[Medicinski fakultet u Rijeci]

Curriculum
2023/2024

[Za kolegij]

Physiology and Pathophysiology I

Study program:	**Medical Studies in English (R)** [Sveučilišni integrirani prijediplomski i diplomski studij]
Department:	**[Katedra za fiziologiju, imunologiju i patofiziologiju]**
Course coordinator:	**prof. dr. sc. Mrakovčić-Šutić Ines, dr. med.**
Year of study:	**2**
ECTS:	**5**
Incentive ECTS:	**0 (0.00%)**
Foreign language:	**Possibility of teaching in a foreign language**

Course information:

The course consists of 66 class hours (38 hours of lectures, 12 hours of seminars, and 16 hours of practicals) and is conducted in the third semester. The class performance totals 5 ECTS credits. The main aim of this course is to enable the students to apply previously acquired knowledge of physics, chemistry, biology, biochemistry, and normal morphology in order to acquire knowledge about normal organism functions and pathophysiological mechanisms, which lead to disorders of the normal function and disease emergence. Seminars and practicals should prepare the students for independent problem-solving and integrative reasoning on health and disease. Individual functions are explained on a molecular level, as well as on the level of an organism as a whole, and analyzed in the adaptation process of the organism to changing environmental circumstances. The emphasis is on learning basic “applied” physiology, i.e., on the vertical knowledge upgrade acquired while explaining basic physiological functions.

Classes are performed in terms of lectures, seminars, and practicals. Active student participation in the curriculum is achieved by performing laboratory practicals and by using computer programs that simulate pathological conditions and yield clinical correlates of certain diseases.

Throughout seminars and practicals, the student actively discusses physiological and pathophysiological mechanisms. The student is obligated to prepare the material that is being discussed in seminars and practicals. The teacher evaluates student participation throughout seminars (demonstrated knowledge, understanding, the ability to set up a problem, concluding, etc.). Acquired grade points are then added to the number of grade points obtained at the final exam.

Course content:

General concepts of physiology and pathophysiology: Concepts of health and disease. Homeostasis. Etiology. Pathogenesis. Disease. Clinical manifestations. Diagnosis. Clinical course. Etiological factors. General disorders of the body: Structure and function of macromolecules. Pathophysiological principles of inheritance of diseases and syndromes and hereditary metabolic diseases. Energetic homeostasis and Energy metabolic disorders. Hypoenergoses.

Cellular physiology and pathophysiology: Disorders of structure and function of mitochondria. An integral reaction of the cells to the injuries. Cellular death. Malignant transformation and growth. Physiology and pathophysiology of cell membranes: transfer of substances through cell membranes. Canalopathies and membrane transport disorders. Membrane and action potential.

Physiology and pathophysiology of muscle cells: contraction of skeletal muscle. Skeletal muscle relaxant, neuromuscular transmission, poaching, and contraction. Smooth muscle contraction.

Blood cells and clotting. Erythrocytes. Erythrocyte disorders. Blood type. Platelets, hemostasis, and blood clotting. Hemostasis disorders. White blood cells. White blood cell disorders. Endogenous bioactive compounds. Inflammation, repair of damage and wound healing.

Integrative functions and disorders of integrative functions. The overall reaction of the organism to the noxa. Stress and adaptation. Homeostasis. Stress response disorders.

List of assigned reading:

1. Guyton A.C., Hall J.E. Textbook of Medical Physiology (13th edition), Elsevier, 2016.

2. Gamulin S, Marušić M, Kovač Z. Pathophysiology – Basic Mechanisms of disease - Textbook, Medicinska naklada Zagreb, 2014.

3. Handbook for Practicals in Physiology, Neurophysiology, and Immunology, Department of Physiology, Immunology, and Pathological Physiology, Faculty of Medicine in Rijeka, October 2001. (can be downloaded from the SharePoint platform of the Department of Physiology)

4. Kovač Z. et al. Clinical Pathophysiology – Etiopathogenetic Nodes – Third Book (I-IV part). Medicinska naklada Zagreb 2013.

All materials that are not included in the compulsory reading will be published on the course website.

List of optional reading:

1. Alberts et al. Molecular biology of the Cell, Sixth Edition, Garland publ., New York, 2015.

2. Abbas A.K, Lichtman A.H., Pillai S. Basic Immunology. Functions and Disorders of the Immune System. Fifth edition. Elsevier, 2016.

Curriculum:

[Seminari] list (with titles and explanation):

Seminar 1. Disorders of function and structure of mitochondria. An integral reaction of the cells to the injuries. Cellular death. Malignant transformation and growth.

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Seminar 2. Transfer of substance through cell membranes.

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Seminar 3. Action potential.

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Seminar 4. Skeletal muscle physiology.

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Seminar 5. Erythrocytes and blood groups.

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Seminar 6. Platelets and clotting.

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Seminar 7. White blood cell disorders.

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[Vježbe] list (with titles and explanation):

Practical 1. Cellular transport and membrane permeability.

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Practical 2. Action potential.

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Practical 3. Skeletal muscle physiology.

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Practical 4. Erythrocytes and blood group.

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Practical 5. Platelets and clotting. Bleeding time and clotting.

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Practical 6. Leukocytes and inflammation. Leukocytes count. Differential blood count.

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[Predavanja] list (with titles and explanation):

Lecture 1. Concepts of health and disease. Homeostasis.

To adopt the principles of physiological biofeedback and to identify homeostatic mechanisms of main functional

systems. To understand functional tests in the assessment of an organism's condition, the general principles of assessing biological systems, the role of clinical laboratory tests, the concept of reference value, the principles of interpreting laboratory tests, and the assessment of an organism's general condition. To define health and disease and to understand the principles of maintaining normal and impaired homeostasis.

Lecture 2. Principles of the pathogenetic mechanisms.

To explain positive biofeedback and homeostatic regulation by multiple biofeedbacks. To explain the relationship between negative and positive biofeedbacks in disease development. To understand and explain the limits of variability in physiological values, the principles of adjustment and adaptation, reactivity, the meaning of constitution, the pathobiological concept of anabiosis and catabiosis. To explain the terms etiology, pathogenesis, and etiological factors. To understand the development of the pathological process, the impact of weather factors in pathogenesis, heritage, environment, and risk factors. To explain the disease as a nosological entity and characteristics of the disease. To define death. To understand functional tests in the assessment of an organism's condition, the general principles of the assessing biological systems, the role of clinical laboratory tests, the concept of reference values, the principles of interpreting laboratory tests, and the assessment of an organism's general condition.

Lecture 3. Etiological factors.

To explain the terms etiology, pathogenesis, and etiological factors. To understand the development of the pathological process, the impact of weather factors in pathogenesis, heritage, environment, and risk factors. To explain mechanical, chemical, and biological factors

Lecture 4. Disorders of structure and functions of macromolecules.

To understand the principles of chromosomal disorders. To explain disorders of gene expression. To explain disorders of protein production and degradation (transcriptional and translational disorders, disorders of intracellular protein degradation). To understand the pathophysiological principles of disease and syndrome inheritance. To explain the principles of inherited metabolic diseases. To explain the occurrence of protein-folding diseases (amyloidosis, prion diseases).

Lecture 5. Pathophysiological principles of inheritance of diseases and syndromes and hereditary metabolic diseases.

To explain disorders of protein production and degradation (transcriptional and translational disorders, disorders of intracellular protein degradation). To understand the pathophysiological principles of disease and syndrome inheritance.

Lecture 6. Energetic homeostasis and Energy metabolic disorders. Hypoenergoses.

To understand the principles of hypoxic hypoenergosis, dysenzymatic hypoenergosis, substrate hypoenergosis, and energy metabolism assessment.

Lecture 7. Disorders of structure and function of mitochondria. An integral reaction of the cells to the injuries. Cellular death.

To explain disorders of the cell membrane, structure and function of mitochondria, lysosomes, and other intracellular organelles. To understand the integral response of a cell to injury. To explain cell death. To explain methods for assessing the function of subcellular structures

Lecture 8. Malignant transformation and growth.

To explain the principles of carcinogenesis and the impact of chemical, physical, and biological carcinogens. To explain the action of oncogenes and antioncogenes, the transformation of proto-oncogenes into oncogenes, and the types and role of tumor-suppressor genes. To understand the etiopathogenetic factors of malignant transformation of human cells. To explain the properties of malignant cells, main gene disorders in malignant cells, the kinetics of malignant growth, tumor growth, and metastasis. To explain, based on the example of the colorectal cancer, the appearance of a malignant tumor, the role of genetic disorders in the transformation and appearance of metastases. To understand the clonal tumor growth, the local factors that affect tumor growth, the metastasis, and paraneoplastic disorders.

Lecture 9. Transfer of substance through cell membranes I.

To explain polar and nonpolar molecules, hydrophobic and hydrophilic interactions. To explain cell membrane composition, membrane permeability, and the effect of phospholipids and membrane proteins on the permeability of ions, hydrophilic, and hydrophobic molecules. To understand the osmotic pressure on the cell membrane. To define and describe units for expression of concentration: mM, mEq/l, mg/dl, mg%. To learn the normal values of plasmatic Na^+ , K^+ , H^+ (pH), HCO_3^- , Cl^- , Ca^{2+} , and glucose, normal cellular pH, and cellular concentrations of Na^+ , K^+ , Cl^- , Ca^{2+}, and HCO_3^- . To distinguish the terms osmole, osmolarity, and osmolality. To memorize the normal values for

plasma. To define Donnan equilibrium. To explain cell volume maintenance. To name transfer proteins. To explain diffusion through the cell membrane. To define the laws of diffusion and to explain how differences in concentration gradient, surface, time, and distance affect the motion of a substance. To explain the distribution of anions and cations on the cell membrane.

Lecture 10. Transfer of substance through membrane II. Channelopathies and membrane transport disorders.

Active transfer. Primary active transport. Secondary active transport. Endocytosis. To describe the transport of molecules and ions using membrane transport proteins (carriers and channels). To describe the role of ATPa hydrolysis in the conformational changes of the receptors required for the transfer of Na+ , K+ , Ca2+, and H+ ions against their concentration gradient. Na+ /K+ pump, proton pump, Ca++ pump. To understand the role of ATP-binding cassette transporters on the example of TAP transporters, multi-drug resistance transporters, and cystic fibrosis proteins. Significance for chemotherapy. To understand the principles of substance transport against a concentration gradient using energy from a sodium concentration gradient: cotransport of Na+ and glucose, Na+ /Ca++ exchanger. To describe water channels (aquaporins) and transport of water molecules through the cell membrane. Collector tube cell permeability and aquaporin duct regulation by ADH. Glucose transport into cells: an example of facilitated diffusion (saturation kinetics), secondary active transport, and regulation of the number of receptor molecules (GLUT) on the cell surface by insulin. To understand the principles of signal transduction using signaling molecules that are soluble and insoluble in the lipid bilayer. To understand the principles of cellular protein activation by phosphorylation and replacement of GDP/GTP. Protein kinases and protein phosphatases. Guanosine triphosphatase domains and proteins that replace guanine nucleotides. Proteins with SH2 domain. Types of signaling molecules considering their chemical structure and types of receptors. Transmembrane signal transmission at the cell membrane. G-protein-coupled receptors and signal transduction by cAMP, diacylglycerol, and inositol triphosphate. Enzyme-linked receptors: tyrosine kinases, proteins with the SH2 domain, Ras protein, the Ras protein family and its signaling pathways. Signaling pathway activation and inactivation, up-regulation, down-regulation. Intracellular receptors and signal transmission to the nucleus. Steroid hormone receptors.

Lecture 11. Membrane and action potential.

To describe and explain membrane and action potential.

Lecture 12. Skeletal muscle contraction.

To explain neuromuscular transmission, synaptic transmission, nicotinic cholinergic receptor, skeletal muscle action potential, biofeedback of stimulation and contraction.

Lecture 13. Skeletal muscle stimulation, neuromuscular transmission. Smooth muscle contraction.

To describe the formation and excretion of acetylcholine at the molecular level. To explain the molecular mechanisms of muscle contraction. To describe the structure of skeletal and smooth muscle and the mechanisms of muscle contraction. To understand the energetics of muscle contraction, the characteristics of contraction of the whole muscle.

Lecture 14. Hematopoiesis. Lecture 14a. Hematopoiesis Lecture 14.b Erythrocytes.

To explain the development of blood cells: location and stages of blood cell differentiation. To describe and list basic growth factors.

To describe erythropoiesis (primary and secondary centers of hematopoiesis, stages of erythrocyte differentiation, growth and differentiation factors (vitamins and iron), and regulation of erythropoiesis by erythropoietin and the amount of oxygen in tissues, lymphopoiesis, myelopoiesis, and thrombocytopoiesis. To describe the formation, shape, size, and concentration of erythrocytes in blood. To explain hemoglobin formation and function in erythrocytes (transmission of O2, CO2). To explain the mechanism of erythrocyte and hemoglobin degradation in the spleen.

Lecture 15. Erythrocyte disorders.

To explain disorders in erythrocyte formation and function. To explain the pathogenesis of anemia and polycythemia To understand the metabolism and pathophysiological consequences of iron turnover. To familiarize with the basic laboratory tests for assessment of the number and function of erythrocytes.

Lecture 16: Hemostasis and blood clotting.

To describe the process of hemostasis. To describe the types of bleeding into the skin and mucosa – petechiae, ecchymoses, purpura. To name and explain innate and acquired causes of bleeding tendency. To name and describe qualitative and quantitative disorders in platelet function. To name and describe conditions of excessive tendency for blood clotting.

Lecture 17: Hemostasis disorders.

To name and describe qualitative and quantitative disorders in platelet function. To describe the pathophysiological states of bleeding tendency. To name and describe conditions of excessive tendency for blood clotting. To describe spleen function disorders.

Lecture 18: White blood cells.

To explain the concentration and classification of leukocytes in the blood (granulocytes – neutrophils, eosinophils, basophils; and agranulocytes – lymphocytes, monocytes and plasma cells). To describe the differential blood count and its clinical importance. To explain the life span and recirculation of leukocytes in the body (leukodiapedesis, chemotaxis). To explain defense properties of neutrophils and macrophages (phagocytosis and killing of bacteria, antigen presentation and stimulation of the immune response, secretion of cytokines to stimulate inflammation). To describe the role of eosinophils and basophils.

Lecture 19: White blood cell disorders.

To describe the causes and basic features of qualitative and quantitative leukocyte disorders. To explain the etiopathogenetic features and classification of leukemias and lymphomas.

Lecture 20: Endogenous bioactive compounds.

To understand the principles of formation and activity of main endogenous biologically active compounds: biogenic amines, plasmakinin systems and complements, phospholipid derivatives, renin-angiotensin systems, cytokines, gastrointestinal hormones and neuropeptides, atrial natriuretic peptides, endothelins and nitrogen monoxides, oxygen radicals.

Lecture 21: Inflammation, tissue repair after damage, and wound healing.

To understand the basic properties of inflammation and to explain the etiopathogenesis of acute and chronic inflammation. To clarify the systemic response of an organism to inflammation. Being able to assess an inflammatory response.

Lecture 22: The overall reaction of the organism to the noxa. Stress and adaptation. Homeostasis. Stress response disorders.

To explain and describe the systemic response of the organism to stress. To describe stress and neuroimmunomodulation of the stress response.

Student obligations:

Exam (exam taking, description of the written/oral/practical part of the exam, point distribution, grading criteria):

ECTS grading system: Student grading will be conducted according to the current Ordinance on Studies of the University of Rijeka and the Ordinance on Student Grading at the Faculty of Medicine in Rijeka. Student work and achievement are assessed and graded during the course, which is the basis for the final grade. Student work and competencies are evaluated during classes with a maximum of 70 grade points and up to 30 grade points at the final exam, which totals 100 grade points. Students are graded according to the ECTS (A-E) and numerical system (1-5). Grading according to the ECTS system is conducted according to the absolute redistribution, as well as according to the graduate grading criteria.

I. The following components are evaluated during the course (maximum of 70 grade points):

a) acquired knowledge (up to 66 grade points)

b) seminar thesis (up to 6 grade points)

a) acquired knowledge (up to 66 grade points)

During classes, acquired knowledge will be evaluated by two midterm exams comprising 60 questions, which will take place on November 2020 (first midterm exam) and on January, 2021 (second midterm exam). A student may obtain up to 16,5 grade points on each midterm exam:

Correct answers	Grade points		Correct answers	Grade points
58-60	33		44	24
56-57	32		43	23
54-55	31		42	22
53-54	30		40-41	21
51-52	29		39-40	20
49-50	28		37-38	19
47-48	27		35-36	18
46	26		33-34	17
45	25		30-32	16,5

Students who fail to earn a minimum number of points one or both MTEs can repeat one or both MTEs, which will be organised in February, between the first and second term of the Final exam. At repeated MTEs, student can acquire grade point according to the above table and correct/improve the final score.

Improvement of the overall performance during the course. Students who have achieved sufficient points on a regular MTEs can improve their final score at the repeated MTE/MTEs. The repeated MTEs (writing the test) will be organized at the Faculty of Medicine under controlled conditions: either using traditional printed tests or using the Merlin platform in the faculty's computer classroom.

Additional acquisition of minimum conditions for the Final exam. Students who failed to acguire a minimum score on one of the MTEs can earn minimum grades required to access the Final exam. This will be organized in early September. The acquisition of minimum grade pointe will be carried out by writing one or both tests covering the material of the first and/or second MTE. The acquisition of minimum garde points (writing a test) will be organized at the Faculty of Medicine under controlled conditions: either using traditional printed tests or using the Merlin platform in the Faculty's computer classroom. On tests for the acquisition of minimum conditions, students cannot earn additional grade points With a positive test result (more than 50%) student can earn the minimum number of grade points (17.5+17.5) and can access the Final exam. If it is not possible to approach the Faculty due to the epidemiologic situation, additional acquisition of minimum conditions will be carried out by oral examination of the required materials using MS teams or Google Meets. At the oral check, students can achieve a positive result and earn the minimum number of points needed to enter the Final exam.

b) Independent work (up to 4 grade points)

A student must prepare a Powerpoint presentation and present it to other students during practicals (starting from P2). After that, a student submits the presentation to the teacher in a printed form with a front page containing the topic title, name and surname of the student, their group, and the date. The presentation should not last longer than 10 minutes, and the student can choose only one topic for the presentation. The list of topics will be announced at the Share-portal of the course. The number of grade points granted for the presentation is evaluated by the teacher according to the quality of content and presentation in categories.

A positively evaluated presentation in a certain field is graded as follows:

Grade of the presentation	Grade points
A (5)	4
B (4)	3
C (3)	2
D (2)	1
F (1)	0

Attending lectures, seminars, and practicals are mandatory. Students can be absent from 30% of classes provided they have a justifiable cause, i.e. a doctor's note. If a student is absent for more than 30% of the classes, whether it is justifiable or not, they cannot continue to participate in the course and cannot access the final exam. In that case, the student is graded with 0 ECTS points and an F grade.

II. Final exam (up to 30 grade points)

Students who obtained 35-70 grade points during classes are obligated to access the final exam at which they may obtain additional grade points. The final exam consists of a multiple-choice questions test and an oral part. Students who obtained less than 35 grade points during classes or were absent for more than 30% of classes are not allowed to access the final exam (insufficient F).

Students can obtain 15-30 grade points at the final exam. The final exam consists of an oral and a written part, where students are expected to show at least 50% of knowledge, skills, and competencies. A student who demonstrates at least 50% of knowledge, skills, and competencies at the written and the oral part of the exam, is credited with points according to the achieved result, which is added to the grade points obtained during classes. At the written part of the final exam, a student can obtain 15 grade points according to the table:

Correct answers	Grade points		Correct answers	Grade points
47-50	15		34-36	10
43-46	14		31-33	9
41-42	13		28-30	8
39-40	12		25-27	7
37-38	11			

At the oral part of the final exam, a student can obtain 15 grade points that are divided into 5 categories:

Grade obtained at the oral part of the final exam	Number of grade points obtained at the oral part of the final exam
excellent A	13-15
very good B	11-12
good C	9-10
sufficient D	1-8
insufficient F	0

In order to pass the final exam, a student must achieve a minimum of 7 grade points at the written part and a minimum of 8 grade points at the oral part of the exam. The final exam is an integral part, therefore, if the student does not achieve a positive assessment of the oral part of the final exam, the results of the written part of the final exam are invalid in the following final exam terms.

III. The final grade (maximum of 100 grade points) The final grade represents a sum of all grade points obtained during classes and at the final exam based on the absolute redistribution according to the following scale

90-100 grade points	A	excellent (5)
75-89,99 grade points	B	very good (4)
60-74,99 grade points	C	good (3)
50-59,99 grade points	D	sufficent (2)
less than 50 grade points	E	insufficient (1)

Other notes (related to the course) important for students:

Course content and all information regarding the course, including exam dates, can be found on the SharePoint platform of the Department of Physiology and Immunology on the following website: https://spp.uniri.hr/ss_medri/katedre/427 - accessed via an AAI address.

COURSE HOURS 2023/2024

Physiology and Pathophysiology I

[Predavanja] (Place and time or group)	**[Vježbe]** (Place and time or group)	**[Seminari]** (Place and time or group)
04.10.2023		

Lecture 1. Concepts of health and disease. Homeostasis.:
• [P08] (13:15 - 14:00) [214]
  ○ PAPI
 	
Lecture 2. Principles of the pathogenetic mechanisms.:
• [P08] (14:15 - 15:00) [214]
  ○ PAPI		

prof. dr. sc. Mrakovčić-Šutić Ines, dr. med. [214]		
06.10.2023		
Lecture 3. Etiological factors.: • [P02] (13:15 - 15:00) [214] ○ PAPI		
prof. dr. sc. Mrakovčić-Šutić Ines, dr. med. [214]		
11.10.2023		

Lecture 4. Disorders of structure and functions of macromolecules.:
• [P08] (13:15 - 14:00) [143]
  ○ PAPI
 	
Lecture 5. Pathophysiological principles of inheritance of diseases and syndromes and hereditary metabolic diseases.:
• [P08] (14:15 - 15:00) [143]
  ○ PAPI
 	
Lecture 6. Energetic homeostasis and Energy metabolic disorders. Hypoenergoses.:
• [P08] (15:15 - 16:00) [214]
  ○ PAPI		

prof. dr. sc. Lučin Pero, dr. med. [143] · prof. dr. sc. Mrakovčić-Šutić Ines, dr. med. [214]		
18.10.2023		
Lecture 7. Disorders of structure and function of mitochondria. An integral reaction of the cells to the injuries. Cellular death.: • [P15 - VIJEĆNICA] (13:15 - 15:00) [143] ○ PAPI		
prof. dr. sc. Lučin Pero, dr. med. [143]		
20.10.2023		
Lecture 8. Malignant transformation and growth.: • [P08] (12:15 - 14:00) [143] ○ PAPI		

prof. dr. sc. Lučin Pero, dr. med. [143]		
25.10.2023		
Lecture 9. Transfer of substance through cell membranes I.: • [P08] (13:15 - 15:00) [210] ○ PAPI		
prof. dr. sc. Mahmutefendić Lučin Hana, dipl. ing. biol. [210]		
26.10.2023		

		Seminar 1. Disorders of function and structure of mitochondria. An integral reaction of the cells to the injuries. Cellular death. Malignant transformation and growth.:
		• [Zavod za fiziologiju - Vježbaonica] (14:15 - 15:45) [213]
		  ○ PAPI
		  ○ Group II (B)

doc.dr. sc. Karleuša Mujkić Ljerka, dipl. ing. bioteh. [213]		
27.10.2023		

Lecture 10. Transfer of substance through membrane II. Channelopathies and membrane transport disorders.:
• [P15 - VIJEĆNICA] (12:15 - 14:00) [210]
  ○ PAPI
		Seminar 1. Disorders of function and structure of mitochondria. An integral reaction of the cells to the injuries. Cellular death. Malignant transformation and growth.:
		• [Zavod za fiziologiju - Seminarska] (14:15 - 15:45) [214]
		  ○ PAPI

prof. dr. sc. Mahmutefendić Lučin Hana, dipl. ing. biol. [210] · prof. dr. sc. Mrakovčić-Šutić Ines, dr. med. [214]		
02.11.2023		

	Practical 1. Cellular transport and membrane permeability.:
	• [ONLINE] (15:00 - 17:15) [213]
	  ○ PAPI
		Seminar 2. Transfer of substance through cell membranes.:
		• [ONLINE] (14:15 - 15:00) [213]
		  ○ PAPI

doc.dr. sc. Karleuša Mujkić Ljerka, dipl. ing. bioteh. [213]		
03.11.2023		

Lecture 11. Membrane and action potential.:
• [P01] (15:15 - 17:00) [143]
  ○ PAPI
	Practical 1. Cellular transport and membrane permeability.:
	• [Zavod za fiziologiju - Seminarska] (13:00 - 15:15) [143]
	  ○ PAPI
		Seminar 2. Transfer of substance through cell membranes.:
		• [Zavod za fiziologiju - Seminarska] (12:15 - 13:00) [143]
		  ○ PAPI

prof. dr. sc. Lučin Pero, dr. med. [143]		
08.11.2023		
Lecture 12. Skeletal muscle contraction.: • [P01] (14:15 - 16:00) [143] ○ PAPI		
prof. dr. sc. Lučin Pero, dr. med. [143]		
09.11.2023		

	Practical 2. Action potential.: • [P05] (14:30 - 16:00) [213] ○ PAPI	Seminar 3. Action potential.: • [P05] (13:00 - 14:30) [213] ○ PAPI
doc.dr. sc. Karleuša Mujkić Ljerka, dipl. ing. bioteh. [213]		
10.11.2023		
Lecture 13. Skeletal muscle stimulation, neuromuscular transmission. Smooth muscle contraction.: • [P08] (12:15 - 14:00) [143] ○ PAPI	Practical 2. Action potential.: • [Zavod za fiziologiju - Seminarska] (15:45 - 17:15) [211] ○ PAPI	Seminar 3. Action potential.: • [Zavod za fiziologiju - Seminarska] (14:15 - 15:45) [211] ○ PAPI
doc. dr. sc. Gulić Tamara, mag. biol. [211] , prof. dr. sc. Lučin Pero, dr. med. [143]		
15.11.2023		
	Practical 3. Skeletal muscle physiology.: • [Zavod za fiziologiju - Seminarska] (15:30 - 17:00) [1397] ○ PAPI	Seminar 4. Skeletal muscle physiology.: • [Zavod za fiziologiju - Seminarska] (14:00 - 15:30) [1397] ○ PAPI
Viduka Ivona [1397]		
16.11.2023		
	Practical 3. Skeletal muscle physiology.: • [Zavod za fiziologiju - Vježbaonica] (14:30 - 16:00) [143] ○ PAPI	Seminar 4. Skeletal muscle physiology.: • [Zavod za fiziologiju - Vježbaonica] (13:00 - 14:30) [143] ○ PAPI
prof. dr. sc. Lučin Pero, dr. med. [143]		
29.11.2023		
Lecture 14. Hematopoiesis. Lecture 14a. Hematopoiesis Lecture 14.b Erythrocytes.: • [P01] (13:15 - 15:00) [214] ○ PAPI		
prof. dr. sc. Mrakovčić-Šutić Ines, dr. med. [214]		
01.12.2023		
Lecture 15. Erythrocyte disorders.: • [P08] (12:15 - 14:00) [214] ○ PAPI		
prof. dr. sc. Mrakovčić-Šutić Ines, dr. med. [214]		
05.12.2023		
Lecture 16: Hemostasis and blood clotting.: • [P01] (12:00 - 13:30) [214] ○ PAPI		
prof. dr. sc. Mrakovčić-Šutić Ines, dr. med. [214]		

07.12.2023		
	Practical 4. Erythrocytes and blood group.: • [Zavod za fiziologiju - Vježbaonica] (14:45 - 17:00) [211] ○ PAPI	Seminar 5. Erythrocytes and blood groups.: • [Zavod za fiziologiju - Vježbaonica] (14:00 - 14:45) [211] ○ PAPI
doc. dr. sc. Gulić Tamara, mag. biol. [211]		
08.12.2023		
Lecture 17: Hemostasis disorders.: • [P15 - VIJEĆNICA] (12:15 - 14:00) [214] ○ PAPI	Practical 4. Erythrocytes and blood group.: • [Zavod za fiziologiju - Vježbaonica] (14:45 - 17:00) [210] ○ PAPI	Seminar 5. Erythrocytes and blood groups.: • [Zavod za fiziologiju - Vježbaonica] (14:00 - 14:45) [210] ○ PAPI
prof. dr. sc. Mahmutefendić Lučin Hana, dipl. ing. biol. [210] · prof. dr. sc. Mrakovčić-Šutić Ines, dr. med. [214]		
13.12.2023		
Lecture 18: White blood cells.: • [P08] (13:15 - 15:00) [143] ○ PAPI		
prof. dr. sc. Lučin Pero, dr. med. [143]		
14.12.2023		
	Practical 5. Platelets and clotting. Bleeding time and clotting.: • [Zavod za fiziologiju - Vježbaonica] (14:45 - 17:00) [211] ○ PAPI	Seminar 6. Platelets and clotting.: • [Zavod za fiziologiju - Vježbaonica] (14:00 - 14:45) [211] ○ PAPI
doc. dr. sc. Gulić Tamara, mag. biol. [211]		
15.12.2023		
Lecture 19: White blood cell disorders.: • [P08] (12:15 - 14:00) [143] ○ PAPI	Practical 5. Platelets and clotting. Bleeding time and clotting.: • [Zavod za fiziologiju - Vježbaonica] (14:45 - 17:00) [213] ○ PAPI	Seminar 6. Platelets and clotting.: • [Zavod za fiziologiju - Vježbaonica] (14:00 - 14:45) [213] ○ PAPI
doc.dr. sc. Karleuša Mujkić Ljerka, dipl. ing. bioteh. [213] · prof. dr. sc. Lučin Pero, dr. med. [143]		
20.12.2023		
Lecture 20: Endogenous bioactive compounds.: • [ONLINE] (13:15 - 14:00) [214] ○ PAPI		
prof. dr. sc. Mrakovčić-Šutić Ines, dr. med. [214]		
21.12.2023		

Lecture 21: Inflammation, tissue repair after damage, and wound healing.:
• [ONLINE] (10:15 - 12:00) [143]
  ◦ PAPI
		Seminar 7. White blood cell disorders.:
		• [ONLINE] (13:00 - 15:15) [214]
		  ◦ PAPI

prof. dr. sc. Lučin Pero, dr. med. [143] · prof. dr. sc. Mrakovčić-Šutić Ines, dr. med. [214]		
22.12.2023		
		Seminar 7. White blood cell disorders.: • [ONLINE] (11:00 - 13:15) [214] ◦ PAPI
prof. dr. sc. Mrakovčić-Šutić Ines, dr. med. [214]		
08.01.2024		
	Practical 6. Leukocytes and inflammation. Leukocytes count. Differential blood count.: • [Zavod za fiziologiju - Vježbaonica] (11:00 - 13:15) [213] ◦ PAPI	
doc.dr. sc. Karleuša Mujkić Ljerka, dipl. ing. bioteh. [213]		
09.01.2024		
Lecture 22: The overall reaction of the organism to the noxa. Stress and adaptation. Homeostasis. Stress response disorders.: • [ONLINE] (17:00 - 18:30) [214] ◦ PAPI		
prof. dr. sc. Mrakovčić-Šutić Ines, dr. med. [214]		
10.01.2024		
	Practical 6. Leukocytes and inflammation. Leukocytes count. Differential blood count.: • [Zavod za fiziologiju - Seminarska] (13:15 - 15:30) [395] ◦ PAPI	
doc. dr. sc. Ćurko-Cofek Božena, dr. med. [395]		

List of lectures, seminars and practicals:

[PREDAVANJA] (TOPIC)	Number of hours	Location
Lecture 1. Concepts of health and disease. Homeostasis.	1	[P08]
Lecture 2. Principles of the pathogenetic mechanisms.	1	[P08]
Lecture 3. Etiological factors.	2	[P02]
Lecture 4. Disorders of structure and functions of macromolecules.	1	[P08]
Lecture 5. Pathophysiological principles of inheritance of diseases and syndromes and hereditary metabolic diseases.	1	[P08]

Lecture 6. Energetic homeostasis and Energy metabolic disorders. Hypoenergoses.	1	[P08]
Lecture 7. Disorders of structure and function of mitochondria. An integral reaction of the cells to the injuries. Cellular death.	2	[P15 - VIJEĆNICA]
Lecture 8. Malignant transformation and growth.	2	[P08]
Lecture 9. Transfer of substance through cell membranes I.	2	[P08]
Lecture 10. Transfer of substance through membrane II. Channelopathies and membrane transport disorders.	2	[P15 - VIJEĆNICA]
Lecture 11. Membrane and action potential.	2	[P01]
Lecture 12. Skeletal muscle contraction.	2	[P01]
Lecture 13. Skeletal muscle stimulation, neuromuscular transmission. Smooth muscle contraction.	2	[P08]
Lecture 14. Hematopoiesis. Lecture 14a. Hematopoiesis Lecture 14.b Erythrocytes.	2	[P01]
Lecture 15. Erythrocyte disorders.	2	[P08]
Lecture 16: Hemostasis and blood clotting.	2	[P01]
Lecture 17: Hemostasis disorders.	2	[P15 - VIJEĆNICA]
Lecture 18: White blood cells.	2	[P08]
Lecture 19: White blood cell disorders.	2	[P08]
Lecture 20: Endogenous bioactive compounds.	1	[ONLINE]
Lecture 21: Inflammation, tissue repair after damage, and wound healing.	2	[ONLINE]
Lecture 22: The overall reaction of the organism to the noxa. Stress and adaptation. Homeostasis. Stress response disorders.	2	[ONLINE]

[VJEŽBE] (TOPIC)	Number of hours	Location
Practical 1. Cellular transport and membrane permeability.	3	[ONLINE] [Zavod za fiziologiju - Seminarska]
Practical 2. Action potential.	3	[P05] [Zavod za fiziologiju - Seminarska]
Practical 3. Skeletal muscle physiology.	2	[Zavod za fiziologiju - Seminarska] [Zavod za fiziologiju - Vježbaonica]
Practical 4. Erythrocytes and blood group.	3	[Zavod za fiziologiju - Vježbaonica]
Practical 5. Platelets and clotting. Bleeding time and clotting.	2	[Zavod za fiziologiju - Vježbaonica]
Practical 6. Leukocytes and inflammation. Leukocytes count. Differential blood count.	3	[Zavod za fiziologiju - Seminarska] [Zavod za fiziologiju - Vježbaonica]

[SEMINARI] (TOPIC)	Number of hours	Location
Seminar 1. Disorders of function and structure of mitochondria. An integral reaction of the cells to the injuries. Cellular death. Malignant transformation and growth.	2	[Zavod za fiziologiju - Seminarska] [Zavod za fiziologiju - Vježbaonica]
Seminar 2. Transfer of substance through cell membranes.	1	[ONLINE] [Zavod za fiziologiju - Seminarska]

Seminar 3. Action potential.	1	[P05] [Zavod za fiziologiju - Seminarska]
Seminar 4. Skeletal muscle physiology.	2	[Zavod za fiziologiju - Seminarska] [Zavod za fiziologiju - Vježbaonica]
Seminar 5. Erythrocytes and blood groups.	1	[Zavod za fiziologiju - Vježbaonica]
Seminar 6. Platelets and clotting.	2	[Zavod za fiziologiju - Vježbaonica]
Seminar 7. White blood cell disorders.	3	[ONLINE]

EXAM DATES (final exam):

1.	02.02.2024.
2.	16.02.2024.
3.	12.07.2024.
4.	10.09.2024.
5.	24.09.2024.