

II year
(1st and 2nd semester)

Scientific Field	PHYSIOLOGY	TUTOR	ECTS
BIO/09	Physiology 1	Bosco Gianfranco	11
BIO/09	Physiology 2	Bosco Gianfranco	7
		TOT	18

BOSCO G.
COORDINATOR

SPECIFIC AIMS

To obtain the knowledge of how the different organs of the Human body work, their dynamic integration in apparatuses and the general mechanisms of functional control in normal conditions.
To acquire the knowledge of the main functional findings in healthy humans.

**TOPICS
CELL PHYSIOLOGY**

Overview of membrane transport. Unassisted and assisted membrane transport. Fick's law. Osmosis. Membrane potential. Equilibrium potential: Nernst's Equation. Passive electric properties of the plasma membrane. Membrane electric conduction. Ion channels. The action potential. Refractory period. Conduction of action potentials.

**TOPICS
NEURAL
COMMUNICATION**

Electric and chemical synapses. Quantal theory of neurotransmitter release. Synaptic potentials and synaptic integration. Neuromuscular junction. Neurotransmitter types and functional mechanisms. Signal transduction: G proteins, cyclic nucleotides, calcium, IP3 pathway, phosphorylation. Synaptic plasticity.

**TOPICS
MUSCLE PHYSIOLOGY**

Structure of skeletal muscle. Molecular basis of skeletal muscle contraction. Cycles of cross-bridge binding. Electro-mechanical coupling. Muscle twitch and tetanus. Skeletal muscle mechanics. Isometric and isotonic contraction. Tension-length and speed-load relationships. Muscle power. Skeletal muscle metabolism and muscle fatigue. Motor units and muscle fiber types. Smooth muscle. Control and modulation of smooth muscle contraction. Cardiac muscle. Electro-mechanical coupling in the cardiac muscle.

**TOPICS
CARDIOVASCULAR
PHYSIOLOGY**

Morphofunctional features of the heart. Electrical activity of the heart. Pacemaker activity of the sinoatrial node. Spread of cardiac excitation. Electrocardiogram (ECG). Mechanical events of the cardiac cycle. Heart sounds and murmurs. Cardiac output and its control. Morphofunctional characteristics of blood vessels: Arteries, arterioles, capillaries, veins. Patterns and physics of the blood flow. Microcirculation and capillary exchange. Diffusion and filtration. Venous return. Lymphatic system. Vasoactive substances. Special vascular districts: coronary, pulmonary, cutaneous, brain.

**TOPICS
THE RESPIRATORY
SYSTEM**

Respiratory anatomic-functional characteristics. Respiratory mechanics. Respiratory muscles and movements. The pleural sac. Intrapleural pressure. Intra-alveolar and transmural pressure. Boyle's law and pressure-volume relationship. Pulmonary compliance. Airways resistance. Alveolar stability and pulmonary surfactant. Ventilation: lung volumes and capacities. Anatomic and functional dead space. Breathing work. Gas exchange. Diffusion and partial pressure gradients of O₂ and CO₂. Alveolar perfusion and ventilation / perfusion ratio. Gas transport. Hemoglobin and transport of oxygen. Transport of CO₂. Respiratory contribution to acid-base balance. Control of respiration: respiratory centers and respiratory muscles innervation. Reflex mechanisms. Peripheral and central chemoreceptors. Baroreceptors. Physiological and pathological adaptation of respiratory function.

**TOPICS
THE URINARY SYSTEM**

Fluid compartments: distribution and exchange of water and solutes. Functional anatomy of the kidneys. Homeostatic functions of the kidneys. Glomerular filtration. Extrinsic control and autoregulation of glomerular filtration. Tubular reabsorption and secretion. Urine excretion and plasma clearance. Concentration of the urine: medullary osmotic gradient and countercurrent multiplication.

Countercurrent exchange and vasa recta. Water reabsorption and vasopressin. Actions of vasopressin, aldosterone and natriuretic peptides on kidneys' function. Endocrine functions of the kidneys: renin-angiotensin-aldosterone.

TOPICS THE DIGESTIVE SYSTEM

General aspects of digestion. The mouth: chewing and salivary secretion. Pharynx and esophagus: control of swallowing. Functions of the stomach. Gastric secretion and its control. Pancreatic and biliary secretions: composition and control. Small intestine: digestion and absorption of nutrients. Functions of the large intestine. The enteric nervous system and the control of gastrointestinal motility. Overview of gastrointestinal endocrine and immune functions. Food intake and energy balance.

TOPICS SYSTEMS NEUROPHYSIOLOGY

General organization of sensory systems. The somatosensory system: touch, proprioception, thermoception and nociception. Vision: Retinal functions. Central processing of visual information: analysis of shape, colour and motion. Hearing: functional properties of the external and middle ear. Functions of the cochlea. Central processing of auditory signals. Chemical senses: taste and smell. General principles of motor control. Spinal reflexes: stretch reflex and withdrawal reflex. Locomotion. The vestibular system and the control of balance. Oculomotor control. The cerebellum and the basal ganglia. Motor learning. Cortical control of action. Cognitive function: language and memory. Neurophysiology of sleep.

TOPICS THE ENDOCRINE SYSTEM

The hypothalamus and the control of homeostatic functions. Circumventricular organs. The pineal gland: melatonin and circadian rhythms. The autonomic nervous system. Endocrine control of fluid balance. Endocrine control of calcium metabolism. Endocrine control of fuel metabolism: pancreatic hormones and glycemic / lipostatic control. The pituitary gland and the hypothalamus-pituitary axes. Endocrine control of growth: Growth hormone (GH) and insulin-like growth factors (IGF). The thyroid: hormones (T4, T3) and their functions. Thermogenesis and thermoregulation. The adrenal gland and the stress response. Pro-opiomelanocortin (POMC) e glucocorticoids: target organs and molecular mechanisms. Endocrine control of reproductive functions. Hormones during pregnancy and lactation. Hormones and the immune system; cytokines and their action on the nervous and endocrine system.

TEXTBOOKS

- L. Sherwood: Human Physiology: From Cells to Systems
- B. Koeppen, B. Stanton: Berne & Levy Physiology
- Guyton and Hall: Textbook of Medical Physiology
- Purves: Neuroscience

EXAM METHOD

Oral Exam. Exam dates: to be defined (it is a yearly course, therefore the earliest dates available will be in June).

EXAM COMMISSION

The Coordinator, full Professors of the disciplines, Professors of similar disciplines, Specialists of the subject, compose the exam Commission of the Integrated Course.

Bosco Gianfranco, President

Tancredi Virginia

D'Arcangelo Giovanna

Daprati Elena

CONTACTS

Bosco Gianfranco	bosco@med.uniroma2.it	0672596420
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PREREQUISITES: Previous knowledge and competence in the following subjects:

Human Anatomy 1, Human Anatomy 2, Chemistry and Introductory Biochemistry, Histology and Embryology, Biology and Genetics.

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:

1. **Knowledge and Understanding**

- Assess the physiologic principles which govern the function of the main body systems and have a first approach to the alterations induced by functional and structural abnormalities.
- Demonstrate knowledge of cellular and organ system functions.
- Achieve the ability to integrate physiology from the cellular and molecular level to the organ system and organismic level of organization.
- Describe the molecular aspects and functional process of each organ of the human system necessary for maintenance of the homeostasis.
- Understand the consequences of alterations at the cellular and organ level in the overall functioning of the body system.
- Learn to interpret appropriate laboratory and diagnostic studies.

2. **Applying Knowledge and Understanding**

- Apply the theoretical knowledge to the clinical setting, being able to recognize the general diagnostic aspects of the diseases.
- Approach to the main functional diagnostic tests used to assess the activities of each organ. (ex. Respiratory function tests, liver function tests) and learn how to differentiate the physiological and pathological results.
- Provide a differential diagnosis based on specific clinical data, providing a comprehensive explanation of the underlying reasoning.
- Learn the practical aspects of the diagnostic instruments, when to use them and how to perform them.

3. **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 subject in the clinical practice.

4. **Communication Skills**

- Present the topics orally in an organized and consistent manner.
- Use of proper scientific language coherent with the topic of discussion.

5. Learning Skills

- Identify the possible use of the acknowledged skills in the future career.
- Assess the importance of the acquired knowledge in the overall medical education process.