



UNICAMILLUS

Degree in Medicine and Surgery

Course: **Physiology I**

Code: BIOS-06/A, MEDF-01/A

Number of CFU: **10**

Reference Professor: **Prof. [Giovanna D'Arcangelo](#)** e-mail: giovanna.darcangelo@unicamillus.org

Module: **Physiology**

SSD course: **BIOS-06/A**

Prof. Giovanna D'Arcangelo	(2 CFU)	e-mail: giovanna.darcangelo@unicamillus.org
Prof. Claudio Frank	(3 CFU)	e-mail: claudio.frank@unicamillus.org
Prof. Danny Spampinato	(2 CFU)	e-mail: dannyadrian.spampinato@unicamillus.org
Prof. Andrea Vitali	(2 CFU)	e-mail: andrea.vitali@unicamillus.org

Number of credits (CFU): **9**

Module: **Methods and Didactics of Motor Activities**

SSD course: **MEDF-01/A**

Prof. [Anna Maria Malagoni](#) e-mail: annamaria.malagoni@unicamillus.org

Number of credits (CFU): **1**

PREREQUISITES

The treatment of the specific topics of the subject requires sufficiently detailed knowledge of Anatomy, Medical Physics, Biology and Biochemistry.

LEARNING OBJECTIVES

The course includes the acquisition by the student of knowledge of the operating principles of the organs that compose the human body, their dynamic integration into apparatus and the understanding of the general mechanisms of homeostatic function control and their variations following physical activity. The course also includes the ability to independently apply the knowledge of organ and system functioning mechanisms to potential functional alteration situations.

LEARNING OUTCOMES

Knowledge and Understanding

To know and understand the physiological principles that govern the function of the organism's systems. To demonstrate the knowledge of cellular and organ functions and to acquire the ability to integrate the physiology from the cellular and molecular level to the organ and apparatus systems. To describe the molecular and functional aspects of each organ in humans, necessary for the homeostasis maintenance. To know the adaptations of the vital functions of the human body in response to the practices of physical activity. To evaluate the consequences of alterations at the cellular and organ level in the overall functioning of the human body.

Applying Knowledge and Understanding

To autonomously apply the knowledge of the organ and system functioning mechanisms to situations of potential functional alteration relating to the specific field to which the student will dedicate himself in the professional activity.

Making Judgements

To recognize the importance of a thorough knowledge of the topics covered for an adequate medical education. To identify the fundamental role of the correct theoretical knowledge of the subject in



UNICAMILLUS

clinical practice.

Communication Skills

To orally present the topics in an organized and coherent way, using adequate scientific terminology and compliant with the topic of the discussion.

Learning Ability

To identify the possible applications of the skills acquired in the future career and to have communication skills to convey what has been learned.

COURSE SYLLABUS

Cellular Physiology

Homeostatic mechanisms and control systems. Transport across the cell membrane. Passive and active membrane transport processes. Osmosis. Cell membrane potential and equilibrium potential. Electrical properties of the cell membrane. Propagation of electrical signals along excitable fibers. Voltage-gated Na^+ , K^+ , and Ca^{2+} ion channels. Action potential and membrane refractoriness. Electrical signal propagation and action potential conduction. Electrical and chemical synapses. Excitatory and inhibitory synaptic potentials. Neurotransmitters and their receptors. Signal transduction and intracellular signaling pathways. Synaptic integration. Neuromuscular junction. Examples of diseases associated with alterations in neural communication.

Muscle Physiology

Structure of the contractile apparatus of skeletal muscle. Sliding filament theory. Cross bridge cycle and force development. Excitation–contraction coupling. Single twitch and tetanic contraction. Isometric and isotonic contractions. Length–tension and force velocity relationships. Muscle power. Energy sources for muscle contraction. Muscle fatigue. Motor unit. Smooth muscle: regulation and control of smooth muscle contraction.

Cardiovascular physiology

General concepts and functions. Biophysical laws applied to cardiovascular physiology. Stress, strain, blood viscosity. Systemic and pulmonary circulation. Circulation in series and in parallel. Compliance and elastance. Laminar and turbulent flow. Cardiac conduction system. Cardiac (contractile and specialized) and vascular muscle fibers: structure, function, and action potential. Structural aspects and excitation–contraction coupling of cardiac muscle. Muscle contraction, myocardial band, and fulcrum based on Torrent Guasp's anatomical model. Muscle length–tension relationship. Vasoactive compounds. Receptors involved in mechanical and electrical activity in the cardiovascular system. Effects of the autonomic nervous system on cardiovascular physiology.

Phases of the cardiac cycle: pressure and volume aspects. Functional differences between the two ventricles. Preload, contractility, afterload, systemic and pulmonary resistances, arterial and aortic impedance, inertance. Windkessel mathematical models. Cardiac output: physical laws, variations in different clinical contexts, and measurement using non-invasive and invasive methods. Heart rate, blood volume, blood velocity, arterial elastance, ventriculo-arterial coupling. Arteries, veins, lymphatic vessels: classification, morphology, and functions. Principles of hemodynamics. Arterial and venous pulse. Relationship between flow resistance, pressure, and volume. Capillaries and microcirculation. Blood pressure: physical laws, variations in different clinical contexts, and measurement using non-invasive and invasive methods; perfusion pressure; pulse pressure; pulse pressure transmission; mean arterial pressure; mean systemic filling pressure; critical closing pressure. Mechanisms involved in the regulation of cardiovascular function and arterial pressure:



UNICAMILLUS

baroreceptors, chemoreceptors, neuro-hormonal system, natriuretic peptides, erythropoietin, atrial Bainbridge reflex, kidney and blood pressure regulation. Venous return. Venous pressure. Relationship between central venous pressure, cardiac output, and right atrial pressure. Lymphatic circulation. Circulation in special regions: coronary, cerebral, intestinal, hepatic, renal, splenic, muscular, cutaneous, placental, and fetal. Cardiac electrophysiology: general concepts, electrical vectors and dipoles. Electrocardiogram: general principles, interpretation on standard paper, waves and segments, Einthoven's triangle, Wilson central terminal, depolarization and repolarization, vector forces, electrical axis and transition, rhythm and heart rate.

Nervous System Physiology.

Organization of the nervous system. Sensory receptors. Somatic sensitivities: tactile and proprioceptive sensitivity. Pain. Motor functions of the spinal cord: spinal reflexes. Control of motor function by the cerebral cortex and the brainstem. Basal nuclei and motor control. Cerebellum and motor control. Cerebral cortex and intellectual functions: language, memory and learning. Sleep-wake rhythm. Functions of the limbic and hypothalamus system. Autonomously nervous system and adrenal medulla.

Respiratory System Physiology.

Organization of the respiratory system. Lung ventilation. Pulmonary circulation. Alveolar-capillary gas exchange. Oxygen and carbon dioxide transport in the blood and body fluids. Ventilation and perfusion of the lungs. Breathing regulation. Respiration at high altitude. Adaptations of the respiratory system to physical exercise.

Methods and Didactics of Motor Activities.

Energy systems involved in exercise (ATP turnover, phosphagen system, glycolytic and oxidative metabolism). The role of lactate in exercise physiology ((lactate production, clearance, shuttle mechanisms, lactate threshold, and exercise-related physiological significance). Oxygen uptake kinetics during exercise and recovery (VO_2 kinetics, oxygen deficit, EPOC). Maximal oxygen consumption (physiological determinants, measurement modalities, clinical interpretation). Physical capacity and cardiorespiratory fitness evaluation (functional capacity assessment, clinical application, prognostic value). Principles of physical exercise prescription (exercise-defining parameters, intensity domains based on physiological indicators and their measurement, individualization). Exercise in the prevention and treatment of chronic diseases (exercise as a preventive and therapeutic intervention, with particular reference to cardiovascular and metabolic diseases).

COURSE STRUCTURE

The course is structured in 200 hours of frontal teaching, divided into lessons of 2 or 4 hours based on the academic calendar. Lectures will include theoretical lessons and supplementary seminars on the topics covered.

COURSE GRADE DETERMINATION

The verification of the student preparation will take place with a written exam followed by an oral exam. The written test will consist of 30 questions with multiple choice answers, for each correct answer a point will be assigned. The final score of the written test will be given by the sum of the partial scores assigned to each question answered correctly. To access the oral exam the student must have totaled at least a minimum of 18 points. During the oral exam, the examining Commission will assess the student's learning skills as well as the ability to apply the knowledge and ensure that the skills are adequate to support and solve problems of a physiological nature (50% of the score). It will also be assessed: autonomy of judgment (25% of the score) and communication skills (25% of the score) as indicated in the Dublin descriptors.



Not sufficient:

Poor or deficient knowledge and understanding of topics; limited ability to analyze and synthesize; frequent generalization of required contents; inability to use technical language.

18-20: Barely sufficient knowledge and understanding of topics, with evident imperfections; barely sufficient ability to analyze, synthesize and making judgment; poor ability to use technical language.

21-23: Sufficient knowledge and understanding of topics; sufficient ability to analyze and synthesize with ability to argue the required contents, with logic and coherence; sufficient ability to use technical language.

24-26: Fair knowledge and understanding of topics; fair ability to analyze and synthesize with ability to rigorously argue the required contents; fair ability to use technical language.

27-29: Good knowledge and understanding of the required contents; good ability to analyze and synthesize with ability to rigorously argue the required contents; good ability to use technical language.

30-30L: Excellent level of knowledge and understanding of the required contents with excellent analytical and synthesis skills with the ability to rigorously, innovatively and originally argue the required content; excellent ability to use technical language.

Support activity

In addition to the didactic activity, the student will be given the opportunity to attend seminars, research internships, laboratory attendance. The topics of the activities are not subject to examination.

OPTIONAL ACTIVITIES

Students are received by appointment by writing via email.

Recommended texts

- Guyton & Hall, Textbook of Medical Physiology, Elsevier, 2024.
- Neuroscience. Purves. Editore: OUP USA (to be integrated for the Nervous System)
- Cardiovascular Medical Physiology: from Biophysics to Pathophysiology and Clinical Practice. Andrea Vitali. Edizioni Scientifiche Falco.
- Essentials of exercise Physiology. W.D. Mcardle, F.I. Katch, V.L. Katch, Casa Editrice Piccin
- Exercise Physiology: Nutrition, Energy, and Human Performance. Lippincott Williams & Wilkins