

Human physiology examination syllabus

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 signaling. 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 excitable tissues. Irritability and Excitability. General and specific properties of the excitable cells. Membrane potential – ionic basis of the membrane potential.
4. Measurement of excitability. Changes in the excitability during excitation. Inhibition. Conduction of excitation.
5. Transmission of the excitation (inhibition) between excitable cells. Synapses - types of synapses. Chemical synapses. Neurotransmitters and neuromodulators. 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 in groups 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 reflex arc.
8. Nerve centers. Types and properties. Cerebral blood flow. Cerebrospinal fluid.
9. The autonomic nervous system (ANS). General organization of the autonomic nervous system. Autonomic nerve centers, ganglia, neurotransmitters 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 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 physiological functions. Telecrinia and paracrinia. Classification, synthesis and mechanism of action of the hormones. Control of the hormone secretion.

13. Hypothalamic-neurohypophysial system. Neurosecretion. Hormones of the neurohypophysis. Physiological effects and control of secretion.
14. Hypothalamo-adenohypophysial system. Hormones of the adenohypophysis. Physiological effects and control of secretion.
15. Functional morphology of the thyroid gland. Iodine containing thyroid hormones. Physiological effects and control of secretion. Hyperthyroidism and hypothyroidism.
16. Functional morphology of adrenal glands. Hormones of the adrenal medulla. Physiological effects and control of secretion of adrenaline (epinephrine) and noradrenaline (norepinephrine).
17. Hormones of adrenal cortex – glucocorticoids. Physiological effects and control of secretion. Pharmacological 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. The calcium-phosphate homeostasis. Parathyroid hormone, calcitonin, vitamin D - physiologic effects and control of secretion. Disorders 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 the skeletal muscles – functional morphology, mechanism and energetics of muscle contraction. Types of muscle contractions. Types of muscle fibers. Muscle work and muscle fatigue. Electromyography.
25. Functional morphology of the smooth muscles. Excitation, electrophysiological characteristics and mechanism of contraction of the smooth muscles.
26. Blood physiology. 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.
28. Blood types. Physiological and clinical significance. The 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 leucopoiesis and leukocyte count. Immunity.
30. Homeostasis and blood coagulation. Vascular-thrombocyte and coagulation hemostasis. Fibrinolysis and anticoagulant mechanisms. Control of hemostasis.
31. Physiology of lymphatic system. Formation, composition and functions of lymph. Physiology of the spleen.
32. The cardiovascular system. Systemic and pulmonary circulation. The heart – functional morphology of the pericardium, endocardium and myocardium. Nerve supply. Myocardial blood supply.
33. Functional morphology and physiological characteristics of the conduction 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 heart valves during different phases of the cardiac cycle.
37. Functions of the heart valves. 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.
40. Extrinsic neural regulation of the cardiac performance – characteristics of the sympathetic and parasympathetic effects. Humoral factors affecting cardiac performance.
41. Functional characteristics of the 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 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 features of the capillaries. Control of microcirculation.
45. Vascular tone. Basal tone of blood vessels. Local, neural and humoral regulatory mechanisms of the vascular tone.
46. Control of the circulation. Characteristics and localization of the receptors. Vasomotor centre. Supramedullary 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 cage. Mechanics of breathing. Intrapleural and intrathoracic pressure. The role of surfactant. Cough and sneeze.
49. Rate and rhythm of breathing. Pulmonary and alveolar ventilation. Elastic and non-elastic resistance to breathing. Air flow during breathing. The work of breathing.
50. Static lung volumes and capacities and their functional importance. Anatomical and physiological 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 the air, lungs and blood. Diffusion of gases across the alveolo-capillary membrane. Ventilation-perfusion ratio.
52. Transport of O₂ in the blood. Oxyhemoglobin dissociation curves. Oxygen exchange in the lungs and tissues.
53. Transport of CO₂ in the blood. Carbon dioxide exchange in the lungs and tissues.
54. Control of respiration. Respiratory center and the rhythm of breathing. Chemical control of respiration. Reflex control of respiration. Effects of the cerebral cortex on respiration.
55. The gastrointestinal system – functions. Digestion in the mouth: mastication, secretion, enzyme activity and absorption. Swallowing – phases and regulation.
56. Motility in the stomach – hunger contractions, storage function, mixing and propulsion of food. Emptying of the stomach. Regulation of gastric motility. Vomiting.

57. Secretion, enzyme activity and absorption in the stomach. Gastric juice: composition, mechanism of secretion and functions. Gastric secretion and its regulation: cephalic, gastric and intestinal phases. Protective functions of the gastric barrier.
58. Motility of the small intestine : type of movements and regulation; secretion, digestion and absorption.
59. Motility of the colon – type of movements and regulation; secretion, digestion and absorption. Defecation.
60. Pancreatic juice – composition and functions. Regulation of the pancreatic secretion.
61. Formation and secretion of bile. Composition and functions of the bile. Regulation of 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 nutrients in the body. Carbohydrate metabolism: the level and regulation of glucose in the circulating blood. Protein metabolism and its regulation. Lipid metabolism and its regulation.
64. Energy metabolism in the body. Energy values of the nutrients. The oxygen energy equivalent. Measurement of the metabolic rate: direct and indirect calorimetry. The basal metabolic rate and daily energy requirements under different physiological conditions.
65. Nutrition: main principles in defining the physiological standards – plastic and energy needs of the body. Physiology of starvation and satiety.
66. Temperature regulation. Body temperature and isothermia. Mechanisms of heat production and heat loss. Neurophysiological bases of temperature regulation. Hyperthermia and hypothermia. Acclimatization. Regulation of body temperature during exercise.
67. Excretion functions and the systems involved. The kidneys – functional structure. Specific features of their blood supply and innervation. Mechanism and control of glomerular filtration. Methods of glomerular function assessment.
68. Functions of renal tubules. Transport in different parts of the tubules. Mechanisms for the excretion of diluted/concentrated urine. Renal excretion.
69. Renal clearance tests. Urine volume the composition. Micturition. Endocrine and metabolic functions of the kidneys. Regulation of the renal functions.
70. Water-electrolyte balance of the body - fluids and electrolytes. Dynamics of volume and osmolality. Regulation of water-salts homeostasis. Physiology of thirst.
71. Acid-Base balance of the body. Buffer systems of the body fluids. Respiratory regulation of pH. Renal regulation of pH. Abnormalities of the acid-base balance.

72. The sensory systems - functional morphology. General principles of coding and processing of information; adaptation.
73. General sensitivity. The somatosensory system – organization and modalities. Mechanisms of thermo- and mechanoreception. Physiology of pain and itch.
74. Vision. Functional morphology of the eye – optics, accommodation and refraction errors. The pupillary reflex. Eye movements and their regulation. Protective structures of the eyes.
75. Detection, transmission and processing of the information in the retina. Physiology of vision. Light and dark adaptation. Visual acuity. Colour vision.
76. The sense of hearing. Functional morphology of the external, middle and inner ear. Processing of sound. Central auditory mechanisms. The vestibular apparatus. Regulation of balance. Vestibular reflexes.
77. Physiology of the chemical senses - taste and smell. Peripheral and central mechanisms of taste and smell.
78. General characteristics of motor control. Muscle receptors – functions of the muscle spindles and tendon receptors. Spinal cord control of motor activity. Reflexes of the spinal cord. Higher levels of motor control.
79. Brain activity and sleep. Neural structures involved in brain activity. Physiological changes during sleep. Electroencephalography.
80. Higher nervous activity – types and characteristics. Learning and memory. Primary and secondary signalling systems. Communication skills. Reading, writing and speech praxis. Auditory and visual gnosis.