DEGREE IN MIDWIFERY

Integrated Teaching: BIOLOGY, APPLIED PHYSICS, BIOCHEMISTRY
SSD: FIS/07, BIO/10, MED/03, BIO/13
Credits: 4
Responsible Professor: Cinzia Ciccacci
E-mail: cinzia.ciccacci@unicamillus.org

Module: Applied Physics
SSD: FIS/07
Numbers of credits: 1
Professor: Rita Alaimo
Email: rita.alaimo@unicamillus.org

Module: BIOCHEMISTRY
SSD: BIO/10
Number of credits: 1
Professor: Eleonora Nicolai
Email: eleonora.nicolai@unicamillus.org

Module: Medical Genetics
SSD: MED/03
Number of credits: 1
Professor: Cinzia Ciccacci
Email: cinzia.ciccacci@unicamillus.org

Module: Applied Biology
SSD: BIO/13
Number of credits: 1
Professor: Roberta Nardacci
Email: roberta.nardacci@unicamillus.org

PREREQUISITES

There are no prerequisites. It would be desirable for the student to know the basics of biology, chemistry and mathematics at High School level.

LEARNING OBJECTIVES

Aim of the teaching is to provide students with knowledge on the fundamentals of applied physics, biochemistry, medical genetics and biology necessary to the performance of their future activity.
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). They will acquire basic knowledge on the main metabolic pathways and cycles with particular regard to carbohydrate, lipid and amino acid metabolism.
Students will learn the main notions 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 utilize the experimental 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, radiation heat 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

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- Understanding of how to reconstruct family pedigrees and to calculate disease recurrence
- Understanding of the major kinds of genetic testing and their proper use
- Bacteria and viruses
- The structure and function of biological molecules
- The differences between eukaryotic cell and prokaryotic cell
- The approaches and tools to study the cell
- The cellular compartments and intracellular organelles
- The 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
- The protein biosynthesis
- Knowledge of correct genetic terminology
- Knowledge of the main inheritance models of monogenic, chromosomal, and multifactorial diseases
- Knowledge about how to construct pedigrees
- Knowledge about the recurrence risk of main types of genetic disorders

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
- 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
- Use the acquired knowledge for an in-depth study of aspects related to his future professional activity

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 terminology
- Ability to describe the main topics

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Making Judgements

- Carry out assessments of the topics covered
- Ability to synthesize and correlate the various topics
- the student must be able to adequately describe a biological phenomenon demonstrating an appropriate scientific language for the purpose of correct and rigorous communication

PROGRAMS

APPLIED PHYSICS

PHYSICAL QUANTITIES: Operational concept of physical quantity. Fundamental and derivative quantities. Scalar and vector quantities. Systems of measurement units. Measurement of physical quantities. Systematic errors and accidental errors. Sensitivity, precision of a measuring instrument.
MOVEMENT: Velocity and acceleration as scalar quantities. Velocity and acceleration as vectors.
THE FORCES: The concept of strength and the principle of inertia. The concept of mass is the second principle of dynamics. The weight force is the acceleration of gravity. The third principle of dynamics. Static balance of a material point. Balancing of a system of forces. Friction. Rigid bodies and center of gravity. Moment of a force with respect to a point. Balance of a rigid body. Definition and equilibrium condition of a lever. Various types of leverage. Levers in the human body.
WORK AND ENERGY: Work of a force. Work and kinetic energy. The concept of energy. Conservative forces (outline). Potential energy.
LIQUIDS: Definition and unit of measurement of pressure. Density and specific weight. Forces acting on a volume of fluid at rest. Stevino Law. Pressure gauges. Pascal's law.
THERMOMETRY and GAS: The concept of temperature. The centigrade temperature scale. Expansion thermometers. Clinical thermometer. Absolute temperature scale. The equation of state of perfect gases.
HEAT AND INTERNAL ENERGY: The concept of quantity of heat. Heat measurement unit. Thermal capacity of a body and specific heat of a substance. Expression of the amount of heat exchanged by a body. The internal energy of a system. The first principle of thermodynamics. Thermodynamic transformations. State changes. Metabolic power. Energy value of food. Temperature control
SOUND: wave phenomena. Elastic and electromagnetic waves. Nature of sound. Wavelength. Sound intensity. Technical applications and biological effects of ultrasound. Ultrasound in medical diagnostics.
THE ELECTRICAL PHENOMENA: The electric charge. Conductors and insulators. Electric field and intensity of the electric field. Coulomb law. Unit of measurement of electric charges. Dielectric constant. Electrical potential and potential difference. Electric capacitors. Electric current and current intensity. The direct current. Energy considerations on electrical circuits. Ohm's law. Electrical resistance and resistivity. Resistance in series and in parallel. Internal resistance of a generator. The thermal energy connected with the Joule effect. Power absorbed by a device. Electrical Safety
IONIZING RADIATION: Introduction to radiation. Radiation, radioactive decay, law of radioactive decay. Biological half-life. The most common decays and associated radiation. Interaction of radiation with matter and hints of dosimetry

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 (O2, CO2). 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, codominance, mutation, polymorphism.
- Principles of Genetic Transmission: Mendel's Genetic Hypothesis, The Monohybrid and Dihybrid Crosses, Segregation in Human Pedigrees, Blood groups Genetics
- 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

APPLIED BIOLOGY

- Characteristics of living organisms, levels of organization and principles of classification.
- Macromolecules of biological interest: carbohydrates, lipids, elements of structure and function of proteins and nucleic acids.
- The cell as the basic unit of life, Cell Theory. Prokaryotic and eukaryotic cells, organization and differences. Endosymbiontic theory. Notes on viruses.
- Structure and function of the eukaryotic cell: plasma membrane, cytoplasm, ribosomes, smooth and rough endoplasmic reticulum, Golgi apparatus, lysosomes, peroxisomes, cytoskeleton.
- Notes on relationship between energy conversion processes and cellular structures, mitochondria and chloroplasts.
- The nucleus: Nuclear envelope, nucleoli, chromatin and chromosomes.

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- Molecular basis of hereditary information. DNA structure and function.
- Gene expression: transcription and maturation of primary transcripts.
- Genetic code and translation. Reading and interpretation of the genetic code, protein synthesis, major post-translational modifications and post-synthetic fate of proteins.
- Endomembranes and vesicular trafficking. Exocytosis and Endocytosis.
- Cell cycle, mitosis and meiosis.

COURSE STRUCTURE

The integrated course consists of 4 modules, each one structured in 14 hours of lesson. The attendance at lectures is mandatory (at least 75% of attendance, calculated on the entire integrated course)

- The module of Biophysics consists of 14 hours of frontal teaching. 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. Lectures will include theoretical lessons on the topics of the program.
- The module of Medical Genetics is structured in 14 hours of frontal lessons. Lectures will include theoretical lessons with power-point presentations and exercises (both in groups and alone).
- The module of Applied Biology is structured in 14 hours of frontal teaching, divided into 2-hour lessons.

COURSE GRADE DETERMINATION

The finale evaluation will be determined with a mandatory written test and an optional oral test to be taken in the same session. The written test will cover the main topics of the four teaching modules and will consist of 30 questions for each teaching module. For each module, the written test is passed with a score of 18/30. The oral exam is optional. Only students who have obtained a grade ≥15 in the written test are admitted to the oral exam.

The oral exam will assess the student's knowledge and mastery of specific scientific language.

The evaluation criteria considered will be: acquired knowledge, independent judgment, communication skills and learning skills. The exams will be assessed according to the following criteria:

< 18 Fail	The candidate possesses an inadequate knowledge of the topic, makes significant errors in applying theoretical concepts, and shows weak presentation skills.
18-20	The candidate possesses a barely adequate and only superficial knowledge of topic, limited presentation skills, and only an inconsistent ability to apply theoretical concepts.
21-23	The candidate possesses an adequate, but not in-depth, knowledge of the topic, a partial ability to apply theoretical concepts, and acceptable presentation skills.

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24-26	The candidate possesses a fair knowledge of the topic, a reasonable ability to apply theoretical concepts correctly and present ideas clearly.
27-29	The candidate possesses an in-depth knowledge of the topic, a sound ability to apply theoretical concepts, good analytical skills, clear argumentative clarity and an ability to synthesize.
30-30L	The candidate possesses an in-depth knowledge of the topic, an outstanding ability to apply theoretical concepts, a high level of argumentative clarity, as well as excellent analytical skills, and a well-developed ability to synthesize and establish interdisciplinary connections.

OPTIONAL ACTIVITIES

There are no optional activities.

READING MATERIALS

The indicated textbooks are just a reference. Students can adopt the book/books of their choice. Additional material will be provided by the Teachers.

APPLIED PHYSICS
Paul Davidovits: Fisica per le professioni sanitarie. UTET.

BIOCHEMISTRY
Massimo Stefani, Niccolò Taddei. Chimica & Biochimica. Ed. Zanichelli.
Bertoldi, Colombo, Magni, Marin, Palestini. Chimica e Biochimica. EdiSES.

MEDICAL GENETICS
Nussbaum, McInnes, Willard:Genetica in Medicina. Edises.
Clementi: Elementi di Genetica Medica. Edises.

APPLIED BIOLOGY
Sadava D, M. Hillis D, Craig Heller H, Hacker S, "Elementi di Biologia e genetica", Zanichelli, V ed.
Raven PH, Johnson GB, Mason KA “Elementi di Biologia e Genetica” Piccin, II ed.