Ministry of Science and Higher Education of the Russian Federation
Federal State Autonomous Institution of Higher Education
“National Research Nuclear University “MEPhI”

INSTITUTE OF ENGINEERING PHYSICS FOR BIOMEDICINE

APPROVED НТС ИФИБ

Protocol No. 3.1

dated 30.08.2024

ACADEMIC COURSE OUTLINE

ГИСТОЛОГИЯ, ЭМБРИОЛОГИЯ, ЦИТОЛОГИЯ / HISTOLOGY, EMBRYOLOGY, CYTOLOGY

Educational program track (speciality) [1] 31.05.01 General Medicine

Semester	**Labour input, credits**	**Total course academic, hours**	**Lectures, hrs.**	**Practical sessions, hrs.**	**Laboratory sessions, hrs.**	**In the form of practical studies, hrs.**	**Independent studies, hrs.**	**Independent studies monitoring, hrs.**	**Course progress, Exam/Pass-fail exam/Term**
1	2	72	16	0	32		24	0	PFE
2	7	252	30	0	45		123	0	Ex
Total	9	324	46	0	77	0	147	0	

ABSTRACT

The program of the course is compiled based on the requirements for the results of mastering the training program in the direction of "General Medicine"

In particular, a graduate (medical doctor) should be prepared to evaluate morphofunctional, physiological conditions and pathological processes in the human body in order to solve professional problems.

In the process of mastering this discipline, a medical student studies the micromorphological features of the human body structure at various levels (cellular, tissue, organ). The discipline's structure includes sections on cytology, embryology, general histology, and private histology.

The development of theoretical material is supported by the formation of skills and abilities in microscopy, recognition and analysis of histological preparations and electronic micrographs, and skills in understanding the processes occurring in the human body based on knowledge and skills in histology, embryology, and cytology.

The discipline also forms a culture of intellectual work; an understanding of the social role of the profession, a positive and active attitude towards the values of the chosen specialty, and a responsible attitude towards professional activity and work.

1. ACADEMIC COURSE GOALS AND OBJECTIVES

The purpose of mastering the discipline is to gain systematic knowledge about the patterns of development and morphological structure of the human body at the subcellular, cellular, tissue and organ levels and to master the skills of analyzing morphological structure using magnifying technology as a fundamental theoretical basis for mastering and understanding the essence of morphofunctional states in the body, the formation of the conceptual apparatus of medicine and the development of the foundations of clinical thinking.

OBJECTIVES

- formation of a system of knowledge about the specific features of the microscopic structure of various organs, tissues, cells and non-cellular structures that make up them, as well as the features of the development and vital activity of cells, tissues and organs;
- formation of skills and analysis of tissue research at the light-optical level, identification, analysis and understanding of the state of structural components of organs at the histological and cytological levels;
- formation of readiness and ability to apply knowledge and skills in the field of histology, embryology and cytology to recognize morphofunctional changes in cells, tissues, organs and systems of the human body;
- development of skills in working with educational and scientific literature; teamwork skills.

2. PLACE OF THE ACADEMIC COURSE IN THE MAIN HIGHER EDUCATION CURRICULUM

The academic discipline is implemented within the framework of the basic part according to the curriculum of training in the specialty of Medical science.

The previous disciplines are: biology; chemistry; anatomy, Latin. Biology, anatomy, and biological chemistry are studied in parallel.

The discipline is fundamental for the study of the following disciplines: normal physiology, pathological anatomy, pathological physiology, pharmacology, immunology, medical microbiology and virology.

The development of competencies in the process of studying the discipline contributes to the formation of knowledge, skills and abilities that are basic for further development of specialized disciplines, allowing for effective work in solving medical and scientific research tasks of professional activity.

3. DEVELOPED COMPETENCIES AND INTENDED LEARNING OUTCOMES

Universal and/or general professional competencies:

Competency code and title	**Code and title of competency-based rubrics**
ОПК-5 [1] – Capable of assessing morphofunctional and physiological states, as well as pathological processes in the human body to solve professional tasks.	З-ОПК-5 [1] – Know: - basic medical, pharmaceutical, and morphofunctional terminology, including Latin terms; - structure and functions of the human body, age-related, gender-specific, and individual characteristics of the structure and development of a healthy organism; - physical and chemical nature of processes occurring in a living organism; - patterns of vital activity of the organism, mechanisms of self-regulation and regulation; - features of regulation of the functioning of human body systems in pathological conditions; - patterns of occurrence, development, and outcome of typical pathological processes, the concept of sanogenesis; - etiology and pathogenesis of the most common diseases; - the concept of nosology, principles of disease classification; - principles of microorganism classification, their morphology, physiology, and impact on human health; - structure and functions of the human immune system. У-ОПК-5 [1] – Be able to: - analyze mechanisms of disease development and manifestation; - recognize morphological and functional changes in cells, tissues, organs, and systems of the human body; - use basic physical-chemical and other natural science concepts and methods in solving professional tasks; - determine the cause of death and formulate a pathological diagnosis. В-ОПК-5 [1] – Possess skills in: - conducting microscopy and analyzing microscopic specimens; - correlating morphological and clinical manifestations of diseases; - assessing morphofunctional, physiological states, and pathological processes in humans; - clinical-anatomical analysis of autopsy results.

4. PEDAGOGIC POTENTIAL OF THE COURSE

Pedagogic tracks/objectives	**Pedagogic goals (code)**
Intellectual education	Establishing conditions for: formation of culture of

	intellectual work (B11)
Vocational and labor education	Establishing conditions for: formation of a deep understanding of the profession's social role, a positive and active commitment to the values of the chosen specialty, and a responsible attitude towards professional activity and work (B14)

5. ACADEMIC COURSE STRUCTURE AND CONTENT

Academic course sections, their scope, terms of study and assessment:

No.	Academic course section name	Weeks	Lectures/ Practical (seminars)/ Laboratory sessions, hrs.	Compulsory current assessment (form*, week)	Maximum grade per section**	Section assessment (form*, week)	Competency-based rubrics
	1 Semester						
1	The First Section	1-8	8/0/16	T-8 (25)	25	T-8	З-ОПК-5, У-ОПК-5, В-ОПК-5
2	The Second Section	9-14	8/0/16	T-14 (25)	25	T-14	З-ОПК-5, У-ОПК-5, В-ОПК-5
	Totals for 1 Semester		16/0/32		50		
	Assessment events for 1 Semester				50	PFE	З-ОПК-5, У-ОПК-5, В-ОПК-5
	2 Semester						
1	The First Section	1-8	12/0/16	T-8 (25)	25	T-8	З-ОПК-5, У-ОПК-5, В-ОПК-5
2	The Second Section	9-15	18/0/29	T-15 (25)	25	T-15	З-ОПК-5, У-ОПК-5, В-ОПК-5
	Totals for 2 Semester		30/0/45		50		
	Assessment events for 2 Semester				50	Ex	З-ОПК-5, У-ОПК-5, В-ОПК-5

* – abbreviated name of assessment

** – 100 maximum points per semester including a pass/fail exam and (or) an exam

Abbreviated current assessment forms and section assessment

Abbreviation	Full name
T	Testing
PFE	Pass/fail examination
Ex	Exam

SYLLABUS

Weeks	Topics / Content	Lect., hrs.	Pr./sem., hrs.	Lab., hrs.
	1 Semester	16	0	32
1-8	**The First Section**	8	0	16
1	**Introduction to Histology** Research methods in histology. Microscopy, types of microscopy. The subject and tasks of histology. Types of light and electron microscopy (light field, dark field, phase contrast, polarization microscopy, differential interference contrast, luminescent microscopy; transmission and scanning electron microscopy). Microscopy, the device of a light microscope, the rules and skills of working with it. Preparation of the material for microscopy (sampling of the material, fixation, dehydration, clarification, impregnation, pouring into paraffin). Preparation and staining of sections and smears.	All		
		2	0	4
		Online		
		2	0	4
4	**Cytology** The general plan of the cell structure. Plasmalemma (cell membrane), structure and functions. Cytoplasm. Cell organelles (mitochondria, ribosomes, polyribosomes, endoplasmic reticulum, smooth and rough, Golgi complex). The cytoskeleton of a cell (microtubules, microfilaments, intermediate filaments). Centrioles, cilia, flagella. The nucleus (structure, nuclear shell, chromatin, nucleolus, nucleoplasm). The cell cycle. Cell division (mitosis). Cell death (degeneration, necrosis, apoptosis).	All		
		2	0	4
		Online		
		2	0	4
6	**Epithelial tissue** General characteristics of the fabric. Classification of tissues. General characteristics and principles of organization of epithelial tissues. Morphological and functional classification of epithelial tissues. Intercellular contacts: simple contacts, dense (closing) contacts, adhesive contacts (encircling desmosomes), desmosomes, semi-desmosomes, gap contacts (nexuses). General characteristics of exocrine and endocrine glands. Epitheliocytes. Glandulocytes. Types of secret release mechanisms. Types of secrets. General characteristics and classification of connective tissues. Fabrics with special properties. Blood. Hematopoiesis. General characteristics, classification and function of muscle tissues. The structure of the skin. Skin derivatives: sebaceous and sweat glands, hair follicle, hair. Skin receptors	All		
		2	0	0
		Online		
		2	0	4
8	**Tissues of the Internal environment. Blood and lymph** Hematopoiesis. Features of embryonic and postnatal Hematopoiesis. The concept of CCM.	All		
		2	0	4
		Online		
		2	0	4
9-14	**The Second Section**	8	0	16
9	**Connective tissue proper.**	All		

	The structure and function of the connective tissue itself.	2	0	4
		Online		
		2	0	4
12	**Skeletal connective tissue.**	All		
	Development, structure, regeneration, age characteristics.	2	0	4
	Skeletal tissue: cartilage and bone tissue. Regeneration of	Online		
	cartilage and bone tissue. Bone growth in length and thickness.	2	0	4
14	**Muscle tissue**	All		
	General characteristics, classification and function of muscle	2	0	4
	tissue. Features of contraction and regeneration of different	Online		
	types of muscle tissue.	2	0	4
16	**Nervous tissue**	All		
	General characteristics. Development. Structure, functions and	2	0	4
	regeneration of nervous tissue. The morphofunctional unit of	Online		
	nervous tissue is a neuron. Soma and appendages - dendrites and axon. Structure, functions and regeneration of nervous tissue. Morphological classification of neurons. Glial cells: astrocytes, oligodendrocytes, ependymocytes, microglia. Schwann cells. The process of myelination, the production of myelin in the central nervous system and the PNS. Saltatory type of nerve impulse transmission	2	0	4
	2 Semester	30	0	45
1-8	**The First Section**	12	0	16
1	**Private histology. Nervous system I**	All		
	General morphofunctional characteristics. Sources and course	2	0	4
	of embryonic development. The central nervous system.	Online		
	Features of the structure of gray and white matter. The concept of nerve centers. The structure of the meninges. The spinal cord. General morphofunctional characteristics. Development. The structure of gray matter. Nervous structure, gliocytes. Nuclei, their structure and functional characteristics. Own reflex activity apparatus. Front and back roots. The structure of the white matter. Morphofunctional characteristics of the pathways. The brain. General morphofunctional characteristics. Embryogenesis. Gray and white matter. The brain stem. Nervous organization of gray matter. The medulla oblongata. The reticular formation. Hypothalamus. Characteristics of the main nuclear groups. Brain functions. The cerebellum. Structure and functional significance. The neuronal composition of the cerebellar cortex. Afferent and efferent fibers. Interneuronal connections. Cerebellar gliocytes. The cerebral cortex. General morphofunctional characteristics of the cerebral cortex. Cytoarchitectonics. Neural structures. Plates (layers) of the cerebral cortex. Column designation. Interneuronal connections. Myeloarchitectonics: radial and tangential fiber. Gliocytes. The blood-brain barrier, its structure and significance.	2	0	4
2	**Nervous system II.**	All		
	Peripheral nervous system. The nerve. Structure. Reaction to	2	0	4
	damage and regeneration. Sensory ganglia (spinal and cranial).	Online		
	The source of development. The composition of the tissues.	2	0	4

	Structure: capsular neurocytes and gliocytes. The position of the nodes in the reflex arc. The autonomic (autonomic) nervous system. General morphofunctional characteristics and division into departments. Ganglia of the autonomic nervous system (extra- and intramural). The core of the central parts of the autonomic nervous system. Pre- and postganglionic nerve fibers. The structure of reflex arcs of the autonomic nervous system. Pre- and postnatal development of nervous system organs. Age-related changes in the cerebral cortex. Pre- and postnatal dynamics of myelination processes in the central and peripheral nervous system.			
4	**Sensory system.** The organ of vision. The general plan of the structure and development, the membranes of the eyeball, their departments, derivatives, tissue composition, functional apparatus of the eye. The structure of the sclera, cornea, lens, vitreous body, iris, ciliary body, choroid of the eye, retina, central fossa, optic disc. Auxiliary apparatus of the eye. The structure of the century. The organ of hearing. The outer, middle and inner ear: morphofunctional characteristics. Development of the inner ear. The cochlear canal of the inner ear. The cortical organ. Vestibular part of the membranous labyrinth of the inner ear, ampullary scallops and macular sacs. Organs of smell, taste and touch. Olfactory sensory systems. The organ of smell: development, structure, cytophysiology of sensorineural cells, age characteristics, regeneration. Organ of taste: development, topography, cellular composition and structure of taste buds, cytophysiology of sensory epithelial cells, innervation, regeneration, age-related changes	All		
		2	0	4
		Online		
		2	0	4
4 - 5	**The cardiovascular system.** General morphofunctional characteristics of the cardiovascular system. The origins and course of the embryonic development of the organs of the vascular system. Heart. General morphofunctional characteristics of the heart. Sources and course of embryonic development of the heart wall, its membranes, and their tissue composition. Vessels of the heart. Innervation of the heart. The endocardium and its derivatives are heart valves. The myocardium, its typical and atypical muscle tissue, importance in the work of the heart, its morphofunctional characteristics. Epicardium and the parietal layer of the pericardium. A newborn heart. The process of heart recovery after birth. Age-related heart changes. Vascularization and innervation of the heart.	All		
		2	0	4
		Online		
		2	0	4
5 - 6	**Circulatory system** The walls of blood vessels. General principles of structure, tissue composition and histochemical features of blood vessel walls. Dependence of vascular structure on hemodynamic conditions. Reconstruction and regeneration of blood vessels. Vascular vascularization. Innervation of blood vessels. The vascular system of the newborn. Postnatal vascular wall changes are caused by age and profession.	All		
		2	0	4
		Online		
		2	0	4

	The artery. The structure of the arterial wall is determined by hemodynamic conditions. Structural features and functions of different types of arteries: muscular, musculoskeletal and elastic. Organ features of the arteries. Microcirculation vessels. Structure, hemodynamic conditions, importance in metabolism. Arterioles, their role in blood circulation. Structure. Hemocapillaries. Classification, structure and functions. Morphological basis of capillary permeability and regulation of their functions. Special capillaries of organs. Venules. Functional value and structure. Arteriolar-venular anastomoses. Classification. The structure of arteriovenular anastomoses of various types. Vienna. The structure of the vein walls is determined by hemodynamic conditions. Structural features of various types of veins (muscular and amyotic). The structure of venous valves. Organ features of veins.			
6 - 7	**Endocrine system** General and morphofunctional characteristics of the system. The concept of hormones and their importance in the body. Classification of endocrine glands. Central and peripheral parts of the endocrine system. The concept of target cells and hormone receptors. Mechanisms of action of hormones on target cells. The relationship between the endocrine and nervous systems. Hypothalamic-pituitary neurosecretory system. Hypothalamus. The origins and course of embryonic development, the large-cell and small-cell nucleus of the hypothalamus. Features of the structure and function of neurosecretory cells. Classification of neurohormones by their chemical composition and functions. The area of the adenohypophysis of the hypothalamus. Liberins and statins. Ways of regulation of the endocrine glands by the hypothalamus. Regulation of hypothalamic functions by the nervous and endocrine systems. The pituitary gland. The origins and course of embryonic development of the adenohypophysis and neurohypophysis. Structure, tissue and cellular composition of the adenohypophysis. Morphofunctional characteristics of adenocytes. Changes in adenocytes due to hormonal status disorders. Hypothalamic-adenohypophysial circulation, its role in hormone transport. Structure and functions of the neurohypophysis. The epiphysis. Sources and course of embryonic development. Structure, cellular composition. Relationships with other endocrine glands. Innervation. Age-related changes. Peripheral endocrine glands. Thyroid gland. Sources and course of embryonic development. Structure, tissue and cellular composition. Thyrocytes and their hormones, phases of the secretory cycle. Development of sources, secretory function. Vascularization and innervation of the thyroid gland. Proliferation of the thyroid epithelium.	All		
		2	0	4
		Online		
		2	0	4

7 - 8	**Organs of Hematopoiesis and Immune system** General morphofunctional characteristics. The main sources and stages of formation of hematopoietic organs in the phylogeny of humans, animals and vertebrates. Central hematopoietic and immunogenetic organs Bone marrow. The structure and functions of the bone marrow. Features of vascularization and structure of hemocapillaries. Yellow bone marrow. Age-related changes. Bone marrow regeneration. The thymus. Role in T-lymphocytopoiesis. The structure and tissue composition of the cerebral cortex and medulla oblongata. Vascularization. Regeneration. Age-related changes. Peripheral hematopoietic and immunogenetic organs. Lymphatic follicles in the wall of the respiratory tract and digestive tract (single and multiple). The lymph node. Structure and composition of tissues. Cerebral cortex, medulla oblongata, paracortical region. The sinusoidal system. Vascularization. The role of blood vessels in the development and histophysiology of lymph nodes. Innervation, regeneration of lymph nodes. Age-related changes. Hemolymphatic nodes. Structure and functional significance. The spleen. White and red pulp, their structure and tissue composition. Blood supply to the spleen. Structural and functional features of venous sinuses. Innervation. Regenerative potential of the spleen. Age-related changes.	All		
		0	0	0
		Online		
		0	0	0
9-15	**The Second Section**	18	0	29
9	**Digestive system I** The structure of the walls of the digestive canal. General morphofunctional characteristics. The mucous membrane, submucosa, muscle layer, outer shell, their layers and tissue composition. General characteristics of the mucous membrane, its structure and significance. Features of the mucous membrane, various parts of the digestive canal. Innervation and vascularization of the digestive tube and its lymphoid apparatus. Glands of the digestive system, localization and structural organization, principles of blood supply and innervation. The endocrine system of the digestive tract. Morphofunctional characteristics. The oral cavity. Development. Function. The structure of the mucous membrane in connection with the function and peculiarities of conditions in the oral cavity. Large salivary glands. Exo- and endocrine function. Structure, histophysiology in the pre- and postnatal periods, blood supply and innervation. Language. Function, structure. Features of the structure of the mucous membrane on the upper and lower surfaces of organs. Lingual papillae and their types. Blood supply and innervation. Teeth. Structure. Sources and course of embryonic development. Pharynx and esophagus. Function, wall structure, sources and	All		
		2	0	4
		Online		
		2	0	4

	course of embryonic development. The structure of the various sections of the esophageal wall. Glands of the esophagus, their histophysiology. Features of the structure of the esophageal wall in a newborn and at different times after birth. Stomach. Morphofunctional characteristics, sources and course of embryonic development. The structure of the wall, its tissue composition. Features of the structure of the mucous membrane in various parts of the organ. Localization, structure and cellular composition of glands. Histophysiology of secretory cells, blood supply and innervation of the stomach wall. Regenerative potencies of organs. Age-related features of the structure of the stomach wall. Small and large intestines. Sources of embryonic development of the intestinal tube. Development of villi, crypts, and glands. The concept of physiological atresia. Intestinal development in the pre- and postnatal periods. The small intestine. Morphofunctional characteristics. The structure of the wall. The crypta-villus system as a structural and functional unit. Types of epithelial cells, their structure and cytophysiology. Features of the structure of the mucous membrane in various parts of the intestine (duodenum, jejunum). Histophysiology of the digestive process. The role of enterocyte microvilli in parietal digestion. Blood supply and innervation of the small intestine wall. Regenerative potencies. Age-related changes in the wall of the small intestine. Large intestine, morphofunctional characteristics. The structure of the wall. Features of the structure of the mucous membrane in connection with its function. Blood supply and innervation. The application, its structure and meaning. The rectum. Morphofunctional characteristics of the wall			
9 - 10	**Digestive system II** The pancreas. Morphofunctional characteristics, sources of embryonic development. The structure of the exocrine and endocrine parts. Cytophysiological characteristics of acinar cells. Types of endocrine cells and their morphofunctional characteristics. Blood supply and innervation of the pancreas. Regenerative potencies of organs. Features of histophysiology in different periods of childhood. Age-related changes in the aging of the prostate gland. Liver. Morphofunctional characteristics. Sources and course of embryonic development. Features of blood supply to the liver. The structure of the lobule as a structural and functional unit. The concepts of the portal lobule and acinus. Hepatic triads. Histofunctional characteristics of intracellular hemocapillaries. Hepatocytes, their structure, cytochemical features and functions. Ideas about the morphofunctional differentiation of hepatocytes within the hepatic lobule. Regeneration of liver tissue. The gallbladder and bile duct	All		
		2	0	4
		Online		
		2	0	4
10 - 11	**Respiratory system** General morphofunctional characteristics. Respiratory tract and respiratory department. Sources and course of embryonic	All		
		2	0	4
		Online		

	development. The composition of the tissues. The lining of the respiratory tract walls: mucous membrane, submucosa, fibrous-cartilaginous membrane, outer membrane and their layers. Extra pulmonary respiratory tract. The structure of the respiratory tract: nasal cavity, larynx, trachea and main bronchi. Morphofunctional features of the mucous membrane. Lungs. The intrapulmonary respiratory tract: bronchi and bronchioles. The dependence of the structure of the bronchial wall and bronchioles on their calibre. Acinus as a morphofunctional unit of the lung. Structural components of the acinus. The structure of the alveolar walls. Types of neurocytes, their morphofunctional characteristics. The structural and chemical organization and function of the surfactant is the alveolar complex. The structure of the interalveolar septa. The aerohematic barrier and its significance in gas exchange. Lung macrophages. Blood supply and innervation of the lungs. Age-related features of the lungs. The structure of the lungs of newborns (live and stillborn). Age-related changes in the lungs. Regenerative potency of respiratory organs. The pleura. Morphofunctional characteristics	2	0	4
12	**urinary system** General morphofunctional characteristics. Sources and course of embryonic development. Kidneys. The cortical and cerebral layers. The nephron is the morphofunctional unit of the kidney. Types of nephrons. Histophysiology of nephrons and collecting tubules. Vascularization of the kidney. The structure of the counter current system. Morphofunctional principles of regulation of the urine formation process. The structure of the wall of the renal calyx and pelvis. Morphofunctional characteristics of the ureter, bladder, and urethra	All		
		2	0	4
		Online		
		2	0	4
13	**Skin and its derivatives** Skin. Morphofunctional characteristics of the skin of both the organ and the integumentary system. Sources and course of embryonic development. Skin tissue composition. Postpartum development, regional characteristics. Secularization and innervation. Skin as a sense organ. Skin regeneration. Age-related changes. Epidermis. Layers of the epidermis. The concept of the process of keratinization and soft keratin as a protein complex. Basal layer. Styloid layer as a synthesis area for the sulfur-containing component of keratin. Transition zone (grainy and shiny layers). Cell changes in the process of keratinization. Stratum corneum. Cellular renewal of the epidermis and the idea of its columnar organization. Additional differentiations of the epidermis: macrophage and melanocytic. Melanosomes and skin pigmentation. Basal lamina, epidermal junction. Dermis. Papillary and reticular layers, their tissue composition. Skin glands. Sebaceous and sweat glands, their development, structure, histophysiology. Squamous skin appendages. Hard keratin cells and changes	All		
		2	0	4
		Online		
		2	0	4

	associated with their production. Hair. Hair development, structure, growth and change. Nails. The structure and growth of nails.			
14	**Male reproductive system** General morphological and functional characteristics. Sources and course of embryonic development. Primary gonocytes of initial localization, migration routes in the gonadal primordium. Histologically indifferent stage of gonadal development and histogenetic processes at this stage. Sexual differentiation factors. The tissue composition of the organs of the reproductive system. The male genital organ. Histogenetic processes in the embryonic gonad, leading to the development of the testicle. The origins and development of the seed tract in embryogenesis. Testicle. Its generative and endocrine functions. coiled seminiferous tubular wall. Spermatogenesis. The role of sustentocytes in spermatogenesis. Glandulocytes (interstitial glandulocytes), their participation in the regulation of spermatogenesis and the development of secondary sexual characteristics. Blood-brain barrier. Histophysiology of the rectal tubular network and testicular efferent tubules. Regulation of the generative and endocrine function of the testicles. Age-related changes in the testicles - structural features of the newborn before puberty, puberty and aging. Ejaculatory way. Appendage. The vas deferens. Seminal vesicle. Ejaculatory duct. Prostate. Penis.	All 2 Online 2	0 0	4 4
14	**Female reproductive system** Female genital organs. Histogenetic processes in the embryonic gonad, leading to the development of the ovary. Sources and development of the uterine oviduct. The ovary, its structure and functions - generative and endocrine. Oogenesis. Differences between spermatogenesis and oogenesis. Follicle structure and development. Ovulation. The concept of the ovarian cycle and its regulation. Development, structure and function of the corpus luteum during the cycle and during pregnancy. Follicular atresia. Atretic follicles, atretic body. Age-related changes in the ovary. Features of the ovaries of newborns, girls before puberty, puberty and aging. Vascularization and innervation of the uterus. Fallopian tubes. The structure and function of the fallopian tube. Uterus. The structure of the wall of the uterus in its various departments. The menstrual cycle and its phases. Features of the structure of the endometrium in different phases of the cycle. Relationship between the ovarian and menstrual cycles. Reorganization of the uterus during pregnancy and after childbirth. Vascularization and innervation of the uterus. Age-related changes. Features of the uterus of newborn girls before puberty, in adult women and with aging. Vagina. The structure of the walls in different phases of the menstrual cycle. Breast. Sources and course of development in embryogenesis. Postpartum changes. Functional morphology of	All 2 Online 2	0 0	4 4

	lactating and non-lactating mammary glands. Neuroendocrine regulation of mammary gland functions. Changes in the mammary gland during the sexual cycle and pregnancy. Vascularization and innervation. Regenerative abilities.			
15	**Early embryogenesis** The structure of the sex cells. Meiosis. Spermatogenesis and Ovogenesis. The main stages of fertilization. The sequence and significance of the acrosomal and cortical reactions. Zygote formation. Crushing stage. Morula. Blastula. Trophoblast (syncytiotrophoblast, cytotrophoblast). Internal cell mass (epiblast, hypoblast). Implantation. Gastrulation. Neurulation. Germ layers (ectoderm, endoderm, mesoderm) and their derivatives. Extraembryonic ectoderm, mesoderm, endoderm and their derivatives. Mesenchyme and its importance in the formation of various tissues. Stages of formation of the placenta, its structure and function, placental barrier.	All		
		2	0	4
		Online		
		2	0	4

Abbreviated names of online options:

Abbreviation	**Full name**
EC	E-course
FtM	Full-text material
FtL	Full-text lectures
VM	Video materials
AM	Audio materials
Prs	Presentations
T	Tests
ERM	E-reference materials
IS	Interactive site

LABORATORY (LAB) SESSIONS TOPICS

Weeks	**Topics / Content**
	1 Semester
1	**Cytology** The structure of the cell. Life cycle of a cell. Cell division, types of division, phases. Cell death. Apoptosis. Microscopy of histopreparations, familiarization with the morphological structures of tissues and organs. Schematic fixation of the tissue. Working with a digital atlas.
4	**Human embryology** Stages of embryonic development. Patterns of embryogenesis. Microscopy of specimens, familiarization with the morphological structures of tissues and organs. Working with a digital atlas.
6	**General Histology. Epithelial tissues** Classification of tissues. Epithelial tissues. Glands. Regeneration. Microscopy of specimens, familiarization with the morphological structures of tissues and organs. Schematic fixation of the fastening material. Working with a digital atlas.
8	**Internal fabrics. Blood and lymph.** Hematopoiesis. Features of embryonic and postnatal hematopoiesis. Microscopy of specimens, familiarization with the morphological structures of tissues and organs. Schematic fixation of the fastening material. Working with a digital atlas

9	**Connective tissue proper.** Microscopy of specimens, familiarization with the morphological structures of tissues and organs. Schematic fixation of the fastening material. Working with a digital atlas.
12	**Skeletal connective tissue.** Microscopy of specimens, familiarization with the morphological structures of tissues and organs. Schematic fixation of the fastening material. Working with a digital atlas.
14	**Muscle tissue** Microscopy of specimens, familiarization with the morphological structures of tissues and organs. Schematic fixation of the fastening material. Working with a digital atlas.
16	**Nervous tissue** Microscopy of specimens, familiarization with the morphological structures of tissues and organs. Schematic fixation of the fastening material. Working with a digital atlas.
	2 Semester
1	**Nervous system I** Microscopy, identification of morphological structures of tissue and organ. Filling in an album with the structures indicated.
2	**Nervous system II.** Microscopy, identification of morphological structures of tissue and organ. Filling in an album with the structures indicated.
3	**Sensory system.** Sensory organs. Microscopy, identification of morphological structures of tissue and organ. Filling in an album with the structures indicated.
4 - 5	**The cardiovascular system.** The structure of the Heart. Valve apparatus. Microscopy, identification of morphological structures of tissue and organ. Filling in an album with the structures indicated. Conductive system.
5 - 6	**The circulatory system** Vessels of the microcirculatory bed. Arteries, arterioles, veins, venules. Microscopy, identification of morphological structures of tissue and organ. Filling out an album with the designation of structures.
7	**Endocrine system** Hypothalamus, pituitary gland, and epiphysis. The thyroid gland. The adrenal gland. Microscopy, identification of morphological structures of tissue and organ. Filling in an album with the structures indicated.
8	**Organs of hematopoiesis and immune defense** Microscopy, identification of morphological structures of tissue and organ. Filling in an album with the structures indicated
9	**Digestive system I** Microscopy, identification of morphological structures of tissue and organ. Filling in an album with the structures indicated. Oral cavity (tongue, teeth), composition of saliva, pharynx, esophagus, stomach, composition of gastric juice, thin (duodenum, jejunum and iliac), composition of intestinal juice, and thick (blind, colon and rectum) intestine, microflora.
10	**Digestive system II** Microscopy, identification of morphological structures of tissue and organ. Filling in an album with the structures indicated. Liver, gallbladder, and pancreas.
11	**Respiratory system** Microscopy, identification of morphological structures of tissue and organ. Filling in an album with the structures indicated.
12	**Urinary system** Microscopy, identification of morphological structures of tissue and organ. Filling in an album with the structures indicated.

13	**Skin and its derivatives** Microscopy, identification of morphological structures of tissue and organ. Filling in an album with the structures indicated.
14	**Male reproductive system** Microscopy, identification of morphological structures of tissue and organ. Filling in an album with the structures indicated.
14	**Female reproductive system** Microscopy, identification of morphological structures of tissue and organ. Filling in an album with the structures indicated.
15	**Early embryogenesis** Stages of early embryogenesis. Microscopy, identification of morphological structures of tissue and organ. Filling in an album with the structures indicated.

6. EDUCATIONAL TECHNOLOGIES

The discipline is taught using the following educational technologies:

Forms of organization of the educational process:

1. Lecture

2. Laboratory classes, including:

- traditional classes on visual aids, electronic atlases;

- the study of micro-preparations in a light microscope and the fixation of the main histological elements in a notebook and album;

- solving situational tasks;

- execution of written works.

3. Independent student's work

The content of the discipline has both theoretical and practical orientation. Consequently, the teaching of this course is based on a close connection between the achievements of theory and practice and is accompanied by the acquisition of practical skills in histology.

In this regard, studying the course involves a combination of complementary forms of classes such as lectures, laboratory classes, independent work with scientific and educational sources.

7. ASSESSMENT TOOLKIT

The assessment toolkit ensures verification of the intended learning outcomes achievement (competency-based rubrics) using current, midterm and interim assessment of the course.

The link between developed competencies and their assessment is presented in the following table:

Competency	**Achievement rubrics**	**Assessment activity (Syl 1)**	**Assessment activity (Syl 2)**
ОПК-5	З-ОПК-5	PFE, T-8, T-14, T-8, T-14	Ex, T-8, T-15, T-8, T-15
	У-ОПК-5	PFE, T-8, T-14, T-8, T-14	Ex, T-8, T-15, T-8, T-15
	В-ОПК-5	PFE, T-8, T-14, T-8, T-14	Ex, T-8, T-15, T-8, T-15

Educational achievement rubrics scales

The scale of each assessment activity varies from 0 to the maximum established point, inclusive. The final assessment of the course is performed on a 100-point scale and represents the sum of the points earned by the student in the section assessments, framework of current and interim assessment.

Sections and interim assessments are considered passed when the student achieves a minimum score equal to 60% of the maximum. The final grade is assigned only upon passing all sections and the interim assessment.

The final grade is assigned in accordance with the following scale:

<table>
<tr><th>Total score</th><th>Rating on a 4-point scale</th><th>Pass/fail examination</th><th>ECTS assessment</th></tr>
<tr><td>90-100</td><td>5 – «excellent»</td><td rowspan="7">«pass»</td><td>A</td></tr>
<tr><td>85-89</td><td rowspan="3">4 – «good»</td><td>B</td></tr>
<tr><td>75-84</td><td>C</td></tr>
<tr><td>70-74</td><td rowspan="2">D</td></tr>
<tr><td>65-69</td><td rowspan="2">3 – «satisfactory»</td></tr>
<tr><td>60-64</td><td>E</td></tr>
<tr><td>below 60</td><td>2 – «fail»</td><td>«fail»</td><td>F</td></tr>
</table>

An “excellent” grade indicates a deep and solid mastery of the program material by a student who presents their answers consistently, clearly, and logically, is able to closely link theory with practice, and uses materials from monographic literature in their answers.

A “good” grade corresponds to a student’s solid knowledge of the material, who presents their answers competently and to the point, without any significant inaccuracies.

A “satisfactory” grade corresponds to the basic level of mastery of the material by the student, in which the main material has been mastered, but its details have not been assimilated, the answers contain inaccuracies, insufficiently correct wording and logical inconsistencies.

A grade “pass” corresponds to at least a basic level of mastery of the program material, in which the student possesses the necessary knowledge, skills, and abilities, and is able to apply theoretical principles to solve typical practical problems.

A grade “fail” is given to a student who lacks a significant understanding of the curriculum material, makes significant errors in their answers, or fails all required assignments. These students are generally unable to continue their studies without additional classes.

8. ACADEMIC COURSE EDUCATIONAL, METHODOLOGICAL AND INFORMATIONAL SUPPORT

CORE READING:

1. ЭИ А24 Histology, Embryology, Cytology : , Afanasyev Yu.I. , Yurina N.A. , Москва: ГЭОТАР-Медиа, 2022

2. ЭИ D18 Histology, Embryology, Cytology : Textbook : учебник, Borovaya T.G., Danilov R.K., Москва: ГЭОТАР-Медиа, 2022

3. ЭИ К 60 Terminologia Embryologica. Международные термины по эмбриологии человека с официальным списком русских эквивалентов : терминологический словарь, Ерофеева Л.М., Колесников Л.Л., Шевлюк Н.Н., Москва: ГЭОТАР-Медиа, 2014

FURTHER READING:

1. ЭИ Г33 Гистология и эмбриология органов полости рта и зубов : учебное пособие, Фалин Л.И., Лаврова Э.Н., Гемонов В.В., Москва: ГЭОТАР-Медиа, 2019

2. ЭИ С 13 Гистология органов пищеварительной системы : , Саврова О.Б., Ерёмина И.З., Moscow: ИздательствоРУДН, 2011

3. ЭИ Г51 Гистология, эмбриология, цитология : учебник, , Москва: ГЭОТАР-Медиа, 2019

4. ЭИ Д18 Гистология, эмбриология, цитология : учебник, Боровая Т.Г., Данилов Р.К., Москва: ГЭОТАР-Медиа, 2020

5. ЭИ Б 77 Гистология. Атлас для практических занятий : Гриф УМО по медицинскому и фармацевтическому образованию вузов России., Кузнецов С.Л. [и др.], Москва: ГЭОТАР-Медиа, 2014

6. ЭИ Б 23 Цитология и общая гистология: атлас : учебное наглядное пособие, Банин В.В., Яцковский А.Н., Павлов А.В., Москва: ГЭОТАР-Медиа, 2019

7. ЭИ Ц 74 Цитология. Функциональная ультраструктура клетки. Атлас : учебное наглядное пособие, , Москва: ГЭОТАР-Медиа, 2016

SOFTWARE:

1. Microsoft Office 2016+ ()

2. Microsoft Word (К64-303)

LMS AND ONLINE RESOURCES

1. Электронный гистологический атлас (https://histologyguide.com/)

2. Histology Guide - virtual microscopy laboratory (https://histologyguide.com/)

https://online.mephi.ru/

http://library.mephi.ru/

9. LOGISTICAL SUPPORT

1. «Интерактивный анатомический стол «Пирогов I» с программным обеспечением «3D атлас нормальной и топо (64-403)

2. Персональный компьютер: Моноблок Lenovo V540-24IWL All-In-One 23,8" i3-8145U 8Gb 256GB_SSD_M.2 Intel (64-303)

3. Мышь, клавиатура (64-303)

4. Интерактивная доска SMART SBM 685 (64-303)

5. Проектор SMART P109 (64-303)

6. Мебель лабораторная, стулья, шкафы для хранения (64-303)

7. Мойка лабораторная (64-303)

8. Бинокулярные микроскопы "Микромед 2" (64-303)

9. Тринокулярный микроскоп "Микромед-3" (64-303)

10. Видеоокуляр ToupCam 5,1 MP (64-303)

11. Персональный компьютер: Моноблок Lenovo V540-24IWL All-In-One 23,8" i3-8145U 8Gb 256GB_SSD_M.2 Intel (64-304)

12. Мышь, клавиатура (64-304)

13. Интерактивная доска SMART SBM 685 (64-304)

14. Проектор SMART P109 (64-304)

15. Мебель лабораторная, стулья, шкафы для хранения (64-304)

16. Мойка лабораторная (64-304)

17. Шкаф лабораторный вытяжной "Лабтех" ШВ202 (64-304)

18. Бинокулярные микроскопы "Микромед 2" (64-304)

19. Тринокулярный микроскоп "Микромед 1" (64-304)

20. Видеоокуляр ToupCam 10,0 MP (64-304)

21. Персональный компьютер: Моноблок Lenovo V540-24IWL All-In-One 23,8" i3-8145U 8Gb 256GB_SSD_M.2 Intel (64-305)

22. Мышь, клавиатура (64-305)

23. Видеокамера Microsoft LifeCam Cinema HD (64-305)

24. Интерактивная доска SMART SBM 685 (64-305)

25. Проектор SMART P109 (64-305)

26. Мебель лабораторная, стулья, шкафы для хранения (64-305)

27. Мойка лабораторная (64-305)

28. Шкаф лабораторный вытяжной "Лабтех" ШВ202 (64-305)

29. Бинокулярные микроскопы "Микромед 2" (64-305)

30. Тринокулярный микроскоп "Микромед 3" (64-305)

31. Видеоокуляр ToupCam 10,0 MP (64-305)

32. Набор микропрепаратов по гистологии (64-305)

33. Набор микропрепаратов по гистологии (64-303)

34. Набор микропрепаратов по гистологии (64-304)

35. Compact MRT 09500-99 с набором образцов (64-306)

36. Видеокамера Microsoft LifeCam Cinema HD (64-302)

10. EDUCATIONAL AND METHODOLOGICAL RECOMMENDATIONS FOR STUDENTS

There is a point-rating system for assessing students' knowledge. In total, the discipline (module) can receive a maximum of 100 points per semester, of which the current work is estimated at 50 points – 2 tests of 25 (min 15) points (or 5 tests of 10 points). The final form of control (final test, exam) is 50 (min 30) points.

11. EDUCATIONAL AND METHODOLOGICAL RECOMMENDATIONS FOR TEACHERS

"Unsatisfactory" – the student does not answer the theoretical questions of the ticket, does not have a medico-functional conceptual framework for the discipline. It does not answer questions on the basic concepts of Histology, Embryology and Cytology, and has gross theoretical errors in the formulation of definitions. The student does not know the name of histological preparations, does not give a histological description of visible morphological structures, or makes gross errors in the description of visible morphological structures, which significantly complicates the identification of micro-preparations.

"Satisfactory" - the student, answering theoretical questions, is poorly versed in the required literature, makes gross mistakes in covering fundamental, key issues. It is guided by basic terms and concepts. The answers to the problem are not fully formulated or do not contain all the necessary initial data, which makes it difficult to present the answers to the questions correctly. The student has microscopy skills and partially identifies histological micro-preparations, and has difficulty describing visible morphological structures. The student determines the electronogram, but has difficulty describing the visible structures.

"Good" - the student competently answers theoretical questions within the framework of the required literature, there may be isolated inaccuracies. Actively uses special terminology in answering questions. When answering, mistakes may be made in the interpretation of individual, non-key questions. The questions of the task are answered clearly, but the answer is not always theoretically justified. The student has full microscopy skills, determines histological preparations, but has minor difficulties (inaccuracies) in describing visible morphological structures.

"Excellent" - the student answers the theoretical questions of the ticket competently, as fully as possible, uses the literature data, complements the answer with clinical examples. The answer to the situational problem is theoretically justified, and additional information is provided that may be required to confirm the solution of the problem. The student has microscopy skills, names micro-preparations and fully describes morphological structures, has skills in analyzing and comparing histological preparations, connects practical information obtained during the study of histological preparations with theoretical data. The student determines the specimens, accurately and competently describes the visible structures.

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