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## MEDICAL UNIVERSITY - PLEVEN

### FACULTY OF MEDICINE

#### DEPARTMENT OF ANATOMY, HISTOLOGY, CYTOLOGY AND BIOLOGY

2019/2020 academic year

### PROGRAMME OF CYTOLOGY AND HISTOLOGY FOR MEDICAL STUDENTS

<b>Разработил:</b> Доц. д-р Стефан Трифонов, дм Ръководител катедра /фамилия, длъжност/	<b>Одобрил:</b> Проф. д-р А.Аспарухов, дмн Декан ФМ /фамилия, длъжност/	<b>Утвърдена:</b> На Факултетен съвет	Екземпляр № 05
07.09.2019 г..... /дата, подпис/	.....2019 г..... /дата, подпис/	..... /дата/	Валиден от: 11.09.19

### **First semester**

Lectures - **60** hours and practical exercises - **30** hours

**Credit points: 6**

	Credit points	%
1. Attendance the practical exercises	1.0	17
2. Attendance the lectures	1.9	32
3. Self preparation	0.9	15
4. Preparation for the seminar of cytology	0.25	4
5. Preparation for the seminar of histology	0.25	4
6. Preparation for the final exam	1.7	28
Total	6	100

### **Academic teaching staff :**

Associate professor Stefan Trifonov, MD, PhD – tel: 884 236;

Assistant professor Stilyanka Yochkova, MD – tel: 884 201;

Assistant professor Michail Iliev MD – tel: 884 235;

Assistant professor Romyana Davidova, MD – tel: 884 238;

Assistant professor Desislava Marinova, MD – tel: 884 201;

Assistant professor Tihomir Rashev – tel: 884 247;

Assistant professor Miroslav Dobrev, MD – tel: 884 200.

	<b>THEMATIC PLAN LECTURE COURSE OF CYTOLOGY AND HISTOLOGY I SEMESTER</b>	<b>Hours</b>
1.	Introduction in Anatomy. Historical overview. Anatomical nomenclature. Norm and variants.	2
2.	Osteology – types of bone, structure, development and growing of the bones.	2
3.	Cytology, general histology and general embryology – object, purposes and their place in the morphologic discipline.	2
4.	External cell morphology and chemical composition.	2
5.	Plasma membrane.	2
6.	Membrane limited cell organelles: Endoplasmic reticulum, mitochondria.	2
7.	Membrane limited cell organelles: Golgi apparatus and its products.	2
8.	The cell nucleus – structure of the interphase nucleus.	2
9.	The cell nucleus – genetical cell apparatus.	2
10.	Nonmembrane limited cell organelles: Ribosomes.	2
11.	Nonmembrane limited cell organelles: Cytoskeleton; Cell inclusions.	2
12.	Cytophysiology – cell metabolism, membrane transport, cell signaling, cell reactivity and movement.	2
13.	Cytophysiology – cell cycle, amitosis, mitosis, endomitosis, meiosis.	2
14.	Cytophysiology – cell differentiation, growth, aging and cell death.	2
15.	General histology – introduction. Tissues, classification. Epithelial tissue: Covering epithelium.	2
16.	Epithelial tissue: Glandular epithelium.	2
17.	Connective tissue 1: Origin, general characteristic and classification.	2
18.	Connective tissue 2: Connective tissue with special properties – cartilaginous tissue and bone tissue.	2
19.	Syndesmology – types of interosseous connection. Joints - principal structure.	2
20.	Types of joints. Mechanic of the joints.	2
21.	Blood and lymph.	2
22.	Hematopoiesis.	2
23.	Muscle tissue.	2
24.	Nerve tissue1: Origin, general characteristics and classification. Nerve cells, neuroglia.	2
25.	Nerve tissue 2: Nerve fibers.	2
26.	Embryology - introduction. Male and female sex cells. Gametogenesis, ovulation, fertilization.	2
27.	Cleavage, blastogenesis, implantation.	2
28.	Gastrulation.	2
29.	Germ layers: Amnion and chorion. Fetal circulation. Twins.	2
30.	Teratology.	2
	<b>Total</b>	<b>60</b>

	THEMATIC PLAN PRACTICAL EXERCISES OF CYTOLOGY AND HISTOLOGY I SEMESTER	
№	Topic	Hours
1.	Light and electron microscope. Preparation of permanent histological slides. External cell morphology.	2
2.	Internal cell morphology: Cell membrane, endoplasmic reticulum, ribosomes.	2
3.	Internal cell morphology: Mitochondria, lysosomes, Golgi apparatus	2
4.	Internal cell morphology: Nucleus, cytocenter.	2
5.	Internal cell morphology: Specialized cytoplasmic structures and cytoplasmic inclusions.	2
6.	<b>Seminar: Cytology.</b>	2
7.	Epithelial tissue: Surface epithelium.	2
8.	Epithelial tissue: Glandular epithelium.	2
9.	Connective tissue: Embryonal connective tissue, loose and dense connective tissue.	2
10.	Supporting connective tissue: Cartilage and bone connective tissue. Blood.	2
11.	Muscle tissue: Smooth, skeletal and cardiac muscle tissue	2
12.	Nerve tissue: Neurons and neuroglia.	2
13.	Nerve tissue: Nerves, receptors and synapses.	2
14.	<b>Seminar: Histology</b>	2
15.	Embryology	2
	Total	30

**THEMATIC PLAN**  
**LECTURE COURSE OF CYTOLOGY AND HISTOLOGY**  
**I SEMESTER**

1. Introduction to Anatomy. Historical overview. Anatomical nomenclature. Norm and variants.
2. Osteology – types of bone, structure, development and growth of the bones.
3. Cytology, general histology and general embryology – object, purposes and place among other morphological disciplines. History. Principles of the cytological and histological research. Types of microscopes and methods: Histochemistry, immunocytochemistry, *in situ* hybridization, cell cultures, cell fractionation.
4. Cell. Prokaryotes and eukaryotes. External cell morphology and chemical composition. Hierarchy of the cell organization.
5. Plasma membrane. Composition and structure. Models. Structure and function of the plasma membrane proteins. Membrane receptors. Specialized structures of the cell membrane. Cell coat (Glycocalyx).
6. Membrane limited cell organelles: Endoplasmic reticulum – rough and smooth, mitochondria, annular lamellae.
7. Membrane limited cell organelles: Golgi apparatus, lysosomes, peroxisomes, secretory vesicles, coated vesicles.
8. The cell nucleus. Structure of the interphase nucleus: Nuclear envelope, chromatin, nucleolus, nuclear matrix.
9. The cell nucleus. Genetic cell apparatus. Structure of the chromosomes. Structure and replication of DNA. Genome and mutations.
10. Nonmembrane limited cell organelles: Ribosomes – chemical composition, organization, types, participation in the protein synthesis. Cytocenter and centrioles.
11. Nonmembrane limited cell organelles: Cytoskeleton – microtubules and cytofilaments. Cell inclusions.
12. Cytophysiology – cell metabolism, membrane transport, cell signaling, cell reactivity and movement.
13. Cytophysiology – cell cycle, amitosis, mitosis, endomitosis, meiosis.
14. Cytophysiology – cell differentiation, growth, aging and cell death (necrosis and apoptosis).

15. General histology – introduction. Tissues, classification. Common properties of the tissues. Epithelial tissue 1. Origin, general characteristic and classification. Covering epithelium: simple and stratified.
16. Epithelial tissue 2. Glandular epithelium: Exocrine and endocrine glands.
17. Connective tissue 1. Origin, general characteristic and classification. Collagen and elastogenesis. Connective tissue proper – loose and dense connective tissue.
18. Syndesmology – types of interosseous connection. Joints – principal structure.
19. Types of joints. Mechanic of the joints.
20. Connective tissue 2. Connective tissue with special properties. Cartilaginous tissue – hyaline, elastic and fibrocartilage (cells and intercellular substances). Bone tissue: Compact and spongy bone, haversian system.
21. Blood and lymph. Origin, general characteristic and classification. Blood plasma, blood cells. Immune system.
22. Hematopoiesis. Time and places of hematopoiesis. Erythropoiesis. Granulocytopoiesis. Thrombocytopoiesis. Lymphocytopoiesis. Monocytopoiesis. Regulation of hemopoiesis.
23. Muscle tissue: Origin, general characteristic and classification Types of muscle tissue. Sarcomere. Molecular mechanism of the muscular contraction. Myoepithelial cells. Regeneration of muscle tissue.
24. Nerve tissue 1. Origin, general characteristics and classification. Nerve cells, neuroglial, neurosecretory cells, paraneurons. Types of nerve processes.
25. Nerve tissue 2: Nerve fibers, formation of myelin, synapses, Neurotransmitters, nerve endings (receptors, neuromuscular junction).
26. Embryology – introduction. Male and female sex cells, Gametogenesis (spermatogenesis, spermiogenesis, oogenesis), ovulation, fertilization.
27. Cleavage, blastogenesis, implantation. Assisted reproduction.
28. Formation of two – and three-layered germinal disk (gastrulation).
29. Germ layers: Amnion and chorion. Yolk sac, allantois, placenta, umbilical cord. Embryonic circulation. Twins.
30. Teratology. Malformations caused of genetic and environmental factors. Teratogens.

**THEMATIC PLAN**  
**PRACTICAL EXERCISES OF CYTOLOGY AND HISTOLOGY**  
**I SEMESTER**

**1. Light and electron microscope – structure and usage. Preparation of permanent histological slides. The cell. External cell morphology.**

Slides:

1. Ovarium, HE – spherical cells.
2. Intestinum tenuae, HE – cylindrical cells.
3. Medulla spinalis, HE – multipolar cells.
4. Cerebellum, AgNO<sub>3</sub> – pear-like cells.
5. Cerebrum, AgNO<sub>3</sub> – pyramidal cells.

**2. Internal cell morphology: Cell membrane, endoplasmic reticulum, ribosomes.**

Slides:

1. Omentum majus, AgNO<sub>3</sub>.
2. Duodenum, HE.
3. Medulla spinalis, Nissl.

**3. Internal cell morphology: Mitochondria, lysosomes, Golgi apparatus.**

Slides:

1. Ren, HE.
2. Ganglion spinale, AgNO<sub>3</sub>.

**4. Internal cell morphology: Nucleus, cytocenter.**

Slides:

1. Hepar, HE.
2. Duodenum, HE.
3. Blood smear, Gimza.

**5. Internal cell morphology: Specialized cytoplasmic structures and cell inclusions.**

Slides:

1. Hepar, PAS reaction.
2. Glandula suprarenalis, Sudan III.
3. Pancreas, Brache.
4. Ren, Burnstone staining.

**6. Seminar: Cytology**

Theoretical part: Light and electron microscope – structure and usage. Organelles.

Practical part: Identification and description of histological slides.

**7. Epithelial tissue: Surface epithelium – simple, cuboidal, columnar, pseudostratified columnar ciliated, transitional and stratified simple epithelium (keratinized and nonkeratinized).**

Slides:

1. Omentum majus, AgNO<sub>3</sub>.
2. Glandula thyroidea, HE.

3. Intestinum tenuae, HE.
4. Trachea, HE.
5. Ureter, HE.
6. Oesophagus, HE.
7. Cornea, HE.
8. Cutis, HE.

## **8. Glandular epithelium.**

Slides:

1. Intestinum tenuae, Mucicarmin.
2. Intestinum crassum, HE.
3. Glandula parotis, HE.
4. Glandula sublingualis, HE.
5. Glandula submandibularis, HE.
6. Pancreas, HE.

## **9. Connective tissue: Embryonal connective tissue, loose and dense connective tissue**

Slides:

1. Funiculus umbilicalis, HE.
2. Placenta, HE.
3. Hypoderma, HE.
4. Tendo, Van-Gizon.
5. Aorta, Orceine.
6. Nodus lymphaticus, AgNO<sub>3</sub>.

## **10. Supporting connective tissue: Cartilage and bone connective tissue. Blood.**

Slides:

1. Trachea, HE.
2. Epiglottis, Orceine.
3. Bone, Shmorl.
4. Blood smear, Gimza.
5. Bone marrow, Gimza.

## **11. Muscle tissue: Smooth, skeletal and cardiac muscle tissue.**

Slides:

1. Intestinum tenue, HE.
2. Lingua, HE.
3. Lingua, FeH.
4. Cor, HE.

## **12. Nerve tissue: Neurons and neuroglia.**

Slides:

1. Medulla spinalis, HE.
2. Medulla spinalis, AgNO<sub>3</sub>.
3. Ganglion spinale, AgNO<sub>3</sub>.
4. Cerebrum, HE.
5. Cerebrum, AgNO<sub>3</sub>.
6. Cerebellum, HE.
7. Cerebellum, AgNO<sub>3</sub>.
8. Cerebrum, Au-sublimate.



### **13. Nerve tissue: Nerves, receptors and synapses.**

Slides:

1. Spinal nerve, AgNO<sub>3</sub>.
2. Nervus spinalis, Azan.
3. Ganglion spinale, HE.
4. Hypoderma – Vater-Pacini corpuscles, HE.

### **14. SEMINAR: HYSTOLOGY**

Theoretical part: Epithelial tissue. Connective tissue. Muscle tissue Nerve tissue.

Practical part: Identification and description of histological slides.

### **15. Embryology.**

Slides:

1. Ovarium, HE.
2. Ovarium, Azan.
3. Testis, HE.
4. Testis, Azan.
5. Uterus, HE.

## **SYNOPSIS**

### **CYTOLOGY AND HISTOLOGY**

1. Subject, purpose and history of the cytology.
2. Introduction in cytology. Methods of the cell study. Principles of cytological and histological investigation, cytochemistry, immunohistochemistry and in situ hybridization.
3. Methods of cell study – preparation of permanent histological slide.
4. Methods of cell study – microscope and different types of microscopes.
5. The cell – chemical composition. Hyaloplasm.
6. The cell – external morphology.
7. The cell – internal morphology and organization.
8. The cell membrane – structure and functions. Glycocalyx (cell coat).
9. The cell membrane – specialized structures of the cell membrane, intercellular junctions.
10. Membranous cell organelles – endoplasmic reticulum.
11. Membranous cell organelles – mitochondria.
12. Membranous cell organelles – Golgi apparatus. Secretory vesicles, coated vesicles.
13. Membranous cell organelles – lysosomes. Peroxisomes.
14. Cell nucleus – structure of interphase nucleus: chromatin, nucleolus, nuclear matrix.
15. Cell nucleus. Ultrastructural organization: Structure of the nuclear envelope – nuclear pores.
16. Cell nucleus – chromosomes, structure and replication of DNA.
17. Nonmembranous cell organelles – ribosomes, polyribosomes.
18. Nonmembranous cell organelles – microtubules and cytofilaments.
19. Nonmembranous cell organelles – cytocenter.
20. Specialized cell organelles. Cell inclusions.
21. Cytophysiology – vital and mitotic cycle of the cell. Amitosis, mitosis, meiosis.
22. Cytophysiology – cellular metabolism, transmembrane transport.
23. Cytophysiology – cellular signaling, cellular reactivity and motility.
24. Cytophysiology – cellular differentiation, growth, aging and death.
25. General histology – introduction. Tissues – definition, general features, classification.
26. Epithelial tissue – general features, types of epithelial tissue.
27. Epithelial tissue – surface epithelium.
28. Epithelial tissue – glandular epithelium.
29. Connective tissue – general features and classification.
30. Connective tissue – connective tissues with non-differentiated intercellular substance.
31. Connective tissues – connective tissues with fibrous intercellular substance.
32. Connective tissues – connective tissues with dense intercellular substance.
33. Blood and lymph – blood and lymph plasma: content, antibodies
34. Morphology and function of erythrocytes, leucocytes, thrombocytes.
35. Erythropoiesis – formation of erythrocytes.
36. Leukopoiesis – formation of granulocytes and agranulocytes.
37. Thrombocytopoiesis – formation of thrombocytes.
38. Muscle tissue – general features. Types of muscle tissue.

39. Muscle tissue – skeletal muscle tissue. Muscle contraction.
40. Muscle tissue – smooth and cardiac muscle tissue
41. Nerve tissue – general features. Neuroganglion cells: External and internal morphology. Neurosecretory cells.
42. Nerve fibers and their sheaths. Peripheral nerves.
43. Terminal section of nerve cells. Synapses – principle of organization, types.
44. Neuroglia – types and features.
45. Receptor and effector nerve endings – structure and functions.
46. Sex cells – female sex cells.
47. Sex cells – male sex cells.
48. Subject, tasks and methods of general embryology.
49. Spermato- and ovogenesis. Ovulation
50. Fertilization.
51. Segmentation, blastogenesis.
52. Cyclic changes in uterine mucosa.
53. Implantation.
54. Formation of germ layers and axial organs.
55. Derivatives of germ layers. Disturbances in the development – mutations
56. Formation and development of embryonic envelopes.
57. Placentation. Structure of the placenta. Umbilical cord.
58. Fetal blood circulation.
59. Teratology – teratogenic factors.

### **RECOMMENDED LITERATURE**

1. M. H. Ross, W. Pawlina. Histology : a text and atlas with correlated cell and molecular biology. 7th ed., Philadelphia: Wolters Kluwer/Lippincott Williams & Wilkins Health, 2016.
2. A. L. Mescher (editor). Junqueira's basic histology: text and atlas. 14th ed., New York: McGraw-Hill Education, 2016.
3. T.W. Sadler. Langman's medical embryology. 13th ed., Philadelphia: Wolters Kluwer Health/Lippincott Williams & Wilkins, 2014.
4. Gary C. Schoenwolf, Steven B. Bleyl, Philip R. Brauer, Philippa H. Francis-West. Larsen's human embryology. 5th ed., Philadelphia, PA: Elsevier/Churchill Livingstone, 2015.
5. Leslie P. Gartner. Color Atlas and Text of Histology. 7th ed., Wolters Kluwer Health/Lippincott Williams & Wilkins, 2017.

September 2019

Head of the Department: .....  
(Associate Professor Stefan Trifonov, MD, PhD)