



Physiology with pathophysiology elements

1. IMPRINT	
Academic Year	2024/2025
Department	Faculty of Medicine
Field of study	Medicine
Main scientific discipline	<i>Medical Sciences</i>
Study Profile	<i>general academic</i>
Level of studies	<i>uniform MSc</i>
Form of studies	Full time studies
Type of module / course	<i>obligatory</i>
Form of verification of learning outcomes	<i>exam</i>
Educational Unit / Educational Units	<i>Chair and Department of Experimental and Clinical Physiology (1MA) ul. Pawińskiego 3c 02-106 Warszawa</i>
Head of Educational Unit / Heads of Educational Units	Agnieszka Cudnoch-Jędrzejewska, MD, PhD, Professor
Course coordinator	<i>Kaja Kasarełło, PhD, kaja.kasarello@wum.edu.pl Michał Kowara, MD, PhD, michal.kowara@wum.edu.pl</i>
Person responsible for syllabus	<i>Kaja Kasarełło, PhD, kaja.kasarello@wum.edu.pl Michał Kowara, MD, PhD, michal.kowara@wum.edu.pl</i>
Teachers	Agnieszka Cudnoch-Jędrzejewska, MD, PhD, Professor; Emilian Snarski, MD, PhD, Professor; Paweł Zalewski, PhD, Professor; Kasper Buczma, MD; Katarzyna Kamińska, PhD; Kaja Kasarełło, PhD; Michał Kowara, MD, PhD; Jagoda Kruszewska, MD; Longin Niemczyk, MD, PhD; Jan Pawlonka, MD; Katarzyna Romanowska-Próchnicka, MD, PhD; Ewa Sikorska, MD; Aleksandra Stangret, PhD; Mateusz Szudzik, PhD; Małgorzata Wojciechowska, MD, PhD; Agnieszka Wsół, MD, PhD.; Anna Zalewska-Żmijewska, MD, PhD; Tymoteusz Żera, MD, PhD;

2. BASIC INFORMATION			
Year and semester of studies	2nd year - 3rd and 4th semester	Number of ECTS credits	19.00
FORMS OF CLASSES		Number of hours	ECTS credits calculation
Contacting hours with academic teacher			
Lecture (L)		65	3
Seminar (S)		65	1
Classes (C)		-	-
e-learning (e-L)		-	-
Practical classes (PC)		90	8
Work placement (WP)		-	-
Unassisted student's work			
Preparation for classes and completions		280	7

3. COURSE OBJECTIVES	
O1	Explain physiological mechanisms by applying basic principles of physics and chemistry, describe the fundamental mechanisms underlying normal function of cells, tissues, organs, and organ systems of the human body, commensurate with the requirements for a physician providing primary care to patients.
O2	Explain the basic mechanisms of homeostasis by integrating the functions of cells, tissues, organs, and organ systems.
O3	Apply knowledge of functional mechanisms and their regulation to explain the pathophysiology underlying common diseases.

4. STANDARDS OF LEARNING – DETAILED DESCRIPTION OF EFFECTS OF LEARNING	
Code and number of the effect of learning in accordance with standards of learning	Effects in the field of: <i>(in accordance with appendix to the Regulation of Minister of Science and Higher education from 26th of July 2019)</i>
Knowledge – Graduate* knows and understands:	

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B.W1	water-electrolytes homeostasis in biological systems
B.W2	acid-base balance, functions of buffer solutions and their role in homeostasis
B.W3	definitions of: solubility, osmotic pressure, isotonicity, colloid solutions and Gibbs-Donnan effect
B.W7	physicochemical and molecular basis of the functioning of sensory organs
B.W16	metabolic profiles of the main organs and systems
B.W20	action potential, synaptic transmission and maintenance of nerve function, striated and smooth muscles function and blood function
B.W21	regulatory mechanisms of all organs and systems in human body including: circulatory system, respiratory system, alimentary system, urinary system and skin; relationship between these mechanisms
B.W22	physiology and regulation of reproductive functions of women and men
B.W23	mechanisms of aging of the body
B.W24	main quantitative parameters describing the capacity of particular systems and organs, including scopes of the standard and demographic factors affecting values of such parameters
B.W25	relationship between factors dysregulating homeostasis and physiological as well as pathophysiological changes
C.W6	genetic conditions of human blood groups and the Rhesus incompatibility
C.W27	basic mechanisms of cell and tissue damage
C.W29	definition and pathophysiology of shock, especially the differential diagnosis of shock and multiorgan failure
C.W30	etiology of hemodynamic disorders, regressive and progressive changes
C.W32	consequences of pathological processes at certain localization in the organism to surrounding organs
C.W33	external and internal disease agents, modifiable and non-modifiable
C.W34	clinical forms of the most frequent diseases of particular systems and organs, metabolic diseases, as well as water, electrolyte and acid-base balance disturbances
C.W45	symptoms of the most common acute intoxications, including intoxication with alcohol, drugs and other psychoactive substances, heavy metals and selected groups of medicines
C.W47	influence of oxidative stress on cells and its impact on pathogenesis of diseases and in aging processes
C.W48	consequences of deficiency or excess of vitamins and minerals in human organism
C.W49	enzymes participating in digestion, mechanism of hydrochloric acid production in the stomach, the role of bile, the course of digestion products' intestinal absorption
C.W50	consequences of improper nutrition, including long-term starvation, oversized meals, unbalanced diet as well as disorders of digestion and absorption of digestion products
C.W51	mechanism of hormone activity

Skills– Graduate* is able to:

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B.U1	use the knowledge of the laws of physics to explain the effects of external factors such as temperature, acceleration, pressure, electromagnetic fields and ionizing radiation on the body and its components
B.U7	perform simple functional tests assessing human body as a stable regulatory system (stress tests, exercise tests) and interpret numerical data on basic physiological variables
B.U9	use simple measuring instruments and evaluate the accuracy of performed measurements
C.U11	associate the images of tissue and organ damage with the clinical symptoms of the disease, history and laboratory test results
C.U20	describe changes in the functioning of the body in the event of disturbed homeostasis, in particular define its integrated response to physical exertion, exposure to high and low temperature, loss of blood or water, sudden upright standing, transition from sleep to wakefulness

* In appendix to the Regulation of Minister of Science and Higher education from 26th of July 2019 „graduate”, not student is mentioned.

5. ADDITIONAL EFFECTS OF LEARNING (non-compulsory)	
Number of effect of learning	Effects in the fields of:
Knowledge – Graduate knows and understands:	
K1	Define thesis, understand the difference between law, theory and hypothesis, define strong and weak points of hypotheses.
K2	
Skills– Graduate is able to:	
S1	Predict physiological reactions in different situations
S2	
Social Competencies – Graduate is ready for:	
SC1	Perform constructive discussion about scientific theory or hypothesis
SC2	

6. CLASSES		
Form of class	Class contents	Effects of Learning
Seminar and class	Block 1. Week 1: Cell physiology. Extracellular and intracellular fluid composition. Transport of the substances across cell membranes – functional properties of the cell membrane, diffusion, active transport of substances across membrane. Ion channels function and classification. Donnan equilibrium. Origin of the resting potential. Equilibrium potential for potassium ions. Characteristics of potassium channels responsible for the resting potential. Threshold potential. Origin of the action potential.	B.W3, B.W20, B.W21 B.U1

	<p>Equilibrium potential for sodium ions. Characteristics of channels participating in different phases of the action potential. Differences between the resting and action potential in excitable cells. Channelopathies (Bartter's syndrome, Brugada disease, cystic fibrosis, long and short QT syndrome, malignant hyperthermia, migraine, myasthenia).</p>	
Seminar and class	<p>Block 1. Week 2: Autonomic nervous system. Physiology of myocytes – smooth myocytes, skeletal myocytes, cardiomyocytes.</p> <p>Autonomic nervous system General organization of the autonomic nervous system. Neurotransmitters and autonomic ganglia. Basic characteristics of sympathetic and parasympathetic function. Selective stimulation of target organs by sympathetic and parasympathetic systems or “mass discharge”. Autonomic system impact on different tissues and organs. Atropine, muscarine and phosphoroorganic compounds intoxication. Horner syndrome.</p> <p>Physiology of myocytes – smooth myocytes, skeletal myocytes, cardiomyocytes. Physiological anatomy of skeletal muscle. Central mechanism of muscle contraction. Molecular mechanism of muscle contraction. Energetics of muscle contraction. Characteristics of the whole muscle contraction. Neuromuscular junction and transmission of impulses from nerve endings to skeletal muscle fibers. Muscle action potential. Excitation-contraction coupling. Contraction of smooth muscle. Regulation of contraction by calcium ions. Nervous and hormonal control of smooth muscle contraction. Physiology of cardiac muscle.</p>	B.W20, B.W21, B.U1, B.U7, B.U9, C.U11, C.W45
Seminar and class	<p>Block I. Week 3: Physiology and pathophysiology of blood.</p> <p>Blood composition. Blood proteins and their functions. Role of erythropoietin. Structure and functions of erythrocytes. Classification of leukocytes. Functions of platelets. Iron turnover. Hemoglobin – types and characteristics, hemoglobin dissociation curve. Oxygen and carbon dioxide transport in blood. O-A-B blood types. Rh blood types. Basic diagnostic tests – erythrocyte sedimentation rate (ESR), hematocrit, resistance of erythrocytes to hemolysis – application. Alterations in red cells system – anemias, polycythemias. Hemoglobinopathies. Alterations in white cells system – leukocytosis, leukopenia. Main serological conflicts.</p>	B.W21, B.W24, B.W25, B.U1, B.U7, B.U9, C.W6, C.W27, C.W32, C.W33, C.W34, C.W48, C.W50, C.U11, C.U20
Seminar and class	<p>Block I. Week 4: Physiology of cardiovascular system – part I. Cardiac muscle – the heart as a pump and the function of the heart valves. Rhythmical excitation of the heart. Cardiac output. Overview of the circulation.</p> <p>Cardiac cycle. Specialized excitatory and conductive system of the heart. Control of excitation and conduction in the heart. Physical characteristics of the circulation. Normal values for cardiac output at rest and during activity. Control of cardiac output by venous return – Frank-Starling mechanism of the heart. Main cardiac hemodynamics parameters – end-diastolic and end-systolic volume,</p>	B.W16, B.W20, B.W21, B.W23, B.W24, B.W25, B.U1, B.U7, B.U9,

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	stroke volume, cardiac output, ejection fraction, contraction frequency. Preload and afterload. Regulation of cardiac muscle contraction – contractility (homeometric regulation), Frank-Starling law (heterometric regulation). Influence of afterload on muscle shortening velocity (Hill’s equation). Circulation – arteries, veins, capillaries. Vascular distensibility. Arterial pressure pulsations. Veins and their function Blood flow, velocity, resistance, pressure. Flow continuity equation. Poiseuille equation. Laminar and turbulent flow.	
Seminar and class	<p>Block I. Week 5: Physiology of cardiovascular system – part II. Nervous and humoral regulation of cardiovascular system activity. Sympathetic and parasympathetic innervation of the heart. Innervation of arteries and veins. Pre- and postsynaptic receptors and neurotransmitters.</p> <p>Humoral control of the tissue blood flow – vasoconstrictors, vasodilators, vascular control by ions and other chemical factors. Nervous regulation of the circulation. Special features of nervous control of arterial pressure. Renal-body fluid system for arterial pressure control. Role of the renin-angiotensin system in arterial pressure control. Summary of integrated multifaceted systems for arterial pressure regulation. Definition of the “set-point” of blood pressure. Blood pressure “set-point” changes during visceral and cutaneous pain, carotid sinus syndrome, brain hypoxia, increase of intracranial pressure (Cushing’s sign), changes in oxygen and carbon dioxide level in arterial blood. Orthostatic hypotension.</p>	B.W16, B.W20, B.W21, B.W23, B.W24, B.W25, B.U1, B.U7, B.U9, C.U20
Seminar and class	<p>Block I. Week 6: Physiology of cardiovascular system III. Principles of electrocardiography.</p> <p>Fundamentals of electrocardiography – waveforms of the normal electrocardiogram. Flow of the current around the heart during the cardiac cycle. Electrocardiographic leads. Vectorial analysis of the normal electrocardiogram. Mean electrical axis of the ventricular QRS and its significance. Structure and properties of heart conduction system. Sinus rhythm. Physical and electrophysiological basis of electrocardiography. Defibrillation and electrical cardioversion. Pathological ECG recordings: rhythm and conduction disturbances: respiratory sinus arrhythmia, bradycardia, tachycardia, supraventricular arrhythmias (supraventricular extrasystoles, atrial flutter, atrial fibrillation), ventricular arrhythmias (ventricular extrasystoles, ventricular tachycardia, ventricular fibrillation), atrioventricular blocks (1st, 2nd and 3rd degree), asystole, ischemia and electrolyte balance disturbances, pre-excitation.</p>	B.W16, B.W20, B.W21, B.W23, B.W24, B.W25, B.U1, B.U7, B.U9, C.W27, C.W30, C.W32, C.U11
Seminar and class	<p>Block I. Week 7: Physiology of cardiovascular system IV. Role of endothelium in vascular lumen regulation. Regulation of circulation in different organs. Microcirculation. Pathophysiology of the shock.</p> <p>Local control of blood flow in response to tissue needs. Mechanisms of blood flow control – acute control of local blood flow, long-term blood flow regulation. Control of tissue blood flow – endothelium-derived constricting and relaxing factors (nitric oxide, prostaglandins, prostacycline, thromboxane, endothelin, adenosine). Special mechanisms for acute blood flow control in specific tissues (kidney, brain, skin). Structure of the microcirculation and capillary system. Flow of blood in the capillaries – vasomotion. Exchange of water, nutrients</p>	B.W16, B.W20, B.W21, B.W23, B.W24, B.W25, B.U1, B.U7, B.U9, C.W27, C.W29, C.W30, C.W32, C.W33, C.W34, C.U11, C.U20

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	<p>and other substances between the blood and interstitial fluid. Interstitium and interstitial fluid. Fluid filtration across capillaries. Lymphatic system. Mechanism of edema generation: hydrostatic, oncotic, lymphatic. Blood flow regulation in skeletal muscle at rest and during exercise. Coronary circulation – physiology, physiological control, cardiac muscle metabolism. Circulatory shock and its treatment.</p>	
Seminar and class in center of stimulation	<p>Block I. Week 8: Pathophysiology of cardiovascular system.</p> <p>Pathophysiology in clinical cases - analysis of clinical cases of cardiovascular system pathologies.</p>	<p>B.W16, B.W20, B.W21, B.W23, B.W24, B.W25, B.U1, B.U7, B.U9, C.W27, C.W30, C.W32, C.W33, C.W34, C.W47, C.U11, C.U20</p>
Seminar and class	<p>Block I. Week 9: 1st Midterm – themes from the 1st Block.</p>	<p>B.W3, B.W7, B.W20, B.W21, B.W24, B.W25, B.U1 B.U7, B.U9, C.W27, C.W32, C.W33, C.W34, C.W45, C.U11, C.U20</p>
Seminar and class	<p>Block II. Week 10: Physiology and pathophysiology of urinary system.</p> <p>Kidney structure and vasculature. Nephron as a basic functional unit of kidney. Mechanism of primary urine formation (glomerular filtration: filtration membrane, effective filtration pressure). Creatinine clearance – methods of calculation, Cocroft-Gault formula, MDRD formula. Final urine formation (tubular transport). Renal blood flow regulation and its autoregulation. Pressure diuresis. Other causes of diuresis change. Neurogenic regulation of renal flow and tubular transport (renal innervation, reflexive regulation). Hormonal and humoral regulation of renal flow and tubular transport (renin-angiotensin-aldosterone system, vasopressin, endothelins, nitric oxide, natriuretic peptides, dopamine, adrenomedullin, cytokines). Urine concentrating and diluting mechanisms (countercurrent multiplication, countercurrent exchange, urea recycling). Calcium and phosphate balance regulation by kidney. Hormonal functions of kidney - erithropoietin, vitamin D. Role of kidney in blood pressure regulation. Pathophysiology - Polyuria, oliguria, anuria. Diabetes insipidus (central and renal form). Acute kidney failure and chronic kidney disease, proteinuria. Nephritic and nephrotic syndrome. Nephrolithiasis. Influence of uremia on the whole organism. Cystitis and urinary tract infection.</p>	<p>B.W1, B.W2, B.W3, B.W21, B.W24, B.W25, B.U1, B.U7, C.W27, C.W32, C.W33, C.W34, C.W45, C.U11, C.U20</p>
Seminar and class	<p>Block II. Week 11: Physiology and pathophysiology of water, electrolyte and acid-base balance</p> <p>Water and electrolyte balance. Body fluid compartments – volumes and composition. Body fluids ion composition and osmolarity. Transport of osmotically active substances across biological membranes – regulation. Mechanisms regulating water and electrolytes intracorporeal translocations. Mechanisms regulating cellular volumes. Water, sodium, potassium, calcium and phosphate balance. Mechanisms regulating water and sodium balance. Dehydration and overhydration – types, mechanisms and consequences. Electrolyte balance disturbances – hiper- and hyponatremia, hyper- and hypokaliemia, hyper- and hypocalcemia, hyper- and hypomagnesemia). Acid-base balance. Volatile and non-volatile acids. Inter- and intracellular buffering systems. Role of kidney and respiratory system in pH maintenance. Acid-base balance – methods of assessment. Cerebrospinal fluid pH regulation. Primary and</p>	<p>B.W1, B.W2, B.W3, B.W21, B.W24, B.W25, B.U1, B.U7, C.W27, C.W32, C.W33, C.W34, C.W45, C.U11, C.U20</p>

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	secondary acid-base balance disturbances: acidosis (respiratory, metabolic – causes), alkalosis (respiratory, metabolic – causes). Compensatory mechanisms in primary acid-base balance disturbances (rules of respiratory and renal compensation). Influence of acid-base balance disturbances on electrolyte balance.	
Seminar and class	Block II. Week 12: Respiratory system – anatomical and biophysical basis of respiration. Mechanisms of pulmonary ventilation. Pulmonary volumes and capacities. Alveolar ventilation. Anatomy of the respiratory system. Structure and function of bronchial tree. Respiratory tracts innervation. Structure and function of pulmonary alveolus. . Respiratory system resistances. Surface tension. Surfactant. Respiratory muscles work. Pulmonary leakage. Pulmonary circulation. Pulmonary vessels walls structure. Pressure and flow resistance in pulmonary circulation. Pulmonary vessels diameter regulation, influence of oxygen pressure on pulmonary vessels smooth muscles. Neuronal and humoral regulation of respiratory system activity. Regulation of respiration, generation of respiratory pattern. Regulation of respiratory center; central and peripheral receptors. Airways and lungs receptors and associated reflexes – cough, yawn, reaction to toxic substances inspiration).	B.W16, B.W20, B.W21, B.W24, B.W25, B.U1
Seminar and class	Block II. Week 13: Respiratory system – clinical physiology and pathophysiology. Respiratory system basic diagnostic tests (spirometry). Difference between obturation and restriction. Spirometry testing (obturation reversibility, provocation tests). Plethysmography in restrictive diseases diagnostics. Mechanism of lungs artificial ventilation. Acute and chronic respiratory failure. Pathophysiology of respiratory system inflammatory diseases (laryngitis, bronchitis, pneumonia). Pathophysiology of obstructive and restrictive diseases (bronchial asthma, COPD, emphysema, pneumoconiosis, pneumonia, viral respiratory infections – COVID-19 and others, tuberculosis). Cystis fibrosis. Pulmonary embolism (PE). Pathological respiratory patterns. Obstructive sleep apnea. Nicotinismus. Acute Mountain Sickness (AMS).	B.W16, B.W20, B.W21, B.W24, B.W25, B.U1, B.U7, B.U9, C.W27, C.W30, C.W32, C.W33, C.W34, C.W47, C.U11, C.U20
Seminar and class in center of stimulation	Block II. Week 14: Integrative physiology - respiratory system pathophysiology, urinary system pathophysiology, acid-base balance disturbances. Pathophysiology in clinical cases - analysis of clinical cases of respiratory system pathologies, urinary system pathologies and acid-base balance disturbances	B.W16, B.W20, B.W21, B.W23, B.W24, B.W25, B.U1, B.U7, B.U9, C.W27, C.W30, C.W32, C.W33, C.W34, C.W47, C.U11, C.U20
Seminar and class	Block II. Week 15: 2nd Midterm – themes from the 2nd Block.	B.W16, B.W20, B.W21, B.W23, B.W24, B.W25, B.U1, B.U7, B.U9, C.W6, C.W27, C.W29, C.W30, C.W32, C.W33, C.W34, C.W47, C.U11, C.U20
Seminar and class	Block III. Week 16: Neuron physiology. Neurotransmission systems of the brain	B.W20, B.W21, B.U1, C.W45

	<p>Neuron physiology. Neuron and its properties. Functional and structural classification of neurons. Definitions of terms: stimulus, excitability, nerve impulse. Structure of peripheral nerves, types of nerve fibers and their characteristics. Classification of nerve fibers. Mechanism of transmission of excitation along nerve fibers. Continuous and saltatory conduction. Factors influencing the speed of impulse conduction along nerve fiber. Characteristics of dendrites and their function. Classification of electrical and chemical synapses. Mechanism of neurotransmitter release - vesicular cycle. Synaptic plasticity, factors regulating the process of synaptogenesis. Nerve regeneration.</p> <p>Neurotransmission systems of the brain. Acetylcholine, catecholamines, serotonin, excitatory and inhibitory amino acids. Nitrogen oxide - synthesis and inactivation. Location of neurons producing a given type of neurotransmitter. Projections of the neurotransmitters in the central nervous system. Cotransmitters. Pre- and postsynaptic receptors. Participation of neurotransmitters in the regulation of physiological processes. The influence of psychoactive substances on neurotransmission pathways.</p>	
Seminar and class	<p>Block III. Week 17: Physiology of the motor system - part II. Motor functions at the level of spinal cord, cortex, brainstem, basal ganglia and cerebellum.</p> <p>Organization of the spinal cord for motor functions. Muscle sensory receptors – muscle spindles and Golgi tendon organs and their roles in muscle control. Flexor reflex and the withdrawal reflexes. Crossed extensor reflex. Reciprocal inhibition and reciprocal innervation. Reflexes of posture and locomotion. Motor cortex and corticospinal tract. Control of motor functions by the brain stem. Vestibular sensation and the maintenance of equilibrium. The cerebellum and its motor functions. The basal ganglia and their motor functions. Integration of the many parts of the total motor control system.</p>	B.W20, B.W21, B.U1, B.U7, B.U9
Seminar and class	<p>Block III. Week 18: Pathophysiology of the motor system</p> <p>Pre- and postsynaptic disturbances of neuromuscular junction (myasthenia gravis, Lambert-Eaton syndrome, botulism). Myopathies. Channelopathies of striated muscles. Multiple sclerosis. Pyramid tracts lesion. Pathophysiology of selected extrapyramidal system diseases: Parkinson's disease, Huntington's disease, hemiballismus, essential tremor, cerebellar ataxia. Decerebration. Pathological nystagmus. Motion sickness.</p>	B.W20, B.W21, B.U1, B.U7, B.U9, C.W27, C.W32, C.W33, C.W34,
Seminar and class	<p>Block III. Week 19: Physiology and pathophysiology of sensory system. Physiological and pathological pain.</p> <p>Types of sensory receptors and the stimuli they detect. Transmission of sensory stimuli into nerve impulses. Signal intensity transmission in nerve tracts – spatial and temporal summation. Classification of somatic senses. Detection and transmission of tactile sensations. Sensory pathways for transmitting somatic signals into the central nervous system. Transmission in the dorsal column-medial lemniscal system. Transmission of sensory signals in the anterolateral pathway. Somatosensory cortex lesions. Lesions of sensory integration,</p>	B.W20, B.W21, B.W25, B.U1

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	<p>autism and Asperger syndrome</p> <p>Fast pain and slow pain and their qualities. Pain receptors and their stimulation. Dual pathways for transmission of signals into central nervous system. Pain suppression (analgesia) system in the brain and in the spinal cord. Referred pain. Visceral pain. Thermal sensations. Practical issues - pathological pain, principles of pain treatment: analgetic ladder, opioids in treatment of acute and chronic pain.</p>	
Seminar and class	<p>Block III. Week 20: Physiology and pathophysiology of sensory system. Vision, hearing, taste and smell.</p> <p>Physical principles of optics. Optics of the eye. Fluid system of the eye – intraocular fluid.</p> <p>Anatomy and function of the structural elements of the retina. Photochemistry of vision. Color vision. Eye adaptation to light and darkness. Visual field (stereoscopic vision).</p> <p>Neural function of the retina.</p> <p>Visual pathways. Organization and function of the visual cortex. eye movements and their control. Autonomic control of accommodation and pupillary aperture.</p> <p>Eye refractive errors – nearsightedness (myopia), farsightedness (hyperopia), astigmatism. Strabismus. Cataracts. Glaucoma. Retinal Detachment. Night blindness. Color blindness.</p> <p>Tympanic membrane and the ossicular system. Cochlea. Corti’s organ. Endolymph and perilymph. Mechanism of acoustic waves conversion into electric impulses. Central auditory mechanisms. Vestibular sensation and the maintenance of equilibrium . Basis of laryngological examination – hearing tests. Conductive and sensorineural hearing loss. Hearing aids and cochlear implants.</p> <p>Sense of taste. Sense of smell.</p>	B. W7, B.U1, B.U9
Seminar and class	<p>Block III. Week 21: Cerebral cortex, intellectual functions of the brain, learning and memory. Limbic system. Behavior. Sleep. Basis of the bioelectric activity of brain (EEG). Pathophysiology – sleep disturbances, amnesia, dementia, mood disturbances, psychosis.</p> <p>Characteristics of limbic system. Function of prefrontal cortex. Congenital behavior: unconditional reflex, instinct, imprinting, impulse. Adaptive behavior (classical and instrumental conditioning). Reward system. Definition of learning and memory. Division and types of memory. Anatomy of memory. Long-term potentiation and long-term depression.. Retrograde and anterograde amnesia. Results of prefrontal cortex, hippocampus and surrounding temporal lobes damage. Results of amygdala damage. Amnestic syndromes (Alzheimer’s disease, vascular dementia, Lewy body dementia).</p> <p>Sleep.. Role of reticular system in regulation of sleep and wake. Examination of cerebral bioelectric activity by electroencephalography (EEG). Stages of sleep in human. Characteristics and physiological meaning of REM and NREM sleep. Biological rhythms disturbances – jet lag. Sleep deprivation, narcolepsy, somnambulism. EEG record abnormalities. Epilepsy and its types.</p>	B.W20, B.W24, B.W25, B.U9, C.W32, C.W33, C.W34, C.U11, C.U20
Seminar and class	<p>Block III. Week 22: 3rd Midterm – themes from the 3rd Block.</p>	B.W3, B.W7, B.W20, B.W21, B.W24, B.W25, B.U1 B.U7, B.U9,

		C.W27, C.W32, C.W33, C.W34, C.W45, C.U11, C.U20
Seminar and class	<p>Block IV. Week 23: Physiology and pathophysiology of gastrointestinal system</p> <p>Neurohormonal regulation of food intake. Autonomic intestinal system. Gastrointestinal and biliary system motility. Secretory function of digestive glands – saliva excretion, gastric, pancreatic and intestinal secretion). Interaction between endocrine and exocrine pancreatic secretion. Structure and function of liver. Digestion and absorption (water, electrolytes, vitamins, minerals, carbohydrates, proteins, fats). Hepatic circulation – anatomic and functional peculiarities. Disturbances of gastrointestinal motility function (vomiting, diarrhea, constipation, achalasia, GERD, peptic ulcers). Gastric and duodenal ulcer disease. Pathophysiology of liver, gall bladder and biliary ducts (jaundice, viral hepatic diseases, acute liver failure, liver cirrhosis and portal hypertension, cholecystitis, autoimmune liver disease, Wilson’s disease, non-alcoholic fatty liver disease)). Pathophysiology of pancreas (acute and chronic pancreatitis). Intestinal inflammation – Lesniowski-Crohn’s disease, ulcerative colitis) – Disturbances of digestion and absorption (celiac disease, pernicious anemia). Gastrointestinal neoplastic diseases.</p>	B.W21, B.W24, B.W25, B.U7, C.W27, C.W32, C.W33, C.W34, C.W48, C.W49, C.W50, C.U11
Seminar and class	<p>Block IV. Week 24: Endocrine system part I. Hypothalamic-pituitary-thyroid axis, Hypothalamic-pituitary-suprarenal axis – physiology and pathophysiology. Hypothalamic and pituitary hormones.</p> <p>Hypothalamic-pituitary-thyroid axis. TRH and TSH – activity and regulation of secretion. Thyroid hormones regulatory function. Interaction between thyroid and other hormones. Hypothalamic-pituitary-suprarenal axis. CRH and ACTH – activity and regulation of secretion. Mineralocorticoids and glucocorticoids – regulatory function. Hyperprolactinemia. Cushing’s syndrome and Cushing’s disease. Conn’s syndrome. Hyperthyroidism and hypothyroidism. Suprarenal cortex and medulla disturbances.</p>	B.W21, B.W24, B.W25, B.U7, C.W27, C.W32, C.W34, C.W51, C.U11
Seminar and class	<p>Block IV. Week 25: Endocrine system part II. Pancreatic endocrine function. Endocrine regulation of growth and metabolism. Stress phenomenon.</p> <p>Endocrine regulation of growth and metabolism. Growth hormone – regulation of secretion and mechanism of action. Specificity and selectivity of individual growth factors activity in organs and tissues. Gigantism, acromegaly, pituitary dwarfism. Pancreas as endocrine organ (glucagon and insulin). Type 1 and type 2 diabetes mellitus. Hypoglycemia. Islet cells tumors (insulinoma, gastrinoma). Theories of stress. Adaptative function of stress. Stress hormones (hypothalamic-pituitary-suprarenal axis, ADH). Brain neurotransmission systems alterations and sympathetic system excitement during stress. Human organism’s reaction to acute and chronic stress. Stress influence on cardiovascular and psychiatric disorders development. PTSD.</p>	B.W16, B.W21, B.W24, B.W25, B.U7, C.W27, C.W32, C.W34, C.W51, C.U11

Załącznik nr 4C do Procedury opracowywania i okresowego przeglądu programów studiów
(stanowiącej załącznik do Zarządzenia nr .../2024 Rektora WUM z dnia2024 r.)

Seminar and class	<p>Block IV. Week 26: Physiology and pathophysiology of reproductive system, pregnancy and bird. Lactation. Endocrine regulation of reproductive function. Sex hormones in men and women – mechanism of action and regulation of secretion. Menstrual cycle (hormone levels alterations, endometrial alterations, vaginal mucosal alterations). Maturation and puberty. Menopause. Andropause. Klinefelter Syndrome, Turner Syndrome, true hermaphroditism, pseudohermaphroditism, hypogonadism, hyperprolactinemia, endometriosis. Fertilization and zygote implantation. Uterine-fetal unit (exchange between mother and fetus, hormones of uterine-fetal unit). Development of the fetus. Alterations in pregnant woman’s organism (hormonal, metabolic, cardiovascular, respiratory, genitourinary, gastrointestinal and nervous system). Birth. Lactation. Female and male infertility. Miscarriage risk factors. Gestational diabetes and hypertension.. Ectopic pregnancy., Fetal Alcoholic Syndrome (FAS), Fetal hypotrophy. Prematurity – causes and long-term consequences.</p>	B.W21, B.W22, B.W23, B.W24, B.W25, B.U7, C.W33, C.W51, C.U11
Seminar and class	<p>Block IV. Week 27: Resting and exercise energy expenditure. Thermoregulation. Obesity. Metabolic disturbances. Central regulation of hunger and satiety. Fat tissue as a source and target of hormones. Basic and rest metabolism. Energetic balance of the organism. Rules of proper nutrition. Metabolic disorders. Obesity and malnutrition. Heat production and exchange with environment. Heat balance. Internal and skin temperature. Internal temperature alterations – tolerance limits. Thermoregulation system – mechanism of action central and peripheral thermoreceptors, cerebral thermoregulation center. Role of cutaneous circulation in thermoregulation. Regulation of perspiration. Human organism reaction to heat and cold. Acclimatization to cold and hot temperatures. Hypothermia. Hyperthermia (heat shock – mechanism, diagnosis). Malignant hyperthermia. Fever.</p>	B.W20, B.W21, B.W24, B.W25, B.U9, C.W33, C.W34, C.W50, C.W51, C.U11, C.U20.W20, B.W21, B.W24, B.W25, B.U9, C.W33, C.W34, C.W50, C.W51, C.U11, C.U20
Seminar and class	<p>Block IV. Week 28: Physiology of physical exercise. Male and female athletes. Muscles in exercise – strength, power, endurance of muscles, muscles metabolic systems. Nutrients used during muscles activity. Effects of athletic training on muscles and muscle performance. Cardiovascular system in exercise. Body heat in exercise. Body fluids and salt in exercise. Drugs and athletes. Body fitness benefits.</p>	B.W1, B.W2, B.W16, B.W20, B.W21, B.W23, B.W24, B.W25, B.U7, B.U9, C.W27, C.W30, C.W33, C.U11, C.U20
Seminar and class	<p>Block IV. Week 29: 4th Midterm – themes from the 4th Block.</p>	B.W1, B.W2, B.W3, B.W16, B.W20, B.W21, B.W22, B.W23, B.W24, B.W25, B.U1, B.U7, B.U9, C.W27, C.W30, C.W32, C.W33, C.W34, C.W45, C.W48, C.W49, C.W50, C.W51, C.U11, C.U20
Seminar and class	<p>Summary seminar – final seminar for the entire course. Retakes.</p>	B.W1, B.W2, B.W3, B.W16, B.W20, B.W21, B.W22, B.W23, B.W24, B.W25, B.U1, B.U7, B.U9, CW.27, C.W30, C.W32, C.W33, C.W34, C.W45, C.W48, C.W49, C.W50, C.W51, C.U11, C.U20

Załącznik nr 4C do Procedury opracowywania i okresowego przeglądu programów studiów
(stanowiącej załącznik do Zarządzenia nr .../2024 Rektora WUM z dnia2024 r.)

Lecture	Inauguration lecture	
Lecture	Hemostasis. Hemostatic disorders	B.W21, B.W25, C.W27, C.W33, C.W34
Lecture	Hematologic disorders	B.W25, C.W6, C.W34
Lecture	Short- and long-term regulation of blood pressure. Arterial hypertension.	B.W1, B.W20, B.W21, B.W24, B.W25, C.W30, C.W32, C.W33, C.W34
Lecture	Pulmonary circulation. Deep vein thrombosis and pulmonary embolism. Pulmonary hypertension.	B.W21, B.W25, C.W27, C.W33, C.W34
Lecture	Electrocardiography	B.W20, B.W25, C.W32, C.W45
Lecture	The conducting system of the heart. Mechanisms of cardiac arrhythmia. The examples of the most common arrhythmia.	B.W1, B.W20, B.W21, B.W24, B.W25, C.W30, C.W32, C.W33, C.W34
Lecture	Pathophysiology of the most common heart diseases	B.W21, B.W25, C.W29, C.W30, C.W32, C.W33, C.W34
Lecture	Coronary artery disease. Myocardial infarction.	B.W21, B.W24, B.W25, C.W30, C.W32, C.W33, C.W34
Lecture	Pathophysiology of acute and chronic heart failure.	B.W21, B.W24, B.W25, C.W30, C.W32, C.W33, C.W34
Lecture	The pathophysiology of the most common respiratory system diseases. Basic diagnostic tests. Mechanical ventilation.	B.W21, B.W24, B.W25, C.W30, C.W32, C.W33, C.W34
Lecture	Pathophysiology of urinary tract diseases. Basic diagnostic tests.	B.W1, B.W2, B.W21, B.W24, B.W25, C.W30, C.W32, C.W33, C.W34
Lecture	Brain neuroplasticity. Developmental disorders of plasticity.	B.W20, B.W21, B.W25, C.W27, C.W32, C.W34
Lecture	Behaviour. Limbic system. Prefrontal cortex. Neurobiology of speech.	B.W20, B.W21, B.W25, C.W27, C.W32, C.W34
Lecture	Neurodegenerative diseases.	B.W20, B.W21, B.W25, C.W27, C.W32, C.W34
Lecture	Consciousness and awareness. Disturbances of consciousness.	B.W20, B.W21, B.W25, C.W27, C.W32, C.W34
Lecture	Neurodegeneration in ophthalmic diseases. Clinical aspects.	B.W.7, B.W.24, C.W.22, C.W.33, C.W.34
Lecture	Pathophysiology of the most common diseases of the digestive system.	B.W21, B.W24, B.W25, C.W30, C.W32, C.W33, C.W34, C.W49
Lecture	Hormonal regulation of metabolism. Regulation of calcium homeostasis. Hormonal regulation of growth. Pathophysiology of the endocrine system.	B.W16, B.W21, B.W24, B.W25, C.W30, C.W32, C.W33, C.W34, C.W51

Lecture	Physiology and pathophysiology of pregnancy.	B.W21, B.W22, B.W24, B.W25, C.W30, C.W32, C.W33, C.W34, C.W51
Lecture	Mechanisms of human adaptation to extreme conditions.	B.W1, B.W2, B.W21, B.W25, C.U20
Lecture	Physiology of ageing. Civilization diseases.	B.W23, B.W24, C.W47

7. LITERATURE

Obligatory

John E. Hall. Guyton and Hall Textbook of Medical Physiology, 14th Edition , 2021, Elsevier

Supplementary

Rodney A. Rhoades, David R. Bell : Medical physiology : principles for clinical medicine — 2013, 4th ed. Wolter's Kluwer

Gary D. Hammer, MD, PhD, Stephen J. McPhee, MD, Pathophysiology of Disease: An Introduction to Clinical Medicine, 2014, 7e, McGraw Hill.

8. VERIFYING THE EFFECT OF LEARNING

Code of the course effect of learning	Ways of verifying the effect of learning	Completion criterion
B.W1,2,3,7,16,20,21-25 B.U1,7,9 C.W6,20,27,29,30,32-34,45,47-51 C.U11,20	Seminars and classes – Students need to actively participate in the seminars and classes, which is assessed by the assistant who perform the seminar or class. In every week , the “Weekly Set” , which is a MCQ with 5 questions on e-learning platform needs to be completed. There will be 2 trials for each “Weekly Set”. Student should take all the Weekly Sets. If A Weekly Set is not taken the vote from this Weekly Set is 0 point. The summary vote is calculated before every Midterm MCQ Test, from the Weekly Sets in all didactic weeks <u>from the certain Block.</u>	Weekly Sets – the MCQs after the seminars – student needs to obtain average vote 3/5 or higher (from all the Weekly Sets) to be qualified for the Midterm MCQ Test. If average vote is lower than 3/5 the additional qualification to the Midterm MCQ is needed.
B.U1,7,9 B.W1-3, 7,16,2-25,33 C.U11,20 C.W22,27,29,30,32-34,45,47-51	4 Midterm MCQ Tests after completion of each Block – test with 20 MCQ. Retake if the Midterm MCQ is failed – test with 10 MCQ If the retake is failed – 2 nd retake (Commission Midterm Retake) - oral examination directly by the assistant responsible for the didactic, during summary seminar, at the end of the academic year, before the session.	12/20 (60%) points to pass Retake – 6/10 points to pass 2 nd retake – completion confirmed by the lecturer
B.U1,7,9 B.W1-3, 7,16,2-25,33 C.U11,20	Final exam – test with 100 MCQ Includes topics from lectures, seminars and classes.	60% of points to pass

C.W22,27,29,30,32-
34,45,47-51

9. ADDITIONAL INFORMATION

COURSE SITE:

Lectures: on site or e-learning – information will be given on e-learning platform and the website.

Seminars:

- Group 1 Tuesday - 16.40-18.20 - Classroom 4.05/4.06, Medical Simulation Center, Pawińskiego 3a
- Group 2 Monday - 16.40-18.20 - Classroom 4.05/4.06, Medical Simulation Center, Pawińskiego 3a
- Group 3 Monday - 15.00-16.40 – Classroom 4.05/4.06, Medical Simulation Center, Pawińskiego 3a
- Group 4 Tuesday - 15:00-16:40 - Classroom 4.05/4.06, Medical Simulation Center, Pawińskiego 3a

Practical classes

- Group 1 Friday 16:45-19:15 Classroom 4.05/4.06, Medical Simulation Center, Pawińskiego 3a
- Group 2 Friday 09:00-11:30 Classroom 4.05/4.06, Medical Simulation Center, Pawińskiego 3a
- Group 3 Friday 11:30-14:00 Classroom 4.05/4.06, Medical Simulation Center, Pawińskiego 3a
- Group 4 Friday 14:15-16.45 Classroom 4.05/4.06, Medical Simulation Center, Pawińskiego 3a

PRESENCES/ABSENCES

The presence on the lectures, seminars and classes is compulsory. **During the entire course 4 absences (either on seminar or on class – class and seminar are treated separately) are permissible . Any additional absence requires formal justification. All the absences (even those permissible) must be made up in the form announced by course coordinator.**

WEEKLY SETS

- In every week the “Weekly Set” – a MCQ (5 questions, 1 point for each question) on e-learning platform needs to be completed. There will be 2 trials for the Weekly Set.

- Importantly – the required knowledge to pass the MCQ covers the entire material arranged for the certain week (not only material from the seminars).

- If the Weekly Set doesn't be prepared on e-learning platform the Students will be informed and the MCQ will be organized on Classes (on Friday).

MIDTERM MCQ TEST

- Each Block is summarized with **Midterm MCQ Test** with 20 questions. Scoring 60% is necessary to pass.

FINAL EXAM

Final exam – 100 MCQs

- 60% of points needs to be gained in order to pass the exam and obtain grade 3 (satisfactory). The scoring for the higher grades will be created after the exam, according to the Gaussian curve.

- In case of the failure in the Final Exam – the organization, form and complete criterion for the retake will be issued by the Chair and Department of Experimental and Clinical Physiology.

SCIENTIFIC CLUB

information on the Department website.

It will be an opportunity for activity in the Scientific Club – the students are invited for the qualification to Scientific Club after the Final Exam.

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ATTENTION

The final 10 minutes of the last class of the block/semester/year should be allotted for students to fill out the Survey of Evaluation of Classes and Academic Teachers