**EXAM QUESTIONS**

**HISTOLOGY, EMBRYOLOGY, CYTOLOGY**

**31.05.01 GENERAL MEDICINE**

1. Role of histology, cytology and embryology in the medical education. Historical evolution of histology as a science. Tendency of histology development. Advanced visualization procedures.
2. Light microscopy and its modifications. General structure of light microscope. Principles of light microscopy. Electron microscopy: transmission and scanning. Laser confocal microscopy.
3. The main steps of routine histological processing: exposition and description.
4. The principals of histological staining. Routine method of staining. Selective methods of staining. Histochemical and immunohistochemical methods of staining. Modern trends in labeling of the cells and their ultrastructures.
5. Cell as a basic structural and functional unit of all multicellular organisms. General structure of an eukariotic cell.
6. Plasma membrane: fluid mosaic model. Functions of the cell membrane. Endocytosis and exocytosis. Integral and superficial proteins of the cell membrane.
7. Membranous organelles: mitochondria, Golgi apparatus, rough and smooth endoplasmic reticulum. Ultrastructure and functions.
8. Protein synthetic and packaging machinery of the cell. Free ribosomes and rough endoplasmic reticulum: the structure and role in the cell metabolism.
9. Organelles of protein synthesis in the eukaryotic cell. Ultrastructure of ribosomes, rough endoplasmic reticulum. Modification of new manufactured proteins.
10. Classification of the cell organelles. Rough (RER) and smooth endoplasmic reticulum (SER). The role of RER and SER in the cell activity.
11. Golgi apparatus. Cis- and trans-Golgi network. Vesicles associated with the Golgi apparatus. Sorting in the trans-Golgi network.
12. Ingestion apparatus of cell: lysosomes, proteasomes, peroxisomes. Ultrastructure and functions.
13. Cytoskeleton of the cell: microtubule and filaments. The role of microtubules in mitotic activity of cell. Ultrastructure of centrioles.
14. Special organelles of cell: microvilli, cilia, stereocilia. The role of the specialized cell surface modifications in functioning of organs.
15. Cytoplasmic matrix. Compartmentalization of the cell. Inclusions: classification, chemical and morphofunctional characteristic. The methods of identification.
16. Nucleus: structural and functional characteristics. Nuclear pore complex. Main components of nucleoplasm. Nucleolus. Chromatin packaging. Nuclear/cytoplasmic ratio, its significance.
17. Cell cycle, definition. Morphofunctional characteristics of the cell cycle periods.
18. Mitosis. The phases of mitosis; the importance of mitosis for the cell population.
19. Meiosis and its role in the formation of gametes. The stages of meiosis. Comparison of meiosis and mitosis.
20. Male gametes. Spermatogenesis. Comparative characteristic of male and female gamet formation.
21. Female gametes. Oogenesis. Comparative characteristic of male and female gamet formation
22. Early embryogenesis. Fertilization. The events of the 1st week after fertilization. Zygote, Morula, blastula. Implantation.
23. Development of the primary axial complex in human embryo: primitive streak, notochord, oral and cloacal membranes. Determination of right and left symmetry.
24. Early embryogenesis. Human development in the 2nd week. Gastrulation. The role of gastrulation in the formation of germ layers.
25. The 2nd week of development. Epiblast and hypoblast. Formation of extraembryonic mesoderm and its splitting.
26. Early embryogenesis. Gastrulation and its significance for the formation of germ layers. Human development in the 2nd and 3rd weeks after fertilization.
27. Differentiation of germ layers: ectoderm and its derivatives. The role of placodes in the development of ear and eye.
28. Differentiation of germ layers: mesoderm and its derivatives.
29. Differentiation of germ layers: entoderm and its derivatives.
30. Placenta. The formation of primary, secondary, tertiary villi. Placental blood circulation. Placenta as a barrier organ.
31. Placenta. Fetal and maternal parts. Formation of decidua and chorion. Placental barrier.
32. Epithelial tissue: morphofunctional characteristics. Types of epithelia. Polarity. Basal surface specializations: basal lamina, plasma membrane infoldings, hemidesmosomes.
33. Exocrine glands: morphological characteristic, classifications. Types of secretion. Secretory cycle, phases and their characteristics.
34. Red blood cells (RBC/erythrocytes). Cytoskeleton of RBC. Size, shape, function, life span of RBC. Types of hemoglobin. Hematocrit. Haemogram.
35. White blood cells (WBC). Classification, morphological characteristics, functions of different types of WBC. Granular and agranular leucocytes. T- and B-lymphocytes, their role in the immune response. Differential leucocyte count.
36. Hematopoiesis. The periods of prenatal hematopoiesis. Postnatal hematopoiesis: classes of hemopoietic cells. Growth stimulating factors.
37. Connective tissue: morphofunctional characteristic and classification. Connective tissue cells: classification, morphofunctional characteristics. Macrophagal system of organism. The types of resident macrophages. Extracellular matrix composition. Types of connective fibers, and their role in the integrity of organs.
38. Connective tissue with special properties: cellular and intercellular components, functions.
39. Cartilage. Morphological characteristics and classification. Structure, functions, histogenesis, and growth of cartilage.
40. Bone tissue. Morphofunctional characteristics and classification. Bone cells and extracellular matrix. Haversian system. Repair of bone.
41. Bone tissue: endochondral type of bone formation.
42. Bone tissue: intramembranous type of bone formation.
43. Skeletal muscle. Connective tissue investments of the skeletal muscle. Fine structure of skeletal muscle fiber. Structural organization of myofibrils. T-tubules and sarcoplasmic reticulum. Mechanism of the muscle contraction.
44. Cardiac muscle. Ultrastructure of a typical cardiac muscle cell. Intercalated discs. Specialized cardiac muscle cells.
45. Neuron as a structural and functional unit of the nervous system. Morphological classification of neurons. Ultrastructure of neuron. Dendrites and axon. Nissl bodies. Cytoskeleton of neuron. The role of neuron in synaptic transmission.
46. Nervous tissue: morphofunctional characteristic. Neuroglial cells: classification, structure, functions. The brain-blood barrier.
47. Nerve fibres. Ultrastructural and functional characteristic of myelinated and unmyelinated nerve fibres. Histogenesis and regeneration.
48. Synapses. Classification. Synaptic morphology. The role of synapses in transmission of nerve impulse.
49. Peripheral nervous system. Peripheral nerves: classification, nervous tissue organization, connective tissue investments.
50. Pacinian corpuscles, Golgi tendon organs, neuromuscular spindles, Meissner's corpuscles
51. Somatic motor and autonomic systems. Sympathetic and parasympathetic nervous system. Sensory and autonomic ganglia.
52. Spinal cord. Organization of the spinal cord. Key features of the cell types of the grey and white matter. Connective tissue investments of the spinal cord.
53. Cerebrum. Cerebral cortex layers (cytoarchitectonics). Key features of the primary cell types of thecerebrum greymatter. Myeloarchitectonics of the cerebrum. Principals of cortical organization. Radial column as a functional unit of the cerebrum.
54. Cerebrum. Phylogenetic subdivisions of the cortex: allocortex (paleocortex) and isocortex (neocortex). Histological structure of meninges. Plexus choroideus. Blood-brain barrier.
55. Cerebellum. Morphofunctional characteristics. White and grey matter. Neuron composition of the cerebellar cortex.
56. Eye. Microanatomy of the eye. Fibrous, vascular, and neural tunics of eyeball. Accommodation. Production and outflow of aqueous humor. The layers of photosensitive retina. Image processing of retina.
57. Structure of the accessory organs of eye: eyelid, conjunctiva, lacrimal apparatus, extraocular muscles.
58. Morphofunctional classification of blood vessels. Microstructure of elastic, and muscle arteries. Histological structure of aorta.
59. The general morphofunctional characteristics of heart. The layers of heart: endocardium, myocardium, pericardium. Intercalated disc. Specialized types of cardiomyocyte. Heart valve. Histophysiology of impulse-conducting system. Age-related changes of heart.
60. Histology of the red bone marrow. Hematopoietic and stromal components of the red bone marrow.
61. Lymph node: cortex, paracortex (deep cortex), medulla. T- and B-zones. Histophysiology of the lymph node. Drainage of lymph through the lymph node.
62. Thymus. Structure. Interaction between stromal and developing cells. Hassal’s corpuscles. Age-related and accidental involution of thymus.
63. Spleen: red and white pulp, T- and B-dependent zones. Functions of the spleen. The role of spleen in the antigen-dependent differentiation of lymphocytes. Cellular mechanism of red blood cell selection.
64. Morphofunctional characteristic of endocrine system. Comparison of exocrine and endocrine glands. Classification of endocrine organs. Hormones. Target organ: definition, examples. Mechanism of negative feed-back.
65. Hypothalamus, morphofunctional characteristic. Neurosecretory neurons. Control of hypothalamic functions.
66. Hypophysis (pituitary gland). Adenohypophysis and neurohypophysis. The cells of pituitary and their regulatory functions. Hypothalamo-hypophyseal system. Mechanism of negative feed-back.
67. Thyroid gland: cellular composition. Histophysiology of thyroid gland: synthesis and release of thyroid hormones (T3, T4).
68. Parathyroid gland. Cellular organization. Histophysiology of parathyroid gland. Morphological aspects of Ca2+ level regulation.
69. Parathyroid gland. Cellular organization. Physiological effect of parathyroid hormone. Calcium homeostasis-regulating cells and glands in organism.
70. Adrenal (suprarenal) glands. Structure of the adrenal cortex and medulla. Hormones of adrenal gland and their functions. Age-related changes.
71. Еаr. External, middle, and inner ear. Bone and membranous labyrinth. Corti organ. Histophysiology of the auditory system. Microstructure of the vestibular system.
72. Overview of oral mucosa. The role of oral mucosa in defense against invading microorganisms. Lingual tonsil: structure, function. T- and B-zones of tonsil.
73. Oral cavity. The general morphofunctional characteristics of major salivary glands; secretory and excretory portions; histophysiology, individual properties of the major salivary glands.
74. Tongue: histological structure; types of papillae. The taste bud histophysiology.
75. Oral cavity. Histological structure of palate, cheek, and lip.
76. Teeth. The mineralized components of teeth. The structure of enamel. Enamel rod (prism)– structural unit of enamel. Hunter-Shreger bands and Retzius lines. The sites of hypomineralization. Amelogenesis.
77. Teeth. The mineralized components of teeth. The structure of dentin. Organic and inorganic components of dentin. Globular and interglobular dentin. The sites of hypomineralization. Prenatal and postnatal dentinogenesis.
78. Teeth: structure of pulp. Cellular and intercellular components of pulp. The role of the pulp cells in dentinigenesis. Age-related changes of pulp.
79. Teeth. The mineralized components of teeth. The structure of cementum. Cellular and acellular cementum. Formation of cementum.
80. Supporting apparatus of teeth: alveolar bone, cementum, periodontal ligament, gingiva. Age-related change of gingiva.
81. General characteristic of teeth development. The stages of teeth development. The theories of tooth eruption.
82. The general characteristic of teeth formation stages. Enamel organ ultrastructure; its role in the formation of hard and soft tissues of teeth.
83. General plan of the alimentary canal. Morphofunctional characteristic of the layers. Nerve and blood supply. Endocrine and lymphoid apparatus of alimentary tube.
84. Histological structure of the esophagus. Esophageal cardiac glands and esophageal glands proper.
85. Stomach: histological structure of the layers. Comparative histology of mucosa in cardia, fundus, and pylorus. Histophysiology and cellular composition of fundic glands.
86. Small intestine. General morphofunctional characteristics. Modifications of the luminal surface. The cells of intestinal mucosa. Villus-crypt system. Defense mechanisms of intestine.
87. Histophysiology of large intestine. Cellular composition of colon mucosa. Appendix: structure and function.
88. Liver. General morphofunctional characteristic. The general structural organization and blood supply of liver. Three concepts of liver lobules: classic hepatic lobule, portal lobule, hepatic acinus.
89. Liver. General structural organization of the liver. Exocrine function of liver. Excretory bile system. Gallbladder: structure and functions.
90. Pancreas. General morphofunctional characteristic. Exocrine and endocrine portions. Age-related changes.
91. Kidney: lobe and lobule. Renal corpuscle. Filtration barrier. Histophysiology of the first phase of urine formation. Endocrine functions of kidney.
92. The nephron as the structural and functional unit of the kidney. Types of nephrons. Blood supply of kidney. The cellular composition of renal cortex and medulla.
93. Excretory passages of the urine system: histology of ureter, urinary bladder, urethra.
94. Integumentary system. The general histological structure of skin. Blood supply, innervation. Comparison of thick and thin skin. Regeneration of skin.
95. Respiratory system. Conducting portion of the respiratory system: overview. Nasal cavity. Ultramicroscopy of olfactory region of nasal cavity. Larynx: histological structure.
96. Respiratory system. Respiratory portion of the respiratory system. Respiratory bronchiole, alveolar duct, alveolar sack, alveolus. Cellular composition of alveolus. Surfactant. Blood-gas barrier.
97. Male reproductive system.. Histophysiology of testis. Ledig cells, Sertoli cell. Hormonal regulation of male reproductive system . Blood-testis barrier.
98. Excretory ducts and accessory sex glands of male reproductive system. Histological structure of epididymis, seminal vesicles, and prostate gland.
99. Female reproductive system. Ovary: cortex and medulla of ovary. Ovarian follicles. Hormonal regulation of follicle growth. Ovulation. Corpus luteum.
100. Female reproductive system. Histological structure of uterus. Hormonal regulation of endometrium morphology in menstrual cycle. Age-related changes of endometrium. The histological structure of oviduct. Hormonal regulation of oviduct mucosa.