Degree in Nursing

Teaching: BIOLOGY, APPLIED PHYSICS, BIOCHEMISTRY
SSD: BIO/13, BIO/09, BIO/10, MED/03
CFU: 4
Coordinator: Laura Pacini Email: laura.pacini@unicamillus.org

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 : Almerinda Di Venere
Email : almerinda.divenere@unicamillus.org

Module: BIOCHEMISTRY
SSD Course: BIO/10
CFU: 1
Professor's name: Barbara Tavazzi
Email: barbara.tavazzi@unicamillus.org

Module: MEDICAL GENETICS;
SSD Course: MED/03
CFU: 1
Professor's name: Roberto Tullio Zori
Email: zorirt@peds.ufl.edu

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 gene structure, DNA replication, concepts of meiosis and mitosis.

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 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
- 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

Characteristic of living cells: Cellular theory. Classification principles of living organisms.
Prokaryotic and eukaryotic cell models: classification and major structural differences.
Cell Chemistry: Macromolecules: structure, shape and function
Plasma membrane: properties and functions.
Internal organization of the cell: Cellular compartments. Cytoplasm and cytoplasmic organelles, ribosomes, smooth and rought endoplasmic reticulum, Golgi apparatus, lysosomes, peroxisomes.
The cytoskeleton. Microtubules, intermediate filaments and microfilaments. Cilia and flagella. Centrioles and centrosomes.
Energy conversion: Glycolysis, fermentation, cellular respiration, photosynthesis. (outline). Mitochondria and Chloroplasts, structure and function.
Molecular basis of hereditary information: DNA replication. DNA repair and its correlation with human diseases.
RNA, structure and function: Main types of cellular RNAs and differences with respect to DNA in terms of molecular size, stability and biological functions. Transcription and RNA maturation.
Genetic Code and its properties. Protein synthesis: How cells read the genome. Main post-translational modifications of the polypeptide chains.
Post-synthetic fate of proteins, endomembranes and membrane traffic: Endocytosis and exocytosis.
Cell Cycle, Mitosis and Meiosis

APPLIED PHYSICS

Chapter 1: Introduction, Measurement, Estimating
1.4: Measurement and Uncertainty; Significant Figures
1.5: Units, Standards, and SI Units
1.6: Converting Units
1.8: Dimensions and Dimensional Analysis

Chapter 14: Heat
14.1 Heat as Energy Transfer
14.2 Internal Energy
14.3: Specific Heat
14.4: Calorimetry
14.5: Latent Heat
14.6: Heat Transfer: Conduction
14.7: Heat Transfer: Convection
14.8: Heat Transfer: Radiation

Chapter 15: The Laws of Thermodynamics
15.1: The First Law of Thermodynamics
15.2: Thermodynamic Processes and the First Law

Chapter 10: Fluids
10.1: Phases of Matter

10.2: Density and Specific Gravity
10.3: Pressure in Fluids
10.4: Atmospheric Pressure Gauge Pressure
10.5: Pascal's Principle
10.6: Measurement of Pressure; Gauges and the Barometer
10.7: Buoyancy and Archimedes' Principle

Chapter 11: Vibrations and Waves

11.7: Wave Motion
11.8: Types of Waves: Transverse and Longitudinal
11.9: Energy Transported by Waves
11.10: Intensity Related to Amplitude and Frequency

Chapter 12: Sound

12-1 Characteristics of Sound
12-2 Intensity of Sound: Decibels
12-7 Doppler Effect

Chapter 16: Electric Charge and Electric Field

16.1: Static Electricity; Electric Charge and its Conservation
16.2: Electric Charge in the Atom
16.3: Insulators and Conductors
16.4: Induced Charge; the Electroscope
16.5: Coulomb's Law
16.6: Solving Problems Involving Coulomb's Law and Vectors
16.7: The Electric Field
16.8: Field Lines
16.9: Electric Fields and Conductors

Chapter 17: Electric Potential

17.1: Electric Potential Energy and Potential Differences
17.2: Relation Between Electric Potential and Electric Field
17.3: Equipotential Lines
17.4: The Electron Volt, a Unit of Energy
17.5: Electric Potential Due to Point Charges
17.7: Capacitance
17.8: Dielectrics
17.9: Storage of Electric Energy

Chapter 18: Electric Currents

18.1: The Electric Battery
18.2: The Electric Current
18.3: Ohm's Law: Resistance and Resistors

18.4: Resistivity
18.5: Electric Power

Chapter 19: DC Circuits

19.1: EMF and Terminal Voltage
19.2: Resistors in Series and in Parallel
19.3: Kirchhoff's Rules
19.4: EMFs in Series and in Parallel; Charging a Battery
19.5: Circuits Containing Capacitors in Series and in Parallel
19.6: RC Circuits-Resistor and Capacitor in Series

25-11: X-Rays and X-Ray Diffraction
25-12: X-Ray Imaging and Computed Tomography (CT Scan)

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

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 examination of the modules of BIOPHYSICS, BIOCHEMISTRY, MEDICAL GENETICS and APPLIED BIOLOGY, whose marks are an integral part of the Teaching.
The student can take the exams in a single session or in different sessions of the academic year according to the modalities listed below.

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.

BIOPHYSICS EXAM: The Physics exam consists of a mandatory written test and an optional oral tests. The written and oral tests are aimed at evaluating both the theoretical knowledge and the student's ability to solve problems. The result of the written test is valid for one academic year. The written test consists of 15 multiple choice questions. Each correct answer gets a score of 2/30, while there is no penalty for wrong answers. Only students who have obtained at least 8/30 in the written test are admitted to the oral test.
Grade less than 8 in the written test: the written test need to be repeated in a following session.
Grade range 8-16 in the written test: the student have to mandatorily perform the oral test.
Grade range 18-30L in the written test: the student can optionally perform the oral test.
The exam grade is established according to the following criteria:
Exam failed: important deficiencies and / or inaccuracies in knowledge and understanding of the topics.
18-20: Just sufficient knowledge and understanding of the subjects.
21-23: Modest knowledge and understanding of topics.
24-26: Good knowledge and understanding of the topics.
27-29: Complete knowledge and understanding of the subjects.
30-30L: Excellent level of knowledge and understanding of the topics.

BIOCHEMISTRY EXAM: The Biochemistry exam will consist of a written test with 31 multiple choice questions on all the topics of the program. One point will be awarded for each correct answer and 0

points for each wrong answer or not provided. The final score of the exam will be given by the sum of the scores of each correct answer.

MEDICAL GENETICS EXAM: The written test will consist of 20 questions with multiple choice answers, for each correct answer a 1.5 point will be assigned. The final score of the written test will be given by the sum of the partial scores assigned to correct answers. Oral exam is optional. To access the oral exam student must have obtained at least a minimum of 15 points at the written exam (15/30). The minimum score to pass the exam is 18/30.
Student learning will be assessed through a written exam held at the end of the course, in which the student answers to multiple choice questions on topics presented during lectures.

APPLIED BIOLOGY EXAM: Student learning will be assessed through a written exam held at the end of the course, in which the student answers to multiple choice questions on topics presented during lectures.
The 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 20 multiple choice questions. Each correct answer gets a score of 1,5/30, while there is no penalty for wrong answers. Only students who have obtained at least a score of 18/30, are admitted to the oral test.
The student can take the exam of Applied Biology in a single exam session or in different sessions of the current academic year.

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.