Physiology with the basics of anatomy

Plan of lectures

I semester

1. The biological membrane. Transport through the cell membrane.
2. Physiology of the skeletal and smooth muscles.
3. Mechanisms of transmission in synapses.
4. General principles of coordination of body functions by central nervous system.
5. Functions of the spinal cord, medulla oblongata, pons, midbrain.
6. Functions of diencephalon. Autonomic nervous system.
7. The Sensory System. Perception.
8. Morphological and functional features of the organization of the heart.
9. Cardiac cycle. ECG.

II semester

10. Physiology of blood vessels. Arterial pulse. Venous pulse. Microcirculation.
11. Arterial pressure regulation.
12. The role of the blood in maintaining homeostasis. Red blood cells. Hemoglobin.
13. White blood cells. Immune system.
14. Hemostasis.

III semester

15. The respiratory physiology.
16. The gastrointestinal system. Digestion in the oral cavity, stomach.
17. Digestion in the small, large intestine.
18. Kidney Structure and Function.
19. Physiology of the Endocrine 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. 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. 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.
5. Ionotropic and metabotropic receptors.
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.
8. Reflexes of spinal cord. 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. 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.
10. Structure and functions of the basal nuclei. Structure and functions of the Cerebral cortex. Motor, sensory and associative areas. Cerebral lateralization. Electroencephalogram. Clinical use of the electroencephalogram.
11. 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.
12. Module on topics 7-11.
13. Somatosensory perception. Receptive field of sensory neuron. Touch and temperature sensitivity.
14. Thermal balance. Energy metabolism and calorimetry.
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. Intrinsic and extrinsic control of the cardiac functions. Intrinsic autoregulation of the heart (Frank-Starling law). Intracardial and extracardial reflexes. Sympathetic and parasympathetic effects.
17. Module on topics 15-16.
18. 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.
19. Arterial blood-pressure curve. Endothelial exchange processes (Starling's relationship). Exchange of fluids via capillaries and venules. Causes of edema.
20. Regulation of the circulation. Vasoconstriction and vasodilatation. Local regulation of blood flow. Neuronal and hormonal control of circulation.
21. Module on topics 18-20.
22. Composition and function of blood. plasma. Flow properties of blood. Red blood cells. The formation of blood cells.
23. White blood cells. Immune system. Nonspecific and specific immunity.
24. Blood groups: AB0 system, Rh system. Blood transfusion.
25. Hemostasis. Platelet-mediated hemostasis. Blood clotting. Fibrinolysis. Anticoagulants.
26. Module on topics 22-25.
27. Lung function, respiration. External respiration. Mechanics of breathing. Respiratory muscles. Pleural pressure. Surface tension, surfactant. Lung volumes and their measurement.
28. Pulmonary gas exchange. O_2 and CO_2 transport in blood. O_2 dissociation curve: Respiratory control.
29. Saliva (functions, production, secretion). Mechanism and control of saliva secretion. Deglutition.

30. Stomach structure and motility. Gastric juice. HCl secretion by parietal cells. Small Intestinal Function. Pancreas. Pancreatic secretions. Pancreatic enzymes. Control of pancreatic juice secretion.
31. 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. Kidney Structure and Function. Renal Circulation. Glomerular filtration and clearance. Transport processes at the nephron.
33. 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.