BSC IN MIDWIFERY

INTEGRATED TEACHING: BIOLOGY, APPLIED PHYSICS, BIOCHEMISTRY
SSD: PHYS-06/A, BIOS-07/A, MEDS-01/A, BIOS-10/A
Responsible Professor: Jessica Diana Rosati E-mail: jessicadiana.rosati@unicamillus.org
Credits: 4

Module: **Applied Physics**
SSD: PHYS-06/A
Professor: Maria Giovanna Guerrisi E-mail: mariagiovanna.guerrisi@unicamillus.org
Numbers of credits: 1

Module: **Biochemistry**
SSD: BIOS-07/A
Professor: Maria Elisabetta Clementi E-mail: mariaelisabetta.clementi@unicamillus.org
Number of credits: 1

Module: **Medical Genetics**
SSD: MEDS-01/A
Professor: Antonio Novelli E-mail: antonio.novelli@unicamillus.org
Number of credits: 1

Module: **Applied Biology**
SSD: BIOS-10/A
Professor: Jessica Diana Rosati E-mail: jessicadiana.rosati@unicamillus.org
Number of credits: 1

PREREQUISITES
The student can take the exam if he/she is in compliance with the Additional Learning Requirements (OFA).

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.
The student will be able to:

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
- Know the basic information on the structure and function of the main biological macromolecules
- Know the basic principles of enzymatic catalysis
- Know the different metabolic pathways of eukaryotic cells
- Know the role of different "fuels" in energy production
- Know the biosynthetic pathways of some molecules of biochemical interest
- Understand how to reconstruct family pedigrees and to calculate disease recurrence
- Understand the major kinds of genetic testing and their proper use
- Know differences among Bacteria and viruses, and among eukariotis and prokaryotics
- Know the structure and function of biological molecules
- Understand the approaches and tools to study the cell
- Understand the physiology of the cell
- Know the cell cycle and the protein biosynthesis
- Know correct genetic terminology
- Know of the main inheritance models of monogenic, chromosomal, and multifactorial diseases
- Know about how to construct pedigrees
- Know 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
- Analyse family history and reconstruct pedigrees
- 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/her future professional activity

Communication Skills

- Understand the scientific language used in written tests
- Present the topics orally in an organized and coherent manner
- Adequately describe the phenomena of basic science demonstrating an appropriate scientific language for the purpose of correct and rigorous communication

Making Judgements

- Carry out assessments of the topics covered
- Synthesize and correlate the various topics

Learning Skills

- Adopt skills and learning methods suitable for deepening and improving their knowledge in the fields of biology, physics, biochemistry and medical genetics

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

- Foundational concepts and terminology in genetics, including gene, locus, allele, genotype, phenotype, haplotype, homozygote, heterozygote, haploid, diploid, dominance, recessiveness, mutations (variants) and polymorphism.
- Mendelian inheritance laws: principles of dominant and recessive traits.
- Genetics of major blood group systems (AB0 and Rh);maternal-fetal blood group incompatibility.
- Patterns of inheritance for Mendelian (monogenic) traits, including autosomal dominant and recessive inheritance, and X-linked dominant and recessive inheritance.
- Risk assessment calculations based on inheritance patterns and pedigree (family tree) analysis.
- Key genetic concepts such as penetrance, expressivity, epistasis, anticipation, consanguinity, and genetic heterogeneity.
- Chromosomal structure and function; numerical and structural chromosomal abnormalities.
- Genomic imprinting and X-chromosome inactivation.
- Mitochondrial inheritance.
- Use of genetic markers and polymorphisms; inter-individual genetic variability.
- Introduction to multifactorial inheritance.
- Overview of pharmacogenetics and the principles of personalized medicine.
- Applications of genetic testing and basic principles of genetic counseling.

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. Notes on viruses.
- Structure and function of the eukaryotic cell: plasma membrane, cytoplasm, ribosomes, smooth and rough endoplasmic reticulum, Golgi apparatus, lysosomes, peroxisomes, cytoskeleton.
- The nucleus: Nuclear envelope, nucleoli, chromatin and chromosomes.
- 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

Attendance is mandatory for at least 75% of the hours, summed across all the integrated course teachings.

• The Applied Biophysics module is structured in 14 hours of classroom teaching. Before the course, a review of the mathematical concepts and skills that are essential prerequisites for a successful completion of the Course is carried out. Within the limits of the available hours, the teaching method tends to stimulate the active participation of students by involving them in "inverted teaching" activities.

• The Biochemistry module is structured in 14 hours of classroom teaching, divided into 1 or 2-hour lessons based on the academic calendar. The classroom teaching includes theoretical lessons on the program topics.

• The Genetics module consists of 1 CFU and 14 hours of classroom teaching. The lessons include both theory lessons with power-point presentations and interactive lessons with exercises done in class (both alone and in groups).

• The Applied Biology module consists of 14 hours of classroom teaching. The first lesson of the course reviews the concepts that are essential prerequisites for successful completion of the course.

COURSE GRADE DETERMINATION

The final 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.
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 Professors.
APPLIED PHYSICS:
- Paul Davidovits: Fisica per le professioni sanitarie. UTET.

BIOCHEMISTRY:
- Emine Ercikan Abali, Susan D. Cline, David S. Franklin, Susan Viselli. Le basi della biochimica. Zanichelli
- Massimo Stefani, Niccolò Taddei. Chimica & Biochimica. Ed. Zanichelli.
- Bertoldi, Colombo, Magni, Marin, Palestini. Chimica e Biochimica.EdiSES.

MEDICAL GENETICS:
- Fundamental of Medical Genetics; Bruno Dallapiccola, Giuseppe Novelli- Scientific Editions Falco 2025

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.