Plovdiv Medical University

Faculty of Medicine

SYLLABUS

in

Human Physiology

Approved at a meeting of the Department of Human Physiology on № 31/22.06.2020 г.

Confirmed by the Faculty Board - 08.07.2020 г.

Syllabus

Discipline	Final exam/ semesters	Academic hours				Dcademic hours in years and semesters	
						IInd year	
		Total	Lectures	Practices	ECTS	IIIth sem.	IVth sem.
Physiology	IV sem.	195	75	120	16.3	30/60	45/60

DISCIPLINE:
Human Physiology.

TYPE OF DISCIPLINE ACCORDING TO THE UNIFORM STATE
Human Physiology.

LEVEL OF QIALIFICATION:
Master (M).

FORMS OF TRAINING:
Lecture course. Practical exercises. Ongoing assessment tests. Consultations. Participation in experiments conducted at the department. Homework, using textbooks and manuals recommended by the department.

YEAR OF TRAINING:
Second Year.

DURATION OF TRAYNING:
Two semesters.

ACADEMIC HOURS:
75 hours of lectures and 120 hours of laboratory practical sessions.

TECHNICAL ECQIPMENT APPLIED IN THE TRAINING:

- Textbooks, seminar manuals for medical students, physiology quizzes guide.
- Visualizing teaching tools.
- Specially equipped laboratories for registration and evaluation of physiological functions and their regulation. Video monitors; disks with educational videos; computers; complete multimedia lecture course; CARDIOVIT-AT 104, SCHILLER, Switzerland, the Schiller AT-104 Ergospirometric system; BIOPAC Systems, Inbody 270, InBody Co, Ltd, Korea Inc., USA a three-channel ECG recorder (RFT, Germany); a multi-function patient monitor (Hewlett Packard, USA); MIOTON AS,TALLINN, ESTONIA, Manual CNAP TM Monitor 500, CNSystems Medizintechnic AG, Austria, a special external respiration spirometer (‘Flowscreen’, Jaeger, Germany); ‘Oxymax’- a device for monitoring the metabolism of test

animals (Columbus, USA); A Jaeger veloergometer (Germany); operation boards for small animals; a device for controlled breathing of small animals ('Hugo Sachks', Germany); a Leika capillary scope; microscopes; devices for registration of muscle contractions; rheograph; audiometers; colour perimeter; blood pressure measuring devices; compete multimedia lecture course (in Bulgarian and in English); complete multimedia lecture course in English for master programs in medical physics and engineering; seminar manuals for medical students

FORMS OF EVALUATION:

Preliminary assessment of progress: Evaluation of 7 chapter; oral and written examination.
Final evaluation: Assessment test of the final examination. Written exam topic drawn from the syllabus on the day of the final exam. Oral examination. Evaluation of practical skills.

EVALLUATION CRITERIA:

Two preliminary evaluation scores for each of the two semesters and a final examination comprising a general assessment multiple-choice question test, written, practical and oral presentation.

ASPECTS OF EVALUATION CRITERIA:

Active participation in the practical course, accompanying discussions, tests, written and oral exams.

SEMESTER EXAM – at the end of the 4th semester.

Affirmative (general assessment test, written exam practical exam and oral presentation).

STATE EXAM:

Negative.

LECTURER:

Lecturer with an academic degree from the Department of Human Physiology.

DEPARTMENT: Department of Physiology.

ANOTATION

Cell physiology. The human body systems. Physiological functions and general principles of their regulation – cybernetic and physiological aspects. Homeostasis. General and specific properties of excitable cells. Synapse types. Chemical synapses. Neuro-reflex regulation of physiological functions. Functional morphology and main physiological properties of the autonomous nervous system. General principals of humoral regulation of physiological functions; physiological effects of the hormones released by the thyroid gland, adrenal glands, pituitary gland and pancreas. Functional morphology of the skeletal and smooth muscles. Blood physiology. The cardiovascular system – physiological characteristics of the working myocardium and the cardiac conduction system; electrical phenomena accompanying cardiac activity; registration and assessment of the ECG; heart sounds; regulation of cardiac activity; arterial pulse; nervous and humoral effects on vascular tone. Regulation of blood pressure. The respiratory system – regulation of respiration; lung volumes and capacities and gas exchange. Functions and regulation of the digestive system. Nutrition and metabolism of proteins, fats, sugars and energy. Excretory functions of the body. Water/electrolyte and acid/base balance. Sensory systems – somatosensory physiology, vision, hearing, smell and taste. Wakefulness and sleep. Higher nervous activity.

BASIC AIMS OF THE DISCIPLINE

Attaining relevant theoretical knowledge and practical skills.

1. Study of the normal physiological functions and their parameters.
2. Introduction to regulation of physiological functions.
3. Introduction to the body's capacity to respond to internal and external stimuli while preserving its uniqueness and integrity in achieving goals concerning oneself and one's surroundings.
4. Building a theoretical basis for uncovering pathophysiological processes as well as for the management of physical and drug therapies.
5. Learning the main medical and instrumental methods for evaluation of physiological parameters.
6. Introduction to the basic principles of experimental medicine.

EXPECTED RESULTS:

Following termination of the course the students must attain the following knowledge and skills:

1. The basic physiological functions of the human body and their normal indices.
2. Regulation of physiological functions.
3. The ability of the human body to respond to internal and external stimuli, while maintaining its relative independence and integrity in achieving its goals pertaining to itself and the environment.
4. To develop skills in uncovering pathological processes and those of physical and drug therapy.
5. To learn the main methods of evaluation of the physiological indices through physical methods and investigative techniques.
6. Basic principles of experimental work.

LECTURES

Lecture № 1 - 2 acad. hours

Organization of the cell. Physical structure of the cell. Functional systems of the cell. Properties of the cell membrane and junctions between the cells. Intercellular signalization. Transport of substances through the cell membrane.

The human body. Homeostasis. General principles of the homeostatic regulation – regulatory systems and elements of the homeostatic regulatory system. Levels of physiological regulation.

Lecture № 2 - 2 acad. hours

Physiology of the excitatory tissues. Irritability and excitability. General and specific properties of the excitable cells. Membrane potential – ionic basis of the membrane potentials.

Measurement of excitability. Changes in the excitability during excitation. Inhibition. Conduction of the excitation.

Transmission of the excitation (inhibition) from an excitable cell to another. Synapses - types of synapses. Chemical synapses. Transmitters and modulators. Postsynaptic potentials. Summation of the postsynaptic potentials.

Lecture № 3 - 2 acad. hours

Functions of the nervous system – functional morphology of the nervous system. Physiology of the nerve cell. Glial cells. Neuronal circuits and processing of information form group of nerve cells – convergence, divergence, reverberating circuits, inhibition.

Lecture № 4 - 2 acad. hours

Reflex regulation of the physiological functions. Type of reflexes according to the mechanism of formation and the characteristics of the reflex arc.

Nerve centers. Types and properties. Cerebral blood flow. Cerebrospinal fluid.

Lecture № 5 - 2 acad. hours

The autonomic nervous system. General organization of the autonomic nervous system. Autonomic nerve centers, ganglia, transmitters and receptors in the autonomic nervous system.

Effects of sympathetic and parasympathetic stimulation on specific organs. Autonomic reflexes.

Role of the hypothalamus, reticular formation, cerebellum, basal ganglia and cerebral cortex in the control of the autonomic functions. Integration of the central nervous system in the adaptation processes of the body – "alarm" or "stress" response of the sympathetic nervous system.

Lecture № 6 - 2 acad. hours

General principles of the humoral control of the physiologic functions. Telecrinia and paracrinia. Classification, synthesis and mechanism of action of the hormones. Control on the hormone secretion.

Lecture № 7 - 2 acad. hours

Hypothalamic-neurohypophysial system. Neurosecretion. Hormones of the neurohypophysis. Physiologic effects and control of secretion.

Hypothalamo-adenohypophysial system. Hormones of the adenohypophysis. Physiologic effects and control of secretion.

Functional morphology of the thyroid gland. Iodine containing thyroid hormones. Physiologic effects and control of secretion. Hyperthyroidism and hypothyroidism.

Lecture № 8 - 2 acad. hours

Functional morphology of adrenal glands. Hormones of the adrenal medulla. Physiologic effects and control of secretion of adrenaline (epinephrine) and noradrenaline (norepinephrine).

Hormones of adrenal cortex – glucocorticoids. Physiologic effects and control of secretion. Pharmacologic effects of glucocorticoids.

Hormones of adrenal cortex – mineralcorticoids and adrenal androgens. Abnormalities of the adrenocortical secretion.

Lecture № 9 - 2 acad. hours

Physiology of reproduction. Male reproductive system. Spermatogenesis. Male sex hormones (androgens) – types, physiologic effects and control of secretion. Erection and ejaculation.

Physiology of reproduction. Female reproductive system. Ovogenesis. Female sex hormones (estradiol and progesterone) – types, physiologic effects and control of secretion. Regulation of the female monthly rhythm. Pregnancy and lactation. Tests for early pregnancy.

Lecture № 10 - 2 acad. hours

Endocrine functions of the pancreas – type of hormones, physiologic effects and control of secretion. Diseases of the endocrine pancreas.

Calcium and phosphate homeostasis. Parathyroid hormone, calcitonin, vitamin D - physiologic effects and control of secretion. Impairment of the calcium and phosphate homeostasis.

Lecture № 11 - 2 acad. hours

Physiology of skeletal muscles – functional morphology, mechanism and energy of muscle contraction. Types of muscle contractions. Types of muscle fibers. Muscle work and muscle fatigue. Electromyography.

Lecture № 12 - 2 acad. hours

Functional morphology of smooth muscles. Excitation, electrophysiologic characteristics and mechanism of contraction of smooth muscles.

Lecture № 13 - 2 acad. hours

Physiology of respiration. Lung ventilation. Functional organization of the airways, lungs and thoracic basket. Mechanics of breathing. Intrapleural and intrathoracic pressure. Role of the surfactant. Reflexes – cough and sneeze.

Rate and rhythm of breathing. Pulmonary and alveolar ventilation. Elastic and non-elastic resistance to breathing. Air flow during breathing. Work of breathing.

Static lung volumes and capacities and their functional concern. Anatomic and physiologic dead space. Estimation of the external respiration.

Lecture № 14 - 2 acad. hours

Physical basis of gas exchange. Solubility, diffusion coefficient and diffusion capacity of the gases. Composition of the gases in air, lungs and blood. Diffusion of gases across the alveolocapillary membrane. Ventilation-perfusion ratio.

Transport of O_2 in the blood. Oxyhemoglobin dissociation curves. Oxygen exchange in lungs and tissues.

Transport of CO_2 in the blood. Carbon dioxide exchange in lungs and tissues.

Lecture № 15 - 2 acad. hours

Control of respiration. Respiratory center and rhythm of breathing. Chemical control of respiration. Reflex control of respiration. Effects of the cerebral cortex on the respiratory functions.

Aviation, high altitude and space physiology, physiology of deep-sea diving.

Lecture № 16 - 3 acad. hours

Physical basis of gas exchange. Solubility, diffusion coefficient and diffusion capacity of the gases. Composition of the gases in air, lungs and blood. Diffusion of gases across the alveolocapillary membrane. Ventilation-perfusion ratio.

Transport of O_2 in the blood. Oxyhemoglobin dissociation curves. Oxygen exchange in lungs and tissues.

Transport of CO_2 in the blood. Carbon dioxide exchange in lungs and tissues.
Control of respiration. Respiratory center and rhythm of breathing. Chemical control of respiration. Reflex control of respiration. Effects of the cerebral cortex on the respiratory functions.

Lecture № 17 - 3 acad. hours

Cardiovascular system. Systemic and pulmonary circulation. Heart as an organ –functional morphology of the pericardium, endocardium and myocardium. Nerve supply. Myocardial blood supply.

Functional morphology and physiological characteristics of the excitatory and conductive system of the heart. Automaticity. Cardiac rhythm. Abnormalities of conductivity.

Physiological characteristics of the working myocardium. Excitation and contraction. Refractory periods**.** Extrasystoles**,** flutter and fibrillation**.** Myocardial metabolism.

Dynamics of the cardiac contractions – cardiac cycle. States of the valvular apparatus during different phases of the cardiac cycle.

Lecture № 18 - 3 acad. hours

Electrical events during cardiac performance. Origin, registration and evaluation of the electrocardiogram.

Functions of the heart valves of the heart. Heart sounds. Methods of examination. Stenosis and insufficiency of the valves. Correlation between a synchronous phonocardiographic and electrocardiographic record.

Heart rate. Stroke volume and cardiac output and their changes during different physiological conditions.

Control of the cardiac performance – intrinsic (self-control). Energetics of the heart pumping.

Extracardial neural regulation of the cardiac performance – characteristics of the sympathetic and parasympathetic effects. Humoral factors affecting cardiac performance.

Lecture № 19 - 3 acad. hours

Functional characteristics of blood vessels. Hemodynamic principles – characteristics of the vessels and the blood. Hemodynamic indices. Volume and linear velocity of the blood flow through the various parts of vascular system and factors determining them.

Blood pressure in the various parts of the cardiovascular system. Arterial blood pressure – methods of measurements and normal values. Factors determining the blood pressure levels.

Lecture № 20 - 3 acad. hours

Physiology of the microcirculation. Functional organization of the microcirculation unit.

Organ–related peculiarities of the capillaries. Control of the microcirculation.

Lecture № 21 - 3 acad. hours

Vascular tone. Basal tone of blood vessels. Local, neural and humoral regulatory mechanisms of the vascular tone.

Control of the circulation. Characteristic and localization of the receptors. Vasomotor center. Supramedular control of the circulation.

Control of the arterial blood pressure. Mechanisms of the quick short-term, quick ongoing, and long-term regulation.

Lecture № 22 - 3 acad. hours

Gastrointestinal system – functions. Digestion in the Mouth: processes of mastication, secretion, enzyme destruction and absorption. Swallowing – phases and regulation.

Motor functions of the Stomach – hunger contractions, storage function, mixing and propulsion of food. Emptying of the Stomach. Control of the Stomach motor activity. Vomiting.

Secretion, enzyme destruction and absorption in the Stomach. Gastric juice: composition, mechanism of secretion and functions. Gastric secretion and its control: cephalic, gastric and intestinal phases. Protective potentialities of the gastric barrier.

Lecture № 23 - 3 acad. hours

Small Intestine – motor activity: type of movements and regulation; secretion, digestion and absorption.

Colon – type of movements and their regulation; secretion, digestion and absorption. Defecation.

Pancreatic juice – composition and functions. Control of the pancreatic secretion.

Processes of formation and secretion of Bile. Composition and functions of the Bile. Regulation of the Bile secretion. Functions of the Liver.

Lecture № 24 - 3 acad. hours

Digestion and absorption of Proteins, Fats and Carbohydrates in the Gastrointestinal Tract. Absorption of Salts, Water and Vitamins.

Metabolism of the Nutrients in the organism. Metabolism of Carbohydrates: the level and regulation of Glucose in the circulating blood. Metabolism of Proteins and its control. Metabolism of Lipids and its control.

Energy metabolism in the organism. Energy values of the Nutrients. The Energy Equivalent of Oxygen. The measurement of the Metabolic Rate: Direct and Indirect Calorimetry. The Basal Metabolic Rate and the Daily Energy Requirements for different physiologic states.

Lecture № 25 - 3 acad. hours

Excretion functions of the organism and systems, accomplishing them. The Kidneys – functional structure. Peculiarities of the kidneys blood supply and innervation. Mechanism and control of glomerular filtration. Methods of glomerular function assesment.

Functions of renal tubules. Transport processes within the different parts of the tubules. Mechanisms for excretion of a dilute urine and a concentrated urine. Renal excretion.

Renal clearance tests. Volume of the urine and its components. Micturition. Endocrine and metabolic functions of the kidneys. Control of the renal functions.

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Lecture № 26 - 3 acad. hours

Temperature regulation. Body temperature and isothermia. Mechanisms of heat production and heat loss. Neurophysiologic bases of temperature regulation. Hyperthermia and hypothermia. Acclimatization. Regulation of body temperature within exsercise.

Lecture № 27 - 3 acad. hours

Water-electrolyte balance of the organism. Body fluids and electrolytes. Dynamics of body fluids volume and osmolality. Control of Water-Salts homeostasis. Thirst – physiologic mechanisms.

Acid-Base Balance of the organism. Buffer systems of the body fluids. Respiratory regulation of pH. Renal regulation of pH. Abnormalities in Acid-Base Balance.

Lecture № 28 - 3 acad. hours

Sensory systems. Functional morphology. General principles of sensory systems information coding and processing. Sensory systems adaptation.

General sensation. Somatosensory system – organization and modalities. Mechanisms of thermo- and mechanoreception. Pain sensation. Itch.

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Lecture № 29 - 3 acad. hours

States of brain activity and sleep. The role of the different neuronal structures in the maintenance of the brain activity. Physiologic changes within sleep. Electroencephalography.

Lecture № 30 - 3 acad. hours

Higher nerve activity – types and characteristics. Learning and memory: types and physiologic bases. Primary and secondary signalling systems. Communicative capabilities of man. Reading and writing speech. Auditory and visual gnosia.

PRACTICES

Laboratory exercise № 1 - 4 acad. hours

General physiology of excitable systems. The living organism. Homeostasis. Irritability and excitability of living organism. 1. Elaboration of a frog neuromuscular preparation. 2. Galvani's experiments. 3. Mateucci's experiment. 4. Types of stimuli. 5. Determination of the threshold of the stimulus (both direct and indirect) as applied to a muscle.

Laboratory exercise № 2 - 4 acad. hours

General physiology of excitable systems. Excitability and Excitation. Physiology of the Nerve Cells and Peripheral Nerves. Functions of the Nervous System. 1. Registration of response gradation relative to stimulus strength or frequency. 2. The effect of low temperature on the excitability of a frog sciatic muscle. 3. Electroneurogram (ENG) of a frog mixed nerve (the sciatic nerve). 4. Determining the conduction velocity of different nerve fibres of the sciatic nerve. 5. Relatedness between stimulus intensity (I) and duration (t), and excitation (the Horveg-Weiss curve).

Laboratory exercise № 3 - 4 acad. hours

General physiology of excitable systems. Synapses. Reflex activity of the nervous system. Unconditioned reflexes. 1**.** Analysis of the reflex arc. 2. Measuring reflex time (after Turk).

3. Irradiation of excitation in the CNS. 4. The effect of Strychnine on the CNS. 5. Effect of narcosis on reflex activity.

Laboratory exercise № 4 - 4 acad. hours

General physiology of excitable systems. Nerve centres. Unconditioned reflexes. Clinically important reflexes. 1. Reflexes of a spinal frog. 2. Investigating of frog segmental reflexes. 3. Clinically important reflexes. 4. Examination of the papillary reflex to light, convergence and accommodation.

Laboratory exercise № 5 - 4 acad. hours

General physiology of excitable systems. Conditioned reflexes. The electroencephalography (EEG). 1. Conditioned reflexes in animals. 2. Conditioned reflexes in man. 3. The EEG – a method for registering summated bioelectric activity.

Laboratory exercise № 6 - 4 acad. hours

General physiology of excitable tissues. Review of 'General Physiology of Excitable Systems'.

Laboratory exercise № 7 - 4 acad. hours

Blood. Functions and Properties of Blood. Blood Constituents. Blood Types. 1. Taking blood. 2. Haematocrit determination. 3. The erythrocyte sedimentation rate (ESR) by the Westergren method. 4. Determination of blood types.

Laboratory exercise № 8 - 4 acad. hours

Blood. Red Blood Cells (RBC, Erythrocytes). Hemoglobin. 1. The chamber method for counting of erythrocytes. 2. Measurement of haemoglobin concentration of the blood. 3. Measurement of osmotic resistance of erythrocytes. 4. Measurement of erythrocyte indices.

Laboratory exercise № 9 - 4 acad. hours

Blood. White Blood Cells (WBC, Leucocytes). The Lymphatic System. 1. Chamber method for counting of leukocytes. 2. WBC differential count. 3. Platelet count. 4. Electronic methods for counting formed elements.

Laboratory exercise № 10 - 4 acad. hours

Blood. Haemostasis and coagulation. Review questions on Blood. Colloquium on the Chapter "Blood". 1. Bleeding time determination (Duke's method). 2. Thrombin (thromboplastin) time determination (Quick's method).

Laboratory exercise № 11 - 4 acad. hours

The Endocrine System. Hormonal Regulation. 1. Examination of the thyroid gland. 2. Methods for examining the adrenal gland. 3. Methods for examining the pancreas. 4. Hypoglycaemic shock in rabbit.

Laboratory exercise № 12 - 4 acad. hours

The Endocrine System. Hormonal Regulation (continued) – Sex Hormones.
Revision of 'Endocrine Physiology'. 1. The Galli-Mainini Test. 2 Immunologic pregnancy tests.

Laboratory exercise № 13 - 4 acad. hours

Sensory Systems. 1. Visual acuity. 2. Perimetry. 3. Color vision test. 4. Audiometry. 5. Acoumetry. 6. Aesthesiometry. 7. Skin sensitivity. 8. Kinaesthetic sensitivity.

Laboratory exercise № 14 - 4 acad. hours

The Locomotor System. Skeletal muscles. (Seminar question N 14 of the Examination Synopsis). **Smooth muscles**. (Seminar Question N 25 of the Examination Synopsis). **Practical Tasks**: 1. Recording of a single muscle contraction. 2. Recording of incomplete and complete tetanus. 3. Measurement of the absolute and specific strength of a frog muscle. 4. The effect of loading on amplitude and performance. 5. Myoneural transmission- the Claude Bernard test. 6. Recording of the muscle fatigue curve from an isolated frog muscle. 7. Measurement of muscle strength.

Laboratory exercise № 15 - 4 acad. hours

The Locomotor System. Skeletal Muscles (part II). Smooth Muscles. 1. Recording of the fatigue curve of an isolated frog muscle. 2. Measurement of muscle strength. 3. Ergography. 4. Demonstration of smooth muscle contractions using a section of the small intestine.

Laboratory exercise № 16 - 4 acad. hours

Respiratory system. External respiration. Lung volumes and lungs capacities. 1. Donders' model. 2. Physical examination of lungs. 3. Measurement of lung volumes and capacities.

Laboratory exercise № 17 - 4 acad. hours

Respiratory system. Exchenge and transport of oxygen and carbon dioxide. 1. Calculation of the partial pressure of oxygen in the air. 2. Calculation of the partial pressure of O_2 in alveolar air. 3. Calculation of the chemically bound O_2 in the blood. 4. Calculation of of the Ventiltion/Perfusion ratio in the different parts of the lungs in straight position at rest. 5. Calculation of the coefficient of utilization (UC) of O_2 in the tissues. 6. Measurement of O_2 consumption and CO_2 release.

Laboratory exercise № 18 - 4 acad. hours

Respiratory system. Regulation of Respiration. Review of 'Respiratory Physiology'.

Laboratory exercise № 19 - 4 acad. hours

The Cardiovascular System. The Heart. Physiological Features of the Cardiac Conduction System and of the Working Myocardium. 1. Mechanogram of a frog heart. 2. Effect of temperature on a frog venous sinus. 3. Stannius' ligatures. 4. Recording of ventricular extrasystoles.

Laboratory exercise № 20 - 4 acad. hours

Cardiovascular system. Cardiac Cycle. Electrical Phenomena Accompanying Cardiac Activity. Functions of the Heart Valves. 1. Auscultation of heart sounds. Recording and analysis of the ECG. 3. Registrasion and analysis of ST-segment. 4. Phonocardiography.

Laboratory exercise № 21 - 4 acad. hours

Cardiovascular system. Stroke Volume and Cardiac Output. Regulation of Cardiac Function. 1. Stroke Volume and Cardiac Output. Regulation of Cardiac Function. 2. Calculation of the stroke volume of the heart by Starr's formula. 3. Determining the cardiac output by the Fick method using data in a table. 4. Effects of vagal stimulation, epinephrine, acetylcholine and atropine on the cardiac activity of a warm-blooded test animal.

Laboratory exercise № 22 - 4 acad. hours

Cardiovascular system. Blood Vessels. Hemodynamic Indices. Arterial Pulse. Capillary Physiology. 1.Defying the characterictics of arterial pulse. 2. Sphygmography. Measurement of pulse wave velocity of conduction. 3. Plethysmography. 4. Capilliaroscopy. 5.Investigation of frogs' tongue capilliaries.

Laboratory exercise № 23 - 4 acad. hours

Cardiovascular system. Regulation of vascular tone. Arterial blood pressure and its control. 1. Claude-Bernard's experiment. 2. Measuring the arterial blood pressure with the Riva-Rocci device by the Korotkoff method. 3. Neural and humoral effects on the blood pressure of a warm-blooded animal.

Laboratory exercise № 24 - 4 acad. hours

Cardiovascular system. Review of 'Cardiovascular Physiology".

Laboratory exercise № 25 - 4 acad. hours

The Digestive System. 1. Demonstration of the motor activity of a frog's small intestine in situ.. 2. Demonstration of movements of the small intestine of a warm-blooded animal in vitro.
3. Effect of bile on the filtration speed of vegetable oil (cooking oil). 4. Effect of bile on the sedimentation of sulphur powder.

Laboratory exercise № 26 - 4 acad. hours

Digestion, Energy Metabolism and Nutrition. 1. Methods of determining the basal metabolic rate. 2. Measurement of loading providing maximal fat catabolism using indirect calorimetry. Principles of rational nutrition. Composing a meal plan.

Laboratory exercise № 27 - 4 acad. hours

The Excretory System and Water/Electrolyte Balance of the Body. 1. Effect of ADH on the diuresis of white mice. 2. Determining the effective filtration pressure (EFP) 3. Calculation of the clearance and transport maximum (Tm).

Laboratory exercise № 28 - 4 acad. hours

The Gastrointestinal System, Energy Metabolism and Nutrition. The Renal excretory System, Water-electrolyte and Acid-base Balance. (Review)

Laboratory exercise № 29 - 4 acad. hours

Body Changes during Physical Exercise. Assessment of the Body Condition by Function Tests. 1. Gas exchange changes during load testing. Spiroergometry. 2. Combined functional test of the cardiovascular system 3. Harvard step test. 4. Evaluation of the physical aerobic work capacity by the Sjostrand – PWC_{170} test.

Laboratory exercise № 30 - 4 acad. hours

Higher Nervous Activity. 1.Tachistoscopia. 2. Determination of types of higher nervous activity by the Sharankov test. 3. Bay Miller's visual memory test. 4. Raven's test.

BIBLIOGRAPHY

Ganong W, Medical Physiology, 17th ed, 1996; A. C. Guyton and J. E. Hall. Textbook of Medical Physiology, 13th ed. 2016; W. Boron and E. Boulpaep. Medical Physiology, Elsevier 3th ed., 2017.

CONSPECTUS

1. Organization of the cell. Physical structure of the cell. Functional systems of the cell. Properties of the cell membrane and junctions between the cells. Intercellular signalization. Transport of substances through the cell membrane.
2. The human body. Homeostasis. General principles of the homeostatic regulation – regulatory systems and elements of the homeostatic regulatory system. Levels of physiological regulation.
3. Physiology of the excitatory tissues. Irritability and Excitability. General and specific properties of the excitable cells. Membrane potential – ionic basis of the membrane potentials.
4. Measurement of excitability. Changes in the excitability during excitation. Inhibition. Conduction of the excitation.
5. Transmission of the excitation (inhibition) from an excitable cell to another. Synapses - types of synapses. Chemical synapses. Transmitters and modulators. Postsynaptic potentials. Summation of the postsynaptic potentials.
6. Functions of the nervous system – functional morphology of the nervous system. Physiology of the nerve cell. Glial cells. Neuronal circuits and processing of information form group of nerve cells – convergence, divergence, reverberating circuits, inhibition.
7. Reflex regulation of the physiological functions. Type of reflexes according to the mechanism of formation and the characteristics of the involved reflex arc.
8. Nerve centers. Types and properties. Cerebral blood flow. Cerebrospinal fluid.
9. The autonomic nervous system. General organization of the autonomic nervous system. Autonomic nerve centers, ganglia, transmitters and receptors in the autonomic nervous system.
10. Effects of sympathetic and parasympathetic stimulation on specific organs. Autonomic reflexes.
11. Role of the hypothalamus, reticular formation, cerebellum, basal ganglia and cerebral cortex in the control of the autonomic functions. Integration of the central nervous system in the adaptation processes of the body – "alarm" or "stress" response of the sympathetic nervous system.

12. General principles of the humoral control of the physiologic functions. Telecrinia and paracrinia. Classification, synthesis and mechanism of action of the hormones. Control on the hormone secretion.
13. Hypothalamic-neurohypophysial system. Neurosecretion. Hormones of the neurohypophysis. Physiologic effects and control of secretion.
14. Hypothalamo-adenohypophysial system. Hormones of the adenohypophysis. Physiologic effects and control of secretion.
15. Functional morphology of the thyroid gland. Iodine containing thyroid hormones. Physiologic effects and control of secretion. Hyperthyroidism and hypothyroidism.
16. Functional morphology of adrenal glands. Hormones of the adrenal medulla. Physiologic effects and control of secretion of adrenaline (epinephrine) and noradrenaline (norepinephrine).
17. Hormones of adrenal cortex – glucocorticoids. Physiologic effects and control of secretion. Pharmacologic effects of glucocorticoids.
18. Hormones of adrenal cortex – mineralcorticoids and adrenal androgens. Abnormalities of adrenocortical secretion.
19. Endocrine functions of the pancreas – type of hormones, physiologic effects and control of secretion. Diseases of the endocrine pancreas.
20. Calcium-phosphate homeostasis. Parathyroid hormone, calcitonin, vitamin D - physiologic effects and control of secretion. Impairment of the calcium and phosphate homeostasis.
21. Physiology of reproduction. Male reproductive system. Spermatogenesis. Male sex hormones (androgens) – types, physiologic effects and control of secretion. Erection and ejaculation.
22. Physiology of reproduction. Female reproductive system. Ovogenesis. Female sex hormones (estradiol and progesterone) – types, physiologic effects and control of secretion. Regulation of the female monthly rhythm. Pregnancy and lactation. Tests for early pregnancy.
23. Epiphysis, thymus and non-endocrine organs with endocrine functions. Tissue hormones – types, physiologic effects and control of secretion.
24. Physiology of skeletal muscles – functional morphology, mechanism and energetic of muscle contraction. Types of muscle contractions. Types of muscle fibers. Muscle work and muscle fatigue. Electromyography.
25. Functional morphology of smooth muscles. Excitation, electrophysiologic characteristics and mechanism of contraction of smooth muscles.
26. Physiology of the blood. Functions of the blood. Composition and volume of the circulating blood – regulation of the volume. Blood plasma – composition and its regulation. Hematocrit. Blood reservoirs.
27. Erythrocytes. Count and functions**.** Erythrocyte sedimentation rate**.** Hemoglobin**.** Erythrocyte indices. Iron metabolism. Hemolysis. Control of erythropoiesis and erythrocyte count in the bloodstream.
28. Blood types. Physiological and clinical significance. ABO and Rh blood type systems. Methods of analysis. Principles of blood transfusion.
29. Leukocytes. Count and functions of the different leukocyte types. Control of leukopoiesis and leukocyte count in the bloodstream. Immunity.
30. Hemostasis and hemocoagulation. Vascular-trombocyte and coagulation hemostasis. Fibrinolysis and anticoagulational mechanisms. Control of hemostasis.

31. Physiology of lymphatic system. Formation, composition and functions of lymph. Physiological role of the spleen.
32. Cardiovascular system. Systemic and pulmonary circulation. Heart as an organ – functional morphology of the pericardium, endocardium and myocardium. Nerve supply. Myocardial blood supply.
33. Functional morphology and physiological characteristics of the excitatory and conductive system of the heart. Automaticity. Cardiac rhythm. Abnormalities of conductivity.
34. Physiological characteristics of the working myocardium. Excitation and contraction. Refractory periods**.** Extrasystoles**,** flutter and fibrillation**.** Myocardial metabolism.
35. Electrical events during cardiac performance. Origin, registration and evaluation of the electrocardiogram.
36. Dynamics of the cardiac contractions – cardiac cycle. States of the valvular apparatus during different phases of the cardiac cycle.
37. Functions of the heart valves of the heart. Heart sounds. Methods of examination. Stenosis and insufficiency of the valves. Correlation between a synchronous phonocardiographic and electrocardiographic record.
38. Heart rate. Stroke volume and cardiac output and their changes during different physiological conditions.
39. Control of the cardiac performance – intrinsic (self-control). Energetics of the heart pumping.
40. Extracardial neural regulation of the cardiac performance – characteristics of the sympathetic and parasympathetic effects. Humoral factors affecting cardiac performance.
41. Functional characteristics of blood vessels. Hemodynamic principles – characteristics of the vessels and the blood. Hemodynamic indices. Volume and linear velocity of the blood flow through the various parts of vascular system and factors determining them.
42. Blood pressure in the various parts of the cardiovascular system. Arterial blood pressure – methods of measurements and normal values. Factors determining the blood pressure levels.
43. Arterial blood flow. Arterial pulse. Sphygmography. Characteristics of the arterial pulses. Venous blood flow. Venous pulse. Phlebography.
44. Physiology of the microcirculation. Functional organization of the microcirculation unit. Organ–related peculiarities of the capillaries. Control of the microcirculation.
45. Vascular tone. Basal tone of blood vessels. Local, neural and humoral regulatory mechanisms of the vascular tone.
46. Control of the circulation. Characteristic and localization of the receptors. Vasomotor center. Supramedular control of the circulation.
47. Control of the arterial blood pressure. Mechanisms of the quick short-term, quick ongoing, and long-term regulation.
48. Physiology of respiration. External respiration. Functional organization of the airways, lungs and thoracic basket. Mechanics of breathing. Intrapleural and intrathoracic pressure. Role of surfactant. Defense reflexes – cough and sneeze.
49. Rate and rhythm of breathing. Pulmonary and alveolar ventilation. Elastic and non-elastic resistance to breathing. Air flow during breathing. Work of breathing.
50. Static lung volumes and capacities and their functional concern. Anatomic and physiologic dead space. Estimation of the external respiration.

51. Physical basis of gas exchange. Solubility, diffusion coefficient and diffusion capacity of the gases. Composition of the gases in air, lungs and blood. Diffusion of gases across the alveolocapillary membrane. Ventilation-perfusion ratio.
52. Transport of O_2 in the blood. Oxyhemoglobin dissociation curves. Oxygen exchange in lungs and tissues.
53. Transport of CO_2 in the blood. Carbon dioxide exchange in lungs and tissues.
54. Control of respiration. Respiratory center and rhythm of breathing. Chemical control of respiration. Reflex control of respiration. Effects of the cerebral cortex on the respiratory functions.
55. Gastrointestinal system – functions. Digestion in the Mouth: processes of mastication, secretion, enzyme destruction and absorption. Swallowing – phases and regulation.
56. Motor functions of the Stomach – hunger contractions, storage function, mixing and propulsion of food. Emptying of the Stomach. Control of the Stomach motor activity. Vomiting.
57. Secretion, enzyme destruction and absorption in the Stomach. Gastric juice: composition, mechanism of secretion and functions. Gastric secretion and its control: cephalic, gastric and intestinal phases. Protective potentialities of the gastric barrier.
58. Small Intestine – motor activity: type of movements and regulation; secretion, digestion and absorption.
59. Colon – type of movements and their regulation; secretion, digestion and absorption. Defecation.
60. Pancreatic juice – composition and functions. Control of the pancreatic secretion.
61. Processes of formation and secretion of Bile. Composition and functions of the Bile. Regulation of the Bile secretion. Functions of the Liver.
62. Digestion and absorption of Proteins, Fats and Carbohydrates in the Gastrointestinal Tract. Absorption of Salts, Water and Vitamins.
63. Metabolism of the Nutrients in the organism. Metabolism of Carbohydrates: the level and regulation of Glucose in the circulating blood. Metabolism of Proteins and its control. Metabolism of Lipids and its control.
64. Energy metabolism in the organism. Energy values of the Nutrients. The Energy Equivalent of Oxygen. The measurement of the Metabolic Rate: Direct and Indirect Calorimetry. The Basal Metabolic Rate and the Daily Energy Requirements for different physiologic states.
65. Feeding: main principles in defining the physiologic standards– plastic and energy needs of the organism. Physiologic mechanisms of Starvation and Satiety.
66. Temperature regulation. Body temperature and isothermia. Mechanisms of heat production and heat loss. Neurophysiologic bases of temperature regulation. Hyperthermia and hypothermia. Acclimatization. Regulation of body temperature within exsercise.
67. Excretion functions of the organism and systems, accomplishing them. The Kidneys – functional structure. Peculiarities of the kidneys blood supply and innervation. Mechanism and control of glomerular filtration. Methods of glomerular function assesment.
68. Functions of renal tubules. Transport processes within the different parts of the tubules. Mechanisms for excretion of a dilute urine and a concentrated urine. Renal excretion.
69. Renal clearance tests. Volume of the urine and its components. Micturition. Endocrine and metabolic functions of the kidneys. Control of the renal functions.

70. Water-electrolyte balance of the organism. Body fluids and electrolytes. Dynamics of body fluids volume and osmolality. Control of Water-Salts homeostasis. Thirst – physiologic mechanisms.
71. Acid-Base Balance of the organism. Buffer systems of the body fluids. Respiratory regulation of pH. Renal regulation of pH. Abnormalities in Acid-Base Balance.
72. Sensory systems. Functional morphology. General principles of sensory systems information coding and processing. Sensory systems adaptation.
73. General sensation. Somatosensory system – organization and modalities. Mechanisms of thermo- and mechanoreception. Pain sensation. Itch.
74. Vision sensory system. Functional morphology of the eye – the optics of the eye; the mechanism of accommodation; errors of refraction. The pupillary reflex. Eyes movements and their control. Protective appliances of the eyes.
75. Detection, transmission and processing of the information in the retina. Central neurophysiology of vision. Light and dark adaptation. Visual acuity. Color vision.
76. The sense of hearing. Functional morphology of the external, middle and inner ear. Processing of the sound signal. Central auditory mechanisms. Vestibular apparatus. Central mechanisms of the maintenance of equilibrium. Vestibular reflexes.
77. Physiology of the chemical senses - taste and smell. Peripheral and central mechanisms of taste and smell sensations.
78. General characteristics of motor control. Muscle receptors – functions of the muscle spindles and tendon receptors. Spinal cord control of motor activity. The spinal cord reflexes. Motor control from higher levels of the brain.
79. States of brain activity and sleep. The role of the different neuronal structures in the maintenance of the brain activity. Physiologic changes within sleep. Electroencephalography.
80. Higher nerve activity – types and characteristics. Learning and memory: types and physiologic bases. Primary and secondary signalling systems. Communicative capabilities of man. Reading and writing speech. Auditory and visual gnosia.

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