Course Title	**Integrated physiology**				
Course Code	ABS302				
Course Type	Compulsory				
Level	BSc				
Year / Semester	3rd year / 6th semester				
Teacher's Name	Dr George Miltiadous, Dr Stavroula Gouzelou				
ECTS	6	Lectures / week	3	Laboratories/week	2
Course Purpose	Integrated physiology serves as a structured framework that elucidates the interconnections between various physiological processes in the human body. Its primary goal is to explore the collaborative functioning of diverse systems and functions to uphold homeostasis and overall health. Students are exposed to cellular processes, organ systems, and regulatory mechanisms, enabling them to grasp the intricate relationships between different physiological systems. By comprehensively studying these categories, students gain a deeper understanding of how these systems interact and mutually impact one another, facilitating a holistic perspective on the functioning of the human body and maintenance of health.				
Learning Outcomes	**1.0 Cellular Organization and Structure – Biomolecules:** Understanding of the fundamental aspects of cellular physiology and biochemistry. Hierarchical organization of cells and their various components. Major biomolecules: carbohydrates, lipids, proteins, and nucleic acids, structure, and functions. **1.1 Cell Signalling and Membrane Transport:** Cellular communication and substance transport across the plasma membrane, signaling pathways, receptor activation, and intracellular signal transduction. Membrane transport mechanisms, and their significance in maintaining cellular homeostasis. **1.2 Metabolism: Energy Production and Regulation:** Cellular respiration: glycolysis, the Krebs cycle, and oxidative phosphorylation, which collectively generate ATP. Anabolic and catabolic processes, regulatory mechanisms that maintain metabolic balance. **2.0 Digestive System: GI Tract and Liver Functions:** Intricacies of the digestive system and the pivotal significance of the liver. Structure and functions of the gastrointestinal (GI) tract, including digestion, absorption, and motility. Specialized adaptations for efficient nutrient breakdown and absorption. Liver's multifaceted functions, including metabolism, detoxification, and bile production. **3.0 Renal Physiology: Anatomy, Filtration, and Fluid-Electrolyte Balance:**				

	Kidney anatomy and filtration processes that occur in the nephrons. Glomerular filtration, tubular reabsorption, and tubular secretion. Renal system's role in maintaining fluid and electrolyte balance and acid-based homeostasis. Mechanisms of reabsorption and secretion in the renal tubules, hormone regulation, and the kidneys' involvement in controlling osmotic balance, sodium, potassium, calcium levels, and pH regulation. **4.0 Cardiovascular Physiology: Heart, Vessels, and Blood:** Structure and function of the heart, blood vessels, and blood. Cardiac electrophysiology, blood pressure regulation, cardiac output, distribution of blood flow, including the regulation of blood flow to various organs and tissues. **5.0 Respiratory Physiology: Anatomy, Gas Exchange, and Breathing Regulation:** Mechanisms of respiration, anatomy of the respiratory system, gas exchange in the lungs, and the regulation of breathing. Participants will explore the structure and function of the respiratory system. Comprehensive understanding of respiratory physiology and its vital role in gas exchange and maintaining homeostasis**.** **6.0 Immunology: Components, Recognition, Response:** Innate and adaptive components of the immune system, roles of phagocytes, natural killer cells, lymphocytes, antibodies, and cytokines in recognizing and eliminating pathogens. Mechanisms of antigen recognition and the subsequent immune response. Immunological tolerance and the significance of vaccination in preventing infectious diseases.. **7.0 CNS: Anatomy, Development, and Neuroplasticity:** Anatomy of the brain and spinal cord, learning about their structural components and functions. Hierarchical organization of the CNS and how different regions work together to process and coordinate information. Neural development and neuroplasticity. **8.0 Neurons: Structure, Function, and Electrical Signaling:** Structure and function of neurons, including their various components and the role of glial cells. Specialized properties of neurons that enable them to transmit electrical signals and participate in neural circuits. The electrical properties of neurons, resting membrane potential and the generation and propagation of action potentials, ion channels, the all-or-none principle, and factors influencing action potential conduction. Additionally, the mechanisms of synaptic transmission, neurotransmitter release, and postsynaptic receptor interactions. **9.0 Autonomic and Somatic Nervous Systems: Anatomy and Function:** Anatomical structures and functions of these two divisions, including their roles in regulating involuntary and voluntary bodily functions. Sympathetic and parasympathetic divisions, covering their unique characteristics, neurotransmitters, and physiological responses. Students learn about the “fight-or-flight” and “rest-and-digest” responses mediated by these divisions and their coordination in maintaining homeostasis. Reflex arcs involved in

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<tr><td></td><td colspan="3">autonomic responses and the organization of motor pathways for voluntary movements.

10.0 Muscle Physiology: Structure, Contraction, and Neural Control: Muscles and the control of body movement. Different types of muscles, including skeletal, smooth, and cardiac muscles, and structures. Skeletal muscle contraction, sliding filament theory and the recruitment of motor units to generate varying levels of force. Neural control of muscle movement and coordination, understanding the hierarchical organization of the motor system, the role of upper and lower motor neurons, and the transmission of signals through motor pathways.

11.0 Sensory Physiology: Receptors, Transduction, and Perception: Various types of sensory receptors and their functions in detecting diverse stimuli. Process of transduction, where sensory stimuli are converted into electrical signals for transmission to the brain. Anatomy and physiology of specific senses, including vision, hearing, taste, smell, and touch. Integration of sensory information and the formation of perception.

12.0 Endocrinology: Glands, Regulation, and Disorders: Major endocrine glands and the hormones they secrete, gaining knowledge of their functions in regulating various physiological processes. Mechanisms involved in the regulation of hormone release and the crucial role of feedback mechanisms in maintaining hormonal balance. Endocrine disorders, causes, symptoms, and management options. Hormone therapies used to restore hormonal balance in individuals with endocrine disorders.</td></tr>
<tr><td>Prerequisites</td><td>ABS108</td><td>Corequisites</td><td>None</td></tr>
<tr><td>Course Content</td><td colspan="3"><u>Theory:</u>
• Cellular organization and structure
• Biomolecules (carbohydrates, lipids, proteins, nucleic acids)
• Enzymes and their role in metabolism
• Cell signaling pathways and signal transduction
• Receptors and second messengers
• Membrane transport mechanisms (diffusion, facilitated diffusion, active transport)

• Energy metabolism (glycolysis, Krebs cycle, oxidative phosphorylation)
• Anabolism and catabolism
• Regulation of metabolism and metabolic disorders
• Anatomy and physiology of the gastrointestinal tract
• Digestion, absorption, and assimilation of nutrients
• Liver functions, including metabolism, detoxification, and bile production
• Renal anatomy and filtration
• Renal tubular reabsorption and secretion
• Regulation of fluid and electrolyte balance, acid-base balance
• Components of the immune system (innate and adaptive immunity)
• Antigen recognition and immune response

• Immunological disorders and vaccination</td></tr>
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	• Anatomy and organization of the central nervous system (brain and spinal cord) • Neural development and neuroplasticity • Neurotransmitters and their roles in CNS function • Neuron structure and function • Resting membrane potential and action potentials • Synaptic transmission and neuronal communication • Anatomy and function of the autonomic and somatic nervous systems • Sympathetic and parasympathetic divisions • Autonomic reflexes and voluntary motor control • Muscle types and structure • Skeletal muscle contraction and motor unit recruitment • Neural control of muscle movement and coordination • Sensory receptors and transduction • Vision, hearing, taste, smell, and touch • Sensory integration and perception • Endocrine glands and hormones • Regulation of hormone release and feedback mechanisms • Endocrine disorders and hormone therapies • Cardiac electrophysiology • Blood pressure regulation • Cardiac output and blood flow distribution • Anatomy of the Respiratory System • Gas Exchange in the Lungs • Regulation of Breathing <u>Laboratory experiments/exercises:</u> Laboratory exercises are an integral part of the course, designed to enhance understanding and consolidate theoretical concepts. Through hands-on experiences, these exercises complement the course material and facilitate deeper exploration. Students will engage in various laboratory exercises, including Electrocardiogram (ECG) interpretation and analysis, spirometry to measure lung volumes and capacities, measurement of basal metabolic rate (BMR), determination of renal function through assessment of urine analysis findings, and interpretation of electromyography (EMG) recording and analysis of muscle activity. In addition to laboratory exercises, workshops will be conducted to further enhance understanding of integrated physiology. These workshops provide interactive learning experiences and foster critical thinking and problem-solving skills. Students will participate in small group activities to tackle physiological problems and case scenarios, analyze and interpret data, and undertake research projects focused on specific topics within integrated physiology. These workshops promote collaborative exploration and application of knowledge, allowing students to develop a deeper understanding of the complexities of integrated physiology.
Teaching Methodology	The teaching methodology in the field of integrated physiology combines lectures on the theoretical background with laboratory exercises and experiments to enhance students' understanding and comprehension of human physiology. The lectures are accompanied by detailed notes that incorporate image-rich material and short animations, promoting a visual

	and integrated approach to studying physiology. Through in-class discussions, students are actively engaged, encouraged to participate, answer questions, and critically analyse information. To cultivate students' practical skills, laboratory exercises are conducted by the students themselves in the well-equipped Multidisciplinary Laboratory, under the guidance and supervision of experienced teaching personnel. Prior to each laboratory exercise, the laboratory staff ensures appropriate preparation and provides demonstrations to familiarize students with the experimental procedures. The assessment of laboratory exercises is conducted through the submission of comprehensive laboratory reports, enabling students to demonstrate their practical application of the concepts learned. This teaching methodology in integrated physiology aims to create a holistic learning experience. By combining theoretical lectures with hands-on laboratory exercises, and workshops students develop a deep understanding of human physiology and gain practical skills in experimental techniques and data analysis. The integrated approach encourages students to connect theoretical concepts with real-world applications, fostering critical thinking, problem-solving abilities, and a comprehensive understanding of the field. Through active participation in laboratory exercises, students not only acquire knowledge but also develop essential skills that are relevant to their future careers in the field of integrated physiology.
Bibliography	(a) Textbooks: 1. CARROLL, Robert G. Elsevier's Integrated Physiology E-Book. Elsevier Health Sciences, 2006. (b) References: A list of recently published articles will be provided for further reading.
Assessment	For student evaluation, the overall grade is determined by a written midterm exam (20%), a laboratory grade (20%) and a written final exam (60%). The mid-term exam is carried out between the 6th and 8th week, and it mainly includes short answer questions and problem- solving questions and examines most modules of the course. As far as the laboratory grade is concerned, it comprises of the evaluation of the laboratory reports (60% of the laboratory grade) submitted by the students for each experiment and a final laboratory examination (40% of the laboratory grade) which mainly includes short answer questions and problem-solving questions. In the laboratory reports, students are asked to describe the experiment procedure, to evaluate and analyse their results and to answer specific questions. The following criteria are considered when evaluating laboratory reports: (a) experimental data collection (30%), (b) data analysis (40%), and application of theory to draw conclusions (30%). The final exam of the course is carried out during the 14th-16th week of each semester, and it includes short answer questions, critical thinking questions, and problem-solving questions regarding all course modules.

	The final assessment of the students is formative and summative and complies with the subject's expected learning outcomes and the quality of the course.
Language	Greek, English