Sveučilište u Rijeci • Fakultet dentalne medicine
University of Rijeka • Faculty of Dental Medicine

Course: Physiology and Pathophysiology II
Course Coordinator: Gordana Blagojević Zagorac, MD, PhD, Associate professor
Department: Department of Physiology, Immunology, and Pathophysiology
Study: Integrated Undergraduate and Graduate University Study of Dental Medicine
Year of the study: 2.
Academic year: 2021/2022

COURSE SYLLABUS

Course information (basic description, general information, teaching overview, required equipment and preparation, etc.)

The course **Physiology and Pathophysiology II** is a compulsory course in the second year of the Integrated Undergraduate and Graduate University Study of Dental Medicine. Classes are organized in shifts and are performed in the winter semester. Classes are held in the form of lectures (30 hours), seminars (30 hours) and practicals (30 hours), which amounts to a total of 90 hours (7.5 ECTS).

The main goal of this course is to enable students to apply the previously acquired knowledge from all subjects of the first year of study, especially the course Physiology and Pathophysiology I, to get acquainted with the normal function of the cardiovascular, renal and respiratory systems, as well as pathogenetic mechanisms that lead to the onset of disease. The application of increasingly invasive methods of treatment of dental and oral diseases imposes the need for a comprehensive approach to the dental patient, and therefore learning about the functions of these organ systems will provide a better understanding of pathological conditions of the oral cavity encountered by dentists in clinical practice.

Class organization:
Classes are held in the form of lectures, seminars and practicals. During seminars and practicals, the student actively discusses with the teacher the physiological and pathophysiological mechanisms in order to prepare for independent problem solving and integrative thinking about health and disease. The practicals use animal models and computer programs (Biopac) that allow detailed analysis of the function of the cardiovascular, renal and respiratory systems, and simulate the pathological conditions of these organ systems. The student is required to prepare material that is discussed in seminars and practicals.
In accordance with the Law and the Statute of the Faculty of Medicine, all forms of teaching (lectures, practicals, seminars,) are mandatory. Justification of absences from seminars and practicals is proven by valid certificates.
Lectures, seminars and practicals are held according to the Program. The schedule of students by groups can be found on the Merlin as well as on the Share point portal of the Department of Physiology and Immunology at the following address: https://spp.uniri.hr/ss_medri/katedre/427na which is accessed with the AAI address.

Content of the course Physiology and Pathophysiology II:
Physiology and Pathophysiologies of the Heart and the Circulation:
Heart – structure and function. Creating and spreading impulses. Creating a normal electrocardiogram. Cardiac arrhythmias and their electrocardiographic interpretation. Heart sounds. Overview of the circulation. Cardiac output regulation. Arterial pressure regulation. Arterial and venous pulse. Microcirculation and lymphatic system. Hypertension and hypotension. Coronary circulation and ischemic heart disease. Cardiac failure. Syncope. Circulatory shock and the basics of its treatment.
Physiology and Pathophysiology of Urinary system: Kidney – structure and function. Filtration and reabsorption. Creating concentrated and diluted urine. Prerenal, renal, and postrenal kidney disorders. Disorders of water and electrolytes turnover. Acute and chronic renal insufficiency.
Physiology and Pathophysiology of Respiration: Respiratory system – structure and function. Pressures and volumes. Pulmonary ventilation. Gas exchange through the respiratory membrane. Regulation of respiration. Pulmonary function tests. Obstructive and restrictive respiration disorders.
Acid-base Balance Regulation and Disorders: Pathophysiological factors of acid-base balance disorders. Metabolic and respiratory acidosis and alkalosis. Compensation mechanisms and consequences of acid-base balance disorders.

LEARNING OUTCOMES FOR THE COURSE:

Development of general competencies (knowledge and skills)

At the end of the course Physiology and Pathophysiology II it is expected that the student will be able to:
1. observe the cell and the organism as an integrated system, interpret and explain normal and disturbed physiological values, as well as basic physiological and pathophysiological tests.
2. critically normal functioning as well as disorders of individual organ systems.

Development of specific competencies (knowledge and skills)

At the end of the course Physiology and Pathophysiology II it is expected that the student will be able to:
1. explain the normal functioning and electrophysiology of the heart, the physical properties of the circulatory system and the mechanisms of regulation of arterial pressure, capillary dynamics, as well as the pathophisyiological mechanisms of cardiovascular system disorders.
2. explain the function of the nephron, the mechanisms of urine production, the role of the kidney in the regulation of the composition and volume of extracellular fluid, as well as the pathophysiological mechanisms of renal diseases and renal failure.
3. explain the structure and function of the respiratory system, regulation of respiration, and the mechanisms of respiratory disorders.
4. explain the mechanisms of acid-base balance regulation, acid-base balance disorders and their consequences.

Compulsory literature:

1. Guyton A. C. and Hall J. E. Textbook of Medical Physiology , thirteenth edition, Elsevier Inc., 2016.
2. Gamulin S., Marušić M., Kovač Z. (Eds). Pathophysiology – basic mechanisms of disease - textbook (book one: volume one and volume two), Medicinska naklada, Zagreb, 2014. 3. Ravlić-Gulan J. et al. Textbook „Practicals of Physiology and Pathophysiology II“ (first edition),

University od Rijeka, Faculty of Medicine, Department of Physiology, Immunology and Pathophysiology; Rijeka, 2018.

3. Kovač Z., Gamulin S (Eds). Pathophysiology, study guide algorhythms – problem solver, Medicinska naklada Zagreb, 2014.
4. All contents published on the Share point portal of the Department of Physiology and Immunology and the Merlin platform

Additional literature:

Course teaching plan:

List of lectures (with titles and learning outcomes):

Lecture 1: Introduction to Cardiovascular System. Physiology of the Cardiac Muscle. Cardiac Cycle

To describe the anatomical and functional characteristics of the cardiac muscle and the cardiovascular system. To explain and to analyze core principles of cardiac function. To describe the role of valves and to evaluate their importance in the cardiac function. To describe cardiac muscle as a pump. To analyze phases of systole and diastole. To analyze and to evaluate the importance of different mechanisms for regulating cardiac function.

Lecture 2: Rhythmical Excitation of the Heart.

Learning outcomes:
Clarify the specifics of membrane and action potential in the heart.
Explain the special system for creating and conducting impulses in the heart.

Lecture 3: Vectorial Analysis and a Normal Electrocardiogram (ECG)

Learning outcomes:
Define standard electrocardiographic leads.
Explain the basic principles of electrocardiography and the principles of vector analysis.
Describe the features of a normal electrocardiogram.

Lecture 4: Disorders of generation and conduction of electrical impulses in the heart and their ECG interpretation

Learning outcomes:
Describe the mechanisms that lead to impulse generation disorders.
Describe the effect of ions (sodium, potassium and calcium) on heart function.
Explain normotopic and heterotopic disorders of pulse generation in the heart with ECG interpretation.
Describe the mechanisms that lead to impulse conduction disturbances.
Explain supraventricular and ventricular blocks with ECG interpretation.
Describe atrial and ventricular undulation and fibrillation with ECG interpretation.
Describe the hemodynamic consequences of heart rhythm disorders.

Lecture 5: Basic principles of circulation, pressure and blood flow

Learning outcomes:

Describe the functional features of the arterial and venous part of the circulatory system.
Explain the physical properties of circulation.
Define the relationships between pressure, flow and resistance.

Lecture 6: Microcirculation and control of local tissue blood flow
Learning outcomes:
Explain the structure of microcirculation and the mechanisms of capillary exchange.
Explain the function of the lymphatic system
Describe the principles of metabolic, humoral and neural regulation of blood flow.

Lecture 7: Regulation of cardiac output and venous return
Learning outcomes:
Clarify the parameters that affect venous return: central venous pressure, systemic filling pressure, and venous return resistance.
Explain the cardiac output curve, as well as the parameters that lead to its shift.
Explain the relationship between venous return and cardiac output using an example of sympathetic stimulation.

Lecture 8: Regulation of blood pressure and blood pressure disorders
Learning outcomes:
Explain the mechanisms of blood pressure regulation: short-term, medium-term and long-term.
Define arterial hypertension and hypotension.
Describe the division of hypertension and hypotension based on the pathogenetic mechanism.
Explain the pathogenetic consequences of arterial hypertension.

Lecture 9: Cardiac disorders
Learning outcomes:
Explain the mechanisms by which the heart adapts to the load.
Define the pathophysiological mechanisms of systolic and diastolic heart dysfunction, and their hemodynamic consequences.
Analyze the basic features of the pathophysiological mechanism and hemodynamic consequences in valvular heart disease.
Explain the pathogenetic mechanisms of heart failure.
Explain the differences between compensated and decompensated heart failure, and the mechanisms and pathophysiological consequences of unilateral and bilateral heart failure.

Lecture 10: Ischemic heart disease
Learning outcomes:
Describe the disorders of coronary blood flow and the pathogenesis of ischemic heart disease.
Describe the biochemical, mechanical and electrophysiological consequences of ischemia.

Lecture 11: Physiology of the renal system
Learning outcomes:
Explain the physiological structure of the urinary system and kidneys.
Explain glomerular function and renal tubule function.
Describe renal blood flow, clarify glomerular filtration, and processing of glomerular filtrate in renal tubules, as well as their regulation.
Explain the regulation and secretion of individual ions.

Describe the mechanisms of concentration and dilution of urine.

Lecture 12: Pathophysiology of the renal system
Learning outcomes:
Explain the basic pathophysiological mechanisms in prerenal, renal (glomerular disorders and tubulointerstitial disorders) and postrenal renal disorders.
Describe the compensatory mechanisms of maintaining normal glomerular filtration and blood flow through the kidney.
Describe nephrotic and nephritic syndrome.
Interpret the pathogenesis of acute and chronic renal failure.

Lecture 13: Physiology of the respiratory system
Learning outcomes:
Describe the physiological structure of the respiratory system and its function.
Describe the mechanics of pulmonary ventilation and the physical principles of gas exchange.
Define anatomical and physiological dead space.
Describe pulmonary volumes and capacities, minute tidal volume, and alveolar ventilation.
Describe the transport of oxygen and carbon dioxide through the blood.
Describe the specifics of pulmonary circulation.
Clarify respiratory regulation.
Define static and dynamic lung tests.

Lecture 14: Pathophysiology of the respiratory system
Learning outcomes:
Explain the differences between obstructive and restrictive ventilation disorders.
Explain gas diffusion disorders.
Explain pulmonary edema (cardiogenic and noncardiogenic), clarify pulmonary hypertension and pulmonary embolism.
Define and explain the pathogenetic mechanism of respiratory insufficiency, and emphasize the differences between hypoxemic and hypercapnic forms of respiratory insufficiency.

Lecture 15: Regulation of acid-base balance
Learning outcomes:
Describe and clarify the role of regulatory systems for monitoring acid-base balance: buffers, respiratory and renal system.

Lecture 16: Disorders of acid-base balance
Learning outcomes:
Explain metabolic and respiratory acidosis and alkalosis.
Explain the pathophysiological consequences of acid-base imbalance and the principles of their assessment.

List of seminars (with the titles and learning outcomes):

Seminar 1: Heart structure, cardiac cycle, regulation of cardiac work. Generation and conduction of electrical impulses in the heart.
Learning outcomes:

Describe the structure of the heart and the structure of the heart muscle.
Describe the heart as a pump and the function of the heart valves.
Define the cardiac cycle and describe the characteristics of each of its phases.
Define cardiac output and venous inflow.
Explain the mechanisms of regulation of cardiac work.
Describe the specifics of the formation of membrane and action potentials in the heart.
Understand the mechanism of rhythmic excitation of the heart.
Describe the basic principles of electrocardiography.

Seminar 2: Basic principles of circulation, pressure and blood flow.
Learning outcomes:
Describe the circulatory system. Explain the physical properties of circulation.
Define the relationships between pressure, flow and resistance.
Explain pressure and volume curves in the arterial and venous systems.

Seminar 3: Microcirculation and tissue flow control.
Learning outcomes:
Describe microcirculation and lymphatic system, capillary fluid exchange, intercellular fluid, and lymph flow.
Explain autoregulation, and humoral and nervous regulation of local blood flow.

Seminar 4: Blood pressure regulation and blood pressure disorders..
Learning outcomes:
Explain the mechanisms of blood pressure regulation - short-term, medium-term and long-term.
Describe the integrated pressure control system.
Explain the pathogenesis of hypertension and hypotension, and their consequences on the body as a whole.

Seminar 5: Cardiac disorders.
Learning outcomes:
Describe and explain the adaptation of the heart to pressure and volume load.
Define the pathophysiological mechanisms of systolic and diastolic heart dysfunction, and their hemodynamic consequences.
Explain the pathogenetic mechanisms of heart failure.

Seminar 6: Physiology of the renal system.
Learning outcomes:
Describe the general structure of the kidneys and urinary system.
Analyze the structure of the nephron. Explain the functions of the glomeruli and tubules.
Describe the production of urine in the kidneys and control processes in the tubules.
Describe the control of osmolarity and sodium concentration in extracellular fluid.

Seminar 7: Pathophysiology of the renal system.
Learning outcomes:

Explain prerenal, renal and postrenal renal dysfunction.
Explain the etiopathogenesis of renal failure.

Seminar 8: Physiology of the respiratory system.
Learning outcomes:
Describe the mechanisms of pulmonary ventilation.
Describe the specifics of pulmonary circulation.
Name the physical principles of gas exchange; diffusion of oxygen and carbon dioxide through the respiratory membrane.
Describe the transport of oxygen and carbon dioxide through blood and body fluids.
Describe regulation of respiration.

Seminar 9: Pathophysiology of the respiratory system.
Explain alveolar ventilation disorders (obstructive and restrictive disorders).
Explain gas diffusion disorders.
Describe pulmonary edema, pulmonary hypertension, and pulmonary embolism.
Clarify respiratory rhythm disorders.
Explain the etiopathogenesis of respiratory failure, and clarify the difference between hypoxemic and hypercapnic respiratory failure.

Seminar 10: Regulation of acid-base balance and acid-base balance disorders.
Learning outcomes:
Describe the mechanisms of acid-base balance regulation.
Describe acid-base imbalances.

List of laboratory practicals (with the titles and learning outcomes):

Practical 1: Membrane and action potentials.
Learning outcomes:
Explain the genesis of the resting membrane potential, the action potential and the effect of different electrolytes on the membrane and action potentials.
Analyze the effect of the nervous system and various neurotransmitters on heart function.

Practical 2: Electrography (ECG)
Learning outcomes:
Record and interpret a normal electrocardiogram in humans.

Practical 3: Electrocardiographic interpretation of disorders of generation and conduction of electrical impulses in the heart.
Learning outcomes:
Analyze and recognize basic heart rhythm disorders based on electrocardiographic records.

Practical 4: Pulse and ECG
Learning outcomes:

Explain pulse pressure and its disorders and various pathophysiological conditions.

Practical 5: Blood pressure
Learning outcomes:
Measure arterial pressure by auscultation method.
Explain the mechanisms of arterial pressure regulation.
Analyze the mechanisms that maintain blood pressure based on blood pressure measurements by the direct method-video recording.

Practical 6: Heart tones and valvular disorders.
Learning outcomes:
Explain the origin of heart tones.
Analyze the action of heart valves and the formation of heart tones and the haemodynamics of congenital and acquired cardiac defects.

Practical 7: Circulatory shock.
Learning outcomes:
Define circulatory shock, explain different types of circulatory shock, stages of circulatory shock and its consequences. Define compensated and decompensated stages of circulatory shock.
Explain the symptomatology of circulatory shock on individual organs.

Practical 8: Analysis of urine composition
Learning outcomes:
Learn ways to assess kidney function based on a urine tests.
Define the normal composition of urine.
Analyze urine and urine sediment.
Clarify basic tests of renal function.

Practical 9: Static lung tests
Learning outcomes:
Perform static tests to assess lung function.
Measure lung volumes and capacities using a spirometer and Biopac.
Spirogram analysis (lung volumes and capacities).

Practical 10: Dynamic lung tests
Learning outcomes:
Perform dynamic lung ventilation tests.
Measure FVC, FEV1 and MVV.
Define changes in dynamic lung tests in obstructive and restrictive lung diseases.

Student obligations:

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

ECTS grading system:

Student grading will be conducted according to the current **Ordinance on Studies of the University of Rijeka.**

Student work will be assessed and graded during the course and on the final exam. During the course, students may obtain a total of 100 grade points. Students may achieve up to 50 grade points during classes, and up to 50 grade points at the final exam.

I. Evaluation during the course (maximum of 50 grade points):

During classes, acquired knowledge will be evaluated on two tests: Test 1 (1st midterm exam): Heart and Circulation (lectures 1–10, seminars 1–5 and practicals 1–7) – a student may obtain a maximum of 25 grade points; Test 2 (2nd midterm exam): Kidney, Respiration, and Acid-base Balance (lectures 10–16, seminars 6–10 and practicals 8–10)– a student may obtain a maximum of 25 grade points

A student may access the correction of the first and the second midterm exam if they did not obtain a minimum number of grade points for accessing the final exam, if they did not access the midterm exam, or if they are not satisfied with the obtained grade points. If a student retakes the midterm exam because they are not satisfied with the obtained grade points, only the grade points obtained from the retaken midterm will be considered. Correction of the midterm exams will be held in the period between the 1st and the 2nd exam date.

Up to 25 points can be "earned" on each midterm exam as follows:

Correct answers	Grade points
39, 40	25
37, 38	24
35,36	23
33, 34	22
31, 32	21
30	20
29	19
28	18
27	17
26	16
24, 25	15
22, 23	14
20, 21	13

Midterm exams:

I. 06.12.2021.
II. 15.12.2021.

II. Final exam (up to 50 grade points)

Students who have earned 25-50 points during the course must take the final exam where they receive additional points. Students who achieved less than 25 points during classes or missed

more than 30% of classes are not eligible to take the final exam (unsuccessful/failed F). The final exam evaluates specific competencies that are established for each section, and it consists of a written and an oral part. The student is required to demonstrate at least 50% of knowledge, skills and competencies in written and at least 50% of knowledge, skills and competencies in the oral part of the exam

a) Written part consists of 50 questions, and grade points (minimum of 20 – maximum of 40) are obtained if the student solves correctly more than 50% of questions as shown in the table:

Correct answers	Grade points
49, 50	**40**
47, 48	**39**
45, 46	**38**
44	**37**
43	**36**
42	**35**
41	**34**
40	**33**
39	**32**
38	**31**
37	**30**
36	**29**
35	**28**
34	**27**
33	**26**
32	**25**
31	**24**
30	**23**
29	**22**
27, 28	**21**
25, 26	**20**

b) A student may access the oral part of the final exam if they obtained a minimum of 20 grade points at the written part of the final exam. At the oral part of the final exam, a student may obtain grade points as shown in the Table:

ORAL EXAM GRADE	**GRADE POINTS**
5	**9, 10**
4	**8**
3	**7**
2	**5, 6**
1	**0**

In order to pass the final exam, a student must achieve a minimum of 20 grade points at the written part and a minimum of 5 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 represents a sum of all grade points (ECTS credits) obtained during classes and at the final exam:

FINAL GRADE		
90-100 pints	**A**	**excellent (5)**
75-89,99 points	**B**	**very good (4)**
60-74,99 points	**C**	**good (3)**
50-59,99 points	**D**	**sufficient (2)**
less than 50 points	**F**	**failed (1)**

Other important information regarding the course:

Course content and all the notifications regarding the course may be found on the Share-portal for internal communication of the Department of Physiology and Immunology as well as on the Merlin.

IMPORTANT NOTIFICATION

If the epidemiological instructions related to Covid-19 infection determine some precautions regarding student gathering at the faculty, we will adjust the Syllabus and the method of assessment to the current situation. In that case, teaching would be performed online (via audio presentations, using the MS teams platform, etc.), and the writing of tests would be carried out via the Merlin system. Students will be notified of any changes to the Syllabus on time.

COURSE SCHEDULE for academic year 2021/2022

Date	Lectures (time and place)	Seminars (time and place)	Practicals (time and place)	Lecturer
22.11.2021.	L1 (10,15-11,45)			Associate prof. G. Blagojević Zagorac, MD
22.11. 2021.	L2 (12,00-12,45)			Prof. J. Ravlić-Gulan, MD
22.11. 2021.	L3 (13,15-14,45)			Associate prof. G. Blagojević Zagorac, MD
23.11.2021.			P1 (08,15-10,30)	Associate prof. G. Blagojević Zagorac,MD
23.11.2021.			P2 (11,00-13,15)	Associate prof. G. Blagojević Zagorac, MD
23.11.2021.	L4 (14,00-15,30)			Prof. J. Ravlić-Gulan, MD

24.11.2021.			P3 (8,15-10,30)	S. Lukanović Jurić, MD
24.11.2021.		S1 (11,00-13,15)		Prof. Z. Trobonjača, MD
25.11.2021.	L5 (8,15-9,45)			Associate prof. H. Jakovac, MD
25.11.2021.	L6 (10,00-11,30)			Associate prof. G. Blagojević Zagorac, MD
25.11.2021.			P4 (12,30-14,45)	Associate prof. H. Jakovac, MD
26.11.2021.	L7 (10,00-10,45)			Associate prof. G. Blagojević Zagorac, MD
26.11.2021.	L8 (11,00-12,30)			Prof. dr. sc. Gordana Laškarin, MD
26.11.2021.			P5 (13,15-15,30)	Associate prof. H. Jakovac, MD
29.11.2021.		S2 (8,00-10,00)		Prof. dr. sc. Z. Trobonjača, MD
29.11.2021.		S3 (11,00-13,15)		S. Lukanović Jurić, MD
29.11.2021.		S4 (14,00-16,15)		Associate prof. G. Blagojević Zagorac, MD
30.11.2021.	L9 (8,15-9,45) **online**			Associate prof. G. Blagojević Zagorac, MD
30.11.2021.	L10 (10,00-11,30) **Online**			Prof. dr. sc. J. Ravlić-Gulan, dr. med.
30.11.2021.			P6 (12,30-14,45)	Associate prof. H. Jakovac, MD
01.12.2021.		S5 (8,15-10,30)		Prof. J. Ravlić-Gulan, MD
01.12.2021.			P7 (11,00-13,15)	S. Lukanović Jurić, MD
06.12.2021.	L11 (12,15-13,45)			Prof. .dr. sc. Z. Trobonjača, MD
06.12.2021.	L12 (14,00-15,30)			Associate prof. V. Sotošek, MD
06.12.2021.	L13 (8,15-9,45)			Associate prof. G. Blagojević Zagorac, MD
06.12.2021.	L14 (10,00-11,30) online			Associate prof. G. Blagojević Zagorac, MD
07.12.2021.			P8 (8,15-10,30)	Associate prof. H. Jakovac, dr. med.

07.12.2021.		S6 (11,00-13,15)		Assistant prof. T. Gulić, mol. biol.
08.12.2021.		S7 (12,00-14,15)		Associate prof. V.
				Sotošek, MD
08.12.2021.			P9 (15,00-17,15)	Associate. prof. G. Blagojević Zagorac, MD
08.12.2021.			P10 (17,30-19,45)	Assistant prof. T. Gulić, mol. biol.
09.12.2021.		S8 (10,45-12,30)		Assistant prof. T. Gulić, mol. biol.
09.12.2021.		S9 (12,45-15,00)		Assistant prof. T. Gulić, mol. biol.
10.12.2021.	L15 (10,45-12,30) **online**			Associate prof. G. Blagojević Zagorac, MD
10.12.2021.	L16 (12,45-14,30)			Associate. prof. G. Blagojević Zagorac, MD
13.12.2021.		S10 (8,15-10,30)		Assistant prof. T. Gulić, mol. biol.

List of lectures, seminars, and practicals:

	LECTURES (topics)	Teaching Hours	Lecture room
L1	Heart structure, heart as a pump, cardiac cycle	2	online
L2	Generation and conduction of electric impulses in the heart	1	online
L3	ECG	2	online
L4	ECG- pathological findings	2	online
L5	Basic principles of circulation, blood pressure and blood flow	2	online
L6	Microcirculation and regulation of the tissue blood flow	2	online
L7	Cardiac output and venous return regulation	1	online
L8	Blood pressureregulation and its disorders	2	online
L9	Pathophysiology of the heart	2	online
L10	Ishemic heart disease	2	online
L11	Physiology of urinary system	2	online
L12	Pathophysiology of urinary system	2	online
L13	Physiology of respiratory system	2	online
L14	Pathophysiology of respiratory system	2	online

L15	Regulation of acid-base balance	2	online
L16	Acid-base balance disorders	2	online
	Total	**30**	

	SEMINARS (topics)	Teaching Hours	Lecture room
S1	Heart structure, heart as a pump, cardiac cycle, generation and conduction of electric impulses in the heart	3	**online**
S2	Basic principles of circulation, blood pressure and blood flow	3	**online**
S3	Microcirculation and regulation of the tissue blood flow	3	**online**
S4	Blood pressureregulation and its disorders	3	**online**
S5	Pathophysiology of the heart	3	online
S6	Physiology of urinary system	3	**online**
S7	Pathophysiology of urinary system	3	**online**
S8	Physiology of respiratory system	3	**online**
S9	Pathophysiology of respiratory system	3	**online**
S10	Regulation of acid-base balance and acid-base balance disorders	3	**online**
	Total	**30**	

	PRACTICALS (topics)	Teaching Hours	Lecture room
P1	Membrane and action potencials	3	Practical room
P2	ECG	3	Practical room
P3	ECG- pathological findings	3	Practical room
P4	Puls and ECG	3	Practical room
P5	Blood pressure measurments	3	Practical room

P6	Heart sounds and heart valvular disorders	3	Practical room
P7	Circulation shock	3	Seminar room
P8	Urin analysis	3	Practical room
P9	Static lung tests	3	Practical room
P10	Dynamic lung tests	3	Practical room
	Total	**30**	

	FINAL EXAM
1.	17.12.2021.
2.	14.01.2022.
3.	27.06.2022.

Midterm exams:

1. 6.12.2021
2. 15.12.2021.

Course syllabus by teaching units

Seminars- prepare a course content
S1: Physiology of the Heart **Guyton and Hall:** Ch. 5. Membrane Potentials and Action Potentials (p. 61-74) Ch. 9. Cardiac Muscle; The Heart as a Pump and Function of the Heart Valves (p. 109-122) Ch. 10. Rhythmical Excitation of the Heart (p. 123-129)
S2: The Circulation Guyton and Hall: Ch. 14. Overview of the Circulation; Biophysics of Pressure, Flow, and Resistance (p. 169-178) Ch. 15. Vascular Distensibility and Functions of the Arterial and Venous Systems (p. 179-188)
S3: Microcirculation and regulation of tissue blood flow **Guyton i Hall:** Ch. 16. The Microcirculation and Lymphatic System: Capillary Fluid Exchange, Interstitial Fluid, and Lymph Flow (p. 189-201) Ch. 17. Local and Humoral Control of Tissue Blood Flow (p. 203-213) Ch. 18. Nervous Regulation of the Circulation and Rapid Control of Arterial Pressure (p. 215-225)

S4: Blood pressure
Guyton i Hall:
Ch. 18. Nervous Regulation of the Circulation and Rapid Control of Arterial Pressure (p. 215-225)
Ch. 19. Role of the Kidneys in Long-Term Control of Arterial Pressure and in Hypertension: The Integrated System for Arterial Pressure Regulation (p. 227-243)

S5: Disorders of Heart Function
Gamulin et al.:
Chapter 27. Disorders of Heart Function (listed chapters):
Ch. 27. 2. Disorders of myocardial function (p. 1213-1226)
Ch. 27. 4. Disorders of heart filling (p. 1234-1239)S5: Poremećaji rada srca.
Ch. 27. 8. Heart adaptation to the functional load (p. 1271-1281)

S6: Physiology of urinary system
Guyton i Hall:
Guyton and Hall:
Ch. 28. Renal Tubular Reabsorption and Secretion (p. 347-368)
Ch. 29. Urine Concentration and Dilution; Regulation of Extracellular Fluid Osmolarity and Sodium Concentration (p. 371-387)

S7: Pathophysiology of urinary system
Gamulin et al.:
Chapter 30. Pathophysiology of Kidney and Urine Excretion System:
Ch. 30.1. Etiopathogenesis and classification of nephropathies and uropathies (p. 1390-1394)
Ch. 30.2. Prerenal disorders of the renal functions (p. 1394-1398)
Ch. 30.3. Renal disorders of the renal functions (p. 1398-1417)
Ch. 30.5. Etiopathogenesis of nephrotic syndrome (p. 1420-1423)

S8: Physiology of respiratory system
Guyton i Hall:
Ch. 40. Principles of Gas Exchange; Diffusion of Oxygen and Carbon Dioxide Through the Respiratory Membrane (p. 517-526)
Ch. 42. Regulation of Respiration (p. 539-548)

S9: Pathophysiology of respiratory system
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Ch. 29.5. Respiratory insufficiency (p. 1375-1378)

S10: Acid-base balance
Guyton and Hall:
Ch. 31. Acid-Base Regulation (p. 409-426)
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Chapter 9. Acid-base Balance Disorders:
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Ch. 9. 3. Acidosis (p. 461-473)
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Practicals- prepare a corse content
P1: Membrane and action potentials **Guyton and Hall:** Ch. 9. Cardiac Muscle; The Heart as a Pump and Function of the Heart Valves (p. 109-122) Ch. 10. Rhythmical Excitation of the Heart (p. 123-129) **Textbook for practicals (Ravlić-Gulan J. et al.):** Practical 1.1. **Practical part:** PhysioEx
P2: ECG **Guyton and Hall:** Ch. 11. The Normal Electrocardiogram (p. 131-137) Ch. 12. Electrocardiographic Interpretation of Cardiac Muscle and Coronary Blood Flow Abnormalities: Vectorial Analysis (p. 139-145, i.e. to the title "Abnormal Ventricular Conditions That Cause Axis Deviation") **Textbook for practicals (Ravlić-Gulan J. et al.):** Practical 1.2. Practical 1.3.
P3: Cardiac Arrhythmias and the Pathological Electrocardiogram **Guyton and Hall:** Ch. 12. Electrocardiographic Interpretation of Cardiac Muscle and Coronary Blood Flow Abnormalities: Vectorial Analysis (p. 145-148, i.e. from the title "Abnormal Ventricular Conditions That Cause Axis Deviation" to the title "Current of Injury") Ch. 13. Cardiac Arrhythmias and Their Electrocardiographic Interpretation (p. 155-165) **Gamulin et al.:** Ch. 27. 5. Heart Rhythm Disorders (p. 1239-1252) **Textbook for practicals (Ravlić-Gulan J. et al.):** **Practical 1.4.** **Additional material for practicals:** Book of arrhythmias – examples; Kovač et al.: problem-solving assignments

P4: ECG and puls

Gamulin et al.:
Chapter 28. Disorders of Blood pressure and Perfusion:
Ch. 28. 3. Disorders of arterial and venous pulse (p. 1326-1333)
Textbook for practicals (Ravlić-Gulan J. et al.):
Practical 1.5

P5: Blood pressure measurement

Gamulin et al.:
Chapter 28. Disorders of Blood pressure and Perfusion:
Ch. 28. 2. Arterial pressure disorders (p. 1309-1326)
Textbook for practicals (Ravlić-Gulan J. et al.):
Practical 1.7.

P6: Heart sounds and heart valvular diseases
Guyton & Hall:
Ch. 23. Cardiac valvules and cardiac defects (265-272)

Gamulin et al.
Ch. 27. 3. Valvular defects (str. 897-902)
Ch. 27. 7. Congenital cardiac defects (str. 925-927)

Textbook for practicals (Ravlić-Gulan J. et al.):
Practical 1.6.

P7: Circulatory Shock
Textbook for practicals (Ravlić-Gulan J. et al.):
Practical 1.9.
Exercise: Circulatory shock in animals (video recording)

P8: Physiology and Pathophysiology of the Kidney
Guyton and Hall:
Ch. 26. The Urinary System: Functional Anatomy and Urine Formation by the Kidneys (p. 323-333)
Ch. 27. Glomerular Filtration, Renal Blood Flow, and Their Control (p. 335-345)
Gamulin et al.:
Ch. 30.7. Disorders of urine quantity and composition (p. 1434-1445)
Ch. 30.8. Pathophysiological basis of kidney diagnostic tests (p. 1445-1450)
Textbook for practicals (Ravlić-Gulan J. et al.):

Practical 2.1. Practical 2.2. **Additional material for practicals: Kovač et al.: problem-solving assignments**
P9: Statical lung tests **Guyton i Hall:** Ch. 38. Pulmonary Ventilation (p. 497-507). Ch. 39. Pulmonary Circulation, Pulmonary Edema, Pleural Fluid (p. 509-516) **Gamulin et al.:** Chapter 29. Pathophysiology of Respiration: Ch. 29.8. Tests of pulmonary functions (p. 1381-1386) **Textbook for practicals (Ravlić-Gulan J. et al.):** Practical 3.1. Practical 3.2.
P10: Dynamic lung tests **Gamulin et al.:** Chapter 29. Pathophysiology of Respiration: Ch. 29.5. Respiratory insufficiency (p. 1375-1378) Ch. 29.8. Tests of pulmonary functions (p. 1381-1386) **Textbook for practicals (Ravlić-Gulan J. et al.):** Practical 3.3.