PHYSIOLOGY	
GENERAL INFORMATION	
Course coordinator	Professor Ines Drenjančević, MD, PhD
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Study Programme	Integrated undergraduate and graduate university study of Medicine
Status of the course	Mandatory
Year of study, semester	2nd year, 4th semester
ECTS	**19**
Workload (hours)	Lectures (41); Seminars (99); Exercises (50)
Expected number of students	70
COURSE DESCRIPTION	
Course objectives	
To enable the student to apply knowledge of the normal function of the organism by applying previously acquired knowledge from physics, chemistry, biology, biochemistry and normal morphology. Seminars and exercises prepare students for independent problem solving and integrative health thinking. In doing so, they try to explain individual functions to the changing conditions of the external environment. Teaching focuses on learning basic and applicable physiology, ie on the vertical upgrade of knowledge acquired in explaining basic physiological functions. **Development of general and specific competencies (knowledge and skills):** After completing classes and passing the exam the student will master the knowledge of physiological functions of the organism, understanding bodily processes and keeping them healthy and acquire basic skills of measuring and interpreting measurement results of various physiological parameters. **Through lectures and seminar part of the material:** Acquisition of knowledge, understanding and ability of vertical and horizontal interdisciplinary integration of acquired knowledge of physiological function of the organism, from the cellular level, through tissue organization, tissue association in organs and organ systems. Understanding the physiological processes of the organism and homeostatic mechanisms that maintain the integrity and individuality of the organism as an open system in interaction with the environment. Developing the ability to apply physiological knowledge in pathophysiology and clinical medicine. Developing an attitude about physiology as a basic medical experimental science whose results serve to understand the processes of health and disease in the human body. **Laboratory exercises:** The aim of laboratory exercises is to illustrate knowledge of physiological processes acquired during lectures and seminars, developing practical skills of measuring basic physiological parameters, understanding the procedure and gaining knowledge of interpreting results. Also getting acquainted with the process of planning experiments, conducting experiments and interpreting the results of experiments.	

Enrolment requirements and entry competencies
Regular enrollment in the 2nd year of study adopted learning outcomes of the course of anatomy, biology
Learning outcomes at the Programme level
1.1., 2.1., 3.5. 4.2.
Learning outcomes (5-10)
1. Identify and present the most important functional features of individual organ systems at the level of cells, organs and the whole organism 2. Describe, analyze and interpret the control mechanisms necessary to maintain homeostasis 3. Explain the mechanisms of communication and the integration function of individual organ systems (eg kidney, endocrine system, autonomic nervous system) 4. Discuss and present the role and function of the heart and blood vessels, analyze the feedback mechanisms in the control of blood pressure, flow and resistance and conclude on the role of the heart in the general functioning of the organism, analyze and present the role of the cardiovascular system at rest and in special conditions. altitude, ambient temperature, physical activity). 5. Discuss and present the role and function of the respiratory system at rest and in adapting to changing environmental conditions, analyze feedback mechanisms in respiratory control, acid-base balance and conclude on the role of respiration in the general functioning of the organism. 6. Discuss and present the role and function of the kidneys and urinary system at rest and in adapting to changing environmental conditions, analyze feedback mechanisms in controlling urine production, maintaining blood pressure, volume balance, osmolarity and electrolyte composition of body fluids and acid-base balance and conclude about the role of the kidneys in the general functioning of the organism. 7. Analyze and present the role and function of the endocrine and reproductive system at rest and in adapting to changing environmental conditions, analyze feedback mechanisms in controlling hormone production, compare gender differences, and compare and conclude on physiological differences in special conditions such as pregnancy and neonatal age. 8. Formulate the basic processes of intermediate metabolism and energy flows and interpret their relationships with the physiology of organic systems. 9. Discuss and present the role of the digestive system, interaction with other organ systems and feedback mechanisms in the control of movements, secretion and absorption in the digestive system and associated exocrine glands. Interpret digestion in the context of general metabolism and neural regulation.
Course content
• **Introduction to physiology: cell physiology and general physiology-** • **Cell and functional organization of the human body** The concept of homeostasis, description of homeostatic mechanisms, examples and features, application. Stations, composition ext. and interior. fluids, the transfer of matter across the st. membrane. • **Physiology of membranes, nerves and muscles-** • **Transfer of matter across the cell membrane** • **Membrane and action potentials. Skeletal muscle contraction, Skeletal muscle stimulation, neuromuscular transmission, stimulation-contraction coupling** • **Contraction and stimulation of smooth muscle** • **Heart muscle, Heart as a pump and heart valve function, Rhythmic excitation of the heart. Basics of ECG, Electrocardiographic interpretation of disorders of cardiac muscle and coronary flow - vector analysis:** Physiology of cardiac muscle, cardiac cycle, heart tones, regulation of

cardiac work, conducting cardiac musculature. Normal ECG: method of registration, ECG leads.

• **Circulation-**

• **General examination of circulation, medical physics of pressure, flow and resistance,**

• **Physical principles of circulation, hemodynamics:** dilatation of blood vessels and functions of arterial and venous system, pulsation of arterial pressure, veins and their functions

• **Microcirculation and lymphatic system:** Structure of microcirculation and capillaries, vasomotion, diffusion through the capillary wall, intercellular space and fluid, lymphatic system,

• **Tissue surveillance and humoral regulation of local blood flow:** blood flow to the brain, cerebrospinal fluid, and brain metabolism.

• **Nerve regulation of circulation and rapid control of arterial pressure**

• **Dominant role of the kidney in long-term regulation of arterial pressure and hypertension: integrated pressure control system**

• **Cardiac output and venous inflow and their regulation**

• **Blood flow through the muscles and cardiac output during muscle work; coronary circulation; heart valves and heart tones**

• **Body fluids and examination of normal kidney function**

• **Composition and distribution of body fluids.**

• **Urine production in the kidneys**, glomerular filtration, renal blood flow and control; autoregulation of GF and BOD, renal tubular function, control of mineral circulation renal tubular function, control of mineral circulation, maintenance of sodium homeostasis in body fluids, AHD, thirst.

• **Renal regulation of potassium, calcium, phosphate and magnesium, combined mechanisms for monitoring blood and extracellular fluid volume**

• **Regulation of acid-base balance: body fluid buffers, renal and respiratory regulation A-B, compensation of acid-base disorders**

• **Blood and blood cells. Hemostasis, blood clotting.** Blood composition, erythrocytes, anemia and polycythemia, events in hemostasis, mechanism of blood clotting, conditions that cause heavy bleeding, thromboembolic conditions, anticoagulants, blood clotting tests.

• **Respiratory system-**

• **Pulmonary ventilation**, mechanics of pulmonary ventilation, pulmonary volumes and capacities, MV respiration, alveolar ventilation, airway functions

• **Pulmonary circulation**, pulmonary capillary dynamics, Starling forces, pulmonary edema and pleural fluid.

• **Physical principles of gas exchange, Transmission of gases through the respiratory membrane. Respiratory regulation:** Physical principles of oxygen and CO2 diffusion gas transmission through the respiratory membrane; transfer of oxygen and CO2 by blood and body fluids, ratio of respiratory change. Respiratory center, chemical control of respiration, central and peripheral chemoreceptors, regulation of respiration during muscular work.

• **Physiology of flying, space travel and deep diving-**

• **Physiological problems in aviation, altitude and space, deep diving and other high pressure conditions**

• **Muscle work and adaptation of respiration, cardiovascular system, energy and metabolism to muscle work**

• **Senses - eye, physiology of sight, ear - physiology of hearing**

• **Autonomic nervous system marrow of the adrenal gland:** structure, basic features of sympathetic and parasympathetic functions, autonomic reflexes.

• **Digestive system: general principles of gastrointestinal function - mobility, nervous control and blood circulation; Suppression and mixing of food in the digestive system; Secretory functions in**

the digestive system; Digestion and absorption in the digestive system;

• **Metabolism and temperature regulation:** carbohydrate metabolism and ATP production, lipid metabolism, protein, dietary balance, energy and metabolic rate, body temperature, temperature regulation and fever

• **Liver.** The structure of the liver. Metabolic functions of the liver, Blood flow through the liver, bile production, bilirubin.

• **Endocrine system.** Function of the pituitary, thyroid, adrenal glands, endocrine pancreas, parathyroid glands and gonads. Hypothalamus-pituitary axis. Reproductive and hormonal functions in men; pineal gland. Physiology of women before pregnancy and female sex hormones, Pregnancy and lactation; Physiology of fetus and newborn

• **Physiology of sport**

Mode of teaching

Lectures; Seminars; Laboratory exercises

Student obligations

Attendance at all forms of classes is mandatory, and the student must access all knowledge tests. A student may justifiably miss 30% of each form of instruction. Absence from exercise must be colloquial.

Monitoring student work *(alignment of learning outcomes, teaching methods and grading)*

Teaching activity	ECTS	Learning outcome	Student activity	Assessment methods	Scoring points	
					Min.	Max.
Class attendance (Lectures)	0,5	1-8	Class attendance	Record	2	4
Seminars	6	1-8	Active participation in focused discussion	Record	6	11
Exercises	3,5	1-8	Active participation in exercises	Record	6	10
Colloquia	4,5	1-8	Learning for colloquia	Test	21	45
Oral exam	4,5	1-8	Learning for the oral exam	Oral exam	15	30
Total	**19**				**50**	**100**

Evaluation of student obligations

Class attendance

The student must attend a minimum of 70% of all forms of teaching (seminars and lectures, **exercises are not allowed to be absent**) and access all forms of knowledge testing. A student who is justifiably absent from the seminar must make up for the missed material by colloquium.

Student work is evaluated during classes and at the final exam. Students are graded numerically and descriptively (insufficient (1), sufficient (2), good (3), very good (4), excellent (5)). During the tour, the student will be able to collect a maximum of 100 points. Students can gain a maximum of 70 points during their classes through various forms of activities (see table). They can earn a maximum of 45 points on partial tests and a maximum of 30 points on the final exam. Mandatory 3 partial tests are provided, the student must meet more than 55% (min. 7 points on each partial test, 21 in total) in order to be able to take the oral part of the exam. The final grade is the sum of grade points achieved during classes and at the final exam.

Practical work (exercises): active participation in the exercise under the guidance of a teacher; problem solving, analysis and synthesis, collecting processing and interpretation of exercise results.
Seminars: preliminary preparation of materials to be covered at the seminar; active participation in the form of asking and answering questions and participating in focused discussion.
Lectures: attendance at lectures

Table 1. Evaluation of student teaching obligations

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Partial tests	Partial test I	15
	Partial test II	15
	Partial test III	15
	In total	**45**
Practical work / Laboratory exercises	Attendance	0
	Active participation	10
	In total	**10**
Seminars	Active participation	11
	In total	**11**
Lectures	Attendance	4
	In total	**4**
	IN TOTAL	**70**
Final exam	The written part	-
	Oral part	30
	In total	**30**
IN TOTAL		**100**

Partial tests

Passed partial tests are a prerequisite for taking the final exam, which is oral. When a student passes them they are valid for the entire academic year. Three mandatory partial tests are required after a certain sequence of material. A student cannot take the partial test if he / she has not attended all

the exercises and colloquialized any absences from the seminar. Each partial test has 50 questions. It is possible to collect a total of 15 points per partial test.

Practical work (exercises)
During the classes there will be 10 exercises during which the student can collect a maximum of 10 grade points, 1 grade point by actively participating in each exercise.
Seminars
During the classes, there will be 33 seminars during which the student can collect a maximum of 11 grade points through active participation (for active participation in three seminars 1 point).
Lectures
By attending lectures, students can achieve max. 4 evaluation points (60 - 80% 2 evaluation points; 81-100% 4 evaluation points).

Table 2. Evaluation of partial tests as a prerequisite for taking the final exam

Percentage of correctly solved tasks (%)	Scoring points
55,00-59,99	7
60-64,99	8
65-69,99	9
70,00-74,99	10
75-79,99	11
80-84,99	12
85-89,99	13
90,00-94,99	14
95-100	15

Final exam
A student who has duly completed all forms of teaching and achieved a total of at least 38 grade points from exercises, seminars and attending lectures, of which at least 21 grade points achieved in partial tests (minimum 7 points per test) gained the right to sign and access the final exam.
The final exam **is mandatory** and consists of an oral part. The student draws 3 cards with integrated questions. During the final exam, the student can receive a maximum of 30 points (for each fully answered question 10 marks). In order to pass the oral part of the exam, the student must achieve a minimum of 3 points from each question, ie a total of at least 9 points in order to form a final grade.
Evaluation of the oral part of the final exam:
0-2 score: the answer does not meet the minimum criteria
3 -4 marks: the answer meets the minimum criteria
5-6 points: average answer with noticeable errors
7-8- grade points: very good answer with slight errors
9-10 rating points: exceptional answer

Formulation of the final grade

Grades earned in the final exam are added to the points earned during the course.
Assessment in the ECTS system is performed by absolute distribution, ie on the basis of final achievement and is compared with the numerical system as follows:

A - excellent (5): 80-100 points
B - very good (4): 70-79.99 points
C - good (3): 60-69.99 points
D - sufficient (2): 50-59.99 points
E - insufficient (1): 40-49.99 points

Required reading (available in the library and through other media)

Title	Number of copies in the library	Availability through other media
1. Guyton and Hall: Medical Physiology, 13th edition, Medicinska naklada Zagreb 2017.	20	
2. Physiology Exercise Manual Taradi et al. Medicinska naklada Zagreb, 2003	12	

Additional reading

Appropriate teaching materials

Course evaluation procedures

Anonymous, quantitative, standardized student survey on the subject and work of teachers conducted by the Office for Quality of the Medical Faculty Osijek.

Note /Other

E-learning is not included in the norm of subject hours, but it is used in teaching and contains links to various pages, video and audio materials available on the website.