[Medicinski fakultet u Rijeci]

Curriculum
2023/2024

[Za kolegij]

Neurophysiology

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

Course information:

Course aims, tasks, and learning outcomes

Neurophysiology is a compulsory course in the second year of the Integrated Undergraduate and Graduate University Study of Medicine in English, taking place in the IV (summer) semester. It consists of **26** hours of lectures, **18** hours of seminars, and **16** hours of practicals, totalling 60 hours (**5 ECTS)**.

This course aims to enable the student to apply previously acquired knowledge of Neuroanatomy, Physiology and Pathophysiology, and to gain knowledge about the normal functioning of the nervous system, as well as knowledge about the pathophysiological mechanisms that lead to the disorders of the normal functioning and the occurrence of a specific disease. The acquired knowledge about basic neurophysiological and neuropathological processes should help students learn the material of the pre-clinical and clinical courses that follow in the study.

Classes are performed in the form of lectures, seminars, and practicals. The practicals include the use of computer programs Biopack and PhysioEx that simulate physiological and pathophysiological processes in humans/animals. Some seminars can be conducted as problem-oriented classes so that students can solve physiological and pathophysiological problems with the help of the teacher based on typical anamnestic and diagnostic data. At seminars and practicals, the student actively discusses the physiological and pathophysiological mechanisms with the professor. **The student is obligated to prepare the material that is being discussed in seminars and practicals.**

Following the Law and Ordinance of the Faculty of Medicine in Rijeka, all forms of classes (lectures, seminars, and practicals) are **mandatory**. For justified reasons, a student may be absent from **a maximum of 30%** of each form of class (30% of lectures, 30% of seminars, 30% of practicals).

Lectures, seminars, and practicals take place according to the Syllabus. During the course, the acquired knowledge will be evaluated by two midterm exams which make up 50% of the final grade. A student who obtains 25 grade points or more may access the final exam that is organised immediately after the completion of the classes.

All information about the course and course materials will be available online on the Merlin platform - accessed via an AAI address.

Course outline

General organisation of the nervous system: central, peripheral, and autonomous; Neuronal cellular biology: microenvironment of a neuron – glial cells; Cerebral blood flow and its disorders; Blood-brain barrier and its disorders; Cerebrospinal fluid and hydrocephalus; General energy metabolism of the brain; Fundamental neurophysiological processes: membrane and action potentials; Emergence and spreading of the nerve impulse; Structure and function of synapses; Neurotransmitters and their receptors: biochemical features of synthesis and decomposition, distribution and interaction of neurotransmitter systems; Membrane receptors: division, structure, activation, distribution; pathophysiology of the nervous transmission; Neural circuits for information processing; Organization of sensory systems and sensory functions: somatic (receptors) and special senses (vision, hearing, balance, taste, smell); Sensory disorders, pathophysiological background of pain; General organization of the motor system: spinal and supraspinal reflexes; Pyramidal and extrapyramidal motor system; Basal ganglia function: cerebellar motoric control, motoric nervous disorders; Autonomic nervous system: physiological and pathophysiological aspects; General and managing brain functions: ascending reticular activation system (attention, vigilance, sleep); Limbic system (emotions, neuroendocrinology of behaviour), sexuality; Higher brain functions: laminar and vertical organization of the cerebral cortex: integrative function of the nervous system; Intellectual functions (memory, thinking, speech); Mental function disorders.

Developing general competencies (knowledge and skills)

At the end of this course, the student will be able to:

1. interpret and explain the basics of nervous system functioning

2. interpret and explain the basics of nervous system disorders

3. connect and determine the importance of the nervous system within the organism

Developing specific competencies (knowledge and skills)

At the end of this course, the student will be able to:

1. explain the principles of emergence and spreading of the action potential (impulse), as well as the basis for the pathophysiology of the nervous transmission

2. explain the concept of synaptic transmission, biochemical features of synthesis and decomposition, and distribution and interaction of neurotransmitter systems

3. list and describe the division, structure, distribution, and activation of membrane receptors

4. explain somatic (touch, pressure, position, pain, temperature) and special senses (vision, hearing, taste, smell, balance), from sensory receptors and input (afferent) fibers to the cerebral cortex

5. explain pathophysiological processes associated with damages to somatosensory and special senses

6. explain the role of the nervous system in motor control: organization of the motor unit, spinal motor system control, voluntary motor movements, posture, role of basal ganglia and small brain in motion control

7. explain the general and managing brain functions, states of vigilance and consciousness, emotions and mood

8. explain the reaction and importance of the autonomic nervous system

9. describe types of learning and memory, cellular learning and memory mechanisms, and learning and memory disorders

10. describe the structure and function of the blood-brain barrier, cerebrospinal fluid, blood flow regulation mechanisms and circulatory disorders (cerebrovascular insult)

List of assigned reading:

1. Medical Physiology, Guyton and Hall, Medicinska naklada Zagreb,13th edition, 2016.
2. Handbook for Practicals in Neurophysiology. Vesna Barac-Latas and Associates, Faculty of Medicine, University of Rijeka, 2019.
3. Pathophysiology, basic mechanisms of disease – textbook, book one – volume one; Stjepan Gamulin, Matko Marušić, Zdenko Kovač: Medicinska naklada -Zagreb, 2014.
4. Pathophysiology, basic mechanisms of disease – textbook, book one – volume two; Stjepan Gamulin, Matko Marušić, Zdenko Kovač: Medicinska naklada -Zagreb, 2014.

List of optional reading:

1. Neuroscience, Dale Purvis: Oxford University Press – New York, 6th edition, 2018.
2. Principles of Neural Science, Eric R. Kandel: McGraw-Hill, 5th edition, 2013.
3. Pathophysiology, Study guide algorithms – problem solver; Zdenko Kovač, Stjepan Gamulin; book two, Medicinska naklada, 2014.

Curriculum:

[Predavanja] list (with titles and explanation):

Lecture 1: Organization of the Nervous System, Basic Functions of Synapses

to describe the organization of the nervous system; to explain the main levels in the function of the central nervous system (CNS); to describe the cellular structure of neurons and glial cells; to describe the structure and function of synapses; to list types of synapses; to describe the physiological structure of synapses; to explain the role of calcium ions; to describe the function of receptor proteins on a postsynaptic neuron; to explain the transmission and signal processing in neuronal groups; to explain signal divergence and convergence and lateral inhibition; to explain the term reverberation, permanent signal output, and rhythmic signal output.

Lecture 2: Neurotransmitters, Neuropeptides, and Receptors

to define the term neurotransmitter; to group low-molecular fast-acting transmitters; to group neuropeptide slow-acting transmitters; to describe the differences between these two groups of transmitters; to describe the procedures for identifying neurotransmitters and neuropeptides (according to Sheperd 1988); to describe the effects of neurotransmitters mediated through ionotropic or metabotropic postsynaptic receptors; to explain the term and meaning of receptor desensitization; to explain the glutamate metabolism in the brain; to describe the structure and function of NMDA and non-NMDA receptors; to explain the action mechanism of inhibitory GABA and glycine neurotransmitters; to describe the emergence and action of acetylcholine via acetylcholine receptors; to describe the emergence and action of monoamine neurotransmitters (dopamine, noradrenaline, and adrenaline) and serotonin; to describe the synthesis and processing of neuropeptides.

Lecture 3: Electrical Events During Neuronal Excitation and Inhibition

to describe the membrane potential of soma neuron inaction: to repeat the ion concentrations on both sides of the neuron membrane; to define the term Nernst potential; to describe the role of diffusion and the Na/K pump in the emergence of the membrane potential of the nerve; to describe the emergence and all phases of the action potential of the nerve; to define the role of sodium and potassium channels regulated by voltage; to describe the law ‘all or nothing’; to explain the term saltatory impulse conduction in the nerves; to explain the emergence of excitatory and inhibitory postsynaptic potential; to describe the emergence of action potential on the axon of the neuron and the concept of threshold stimulus; to define the term presynaptic inhibition; to explain the term spatial and temporal neuron summation; to explain the term neuronal facilitation; to describe the terms "electronic current" and "decrementary" guidance along the dendrite towards the soma; to explain the synaptic transmission fatigue; to describe the effect of acidosis and alkalosis on the synaptic transmission; to describe the concept of synaptic decay.

Lecture 4: Sensory Receptors, Somatic Sensation, Sensory Pathways for Transmitting Somatic Signals

to group senses; to define sensory receptors; to group sensory receptors; to define the term sense modality and the principle of the "marked line"; to describe the emergence of receptor (generator) potential on the example of Pacinian corpuscle; to define the relationship between receptor and action potential; to describe the mechanisms of receptor adaptation; to explain the term "tonic" and "phasic" receptor; to describe the physiological classification and function of nerve fibers; to describe the relationship of tactile senses, pressure, and vibration; to describe tactile receptors; to describe the structure and function of sensory pathways for transmitting somatic signals into the central nervous system: 1. a dorsal column system – a medial lemniscus and anterolateral system 2; to describe the position, parts, and layers of the somatosensory cortex; to explain the functions of certain parts of the somatosensory cortex; to describe somatosensory homunculus; to define the position sense; to define the term dermatome.

Lecture 5: Specific sensations: The Sense of Vision

to describe the eye optics; to explain the formation and function of the intraocular fluid; to describe the structure of the retina; to explain the photochemistry of vision; to explain the phenomenon of adaptation and accomodation; to describe the visual pathway; to describe the contrast analysis in the visual image; to explain the method of determining the visual field; to describe eye movements and control over it; to describe the joining of visual images from both eyes;

Lecture 6: Pathophysiology of the Nervous System; Peripheral and Central Sensory Disorders; Pain

to explain nerve conduction disorders; to extract disorders of hypofunction and hyperfunction of dopamine, acetylcholine, serotonin neurotransmitters; to explain the emergence of Myasthenia gravis; to repeat the mechanism of desensitization; to describe the phenomenon of tardive dyskinesia, as well as the mechanism of abstinence crisis; to explain the concepts of denervation supersensitivity, hypoesthesia, paresthesia, as well as the concept of backward decay; to describe the anatomic isthmus syndrome; to define neuropathies and polyneuropathies; to describe the

Brown-Sequard syndrome, conus and epiconus syndrome; to describe a thalamic syndrome; to describe phantom sensations; to define types of pain; to describe pain receptors; to describe twice for pain: the neospinothalamic tract and paleospinothalamic tract; to describe the functions of reticular formation, thalamus, and cerebral cortex in pain perception; to describe the analgesic system in the brain and the spinal cord; to explain the importance of the opiate system in the brain; to explain the term reflected and visceral pain; to describe and list types of headaches.

Lecture 7: Cerebral Cortex, Intellectual Functions of the Brain, Learning, and Memory

to describe the physiological structure of the cerebral cortex; to describe the thalamocortical system; to explain the functions of specific cortical areas: association areas: parietal-occipital-temporal, prefrontal, and limbic association area; to explain the position and meaning of the Wernicke area; to explain the notion of a dominant hemisphere; to explain the significance of a non-dominant hemisphere; to describe the brain function in communication (speech); to name and describe types of speech disorders; to describe the significance of the corpus callosum; to define the notion of thought, consciousness, and memory; to explain the concept of positive and negative memory; to group memory; to describe the mechanism of short-term, medium-long and long-term memory emergence; to describe the memory consolidation phenomenon: the role of the hippocampus in the process of memory.

Lecture 8: States of Brain Activity – Sleep, Brain Waves, Epilepsy

to describe two types of sleep; to explain basic theories of sleep; to describe the emergence and origin of brain waves; to distinguish epilepsies; to define schizophrenia, Alzheimer's disease, and dementia; to describe parts of the limbic system and the activation-stimulating brain system; to describe the functions of the hypothalamus; to explain the importance of reward and punishment in behavior; to describe the functions of the hippocampus and the amygdala

Lecture 9: Motor Neurophysiology: Motor Functions of the Spinal Cord

to define three types of motor abilities: voluntary, subconscious, and reflexive; to describe the structure of the spinal cord; to describe the function of alpha and gamma motoneurons, interneurons, Renshaw's cells;to describe the structure of the muscle spindle and the sensory and motor innervation of the spindle; to explain the receptor function of the muscle spindle; to describe the reflex arc; to describe the reflex to stretch (dynamic and static part of the reflex); to describe the importance of control of the gamma-motor system; to describe the term clonus; to describe Golgi's tendon reflex; to describe the polysynaptic flexor reflex; to explain the removal pattern; to describe the crosslinked extensor reflex; to define the term reciprocal inhibition; to describe the reflex for body posture and walk; to describe the spinal shock

Lecture 10: Cortical and Brain Stem Control of Motor Function

to define the position and functional parts of the motor cortex; to describe the motor homunculus; to extract specialized motor control areas; to define the medial and lateral motor system; to describe the corticospinal tract; to describe other neural pathways leaving the motor cortex; to describe the input pathways in the motor cortex; to describe the corticospinal tract; to describe the structure and function of cerebral cortex neuron pillars; to describe the stimulation of the spinal cord motoneurons; to describe the role of brainstem in the control of the motor function – the role of reticular and vestibular nuclei (to describe reticulospinal and vestibulospinal tracts); to describe the position and the anatomical and functional parts of the small brain; to define the input tracts into the small brain; to describe the deep nuclei and output tracts of the small brain; to describe the functional unit of the small brain cortex; to describe the parts and function of vestibulocerebellum; to describe the parts and function of spinocerebellum; to describe the parts and function of the cerebrocerebellum; to describe clinical disorders of the small brain.

Lecture 11: Contributions of the Cerebellum and Basal Ganglia to Overall Motor Control

to name basal ganglia; to describe the putamen circuit; to describe the caudate circuit; to explain the function of neurotransmitters in the basal ganglia system; to explain the emergence of Parkinson's disease; to explain the emergence and clinical image of Huntington's disease; to explain the formation of athetosis and hemiballism; to explain the functional connection of the basal ganglia with the brainstem and the motor cortex; to describe the basics of motor neural disorders; to describe the consequences of damage to the corticospinal tract; to describe cerebellar control disorders; to describe disorders of neuromuscular junction (Myasthenia gravis); to describe peripheral motoneuron disorders; to describe motor unit disorders.

Lecture 12: The Autonomic Nervous System; Disorders of Neurovegetative Regulation

to describe the general organization of ANS; to describe the structure of the sympathetic nervous system: preganglionic and postganglionic neurons; to describe the organization of the parasympathetic nervous system: preganglionic and postganglionic neurons; to describe cholinergic and adrenergic fibers; to describe adrenergic and cholinergic receptors and their functions; to describe the effects of sympathetic and parasympathetic stimulation of certain organs: the eye, the glands, the digestive system, the heart, the blood vessels, the blood pressure; to describe the function of the adrenal gland medulla; to explain sympathetic and parasympathetic tone; to describe autonomous reflexes; to describe the alarming reaction of the sympathetic system; to describe ANS control; to name the etiological

factors of the neurovegetative disorder; to explain the concepts of primary and secondary ANS disorders; to describe disorders of circadian rhythms; to describe sleeping disorders - awakeness; to explain the concept of psychosomatic disease; to describe chronic fatigue syndrome.

Lecture 13: Cerebral Blood Flow, Cerebrospinal Fluid and Brain Metabolism

to describe the circle of Willis; to explain the role of the perivascular space; to describe the structure of the blood-brain barrier; to explain the function of the blood-brain barrier; to describe the specificities of the brain microcirculation; to discuss transmission through the blood-brain barrier; to describe the regulation of the cerebral blood flow: autonomous and nervous; to explain the emergence and the clinical image of a stroke (ischemic and hemorrhagic); to describe the cerebral metabolism; to describe the cerebrospinal fluid system: formation, flow, and absorption of the cerebrospinal fluid; to explain the function of the cerebrospinal fluid; to describe the composition of the cerebrospinal fluid; to describe the blood-cerebrospinal fluid barrier; to describe the emergence of the communicating and non-communicating hydrocephalus; to describe the functions of the ependyma; to name and define the functions of circumventricular organs

[Vježbe] list (with titles and explanation):

Practical 1: The Neuromuscular Junction

to describe the membrane and action potential; to describe the skeletal muscle contraction; to describe the structure and function of the neuromuscular junction; to describe the effect of strychnine on the spinal cord; to explain the term and meaning of electromyography; to describe the concept of muscular fatigue.

Practical part: EMG1- Biopac video recordings showing the dependence of the electric current voltage and the frequency of stimulation on the muscle contractions in rats (continuous amplification of the stimulation until tetany) - neuromuscular connection strychnine

For this practical class, students should prepare the following material: from the textbook A. C. Guyton and Hall, Medical Physiology, Chapter 5. Membrane Potentials and Action Potentials; Chapter 6. Contraction of Skeletal Muscle; Chapter 7. Excitation of Skeletal Muscle: Neuromuscular Transmission and Excitation-Contraction Coupling and from the Handbook for Practicals in Physiology, Neurophysiology and Immunology, Rijeka, 2001, exercises number 25, 28 and 29

Practical 2: The Sense of Vision

to examine eye movements and to describe control over it; to perform pupillary reflex; to perform a corneal reflex; to determine visual acuity; to examine color recognition; to determine the width of the visual field by the perimeter method; to perform the optokinetic test, to describe the concept of visual fixation.

Practical part: Eye: 1.) Determining visual acuity; 2.) Color recognition; 3.) Reflex reactions; 4.) Ocular motility; 5.) Perimetry (visual field examination); 6.) Fundus in rats; 7.) Optokinetic record.

The student is expected to be prepared for this practical based on the previously acquired knowledge from the lecture. The student should prepare the following material: from the textbook A. C. Guyton and Hall, Medical Physiology, Chapter 50. The Eye I: Optics of Vision; Chapter 51. The Eye II: Receptor and Neural Function of the Retina; Chapter 52: The Eye III: Central Neurophysiology of Vision and from the Handbook for Practicals in Physiology, Neurophysiology and Immunology, Rijeka, 2001, exercises number 31 and 32.

Practical 3: The Sense of Hearing, Taste and Smell, Vestibular Sensation

to examine the hearing with a tuning fork; to examine the sense of balance; to examine the excitability of the vestibular system; to examine senses of taste and smell.

Practical part: A. Ear: 1) A sense of hearing; 2) Functional tests of balance organs B. Taste: 1) Testing the sense of taste for sour, salty and bitter (clinical application) C. Smell: 1) Measuring smell by Bornstein

The student should prepare the following material: from the textbook A. C. Guyton and Hall, Medical Physiology, Chapter 53. The Sense of Hearing; Chapter 54. The Chemical Senses – Taste and Smell; Chapter 56. Vestibular Sensations (p. 714-719) and from the Handbook for Practicals in Physiology, Neurophysiology, and Immunology, Rijeka, 2001, exercises number 33, 34, 35 and 36

Practical 4: Motor Neurophysiology

to describe the term decerebration; to explain the EEG method; to repeat the motor function of the spinal cord (spinal reflexes); to repeat the role of the cerebral crotex and brainstem over motor functions; to repeat the role of the small

brain and basal ganglia in the motor; to repeat brain activity states: waves, sleep, epilepsies.

Practical part studying spinal reflexes in humans, motor function of the brainstem, basal ganglia, and medulla spinalis, retucilar activation system, cerebral cortex, video recordings, decerebration, syptoms of epiletpsy

The student should prepare the following material from the textbook A.C. Guyton and Hall, Medical Physiology, Chapter 55 Motor Functions of the Spinal Cord, the Cord Reglexes; Chapter 56; Cortical and Brain Stem Control of Motor Function; Chapter 57: Contributions of the Cerebellum and Basal Gnaglia to Overall Motor Control and from the Handbook for Practicals in Physiology, Neurophysiology and Immunology, Rijeka, 2001, execrises number 24, 26, 27 and 30.

[Seminari] list (with titles and explanation):

Seminar 1: Organization of the Nervous System, Basic Functions of Synapses

to group cells of the nervous system; to describe the structure and fuction of neurons; to describe the structure and function of glial cells; to describe the parts and function of central and peripheral synapses; to describe the process of neurotransmitter exocytosis; to describe the activation of ionotripic receptors; to describe the term EPSP and IPSP; to describe synthesis, action, and decomposition of acetylcholine; to describe the effects of certain medicaments and drugs on the neuromuscular junction.

Literature:

Chapter 46. Organization of the Nervous System, Basic Function of Synapses, Electrical Events during Neuronal Excitation

Textbook: Medical Physiology, Guyton and Hall

Seminar 2: Sensory Receptors; Somatic Sensations

sensory receptors; sensory pathways for the transmission of somatic signals; somatic sensations.

Literature:

Chapter 47. Sensory receptors

Chapter 48. Somatic Sensation: General Organization, The Tactile and Position Senses Textbook: Medical Physiology, A.C. Guyton and Hall

Seminar 3: The Sense of Vision – I part

to repeat the physical principles of optics; to describe the eye optics; to explain the notion of visual acuity; to explain the formation and function of the intraocular fluid; to describe the structure of the retina; to explain the photochemistry of vision; to explain the phenomenon of adaptation and accommodation.

Literature:

Chapter 50. The Eye I: Optics of Vision

Chapter 51. The Eye II: Receptor and Neural Function of the Retina

Chapter 52. The Eye: III. Central Neurophysiology of Vision

Textbook: Medical Physiology, Guyton and Hall

to explain the phenomenon of color vision; to describe the neural function of the retina and all of its cells; to explain the phenomenon of lateral inhibition in the visual signal transmission; to describe the visual pathway; to describe the contrast analysis in the visual image; to explain the method of determining the visual field; to describe eye movements and control over it; to describe the joining of visual images from both eyes;

Seminar 4: The Sense of Hearing, The Sense of Taste and Smell, Vestibular Sensations

to describe the anatomical structure of the outer, middle, and inner ear; to explain the mechanism of impedance adaptation using the ossicle system; to describe the "traveling wave"; to describe the function of the organ of Corti; to explain the phenomenon of sound frequency determination (principle of place); to describe the determination of sound volume; to describe the auditory nerve pathway; to understand the role of the auditory cortex; to name hearing disorders; to define types of flavor; to describe the structure and function of the taste bud; to describe taste pathways;

to describe the sense of smell: types, signal transmission into the nervous system; to describe the structure and function of the vestibular apparatus.

Literature:

Chapter 53. The Sense of Hearing

Chapter 54. The Chemical Senses – Taste and Smell Chapter 56. Vestibular Sensations (p. 714-719)

Textbook: Medical Physiology, Guyton and Hall

Seminar 5: Cerebral Cortex and Intellectual Functions

to describe the parts and function of the association areas; to describe all intellectual brain functions (communication, thought, consciousness, memory); to describe the mechanisms of short-term, medium-long, and long-term memory emergence; to describe the excitatory-activating system of the brain; to describe the parts and function of the limbic system (hypothalamus, hippocampus, amygdala, limbic cortex); to describe stages of sleep; to repeat the basic theories of sleep; to define types of brain waves; to describe epilepsies; to define depression, schizophrenia, and Alzheimer's disease. Literature:

Chapter 58. Cerebral Cortex, Intellectual Functions of the Brain, Learning, and Memory

Chapter 59. Behavioral and Motivational Mechanisms of the Brain – The Limbic System and the Hypothalamus

Chapter 60. State of Brain Activity – Sleep, Brain Waves

Textbook: Medical Physiology, Guyton and Hall

Seminar 6: Motor Neurophysiology

define the structure of the motor system; motor functions of the spinal cord and brainstem; cortical and cerebellar control of motor functions and the contribution of basal ganglia to motor control.

Literature:

Chapter 55. Motor Functions of the Spinal Cord; the Cord Reflexes

Chapter 56. Cortical and Brain Stem Control of Motor Function

Chapter 57. Contributions of the Cerebellum and Basal Ganglia to Overall Motor control

Textbook: Medical Physiology, A.C. Guyton and Hall

Student obligations:

Students are required to bring to the practicals **a lab coat and the Handbook** for Practicals in Neurophysiology.

Students are not allowed **to switch groups** unless they find a replacement.

A student is obligated to prepare the material that will be discussed in seminars and practicals.

In accordance with the Law and Ordinance of the Faculty of Medicine in Rijeka, all forms of classes (lectures, seminars, and practicals) are mandatory. For justified reasons, a student may be absent from **a maximum of 30%** of each form of class (30% of lectures, 30% of seminars, 30% of exercises).

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

I. During the course (up to 50 grade points)

During the course, the aquired knowledge wil be evaluated by **two midterm exams comprising 50 questions.**

A student may obtain up to 25 grade points on each exam, as shown in the table:

Correct answers	**Grade points**
49,50	**25**
47,48	**24**
45,46	**23**
43,44	**22**
41,42	**21**
39,40	**20**
37,38	**19**
35,36	**18**
33,34	**17**
31,32	**16**
29,30	**15**
27,28	**14**
26	**13**
25	**12.5**
<25	**0**

Each test has one retake for students who did not obtain the minimal 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 he/she is not satisfied with the obtained grade points, only the grade points obtained from the retaken midterm will be considered. Retakes of the midterm exams will be held in the period between the 1st and the 2nd final exam date.

II. Final exam (up to 50 grade points)

Who can take the final exam: Students who have achieved 25 to 50 grade points during the course take the final exam where they can achieve a maximum of 50 points.

Who can NOT take the final exam: Students who have achieved less than 25 points during classes or were absent for more

than 30% of classes do not have the right to take the final exam and must re-enrol the course in the next academic year (**insufficient F**).

The final exam consists of a written and oral part. To pass the final exam, the student must solve correctly at least 50% of the written test and be positively graded on the oral part of the exam.

A) The written part of the final exam tests consists of **50 questions and 25 grade points.** The student must solve correctly at least 50% of the test to have access to the oral part of the exam, as shown in the table:

Correct answers	Grade points
48,49,50	**25**
45,46,47	**24**
42,43,44	**23**
39,40,41	**22**
37,38	**21**
35,36	**20**
33,34	**19**
31,32	**18**
29,30	**17**
27,28	**16**
25,26	**15**
<25	0

B) A student can access **the oral part** of the final exam if he/she obtained at least 15 grade points at the written part of the final exam (50% of the exam). In the oral part of the exam, the student can obtain **10 to 25 grade points** as shown in the table:

Grade obtained at the oral part of the final exam	Grade points obtained at the oral part of the final exam
excellent (5)	**22-25**
very good (4)	**18-21**
good (3)	**14-17**
sufficient (2)	**10-13**
insufficient (1)	**0**

III. Final grade

The final grade is a sum of ECTS grade points obtained during classes and at the final exam.The method of scoring in the final exam is shown in Table.

A (90-100 %)	**excellent (5)**
B (75-89,99 %)	**very good (4)**
C (60-74,99 %)	**good (3)**
D (50-59,99 %)	**sufficient (2)**
F (students who obtained less than 25 grade points during course classes or did not pass the final exam)	**insufficient (1)**

MIDTERM EXAMS:

25.04.2025. (L1 – L6; S1 – S4; P1 – P3)

02.06.2025. (L7 -L13; S5 – S6; P4)

FINAL EXAMS:

06.06.2025.

03.07.2025.

17.07.2025.

01.09.2025.

15.09.2025.

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

Teaching content and all information related to the course can be found on the Merlin.

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

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COURSE HOURS 2023/2024

Neurophysiology

[Predavanja] (Place and time or group)	**[Vježbe]** (Place and time or group)	**[Seminari]** (Place and time or group)
05.03.2024		
Lecture 1: Organization of the Nervous System, Basic Functions of Synapses: • [P08] (11:15 - 13:00) [499] ○ N_319		
prof. dr. sc. Barac Latas Vesna, dr. med. [499]		
12.03.2024		
Lecture 2: Neurotransmitters, Neuropeptides, and Receptors: • [P08] (11:15 - 13:00) [399] ○ N_319		
prof. dr. sc. Kučić Natalia, dr. med. [399]		
19.03.2024		
Lecture 3: Electrical Events During Neuronal Excitation and Inhibition: • [P08] (11:15 - 13:00) [499] ○ N_319		
prof. dr. sc. Barac Latas Vesna, dr. med. [499]		
20.03.2024		
		Seminar 1: Organization of the Nervous System, Basic Functions of Synapses: • [Zavod za fiziologiju - Seminarska] (13:15 - 15:30) [2302] ○ N-S1
izv.prof.dr.sc. Grubić Kezele Tanja, dr.med. [2302]		
21.03.2024		
		Seminar 1: Organization of the Nervous System, Basic Functions of Synapses: • [Zavod za fiziologiju - Seminarska] (13:15 - 15:30) [2302] ○ N-S2
izv.prof.dr.sc. Grubić Kezele Tanja, dr.med. [2302]		
26.03.2024		
Lecture 4: Sensory Receptors, Somatic Sensation, Sensory Pathways for Transmitting Somatic Signals: • [P08] (11:15 - 13:00) [396] ○ N_319		
prof. dr. sc. Jakovac Hrvoje, dr. med. [396]		
27.03.2024		

		Seminar 2: Sensory Receptors; Somatic Sensations: • [ONLINE] (10:45 - 13:00) [499] ◦ N-S1
prof. dr. sc. Barac Latas Vesna, dr. med. [499]		
28.03.2024		
		Seminar 2: Sensory Receptors; Somatic Sensations: • [ONLINE] (13:15 - 15:30) [499] ◦ N-S2
prof. dr. sc. Barac Latas Vesna, dr. med. [499]		
02.04.2024		
Lecture 5: Specific sensations: The Sense of Vision: • [P08] (11:15 - 13:00) [395] ◦ N_319		
doc. dr. sc. Ćurko-Cofek Božena, dr. med. [395]		
03.04.2024		
		Seminar 3: The Sense of Vision – I part: • [Zavod za fiziologiju - Seminarska] (13:15 - 15:30) [395] ◦ N-S1
doc. dr. sc. Ćurko-Cofek Božena, dr. med. [395]		
04.04.2024		
		Seminar 3: The Sense of Vision – I part: • [Zavod za fiziologiju - Seminarska] (13:15 - 15:30) [395] ◦ N-S2
doc. dr. sc. Ćurko-Cofek Božena, dr. med. [395]		
09.04.2024		
Lecture 6: Pathophysiology of the Nervous System; Peripheral and Central Sensory Disorders; Pain: • [P08] (11:15 - 13:00) [499] ◦ N_319		
prof. dr. sc. Barac Latas Vesna, dr. med. [499]		
10.04.2024		
	Practical 1: The Neuromuscular Junction: • [Zavod za fiziologiju - Vježbaonica] (16:00 - 19:00) [395] ◦ N-P1	
doc. dr. sc. Ćurko-Cofek Božena, dr. med. [395]		
11.04.2024		

	Practical 1: The Neuromuscular Junction: • [Zavod za fiziologiju - Vježbaonica] (16:00 - 19:00) [395] ○ N-P2	
doc. dr. sc. Ćurko-Cofek Božena, dr. med. [395]		
22.04.2024		
Lecture 7: Cerebral Cortex, Intellectual Functions of the Brain, Learning, and Memory: • [ONLINE] (10:30 - 12:00) [499] ○ N_319		
prof. dr. sc. Barac Latas Vesna, dr. med. [499]		
23.04.2024		
Lecture 8: States of Brain Activity – Sleep, Brain Waves, Epilepsy: • [P08] (11:15 - 13:00) [499] ○ N_319		
prof. dr. sc. Barac Latas Vesna, dr. med. [499]		
24.04.2024		
	Practical 2: The Sense of Vision: • [Zavod za fiziologiju - Vježbaonica] (16:00 - 19:00) [395] ○ N-P1	
doc. dr. sc. Ćurko-Cofek Božena, dr. med. [395]		
25.04.2024		
	Practical 2: The Sense of Vision: • [Zavod za fiziologiju - Vježbaonica] (16:00 - 19:00) [395] ○ N-P2	
doc. dr. sc. Ćurko-Cofek Božena, dr. med. [395]		
26.04.2024		

		Seminar 4: The Sense of Hearing, The Sense of Taste and Smell, Vestibular Sensations:
		• [ONLINE] (09:00 - 11:15) [499]
		  ○ N-S2
		  ○ N-S1

prof. dr. sc. Barac Latas Vesna, dr. med. [499]		
30.04.2024		
Lecture 9: Motor Neurophysiology: Motor Functions of the Spinal Cord: • [P08] (11:15 - 13:00) [396] ○ N_319		
prof. dr. sc. Jakovac Hrvoje, dr. med. [396]		

02.05.2024		
		Seminar 5: Cerebral Cortex and Intellectual Functions: • [Zavod za fiziologiju - Seminarska] (13:15 - 15:30) [499] ○ N-S2
prof. dr. sc. Barac Latas Vesna, dr. med. [499]		
03.05.2024		
		Seminar 5: Cerebral Cortex and Intellectual Functions: • [ONLINE] (09:15 - 11:30) [499] ○ N-S1
prof. dr. sc. Barac Latas Vesna, dr. med. [499]		
07.05.2024		
Lecture 10: Cortical and Brain Stem Control of Motor Function: • [P08] (11:15 - 13:00) [499] ○ N_319		
prof. dr. sc. Barac Latas Vesna, dr. med. [499]		
08.05.2024		
	Practical 3: The Sense of Hearing, Taste and Smell, Vestibular Sensation: • [Zavod za fiziologiju - Vježbaonica] (16:00 - 19:00) [395] ○ N-P1	
doc. dr. sc. Ćurko-Cofek Božena, dr. med. [395]		
09.05.2024		
	Practical 3: The Sense of Hearing, Taste and Smell, Vestibular Sensation: • [Zavod za fiziologiju - Vježbaonica] (16:00 - 19:00) [395] ○ N-P2	
doc. dr. sc. Ćurko-Cofek Božena, dr. med. [395]		
14.05.2024		
Lecture 11: Contributions of the Cerebellum and Basal Ganglia to Overall Motor Control: • [P08] (11:15 - 13:00) [499] ○ N_319		
prof. dr. sc. Barac Latas Vesna, dr. med. [499]		
15.05.2024		
		Seminar 6: Motor Neurophysiology: • [Zavod za fiziologiju - Seminarska] (13:15 - 15:30) [499] ○ N-S1

prof. dr. sc. Barac Latas Vesna, dr. med. [499]		
16.05.2024		
		Seminar 6: Motor Neurophysiology: • [Zavod za fiziologiju - Seminarska] (13:15 - 15:30) [499] ◦ N-S2
prof. dr. sc. Barac Latas Vesna, dr. med. [499]		
21.05.2024		
Lecture 12: The Autonomic Nervous System; Disorders of Neurovegetative Regulation: • [P01] (11:15 - 13:00) [396] ◦ N_319		
prof. dr. sc. Jakovac Hrvoje, dr. med. [396]		
22.05.2024		
	Practical 4: Motor Neurophysiology: • [Zavod za fiziologiju - Vježbaonica] (16:00 - 19:00) [395] ◦ N-P1	
doc. dr. sc. Ćurko-Cofek Božena, dr. med. [395]		
23.05.2024		
	Practical 4: Motor Neurophysiology: • [Zavod za fiziologiju - Vježbaonica] (16:00 - 19:00) [395] ◦ N-P2	
doc. dr. sc. Ćurko-Cofek Božena, dr. med. [395]		
28.05.2024		
Lecture 13: Cerebral Blood Flow, Cerebrospinal Fluid and Brain Metabolism: • [P08] (11:15 - 13:00) [499] ◦ N_319		
prof. dr. sc. Barac Latas Vesna, dr. med. [499]		

List of lectures, seminars and practicals:

[PREDAVANJA] (TOPIC)	Number of hours	Location
Lecture 1: Organization of the Nervous System, Basic Functions of Synapses	2	[P08]
Lecture 2: Neurotransmitters, Neuropeptides, and Receptors	2	[P08]
Lecture 3: Electrical Events During Neuronal Excitation and Inhibition	2	[P08]
Lecture 4: Sensory Receptors, Somatic Sensation, Sensory Pathways for Transmitting Somatic Signals	2	[P08]
Lecture 5: Specific sensations: The Sense of Vision	2	[P08]
Lecture 6: Pathophysiology of the Nervous System; Peripheral and Central Sensory Disorders; Pain	2	[P08]

Lecture 7: Cerebral Cortex, Intellectual Functions of the Brain, Learning, and Memory	2	[ONLINE]
Lecture 8: States of Brain Activity – Sleep, Brain Waves, Epilepsy	2	[P08]
Lecture 9: Motor Neurophysiology: Motor Functions of the Spinal Cord	2	[P08]
Lecture 10: Cortical and Brain Stem Control of Motor Function	2	[P08]
Lecture 11: Contributions of the Cerebellum and Basal Ganglia to Overall Motor Control	2	[P08]
Lecture 12: The Autonomic Nervous System; Disorders of Neurovegetative Regulation	2	[P01]
Lecture 13: Cerebral Blood Flow, Cerebrospinal Fluid and Brain Metabolism	2	[P08]

[VJEŽBE] (TOPIC)	Number of hours	Location
Practical 1: The Neuromuscular Junction	3	[Zavod za fiziologiju - Vježbaonica]
Practical 2: The Sense of Vision	3	[Zavod za fiziologiju - Vježbaonica]
Practical 3: The Sense of Hearing, Taste and Smell, Vestibular Sensation	3	[Zavod za fiziologiju - Vježbaonica]
Practical 4: Motor Neurophysiology	3	[Zavod za fiziologiju - Vježbaonica]

[SEMINARI] (TOPIC)	Number of hours	Location
Seminar 1: Organization of the Nervous System, Basic Functions of Synapses	3	[Zavod za fiziologiju - Seminarska]
Seminar 2: Sensory Receptors; Somatic Sensations	3	[ONLINE]
Seminar 3: The Sense of Vision – I part	3	[Zavod za fiziologiju - Seminarska]
Seminar 4: The Sense of Hearing, The Sense of Taste and Smell, Vestibular Sensations	3	[ONLINE]
Seminar 5: Cerebral Cortex and Intellectual Functions	3	[ONLINE] [Zavod za fiziologiju - Seminarska]
Seminar 6: Motor Neurophysiology	3	[Zavod za fiziologiju - Seminarska]

EXAM DATES (final exam):

1.	19.06.2024.
2.	04.07.2024.
3.	18.07.2024.
4.	02.09.2024.
5.	16.09.2024.