DISCIPLINE SHEET

1. Data about the programme

1.1.	**"CAROL DAVILA" UNIVERSITY OF MEDICINE AND PHARMACY**
1.2.	**FACULTY OF MEDICINE**
1.3.	**DEPARTMENT 1 FUNCTIONAL SCIENCES**
1.4.	**DISCIPLINE PHYSIOLOGY - NEUROSCIENCE**
1.5.	**DOMAIN OF STUDY: HEALTH – Sectorally regulated within the European Union**
1.6.	**STUDY CYCLE: LICENCE**
1.7.	**STUDY PROGRAME: MEDICINE – ENGLISH MODULE, 2nd Year**

2. 2. Data about discipline

2.1.	**Name of the discipline in the educational plan: PHYSIOLOGY - NEUROSCIENCE**				
2.2.	**Discipline code: DDII 4 S3M**				
2.3.	**Discipline type (FD/SD/CD): DOS**				
2.4.	**Discipline regimen (MD/OPD/): MD**				
2.5.	**The holder of the course activities** Ana-Maria Zăgrean, Prof. Univ. Dr Adelina Vlad, Prof. Univ. Dr. Bogdan Pavel, Conf. univ. Dr. Ioana Ștefănescu, Sef lucrări Dr. Carmen Denise Mihaela Zahiu, Sef lucrări Dr Daniela Adriana Iliescu, Sef lucr. Dr.				
2.6.	**The holder of the seminar activities :** Ana-Maria Zăgrean, Prof. Univ. Dr. Adelina Vlad, Prof. Univ. Dr. Bogdan Pavel, Sef lucrări Dr Ioana Ștefănescu, Sef lucrări Dr Carmen Denise Mihaela Zahiu, Sef lucrări Dr Daniela Adriana Iliescu, Sef lucr. Dr Monica Cristina Giurgiu, Asist.univ.Dr Mara Ioana Ionescu, Asist.univ. Dr Alexandru-Catalin Paslaru. Asist. Univ. Dr. Delia Popa, Asist. univ. Drd. Laurentiu Tofan, Asist. univ. Drd. Stefan-Alexandru Tirlea. Asist. univ. Drd. Stefan Sandru, Asist. univ. Drd. Cristina Timaru, Asist. Univ. Drd.				
2.7. Year of study	**II**	**2.8. Semester**	**II**	**2.9. Type of evaluation (E/C)**	**E - Written exam**

3. Total estimated time (hours/semester of didactic activity an self-preparation/study

I. Academic training (teaching, practical application, assessment)

3.1. Nr hours/week	**5**	**From which:**	**3.2. lecture**	**2**	**3.3. seminary/ laboratory**	**3**
3.4. Total hours of educational plan	**70**	**From which:**	**3.5. lecture**	**28**	**3.6. seminary/ laboratory**	**42**
Evaluation (nr. of hours) : 2						
II. Self-preparation/study						
Time allocation						**hours**
Study of course materials, textbooks, books, study of the recommended minimal bibliography						**20**
Additional research in the library, research through the internet						**10**
Performing specific activities for preparing projects, laboratories, elaborating reviews or other tasks						**8**
Specific preparation activities for projects, laboratory work, assignments, and reports						**10**
Tutoring						**5**
Other activities						**2**
3.7. Total individual study hours						**55**
3.9. Total hours per semester (3.4.+ 3.7.)		**125**				
3.10. Number of credits		**5**				

4. Preconditions (where applicable)

4.1. of curriculum	Biochemistry, Biophysics, Anatomy, Cell and Molecular Biology, Physiology 1st year
4.2. of competences	

5. Conditions (where applicable)

5.1. to conduct the lecture	PowerPoint presentations, use of multimedia systems, and projector
5.2. to conduct the seminar / laboratory	Equipped with the necessary apparatus for conducting practical activities

6. Learning outcomes

Knowledge	Skills	Responsibility and autonomy
Useful in further development as a student: Assimilation of knowledge of neuro-sensory, muscular, cardiac physiology - theoretical and practical (laboratory work), as a basis for further study of pathophysiology, pharmacology and clinical disciplines	For further professional activity: The notions of physiology are necessary for the grounded approach to clinical disciplines Interpretation of investigations for: nervous system (including analyzers and neuromuscular) and heart.	Development of medical thinking by operating with physiological mechanisms; acquiring skills to work in the laboratory, principles of developing and using experimental protocols

7. Course objectives (aligned with the learning outcomes)

7.1. General objective	At the end of each semester, the student must know the physiological mechanisms of the taught systems/devices. Acquisition of theoretical (course) and applied (practical works) knowledge of neuro-sensory, muscular, cardiac physiology by students of the Faculty of Medicine in the second year of study.
7.2. Specific objective	The course presents the fundamental functional properties of the human body, as well as the mechanisms of adaptation to internal and external environments. At the end of each semester, the student must know the specific physiological mechanisms of the taught systems/devices.

8. Contents

8.1. Lecture	**Teaching methods**	**Observations**
14 weeks x 2 hours = 28 hours (Semester 1, Year II) **Semester 1** **I. NERVOUS SYSTEM PHYSIOLOGY** **II. NEUROMUSCULAR SYSTEM PHYSIOLOGY** **III. HEART PHYSIOLOGY** **I. Nervous System Physiology** **1 Introductory lecture. Morphofunctional organization of the nervous system.** Level of organization in the nervous system. Nervous system - organization, cell types in the nervous system, their features and functional correlations. Cerebrospinal fluid. Blood-brain barrier. **2 Excitability and ionic transport.** Cell membrane selective permeability and transport across the membrane. Excitability. Membrane ionic transport system – ion channels (non-gated/gated – voltage/ligand/mechanically gated), ion pumps, ion exchangers/carriers. Neuronal membrane potential – resting membrane potential, local depolarizing current, hyperpolarizing current, threshold stimulus, action potential (AP -generation, phases and ionic conductance during AP, membrane refractoriness – absolute and relative refractory period, AP conductance, saltatory conduction). **3 Synaptic transmission in the nervous system.** Types of synapses/intercellular connections in the NS. Electrical and chemical synapses – components, functional features, synaptic transmission, distribution in the NS. Receptors at the chemical synapse level – localization, types, functions. Control of neurotransmitter activity in the synaptic cleft. Synaptic delay. Excitatory/inhibitory postsynaptic potentials. Glial cells function at synaptic level. Neurotransmitters and neuromodulators – types, co-localization, receptors (types, features), functions. Presynaptic inhibition. **4 Integrative functions of the brain.** Synaptic connections/networks in the central NS – diffuse modulatory systems and their integrative functions. Spatial and temporal summation of the	**Interactive exposition of the material according to the analytical program, using multimedia means, powerpoint presentations, didactic films**	2h 2h 2h 2h

postsynaptic potentials. Fatigue of synaptic transmission. Synaptic transmission changes due to acidosis/alkalosis, hypoxia, drugs. **5 Visual system.** Anatomy of the eye - Outer layer of the eye. Middle layer of the eye- uvea (uveal tract) - iris, ciliary body, choroid. Pupillary light reflex. Ciliary body - Aqueous humor. Intraocular pressure. Lens- refraction and accommodation. The Index of refraction. Refraction and the eye. Accommodation mechanism. Nervous control of the accommodation. Vitreous body. The emmetropic Hyperopia (or hypermetropia). Myopia. The third layer of the eye - Structure of the Retina. Ganglion cells. Bipolar cells. Horizontal cells. Amacrine cells. Pigment epithelium cells. Photoreceptors. Lateral inhibition- high contrast. Intrinsically photosensitive retinal ganglion cell. Phototransduction - Dark current. Light and dark adaptation. Color vision. Visual pathway. **6 Ear – Auditory and vestibular physiology. Cerebellum role in balance.** Auditive analyzer- Sound. Physical principles of the sound. Sound pressure. Loudness of sound. Ear: Inner ear - The pinna. The ear canal. The tympanic membrane. The middle ear: Acoustic impedance. Acoustic reflex. The cochlea - The innervation of the cochlea. Sensorial innervation. Motor or efferent innervation. The role of basilar membrane. Frequency sound encoding. Scala media and stria vascularis - Endolymph. Organ of Corti The hair cells. Auditory transduction. The electromotility of outer cells Intensity coding (loudness). The detection of the direction of a sound -The direction of a sound along the vertical plane. The direction of a sound along the horizontal plane. Balance - Vestibular system. Utricular and saccular- structure of the maculae. Function of the maculae. Signal transduction. Semicircular canals- Structure of cristae ampullaris. Function of cristae ampullaris. Horizontal canals. Anterior (superior). Posterior canals. Signal transduction. Vestibular pathway. Cerebellum – morphofunctional aspects, role in locomotor coordination and balance. **8 Chemoreception - taste and olfaction. Somatic senses** Sensory receptors convert environmental energy into neural signals - Sensory receptors. Sensory stimuli & modalities. Stimulus. Sensory modalities. Sensory receptors. Sensory transduction. Encode the information. Transfer to CNS, Interpretation (decoding) of the information into a perception. Chemoreception – physiology of taste and olfaction. Chemoreceptors in the body – central and peripheral, chemoreceptors for taste and olfaction. Taste receptors, taste buds. Gustatory discrimination. Taste transduction and molecular signaling involved. Gustatory pathway. Olfactory mucosa and olfaction receptors. Sense of smell, olfactory transduction and molecular signaling involved. Olfactory pathway. Somatic sensation and somatic sensory receptors. Sensory modalities. Somatic sensory receptors - types, distribution and functions. Sensory unit, receptive field and discriminative ability. Skin receptors and somatosensory transduction. Temperature sensation and thermoreceptors. **9 Pain. Autonomic nervous system** Pain Neurophysiology. Definition of pain. Notions of epidemiology and terminology. Pain processing - Peripheral stages Medullary stage and supraspinal inhibition; Thalamo-cortical stage. Visceral pain. Acute pain. Chronic pain. Assessment and treatment of pain. Physiology of the Autonomic Nervous System (ANS). Organization of the autonomic nervous system (origin of sympathetic and parasympathetic		1.5 h 1.5 h 1 h 2h

preganglionic neurons). Enteric division. Synaptic physiology of ANS (neurotransmitters, receptors). Pharmacological modulation of ANS. Non-classical neurotransmitters. Control of the central nervous system over the viscera. **II. NEUROMUSCULAR SYSTEM PHYSIOLOGY** **Neuromuscular physiology.** Striated (skeletal) muscle: skeletal muscle architecture - specific structural elements (sarcomere, proteins involved in contraction, peculiarities of the sarcoplasmic reticulum); muscular innervation; neuromuscular junction - structure, stages of synaptic transmission, pharmacological modulation of the junction; the action potential of a muscle fiber; excitation-contraction coupling; muscle contraction – stages of cross-bridges formation; muscle relaxation; types of muscle contraction (single twitch, isometric/ isotonic contraction); regulation of muscle strength - recruitment of motor units (multiple fiber summation), frequency summation, control through reflex loops (muscle proprioceptors, stretch reflex, tendon reflex), the muscle length - contraction force correlation; energy requirements of contraction, types of skeletal muscle fibers; muscle fatigue. Smooth muscle: structure of muscle fiber; types of smooth muscles; innervation of the smooth muscle; the action potential in the unitary smooth muscle; the excitation-contraction coupling; the mechanism of muscle relaxation. Cardiac muscle – structure, ultrastructure, contractility and relaxation mechanisms. **III. HEART PHYSIOLOGY** 1. **Introduction. Cardiovascular system** - morpho-functional organization; roles. Functional anatomy of the heart, structure of the myocardium (working fibers, excito-conductive tissue). Properties of the myocardium. 2. **The electrical activity of the heart** **Excitability** (bathmotrope function). Membrane ion transport in myocardial fibers. Action potentials in fast response fibers. Refractoriness. The law of periodic inexcitability of the heart. **Automatism** (chronotropic function). The excito-conductive system – histology, vascularization, function. Action potential (PA) in excito-conductive tissue fibers. Physiological and pharmacological modulation of pacemaker activity. Pathological changes in automatism. **Conductivity** (dromotropic function). The mechanism of action potential propagation through myocardial fibers. Myocardial depolarization sequence: atrial conduction, nodal conduction, ventricular conduction. Physiological and pharmacological modulation of conductivity. PA transmission disturbances. **3. Exploring the electrical activity of the heart - electrocardiogram**		2h 1 h 3.5h 3.5 h

Definition, utility. The principle of graphic objectification of cellular and myocardial electrical activity. Dipole theory. Vector theory. Electrocardiogram elements. System of electrocardiographic derivations. Genesis of waves, segments and intervals: atrial depolarization and P wave; atrial repolarization and Ta wave; segment and interval PQ; ventricular depolarization and the QRS complex; the ST segment; ventricular repolarization and T wave; QT interval; U wave. The electrocardiogram interpretation algorithm: checking the calibration of the device; determination of heart rate and rhythm; determining the electrical axis of the heart; analysis of intervals, waves and segments. Special ECG tests. Notions of pathological ECG. **3. The mechanical activity of the heart** Changes in ventricular geometry. Valvular dynamics Cardiac cycle: definition, duration. Stages of the cardiac cycle. Heart sounds and the phonocardiogram. Volume and pressure variations during the cardiac cycle. Ventricular pressure-volume curves. Parietal tension, parietal stress. Laplace's law Cardiac output - definition, normal values, measurement methods. **Cardiac performance:** definition; determinants: preload, afterload, inotropism, lusitropism, chronotropism and dromotropicism. Mechanical work and mechanical performance of the heart. **4. Myocardial metabolism.** **5. Coronary circulation.** Notions of functional anatomy. Coronary blood flow. Regulation of coronary blood flow. **5. Regulation of cardiac activity** Intrinsic regulation: heterometric autoregulation, homeometric autoregulation. Extrinsic regulation: nervous control and humoral control of cardiac activity		2 h 2 h **Total: 28 h**

References

1. Medical Physiology, Walter Boron, Ed. Saunders
2. Guyton and Hall Textbook of Medical Physiology - Arthur C. Guyton, John E. Hall
3. Lectures from the classroom, lecture notes

8.2. Laboratory / practical lessons	**Teaching methods**	Observations
14 weeks x 3 hours = 42 hours (Sem.1, 2nd year)		
1. Introductory information, safety rules in the laboratory. Basics of cellular excitability in the nervous system. Nerve conduction. Exploring nerve conduction – BIOPAC	Practical and theoretical applications (biological samples, biochemical techniques, functional tests).	**1 x 3 h**
2. Exploration of the reflex arc and osteo-tendinous reflexes. Muscle twitch, muscle tetanus, muscle fatigue. Exploring neuromuscular function – BIOPAC		**1 x 3 h**

3. Visual system physiology – assessment of visual acuity, chromatic vision, fields of vision **4.** Auditory and vestibular physiology – clinical exploration, audiometry. Cerebellar function and balance assessment **5.** Electrical activity of the brain – EEG: theoretical principles, recording, analysis, clinical aspects. **6.** Myocardial properties – excitability, automatism, conductivity. Action potential and the law of periodic inexcitability of the heart. The influence of catecholamine's on heart activity. Effect of vagal stimulation on heart activity and vagal escape **7**. Electrocardiography (ECG) – part 1: theoretical principles **8**. Electrocardiography (ECG) – part 2: recording and analysis **9.** Electrocardiography (ECG) – part 3: analysis and clinical aspects. Cardiac cycle **10.** Ventricular volume-pressure diagram. Frank-Starling low of the heart. Identification of cardiac cycle phases through auscultation and phonocardiogram **11**. Carotidogram, apexcardiogram and jugulogram. Polygram recording and analysis – BIOPAC **12.** Verification of theoretical knowledge (written seminar). Thematic discussions, reviewing the analysis bulletins. Recovery of practical laboratories **13.** Evaluation session 1 **14.** Evaluation session 2	Interactive programmed learning. The use of multimedia tools, didactic films, presentation of analysis	**1 x 3 h** **1 x 3 h** **1 x 3 h** **1 x 3 h** **1 x 3 h** **1 x 3 h** **1 x 3 h** **1 x 3 h** **1 x 3 h** **1 x 3 h** **1 x 3 h** **Total: 42 h**
References 1. Nervous System Physiology. A Practical Approach. Coordinator A-M. Zăgrean, Editura Universitară "Carol Davila" București, 2020. 2. Cardiovascular System Physiology. A Practical Approach. Coordinator A-M. Zăgrean, Editura Universitară "Carol Davila" București, 2020.		

9. Evaluation

Activity type	9.1. Evaluation criteria	9.2. Evaluation methods	9.3. Percentage in the final grade
9.4. Lecture	Theoretical Exam	Written test with 60 Multiple Choice Questions (Grouped)	70%
9.5. Seminary/ practical activity	Evaluation of practical /laboratory activity, seminar assessment	Practical exam, seminar, annual activity	30%

9.5.1. Individual project (if applicable	-	-	-

9.6. Minimum performance standard

- Mandatory presence
- Performing all practical laboratories
- Acquiring the knowledge about functions of the nervous system and heart physiology
- The minimum final passing grade is 5 (five). The minimum passing grade for the theoretical exam and the practical exam is 5 (five).

Date of completion :	**Signature of the course holder**	**Signature of the laboratory holder**
Sept. 2025	Prof. Ana-Maria Zăgrean	Prof. Ana-Maria Zăgrean

Date of approval by the Department Council:
Sept. 2025

Signature of the Department Director
Prof. Ion Fulga