

Normal Physiology

Plan of lectures

III semester

1. The biological membrane. Transport through the cell membrane.
2. Membrane potential and action potentials.
3. Mechanisms of transmission in synapses.
4. Physiological properties of skeletal and smooth muscles.
5. The structure and functions of nerve fibers.
6. General principles of coordination of body functions by central nervous system.
7. Motor functions of the central nervous system.
8. Consciousness, thinking. Memory. Sleep. Emotions.
9. Morphological and functional features of the organization of the heart.
10. Cardiac cycle. ECG.

IV semester

11. Physiology of blood vessels. Arterial pulse. Venous pulse. Microcirculation.
12. Vascular tone.
13. Arterial pressure regulation.
14. The role of the blood in maintaining homeostasis. Red blood cells. Hemoglobin.
15. White blood cells. Immune system.
16. Hemostasis.
17. The respiratory physiology.
18. Gases exchange.
19. The gastrointestinal system.

Plan of practical classes

1. Physiology of the excitable cells. The cell membrane structure. Basic mechanisms of passive and active transport (the concentration difference, diffusion, ionic pump, secondary active transport).
2. Membrane potential. Equilibrium K^+ potential. Microelectrode and patch-clamp methods. Action potential. The phases of action potential. The threshold. The refractory period. The «all-or-none» law. The phenomenon of accommodation. The strength-duration curve.
3. Physiology of the skeletal and smooth muscles. Structure, morphological (sarcomere) and physiological (motor units) units of skeletal muscles. Excitation-contraction coupling. Cross-bridges formation. Role of the calcium ions and ATP in the mechanism of muscle contraction. Rigor mortis.
4. The neuromuscular junction. Releasing of acetylcholine from axon terminals. The “end-plate potential” and excitation of the skeletal muscle fiber. Role of cholinesterase Pre- and postsynaptic mechanisms of the effects of the biological active drugs. Ionotropic and metabotropic receptors.
5. Morphological and physiological features of the nerve fibers. Propagation of the action potential along myelinated and unmyelinated nerve fibers. The laws of propagation of AP.
6. Module on topics 1-5.
7. The main functions of central nervous system CNS. Neuronal theory of CNS structure. Interneuronal synapses. Neurotransmitters in CNS. Excitation and Inhibition in CNS. The neural centers (occlusion, spatial facilitation, convergence, divergence, reverberation). Reflex arch. Reflexes of spinal cord.
8. The vital centers of the medulla oblongata: vasomotor center, cardiac control center, respiratory center. Reflexes of medulla oblongata. Static and statokinetic reflexes.

- Midbrain. The role of Cerebellum and Basal nuclei in motor control. Clinical abnormalities of the Cerebellum.
9. Functions of the Reticular Formation. The significance of the Thalamus in processing and transmission of sensory signals. The significance of the Hypothalamus in regulation of autonomic, endocrine, somatic and emotional functions. Hypothalamohypophysial system and its functional significance. Structure and functions of the Cerebral cortex. Motor, sensory and associative areas. Cerebral lateralization. Electroencephalogram. Clinical use of the electroencephalogram.
 10. Structures and functions of the limbic system. The role of limbic system in formation of emotions, behavior and memory. Memory, and its types. classification of memories. Physiological mechanisms underlying memory formation. Sleep. Slow wave sleep and paradoxical (REM) sleep. Basic theories of sleep: role of the reticular activating system, neuronal centers, transmitters, etc.
 11. Conditioned reflexes, their biological role and classification. The mechanism of formation of conditioned reflexes. The inhibition of the conditioned reflexes. The types of higher nervous activity (by I.P.Pavlov and Hippocrates).
 12. Visual perception. Optic system of eye. Pupil and iris contraction reflex. Visual accommodation. Structure and function of retina. Photoreceptors. Blind spot. Color-blindness. Space perception.
 13. Somatosensory perception. Receptive field of sensory neuron. Touch and temperature sensitivity. Smell and taste perception. Thresholds of sensitivity. Functional interrelation between smell and taste perception.
 14. Module on topics 7-11.
 15. Physiology of the Heart. Electrical activity of the heart. The cardiac cycle. Pressure changes during the cardiac cycle. Atrioventricular and semilunar valves. Conducting tissues of the heart. Excitation - contraction coupling in cardiac muscle.
 16. The electrocardiogram (ECG). ECG leads. ECG waves, segments, periods. Basic interpretation of the ECG. Heart sounds and Heart murmurs.
 17. Intrinsic and extrinsic control of the cardiac functions. Intrinsic autoregulation of the heart (Frank-Starling law). Intracardial and extracardial reflexes. Sympathetic and parasympathetic effects.
 18. Module on topics 15-17.
 19. The classification of the blood vessels. Parameters of hemodynamics. The Poiseuille's equation. Blood flow in different parts of vascular bed. Laminar and turbulent blood flow. Arterial blood pressure. Blood pressure measurement. Systolic, diastolic, pulse, mean arterial pressures.
 20. Arterial blood-pressure curve. Endothelial exchange processes (Starling's relationship). Exchange of fluids via capillaries and venules. Causes of edema.
 21. Regulation of the circulation. Vasoconstriction and vasodilatation. Local regulation of blood flow. Neuronal and hormonal control of circulation.
 22. Module on topics 19-21.
 23. Composition and function of blood. plasma. Flow properties of blood. Red blood cells. The formation of blood cells.
 24. White blood cells. Immune system. Nonspecific and specific immunity.
 25. Blood groups: ABO system, Rh system. Blood transfusion.
 26. Hemostasis. Platelet-mediated hemostasis. Blood clotting. Fibrinolysis. Anticoagulants.
 27. Module on topics 23-26.
 28. Lung function, respiration. External respiration. Mechanics of breathing. Respiratory muscles. Pleural pressure. Surface tension, surfactant. Lung volumes and their measurement.
 29. Pulmonary gas exchange. O₂ and CO₂ transport in blood. O₂ dissociation curve: Respiratory control.

30. Saliva (functions, production, secretion). Mechanism and control of saliva secretion. Deglutition. Stomach structure and motility. Gastric juice. HCl secretion by parietal cells.
31. Small Intestinal Function. Pancreas. Pancreatic secretions. Pancreatic enzymes. Control of pancreatic juice secretion. Liver. Bile components and hepatic secretion of bile. Enterohepatic circulation of bile salts. Digestion and absorption. Large intestine, defecation. Endocrine and paracrine hormones and neurotransmitters control GI functions.
32. Module on topics 30-32.
33. Kidney Structure and Function. Renal Circulation. Glomerular filtration and clearance. Transport processes at the nephron. Reabsorption, excretion and urine concentration. The kidney and acid–base balance. Renin–angiotensin system.
34. Endocrine system. Humoral signals: control and effects. Hypothalamic–pituitary system. Hormonal control of blood glucose concentration. Thyroid hormones. Calcium and phosphate metabolism. Adrenal gland. Hormonal control of the menstrual cycle.
35. Thermal balance. Energy metabolism and calorimetry. Physiological constants (test)