[Medicinski fakultet u Rijeci]

Curriculum
2022/2023

[Za kolegij]

Neuroanatomy

Study program:	**Medical Studies in English (R)** [Sveučilišni integrirani prijediplomski i diplomski studij]
Department:	**[Zavod za anatomiju]**
Course coordinator:	**prof. dr. sc. Cvijanović Peloza Olga, dr. med.**
Year of study:	**2**
ECTS:	**3**
Incentive ECTS:	**0 (0.00%)**
Foreign language:	**No**

Course information:

Neuroanatomy is a compulsory course of the second year (3rd semester) of Integrated Undergraduate and Graduate University Study of Medicine in English. It is consisted of 16 hours of lectures, 12 hours of seminars and 12 hours of practicles, a total of 40 hours (3 ECTS).

The course objective is to acquire knowledge about the organization and the structure of gray and white matter within the central nervous system. Except the latter, the goal of the course is to teach students how nerve impulses are transferred from the central nervous system to the target organ and vice versa. Students will also acquire knowledge of the inner ear, sensory areas that are located there and about retina of the eye bulb.

Course content: Arrangement and functional organization of the gray and the white matter of the spinal cord; an overview of arrangement and functional organization of the gray and the white matter of the brain stem; arrangement and functional organization of the grey and white matter of the cerebellum; an overview of the diencephalon nuclei; pituitary and neurosectional systems; telecephalon (telencephalon medium, hemisphere, rhinencephalon); arrangement and functional organization of the gray and the white matter of the telecephalon; limbic system; reflex arc; non specific sensory pathways; specific sensory pathways; motor pathways; reticular formation; an autonomic nervous system (basic principle of structure and function), the sympathetic part of the autonomic nervous system; the parasympathetic part of the autonomic nervous system; inner layer of the eye bulb (retina); inner ear.

List of assigned reading:

Friedrich Paulsen Tobias M. Böckers Jens Waschke. Sobotta Anatomy Textbook1st Edition. Urban & Fischer 2019

List of optional reading:

Alan R Crossman, David Neary. Neuroanatomy 5th edition. Churchil Livingstone, 2015. Werner Kahle, Michael Frotscher. Colored Atlas of Human Anatomy. Nervous System and Sensory Organs. Thieme, 6th Edition.

Curriculum:

[Seminari] list (with titles and explanation):

S1 External aspects of the cerebral hemispheres: functional localization of the lobi, sulci and gyri; major fibre systems in the telencephalon – task resolving (pg. 637-652). Neocortex, archicortex and paleocortex (pg. 638-652) – task resolving.

Learning outcomes: To revise external features of the telencephalon (borders, position, division and relations to the lateral ventricles). To describe and show cerebral lobes, and the main gyri and sulci. To appoint and describe parts of the telencephalon (cortex, white matter, basal ganglia, lateral ventricles). To describe basal ganglia and their internal and external connections. To recognize structures on horizontal, frontal and sagittal sections through the telencephalon. To describe the layers and functional areas of the neocortex. To describe the centers of the archicortex and paleocortex.

S2 Cerebellum – task resolving (pg. 673-679).

Learning outcomes: To revise external features of the cerebellum (position, hemispheres, vermis, cerebellar peduncles, and relations to the fourth ventricle). To describe division of the cerebellum on three functional and phylogenetic parts. To describe the functional organization of the cerebellar cortex (cells of molecular layer, Purkinje cells layer, and granular cells layer) and afferent fibres (mossy and climbing fibres). To identify deep masses of grey matter (nucleus dentatus, nucleus emboliformis, nucleus globosus and nucleus fastigii). To explain the tracts of the cerebellum: the major afferent and efferent connections and the position of the tracts inside the cerebelar peduncles.

S3 Functional organization of the spinal cord (pg. 715 -719) – task resolving (pg. 711-721).

Learning outcomes: To name and to describe the plexuses of the periferal nervous system.To describe the appearance and arrangement of gray and white matter of the spinal cord. To describe the organization of grey and white matter of the spinal cord. To explain the laminar structure of grey matter. To analyze the main ascending and descending tracts and their seating. To describe propriospinal fibres. To explain the origin of the spinal nerve and to describe the spinal nerve, with emphasis on dorsal and ventral nerve roots, dorsal root ganglion as well as division of the spinal nerve. To define the difference between spinal and autonomic ganglia.

S4 Extrapyramidal system and peripheral section of the somatomotor system – task resolving (pg. 728-732)

Learning outcomes: To understand the basics of the motor system setup. To describe hierarchy of the motor system, from the cerebral cortex to the skleletal muscle and vice versa. To explain afferent nerve endings and the concept of the muscle spindle and Golgi tendon organs. To explain efferent nerve endings and the concept of the motor unit, neuromuscular junctions and motor end-plates. To describe the pathways of the extrapyramidal system.

S5 Somatosensory system (pg. 732-738) and nociceptive system – task resolving (pg. 752-754)

Learning outcomes: Students will learn to describe and classify non-specific and specific ascending pathways. To understand components involved in transmission of the stimulus in the nervous system (receptors, ascending pathways, nuclei, cerebral cortex). To understand sensory perception and chemical senses (smell and taste). To explain the types of the sensory receptors and stimuli. To explain dorsal column-medial lemniscus pathway (DCML) that conveys sensations of fine touch, vibration, two-point discrimination, and proprioception (position) from the skin and joints. To explain and understand the spinothalamic tract (anterolateral system) that is constituted of anterior spinothalamic tract which caries information of crude touch and lateral spinothalamic tract which caries information of pain and temperature. To understand pain conduction and pain processing. To comprehand spinal modulation of incoming pain impulses and central modulation via descending tracts.

S6 Visual system – task resolving (pg. 738-742).

Learning outcomes: To revise structure of the retina. To describe primary visual pathway and primary visual cortex as well as visual association cortex of the occipital, temporal and parietal lobes. To describe pupillary reflex. To describe vestibular pathways and eye movement control.

[Vježbe] list (with titles and explanation):

P1 Basal ganglia. Major fibre systems in the telencephalon – task resolving

Learning outcomes: To describe and to position basal ganglia. To name the major pathways of the telencephalon.

P2 Diencephalon – task reslolving (pg. 607-612).

Learning outcomes: To name the specific and non-specific thalamic nuclei. To describe functional systems of the hypothalamus and hypophysis

P3 Cranial nerve nuclei (pg. 679-711) – task resolving

Learning outcomes: To describe the cranial nerve nuclei according to embryonic origin: afferent nuclei (general sensory, specific sensory and visceral) and efferent nuclei (somatic, brachiomotor and parasympathetic).

P4 Motor functions of the spinal cord (720-722) , clinical remarks of the upper and lower motoneurons (pg. 730-732) and referred pain – task resolving

Learning outcomes: To describe spinal ganglia and pseudounipolar neuron. To describe sctructural features of the reflex arc and define spinal reflexes: strech or myotatic reflex (monosynaptic reflex) and flexor or withdrawal reflex (polysynaptic reflex). Interpretation of the motoric and sensible failures with respect to the level of the spinal cord injury..

P5 Somatosensory cortex and pain processing (pg. 754-755) - task resolving

Learning outcomes: To recognize centers of the somatosensory cortex. To revise structure of the retina. To describe primary visual pathway and primary visual cortex as well visual association cortex of the occipital, templral and parietal lobes. To describe autonomic control of the visual reflexes: accomodation-convergence reflex and pupillary reflex. To describe pathways by which is pain processed.

P6 Olfactory and gustatory (pg. 748-751) systems (pg. 742-748). – task resolving

Learning outcomes: To describe olfactory and gustatory pathways as well as the pathways of the auditory and vestibular systems

[Predavanja] list (with titles and explanation):

L1 Neuroaxis, distribution of the grey and white matter in the CNS (pg.593-603).

Learning outcomes: To mark off and to describe the main parts of the central nervous system. To explain the linkage between development of the central nervous system and integral parts of the central nervous system. To explain the neural axis (neuroaxis) and to define the terms ventral/dorsal and the rostral/caudal in the central nervous system (Forel and Meynert axis). To explaine the morphology of the neuron and its functional characteristic. To describe neuroglial cells and their functions. To describe the main morphological characteristic of the grey and white matter. To explaine the main distribution of the grey matter in CNS, point out the difference between superfitial grey matter (cortex) and deep nuclei. To explaine the fibre content in white matter and their functional characteristics.

L2 Telencephalon – hemispheres. Basal ganglia (pg. 652-656). Telencephalon medium and organization of the white matter (pg. 595-603).

Learning outcomes: To describe the main parts of the telencephalon. To describe the external features of the hemispheres (the lobes, gyruses and sulcuses). To explain the distribution of telencephalic grey and white matter and histological structure (layers) of the cerebral cortex. To explain the morphological and functional division of the cortex. To describe white matter of the telencephalon in sense of association, commissural and projection fibres. To describe the topographical anatomy of the basal ganglia. To describe the telencephalon medium as developmental part of telencephalon. To explain organization of white matter of the telencephalon (commissural, association and projection fibres).To describe the topographical anatomy of the basal ganglia. To describe the telencephalon medium as developmental part of telencephalon. To explain organization of white matter of the telencephalon (commissural, association and projection fibres).

L3 Diencephalon: thalamus (pg. 658-660).

Learning outcomes: To describe the external features, position and relations of distinctive parts of the diencephalon. To explain inner organization of the thalamic nuclei. To position thalamus and explain its relationship with hypothalamus. To describe position and relations of the hypothalamus and to discuss its function and afferent/efferent connections.

L4 Subthalamus, epithalamus and metathalamus (pg. 656-658). Hypothalamus and hypophysis (pg. 661-664).

Learning outcomes: To describe constituent parts of the epithalamus and its position, structure and function. To describe the organization of grey and white matter of the subthalamus (fields of Forel, subthalamic nucleus). Metathalamic nuclei and its functions. To explain the function of the hypothalamus, its nuclei and connections. To describe position of the pituitary gland and its division to adenohipophysis and neurohypophysis. To explain the control of hypophysis hormone stimulation and to understand the main principles of the neuroendocrinology. To link hypothalamus to the pituitary gland by means of neurosecretion and the portal system. To explain division of the hypothalamus into three horizontal and three vertical zones. To distinguish magnocellular from the parvocellular system of the hypothalamic neurons. To describe the function of hypothalamus with respect of its connection to anterior and posterior lobe of the pituitary gland. To describe the position and relations of the pituitary gland as well as its division to adenohypophysis and neurohypophysis, control of the hormons secretion, and basic principles of the neuroendocrinology. To analyze portal circulation of the adenohypophysis and systemic circulation of the neurohypophysis.

L5 Brainstem. Mesencephalon (pg. 664-668).

Learning outcomes: An overview of the division and external features of the brainstem. Students will learn to appoint and to describe the major parts of the medulla oblongata, pons and midbrain, and to explain their mutual relationship. To describe the internal structure of constituent parts of the brainstem. To analyze and discuss the arrangement of grey and white matter of the medulla oblongata, pons and midbrain. To know the structures of the midbrain cerebral aqueduct, cerebral crura, substantia nigra, nucleus ruber and corpora quadrigemina. To specify the origin of the cranial nerves and describe the external features of the midbrain. To recognize structures on horizontal and sagittal sections through the midbrain.

L6 Pons and medulla oblogata (pg. 668-673).

Learning outcomes: To identify and distinguish main tracts and nuclei of the brainstem and to analyze the differences of cross sections in the level of the caudal, mid and rostral medulla as well as pons and midbrain. To explain the functional organization of gray and white matter of the brain stem. To appoint and explain function of the reticular formation. To explain the longitudinal zones on the mediosagittal section of the brainstem (basis, tegmentum, tectum). Based on this, to analyze the position of cranial nerve nuclei and other specific nuclei of the brainstem. To analyze the position of the main ascending and descending tracts and reticular formation

L7 Spinal cord – Surface and cross sectional features (711-715).

Learning outcomes: To describe external features of the spinal cord as well as spinal nerves. To recognize and describe centers and tracts of different cross-sectional levels of the spinal cord.

L8 Spinal cord – structure of the substantia grisea and alba (715-718).

Learning outcomes: To describe classification of the cyto-architecture of the substantia grisea and to identify major tracts of the substantia alba

L9 Somatomotor system – central section (pg. 725-728).

Learning outcomes: To explain the basic organization of the motor system. To explain the hierarchy of the motor system – from the skeletal muscle to the cerebral cortex. To explain the concept of the motor unit. To explain the role of the cerebral cortex in control of the volontary movements. To define primary motor and premotor cotrex. To describe pyramidal pathways (corticospinal and corticobulbar tracts). To explain somatotopic representation of the motor cortex. To understand the role of the basal ganglia in movements control. To list and describe the neuronal circuits of the basal gaglia. To understand the role of the cerebellum in movement control and motor learning.To explain major motor pathways and to distinct between pyramidal and extrapyramid tracts. To describe circuits and descending tracts of the extrapyramidal nervous system. To describe cerebellar pathways involved in motoric functions.

L10 Motor cortex and extrapyramidal centers (pg. 728-732).

Learning outcomes: To describe types of motoneurons (upper and lower motoneurons) in the cerebral cortex and spinal cord. To explain areal, laminar and modular orgnization of the motor cerebral cortex. To explaine the connection between motor nuclei and motor cortex. To explaine the execution of motoric information.

L11 Auditory system (pg. 742-746).

Learning outcomes: To explain organization and structure of auditory system. To describe structures of the inner ear, functional anatomy of cochlea, as well as auditory pathways.

L 12 Vestibular system (pg. 746-748).

Learning outcomes: To explain organization and structure of the vestibular system. To describe structures of the inner

ear, functional anatomy of the vestibule and semicircular canals as well as vestibular pathways.

L 13 Limbic cortex. Extrinsic connections of the hippocampal formation (649-650).

Learning outcomes: To explain organization and structure of the vestibular system. To describe structures of the inner ear, functional anatomy of the vestibule and semicircular canals as well as vestibular pathways.

L14 Limbic system (pg. 768-770).

Learning outcomes: To describe parts and function of the limbic system. To explain the hippocampal formation and its connections within the limbic system. To describe gyri of the limbic lobe (inner and outer ring). To describe structures of the hypocampus and gyrus dentatus. To define areas of limbic and paralimbic cortex. To describe connections of the limbic system. To explain Papez circuit. To describe corpus amygdaloideum and its connections

L15 Autonomic nervous system (pg. 755-768).

Learning outcomes: To explain basic organization of the autonomic nervous system. To appoint the centers of the autonomic nervous system. To explain sypathetic afferent and efferent nerve fibres, sympathetic chain and ganglia.To explain parasympathetic efferent (cranio-sacral origin) and afferent nerve fibres. To compare the organization of the sympathetic and parasympathetic parts of the autonomic nervous system. To appoint the plexuses of the autonomic nervous system. To define parasympathetic ganglia. To explain the supervising function of the autonomic nervous system in control of the vital functions. To explain autonomic inervation of organs: lacrimal gland, heart, lung, stomac, intestine to the splenic flexure, colon (descending, sigmoid and rectum), the adrenal gland core, internal rectal sphincter, urinary bladder, autonomic control of the erection (penis and clitoris) and ejaculation.

L16 Overview of the motor and sensory pathways

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Student obligations:

ECTS Grading System: Student grading will be conducted according to the current Ordinance on Studies of the University of Rijeka (approved by the Senate) and the Ordinance on Student Grading at the Faculty of Medicine in Rijeka (approved by the Faculty Council).

Student work will be assessed and graded during the course and on the final exam. During the course, a student may achieve up to 50% of the grade and at the final exam up to 50% of the grade, too. Students are graded according to the ECTS credit (A-D) and numeric (1-5) system.

Students are obliged to attend all forms of teaching during the course and may be absent from 30% of the classes. If a student is absent for more than 30% of the classes, he will not receive a signature and will have to re-enter the course. Also, a student who gains less than 25 credits must re-enter the course.

During the course, students are awarded credits by taking two midterm exams. If a student does not pass a midterm exam, he may take the makeup midterm exam on the announced date. Each midterm has its own makeup date.

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

I. Assessment and grading during the course Assessment will be carried out through two midterm exams:

1. Functional organization of gray and white matter of the central nervous system

2. Functional systems of the central nervous system Midterm is a writen exam.

Each midterm exam is comprised of 50 questions. Midterm exams are graded as follows:

Correct answers	Credits
25	12,5
26	13
27-28	14
29-30	15
31-32	16
33-34	17
35-36	18
37-38	19
39-40	20
41-42	21
43-44	22
45-46	23
47-48	24
49-50	25

II. Requirements for the final exam:

➢ A student who attended classes in accordance with the Ordinance on Studies of the University of 8 Rijeka. ➢ A student who gained at least 25 out of maximum 50 credits at midterms.

III. Grading on the final exam:

The final exam is an oral exam and it is graded as follows:

Grade	Credits
Sufficient (2)	**25**
Good (3)	**30**
Very good (4)	**40**
Excellent (5)	**50**

The final grade consists of the sum of credits gained during the course and on the final oral exam. Grading within the ECTS grading system is carried out with an absolute distribution, i.e. based on the final achievement:

A – (90 - 100%) EXCELLENT (5)

B – (75 - 89,9%) VERY GOOD (4)

C – (60 - 74,9%) GOOD (3)

D – (50 - 59,9%) SUFFICIENT (2)

F – (0 - 49,9%) INSUFFICIENT (1)

The numeric grading system, compared to the ECTS grading system, is as follows: A = excellent (5) B = very good (4) C = good (3) D = sufficient (2) F = insufficient (1)

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

Course content and all the notifications regarding the course, including exam dates, can be found on the official web site - http://www.medri.uniri.hr , http://medical-studies-in-english.com/

Final exam dates:

13.12.2024.

24.02.2025.

7.07.2025.

8.09.2025.

22.09.2025.

COURSE HOURS 2022/2023

Neuroanatomy

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

List of lectures, seminars and practicals:

[PREDAVANJA] (TOPIC)	Number of hours	Location
L1 Neuroaxis, distribution of the grey and white matter in the CNS (pg.593-603).	1	
L2 Telencephalon – hemispheres. Basal ganglia (pg. 652-656). Telencephalon medium and organization of the white matter (pg. 595-603).	1	
L3 Diencephalon: thalamus (pg. 658-660).	1	
L4 Subthalamus, epithalamus and metathalamus (pg. 656-658). Hypothalamus and hypophysis (pg. 661-664).	1	
L5 Brainstem. Mesencephalon (pg. 664-668).	1	
L6 Pons and medulla oblogata (pg. 668-673).	1	
L7 Spinal cord – Surface and cross sectional features (711-715).	1	
L8 Spinal cord – structure of the substantia grisea and alba (715-718).	1	
L9 Somatomotor system – central section (pg. 725-728).	1	
L10 Motor cortex and extrapyramidal centers (pg. 728-732).	1	
L11 Auditory system (pg. 742-746).	1	
L 12 Vestibular system (pg. 746-748).	1	

L 13 Limbic cortex. Extrinsic connections of the hippocampal formation (649-650).	1	
L14 Limbic system (pg. 768-770).	1	
L15 Autonomic nervous system (pg. 755-768).	1	
L16 Overview of the motor and sensory pathways	1	

[VJEŽBE] (TOPIC)	Number of hours	Location
P1 Basal ganglia. Major fibre systems in the telencephalon – task resolving	2	
P2 Diencephalon – task reslolving (pg. 607-612).	2	
P3 Cranial nerve nuclei (pg. 679-711) – task resolving	2	
P4 Motor functions of the spinal cord (720-722) , clinical remarks of the upper and lower motoneurons (pg. 730-732) and referred pain – task resolving	2	
P5 Somatosensory cortex and pain processing (pg. 754-755) - task resolving	2	
P6 Olfactory and gustatory (pg. 748-751) systems (pg. 742-748). – task resolving	2	

[SEMINARI] (TOPIC)	Number of hours	Location
S1 External aspects of the cerebral hemispheres: functional localization of the lobi, sulci and gyri; major fibre systems in the telencephalon – task resolving (pg. 637-652). Neocortex, archicortex and paleocortex (pg. 638-652) – task resolving.	2	
S2 Cerebellum – task resolving (pg. 673-679).	2	
S3 Functional organization of the spinal cord (pg. 715 -719) – task resolving (pg. 711-721).	2	
S4 Extrapyramidal system and peripheral section of the somatomotor system – task resolving (pg. 728-732)	2	
S5 Somatosensory system (pg. 732-738) and nociceptive system – task resolving (pg. 752-754)	2	
S6 Visual system – task resolving (pg. 738-742).	2	

EXAM DATES (final exam):