INFORMATION ABOUT THE COURSE

Physiology with elements of clinical physiology

1. Basic information

Field of studies field of medical and health sciences, discipline: medical sciences **Unit responsible for the field of studies** Faculty of Medicine Bydgoszcz University of Science and Technology **Level of studies** Uniform master's studies **Profile of studies** General academic **Form of studies** Full-time	**Studies cycle** …….. **Course code** 17-EMS-PEC-SP1 17-EMS-PEC-SP2 **Language** English **Obligatory** Yes

Prerequisites	knowledge of biophysics Method of verification: Passing subjects defined as introductory is equivalent to meeting the prerequisites for the subject.
Introductory courses	Biophysics
Coordinator	Małgorzata Gałązka, PhD, Assoc. Prof.

Study period	**Form of assessment** **Form and hours of classes**	**ECTS credits**
Winter semester	Passing with a grade Lecture 45h Exercise 45h	7.0
Summer semester	Exam Lecture 45h Exercise 45h	7.0

2. Learning outcomes

Code	**Description of learning outcomes**	**Learning outcomes reference**
Knowledge (student knows and understands):		
K1	The graduate describes the water and electrolyte balance in biological systems	B.W1.
K2	The graduate describes acid-base balance and the mechanism of buffer action and the importance of buffers in systemic homeostasis	B.W2.
K3	The graduate knows and understands the concepts of: solubility, osmotic pressure, isotonia, colloidal solutions and the Gibbs-Donnan equilibrium	B.W3.

K4	The graduate knows and understands the physical laws describing the flow of liquids and factors influencing the vascular resistance of blood flow	B.W4.
K5	The graduate knows and understands the physicochemical and molecular basis of the functioning of sense organs	B.W6.
K6	The graduate knows and understands the metabolic changes occurring in organs and the metabolic, biochemical and molecular basis of diseases and therapies	B.W15.
K7	The graduate knows and understands the methods of communication between cells and between a cell and the extracellular matrix and the signal transduction pathways in the cell, as well as examples of disorders in these processes leading to the development of cancer and other diseases	B.W16.
K8	The graduate knows and understands the basics of excitation and conduction in the nervous system and higher nervous activity, as well as the physiology of striated and smooth muscles	B.W19.
K9	The graduate knows and understands the activity and mechanisms of regulation of all organs and systems of the human body and the relationships between them	B.W20.
K10	The graduate knows and understands the processes occurring during the aging of the body and changes in the functioning of organs related to aging	B.W21.
K11	The graduate knows and understands the basic quantitative parameters describing the efficiency of individual systems and organs, including the ranges of standards and demographic factors influencing the value of these parameters	B.W22.
K12	The graduate knows and understands the development, structure and functions of the human body in normal and pathological conditions	O.W1.
Abilities (student can do/perform):		
A1	The graduate is able to perform simple functional tests assessing the functioning of the human body as a stable regulation system (load and exercise tests) and interpret numerical data concerning basic physiological variables	B.U7.
A2	The graduate is able to use medical databases and properly interpret the information contained therein needed to solve problems in the field of basic and clinical sciences	B.U8.
A3	The graduate is able to communicate in a team and share knowledge	O.U8.
A4	The graduate is able to critically evaluate the results of scientific research and appropriately justify the position	O.U9.
Social skills (the student is ready to):		

S1	The graduate is ready to formulate conclusions based on their own measurements or observations	O.K8.

3. Programme contents

No.	Programme contents	Form of studies	Learning outcomes covered by the programme content
1	Neurophysiology: Division of the nervous system. Types of nerve cells. Basics of nerve cell electrophysiology: resting and action potential, the concept of excitability, absolute and relative refractory periods. Mechanism of chemical and electrical synapse action. Propagation of action potential. Conduction velocity in the nervous system. Electrophysiological study of the neuron using the PhysioEx simulation program. The concept of transduction, receptor potential and receptive field. Sensory axis: receptors, conduction and perception. Pain and its perception. Transduction in the cells of the visual system, taste, smell, hearing, labyrinth and superficial sensation cells. Study of the function of the sensory system - study of touch, vibration, pain, temperature, deep sensation. Study of visual acuity, colour vision, field of vision, blind spot test (Mariotte). Hearing test: Weber test, Rinne test. Study of taste sensation. The structure and role of the motor cortex. The course and role of the corticospinal tracts. Skeletal muscle physiology: types and characteristics, mechanism of skeletal muscle myocyte contraction; single, tetanic contraction; isotonic, isometric and auxotonic contraction; muscle fatigue - using the PhysioEx program. Smooth muscle physiology: types and characteristics, mechanism of smooth muscle myocyte contraction. Using the SIM Vessel program to study the effect of selected chemicals on the force of smooth muscle myocyte contraction. Spinal cord: structure, organization, spinal reflexes - myotatic reflexes, reverse myotatic reflexes and withdrawal reflexes. Motor axis: motor cortex, pyramidal system, basal nuclei, cerebellum. The structure of the balance system. Reflexes triggered by stimulation of the peripheral vestibular organ: examination of vestibulospinal, vestibulo-ocular reflexes. Post-rotary and caloric nystagmus examination (Hallpike caloric test). Senescence changes in the balance system. Higher nervous functions – speech and memory examination. Brain activation: reticular formation, EEG, sleep and wakefulness.	Lecture, Exercise	K2, K4, K5, K6, K8, A2, A3, S1
2	Blood physiology: blood - composition, plasma and morphological element functions and normal values. Red blood cell count, hematocrit determination, ESR determination, hemoglobin concentration measurement, blood group determination - using the PhysioEx program. Principles of blood transfusion. Serological conflict. Hemostasis: coagulation factors. course of primary and secondary hemostasis, course of fibrinolysis. Coagulation and fibrinolysis inhibitors. Blood coagulation indices - coagulogram. Inflammatory markers: ESR, CRP and PCT.	Lecture, Exercise	K5, K7, K8, A2, A3, S1
3	Physiology of the endocrine system: characteristics of the endocrine system, nervous, metabolic and hormonal control of endocrine, division of hormones according to their structure, hormone receptors, mechanism of action of hormones, hormonal cycles, release and physiological action of	Lecture, Exercise	K5, K6, K8, A2, A3, S1

	hormones of the hypothalamus, pituitary, thyroid, adrenal and pancreatic glands, influence of the autonomic system on endocrine activity of the pancreas, regulation of blood glucose levels. Measurement of blood glucose concentration. Hypothalamic-pituitary-female and male sex glands axis. Effect of female and male sex hormones. Physiology of the reproductive system: menstrual cycle, physiology of puberty and menopause, physiology of pregnancy, childbirth and lactation.		
4	Cardiovascular physiology: basics of cardiac electrophysiology, the role of slow resting depolarization in the generation of action potentials by pacemaker cells in the heart, the course of the action potential of pacemaker cells with regard to the types of ion channels, the course of the action potential in working cardiomyocytes with regard to the types of ion channels. The influence of the autonomic system on pacemaker cells and working cardiomyocytes. The molecular mechanism of contraction of working cardiac myocytes. Contractility of working cardiomyocytes. The structure of the conduction system of the heart. ECG - performance, description and analysis. The hemodynamic cycle of the heart. Concepts: HR, EDV, ESV, SV, CO, MAP, SBP, DBP. Heart sounds - auscultation. Regulation of the heart - internal and external factors. Action of catecholamines and acetylcholine, action of α and β-adrenergic receptor blockers and calcium channel blockers (verapamil) - use of the SIM Heart simulation program. Vascular system: structure of the vascular system, arterial pulse, palpation of pulse, measurement of blood pressure using the Korotkov method, microcirculation, vascular resistance, autoregulation of tissue blood flow, coronary circulation, regulation of blood pressure (role of baroreceptors). Crampton and Martinet orthostatic tests. Orthostatic hypotension. Physiology of physical exercise: the effect of static and dynamic physical exercise on the cardiovascular system. Functional tests in the assessment of circulatory system efficiency: Harvard test, Ruffier test.	Lecture, Exercise	K5, K6, K7, K8, A1, A2, A3, A4, S1
5	Respiratory physiology: structure and physiology of the respiratory tract, ventilation and respiratory mechanics, pulmonary circulation, diffusion and transport of respiratory gases, regulation of breathing. Respiratory mechanics; changes in thoracic volume during inhalation and exhalation, Respiratory function test: resting spirometry, flow/volume curve. Measurement of vital lung capacity, measurement of peak expiratory flow (PEF) and FEV1. Measurement of arterial blood saturation using a pulse oximeter. Effect of physical exercise on the respiratory system. Concepts: hypobaric hypoxia, tissue hypoxia, hypoxemia, hypercapnia.	Lecture, Exercise	K5, K7, K8, A2, A3, A4, S1
6	Physiology of the excretory system: structure and function of the kidneys, glomerular filtration, tubular reabsorption and secretion. Concepts: filtration pressure, filtration fraction, glomerular filtration rate (GFR), effective blood flow through the kidney. Regulation of blood flow through the kidney. Course of tubular transport mechanisms in individual parts of the renal tubule. Mechanisms of action of selected diuretics. Mechanisms of intrarenal regulation: myogenic autoregulation, tubular-glomerular feedback. Mechanism and role of glomerular-tubular balance. Mechanisms of urine dilution and concentration - the role of the amplifier and countercurrent exchanger. Urea circulation in the kidney. The influence of hormones on the volume and concentration of excreted urine. Regulation of water management and acid-base balance of the body. General	Lecture, Exercise	K1, K5, K6, K7, K8, A2, A3, S1

	urinalysis - analysis of results. Calculation of GFR using the clearance method. Analysis of the Davenport diagram and acid-base imbalances. Blood gasometry – analysis of test results.		
7	Digestive system physiology: motor and secretory functions, intestinal hormones, enzymes involved in digestion, absorption of digestive products, colon and liver functions - the role of bile. Neurohormonal mechanisms of body weight control. Calculation of basic and total metabolic rate. Anthropometric measurements, determination of BMI and WHR. Types of metabolic changes. Analysis of energy balance.	Lecture, Exercise	K3, K5, K7, K8, A2, A3, A4, S1

4. Methods of verifying and assessing the learning outcomes achieved by the student

Winter semester

Form of studies		
Lecture	**Methods of studies form:**	
	Lecture	
	Methods of verification:	**Involvement:**
	Test	100%
	Conditions for passing the course:	
	The condition for passing the lectures in the winter semester is passing the colloquia, which cover the topics presented during the lectures.	
Exercise	**Methods of studies form:**	
	Laboratory exercises, Case study, Group work	
	Methods of verification:	**Involvement:**
	Colloquium	60%
	Report	30%
	Entrance test	10%
	Conditions for passing the course:	
	Detailed conditions for passing the subject and being admitted to the exam are specified in the internal regulations, which are made available to each student and discussed during the first exercises. During laboratory exercises, the Student has the opportunity to earn a maximum of 6 points, including 4 points for the entrance test and 2 points for correctly completing the task assigned to a given exercise, correctly interpreting the results and presenting conclusions (passing the report). The Student does not have the opportunity to correct the entrance pass. The Student who has earned at least 60% of the maximum possible number of points from a given thematic block will take the colloquium. The colloquium takes the form of a written test with single-choice closed questions. In the winter semester, 2 colloquia will be held (30 test questions scored on a scale of 0/1 point for each incorrect/correct answer) from individual thematic blocks, from topics discussed during lectures and exercises and given to students in the form of problems.	

Summer semester

Form of studies		
Lecture	**Methods of studies form:**	
	Lecture	
	Methods of verification:	**Involvement:**
	Colloquium	30%
	Written exam	70%
	Conditions for passing the course:	
	Detailed conditions for passing the subject and admission to the exam are specified in the internal regulations, which are made available to each student and discussed during the first classes. In the summer semester, 2 tests will be held (30 test questions scored on a scale of 0/1 point for each incorrect/correct answer) from individual branches of physiology, from topics discussed during lectures and classes and given to students in the form of problems. Students who received positive grades from all tests in the fourth semester will take the exam. The final theoretical exam takes the form of a single-choice test consisting of 100 closed questions (topics presented during lectures and laboratory classes). Each question contains four possible answers - with 1 vertractor and 3 distractors (no negative points for an incorrect answer).	
Exercise	**Methods of studies form:**	
	Laboratory exercise	
	Methods of verification:	**Involvement:**
	Colloquium	70%
	Report	10%
	Entrance exam	20%
	Conditions for passing the course:	
	Students who have scored at least 60% of the maximum number of points that can be obtained within a given thematic block take part in each of the colloquia in the summer semester. A student receives credit for laboratory exercises in the summer semester after receiving a positive grade from all colloquia.	

Learning outcomes	**Methods of verification**			
	Colloquium	Report	Entrance test	Written exam
K1	X		X	X
K2	X	X	X	X
K3	X		X	X
K4	X	X	X	X
K5	X		X	X

K6	X			X
K7	X	X		X
K8	X			X
A1	x	X		X
A2		X		
A3		X		
A4		X		
S1		X		

5. Student workload – balance of hours and ECTS credits

Students activity		**Student workload Number of hours**
Classes conducted with the direct participation of an academic teacher or other persons conducting classes	Lecture	90
	Exercise	90
Student's own work	Preparing for classes	55
	Report preparation	30
	Studying literature	25
	Preparing for a test	30
	Preparing for an exam	30
Total student workload		350
ECTS		14

One (teaching) hour is 45 minutes.

6. Literature

The list of required and recommended literature will be provided by the lecturer at the first meeting.