Course Degree Nursing

Teaching: BIOLOGY, APPLIED PHYSICS, BIOCHEMISTRY
SSD: BIO/13, BIO/09, BIO/10, MED/03
CFU: 4
Director: Laura Pacini
Email: laura.pacini@unicamillus.org office hours (by appointment): tuesday from 15 to 16

Module: APPLIED BIOLOGY
SSD Course: BIO/13
CFU: 1
Professor's name: Laura Pacini
Email: laura.pacini@unicamillus.org

Module: BIOPHYSICS
SSD: BIO/09
CFU : 1
Professor's name : Eleonora Nicolai
Email : eleonora.nicolai@unicamillus.org office hours (by appointment): tuesday from 15 to 16

Module: BIOCHEMISTRY
SSD Course: BIO/10
CFU: 1
Professor's name: Barbara Tavazzi
Email: barbara.tavazzi@unicamillus.org office hours (by appointment): tuesday from 15 to 16

Module: MEDICAL GENETICS;
SSD Course: MED/03
CFU: 1
Professor's name: Maria Rosaria D'Apice
Email: mariarosaria.dapice@unicamillus.org office hours (by appointment): tuesday from 15 to 16

PREREQUISITES
Knowledge and competence in Basic Mathematichs, Physics and Statistics at High School level, appropriate knowledge of the basic concepts of chemistry, including: chemical bonds, properties of solutions, acids, bases, buffers.
There are no prerequisites, but it would be desirable if the student already knows basic biology elements, such as the characteristics of living organisms.

LEARNING OBJECTIVES
Aim of the teaching 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 (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

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know the scientific basis of medical procedures and principles of functioning of the equipment commonly used for diagnostics and therapeutics.
Students will learn knowledge on the structure, function and regulation of biological macromolecules (carbohydrates, lipids, amino acids and proteins). To acquire basic knowledge on the main metabolic pathways and cycles with particular regard to carbohydrate, lipid and amino acid metabolism.
Students will learn with knowledge based on inheritance of monogenic, chromosomal and multifactorial diseases.
At the end of the course the student will be able to distinguish the main classes of genetic diseases and to recognize the modes of transmission of hereditary diseases.
Students will learn knowledge related to the physiological and morphological characteristics of cells, as functional units of living organisms.
Another important goal is to use the scientific method to understand the biological mechanisms that regulate life and as a tool for the study of pathological processes.

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 electricity, vibration and waves, radiationheat 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 the basic information on the structure and function of the main biological macromolecules
- Knowledge of the basic principles of enzymatic catalysis
- Knowledge of the different metabolic pathways of eukaryotic cells
- Knowledge of the role of different "fuels" in energy production
- Knowledge of the biosynthetic pathways of some molecules of biochemical interest
- The approaches and tools to study the cell
- Describe bacteria and viruses.
- Know the differences between prokaryotic and eukaryotic cell
- Know the structure and function of biological membranes
- Characteristic of bacteria and viruses
- Cellular compartments and intracellular organelles.
- Physiology of the cell, the movement of molecules, passive transport, active transport, endocytosis (phagocytosis and pinocytosis) and exocytosis.
- The nucleic acids. DNA and RNA. Transcription and translation. Regulation of gene expression.
- The cell cycle
- Knowledge of correct genetic terminology
- Knowledge of the main inheritance models of monogenic, chromosomal and multifactorial diseases
- Knowledge of the main biological mechanisms that cause hereditary diseases
- Understanding of how to reconstruct family pedigrees and to calculate disease recurrence

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- Understanding of the major kinds of genetic testing and their proper use

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.
- Adequately interpret the importance of biochemical processes alterations, as a cause of various pathological conditions.
- Use the acquired knowledge for an in-depth study of aspects related to his future professional activity.
- Capacity to analyse family history and reconstruct pedigrees
- Ability to calculate disease recurrence risk
- Use the acquired knowledge to understand the biological phenomena that regulate life and pathological processes.

Communication Skills

- Present the topics verbally in an organized and consistent manner.
- Utilize a proper scientific language coherent with the topic of discussion.
- Communicate scientific contents in a clear and unambiguous way, using appropriate technical language.
- Use of correct genetic terminology
- Ability to describe the main models of inheritance and the recurrence risk

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.
- Carry out assessments of the topics covered.
- Ability to synthesize and correlate the various topics
- Critical ability on the use of genetic tests for the molecular diagnosis of monogenic and chromosomal diseases or for the evaluation of genetic susceptibility to complex diseases
- Make assessments, when related to the covered topics

COURSES SYLLABUS

APPLIED BIOLOGY

- Characteristics of living organisms, levels of organization and classification principles.
- Macromolecules structure, shape and function: carbohydrates, lipids, proteins and nucleic acids.
- The cell as the basic unit of life, Cell Theory. Prokaryotic and eukaryotic cells.
- Structure and function of the eukaryotic cell: plasma membrane, cytoplasm, ribosomes, smooth and rough endoplasmic reticulum, Golgi apparatus, lysosomes, peroxisomes, cytoskeleton.
- Relationship between energy conversion processes and cellular structures, mitochondria and chloroplasts (notes).
- Nucleus. Nuclear envelope, nucleoli, chromatin and chromosomes.
- Molecular bases of hereditary information. DNA structure and function.
- Gene expression: transcription and maturation of transcripts.

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- Genetic code and translation. Main post-translational modifications and post-synthetic fate of proteins.
- Endomembranes and vesicular trafficking. Exocytosis and Endocytosis.
- Cell cycle, Mitosis and meiosis.

APPLIED PHYSICS

- Fundamental and derived physical quantities
- Dimensional equations
- Scientific Notation
- Orders of Greatness
- Scalar and vector quantities
- Vectors

Mechanics

- *Kinematics*
- Uniform rectilinear motion
- Rectilinear motion uniformly accelerated
- Graphic representation of the motions
- Uniform circular motion

Dynamics

- Fundamental forces
- Principles of dynamics: Newton's I, II, III law
- Translational equilibrium
- Inertial and non-inertial reference systems
- Inertial mass concept
- Gravitational force
- Strength weight
- Normal force to the supporting surface
- Tension of a rope
- Frictional force
- Centripetal Force / Centrifugal Force
- Electrostatic force
- Elastic force
- Work of a force
- Power
- Kinetic and potential energy
- Kinetic energy theorem
- Potential energy theorem
- Conservative and non-conservative forces
- Principle of conservation of mechanical energy
- Definition of yield

Static

- Moment of a force with respect to a point
- Rotational balance
- Stable, unstable, indifferent equilibrium
- Simple machines: levers and pulleys

CALORIMETRY

- Physical quantities that characterize a thermodynamic system: pressure, volume, temperature
- Thermometric scales
- Heat
- Phase transitions
- Ideal gas law

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- Thermal expansion
- Latent heat
- Heat transfer

FLUIDS

- *Hydrostatic*
- Pressure
- Pascal's principle
- Stevino's law
- Archimedes' principle

Hydrodynamics

- Law of continuity
- Bernoulli's theorem
- Venturi effect
- Poiseuille equation

ELECTROSTATICS

- Coulomb's force
- Electric field
- Electric potential
- Electric current
- Ohm's Laws
- Elementary electrical circuit: resistors in series and in parallel

BIOCHEMISTRY

- Short summary of basic concepts of inorganic and organic chemistry - Chemical bonds, osmotic pressure, pH, buffers. The constituents of biological macromolecules: carbohydrates, lipids, purines, pyrimidines, nucleosides, nucleotides, amino acids. Proteins structure and function. Hemoproteins and gas transport (O_2, CO_2). Coenzymes and vitamins. Enzymes. Introduction to metabolism. Catabolism and anabolism. Glucose catabolism: glycolysis and the Kreb's cycle. Catabolism of fatty acids. The mitochondrion as the power plant of the cell: oxidative phosphorylation. Hormonal control of glucose metabolism. Insulin and glucagon: glycogenolysis, glycogen synthesis, gluconeogenesis and lipolysis. Fasting, diabetes and ketogenesis. Biosynthesis of fatty acids and phospholipids. Cholesterol metabolism. Amino acid metabolism and urea cycle in brief.

MEDICAL GENETICS

- Basic Genetics: Definitions of Key Terms: gene, locus, allele, genotype, phenotype, haplotype, homozygous, heterozygous, haploid, diploid, dominance, recessivity, mutation, polymorphism.
- Principles of Genetic Transmission: Segregation in Human Pedigrees.
- Monogenic Inheritance Models: Autosomal inheritance, Autosomal recessive inheritance, X-linked inheritance
- Genetic Risk calculation and pedigrees
- Chromosomes: Structure and Analysis, Chromosomes Pathologies
- Genomic Imprinting
- X-chromosome inactivation
- Mitochondrial inheritance: mitochondrial DNA, pattern of inheritance
- Multifactorial inheritance: polymorphisms, susceptibility genes, gene-environment interaction, association studies
- Pharmacogenomics and Personalised Medicine
- Genetic tests and Counselling

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COURSE STRUCTURE

- The module of Applied Biology is structured in 14 hours of frontal teaching, divided into 2-hour lessons based on the academic calendar.
- The module of Biophysics consists of 14 hours of frontal teaching, divided into 2-hour lessons based on the academic calendar. Attendance is mandatory for at least 75% of the hours, added to all the courses of the integrated course. Before the course, there will be preliminary lessons necessary to the recovery of the mathematical concepts and skills that are necessary prerequisites for a successful development of the Integrated Course.
- The module of Biochemistry is structured in 14 hours of frontal teaching, divided into 1 or 2 hour lessons basing on the academic calendar. Lectures will include theoretical lessons on the topics of the program.
- The module of Medical Genetics is structured in 1 CFU with 14 hours of frontal lessons. Lectures will include theoretical lessons with power-point presentations and exercises (both in groups and alone). **The attendance at lectures is mandatory.**

COURSE GRADE DETERMINATION

The exam of the teaching of Biology, Applied Physics and Biochemistry is comprised of an oral examination of the modules of BIOPHYSICS, BIOCHEMISTRY, MEDICAL GENETICS and APPLIED BIOLOGY, whose mark is an integral part of the Teaching.

The knowledge and ability to understand, the ability to apply knowledge and understanding, the autonomy of judgment and the communication skills of the student will weigh in the final score as follows 30%, 30%, 30% and 10%, respectively.

OPTIONAL ACTIVITIES

In addition to the teaching activity, the student will be given the opportunity to participate in seminars, research internships, department internships and monographic courses. The topics of the activities are not subject to examination. Acquisition of the hours allocated occurs only with a mandatory frequency of 100%.

READING MATERIALS

- Douglas C. Giancoli "PHYSICS: Principles with Applications" Seventh edition or subsequent, Pearson Education. Inc
- Ashok Kumar J. "Textbook of Biochemistry for Nurses" II edition – 2012. I K International Publishing House
- "Medical Genetics" by Lynn Jorde John Carey Michael Bamshad. Edited by Elsevier
- Sadava, Hillis, Heller, Hacker. Elementi di Biologia e Genetica Zanichelli editore, V ed.
- Curtis, Barnes, Schnek, Massarini. Elementi di Biologia. Zanichelli editore I ed.
- Raven,Johnson, Mason, Losos, Singer. Elementi di Biologia e Genetica Piccin editore II ed.

The indicated textbook is just a reference. Students are allowed to adopt the book/books of their choice. Additional material will be provided by the instructor.

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