# UNIVERSITÀ DEGLI STUDI DI PALERMO

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| **DEPARTMENT** | Biomedicina, Neuroscienze e Diagnostica avanzata |
| **ACADEMIC YEAR** | 2018/2019 |
| **BACHELOR'S DEGREE (BSC)** | MEDICAL AND IMAGE DIAGNOSTICS AND RADIOTHERAPY TECHNIQUES |
| **INTEGRATED COURSE** | STATISTICS, IMAGE PROCESSING AND FILING, PHYSICS - INTEGRATED COURSE |
| **CODE** | 13580 |
| **MODULES** | Yes |
| **NUMBER OF MODULES** | 3 |
| **SCIENTIFIC SECTOR(S)** | MED/01, ING-INF/05, FIS/07 |
| **HEAD PROFESSOR(S)** | CUPANE ANTONIO Professore Ordinario Univ. di PALERMO |
| **OTHER PROFESSOR(S)** | VITABILE SALVATORE Professore Ordinario Univ. di PALERMO<br>CUPANE ANTONIO Professore Ordinario Univ. di PALERMO<br>MATRANGA DOMENICA Professore Ordinario Univ. di PALERMO |
| **CREDITS** | 9 |
| **PROPAEDEUTICAL SUBJECTS** | |
| **MUTUALIZATION** | |
| **YEAR** | 1 |
| **TERM (SEMESTER)** | 1° semester |
| **ATTENDANCE** | Mandatory |
| **EVALUATION** | Out of 30 |
| **TEACHER OFFICE HOURS** | **CUPANE ANTONIO**<br>Tuesday 16:00 18:00 Via Archirafi 36 - Studio del docente<br>Wednesday 17:00 19:00 Via Archirafi 36 - Studio del docente<br>**MATRANGA DOMENICA**<br>Friday 12:00 13:30 Stanza della docente, Dipartimento di Promozione della Salute, Materno-Infantile, Medicina interna e specialistica di eccellenza "G. D'Alessandro", Via del Vespro, 133, piano terra<br>**VITABILE SALVATORE**<br>Monday 16:30 18:30 Piattaforma Microsoft Teams, Dipartimento di Biomedicina, Neuroscienze e Diagnostica avanzata, Plesso di Radiologia – 1° piano, Stanza n. 108. |

**DOCENTE:** Prof. ANTONIO CUPANE

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| **PREREQUISITES** | Basic mathematics; algebraic equations. Logarithms; elements of trigonometry. Cartesian coordinates. Graphical representation. |
| **LEARNING OUTCOMES** | Knowledge and understanding.<br>Students will be able to understand the basic concepts underlying the information/communication technologies that act as a support to diagnostic procedures. The working principles of hardware, software and network informatic systems will be exposed, with particular emphasis to Radiology Information Systems (RIS) and Picture Archiving and Communication System (PACS). In this respect, the student will have a general knowledge and understanding of the techinques commonly used for incresing the quality of digital radiological images. Students will also be able to understand the basic concepts of general physics underlying the often very sophisticated instruments used in medical diagnostics and radiotherapy. Examples are the mechanics of point material bodies, fluid mechanics, thermology and basic thermodynamics, as well as basic concepts of electricity, magnetism and electromagnetic fields. Students will also be able to understand the basic principles of statistics and its use in the field of radiology, with particular emphasis on treatment and statistical analysis of data, probability theory, statistical sampling and elements of inferential statistics.<br>Applying knowledge and understanding<br>Students will be able to use simple informatic systems, typically RIS and PACS. They will also acquire specific technical knowledge to perform simple manipulations (e.g. the scale of greys) to improve the quality of radiological images. Students will apply the general physics knowledge to improve their understanding of the physical principles underlying the instruments and physical techniques used in medical school. They will also be able to perform statistical analysis of the data and to interpret the results obtained.<br>Making judgements<br>The student is expected to be able to study and work independently, with particular attention to the interdisciplinary aspects of knowledge<br>Communication skills<br>Ability to expose what they have learned in a written, oral or multimedial way. Ability to communicate with experts in near fields. The student is expected to gain the communication methodology typical of the scientific/experimental approach in the fields of general physics, informatics, medical statistics.<br>Learning skills<br>The student will be able to study in an autonomous wayan to apply the knowledge acquired to globally improve its professional standard; he is expected to read scientific publications typical of the medical field.<br>The general physics modulus will provide the student with basic concepts essential in the fields of medical physics and radioprotection (physics of ionizing radiation and medical imaging).<br>The statistics modulus will give basic knowledge essential to understand probability, statistical sampling, statistical inference with applications in radiology. |
| **ASSESSMENT METHODS** | Written and/or oral examination. The numerical evaluation of the integrated course will be calculated as the average of the scores obtained by the student in the single moduli. Scores will be ranked as follows: 18-23: sufficient; 24-26: good; 27-30: excellent; 30 cum laude: brilliant. |
| **TEACHING METHODS** | Lectures, exercises, practical |

**MODULE**
**GENERAL PHYSICS**

*Prof. ANTONIO CUPANE*

**SUGGESTED BIBLIOGRAPHY**

D. Scannicchio, “Fisica biomedica”, EdiSES S.r.l., Napoli, 2008, ISBN 9788879594769 (http://www.edises.it).
E. Ragozzino, "Principi di Fisica" EdiSES, Napoli, 2007, ISBN 979-88-7959-378-6
Jewett & Serway, "Principi di Fisica", EdiSES, Napoli, 2006, ISBN 978-88-7959-419-6

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| **AMBIT** | 10337-Scienze propedeutiche |
| **INDIVIDUAL STUDY (Hrs)** | 45 |
| **COURSE ACTIVITY (Hrs)** | 30 |

**EDUCATIONAL OBJECTIVES OF THE MODULE**

THIS MODULE PROVIDES STUDENTS WITH FUNDAMENTAL BASIC CONCEPTS OF PHYSICS. TYPICAL TOPICS COVER KINEMATICS, DYNAMICS, ENERGY, OPTICS, ELECTRICITY, ELECTROMAGNETICS, THERMAL PHYSICS AND FLUID MECHANICS. THE MODULE ALSO AIMS TO ENHANCE THE UNDERSTANDING OF APPLIED PHYSICS IN BIOMEDICAL ENVIRONMENT, WHICH SERVES AS THE BASIS FOR APPLIED PHYSICS MODULE.

## SYLLABUS

| Hrs | Frontal teaching |
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| 3 | Physical quantities. Scalars and vectors. Dimensional analysis; orders of magnitude. The cortesian coordinates. Kinematics. |
| 3 | Dynamics of the material point body. Newton laws. Momentum. Energy; kinetic energy, potential energy. Energy conservation; energy transfer. |
| 4 | Fluids dynamics: pressure, Archimede's principle, continuity equation, Bernouilli's theorem. Real fluids; viscosity. |
| 4 | Thermology and thermodynamics. temperature and internal energy. Heat exchanges. First and second principles of thermodynamics. Internal energy, entropy, free energy. |
| 4 | Electrostatics: electrical forces, Coulomb law, electrical field, electrical potential. Conductors and insulators. Capacity. electrical current and electrical circuits. Kirchoff laws. |
| 5 | Magnetism: Lorentz force and the magnetic field. Ampere's theorem. Varying magnetic fields and electromagnetism: Faraday's law of induction. Self induction, mutual induction. Displacement current; Maxwell's equations: propagation of electromagnetic fields. |
| 5 | Oscillations; harmonic motion. The concepts of amplitude, frequency and phase. Mechanical waves; electromagnetic waves. Light. Geometrical optics (mention). The microscope. Intefference and diffraction (mention). |

| Hrs | Practice |
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| 2 | Introduction to medical Physics. Discussion and solution of simple problems. |

## MODULE
## IMAGE PROCESSING AND FILING SYSTEMS

*Prof. SALVATORE VITABILE*

**SUGGESTED BIBLIOGRAPHY**

D. Sciuto, G. Buonanno, L. Mari; Introduzione ai sistemi informatici, 5/ed, McGraw-Hill.
R.C. Gonzalez, R.E. Woods; Elaborazione delle Immagini Digitali, 3/ed., Prentice Hall.
Dispense integrative e lucidi curati dal docente.

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| **AMBIT** | 10353-Scienze interdisciplinari |
| **INDIVIDUAL STUDY (Hrs)** | 45 |
| **COURSE ACTIVITY (Hrs)** | 30 |

**EDUCATIONAL OBJECTIVES OF THE MODULE**

The course aims at providing basic knowledge associated to the Information and Communication Technology, as a useful support for medical imaging. The course offers an introduction to computer systems, analysing the related basic operating principles of its infrastructures: the hardware, the software, and the network infrastructures. Further details will be provided on RIS (Radiology Information System) and PACS (Picture Archiving and Communication System). The course will also introduce the concept of digital image, the impact of spatial and grey level resolution on its quality, and it will present the common used techniques for medical image filtering and quality enhancement.

## SYLLABUS

| Hrs | Frontal teaching |
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| 3 | Course introduction; Information representation and processing. |
| 5 | Hardware Infrastructure: introduction to computer architetture; central processing unit; memory systems; I/O devices. |
| 3 | Software Infrastructure: features and purposes of an operating system; major components of an operating system. |
| 3 | Network Infrastructure: data and information transmission; computer networks; a brief introduction to TCP/IP. |
| 2 | RIS (Radiology Information System) and PACS (Picture Archiving and Communication System). |
| 2 | DICOM and HL7 standards. |
| 3 | Digital Images. |
| 3 | Digital Image representation. |
| 2 | The impact of spatial and grey level resolution on digital image quality. |
| 4 | Digital image processing techniques. |

**MODULE**
**MEDICAL STATISTICS**

*Prof.ssa DOMENICA MATRANGA*

| **SUGGESTED BIBLIOGRAPHY** | |
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| Libro di testo<br>Triola MM Triola MF, Statistica per le discipline biosanitarie, Pearson | |
| **AMBIT** | 10337-Scienze propedeutiche |
| **INDIVIDUAL STUDY (Hrs)** | 45 |
| **COURSE ACTIVITY (Hrs)** | 30 |
| **EDUCATIONAL OBJECTIVES OF THE MODULE** | |
| The course is aimed to introduce the statistical methodology useful to the skills of the health professional. Students will be introduced to the elementary concepts of descriptive statistics, probability calculation and measurement of accuracy of diagnostic tests. | |

## SYLLABUS

| Hrs | Frontal teaching |
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| 3 | Sources of health data |
| 2 | Basic concepts: qualitative and quantitative characters, discrete and continuous characters, scales of measurement: nominal, ordinal, intervals and ratio |
| 2 | Data presentation: frequency and quantity distributions. Graphical representations |
| 4 | Measures of mean and variability with exercises |
| 4 | Elements of probability theory. Bayes Theorem. Measures of accuracy of diagnostic tests. Roc Curves |
| 3 | Theoretical distributions: Gauss and Binomial distribution, with exercises |
| 2 | Central Limit Theorem. Sample distributions of sample mean, with exercises |
| 2 | Statistical estimate of the mean |
| 2 | Statistical tests of significance for the mean |

| Hrs | Practice |
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| 2 | Practice on the use of health databases |
| 4 | Practice on preparation of tables and graphics to describe and summarize data |