

PRIVATE HIGHER EDUCATIONAL ESTABLISHMENT  
«INTERNATIONAL ACADEMY OF ECOLOGY AND MEDICINE»

Department of fundamental disciplines with a course of pharmacology

SYLLABUS OF THE EDUCATIONAL  
DISCIPLINE

**" Histology, cytology and embryology "**


LEVEL OF HIGHER EDUCATION The second (master's) level

DEGREE OF HIGHER EDUCATION Master

AREA OF KNOWLEDGE 22 "Health care"

SPECIALTY 221 "Dentistry"

Reviewed and approved  
at the meeting of the Department of fundamental  
disciplines with a course of pharmacology

Protocol № 1 of « 01 » 09 2020  
Head of the department Doctor of Biological  
Sciences, associate professor  
 M.R. Vergolyas

Kiev 2020

<b>1. General information</b>	
<b>Subject</b>	<b>Histology, cytology and embryology</b>
<b>Lector</b>	<i>Vergolyas M.R.</i>
<b>Teacher's contact phone number</b>	
<b>Teacher's e-mail</b>	<i>vergolyas@gmail.com</i>
<b>Discipline format</b>	Normative discipline.
<b>The volume of the discipline</b>	210 hours
<b>Link to the distance learning site</b>	maem.kiev.ua
<b>Consultations</b>	
<b>2. Annotation to the course</b>	
The subject of study of the discipline is the microscopic and ultramicroscopic structure of cells, tissues and organs of the human body, their development and changes in various conditions of life.	Interdisciplinary links: Histology, cytology and embryology is based on the study of medical biology, anatomy and integrated with these disciplines; lays the foundations for students to study physiology, biochemistry, pathological anatomy and pathological physiology, propaedeutics of clinical disciplines, which involves the integration of teaching with these disciplines and the formation of skills to apply knowledge of histology, cytology and embryology in further study and professional activities.
<b>3. Purpose and objectives of the course</b>	
<p>The purpose of teaching the discipline "Histology, cytology and embryology" consistent with objectives of the educational-professional training program for applicants for the second educational (master's) level of higher education and are determined by the content of those systemic knowledge and skills that must be mastered by a doctor. The knowledge that students receive from the discipline "Histology, cytology and embryology" is basic for the block of disciplines that provide scientific and professional training.</p> <p>The purpose of the course "Histology, Cytology and Embryology" is to study the microscopic and ultramicroscopic structure of structures of the human body, their development and changes in various conditions of life.</p>	<p>The main tasks of studying the discipline "Histology, cytology and embryology" are:</p> <ul style="list-style-type: none"> <li>• Study the molecular and structural bases of cell function and repair and their derivatives</li> <li>• Study the basics of adapting, reacting and maintaining homeostasis</li> <li>• Determination of adaptation and regenerative capacity of organs taking into account their tissue composition, features of regulation and age changes</li> <li>• Interpretation of patterns of human embryonic development, regulation of morphogenesis processes</li> <li>• Determination of critical periods of embryogenesis, defects and human developmental abnormalities.</li> </ul>
<b>4. Competencies and learning outcomes</b>	
<p>On completion of study of discipline " Histology, Cytology and Embryology " students must <b>know:</b></p> <p>microscopic and submicroscopic structure of cells, tissues and human organs at different ages, as well as in terms of physiological and reparative regeneration;</p> <p><b>to be able:</b></p> <ul style="list-style-type: none"> <li>- to use microscopic instruments;</li> <li>- to study a histological or embryological preparation under a light microscope;</li> <li>- "read" electronic microphotographs;</li> </ul>	

- to make the protocol of the description of the investigated object;
- to master practical skills of work with a light microscope;
- to diagnose histological specimens;
- to study scientific literature and write essays.

According to the requirements of the Standard of Higher Education, the discipline "Histology, Cytology and Embriology " provides students with the following competencies:

*integrated:*

Ability to interpret the general biological patterns that underlie the processes of human life.

*general:*

- ability to abstract thinking, analysis and synthesis;
- ability to learn and master modern knowledge;
- ability to apply knowledge in practical situations;
- knowledge and understanding of the subject area and understanding of professional activity;
- ability to make informed decisions;
- skills of using information and communication technologies;
- definiteness and perseverance in terms of tasks and responsibilities.

*Special (professional, substantive):* capacity for evaluation of laboratory results.

### Matrix of competencies

№	Competence	Knowledge	Skills	Communication	Autonomy and responsibility
	2	3	4	5	6
<b>General competencies</b>					
Ability to solve typical and complex specialized problems and practical problems in a professional health care activity, or in a learning process that involves research and / or innovation and is characterized by complexity and uncertainty of conditions and requirements.					
<b>Special competencies</b>					
	Ability to evaluate the results of laboratory and instrumental research	To know a) the shape and structure of the organs integrated into the system; b) histological structure of organs, vessels, nerves in different parts of the body, which is of great importance for diagnosis; c) aspects of histological features individual human development at different stages of ontogenesis; d) patterns of prenatal and early postnatal development of human organs.	To be able: - to demonstrate and describe the histological structure of organs, systems of human organs; -to determine by histological preparations organs; - to assess the impact of social conditions and labor on the development and structure of the organism; -to apply Latin anatomical terms and their Ukrainian equivalents in accordance with the requirements of the international anatomical nomenclature; - to be able to analyze the results of laboratory	It is reasonable to evaluate the results of the study of the histological structure of human organs, combined into body systems, the relationship of organs and systems, the impact of social conditions and work on the development and structure of the organism.	Responsibility for decision-making on the evaluation of the results of the study of the histological structure of human organs.

			and instrumental studies of organs and systems.		
<b>5. Organization of course training</b>					
<i>The volume of the course</i>					
Type of lesson		<b>Total amount of hours 210</b>			
Lectures		40			
Practical (seminar) classes		120			
Independent work		50			
<i>Course signs</i>					
Semesters: The 1 <sup>st</sup> , the 2 <sup>nd</sup>		Specialty 221 "Dentistry"	Course (year of study) The 1st		Normative discipline
<i>Course thematics</i>					
The program is structured in modules and submodules:					
<b>Module 1. Cytology, general histology and embryology.</b>					
Submodule 1. Cytology.					
Submodule 2. Embryology.					
Submodule module 3. General histology.					
<b>Module 2. Special histology and embryology.</b>					
Submodule module 4. Histology and embryology of regulatory and sensory systems.					
Submodule module 5. Histology and embryology of internal organs.					
Submodule module 6. Histology and embryology of reproductive system.					
<b>Module 1. Cytology, general histology and embryology.</b>					
<i>Specific goals: to interpret molecular and structural bases of functioning and restoration of cells and their derivatives, to interpret structural bases of adaptation, reactivity and homeostasis maintenance, to interpret patterns of human embryonic development, regulation of human morphogenesis, determine critical embryogenesis periods, embryogenesis.</i>					
<b>Submodule 1. Cytology.</b>					
<i>Specific goals:</i>					
- To determine histological elements and their structural components by light and electron microscopy					
- To determine cell life cycle phases, ability of cells to proliferate, restore and function by structural parameters and expression of genes and corresponding molecules					
- To interpret functional specialization (differentiation) and cellular status by structure and molecular markers					
- To identify markers and morphological manifestations of cell proliferation, differentiation, adaptation, senescence and death.					
<b>Submodule 2. Embryology.</b>					
<i>Specific goals:</i>					
- To interpret regularities of the basic stages of embryogenesis.					
- To interpret patterns of human embryonic development.					
- To identify critical periods of embryogenesis, defects in human development.					
<b>Submodule 3. General histology.</b>					
<i>Specific goals:</i>					
- To interpret the concept of "tissue".					
- To draw conclusions about the role of general tissues in the structure of different organs.					

- To analyze age characteristics of common tissues.
- To interpret the embryonic and post-embryonic development of common tissues.
- To evaluate the physiological and reparative regeneration of common tissues.

## **Module 2. Special histology and embryology.**

### **Specific goals:**

To determine the adaptation and regenerative capacity of organs, taking into account their tissue composition, peculiarities of regulation and age-related changes, interpret the structural bases of human reproduction, interpret the structural and molecular bases of regenerative medicine.

## **Submodule module 4. Histology and embryology of regulatory and sensory systems.**

### **Specific goals:**

- To draw conclusions about the role of special tissues in the structure of different organs.
- To analyze age-specific features of special fabrics.
- To interpret the embryonic and post-embryonic development of special tissues.
- To evaluate the physiological and reparative regeneration of special tissues
- To explain the concepts of organs, morphological and functional systems.
- To interpret the features of the microscopic structure of the hollow and parenchymal organs.
- To interpret the structure of different organs of the human body in the aspect of the interrelations of the tissues that make up their composition at different ages, as well as in the conditions of physiological and reparative regeneration.

## **Submodule module 5. Histology and embryology of internal organs.**

### **Specific goals:**

- To explain the concepts of organs, morphological and functional systems.
- To interpret the features of the microscopic structure of the hollow and parenchymal organs.
- To interpret the structure of different organs of the human body in the aspect of the interrelations of the tissues that make up their composition at different ages, as well as in the conditions of physiological and reparative regeneration.

## **Submodule module 6. Histology and embryology of reproductive system.**

### **Specific goals:**

- To interpret embryonic and post-embryonic development of genital tissues.
- To assess the physiological and reparative regeneration of the genitals
- To explain the concept of genitals, morphological and functional systems.
- To interpret the features of the microscopic structure of the genitals.
- To interpret the structure of the human genital organs in the aspect of the interrelations of the tissues that make up their composition at different ages, as well as in the conditions of physiological and reparative regeneration.

## **THEMATIC PLAN OF LECTURES**

<b>The 1<sup>st</sup> semester</b>		
№	Theme	Amount of hours
	<b>Module 1. Cytology, embryology and general histology.</b>	2
1.	Introduction to the course of histology, cytology and embryology. History of science development.	2
2.	General and comparative embryology.	2
3.	Introduction to the doctrine of tissue. Epithelial tissues.	2
4.	Blood and lymph.	2
5.	Hemopoiesis.	2

6.	Connective tissues.	2
7.	Bone and cartilage tissues.	2
8.	Muscle tissue.	2
9.	Nervous tissue.	2
<b>Module 2. Special histology and embryology.</b>		
10.	Cardiovascular system.	2
<b>Total</b>		<b>20</b>
<b>The 2<sup>nd</sup> semester</b>		
1.	Endocrine system.	2
2.	Nervous system.	2
3.	Sensory organs sensory organs.	2
4.	Organs of oral cavity.	2
5.	Digestive tube.	2
6.	Digestive glands.	2
7.	Respiratory system.	2
8.	Urinary system.	2
9.	Male reproductive system.	2
10.	Female reproductive system.	2
<b>Total:</b>		<b>20</b>

### THEMATIC PLAN OF PRACTICAL CLASSES

<b>The 1<sup>st</sup> semester</b>		
№	Theme	Amount of hours
<b>MODULE 1. Cytology, embryology and general histology.</b>		
<b>Submodule 1. Cytology.</b>		
1	Microscope. Microscopic devices. Histological technique. Aim and tasks of Histology.	2
2	Cytology. General organization of cell. Plasmalemma. Cell junctions.	2
3	Structure of cytoplasm. Membranous organelles.	2
4	Nonmembranous organelles and inclusion.	2
5	Cell nucleus.	2
6	Cells division. Cell cycle. Aging and death of cell.	2
<b>Submodule 2. Embryology.</b>		
7	General embryology and gametogenesis.	2
8	Fertilization. Implantation. Formation of extra-embryonic organs.	2
9	Early stages of development of embryo.	2
10	Provisional organs. Placenta. Umbilical cord.	2
11	Submodules 1,2 control.	2
<b>Submodule 3. General histology.</b>		
12	Basic principles of organization of tissues. Epithelium tissues.	2
13	Blood. Erythrocytes and platelets.	2
14	Leukocytes. Leukocytic formula.	2
15	Myeloid and lymphoid tissues. Hematopoiesis and lymphopoiesis.	2
16	Loose connective tissue.	2

17	Dense connective tissue. Specialized connective tissue.	2
18	Cartilage tissues. Structure and development.	2
19	Bone tissues. Structure. Joints of bones. Development of bones.	2
20	Muscles tissues. Structure and development.	2
21	Nervous tissue. Neurons end neuroglia.	2
22	Nervous tissue. Nerve fibers and nerve endings. Regeneration of nerve fibers.	2
23	Submodule 3 control.	2
24	Control of practical skills to module 1.	2
25	<b>Final test control of the module 1.</b>	2
	<b>Total</b>	<b>50</b>
	<b>The 2<sup>nd</sup> semester</b>	
	<b>MODULE 2. Special histology and embryology.</b>	
	<b>Submodule 4. Special histology and embryology of regulatory and sensory systems.</b>	
1	Cardiovascular system. Heart.	2
2	Arteries. Veins.	2
3	Structure of microvasculature. Lymphatic vessels.	2
4	Organs of hematopoiesis and immune defense. Bone marrow. Thymus.	2
5	Spleen. Lymph nodes. Palatine tonsils.	2
6	Immune defense system.	2
7	Endocrine system. Hypothalamus. Epiphysis.	2
8	Hypophysis. Hypothalamo-hypophyseal system.	2
9	Thyroid gland. Parathyroid glands.	2
10	Suprarenal gland. APUD System.	2
11	Nervous system. Brain. Cerebellum.	2
12	Spinal cord. Peripheral nervous system.	2
13	Vegetative nervous system. Reflex arc.	2
14	Sense organs. Eyes.	2
15	Sense organs. Auditory and vestibular organs.	2
16	Taste organ. Organ olfactoria.	2
17	Skin and its derivatives.	2
18	Submodule 4 control.	2
	<b>Submodule module 5. Histology and embryology of internal organs.</b>	
19	Digestive system. Organs of oral cavity.	2
20	Tooth structure.	2
21	Tooth development.	2
22	Esophagus. Stomach.	2
23	Small and large intestine.	2
24	Salivary glands.	2
25	Liver. Pancreas.	2
26	Organs of respiratory system.	2
27	Urinary system. Kidneys. Urinary tract.	2
28	Submodule 5 control.	2
	<b>Submodule 6. Histology and embryology of reproductive system.</b>	
29	Male reproductive system.	2
30	Female reproductive system. Ovaries. Oogenesis.	2

31	Uterus. Mammary gland.	2
32	Menstrual cycle.	2
33	Submodule 6 control.	2
34	Control of practical skills to module 2.	2
35	<b>Final test control of the module 2.</b>	2
	<b>Total</b>	<b>70</b>

### THEMATIC PLAN OF INDEPENDENT WORK OF STUDENTS (IWS)

<b>The 1<sup>st</sup> semester</b>		
№	Theme	Amount of hours
<b>MODULE 1. Cytology, embryology and general histology.</b>		
1	History of Histology.	1
2	The method of investigation in Histology. Histological technique.	1
3	Mechanisms of reception.	1
4	Mitosis and meiosis.	1
5	The reaction of cells to external stimuli.	1
6	Preparation for control submodule 1, 2.	1
7	General principles of tissue organization.	1
8	The epithelium as a main component of histo-hematic barriers .	1
9	The glandular epithelium. Secretory cycle.	1
10	Epithelial stem cells.	1
11	Thrombosis. Stages and mechanisms.	1
12	White blood cells. The mechanisms of adhesion, migration and killing microorganisms .	1
13	Cooperation of blood cells and cells of connective tissue during Inflammation.	1
14	Reparation of loose connective tissue. Regulation of volume and structure of the matrix of connective tissue.	1
15	Articular cartilage .	1
16	Bone as an organ.	1
17	Bone remodeling. Regeneration of bone.	1
18	Muscle as an organ. Regeneration of muscles.	1
19	Nerve endings. Neuromuscular spindle.	1
20	Preparation for final control module 1.	1
	<b>Total</b>	<b>20</b>
<b>The 2<sup>nd</sup> semester</b>		
<b>MODULE 2. Special histology and embryology.</b>		
1	Diffuse endocrine system.	2
2	The regeneration of nerves .	2
3	The development of an eye.	2
4	The development of an ear.	2
5	The development of oral cavity and digestive system.	2
6	Structural basis of digestion.	2
7	Neurohumoral regulation of digestion.	2
8	Gastrointestinal associated lymphoid tissue. .	2

9	Development of digestive glands .	2
10	Regulation of secretory activity of digestive glands. Regeneration of digestive glands.	2
11	The development of the respiratory system.	2
12	The development of the urinary system.	2
13	Regulation of ovarian-menstrual cycle.	2
14	Preparation for control of practical skills from module 2.	2
15	Preparation for final control module 2.	2
	<b>Total</b>	<b>30</b>
	<b>Total per course</b>	<b>50</b>

**THE LIST OF THEORETICAL QUESTIONS FOR PREPARATION OF STUDENTS  
FOR THE FINAL MODULAR CONTROL.**

**MODULE 1. Cytology, embryology and general histology.**

**CYTOLOGY AND EMBRYOLOGY**

1. Cells. General plan of its structure.
2. Plasmalemma. General plan of a structure. Classification and functions of membrane proteins.
3. Connections and contacts between adjoining cells. Classification.
4. Cytoplasm. The basic components, functions. Hyaloplasma.
5. Organelles. Classification. General characteristic of membranous organelles.
6. Non-membranous organelles. Their general characteristic.
7. Special organelles. Classification. Inclusions. Classification, Morphofunctional characteristic.
8. Interaction of cell's structures during metabolism (by the example of protein synthesis).
9. Nucleus. Structure, functions. Value of a nucleus for ability to live of cells.
10. Kariolemma. Morphofunctional characteristic. Nuclear pore, structure, functions.
11. Chromatine as the basic carrier of the hereditary information. Classification, structure.
12. Nucleola. Morphofunctional characteristic and role in ability to live of cells.
13. Life cycle of cells. Its stages, characteristic. Cell cycle. Characteristic of phases.
14. Mitosis. Its stages and Morphofunctional characteristic.
15. Meiosis as type of cell fission. Its basic differences from mitosis.
16. Amitotic division as type of cell fission. The comparative characteristic of mitotic and amitotic division.
17. Stages of development of the human body. Stages of embryogenesis, their characteristic.
18. Gametes. Structure, functions, differences from somatic cells. Spermatogenesis. Its stages and regulation.
19. Ovogenesis. Its stages and regulation. Female reproductive cellular complex. Structure and functions of its components.
20. Comparative characteristic of spermatogenesis and ovogenesis.
21. Fertilisation. Distant stage, contact stage of fertilisation. Synkarion. The factors providing these stages.
22. Segmentation. Its biological value. Characteristic such as segmentation at a human germ.
23. Blastocyst: morphological characteristic of components. Their value for germ and provisional organs formation. Changes of a germ during segmentation. Terms in embryogenesis.
24. Implantation, stages. Human germ during implantation. The morphological characteristic.
25. Gastrulation. General characteristic. Mechanisms, terms.
26. Neurulation. Mechanisms, terms. Segmentation of the mesoderm. The mechanism, terms.
27. Provisional organs and shells. Morphofunctional characteristic.
28. Structure of the fetal eggs' wall. Its features in the field of a placental platform.
29. Yolk sac. Alantois.

30. Umbilical cord. Its structure.
31. Placenta. Its structure, functions.
32. Structure-functional unit of a placenta - kotiledon.
33. Haemo-placentic barrier and its value in system the mother - child.
34. Human placenta. Type, morphofunctional characteristic. Endocrine function of placenta.
35. Structure of the structure-functional units of the placenta. Concept about primary and secondary villies.
36. Amnionic shall. Its formation and value for development of a germ.
37. Chorionic shall. Its formation and value for development of a germ.
38. Decidua. Its formation and value for development of a germ. Parts of decidua. Their functional value.
39. Polyfetal pregnancy, the reasons, possible consequences.
40. Critical periods of human development. Their value for an organism.

### **GENERAL HISTOLOGY**

1. Tissues as one of levels of the alive matter's organization. Definition, principles of a structure. Modern classification of tissues. General characteristic. Stem cells, their properties.
2. Cells and intercellular substance. Symplasts, syncytia. Intercellular substance: fibrillar component, ground substance, their structure and functions. Classification of fibres.
3. Epithelial tissue. Morphofunctional characteristic. Classification. The basic attributes and properties of epithelia.
4. Simple epithelia. Classification, Morphofunctional characteristic. Localization in the human body.
5. Stratified nonkeratinized epithelium. Structure. Features of regeneration.
6. Stratified keratinized epithelium. Structure. Processes of epitheliocytes' differentiations. Keratinization.
7. Transitional epithelium. Morphofunctional characteristic. Features of a structure in different functional conditions.
8. Glands. Classification. Morphofunctional characteristic. Types of the end-pieces and ducts.
9. Secretory cycle of the glands. Phases, its cytophysiological characteristic. Types of secretion.
10. Blood. Morphofunctional characteristic. Cellular structure of blood. Functions of cells.
11. Stem blood cells. Its general characteristic. Modern theories of haemocytopoiesis.
12. Erythrocytopoiesis, its stages. Retikulocytes.
13. Thrombocytopoiesis. Morphological characteristic of the megakariocytes.
14. Granulocytopoiesis.
15. Monocytopoiesis.
16. Haemogramma. Its clinical value.
17. Erythrocytes. Morphofunctional characteristic. Hemoglobin, its chemical compound. Types of hemoglobin.
18. Thrombocytes. Morphofunctional characteristic.
19. Leukocytes. Classification, general characteristic. Their functional value.
20. Leucocytic formula, its clinical value.
21. Granulocytes. Their types. Amount, sizes, shapes, structure, functions, life expectancy.
22. Lymphocytes. Types. Subpopulations T-and B-лимфоцитов. Concept about lymphocytes' differentiation.
23. Monocytes. Subpopulations. Concept about macrophageal system of the body.
24. General characteristic of connective tissue. Classification. A dense fibrous connective tissue. Sources of development. Cellular elements and intercellular substance.
25. Areolar fibrous connective tissue. Morphofunctional characteristic. Cellular structure.

26. Connective tissues with special properties. Cellular structure, localization in an organism, functions.
27. General characteristic and features of the organization of skeletal tissues. Cartilages. Classification. Cells and intercellular substance. Formation of the cartilage tissue.
28. Bone tissue. Classification. Cells and intercellular substance. Osteon. Cortical and trabecular bone. Physiological and reparative regeneration of the bone.
29. Osteogenesis. Intramembranous bone formation, its stages. Endochondral osteogenesis. Its stages.
30. Concept about immunity system. Classification and characteristic immunocytes.
31. Interaction of immunocytes in cellular and humoral immunity.
32. Cooperation of blood cells and connective tissue in immunity answer.
33. Muscle tissue. Morphofunctional characteristic. Classifications. Sources of development. Structural bases of muscular contraction.
34. Smooth muscle tissue. Structure and functions of smooth muscle cells.
35. Skeletal muscle tissue. Histogenesis, structure. Ultrastructure of sarcomer. Role of myosatellitocytes in regeneration of muscle tissue.
36. Cardiac muscle. Structure. Characteristic of cardiomyocytes.
37. Nervous tissue. Morphofunctional characteristic. Histogenesis. Classification of neurocytes. Ultrastructural characteristic.  
Special organelles.
38. Glial cells. Classification. Macroglia. Microglia. Structure and functions of cells.
39. Nervous endings. Classification. A structure of synapses, receptors and effectors.
40. Nervous fibers. Structurally and functional characteristic. Regeneration of nervous fibers.

## **MODULE 2. Special histology and embrvology.**

### **SPECIAL HISTOLOGY**

1. Nervous system. General morphofunctional characteristic and morphological classification. A peripheral nerve. Structure and regeneration.
2. Spinal cord. A structure of grey and white mater. Spinal ganglia, their structure and functions.
3. General morphofunctional characteristic of the large hemispheres of the brain. Cytoarchytectonics. Myeloarchytectonics.
4. Cerebellum. Structure and functional characteristic. Cytoarchytectonics. Myeloarchytectonics.
5. Cardiovascular system. General morphofunctional characteristic. Classification of blood vessels.
6. General plan of the blood vessels wall's structure, haemodynamic conditions. Arteries. Viens.
7. Arterioles, capillaries, vienules. Morphofunctional characteristic. Structure of the different type capillares. Histohaematic barriers.
8. Heart. Morphofunctional characteristic. A structure of the heart's wall.
9. Sense organs. A general characteristic. Classification of sense organs. Organ olfactoria.
10. Optical organ. Morphofunctional characteristic. Functional apparates of an eye. Retina: structure, functions.
11. Taste organ. Morphofunctional characteristic. Cytologic characteristic.
12. Audiovestibular organ. Morphofunctional characteristic. Structure of the Corti organ. Vestibular organ.
13. Endocrine system. Classification of the endocrine glands. Concept about receptors to hormones and targets-cells.
14. Hypothalamus. Nucleuses. Neurosecretory cells, axo-vasal synapses.

15. Hypophysis. Morphofunctional characteristic. Cellular structure. Features of blood supply of the hypophysis.
16. Thyroid gland. Morphofunctional characteristic. Cellular structure. Parathyroid glands.
17. Suprarenal glands. Structure of the cortex and medulla.
18. Alimentary system. A general plan of the digestive tube's structure and classification of glands. Oral cavity. General characteristic of the oral mucosa.
19. Tongue: structure and functions. Tongue's papillae: classification, Gustatory bands.
20. Teeth. General principles of the structure. Micromorphology of enamel, dentine and cement.
21. Teeth. Histomorphology of the pulp and periodontium.
22. Characteristic of stages of teeth's development.
23. Major salivary glands. Features of the structure. Micromorphology of secretory departments and duct's system.
24. Esophagus. Morphofunctional characteristic. Features of the structural organization of its departments. Glands: a structure, functions.
25. Stomach. Morphofunctional characteristic. Histophysiology of the glands, their cellular content, functions.
26. Small intestine. Morphofunctional characteristic. Cellular structure and structure of the mucosa. Large intestine.
27. Pancreas. Morphofunctional characteristic. Structure and functions of exocrine and endocrine parts. Cellular structure of the pancreatic island, functions of different types insulocytes.
28. Hepar. Morphofunctional characteristic. Structure of hepatocytes. Structure of classic and portal lobes, acinuses.
29. Central and peripheral organs of haemopoiesis and immunogenesis. Morphofunctional characteristic. Classification. Bone marrow. Haemopoietic, stromal and vascular components.
30. Thymus: structure of the cortex and medulla. Haemato-thymic barrier, its structure and functions. Endocrine function of thymus.
31. Spleen: a structure and functions of a red pulp. Features of blood supply. White pulp.
32. Lymph node: a structure and functions. Differentiation of the lymphocytes in a lymph node.
33. Respiratory system. General plan of it structure. Structure and functions of the trachea and bronches of different calibre.
34. Lungs. Morphofunctional characteristic. Respiratory and non-respiratory departments. Structure and functions of acini. Alveolocytes. Surfactant. Aero-haematic barrier.
35. Skin. Structure and functions of epidermis. Keratinization and regeneration. Structure of the dermis and hypodermis.
36. Skin glands. Classification and structure. Structural and functional features of nails and hair.
37. Urinary system. General plan of of it organization. Functions. Sources of development and stages of embryogenesis. Nephron: types and cytophysiology. Urinary tract.
38. Male reproductive system. General characteristic. Development. Testis: structure, functions. General characteristic of the male reproductive tract. Additional male glands.
39. Female reproductive system. Development. Morphofunctional characteristic. Structure of the ovaries. Exocrine and endocrine functions.
40. Uterus. Morphofunctional characteristic. Mammary glands. Features of its structure during lactation. Hormonal regulation.

## 6. Course evaluation system

General course evaluation system

**Current control** is performed based on the control of theoretical knowledge, skills and abilities in practical classes. Independent study students are assessed in practical classes, and is an integral part of the final grade of the student. Current control is performed during the training sessions and aims at checking the assimilation of students learning the material. Forms of current control are:

- a) test tasks with a choice of one correct answer, with the definition of the correct sequence of actions, with determination of the conformity, defining the specific portion of the photo or diagram ("detection");
- b) individual oral questioning, interview;
- c) the solution of typical situational tasks;
- g) identification of pathogens and carriers of pathogens of parasitic diseases in the photographs, macro - and micropreparats;
- d) control of practical skills;
- e) the typical problems of genetics and medical genetics.

Grades on the national scale ("excellent" - 5, "good" - 4, "satisfactory" - 3, "unsatisfactory" - 2), received by students, are displayed in the journals of attendance and academic group performance.

### **Final control**

The final control is the form of a differentiated credit at the end of the 1st semester and an exam at the end of the 2nd semester upon completion of the course of medical biology. The semester exam is a form of final control of mastering by the student of theoretical and practical material on academic discipline. The final control (exam) is carried out at the last control lesson.

Students are admitted to the FC who have attended all the classes provided by the curriculum in the discipline and while studying the module scored the number of points not less than the minimum (**72 points**). A student who, for good or bad reasons, has missed classes, is allowed to rework academic debt for a certain period of time.

**Evaluation of current educational activities.** During the assessment of mastering each topic for the current educational activity of the student scores are set on a 4-point (national) assessment scale. This takes into account all types of work provided by the discipline program. The student must receive a score on each topic. Scores on the traditional scale are converted into points. The final assessment of the current academic activity is the arithmetic mean (the sum of scores for each lesson is divided by the number of lessons per semester) and translated into points according to **Table 2**.

**Table 2. Conversion of the average score for the current activity into a multi-point scale (for disciplines completed by diff.credit, exam)**

4- poin t	120- poin t	4- poin t	120- poin t	4- poin t	120- poin t	4- poin t	120- point scale
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scale	scale	scale	scale	scale	scale	scale	
5	120	4,45	107	3,91	94	3,37	81
4,95	119	4,41	106	3,87	93	3,33	80
4,91	118	4,37	105	3,83	92	3,29	79
4,87	117	4,33	104	3,79	91	3,25	78
4,83	116	4,29	103	3,74	90	3,2	77
4,79	115	4,25	102	3,7	89	3,16	76
4,75	114	4,2	101	3,66	88	3,12	75
4,7	113	4,16	100	3,62	87	3,08	74
4,66	112	4,12	99	3,58	86	3,04	73
4,62	111	4,08	98	3,54	85	3	72
4,58	110	4,04	97	3,49	84	<3	Not enough
4,54	109	3,99	96	3,45	83		
4,5	108	3,95	95	3,41	82		

*The maximum number of points that a student can collect for current educational activity during semester in order to be admitted to the exam is 120 points.*

*The minimum number of points that a student can collect for current educational activity during semester in order to be admitted to the exam is 72 points.*

Calculating of the number of points is based on obtained marks of student according to traditional scale while learning subject during the semester, by calculating the arithmetic mean (AM) that is rounded to two signs after comma.

*Evaluation of independent work of students.* Independent work of students, which is provided by the topic of the lesson together with the classroom work, is evaluated during the current control of the topic in the relevant lesson. Assimilation of topics that are submitted only for independent work is checked during the final module control.

*Evaluation of final control.*

**The maximum number of points that a student can score during the exam is 80 points.**

The final control is considered credited if the student scored at least 60% of the maximum amount of points (for a 200-point scale - at least 50 points).

*Determining the number of points that a student scored in the discipline:* the number of points that a student scored in the discipline is defined as the sum of points for the current academic activity (Table1) and for the final control (diff.credit, exam) (Table 3).

**Table 3. Scale of assessment of differentiated (exam) credit:**

Traditional scale	Points
«5»	70-80
«4»	60-69
«3»	50-59

Requirements for written work

The final written work is performed in the form of a test.

Practical classes

Classroom work

*The 1<sup>st</sup> semester*

**Module 1. Cytology, general histology and embryology.**

Topics 1-222: Classroom work - score from 2 to 5 for each topic.			
Topic 23: Written test control consists of 40 tasks. Evaluation criteria			
Score	«3»	«4»	«5»
Number of correct answers	20-29	30-34	35-40
Topic 24: Control of practical skills of module 1: Recognize and give morphofunctional characteristics to different types of cells and tissues. Evaluation criteria			
Score for 4 micropreparations	«3»	«4»	«5»
Number of correct answers	2	3	4
Topic 25: <i>Differentiated credit (semester control)</i> Semester control at the end of the 1st semester is provided in the form of Differentiated credit. (Table 2) Provides a final grade on a 120-point scale as the sum of grades for the current control of knowledge (oral examination, written survey, Practical work, abstracts), the results of 3 submodules. Semester control includes control of theoretical and practical training. Amount: minimum $72 + 50 = 122$ , maximum $120 + 80 = 200$			
<b><i>The 2<sup>nd</sup> semester</i></b>			
<b>Module 2. Special histology and embryology.</b>			
Topics 1-17: Classroom work - from 2 to 5 points for each topic.			
Topic 18: Written test control consists of 40 tasks. Evaluation criteria			
Score	«3»	«4»	«5»
Number of correct answers	20-29	30-34	35-40
Topics 19-27: Classroom work - from 2 to 5 points for each topic.			
Topic 28: Written test control consists of 40 tasks. Evaluation criteria			
Score	«3»	«4»	«5»
Number of correct answers	20-29	30-34	35-40
Topics 29-32: Classroom work - from 2 to 5 points for each topic, calculation of the arithmetic mean and conversion into points according to Table 2.			
Topic 33: Written test control consists of 40 tasks. Evaluation criteria			
Score	«3»	«4»	«5»
Number of correct answers	20-29	30-34	35-40
Topic 34: Control of practical skills of module 1: Recognize and give morphofunctional characteristics to different types of cells and tissues. Evaluation criteria			
Score for 4 micropreparations	«3»	«4»	«5»
Number of correct answers	2	3	4
Topic 35: Final module control 2 is evaluated from 50 to 80 points and consists of: Test control - 40 tests = 40 points (1 point for the correct answer to 1 test). Answer to 2 theoretical questions of 20 points for each = 40 points. Amount: 80. Amount: minimum $72 + 50 = 122$ , maximum $120 + 80 = 200$			
<b>At the end of the course there is an exam.</b>			
<b>The procedure of the exam.</b>			

Issuance of tickets for the exam begins at 09.00. Upon receipt of the ticket, the student provides a credit book. To prepare abstracts, the student uses his own pen.

The student receives a block of questions - a ticket (3 questions), which must be answered in writing within 40 minutes. The questions reflect the material of the discipline and correspond to the topics of lectures, practical classes and ISW, which are part of the final module.

Interview on ticket issues.

1. Test of practical skills:

Misdiagnosed micropreparations - "unsatisfactory";

One correctly diagnosed micropreparation - "satisfactory";

Two correctly diagnosed micropreparations - "good";

Three correctly diagnosed micropreparations - "excellent";

2. Written answer to the ticket question:

The answer to each question is evaluated separately as "unsatisfactory", "satisfactory", "good" or "excellent".

The total grade of the exam in the discipline is defined as the arithmetic mean of the grades in practical skills, test tasks and each question of the ticket.

For example: Diagnosis of micropreparations - "excellent", tests - "good", the first question of the ticket - "good", the second question of the ticket - "excellent", the third question of the ticket - "good". The total grade of the exam is "good".

The exam is evaluated from 50 to 80 points

The traditional score is put in the credit book

"3" 50-60 points

"4" 61-70 points

"5" 71-80 points

### **The list of theoretical questions to prepare students for the exam.**

#### **CYTOLOGY AND EMBRYOLOGY**

1. Cells. General plan of its structure.
2. Plasmalemma. General plan of a structure. Classification and functions of membrane proteins.
3. Connections and contacts between adjoining cells. Classification.
4. Cytoplasm. The basic components, functions. Hyaloplasm.
5. Organelles. Classification. General characteristic of membranous organelles.
6. Non-membranous organelles. Their general characteristic.
7. Special organelles. Classification. Inclusions. Classification, Morphofunctional characteristic.
8. Interaction of cell's structures during metabolism (by the example of protein synthesis).
9. Nucleus. Structure, functions. Value of a nucleus for ability to live of cells.
10. Kariolemma. Morphofunctional characteristic. Nuclear pore, structure, functions.
11. Chromatine as the basic carrier of the hereditary information. Classification, structure.
12. Nucleola. Morphofunctional characteristic and role in ability to live of cells.
13. Life cycle of cells. Its stages, characteristic. Cell cycle. Characteristic of phases.
14. Mitosis. Its stages and Morphofunctional characteristic.
15. Meiosis as type of cell fission. Its basic differences from mitosis.
16. Amitotic division as type of cell fission. The comparative characteristic of mitotic and amitotic division.
17. Stages of development of the human body. Stages of embryogenesis, their characteristic.
18. Gametes. Structure, functions, differences from somatic cells. Spermatogenesis. Its stages and regulation.
19. Ovogenesis. Its stages and regulation. Female reproductive cellular complex. Structure and functions of its components.
20. Comparative characteristic of spermat- and ovogenesis.
21. Fertilisation. Distant stage, contact stage of fertilisation. Synkarion. The factors providing these stages.
22. Segmentation. Its biological value. Characteristic such as segmentation at a human germ.

23. Blastocyst: morphological characteristic of components. Their value for germ and provisional organs formation. Changes of a germ during segmentation. Terms in embryogenesis.
24. Implantation, stages. Human germ during implantation. The morphological characteristic.
25. Gastrulation. General characteristic. Mechanisms, terms.
26. Neurulation. Mechanisms, terms. Segmentation of the mesoderm. The mechanism, terms.
27. Provisional organs and shells. Morphofunctional characteristic.
28. Structure of the fetal eggs' wall. Its features in the field of a placental platform.
29. Yolk sac. Allantois.
30. Umbilical cord. Its structure.
31. Placenta. Its structure, functions.
32. Structure-functional unit of a placenta - cotyledon.
33. Haemo-placental barrier and its value in system the mother - child.
34. Human placenta. Type, morphofunctional characteristic. Endocrine function of placenta.
35. Structure of the structure-functional units of the placenta. Concept about primary and secondary villi.
36. Amnionic shell. Its formation and value for development of a germ.
37. Chorionic shell. Its formation and value for development of a germ.
38. Decidua. Its formation and value for development of a germ. Parts of decidua. Their functional value.
39. Polyfetal pregnancy, the reasons, possible consequences.
40. Critical periods of human development. Their value for an organism.

#### **i. GENERAL HISTOLOGY**

41. Tissues as one of levels of the alive matter's organization. Definition, principles of a structure. Modern classification of tissues. General characteristic. Stem cells, their properties.
42. Cells and intercellular substance. Symplasts, syncytia. Intercellular substance: fibrillar component, ground substance, their structure and functions. Classification of fibres.
43. Epithelial tissue. Morphofunctional characteristic. Classification. The basic attributes and properties of epithelia.
44. Simple epithelia. Classification, Morphofunctional characteristic. Localization in the human body.
45. Stratified nonkeratinized epithelium. Structure. Features of regeneration.
46. Stratified keratinized epithelium. Structure. Processes of epitheliocytes' differentiations. Keratinization.
47. Transitional epithelium. Morphofunctional characteristic. Features of a structure in different functional conditions.
48. Glands. Classification. Morphofunctional characteristic. Types of the end-pieces and ducts.
49. Secretory cycle of the glands. Phases, its cytophysiological characteristic. Types of secretion.
50. Blood. Morphofunctional characteristic. Cellular structure of blood. Functions of cells.
51. Stem blood cells. Its general characteristic. Modern theories of haemocytopoiesis.
52. Erythrocytopoiesis, its stages. Reticulocytes.
53. Thrombocytopoiesis. Morphological characteristic of the megakaryocytes.
54. Granulocytopoiesis.
55. Monocytopoiesis.
56. Haemogram. Its clinical value.
57. Erythrocytes. Morphofunctional characteristic. Hemoglobin, its chemical compound. Types of hemoglobin.
58. Thrombocytes. Morphofunctional characteristic.
59. Leukocytes. Classification, general characteristic. Their functional value.
60. Leucocytic formula, its clinical value.
61. Granulocytes. Their types. Amount, sizes, shapes, structure, functions, life expectancy.
62. Lymphocytes. Types. Subpopulations T- and B-лимфоцитов. Concept about lymphocytes' differentiation.
63. Monocytes. Subpopulations. Concept about macrophageal system of the body.
64. General characteristic of connective tissue. Classification. A dense fibrous connective tissue. Sources of development. Cellular elements and intercellular substance.
65. Areolar fibrous connective tissue. Morphofunctional characteristic. Cellular structure.
66. Connective tissues with special properties. Cellular structure, localization in an organism, functions.

67. General characteristic and features of the organization of skeletal tissues. Cartilages. Classification. Cells and intercellular substance. Formation of the cartilage tissue.
68. Bone tissue. Classification. Cells and intercellular substance. Osteon. Cortical and trabecular bone. Physiological and reparative regeneration of the bone.
69. Osteogenesis. Intramembranous bone formation, its stages. Endochondral osteogenesis. Its stages.
70. Concept about immunity system. Classification and characteristic immunocytes.
71. Interaction of immunocytes in cellular and humoral immunity.
72. Cooperation of blood cells and connective tissue in immunity answer.
73. Muscle tissue. Morphofunctional characteristic. Classifications. Sources of development. Structural bases of muscular contraction.
74. Smooth muscle tissue. Structure and functions of smooth muscle cells.
75. Skeletal muscle tissue. Histogenesis, structure. Ultrastructure of sarcomer. Role of myosatellitocytes in regeneration of muscle tissue.
76. Cardiac muscle. Structure. Characteristic of cardiomyocytes.
77. Nervous tissue. Morphofunctional characteristic. Histogenesis. Classification of neurocytes. Ultrastructural characteristic.
  - a. Special organelles.

78. Glial cells. Classification. Macroglia. Microglia. Structure and functions of cells.
79. Nervous endings. Classification. A structure of synapses, receptors and effectors.
80. Nervous fibers. Structurally and functional characteristic. Regeneration of nervous fibers.

### 81. SPECIAL HISTOLOGY

82. Nervous system. General morphofunctional characteristic and morphological classification. A peripheral nerve. Structure and regeneration.
83. Spinal cord. A structure of grey and white mater. Spinal ganglia, their structure and functions.
84. General morphofunctional characteristic of the large hemispheres of the brain. Cytoarchytectonics. Myeloarchytectonics.
85. Cerebellum. Structure and functional characteristic. Cytoarchytectonics. Myeloarchytectonics.
86. Cardiovascular system. General morphofunctional characteristic. Classification of blood vessels.
87. General plan of the blood vessels wall's structure, haemodynamic conditions. Arteries. Veins.
88. Arterioles, capillaries, venules. Morphofunctional characteristic. Structure of the different type capillares. Histohaematic barriers.
89. Heart. Morphofunctional characteristic. A structure of the heart's wall.
90. Sense organs. A general characteristic. Classification of sense organs. Organ olfactoria.
91. Optical organ. Morphofunctional characteristic. Functional apparatus of an eye. Retina: structure, functions.
92. Taste organ. Morphofunctional characteristic. Cytologic characteristic.
93. Audiovestibular organ. Morphofunctional characteristic. Structure of the Corti organ. Vestibular organ.
94. Endocrine system. Classification of the endocrine glands. Concept about receptors to hormones and targets-cells.
95. Hypothalamus. Nucleuses. Neurosecretory cells, axo-vasal synapses.
96. Hypophysis. Morphofunctional characteristic. Cellular structure. Features of blood supply of the hypophysis.
97. Thyroid gland. Morphofunctional characteristic. Cellular structure. Parathyroid glands.
98. Suprarenal glands. Structure of the cortex and medulla.
99. Alimentary system. A general plan of the digestive tube's structure and classification of glands. Oral cavity. General characteristic of the oral mucosa.
100. Tongue: structure and functions. Tongue's papillae: classification, Gustatory bands.
101. Teeth. General principles of the structure. Micromorphology of enamel, dentine and cement.
102. Teeth. Histomorphology of the pulp and periodontium.
103. Characteristic of stages of teeth's development.
104. Major salivary glands. Features of the structure. Micromorphology of secretory departments and duct's system.
105. Esophagus. Morphofunctional characteristic. Features of the structural organization of its departments. Glands: a structure, functions.
106. Stomach. Morphofunctional characteristic. Histophysiology of the glands, their cellular content, functions.

107. Small intestine. Morphofunctional characteristic. Cellular structure and structure of the mucosa. Large intestine.
108. Pancreas. Morphofunctional characteristic. Structure and functions of exocrine and endocrine parts. Cellular structure of the pancreatic island, functions of different types insulocytes.
109. Hepar. Morphofunctional characteristic. Structure of hepatocytes. Structure of classic and portal lobes, acinuses.
110. Central and peripheral organs of haemopoiesis and immunogenesis. Morphofunctional characteristic. Classification. Bone marrow. Haemopoietic, stromal and vascular components.
111. Thymus: structure of the cortex and medulla. Haemato-thymic barrier, its structure and functions. Endocrine function of thymus.
112. Spleen: a structure and functions of a red pulp. Features of blood supply. White pulp.
113. Lymph node: a structure and functions. Differentiation of the lymphocytes in a lymph node.
114. Respiratory system. General plan of it structure. Structure and functions of the trachea and bronches of different calibre.
115. Lungs. Morphofunctional characteristic. Respiratory and non-respiratory departments. Structure and functions of acini. Alveolocytes. Surfactant. Aero-haematic barrier.
116. Skin. Structure and functions of epidermis. Keratinization and regeneration. Structure of the dermis and hypodermis.
117. Skin glands. Classification and structure. Structural and functional features of nails and hair.
118. Urinary system. General plan of of it organization. Functions. Sources of development and stages of embryogenesis. Nephron: types and cytophysiology. Urinary tract.
119. Male reproductive system. General characteristic. Development. Testis: structure, functions. General characteristic of the male reproductive tract. Additional male glands.
120. Female reproductive system. Development. Morphofunctional characteristic. Structure of the ovaries. Exocrine and endocrine functions.
121. Uterus. Morphofunctional characteristic. Mammary glands. Features of its structure during lactation. Hormonal regulation.

**Circumstance of admission to the final control**

1. Semester control at the end of the 1st semester is provided in the form of a differential credit. (Table 2) Provides a final score on a 120-point scale as the sum of scores for the current control of knowledge (oral examination, written survey, tests, verification of identification of micropreparations, abstracts), the results of 2 content modules.
2. Students are allowed to take the differentiated credit, exam only if there is no debt for the implementation of the curriculum.

**7. Course policy**

The organization of the educational process is carried out with the use of the European Credit Transfer System (ECTS) to assess student performance. The points gained in the current survey, independent work and points of the final control are credited. This must take into account the student's presence in class and his activity during practical work. Inadmissible: absences and late classes; use of a mobile phone, tablet or other mobile devices during the lesson (except for the cases provided by the curriculum and methodical recommendations of the teacher); copying and plagiarism; untimely performance of the task, the presence of unsatisfactory grades for 50% or more of the submitted theoretical and practical material.

**8. RECOMMENDED LITERATURE**

**1.Basic:**

1. Mescher A.L. Junqueira's basic histology. Text and atlas. 13 th. Ed. New York, Mack Graw Hill, 2013. -559 p.
2. Moore K.L. Persaud T.V.N. The developing human: Clinically oriented embryology. 8 th ed. -Philadelphia, Saunders Elsevier, 2008. -493 p.
3. Ovalle W.K., Nahirney P.C. Netter's essential histology. -Philadelphia, Saunders Elsevier, 2008. -493 p.
4. Ed. E.F. Barynova, Yu.B. Chaykovskoho. Cytology and general embryology. Tutorial. Kyiv, NE "Medicine", 2010. - 216 p.
5. Ed. E.F. Barynova, Yu.B. Chaykovskoho. Special histology and embryology internal organs. Tutorial. Kyiv, NE "Medicine", 2013. - 471 p.

**2.Additional:**

6. Sadler TV Medical Embryology at Lanhmanom. Lviv, "Nautilus", 2001. - 550S.
7. Kierszenbaum A.L., Tres L.L. Histology and Cell Biology. - Elsevier, Philadelphia, 2012. - 701 p.
8. Ross M.H., Pawlina W. Histology. A Text and Atlas. - Wolters Kluwer, Philadelphia, 2011. - 974 p.
9. Young B., Lowe J.S., Stevens A., Heath J.W. Wheathers functional histology: A text and colour atlas. 5 th ed. -Philadelphia, Churchill Livingstone Elsevier, 2010. -473p.

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