Federal State Autonomous Educational Institution of Higher Education
PEOPLES' FRIENDSHIP UNIVERSITY OF RUSSIA
NAMED AFTER PATRICE LUMUMBA
RUDN University
Institute of Medicine

educational division (faculty/institute/academy) as higher education programme developer

COURSE SYLLABUS

HISTOLOGY, EMBRRYOLOGY, CYTOLOGY

course title

Recommended by the Didactic Council for the Education Field of:

31.05.01 GENERAL MEDICINE

field of studies / speciality code and title

The course instruction is implemented within the professional education programme of higher education:

GENERAL MEDICINE

higher education programme profile/specialisation title

2026

1. COURSE GOAL(s)

The discipline «Histology, Embryology, Cytology» is part of the Specialist Degree Programme «General Medicine» (Field of Study 31.05.01 «General Medicine») and is studied in Semesters 2 and 3 of Years 1 and 2. The discipline is delivered by the Department of Histology, Cytology and Embryology. It consists of 5 sections and 22 topics and is aimed at studying the patterns of structure and development of tissues, organs and the organism as a whole, based on the latest advances in histology and embryology.

The goal of the course "**Histology, embryology, cytology**" is to equip students with knowledge of human body systems and to introduce students to key concepts of tissue and organs development. Students learn to understand structure-function relationship at the cellular, tissue, organ and organ system levels in the norm, and to analyze changes in the normal structure with clinical aspects.

2. REQUIREMENTS FOR LEARNING OUTCOMES

The mastering of the course "**Histology, embryology, cytology"** is aimed at the formation of the following competencies of students:

Table 2.1. List of competences that students acquire through the course study

Competence code	**Competence descriptor**	**Competence formation indicators** (within this course)
GPC-5	Able to assess morpho-functional, physiological states and pathological processes in the human body to solve professional problems	GPC-5.3. A student should able to determine morpho-functional, physiological states and pathological processes of the human body
GPC-7	Able to prescribe medical treatment and monitor its efficacy and safety.	GPC-7.1. Possesses knowledge of general clinical examination methods and the interpretation of laboratory and instrumental diagnostic results.

3. COURSE IN HIGHER EDUCATION PROGRAMME STRUCTURE

The course refers to the core/variable/elective* component of (B1) block of the higher educational programme curriculum.

* - Underline whatever applicable.

Within the higher education programme students also master other (modules) and / or internships that contribute to the achievement of the expected learning outcomes as results of the course study.

Table 3.1. The list of the higher education programme components/disciplines that contribute to the achievement of the expected learning outcomes as the course study results

Competence Code	**The competence**	**Previous Disciplines**	**Subsequent disciplines**

GPC-5	Able to assess morphofunctional, physiological states and pathological processes in the human body to solve professional problems	Chemistry	Biochemistry; Normal Physiology; General Surgery; Obstetrics and Gynecology (Obstetrics and Gynaecology); Microbiology, Virology; Oncology, Radiation Therapy; Pathophysiology, Clinical Pathophysiology; Molecular Genetic Methods; Methods of Microbiological Diagnostics; Propedeutics of Internal Diseases; Immunology; Pathological Anatomy, Clinical Pathological Anatomy; Radiological Diagnostics; Medical Elementology; Phthisiology; Anesthesiology, Resuscitation, Intensive Care; Ophthalmology; Methods of Cell Biology and Histology; Pharmacology; Anatomy; Topographic Anatomy and Operative Surgery; Forensic Medicine; Maxillofacial Surgery; Medical Criminalistics; Otorhinolaryngology; Pediatrics; Sectional Course.
GPC-7	Able to prescribe treatment and monitor its efficacy and safety.		General Surgery; Otorhinolaryngology; Outpatient Therapy; Ophthalmology; Clinical Pharmacology; Cardiology in Quizzes; Normal Physiology; Propedeutics of Internal Diseases; Pediatrics; Maxillofacial Surgery; Pharmacology; General Medical Practice: Assistant to a Physician in an Outpatient and Polyclinic Facility.

4. COURSE WORKLOAD AND ACADEMIC ACTIVITIES

The total workload of the course "**Histology, embryology, cytology”** is 7 credits (252 academic hours)

*Table 4.1. Types of academic activities during the periods of higher education programme mastering (**full-time training**)**

Type of academic activities		Total academic hours	Semesters/training modules			
			2	3		
Contact academic hours		**170**	**85**	**85**		
including:						
Lectures (LC)		**34**	**17**	**17**		
Lab work (LW)		**136**	**68**	**68**		
Seminars (workshops/tutorials) (S)						
Self-studies		*46*	*14*	*32*		
Evaluation and assessment (exam/passing/failing grade)		*36*	*9*	*27*		
Course workload	academic hours	**252**	**108**	**144**		
	credits	**7**	**3**	**4**		

* To be filled in regarding the higher education programme correspondence training mode.

5. COURSE CONTENTS

Table 5.1. Course contents and academic activities types

Course module title	Course module contents (topics)	Academic activities types
Module 1 Introduction to the discipline. Research methods	**1.1.** Methods of histological, cytological and embryological studies Stages of histological specimen preparation. Types of histological specimens and histological stains. Light and electron microscopy.	**LC, LW**
Module 2 Cytology.	**2.1.** Cell structure General structure of the eukaryotic cell. Cell structure at the microscopic and ultramicroscopic levels. Structure of the plasma membrane. Functions of the plasma membrane. Mechanisms of substance transport across the plasmalemma: passive transport, facilitated diffusion, active transport, vesicular transport. Endocytosis and exocytosis processes, pinocytosis and phagocytosis. Receptor function of the plasmalemma. Cell-cell junctions. Morphological features and functions of cytoplasmic structural components: hyaloplasm, elementary membrane, Golgi apparatus, endoplasmic reticulum (ER), mitochondria, lysosomes, ribosomes, centrioles, inclusions, and specialized organelles. Types of intracellular inclusions. Structure of cell-cell junctions.	**LC, LW**
	2.2. The nucleus: structure and functions. The cell cycle. Structure and functions of the nucleus. Nuclear components: karyolemma, chromatin, nucleolus, and nuclear matrix. The cell cycle.	**LC, LW**

Course module title	Course module contents (topics)	Academic activities types
	Phases of the cell cycle. Mitosis — the main type of cell division in eukaryotes. Characteristics of mitosis and its variants: amitosis, endomitosis. Phases of mitosis.	
Module 3 Basic Histology.	**3.1.** The concept of tissues. Epithelia. Glands. Definition of the term "tissue". Brief information on tissue histogenesis. Tissue classification. Interrelationships between tissues. Tissue regeneration. General characteristics of epithelial tissues and their functions. Classification of epithelial tissues. Microscopic structure and physiological features of various types of covering epithelium: simple (single-layer) and stratified (multi-layer). Structure and functions of glandular epithelium, types of secretion (apocrine, merocrine, holocrine). General characteristics of exocrine glands: structure and classification	**LC, LW**
	3.2. The system of the internal environment tissues. Blood and lymph. Hematopoiesis. General characteristics of blood structure and functions. Blood plasma: composition and properties. Blood cells (formed elements): erythrocytes, leukocytes (granular and non-granular — neutrophils, eosinophils, basophils, lymphocytes, monocytes), their structure at the microscopic and ultramicroscopic levels	**LC, LW**
	3.3. Haemopoiesis. Hemocytopoiesis and immunocytopoiesis. Blood development as a tissue (embryonic hematopoiesis). Post-embryonic hematopoiesis and immunopoiesis — physiological blood regeneration. Unitary theory of hematopoiesis. Classes of hematopoietic elements. Stem and progenitor cells: properties and roles. Concept of colony-forming units (CFU) of blood cells. Blast, differentiating, and mature cells. Characteristics of myeloid and lymphoid tissues and the role of microenvironment in hematopoietic cell development. Regulation of hematopoiesis and immunopoiesis	**LC, LW**
	3.4. Connective tissues. Connective tissue proper. Connective tissues with special properties. Loose connective tissue. Morphology and functions of cellular forms of loose connective tissue. Extracellular matrix. Reticular, elastic, and collagen fibers: their microscopic and electron-microscopic structure, physical properties, and chemical composition. Chemical composition and functions	**LC, LW**

Course module title	Course module contents (topics)	Academic activities types
	of the amorphous substance. Formation of the extracellular matrix and the role of cells in this process. Cell renewal in loose connective tissue (LCT) and the problem of their origin in postnatal ontogenesis. Interactions between blood cells and connective tissue cells. Inflammatory response: the role of blood and connective tissue cells at different stages of inflammation. Dense connective tissue: dermis, fasciae, tendons, ligaments — their structure and functions. Connective tissues with special functions: adipose, mucoid, reticular, and pigmentary tissues — structure and functions performed.	
	3.5. Muscle tissues General morphofunctional characteristics and classification of muscle tissue. Smooth muscle tissue. Microscopic and electron-microscopic structure of smooth muscle tissue in mammals. Origin and histogenesis of smooth muscle tissue. Striated muscle tissue. Cardiac muscle tissue. Histogenesis of cardiac muscle tissue. Microscopic and electron-microscopic structure of cardiac muscle. Regeneration of cardiac muscle tissue. Skeletal muscle tissue. Histogenesis of skeletal muscle tissue. Functional morphology of skeletal muscle tissue. Regeneration of skeletal muscle tissue. Skeletal muscle as an organ.	**LC, LW**
	3.6. Nerve tissue General morphofunctional characteristics. Types of neurons and their structure. Concept of the reflex arc. Microscopic and electron-microscopic structure of nerve cells in relation to their function. Nissl substance. Cytochemical characteristics of neurons. Neurosecretory cells. Structure of myelinated and unmyelinated nerve fibers. Synapses and their electron-microscopic structure. Mechanism of synaptic transmission. Effector and receptor nerve endings: their microscopic structure. Free and encapsulated sensory nerve endings. Structure and functions of neuroglia. Ependyma. Astroglia. Oligodendroglia. Microglia. Relationships between neurons and neuroglia. Histogenesis of nervous tissue. Regeneration and degeneration of neuronal processes.	**LC, LW**
Module 4 Histology of organs and organ systems	**4.1.** Nerve System Nervous system: general morphofunctional characteristics, stages of evolution, sources and course of embryonic development. Mechanisms of	**LC, LW**

Course module title	Course module contents (topics)	Academic activities types
	neuronal integration: convergence and divergence. Concept of nerve centers, their classification and principles of structural organization. Peripheral nervous system. Nerve: structure and histofunctional features, response to injury and regeneration. Sensory ganglia (spinal and cranial): development, structure, tissue composition. Characteristics of neurons and neuroglia. Central nervous system. Structural features of gray and white matter. Structure of brain meninges. Spinal cord: general morphofunctional characteristics. Development. Structure of gray matter. Types of neurons and their role in reflex arc formation; gliocytes. Simple and complex reflex arcs. Spinal cord nuclei. Structure of white matter. Central spinal canal. Principles of organization of ascending and descending spinal tracts. Regeneration. Brain: general morphofunctional characteristics. Process of cephalization and its conditions. Embryogenesis. Gray and white matter. Features of histogenetic processes in brain development. Structure of dura mater, arachnoid mater, and pia mater. Subdural and subarachnoid spaces, vascular plexuses. Cerebellum: structure and functional significance. Layers and neuronal composition of cerebellar cortex. Afferent and efferent nerve fibers. Cerebellar glomerulus. Cerebellar gliocytes. Interneuronal connections (modules) in cerebellum. Cerebral cortex: general morphofunctional characteristics and neuronal composition. Cortical layers. Cytoarchitectonics. Concept of columns and modules. Myelarchitectonics: nerve fibers (association, projection, commissural) and nerve plexuses. Functional localization in cerebral cortex, brain asymmetry. Limbic system and emotions. Brain structures and memory. Structure and significance of the blood-brain barrier.	
	4.2. Sensory organs: primary-sensing and secondary-sensing types. General characteristics of sensory organs in the	**LC, LW**

Course module title	Course module contents (topics)	Academic activities types
	context of the analyzer (sensory system) theory. Peripheral, intermediate, and central parts of the analyzer. Classification of sensory organs by genesis and structure of receptor cells. Cytophysiology of neurosensory and sensory-epithelial cells. Structural and biochemical bases of the reception mechanism. Visual organ: general morphofunctional characteristics, sources and course of embryonic development. General structure of the eyeball. Tunics, their divisions and derivatives, tissue composition. Main functional apparatuses. Dioptric (light-refracting) apparatus (cornea, eye chambers lens, vitreous body): structure, functions, nutrition. Accomodation apparatus (iris, ciliary body, choroid): morphofunctional features. Receptor apparatus. Retina as a screen-type neural center. Neuronal composition and gliocytes of the retina. Layers of the retina. Photoreceptor cells. Organ of hearing and balance: general morphofunctional characteristics, sources and course of embryonic development. External and middle ear: structural features and functional significance. Inner ear. Bony and membranous labyrinths. Cochlear part of the membranous labyrinth. Structure and functional significance of the cochlear duct. Structure of the spiral (organ of Corti): hair (sensory-epithelial) and supporting cells. Histophysiology of sound perception. Vestibular part of the membranous labyrinth: elliptical and spherical sacs, semicircular canals. Receptor regions: maculae and ampullary crests, their structure. Structural features of vestibular hair cells	
	4.3. Circulatory system General morphofunctional characteristics of the cardiovascular system. Sources and course of embryonic development of vascular organs. Classification of blood vessels, general structural principles. Relationship between hemodynamic conditions and vessel structure. Arteries: morphofunctional characteristics and classification. Relationship between arterial structure and hemodynamic conditions. Structural features and	**LC, LW**

Course module title	Course module contents (topics)	Academic activities types
	functions of different artery types: muscular, muscular-elastic, and elastic. Organ-specific features of arteries. Age-related changes in arteries. Microcirculatory vessels: structure, functions, and role in metabolism. Arterioles: structure and role in blood circulation. Significance of endotheliomyocyte contacts in arteriole histophysiology. Structure and functional significance of blood capillaries, their classification and organ-specific features. Morphological bases of capillary permeability and regulation of their functions. Regeneration and age-related changes in microcirculatory vessels. Venules. Arteriolar-venular anastomoses (shunts, half-shunts): role in blood circulation, classification, structure, and functional differences. Veins: morphofunctional characteristics and classification. Wall structure of veins in relation to hemodynamic conditions. Structural features of different vein types (muscular and non-muscular). Heart: general morphofunctional characteristics, sources and course of embryonic development. Structure of the heart wall and its layers. Endocardium and its derivatives — heart valves. Myocardium: working, conducting, and secretory cardiomyocytes. Functions and structural features of different cardiomyocyte types. Conducting system of the heart: morphofunctional characteristics Cardiomyocytes of the conducting system. Epicardium and pericardium	
	4.4. System of organs of hematopoiesis and immune defense General characteristics of the hematopoietic and immune defense system, principles of structural organization. Central organs of hematopoiesis and immunogenesis. Bone marrow: structure and functions, tissue composition of red bone marrow. Reticular and myeloid tissues. Cellular differentials (islands) of red bone marrow, their structural features. Thymus: embryonic development, role in lymphocytopoiesis. Structure and tissue composition of cortex and medulla. Lymphoid tissue. Interaction of epithelial, stromal, and hematopoietic elements. Vascularization and innervation. Structure and significance of the blood-thymic barrier Lymphocyte selection in the thymus. Endocrine function of the thymus. Peripheral organs of hematopoiesis and immunogenesis. Spleen: embryonic development,	**LC, LW**

Course module title	Course module contents (topics)	Academic activities types
	functions, structure. White pulp — structure and tissue composition. T- and B-dependent zones. Role of the spleen in immunological defense. Red pulp. Spleen blood supply (open and closed circulation). Lymph nodes: development, structure, tissue composition, functions, participation in lymphocytopoiesis. Cortex, medulla, paracortical zone — morphofunctional characteristics. T- and B-dependent zones. Lymphoid system of mucous membranes. Structure and localization of lymphoid follicles. Lymphoid follicles in the walls of airways and digestive tract	
	4.5. Endocrine system General morphofunctional characteristics and main structural components of the endocrine system. Autocrine, paracrine, and endocrine signaling. Concept of hormones: classification and significance in the human body. Mechanism of hormone action: target cells and their receptors. Classification of endocrine glands by hierarchical principle — central and peripheral (adenohypophysis-independent and adenohypophysis-dependent) components of the integrated endocrine system. Central endocrine glands. Hypothalamus: developmental sources. Structural organization of anterior, middle, and posterior hypothalamic regions. Neurohemal areas, axovasal synapses. Structural features and functions of neurosecretory cells in major nuclear groups. Hypothalamo-adenohypophysial and hypothalamo-neurohypophysial systems. Oxytocin and vasopressin: significance. Liberins and statins: roles. Pituitary gland: developmental sources, functions. Structure, tissue and cellular composition of adenohypophysis. Anterior, intermediate, and tuberal parts. Ultrastructure of adenocytes. Hormones secreted by adenocytes, their target organs and effects. Adenocyte changes in hormonal imbalance. Hypothalamic-pituitary blood supply. Structure and function of neurohypophysis. Connection of pituitary with other endocrine glands. Peripheral endocrine glands. Thyroid gland: developmental sources and main stages of embryonic development, structure, tissue and cellular composition. Follicles as morphofunctional units: wall structure and colloid composition. Ultrastructure of thyrocytes. Thyroid hormones and their effects. Phases of secretory cycle. Interfollicular islets. Parafollicular © cells: origin,	**LC, LW**

Course module title	Course module contents (topics)	Academic activities types
	structure, localization, and functional significance. Regulation of thyroid cell activity. Parathyroid glands: developmental sources, functions, structure, and cellular composition. Cytological characteristics of parathyroid cell types. Role of parathyroid gland in mineral metabolism regulation. Adrenal glands: developmental sources of cortex and medulla, structure. Zones of adrenal cortex and their cellular composition. Relationship between adrenocorticocyte structure and corticosteroid synthesis/secretion. Role of adrenal cortical hormones in regulatory processes. Adrenal medulla: structure, cellular composition, hormones. Connection of adrenals with pituitary and central nervous system. Role of pituitary in stress defense responses. Diffuse endocrine system (solitary hormone-producing cells): localization, developmental sources, cell types, and morphofunctional characteristics	
	4.6. Digestive system Structure of the oral mucosa in relation to its function and environmental conditions in the oral cavity. Lips, cheeks, hard and soft palate, uvula, gums: structure, blood supply, innervation. Pirogov's lymphoepithelial pharyngeal ring. Tonsils. Tongue: functions, structure, tissue composition, differences in the structure of the dorsal and ventral surfaces. Lingual papillae — types, structure, functions. Structure and tissue composition of the pharyngeal and esophageal wall in different sections. Esophageal glands. Middle and posterior parts of the digestive system: structural features of different sections, development. Stomach: morphofunctional characteristics. Developmental sources of tissues forming the stomach layers. Stomach topography and relief. Structural features of the esophagogastric junction. Distinctive structural features of the mucosa in different stomach regions. Cytophysiological characteristics of the surface epithelium of the stomach, mucus production. Role of the mucus-bicarbonate barrier. Localization, structure, and cellular composition of proper, pyloric, and cardiac glands. Histophysiology of exocrine and endocrine cells. Small intestine: functions, structural components of the wall (layers, coats, and their tissue composition). Developmental sources of tissues forming the intestinal layers. Intestinal relief: circular folds, villi, crypts. Region	**LC, LW**

Course module title	Course module contents (topics)	Academic activities types
	of the gastroduodenal junction. Structural features of the mucosa in different intestinal sections. Duodenal glands — structure and functions. The "crypt-villus" system as a structural and functional unit. Types of epithelial cells in villi and crypts, their structure and cytophysiology. Histophysiology of digestion (cavital, parietal, membranous, intracellular). Role of microvilli of enterocytes in parietal digestion. Large intestine: developmental sources. Morphofunctional characteristics, structure of the colonic and rectal wall. Role of the mucosa in relation to its functions. Liver: developmental sources, morphofunctional characteristics. Specific features of liver blood supply. Structure of the classical liver lobule as a structural and functional unit. Concepts of "portal lobule" and "acinus". Hepatocytes as the main cellular element of the liver: structure, cytochemical features, and functions. Regional features of hepatocytes. Cytophysiology and roles of endothelial cells, macrophages, lipocytes, and pit cells of the liver. Pancreas (parenchymatous lobular organ): morphofunctional characteristics, developmental sources. Structure of the exocrine portion: pancreatic acinus and excretory ducts. Cytophysiological characteristics of acinar cells. Secretory cycle. Regulation of acinar cell function. Endocrine portion. Insulocytes of the islets of Langerhans: morphofunctional characteristics. Acino-islet cells.	
	4.7. Respiratory system Respiratory system: general characteristics, respiratory and non-respiratory functions, sources and course of embryonic development, stages of postnatal development. Extrapulmonary airways. Structural components of the wall (coats, layers, and their tissue composition) in the nasal cavity, larynx, trachea, and main bronchi. Histofunctional features of the mucosa. Cellular composition of tracheobronchial epithelium — ultrastructure and functions. Intrapulmonary airways. Classification of intrapulmonary bronchi, their structure depending on diameter. Terminal bronchioles. General patterns of changes in bronchial wall structure as they branch. Cellular composition of bronchopulmonary epithelium. Structural bases of mucociliary transport. Respiratory sections. Acinus as a morphofunctional unit of the lung. Structural components of the acinus: respiratory bronchioles,	**LC, LW**

Course module title	Course module contents (topics)	Academic activities types
	alveolar ducts, and alveolar sacs. Alveolus (structural and functional unit of the acinus): structure and functions. Types of alveolocytes, their cytofunctional characteristics. Pulmonary surfactant system: structural and chemical organization, functions. Structure of interalveolar septa. Composition and significance of the air-blood barrier	
	4.8. Skin and its derivatives Skin as an organ: functions, structural components, developmental sources. Epidermis and its layers. Regional features of the skin. Concepts of "thin" and "thick" skin. Cellular composition of the epidermis: ultrastructure, origin, and functional significance of cells. Keratinocytes as the main cell type. Keratinization process and its significance. Epidermal cell renewal: concept of proliferative units and columnar organization. Dermis: papillary and reticular layers. Tissue composition and functions of the dermis. Types of the reticular layer depending on the architectonics of collagen fibers. Histofunctional characteristics of the immune system in the dermis. Hypodermis. Skin appendages. Glands (mammary, sweat, and sebaceous): location, structure, and functions. Sweat glands: merocrine and apocrine types. Sebaceous glands. Histophysiology of terminal portions and excretory ducts. Mechanisms of secretion regulation. Hair: development, structure, growth, and replacement. Nails: development, structure, and growth	**LC, LW**
	4.9. Urinary system General characteristics and functions of the urinary system, sources and main stages of embryonic development: pronephros, mesonephros, metanephros. Kidneys: structure and functions, cortex and medulla. Nephron as a structural and functional unit of the kidney. Types of nephrons, topography in the cortical and medullary substance. Histophysiology. Structural and functional parts of the nephron. Renal corpuscle. Capillaries of the glomerulus. Mesangium: cells and functions. Epithelial lining of the capsule. Role of podocytes in the formation of the glomerular basement membrane. Organization of the three-layered basement membrane: structure, chemical composition, significance. Main components of the blood-renal barrier, its role in urine filtration. First phase of urine formation. Tubules of nephrons and	**LC, LW**

Course module title	Course module contents (topics)	Academic activities types
	collecting ducts: their significance. Epithelial lining. Ultrastructural organization of epithelial cells in relation to their function. Second phase of urine formation (reabsorption). Mechanisms of reabsorption regulation. Renal stroma: histofunctional characteristics. Concept of the countercurrent multiplier system of the kidneys. Third phase of urine formation — secretion. Endocrine system of the kidneys (renin-angiotensin apparatus, prostaglandin apparatus, kallikrein-kinin apparatus, renal steroid hormone): localization, structure, and functions. Urinary tracts: morphofunctional characteristics. Structure of renal calyces and pelvis. Ureters, urinary bladder: coats, layers, and their tissue composition. Structural features of male and female urethra	
	4.10. Reproductive system General morphofunctional characteristics of the reproductive system, sources and course of embryonic development. Primordial germ cells (gonocytes): initial localization, migration pathways to the gonadal rudiment. Indifferent stage. Formation of genital ridges and cords — the primordium of gonads from the primary kidney. Development of mesonephric and paramesonephric ducts. Differentiation of the gonad by sex. Male reproductive organs. Testis: structure and functions. Convoluted seminiferous tubule, wall structure. Role of myoid cells. Epitheliospermatogenic layer (spermatogenic cells and sustentocytes): ultrastructure and functions. Generative function of the testis. Spermatogenesis: cytological characteristics of its main phases. Sertoli cells: morphofunctional characteristics. Composition and role of the blood-testicular barrier. Influence of exogenous and endogenous factors on male reproductive function. Glandulocytes (interstitial Leydig cells): structure, involvement in regulation of spermatogenesis and development of secondary sexual characteristics. Endocrine functions of the testis. Regulation of spermatogenesis and endocrine functions of the testis. Postembryonic histogenesis. Regeneration, age-related involution of the testis.	**LC, LW**

Course module title	Course module contents (topics)	Academic activities types
	Ducts of the male reproductive system. Histophysiology of straight tubules, rete testis, and efferent ductules. Duct of the epididymis. Vas deferens and ejaculatory duct: structure and functions of the excretory pathways. Accessory glands of the male reproductive system (seminal vesicles, prostate gland, bulbourethral glands): structure, functions, vascularization, age-related changes. Seminal fluid: composition Female reproductive organs. Ovary: clinical aspects of embryogenesis of female gonads. Structure and functions of the ovary, components of the cortex and medulla. Follicles: types, structure, and functions. Composition of the blood-ovarian barrier. Ovulation and its mechanisms. Stages of corpus luteum development. Structure and functions of the corpus luteum. Follicular atresia. Structure and functions of atretic bodies. Generative function of the ovaries. Oogenesis: stages. Endocrine functions of the ovaries. Uterine tubes (oviducts): structure and functions. Clinical aspects of histophysiology of the uterine tubes. Uterus: developmental anomalies. Structure of the uterine wall in different regions. Cervix uteri. Remodeling of the uterus during pregnancy and after childbirth. Vascularization, innervation, and regeneration of the uterus. Vagina: structure of the walls. External genitalia. Ovarian-menstrual cycle: phases and duration. Features of endometrial structure in different phases of the cycle. Influence of cyclic changes on the ovaries. Changes in the vagina related to the menstrual cycle. Scheme of neurohumoral regulation of the ovarian-menstrual cycle. Mammary glands: origin, development, postnatal changes, structure and cellular composition of secretory lobules and excretory ducts. Ultrastructure of lactocytes. Remodeling of mammary glands during the ovarian-menstrual cycle and pregnancy. Functional morphology of lactating and non-lactating mammary gland	
Module 5 Embryology	**5.1**. Male and female germ cells, progenesis. Fertilization. Cleavage Concept of biological processes underlying embryonic development (components of development): induction, adhesion, determination,	**LC, LW**

Course module title	Course module contents (topics)	Academic activities types
	proliferation, cell migration, growth, differentiation, specialization, cell interactions, physiological cell death. Progenesis. Morphofunctional characteristics of germ cells. Role of the nucleus and cytoplasm in hereditary information transfer. Spermatogenesis. Oogenesis: comparative characteristics. Embryogenesis. Fertilization and its biological significance. Role of spermatozoon and ovum in fertilization. Phases of fertilization. Distant interaction (chemotaxis, rheotaxis, capacitation). Contact interaction (acrosomal reaction, cortical reaction, mechanisms of polyspermy block). Syngamy. Synkaryon. Zygote: structure, optical differentiation, and blastomere determination. Artificial insemination, in vitro fertilization. Cleavage: type and mechanisms of human embryonic cleavage. Process chronology. Significance of the fertilization membrane. Blastomeres: characteristics and interactions. Morula. Blastocyst: embryoblast and trophoblast. Free blastocyst stage	
	5.1. Stages of human embryogenesis: implantation, gastrulation. Histogenesis and organogenesis Features of implantation in humans: adhesion, invasion. Differentiation of the trophoblast (cytotrophoblast, syncytiotrophoblast). Formation of primary and secondary villi. Shift in nutrition types (histiotrophic, hematotrophic). Changes in the uterine mucosa during implantation. Gastrulation: characteristics, significance, and mechanisms in the human embryo. First phase of gastrulation — delamination (formation of epiblast and hypoblast). Development of extraembryonic mesoderm, chorion, amniotic stalk, amnion, and yolk sac. Second phase of gastrulation — migration. Formation of the primitive streak and primitive node. Presumptive zone map. Migration mechanisms. Development of embryonic endoderm, ectoderm, mesoderm, and notochord. Histotypic differentiation. Differentiation of germ layers, formation of the axial complex of rudiments (notogenesis).	**LC, LW**

Course module title	Course module contents (topics)	Academic activities types
	Differentiation of germ layers: Ectoderm: neurulation (formation of ganglionic plates, placodes, and neural tube), cutaneous ectoderm, prechordal plate, extraembryonic ectoderm. Endoderm: formation of the body fold, development of embryonic intestinal endoderm and extraembryonic endoderm of the allantois and yolk sac. Mesoderm: somites, nephrogo-notome, parietal and visceral layers of the splanchnopleure, extraembryonic mesoderm. Mesenchyme. Histogenesis and organogenesis: emergence of tissues and organs based on differentiation of embryonic rudiment cells. Relationship between histogenesis and organogenesis, concept of morphogenesis. Provisional (extraembryonic) organs: chorion, amnion, yolk sac, allantois, umbilical cord, placenta — formation, structure, and functional significance. Chorion development periods. Maternal and fetal parts of the placenta. Cotyledons. Fibrinoid. Hemato-placental barrier. Changes in the endometrium during pregnancy, fetal membranes. Concept of the functional system “mother–fetus”. Critical periods of development and their causal basis (determination of new developmental stages, shift in trophic types, change in regulatory mechanisms, slowing of growth processes).	

* - to be filled in only for **full** -time training: *LC - lectures; LW - lab work; S - seminars.*

6. CLASSROOM EQUIPMENT AND TECHNOLOGY SUPPORT REQUIREMENT

Table 6.1. Classroom equipment and technology support requirements

Type of academic activities	Classroom equipment	Specialised educational / laboratory equipment, software, and materials for course study (if necessary)
Lecture	Lecture room equipped with a set of specialized furniture, a board (screen), and technical equipment for multimedia presentations.	Projector, Laptop

Type of academic activities	Classroom equipment	Specialised educational / laboratory equipment, software, and materials for course study (if necessary)
Seminar	Seminar room designed for seminar-type sessions, group and individual consultations, ongoing assessment, equipped with a set of specialized furniture and multimedia presentation equipment.	projector; laptop; magnetic whiteboard.
Self-studies	A study room for independent work of students (can also be used for seminars and consultations), equipped with a set of specialized furniture and computers with access to the electronic information and educational environment (EIEE).	

7. RESOURSES RECOMMENDED FOR COURSE STUDY

Main readings:

Savrova O.B., Eremina I.Z., Botchey V.M. Cytology, Embryology and General Histology. Lecture Notes. Moscow: RUDN University, 2021. 126 p.

Histology, Embryology, Cytology: Textbook / Yu.I. Afanasiev, B.V. Aleshin, N.P. Barsukov, N.A. Yurina; Afanasiev Yu.I., Aleshin B.V., Barsukov N.P., Yurina N.A. Moscow: GEOTAR-Media, 2023. 832 p.

Additional readings:

Botchey V.M., Savrova O.B., Eremina I.Z. Introduction to Embryology. Short Course. Moscow: RUDN Publishing House, 2023. 131 p.

Resources of the information and telecommunications network "Internet":

Internet (based) sources

- 1. Electronic libraries with access for RUDN students:
  -Electronic library network of RUDN – ELN RUDN http://lib.rudn.ru/MegaPro/Web
  - ELN «University Library online» http://www.biblioclub.ru
  - ELN Urait http://www.biblio-online.ru
  - ELN «Student Advisor» www.studentlibrary.ru
  - ELN «Lan» http://e.lanbook.com/

- 2. Databases and search engines:

- Sage https://journals.sagepub.com/
- Springer Nature Link https://link.springer.com/
- Wiley Journal Database https://onlinelibrary.wiley.com/
- Lens.org https://www.lens.org

Learning toolkits for self-studies during the development of the discipline

1. Lectures Synopsis on the discipline "Histology, embryology, cytology".

* - All teaching materials for self-studing of students are placed in accordance with the current procedure on the discipline page in the RUDN LMS TUIS.

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