exam.
Mark less than 12 in the written test: the writing must be repeated in a subsequent appeal.
Mark from 12 to 16 in the written test: the student must necessarily take the oral test.
Mark from 18 to 30L in the written test: the student can optionally take the oral test.
The exam mark, expressed in thirtieths, is established according to the following criteria:
Not suitable: important shortcomings and / or inaccuracy in the knowledge and

understanding of the topics; limited analysis and synthesis skills, frequent generalizations.
18-20: Knowledge and understanding of the subjects just enough.
21-23: Knowledge and understanding of discreet topics.
24-26: Good knowledge and understanding of the topics.
27-29: Full knowledge and understanding of the topics.
30-30L: Excellent level of knowledge and understanding of the topics.
In the evaluation, knowledge and comprehension skills have a weight equal to 40%, applied knowledge and comprehension skills of 40% and judgment autonomy of 20%

COMPUTER SCIENCE: The acquisition of the expected learning outcomes will be ascertained through classroom tests (which will provide the teacher with a first assessment) and through the written exam test, based on closed and open-ended tests. All the contents covered in the teaching are subject to evaluation. The evaluation is expressed in thirtieths and the result will be communicated to the student after the correction of the task. In the evaluation, knowledge and comprehension skills have a weight equal to 40%, applied knowledge and comprehension skills of 40% and judgment autonomy of 20%

In the final assessment, the weighted average of the teaching modules will be made

SUPPORT ACTIVITIES

MEDICAL STATISTICS: Practical supplementary teaching activity, with seminars and work exercises on statistical software will be communicated and planned during the course.
MEDICAL PHYSICS: The elective teaching activities chosen by the student are offered in the Integrated Course and include Seminars, Research Internships, Department Internships and Monographic Courses. The topics of the A.D.E. they are not subject to examination. The acquisition of the hours attributed to A.D.E. it only happens with a mandatory frequency of 100%.
COMPUTER SCIENCE: No support activities are foreseen.

RECOMMENDED TEXTS AND BIBLIOGRAPHY

MEDICAL STATISTICS
1) Notes from the lessons
2) Stanton A. Glantz: Statistics for Bio-medical disciplines - ed. McGraw-Hill
3) Sidney Siegel, N. John Castellan Jr.: - Non parametric statistics - ed. McGraw-Hill
4) Resources and links from the Internet with particular reference to the use of the PubMEd portal.

MEDICAL PHYSICS
Douglas C. Giancoli "PHYSICS: Principles with applications" Third edition or later, Ambrosiana publishing house.
The textbooks shown are for reference only. Students are allowed to adopt the book (s) of their choice. Additional material will be provided by the instructor.

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

RESPONSABILE RESORITY
The student reception takes place by appointment by writing or phoning the following contact details:
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