



**CD 8.5.1 DISCIPLINE SYLLABUS FOR
UNIVERSITY STUDIES**

Edition: 09

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FACULTY MEDICINE 2

STUDY PROGRAM 0912.1 MEDICINE

CHAIR OF PHYSIOLOGY AND BIOPHYSICS

APPROVED

at the meeting of the Commission for Quality Assurance and Evaluation of the Curriculum

in Medicine/Pharmacy/ Dentistry

Minutes No. 1 of 16.09.21

Chairman PhD, assoc. prof.

Suman Serghei _____

APPROVED

at the Council meeting of the Faculty

Minutes No. 1 of 21.09.21

Dean of Faculty PhD, assoc. prof.

Bețiu Mircea _____

APPROVED

approved at the meeting of the chair _____

Minutes No. 3 of 09.09.2021

Head of chair PhD, prof.

Vovc Victor _____

SYLLABUS

DISCIPLINE NEUROPHYSIOLOGY

Integrated studies

Type of course: **Optional**

Curriculum elaborat de colectivul de autori:

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Lozovanu Svetlana, PhD, associate professor

Lupușor Adrian, assistant

Chișinău, 2021



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I. INTRODUCTION

General presentation of the discipline: place and role of the discipline in the formation of the specific competences of the professional / specialty training program

Neurophysiology is the discipline that studies the physiological basis of the excitability, conductivity and integration of components of the nervous system (SN) and muscle as well as the methods of functional exploration of the nervous system for the diagnosis and subsequent treatment of SN diseases. A special section of the discipline will be about the neurophysiological mechanisms of sleep, methods of studying sleep and the main groups of sleep pathologies. - sensitivity, movement, emotions, thinking, etc. Also, the structures involved in organizing the circadian rhythm, triggering and maintaining sleep state, as well as neurophysiological investigation methods (electroencephalography (EEG), electromyoneurography (EMG), evoked potentials, cardiorespiratory polygraphy, polysomnography) will be discussed. The course ensures the acquisition of knowledge about the functioning of the SN and its diagnostic methods. Also, the study of the function of neuronal and muscular excitability allows us to understand how the skeletal nervous and muscular system works as well as the neurophysiological processes that underlie movement, perception, consciousness and sleep. The acquisition of neurophysiology is necessary for all students who want to know better the methodology of functional investigation of SN. During the neurophysiology course, notions will be accumulated regarding the different types of functional investigations, for the modern approach of multiple neurological diseases, including sleep disorders.

The acquired notions will be a basis for the medical act of prevention and diagnosis for curative or recovery purposes.

Mission of the curriculum (aim) in professional training

Neurophysiology aims to provide the student with fundamental data about the conductive properties of the skeletal nervous and muscular system and the functions derived from these processes and the methodology used in the clinic to record this activity in various forms. The duration of the study in the faculty of this discipline allows to cover the multitude of scientific notions that need to be learned, and for a better understanding of them it is necessary to correlate with medical practice and learn methods to evaluate the function of the nervous system and other organ systems. involved in the pathophysiology of neurological diseases (egg, skeletal muscle system, etc.). This knowledge will be used to understand the operating principles of the SN and the methods of recording its functions as well as to establish deviations from physiological values.

Language (s) of the discipline: Romanian, Russian, English;

Beneficiaries: students of the III year, faculty Medicine.

II. MANAGEMENT OF THE DISCIPLINE

Code of discipline	F.02.O.04/F.03.O.024/F.03.O.033
Name of the discipline	Neurophysiology
Person(s) in charge of the discipline	Victor Vovc, PhD, prof.; Lupușor Adrian, assist..



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Year	III	Semester/Semesters	VI
Total number of hours, including:			30
Lectures	20	Practical/laboratory hours	0
Seminars	0	Self-training	10
Form of assessment	C	Number of credits	1

III. TRAINING AIMS WITHIN THE DISCIPLINE

At the end of the discipline study the student will be able to:

- **at the level of knowledge and understanding:**
 - to master the functional organization of the SN and the relationships between the cortical, subcortical, medullary and peripheral components, as well as the importance of neurotransmitters in the communication process between the mentioned levels, following on this "substrate" especially neurology and psychiatry;
 - to know the neurophysiological constants, their age variations in correlation with the new evolutions within the psycho-neurological sciences;
 - to know the neuro-humoral mechanisms that underlie the circadian rhythm and the neurophysiological basis of sleep, respectively
 - to understand the use of physical-mathematical techniques in neurophysiological and clinical investigations
 - to know the principles of functioning of the neurophysiological methods of recording different functions of the SN
 - to develop skills in recording, measuring and interpreting data for verbal and written presentation of own findings and appreciation of biological and individual variations;
 - to understand the importance of mechanisms for regulating neurophysiological functions in the coordination of organs and separate systems for the normal activity of the whole organism.
- **at the application level:**
 - to possess the method of installing medical devices for the study of neurophysiological functions as well as sleep;
 - to record and analyze the parameters of different neurophysiological tests (electromyoneurogram, electrooculogram, electroencephalogram) by virtual and computerized techniques of the BIOPAC system
 - to record and analyze cardiorespiratory, electroencephalographic parameters as well as other neurophysiological parameters during sleep through medical devices (cardiopulmonary polygraph, polysomnograph, actigraph);
 - to determine, recognize and differentiate between physiological and pathological pathways;
 - to master the training method based on the analysis of the problem (clinical case).
- **at the integration level:**
 - appreciate the importance of general neurophysiological processes as well as sleep neurophysiology in particular for the proper functioning of the nervous system and the whole body



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and apply this knowledge in the context of general medicine and integration with related medical-biological disciplines;
to appreciate the importance of studying the functions of nervous regulation and control of the activity of the organs, of the organ systems as well as of the interactions between them in the context of the circadian rhythm;
use the knowledge gained to understand the principles of functional disorders and their correction mechanisms;
to be aware of the need to continuously assimilate new knowledge in the field.

IV. PROVISIONAL TERMS AND CONDITIONS

Neurophysiology is a medical-biological discipline that consists of fundamental and clinical neurophysiology. Fundamental neurophysiology comprises a complex of information based on such disciplines as anatomy, physiology, biophysics, biochemistry and histology. Clinical neurophysiology is a discipline that includes information on various types of neurophysiological investigations that aim to record the processes studied by fundamental neurophysiology and possibly to identify deviations from normal values, in other words the diagnosis of pathologies, most often neuropsychiatric. A special section of this discipline will be sleep neurophysiology, a new field that will include information on sleep neurological mechanisms and methods used to study sleep and sleep pathologies. Neurophysiology is a discipline whose study will provide students with a complex of basic and clinical information that will allow a holistic understanding of the functioning of the nervous system, the neurophysiology of sleep as well as the functional methods of investigating the nervous system and sleep. The course is structured so that the functions are studied in stages, characterized by increasing the complexity of the information and begins with addressing various aspects of the general physiology of excitable tissues, including fundamental biophysical processes of excitability and conductivity, properties of neurons, neuroglia, synapses, etc. , the course will continue with the study of the functional organization of the nervous system, the functions of the nervous system, sleep and finally the methods of investigation of the nervous system and sleep will be studied. university studies, namely neurology, psychiatry, internal medicine, cardiology, intensive care, surgery, etc.

V. THEMES AND ESTIMATE ALLOCATION OF HOURS

Lectures, practical hours/ laboratory hours/seminars and self-training

No. d/o	THEME	Number of hours		
		Lectures	Practical hours	Self- training
1.	Nervous system terminology. Neuroanatomy and neurohistology. Hierarchical organization and general principles of functioning of the nervous system. Excitability and conductivity - the fundamental property of the living. Electrogenesis of the excitation process - biophysics of the membrane and action potential, generation of the electric dipole. Potential recording, vector analysis.	2	-	-
2.	Signal generation, transmission and processing in the nervous system. Generation and transmission of action potential in neurons, neuroglia. Types and velocity characteristics of nerve fibers.	2	-	2



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No. d/o	THEME	Number of hours		
		Lectures	Practical hours	Self- training
	Physiology of synapses. Neurotransmitters. Neural inhibition and excitation. Motor unit, characteristics and mechanisms of skeletal muscle contraction. Electromyoneurogram. The way of recording, the interpretation of physiological and pathophysiological data. Examples of neuromuscular diseases where this method is applied. Oculogram. Testing and Diagnosis in the chapter: Nervous system, signal generation, transmission and processing in the nervous system.			
3.	The somatosensory system. General organization (receptors, conduction pathways, subcortical, cortical structures, arrangement in columns of neurons in the cortex, sensory cortical areas, etc.), tactile, positional and thermal sensitivity. Somesthetic evoked potentials. The pain. Special sensibilities, visual, auditory evoked potentials. Clinical significance.	2	-	-
4.	Motor functions of the nervous system (I). Spinal cord motor functions, spinal cord reflexes. Appreciation of osteo-tendon reflexes. Control of motor functions performed by the cortex and brainstem. Vestibular sensations and maintaining balance. Nystagmography, reflex caloric test.	2	-	2
5.	Motor functions of the nervous system (II). The contribution of the cerebellum and basal ganglia to the general control of motor function. Deep brain stimulation. Testing and Diagnosis in the chapter: Somatosensory system and motor functions of the nervous system	2	-	-
6.	The limbic system and the hypothalamus in the control of behavior and motivation. Types of personalities. Subjective tests for assessing the level of anxiety, depression, personality types.	2	-	-
7.	Cerebral cortex. Areas of association. The intellectual functions of the brain. Memory and learning. Language and thinking. Conscience. Tests for assessing cognitive functions.	2	-	2
8.	Bioelectricity of the cerebral cortex. Electroencephalogram during wakefulness and sleep.	2	-	2
9.	Circadian rhythm. Sleep: neurophysiological mechanisms, stages, importance, age peculiarities. Vigilance and drowsiness. Sleep hygiene. Clinical methods used for sleep recording: actigraphy, cardiorespiratory polygraphy, polysomnography.	2	-	-
10.	Sleep disorders: pathophysiology, clinical manifestations, prevention, diagnosis, treatment. Questionnaire for the interview of the patient with sleep disorders, standardized subjective	2	-	2



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No. d/o	THEME	Number of hours		
		Lectures	Practical hours	Self-training
	questionnaires for assessing the quality of sleep and sleep disorders. Testing and Diagnosis in the chapter: Superior psychic functions. He slept and watched.			
Total		20	0	10

VI. PRACTICAL TOOLS PURCHASED AT THE END OF THE COURSE

VII. OBJECTIVES AND CONTENT UNITS

Objective	Content units
Theme (chapter) 1.	
<ul style="list-style-type: none"> • To know the origin and meaning of the names used in the description of SN; the mechanism of generating the action potential at the level of neurons, neuroglia; • To know the biophysical mechanisms of electric bipole formation at the level of excitable tissues and the ways and principles of recording the generated biocurrents; • To apply the knowledge from the anatomy and histology course with reference to SN, reflex arch. • To understand the hierarchical organization and the general principles of operation of the SN; the mechanism of propagation of the action potential through neurons, neuroglia, nerve fibers and synapses; • To define the notion of excitable tissue, membrane channels, transmembrane transport, electrochemical gradient, resting and action transmembrane potential; 	<ol style="list-style-type: none"> 1 Functional organization of SN, reflex arch; 2 Intrinsic electrophysiological properties of SN. Excitability and conductivity: ionic mechanisms of resting and action potential. 3. Chemical and electrical synapses; 4. Neurotransmitters and receptors; 5. Propagation of action potential through various structures; 6. Inhibition and excitation processes at the neuronal, synaptic level; 7. Structural and functional characteristics of skeletal muscle fiber; 8. Motor unit; 9. Muscle shaking, tetanic, isometric, isotonic contraction; 10. Electromyoneurogram, clinical application; 11. Electrooculogram, clinical application.



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Objective	Content units
Theme (chapter) 2.	
<ul style="list-style-type: none"> ● To know the types of somato-sensitive receptors and the types of stimuli; motor organization and the principle of operation based on reflexes of the spinal cord; notions of somato-sensitive pathways and specificity of pathways; methodology of deep brain stimulation in case of pathologies of the basal ganglia. ● To define muscle sensory receptors (muscle spindles and Golgi tendon organs), muscle stretching reflex, Golgi tendon reflex. ● To apply the knowledge about the muscular stretching reflex in understanding the clinical application of the osteotendinous reflexes appreciated with the help of the neurological hammer; the knowledge obtained for the understanding of nystagmography and the reflex caloric test, their clinical utility. ● To know the clinical manifestations that appear after the damage of the cerebellum. ● to understand the mechanisms of vestibular sensations and maintain balance; the role and importance of specific neurotransmitters in the basal ganglia in the occurrence of pathologies. ● To define the pathologies where in the diagnostic process the method of evoked potentials can be applied. Integrate many components of 	<ol style="list-style-type: none"> 1. Motor organization of the spinal cord. 2. Flexion reflex and retraction reflexes. Cross extensor reflex 3. Mutual inhibition and reciprocal innervation. Posture and locomotion reflexes. The grate reflex. Medullary reflexes that produce muscle spasms. Autonomous medullary reflexes. 4. Muscular sensory receptors (muscle spindles and Golgi tendon organs) and their roles in muscle control. 5. The cerebellum and its motor functions. 6. Functional anatomy of the cerebellum. 7. The neural circuits of the cerebellum. 8. The role of the cerebellum in overall motor control. 9. Clinical manifestations of cerebellar damage 10. The role of the basal ganglia in the execution of motor activity patterns - the putamen circuit. 11. The role of the basal ganglia in the cognitive control of the sequence of motor patterns - the caudate circuit. 12. The role of the basal ganglia in synchronizing and adapting the speed and amplitude of movements, respectively. 13. Primary motor cortex. Premotor area. Additional motor area. 14. The pyramid system 15. Vestibular sensations and maintaining balance. Vestibular apparatus. 16. Other factors that influence balance. 17. Mechanisms of eyeball movement. 18. Nystagmography, reflex caloric test



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Objective	Content units
the entire engine control system.	
Theme (chapter) 3.	
<ul style="list-style-type: none"> ● To know the physiological anatomy of the cerebral cortex, the architecture of the cerebral cortex. ● To understand the anatomical and functional relationships between the cerebral cortex and subcortical structures. ● To know the functions of specific cortical areas and their role for the cognitive functions of the brain (memory, learning, language, thinking). ● To demonstrate the importance of the hypothalamus for the function of the limbic system; ● To know the neuronal and endocrine foundation of instinctual behavior (male, female, maternal, paternal behavior) and emotions (fear, anxiety, anger, peace, disgust); ● To know the functions of punishment, reward and their importance for learning and memorization; ● To apply the knowledge obtained in order to identify on the basis of subjective tests the type of personality of the person, the level of anxiety, depression, etc. ● To know the functional anatomy and the neurophysiological mechanisms underlying the generation of circadian rhythm, wakefulness and sleep; 	<ol style="list-style-type: none"> 1. Physiological anatomy of the cerebral cortex, architecture of the cerebral cortex; 2. Anatomical and functional relationships between the cerebral cortex and subcortical structures; 3. Cognitive functions of the brain; 4. Subjective tests to assess cognitive function (MMS, MoCA), consciousness and consciousness (Glasgow coma score). 5. Electroencephalography 6. Electrophysiology of sleep 7. Brain waves, their significance and recording by electroencephalography. 8. Neurophysiological bases of circadian rhythm, wakefulness; 9. The neurophysiological mechanisms of sleep; 10. The importance of sleep for mental, emotional and somatic health; 11. Methods of study of sleep and sleep disorders: polysomnography, ambulatory cardio-respiratory monitoring, actigraphy 12. Classification of sleep disorders; 13. Pathophysiogenetic mechanisms of the main groups of sleep pathologies (insomnia, syndrome of periodic movement of the limbs in sleep, respiratory disorders in sleep); 14. Ways to prevent sleep disorders Questionnaire for interviewing the patient with sleep disorders; 15. Questionnaires for the subjective assessment of sleep quality (Pittsburgh), the degree of daytime sleepiness (Epworth), screening for sleep apnea syndrome (Berlin), etc.



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Objective

Content units

- To understand the importance of sleep for the proper functioning of the body, the peculiarities of sleep depending on age;
- To apply the knowledge gained about sleep hygiene to establish an optimal circadian regime;
- To integrate the knowledge gained to understand the processes of sleep investigation - polysomnography (and its derivatives - MSLT, test for maintaining alertness, etc.), ambulatory cardiorespiratory polygraphy.
- To know the main groups of sleep disorders;
- To understand the general mechanisms of triggering sleep disorders, the impact of modern lifestyle on sleep quality;
- To apply knowledge about sleep disorders to prevent them from occurring;
- To know how to use the questionnaire for the interview of the patient with sleep disorders;
- To know how to use the subjective questionnaires to assess the quality of sleep, the degree of drowsiness and the screening of various sleep disorders.

VIII. VII. PROFESSIONAL (SPECIFIC (SC)) AND TRANSVERSAL (TC) COMPETENCES AND STUDY FINALITIES

✓ **Professional (specific) (SC) competences**

- PC1. Responsible execution of professional tasks with the application of the values and norms of professional ethics, as well as the provisions of the legislation in force.



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- PC2. Adequate knowledge of the sciences about the structure of the body, the physiological functions and behavior of the human body in various physiological and pathological states, as well as the external relations between health, physical and social environment.

✓ **Transversal competences (TC)**

- TC1. Autonomy and responsibility in the activity.

✓ **Study finalities**

Upon completion of the course the student will be able to:

To identify the anatomical structures and to explain the development of physiological processes and phenomena in the human body. Possess both knowledge and a vast ability to understand various physiological aspects, to be able to develop a wide range of skills, including research, investigation, analysis, and to be able to face and solve some problems, plan communications, and show team spirit.

To have knowledge regarding the choice of clinical, paraclinical and instrumental investigation methods for the correct and targeted evaluation of physiological functions;

To understand the importance of the correct interpretation of the results obtained in the evaluation of the functional state of the organs and systems in the context of a family doctor-neurologist cooperation.

To have professional and civic attitudes, which allow him to be fair, honest, non-conflicting, cooperative, understanding in the face of suffering, available to help people interested in community development;

To know, respect and contribute to the development of moral values and professional ethics;

Learn to recognize a problem when it arises and provide responsible solutions to solve it.

IX. STUDENT'S SELF-TRAINING

No.	Expected product	Implementation strategies	Assessment criteria	Implementation terms
1.	Presentations, posters and papers (clinical case).	Analysis of the literature, selection of the clinical case, establishment of the work plan and the deadline. Approval of the components of the PowerPoint presentation project, poster or paper - topic, topic, purpose, results, conclusions, practical applications, bibliography.	The level of knowledge and understanding of the project theme, the way of scientific argumentation and data presentation, the quality of conclusions, elements of creativity, the formation of personal attitude, coherence of presentation and scientific correctness, graphic presentation.	Till the end of the course
2.	Learning techniques and strategies	Try to understand the key notions, argue each piece of information with examples, form an inner dialogue with yourself, use different methods of engaging in active reading and resources, which challenge critical thinking to solve situational problems.	The degree of understanding of the essence of different topics, the level of exposition and argumentation of the information, the quality of the conclusions, elements of creativity, the way of	During the course



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solving the situation
problem, the capacity to
systematize the material

X. METHODOLOGICAL SUGGESTIONS FOR TEACHING-LEARNING-ASSESSMENT

Teaching and learning methods used

Discipline Neurophysiology is an optional subject and is taught through lectures and self-trainings. The theoretical course in lectures is given by the course holders.

Applied (specific to the discipline) teaching strategies / technologies

Try to understand the key notions, explained by the teacher, but do not focus on the assessment methods, learn not to take the totals and be admitted to the session, but to gain knowledge, which you will then use in other disciplines.

The course is designed to meet the needs of students for training and professional development, so ask the teacher, that each information is argued through examples, applications, theoretical and practical problems, this will ensure an active way of learning.

Develop metacognition - inner dialogue with yourself, it will help you build learning skills that will allow you to control your training.

Use various nonverbal resources such as schemes, documents, experiences, devices, they support the formation of professional skills, create work tasks, the solution of which will have real consequences.

Use different methods of engaging in active reading and resources, which challenge critical thinking to solve situational problems, they increase the student's ability to systematize.

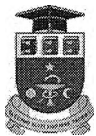
"Try to be a teacher", explains to the colleague / colleagues the key moments from the studied topic, gives their own examples, explains the difficult moments, listens to their opinions. The ability to explain material to colleagues will develop your ability to think and express yourself.

Methods of assessment (including the method of final mark calculation)

Current: at the Department of Human Physiology and Biophysics, the discipline Neurophysiology, for students of the third year of semester 6, includes 2 totalizations and is in the form of computerized tests, which consist of variants of 30 questions each (simple compliment and multiple compliment). The student has a total of 30 minutes to answer the test. The evaluation is performed according to the criteria of the concordance system (MOODLE variant). The test is graded with grades from 0 to 10. The average grade for each semester is calculated from 2 grades obtained in totalizations during the year.

At the final evaluation (colloquium) in the discipline of Neurophysiology, students with an annual average lower than grade 5 and students who have not recovered their absences are not admitted.

Final: takes place in the computerized evaluation room of the department according to the criteria of the concordance system (MOODLE variant). The computerized test from the final evaluation consists of variants of 50 tests, of which 20 tests are multiple-choice test with single correct answer, 30 tests are multiple-choice test with several correct answers. The student has a total of one astronomical hour to answer the tests. The test is graded with grades from 10 to 0. The final grade consists of 2 components: the annual average grade (coefficient 0.5), the test-computerized grade (coefficient 0.5). The assessment of knowledge is assessed with marks from 10 to 1, as follows:



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Method of mark rounding at different assessment stages

Intermediate marks scale (annual average, marks from the examination stages)	National Assessment System	ECTS Equivalent
1,00-3,00	2	F
3,01-4,99	4	FX
5,00	5	E
5,01-5,50	5,5	
5,51-6,0	6	
6,01-6,50	6,5	D
6,51-7,00	7	
7,01-7,50	7,5	C
7,51-8,00	8	
8,01-8,50	8,5	B
8,51-9,00	9	
9,01-9,50	9,5	A
9,51-10,0	10	

The average annual mark and the marks of all stages of final examination (computer assisted, test, oral) - are expressed in numbers according to the mark scale (according to the table), and the final mark obtained is expressed in number with two decimals, which is transferred to student's record-book.

Absence on examination without good reason is recorded as "absent" and is equivalent to 0 (zero). The student has the right to have two re-examinations in the failed exam.

XI. RECOMMENDED LITERATURE:

A. Compulsory:

1. Guyton and Hall. Textbook of medical physiology. 13th ed. Saunders, 2016

B. Additional

1. Silbernagl, Despopoulos. Color atlas of physiology. 7th ed. Thieme, 2015
2. Boron, Boulpaep. Medical physiology. 3rd ed. Elsevier, 2017.