BASIC NEUROSCIENCE

**2° YEAR STUDENTS**

**UNIVERSITY OF SPLIT SCHOOL OF MEDICINE**

All data are valid for the academic year 2023/2024

PROFESSORS AND ASSOCIATES

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* Neuroscience is one of the basic medical sciences studying morphology and function of a healthy nervous system, with an emphasis on the mechanisms responsible for achieving its role as a central organism control and management system. This course will introduce students to and enable them to approach problems in this area using scientific methods. The aim of the Basic neuroscience course is to teach a student how to use the acquired knowledge on physics, chemistry, biochemistry, biology, anatomy, histology and physiology in acquiring knowledge on the normal function of the nervous system to the extent necessary for further successful studying.
* The Basic neuroscience course lectures will be held during the 4th semester *with a total duration of* 115 hours.
* Neuroscience is tested in the form of written exam that consists of 100 multiple answer questions with only one answer being correct. Each correct answer carries one point.
* Topics to be covered through lectures, seminars and practical lessons, including an indication of the prescribed literature, will be announced on the beginning of the course. Attendance of all forms of instruction is MANDATORY (except the attendance of individual consultations), and all students are obligated to study the prescribed material IN ADVANCE for seminars and practical lessons, using the main textbook and/or the additional literature.

1. The course Basic neuroscience is consisted of:

*•LECTURES • SEMINARS • PRACTICAL LABORATORY WORK • INDIVIDUAL TEACHING CONSULTATIONS*

# CURICCULUM - The course content is divided into five units:

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| **A Neuroanatomy** |

LECTURES

CNS research methods. Development of the CNS.

Peripheral nervous system and the spinal cord

Diencephalon and telenchephalon

seminarES

The structure of gray and white matter of the spinal cord, brainstem and cerebellum, diencephalon and telencephalon

Neuroanatomy, summary

PRACTICAL WORK

Review of the CNS structures

Appearance and distribution of gray and white matter of the spinal cord and brainstem

Clinical-anatomic syndromes of the spinal cord

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| **B Basics of neuron electrophysiology** |

LECTURES

Neuron is a basic structural-functional unit of CNS

The biophysical basics of excitability

Neurotransmitters in health and disease

Serotonin

seminarS

The cell membrane, ion channels, passive and active neuron properties

Structure and function of the synapse and the cellular basis of behavior (neuron sequences, pathways, circles, networks, systems)

Neurotransmitters, neuropeptides and their receptors

Electrophysiology of neurons, summary

PRACTICAL WORK

Resting, action, and synaptic potentials

Signalization

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| **C Sensory system** |

LECTURES

General organization of the sensory systems. Taste and smell

Physiology of the eye and phototransduction

seminarS

Pain, heat and cold – anterolateral sensory system. Touch, pressure, and kinesthesia - the dorsal column system

Ear - organ of hearing and balance. Auditory and vestibular system

Organization of the retina, primary visual pathway and primary visual cortex

Perception of colours, shapes, depth and movement; and the organization of the associative visual fields

Sensory system, summary

PRACTICAL WORK

Physiology of sensation

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| **D Motor system** |

LECTURES

General structure of the motor systems

SEMINARES

Role of motor cortex in voluntary movements. Eye movement and eye gaze direction system

Spinal motor mechanisms and reflexes

Role of the descending pathways from the brainstem in maintaining posture and muscle tone; spinal shock

Motor functions of the cerebellum and the basal ganglia

Motor system, summary

PRACTICAL WORK

Muscle and electromyography

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| **E General brain functions** |

LECTURES

General brain function and sleep

Control of breathing during wakefulness and during sleep

Brain lateralization

Basic research and clinical importance

SEMINARS

Neuroanatomy and psychology of speech and language

General brain functions; EEG, evoked potentials

Stages of wakefulness and alertness; sleep

Organization and structure functions of the limbic system

Neurobiology of emotion and sexuality

Neurobiology of attention and associative functions of the prefrontal and posterior parietal cortex

Anatomy and psychology of learning and memory

Cellular mechanisms of learning and memory

General brain function, summary

Clinical seminar

PRACTICAL WORK

TMS

###### EEG and evoked potential

Polysomnography

Polysomnography report

Reflexes and reaction time

Animal neurophysiological research *in vivo*

• LECTURES:

***Lecture program for the academic year 2023/2024***

***Lecture Topic Hours Lecturer***

P-1 Introductory lecture 1 Đogaš

P-2 Neuron is a basic structural-functional 2 Đogaš

unit of the CNS

P-3 Peripheral nervous system and the spinal cord 2 Pavlinac Dodig

P-4 Development of the CNS and processes of

development reorganization and plasticity 1 Pavlinac Dodig

P-5 Diencephalon and telenchephalon 2 Pavlinac Dodig

P-6 Biophysical basics of excitability 2 Đogaš

P-7 Neurotransmitters in health and disease 2 Đogaš

P-8 Serotonin 2 Valić

P-9 General organization of the sensory 2 Đogaš

systems (Ch 15, 18). Taste and smell

P-10 Physiology of the eye and phototransduction 1 Đogaš

P-11 General structure of the motor systems 1 Đogaš

P-12 General brain function and sleep 2 Đogaš

P-13 Control of breathing during 1 Pecotić

wakefulness and during sleep

P-14 Basic research and clinical importance 1 Valić

P-15 Brain lateralization 1 Pecotić

TOTAL: 23 hours

• SEMINARS:

***Seminar program for the academic year 2023/2024***

***Seminar Subject Hours***

S1 The structure of gray and white matter of the spinal cord (Ch 8) (2 hours)

S2 The structure of gray and white matter

of the brainstem and cerebellum (Ch 9, 10, 11, 13) (2 hours)

S3 The structure of gray and white matter of the diencephalon (Ch 12) (2 hours)

S4 Telencephalon (Ch 12, 24) (2 hours)

S5 Neuroanatomy, summary (1 hour)

S6 Cell membrane, ion channels, passive and active neuron properties (Ch 5) (2 hours)

S7 Structure and function of the synapse and the cellular basis of behavior

(neuron sequences, pathways, circles, networks, systems) (Ch 6) (3 hours)

S8 Neurotransmitters, neuropeptides and their receptor (Ch 7) (3 hours)

S9 Electrophysiology of neurons, summary (Ch 5-7) (2 hours)

S10 Pain, heat and cold – anterolateral sensory system

Touch, pressure, and kinesthesia - the dorsal column system (Ch 14) (2 hours)

S11 Ear - organ of hearing and balance.

Auditory and vestibular system (Ch 16) (2 hours)

S12 Organization of the retina, primary visual pathway and primary visual cortex (Ch 15) (2 hours)

S13 Perception of colors, shapes, depth and movement; and the organization of associative visual fields (Ch 25: p519-525) (1 hour)

S14 Sensory system, summary (2 hours)

S15 Role of motor cortex in voluntary movements

Eye movement and eye gaze direction system (Ch 18, 13:p259-68) (2 hours)

S16 Spinal motor mechanisms and reflexes (Ch 8) (1 hour)

S17 Role of the descending pathways from the (1 hour) brainstem in maintaining posture and muscle tone;

spinal shock (Ch 8, 9, 16:p329, 18:p364-5, 25:p525-7)

S18 Motor functions of the cerebellum and the basal ganglia (Ch 19, 20) (2 hours)

S19 Motor system, summary (1 hour)

S20 Neuroanatomy and neurophysiology of eloquent brain areas (2 hours)

(motor, speech, language) (supplementary materials)

S21 General brain functions; EEG, evoked potentials (2 hours)

S22 Stages of wakefulness and alertness; sleep (2 hours)

S23 Organization and structure functions of the limbic system (Ch 24) (1 hour)

S24 Neurobiology of emotion and sexuality (2 hours)

S25 Neurobiology of attention and associative functions

of the prefrontal and posterior parietal cortex (2 hours)

S26 Anatomy and psychology of learning and memory (2 hours)

S27 Cellular mechanisms of learning and memory (2 hours)

S28 General brain function, summary (1 hours)

S29 Clinical seminar (2 hours)

TOTAL: 53 hours

***The prescribed material must be studied in advance.***

The materials are chapters of the textbook by

* Allan Siegel and Hreday N. Sapru: Essential Neuroscience, 4th Edition.

The text for exercise is an Interactive Tutorial by John Huguenard and David A. McCormick: **Electrophysiology of the Neuron,** Windows Version

**All absences and minuses have to be compensated through a colloquium at least 2 days before the exam.**

Students not taking the exam in the first examination period, to compensate their absences and minuses, have to take a colloquium in a 10 days period after the end of the Basic neuroscience course.

• PRACTICAL LESSONS:

***Program of the practical laboratory work for the academic year 2023/2024***

***Practical*** ***Hours*** ***Title***

***Neuroanatomy***

V1 2 Review of the CNS structures

V2 2 Appearance and distribution of gray and white matter of the spinal cord

V3 2 Appearance and distribution of gray and white matter of the brainstem

V4 2 Clinical-anatomic syndromes of the spinal cord

***Neuron electrophysiology***

V5 3 Resting potential

V6 2 Action potential

V7 2 Synaptic potential

V8 3 Signalization

***Motor and Sensory system***

V9 3 Physiology of sensation

V10 2 Muscle and electromyography

***General brain functions***

V11 1 TMS (Transcranial Magnetic Stimulation)

###### V12 2 EEG and evoked potential

\*V13 4 ***SleepLab*** Polysomnography

\*V14 3 ***SleepLab*** Polysomnography report

V15 3 Reflexes and reaction time

\*V16 3 Animal neurophysiological research *in vivo*

**TOTAL:** 39 hours

Practical lessons marked with a star \* (V13, V14 and V16) are organized in multiple groups.

TEXTBOOK AND INSTRUCTIONAL MATERIALS

***OBLIGATORY TEXTBOOK AND PRACTICUM FOR PRACTICAL LESSONS***

* Siegel, A. and Sapru, H.: ESSENTIAL NEUROSCIENCE, 4th Edition, Wolters Kluwer/ Lippincott Williams & Wilkins
* John Huguenard and David A. McCormick: **Electrophysiology of the Neuron,** Windows Version, A Companion to *Neurobiology* by Gordon Shepard

***ADDITIONAL LITERATURE***

* Purves et al Neuroscience 5th edition published by Sinauer Associates
* Kandel, E.R., Schwartz, J.H. and Jessel, T.M.: Principles of Neural Science, 4th edition, McGraw-Hill; New York, SAD, 2000.
* Zigmond, MJ et all.: Fundamental Neuroscience, Academic Press; San Diego, SAD, 1999.
* Guyton, A.C. and Hall: MEDICAL PHYSIOLOGY, 11th edition. 2006.

***Basic Neuroscience 1st exam period will be held on March 22nd (and 25th), 2024.***

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