UNIVERSITY "PROF. DR. ASEN ZLATAROV" – BURGAS

MEDICAL FACULTY

DEPARTMENT OF ANATOMY, HISTOLOGY, EMBRYOLOGY, PATHOLOGY, FORENSIC MEDICINE AND ETHICS

Approved by:

DEAN

/Prof. Rumyana Yankova, PhD/ /

S Y L L A B U S

Discipline:	**CYTOLOGY, GENERAL HISTOLOGY AND EMBRYOLOGY**
Specialty:	**MEDICINE**
Professional field:	**7.1. Medicine**
Educational and qualification degree:	**MASTER**
Form of training:	**REGULAR**

Burgas, 2024

EXTRACTS FROM THE CURRICULUM

1. GENERAL PARAMETERS OF THE DISCIPLINE			
Total (academic hours):	180	**ECTS:**	6
Auditorium classes	**Non-auditorium classes**	**Auditorium ECTS**	**Non-auditorium ECTS**
90	**90**	**3**	**3**
Type of Discipline:	**Academic hours per week: /lectures + practices/**	*Course:*	*Semester:*
Mandatory	3 + 3	I	I

2. STUDY FORMS					
Auditorium classes:	**Academic hours**	**ECTS**	**Non-auditorium classes:**	**Academic hours**	**ECTS**
Lectures	45	1.5	**Consultation**	30	1
Practices	45	1.5	**Individual work**	60	2

3.EVALUATION AND CONTROL	
Forms of evaluation and control	**Relative share in the total score**
Sessional evaluation: exam	**0.4**
Semester (ongoing) assessment:	**0.6**
Forms of semester control:	
- Colloquium	**0.7**
- Evaluation of the protocol notebook	**0.3**

ANNOTATION

of the discipline "Cytology, general histology and embryology"

The course of cytology, general histology and embryology aims to provide in medical students basic knowledge about the structural organization and functions of cells and tissues as well as formation and development of the human embryo.

Structure of the learning content:

Cytology – studying the structure of the eukaryotic cells:

- ✓ Plasma membrane (plasmalemma) - structural, ultrastructural and chemical organization, cell contacts, specialization the cell surface - cilia, flagella, microvilli, basolateral folds, transport of the substances through the cell membrane;
- ✓ Cell organelles - light-microscopic, ultra-microscopic characteristics, chemical composition, functions;
- ✓ Specialized cell organelles - light-microscopic, ultramicroscopic characteristics, chemical composition, functions;
- ✓ Nucleus in interfase- number, shape, elements of nucleus - ultramicroscopic characteristic;
- ✓ Cell division. Mitosis - phases;
- ✓ Cytophysiology.

General Histology – studying the main tissues of the human body – histogenesis, lightmicroscopical, electronmicroscopical, histochemical and functional characteristics: epithelial tissue, connective tissue, blood tissue, muscle tissue, nervous tissue, reproductive tissue.

Embryology – studying the embryonal development and the initial stages of the fetal period, twins, anomalies in the human embryonal development.

Practical skills and knowledge of the discipline

In practical terms, students should:

- ✓ learn to work with a microscope by acquiring habits to protect the microscope and preparations from damage
- ✓ be able to recognize the different structures of the cell, as well as the types of tissues and their cells and intercellular substance
- ✓ be able to recognize the initial stages of prenatal development
- ✓ be able to recognize the cellular structures of electron-microscopic photographs
- ✓ acquire basic knowledge on the preparation of histological preparations

Teaching Tools:

Light-microscopic preparations, electronograms, atlases, collection of tests, multimedia presentations, discussions, demonstration of histological methods and tools, solving practical - clinically oriented.

Assessment of acquired knowledge.

Grading scores during the semester.

- ✓ Three midterm tests during the semester – cover each of the three main divisions: Cytology, General Histology and Embryology.

Final Exam:

- ✓ Practical exam
- ✓ Theoretical exam with a written part stored in the archive of the department and oral part.

Expected results

Students should have the following knowledge upon completion of the studies:

- ✓ general morphology of the eukaryotic cell: cell membrane - chemical composition, structural models, specialized structures of the cell membrane - intercellular contacts, microvilli, cilia. forms of transport across the cell membrane.
- ✓ cell organelles - obligatory, specialized and cell inclusions.
- ✓ cell nucleus in interphase and mitosis. nucleus in interphase – morphology, chromatin, nuclear envelope and pores, nucleolus and nuclear matrix. Cell division - mitosis; phases of mitosis.
- ✓ the characteristic microscopic and ultramicroscopic features of tissues - epithelial, connective, blood, muscle, nervous, sexual.
- ✓ general embryology -human development from a zygote to a full-fledged multicellular organism - embryonic development, as well as the early stages of the fetal period, formation and construction of the placenta.
- ✓ the main developmental disorders - embryopathies and fetopathies.

LECTURE TOPICS

Winter semester		
№	Topic	Hours
1	Life – a property of matter. Characteristics of living matter. The cell – a state of matter organization. Definition, general data. Chemical composition and hierarchy in cellular organization. Basic cytological terms.	1
2	External morphology of the cell. Internal morphology of the cell - cell structure classification. Biological membranes – definition, chemical composition, ultrastructure, relationships and functions. Plasmalemma and glycocalyx. Cytoplasmic matrix (intracellular matrix) (cytosol). Endoplasmic reticulum (ER). Ribosomes; polysomes.	2
3	Golgi apparatus. Lysosomes. Peroxisomes. Mitochondria.	2
4	The cytoskeleton – microfilaments, intermediate filaments and microtubules. Centrioles. Cytocenter. Derivatives of the centrioles – cilia and flagella. Specific cellular organelles. Cell inclusions. Specialized structures with plasmalemma participation on the apical, lateral, and basal surface of the cell.	3

5	Cell nucleus in interphase.	2
6	Cell physiology – cell metabolism, cell signaling, cell cycle. Mitosis. Cell reactivity, motility, differentiation, degeneration and death.	2
7	General Histology. Tissues - definition, classification, origin, general properties. Epithelial tissue – definition, characteristics, functions and classification. Covering epithelia (I).	2
8	Covering epithelia (II). Glandular epithelia.	2
9	Connective tissue – definition, origin, characteristics and classification. Cells of the connective tissue.	2
10	Connective tissue – extracellular matrix. Tissue fluid. Connective tissue proper (loose, dense). Mucous tissue. Elastic tissue. Reticular tissue. Adipose tissue.	2
11	Cartilagenous and osseous connective tissue. Chondrogenesis and osteogenesis.	2
12	Blood. Hemopoiesis.	3
13	Immune system.	2
14	Muscle tissue – definition, classification, origin and characteristics. Skeletal muscle tissue.	2
15	Cardiac muscle tissue. Smooth muscle tissue. Diffuse muscle cells with contractile functions (myoepithelial cells, myofibroblasts, myoid cells).	2
16	Nerve tissue – definition, classification of the cells, origin and characteristics. Neurons (nerve cells) – type, structure and functions. Neurosecretory cells. Paraneurons.	2
17	Neuroglia – types structure and functions. Nerve fibers. Nerve endings.	2
18	General embryology. Introduction to embryology. Meiosis and gametogenesis. Progenesis –spermatogenesis. Regulation. General organization of the male reproductive system.	2
19	Progenesis - ovogenesis. General organization of the ovary, the uterine tube and the uterus. Menstrual cycle in human endometrium. Hormonal regulation of the ovarian and endometrial functions.	2
20	Semen (seminal fluid). Insemination. Sperm migration in the female reproductive tract. Transport of the II order oocyte after ovulation. Ist and IInd week of the human development. Assisted reproductive technology.	2
21	IIIrd week of the human development (gastrulation).	2
22	IVth-VIIIth weeks of the development. Derivatives of ectoderm, mesoderm, endoderm. External view of the human embryo (IInd month). Embryonic and fetal membranes. Placentation and placenta. Umbilical cord. Twins and multiple births. Congenital abnormalities and malformation.	2
	Total hours	45

Practical exercises (seminars) – topics

Winter semester		
№	Topic	Hours
1.	Microscope - light and electron microscopes. Structure and proper use of the light microscope. Histological technique.	3
2.	CELL. External morphology of the cell.	3
3.	Internal morphology of the cell. Common type of organelles: plasma membrane and glycocalyx (cell coat), endoplasmic reticulum, ribosomes, Golgi apparatus, lysosomes, peroxisomes, mitochondria.	3
4.	Internal morphology of the cell: cytoskeleton (microfilaments, intermediate filaments, microtubules), centrioles. Specialized structures with plasma membrane participation on the apical, lateral and basal surface of the cell: microvilli, stereocilia, cilia and flagella, tight junctions (zonula occludens), desmosomes (macula adherens), junctional complex, gap junctions, interdigitations, canaliculi, hemidesmosomes, basal infoldings.	3
5.	Internal morphology of the cell – cell nucleus in interphase. Specific cellular organelles (myofibrils, secretory granules, synaptic vesicles, melanin granules). Cell inclusions.	3
6.	REVISION ON CYTOLOGY. Tissues. Epithelial tissue. Covering epithelia. Single-layer epithelia	3
7.	Epithelial tissue. Transitional epithelia. Multi-layer epithelia. Glandular epithelia.	3
8.	Connective tissue. Loose, collagenous, elastic, reticular and adipose tissue. Cartilaginous and osseous tissue.	3
9.	Blood. Hemopoiesis.	3
10.	Muscle tissue.	3
11.	Nerve tissue. I. Neurons (nerve cells). Neuroglia.	3
12.	Nerve tissue. II. Nerve fibers. Nerves endings.	3
13.	REVISION ON GENERAL HISTOLOGY. Embryology. Formation and development of the human embryo. Progenesis: spermatogenesis.	3
14.	Formation and development of the human embryo. Progenesis: ovogenesis. Menstrual cycle - morphological changes in the endometrium.	3
15.	Ist-VIIIth week of the human development. Bilaminar and trilaminar embryonic disk. Gastrulation. Primitive (Hensen's) node. Primitive streak. Neurulation. Notochord. Somites. Sclerotomes. Myotomes. Dermatomes. Embryonic and fetal membranes. Placentation and placenta. Umbilical cord. REVISION ON EMBRYOLOGY	3
	Total hours	**45**

Questionary

CYTOLOGY, GENERAL HISTOLOGY AND EMBRYOLOGY

Specialty "Medicine"

Educational and qualification degree "MASTER",

CYTOLOGY

1. Concept of life. Living matter - essential characteristics. Cell - definition and general data. Fundamentals of cell theory.
2. Cytological and histological research methods.
3. Chemical composition and hierarchy in the organization of the cell.
4. External morphology of the cell.
5. Classification and general characteristics of cell structures.
6. Biomembranes - characteristic, meaning, relationships and functions.
7. Plasmalemma. Glycocalyx.
8. Cellular matrix.
9. Endoplasmic reticulum.
10. Golgi apparatus (complex).
11. Lysosomes. Peroxisomes.
12. Mitochondria.
13. Cell nucleus in interphase - general data, chemical composition, optical-microscopic and electron-microscopic characteristics.
14. Chromosomes. Human karyotype.
15. Ribosomes. Polysomes.
16. Cell skeleton - microfilaments, intermediate filaments and microtubules.
17. Derivatives of microtubules - centrioles, basal bodies, cilia and flagella.
18. Specialized structures involving the plasmalemma on the apical, contact and basal surfaces of the cell (without cilia and flagella).
19. Specific cell organelles.
20. Cellular inclusions.
21. Transmembrane, intracellular and transcellular transport. Endocytosis and exocytosis.
22. Exchange of substances. Assimilation and dissimilation. Biosynthesis and secretion.
23. Cell signaling.
24. Life cycle of the cell.
25. Cell growth and differentiation.
26. Cell reproduction. Mitosis and amitosis.
27. Intracellular and cellular movements.
28. Irritability and reactivity of the cell.
29. Aging and cell death. Apoptosis.

GENERAL HISTOLOGY

30. Tissues – definition, classification, origin and general properties.
31. Epithelial tissue – definition, classification, origin, characteristics and functions.
32. Covering epithelia – definition, classification, distribution and histophysiology.

33. Exocrine glandular epithelia – definition, classification, distribution and histophysiology.
34. Endocrine glandular epithelia - definition, forms of organization, distribution and histophysiology.
35. Connective tissue – definition, classification, origin, characteristics and functions.
36. Cells of connective tissue.
37. Extracellular matrix of connective tissue.
38. Connective tissue – mesenchyme and mucous connective tissue.
39. Connective tissue - loose connective tissue.
40. Connective tissue - collagen, elastic, reticular and adipose tissue.
41. Connective tissue - cartilaginous tissue. Chondrogenesis.
42. Connective tissue with a calcified extracellular matrix - bone tissue. Osteogenesis.
43. Blood. Lymph.
44. Hematopoiesis – embryonic, fetal and postnatal.
45. Erythrocytes. Erythropoiesis.
46. Granulocytes. Granulocytopoiesis.
47. Monocytes. Monocytopoiesis. Lymphocytes. Lymphocytopoiesis.
48. Blood platelets (incl. formation)
49. Muscle tissue – definition, classification, origin, characteristics and functions.
50. Skeletal muscle tissue.
51. Cardiac muscle tissue.
52. Smooth muscle tissue.
53. Nerve tissue – definition, cellular composition, origin, characteristics and functions.
54. Neurons (neurocytes) - classification, structure, distribution and functions.
55. Synapse. Interneuronal (interneuronal) synapses.
56. Neurosecretory cells. Paraneurons.
57. Neuroglia - types, structure, distribution and functions.
58. Nerve fibers.
59. Receptor nerve endings.
60. Effector nerve endings.

EMBRYOLOGY

61. Subject, purpose, tasks, methods and relations of general embryology with other medical disciplines.
62. Meiosis and gametogenesis. Differences between male and female meiosis. Deviations in the normal course of meiosis.
63. Sperm - structure and function. Spermatogenesis.
64. Ovogenesis.
65. Ovulation. Structure and function of the mature egg cell.
66. Cyclic changes in the endometrium of a woman.
67. Semen (seminal fluid) - formation, components and characteristics.
68. Insemination. Sperm movement in the female genital tract. Order II oocyte transport after ovulation.
69. Fertilization.
70. I week of development - fragmentation, formation of the blastocyst.

71. Implantation.
72. II week of development – differentiation of trophoblast and embryoblast.
73. II week of development – development of the extraembryonic mesoderm.
74. Assisted reproduction.
75. III week of development – gastrulation (formation of embryonic mesoderm and endoderm).
76. III week of development – formation of the notochord.
77. Growth of the germinal disc.
78. III week of development – further changes in the trophoblast.
79. III - VIII week of development - derivatives of the ectodermal germ sheet.
80. III - VIII week of development - development of the mesodermal germ layer.
81. III - VIII week of development - differentiation of the paraxial mesoderm.
82. III - VIII week of development - differentiation of intermediate mesoderm and lateral plate mesoderm.
83. Embryonic circulation.
84. III - VIII week of development - derivatives of the endodermal germ sheet.
85. External view of the embryo in the second month.
86. Embryonic and fetal membranes.
87. Placentation and placenta.
88. Umbilical cord.
89. Twins and multiple births.
90. Congenital abnormalities and malformation. Prenatal diagnosis.

Textbooks and manuals:

1. Vladimir Ovcharov, Tsv. Takeva, Cytology, general histology, general embryology, 10th ed., 2023
2. Ross M and Pawlina W. Histology. A Text and Atlas with Correlated Cell and Molecular Biology. 7th ed. Lippincott Williams & Wilkins, 2015.
3. Gartner LP and Hiatt JL. Color atlas and Textboook of Histology. 6th ed. Saunders, 2014.
4. Sadler TW. Medical Embryology. 14th ed. Lippincott, William & Wilkins, 2018.
5. Anthony L. Mescher, Junqueira's Basic Histology, Text and Atlas, 15th ed, 2018

Programme developed by: ....

/Prof. Minko Minkov, MD, PhD /

.....

/Chief Assistant Ruska Nenkova, PhD /

Approved by a decision of the Council of the Department of Anatomy, Histology, Embryology, Pathology, Forensic Medicine and Ethics, Protocol №17/29.10.2024

Head of Department:..... .....
(Prof. Ivaylo Stefanov, MD, PhD)

Approved by a decision of the Council of the Faculty of Medicine, Protocol № 15/12.11.2024

Secretary of the Council of the Faculty of Medicine: . .....
(Chief Assis. Prof. Ruska Nenkova, PhD)

UNIVERSITY "PROF. DR. ASEN ZLATAROV" - BURGAS

MEDICAL FACULTY

DEPARTMENT OF PHYSICS, BIOPHYSICS, ROENTGENOLOGY AND RADIOLOGY

Approved by!

DEAN:

/Assoc. Prof. Rumyana Yankova, PhD/

SYLLABUS

Discipline:	**PHYSICS**
Specialty:	**MEDICINE**
Professional field:	**7.1. Medicine**
Educational and qualification degree:	**MASTER**
Form of training:	**REGULAR**

Burgas, 2023

EXTRACTS FROM THE CURRICULUM

1. GENERAL PARAMETERS OF THE DISCIPLINE			
Total (academic hours):	180	**ECTS:**	6

Auditorium classes	**Non-auditorium classes**	**Auditorium ECTS**	**Non-auditorium ECTS**
90	90	3	3

Type of Discipline:	**Academic hours per week: /lectures + practices/**	*Course:*	*Semester:*
Mandatory	3 + 3	**I**	**I**

2. STUDY FORMS					
Auditorium classes:	**Academic hours**	**ECTS**	**Non-auditorium classes:**	**Academic hours**	**ECTS**
Lectures	45	1.5	**Consultation**	30	1
Practices	45	1.5	**Individual work** - Preparation for colloquium - Preparation of protocols - Preparing for the exam	15 15 30	0.5 0.5 1

3. EVALUATION AND CONTROL	
Forms of evaluation and control	**Relative share in the total score**
Session evaluation: exam	**0.4**
Semester (ongoing) assessment:	**0.6**
Forms of semester control:	
- Attendance at classes	0.25
- Ongoing testing before each practical lesson	0.125
- Active participation in classes	0.125
- Control and tests	0.25
- Defense of protocols	0.25

ANNOTATION
of the discipline "Physics"

Purpose of the course:

The discipline "PHYSICS" is intended for the students of the specialty "Medicine" at the Faculty of Medicine, in a regular form of education, graduating with the educational-qualification degree "Master" and the professional qualification "Doctor". The discipline is mandatory according to the Uniform State Requirements (USR) of Bulgaria.

The aim of this Physics course is to provide students with knowledge of the application of physics to medicine. All areas of physics can be applied to medicine (mechanics, hydrodynamics, electromagnetism, thermodynamics, geometrical and quantum optics, nuclear physics). The human body is a very complex system. Concepts of modeling in physics are applied to simulate different activities of the human body systems. The development of new instrumentation and technology used for diagnosis and also for treatments is presented.

Main tasks of the curriculum:

- Knowledge and use of physical concepts, quantities and laws applied in medical practice.
- The discipline should acquaint the students with the physical principles of physiological processes, the main methods of diagnosis and treatment of the human body, many of which require in-depth knowledge of physics.
- Evaluation the human impact of a number of natural factors important for hygiene and prevention.
- Acquaintance with the principle of operation and the working methodology of various measuring devices used in clinical practice as ultrasound echographs, lasers with medical application, conventional radiographs and radioscopes, computer X-ray and magnetic resonance tomographs, nuclear medicine diagnostic and therapeutic instrumentation, etc.

Structure of learning content:

Elements of various sections of physics are studied, which are related to clinical practice and are necessary to build the mandatory physical foundation of future physicians. Basic concepts of mechanics, hydrodynamics of ideal and real fluids are introduced and then viscosity and blood flow as well as measuring of erythrocyte sedimentation rate, blood pressure, etc. are discussed. Mechanical vibrations and waves are studied and physical and psychophysical characteristics of sound are given. Ultrasound properties and diagnostic methods are presented. Molecular physics and structure of liquids and solids; temperature and heat concepts; basic laws of thermodynamics; heat exchange; electric field, electrical conductivity of a solids; direct and alternating current; physical foundations of electrodiagnostics; physical basis of electrotherapy; magnetic field; magnetic properties of matter; electromagnetic field applications in medicine are explained. Geometrical optics, the eye as an optical system; light and electron microscopes; external and internal photoelectric effect; optical atomic and molecular spectra; luminescence; lasers; nuclear magnetic resonance; X-rays properties and X-ray diagnostics; radioactivity; interaction of photon ionizing radiation with matter; dosimetric quantities and units; radionuclide diagnostics; action of ionizing radiation on the human body – all these sections of medical physics are studied and discussed.

Teaching methods: traditional and innovative teaching methods, explanation, lecture, discussion, experiment, computer modelling, multimedia presentation, projects, case studies, incidents, teamwork, etc. To illustrate the material, the lecture presentations include schematic

diagrams, computational examples based on basic dependencies, short demonstrations of physical phenomena, devices from clinical practice, or interactive software products are used. In the practical exercises, a physical experiment is conducted, demonstrations are made and computational problems are solved experimentally.

Forms of independent work: solving problems and tests; preparation of protocols of the practical exercises, including assessment and processing of individually obtained results; working with electronic courses in physics on the Internet; work on a given project (report).

Methods of assessment: current control during the practical exercises, colloquia on the main sections of the discipline and final control - theoretical exam.

Prerequisites for students' basic knowledge and skills: students should have good knowledge in general physics from the high school course and skills to apply the apparatus of elementary mathematics to calculate physical quantities and process experimental results.

Expected results:

Upon successful completion of the course in Physics, students should have the following knowledge and skills:

- know the basic physical quantities, units and laws used in medical practice;
- make a quantitative characterization of the physiological processes by measuring the relevant physical quantities;
- know the physical principles of the main methods of diagnosis and treatment of the human body;
- make a comparative assessment of the types of diagnostic equipment in terms of resolution, advantages and disadvantages compared to other research methods and field of application;
- evaluate the harmful factors of the environment on the human organism;
- perform physical measurements independently and present the results in tabular and graphical form, as well as to determine their uncertainty limits after their statistical processing.
- acquired practical skills: working with an audiometer; measurement of speed and volume of blood flow with a portable Doppler echograph; working with an ultrasonic analyzer; determination of viscosity of fluids; blood pressure measurement; osmotic pressure measurement; work with electrical measuring devices, function generator and oscilloscope; explanation of an electrocardiogram; study of the distribution of biological objects using a light microscope; determination of refractive index with a refractometer; determination of concentration of solutions with a photocolourimeter; working with a polarimeter and measuring the concentration of sugar solutions, etc.

CURRICULUM CONTENT

LECTURES

Topic	Hours
1. **Basic concepts of fluid mechanics.** Hydrostatics. Pascal's law. Hydrodynamics. Motion of ideal and real fluids. Viscosity. Laminar and turbulent motion. Blood pressure measurement. Phase separation in liquid heterogeneous systems - sedimentation, centrifugation, filtration. Newtonian and non-Newtonian fluids. Viscosity of solutions and suspensions. Blood viscosity. Erythrocyte sedimentation rate (ESR). Dynamics of erythrocyte centrifugation in blood plasma. Inertial and non-inertial reference systems. Rotation. Action of inertial forces on man.	3
2. **Sound**. Mechanical oscillations and waves. Sound waves. Physical characteristics of sound: pressure, intensity, frequency, wavelength, propagation speed, impedance, spectrum. Tone, noise and shockwaves. Extracorporeal lithotripsy. Psychophysical characteristics of sound. Hearing area. Loudness level and intensity level. Pitch and timbre. Hearing parameters. Physical mechanism of hearing aid action in man. Principles of noise protection. Acoustic methods for diagnosis and treatment. Ultrasound (US). Physical properties. US generators and detectors. Imaging diagnostics with US-techniques. The Doppler effect and examination. US therapy.	3
3. Molecular physics and thermodynamics. Kinetic molecular theory of gases. Gas laws. Phase diagrams. Physical properties of liquids. Surface tension and capillary action. Gas and fat embolism. Molecular structure of matter. Mechanical properties of solids. Types of deformations. Stress strain curve. Mechanical properties of biological tissues.	2
4. Atmosphere and air. Atmospheric pressure. Influence of atmospheric pressure on man. Role of surfactants in volume stability of alveoli. Static and dynamic volumes and capacities.	2
5. Temperature and heat. Temperature scales. Thermal expansion. Principles of thermodynamics. Transport phenomena: diffusion (hemodialysis), thermal conductivity, internal friction Types of heat exchange, laws. Thermoregulation in humans. Application of heat and cold in medicine.	4
6. Electricity. Electrostatic field. Polarization of dielectrics. Electric capacitance. Electrical conductivity of solids. Band theory. Electrical conductivity of metals. Intrinsic and impurity conductivity of semiconductors. Application of semiconductors in medicine. Direct current. Electric conductivity of electrolytes. Principle of medicinal electrophoresis. Batteries. Electric current in gases. Aeroions and aeroionotherapy.	3
7. **Magnetic field**. Magnetic induction. Magnetic field strength. The Biot-Savart law. Forces on currents in magnetic fields. Electromagnetic induction. Electromagnetic field. Alternating current. Basic values of alternating electric current. Alternating current in biological objects. Physical principles of electrical safety.	3
8. Physical foundations of **electric diagnostics and therapy**. Propagation of action potential. Electrocardiography (ECG). Electromyography (EMG), electroencephalography (EEG), electrogastrography (EGG). Direct and alternating current electrotherapy.	3

10. Biomagnetism and magnetobiology. Magnetic properties of substances. Physical nature of magnets – diamagnetism, paramagnetism and ferromagnetism. Magnetocardiography (MCG). Magnetotherapy. Electron Paramagnetic Resonance (EPR). The physics of NMR. Magnetic resonance imaging diagnostics (MRI or MRT).	2
11. Optics. Electromagnetic nature of light. EM spectrum. Photometric quantities and units. Geometrical optics. Optical fibers, cables, endoscopes. Polarized light. Interaction between light and matter: dispersion, absorption, light scattering. Nephelometry. UV and IR light in medicine. Lens parameters. Aberrations. Light microscope. Resolution of human eye and optical instrument. Microscopic observation techniques in clinical practice. Optical system of the eye. Refractive media and refractive power of the eye. Eye defects and correction. Dioptrometry. Perceptual system of the eye - spectral sensitivity.	6
12. Quantum optics. Electronic microscope. Thermal radiation. Solar radiation. Infrared diagnostics and therapy. Thermography. UV bands and properties. Types of optical transitions. Atomic and molecular spectra. Luminescence. External and internal photoelectric effect. Lasers. Parameters of laser radiation. Types of lasers. Application in medicine for diagnosis and therapy.	4
13. Ionizing radiation. Classification. Radioactivity. Alpha- and beta- radioactive conversion. Gamma rays. Interaction of charged particles with matter. X-rays. Interaction of photon ionizing radiation with matter. Dosimetric quantities and units. Equivalent dose Weighting factor. Tissue weighting factor and effective dose. Measuring devices.	3
14. X-ray diagnostics. Interaction of X-ray with matter. Methods of diagnostics. X-ray computed tomography. Biological effects of radiation. Radiation protection standards.	3
15. Nuclear medicine. Radionuclide generators. Common positron emitting radionuclides. PET/computed tomography. Advantages of PET/CT machines. Therapy with photon and corpuscular ionizing beams: deep X-ray therapy, telegamma therapy with ^{60}Co. LINACs generations. Brachytherapy. Radiosurgical techniques - gamma knife, linac based surgery, cyberknife. Hadrontherapy: n, p and heavy-ion beams. Radiation protection and safety in radiotherapy.	5
Total academic hours	45

PRACTICAL EXERCISES

Topic	Hours
1. Measurements of Physical quantities and Introduction to the Theory of Errors	3
2. Atmospheric Pressure. Humidity	3
3. Measurement of Blood Pressure	3
4. Determination of the Dynamic Coefficient of Liquids. Erythrocyte Sedimentation Rate. Rate of Dust Sedimentation	3
5. Determination of the Density of Solids and Liquids with a Pycnometer	3
6. Osmometer with Natural and Artificial Cylindrical Membrane **Colloquium I**	2 1
7. Determination the Spectral Characteristic of the Ear at the Hearing Threshold	3
8. Doppler Effect. Measurement of Particle Flow Velocity and Blood Flow Velocity	3
9. Electric Signals	3
10. Electrocardiogram	3
11. Determination of the Optical Power of Optical Lenses. The Eye as the Optical System	3
12. Measuring the Average Size of Micro-objects with a Microscope	3
13. Investigation of the Law of the Distribution of Biological Micro-objects to their Size Colloquium II.	2 1
14. Polarized Light. Determination of the Concentration of Optically Active Substances with the Polarimeter of Loran.	3
15. Basic Quantities in Medical Radiology.	3
Total academic hours	**45**

Background of Physics Examination
for students of the specialty "Medicine"

1. Hydrostatics. Pascal's law. Hydrodynamics. Motion of ideal fluids. Motion of real fluids. Viscosity. Laminar and turbulent motion. Blood pressure measurement.
2. Phase separation in liquid heterogeneous systems - sedimentation, centrifugation, filtration. Newtonian and non-Newtonian fluids. Viscosity of solutions and suspensions. Blood viscosity. Erythrocyte sedimentation rate (ESR). Dynamics of erythrocyte centrifugation in blood plasma. Inertial and non-inertial reference systems. Rotation. Action of inertial forces on man.

3. Mechanical oscillations and waves. Sound waves. Physical characteristics of sound: pressure, intensity, frequency, wavelength, propagation speed, impedance, spectrum. Tone, noise and shockwaves. Extracorporeal lithotripsy.
4. Psychophysical characteristics of sound. Hearing area. Loudness level and intensity level. Pitch and timbre. Hearing parameters. Physical mechanism of hearing aid action in man. Principles of noise protection. Acoustic methods for diagnosis and treatment - auscultation, percussion phonocardiography. Audiometry, auditory prosthetics.
5. Ultrasound (US). Physical properties. US generators and detectors. Imaging diagnostics with US-techniques. The Doppler effect and examination. US therapy.
6. Molecular physics and thermodynamics. Kinetic molecular theory of gases. Phase Diagrams. Physical properties of liquids. Surface tension and capillary action. Gas and fat embolism.
7. Molecular structure of matter. Mechanical properties of solids. Types of deformations. Stress strain curve. Mechanical properties of biological tissues.
8. Atmospheric pressure. Influence of atmospheric pressure on man. Role of surfactants in volume stability of alveoli. Static and dynamic volumes and capacities.
9. Temperature and heat. Temperature scales. Thermal expansion. Principles of thermodynamics.
10. Transport phenomena: diffusion (hemodialysis), thermal conductivity, internal friction Types of heat exchange, laws. Thermoregulation in humans. Application of heat and cold in medicine.
11. Electric charge. Electrostatics. Electric field strength and electric potential. Electric properties of substances. Polarization of dielectrics. Electric capacitance. Capacitors.
12. Electrical conductivity of solids. Band theory. Electrical conductivity of metals. Direct current. Intrinsic and impurity conductivity of semiconductors. Application of semiconductors in medicine. Direct current. Ohm's law. Microscopic view. Ohm's law for the part and entire circuit.
13. Electrical conductivity of electrolytes. Faraday's laws of electrolysis. Principle of medicinal electrophoresis. Electrochemical cells. Operating parameters of the batteries. Electric current in gases. Aeroions and aeroionotherapy.
14. Magnetic field. Magnetic induction. Magnetic field strength. The Biot-Savart law. Forces on currents in magnetic fields. Electromagnetic induction. Electromagnetic field.
15. Alternating current. Basic values of alternating electric current. Alternating current in biological objects. Physical principles of electrical safety.
16. Physical foundations of electrodiagnostics. Propagation of action potential. Electrocardiography (ECG). Electromyography (EMG), electroencephalography (EEG), electrogastrography (EGG). Direct and alternating current electrotherapy.
17. Magnetic properties of substances. Physical nature of magnets – diamagnetism, paramagnetism and ferromagnetism. Magnetocardiography (MCG). Magnetotherapy.
18. Electron Paramagnetic Resonance (EPR). The physics of NMR. Magnetic resonance imaging diagnostics (MRI or MRT).
19. Optics. Electromagnetic nature of light. EM spectrum. Photometric quantities and units. Geometrical optics. Optical fibers, cables, endoscopes. Polarized light.
20. Interaction between light and matter. Dispersion, Absorption of light, photocolorimetry. Light scattering. Nephelometry. UV and IR light in medicine.
21. Spherical lenses – types. Thin and thick lenses. Lens parameters. Aberrations. Light microscope. Resolution of human eye and optical instrument. Microscopic observation techniques in clinical practice.
22. Optical system of the eye. Refractive media and refractive power of the eye. Eye defects and correction. Dioptrometry. Perceptual system of the eye - spectral sensitivity.

23. Quantum physics. De Broglie waves. Electronic microscope. Thermal radiation. Solar radiation. Infrared diagnostics and therapy. Thermography. UV bands and properties.
24. Types of optical transitions. Atomic and molecular spectra. Luminescence. External and internal photoelectric effect. Photoconverters, types.
25. Lasers. Normal and inverse population; spontaneous and stimulated emission. Schematic diagram of a laser. Parameters of laser radiation. Types of lasers. Application in medicine for diagnosis and therapy.
26. Ionizing radiation. Classification. Radioactivity. Alpha- and beta- radioactive conversion. Gamma rays. Interaction of charged particles with matter. X-rays. Interaction of photon ionizing radiation with matter.
27. Dosimetry of ionizing radiation. Dosimetric quantities and units. Equivalent dose Weighting factor. Tissue weighting factor and effective dose. Measuring devices.
28. Imaging diagnostics methods. Interaction of X-ray with matter. Methods of X-ray diagnostics. X-ray computed tomography. Biological effects of radiation. Radiation protection standards.
29. Physical basis of radionuclide diagnostics. Radionuclide generators. Common positron emitting radionuclides. PET/computed tomography. Advantages of PET/CT machines.
30. Therapy with photon and corpuscular ionizing beams: deep X-ray therapy, telegamma therapy with 60Co. LINACs generations. Brachytherapy. Radiosurgical techniques - gamma knife, linac based surgery, cyberknife. Hadrontherapy: n, p and C-ion beams. Radiation protection and safety in radiotherapy.

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2. Todorov V., Medical Physics, Medicine and physical education, Sofia, 1995.
3. Sultanova N., Physics, Prof. Dr. Assen Zlatarov University, Bourgas, 2014.
4. Medical Physics, Lectures in General Physics for Medical Sciences Students, available from https://www.researchgate.net/publication/321319390 .
5. An Introduction to Medical Physics, Editor Muhammed Maqbool, © Springer International Publishing AG 2017.
6. Radiation Oncology Physics: A Handbook for Teachers and Students , International Atomic Energy Agency, Vienna, 2005.
7. Nikolaeva, Z., N. Sultanova, St. Kasarova, Z. Dimitrova, Manual for laboratory exercises in physics, University "Prof. Dr. Asen Zlatarov", Burgas, (2015).
8. Nikolaeva, Z., A. Petrakiev, Z. Dimitrova, V. Georgieva, Manual for laboratory exercises in biophysics and biophysical methods for purification, University "Prof. Dr. Asen Zlatarov", Burgas, (2006).
9. Alexandrova, M., Manual for Laboratory Exercises and Workbook in Medical Physics, Medical University, Pleven, ISBN 978-954-756-245-5, 2020.
10. Bechev, B., D. Vladimirova, etc. Medical Physics, Exercise Book, TEMTO, ISBN 978-954-9566-73-4, 2014.

Students are encouraged to use any other available textbook in Medical Physics covering the above topics.

Compiled by:

(Prof. Dr. Nina Sultanova)

Practical exercises compiled by:

(Assoc. Prof. Dr. Zdravka Nikolaeva)

Approved by a decision of the Council of the Department of Physics, Biophysics, Roentgenology and Radiology, Protocol № 19/ 7.11.2023

Head of Department ....

(Assoc. Prof. Dr. Stefka Kasarova)

Approved by a decision of the Faculty Council of the Medical Faculty, Protocol № 46/09.11.23г.

Secretary of the Council of the Medical Faculty: ..

(Chief assist. Prof. Ruska Nenkova, PhD)

UNIVERSITY "PROF. DR. ASEN ZLATAROV" - BURGAS

MEDICAL FACULTY

DEPARTMENT OF PHYSIOLOGY, PATHOPHYSIOLOGY, CHEMISTRY AND BIOCHEMISTRY

Approved by!

DEAN:....

/Assoc. Prof. Rumyana Yankova, PhD/

SYLLABUS

Discipline:	**CHEMISTRY**
Specialty:	**MEDICINE**
Professional field:	**7.1. Medicine**
Educational and qualification degree:	**MASTER**
Form of training:	**REGULAR**

Burgas, 2024

EXTRACTS FROM THE CURRICULUM

1. GENERAL PARAMETERS OF THE DISCIPLINE			
Total (academic hours):	210	**ECTS:**	7
Auditorium classes	**Non-auditorium classes**	**Auditorium ECTS**	**Non-auditorium ECTS**
105	105	3.5	3.5
Type of Discipline:	**Academic hours per week: /lectures + practices/**	*Course:*	*Semester:*
Mandatory	4 + 3	**I**	**I**

2. STUDY FORMS					
Auditorium classes:	**Academic hours**	**ECTS**	**Non-auditorium classes:**	**Academic hours**	**ECTS**
Lectures	60	2.0	**Consultation**	30	1
Practices	45	1.5	**Individual work** - Preparation for colloquium - Preparation of protocols - Preparing for the exam	35 20 20	1.5 0.5 0.5

3.EVALUATION AND CONTROL	
Forms of evaluation and control	**Relative share in the total score**
Sessional evaluation: exam	**0.4**
Semester (ongoing) assessment:	**0.6**
Forms of semester control:	
- Attendance at classes	0.25
- Ongoing testing before each practical lesson	0.125
- Active participation in classes	0.125
- Control and tests	0.25
- Defense of protocols	0.25

ANNOTATION
of the discipline "Chemistry"

Purpose of the course:

The course "Chemistry" is designed for students of the specialty "Medicine", full-time form of study.

The aim of the Chemistry course is to provide students with knowledge of the basic chemical processes underlying metabolism, biological oxidation and related energy conversion, and the regulation, control and integration of chemical processes in organisms. The study of the chemical aspects of the molecular basis of life provides insights into the composition, structure and function of cellular components, into the chemical reactions and processes occurring in cells and their regulation, and explains their significance for the organism in norm and pathology. This approach is necessary for understanding and mastering the biochemical processes of the human body, pharmacology, clinical medicine and physiology, for discovering the causes of disease and prescribing therapy.

Main tasks of the curriculum:

Mastery of basic chemical concepts concerning the characteristics of metabolic processes in the body, in particular: buffer systems, enzymes, biological oxidation, chemical aspects of carbohydrate, amino acid and lipid metabolism; basic types of heterocyclic compounds and their biologically active derivatives. Introduction to instrumentation for the analysis of biological objects.

Structure of learning content:

- Chemical bond and structure of the molecule.
- Dispersion systems.
- Chemical kinetics and chemical equilibrium.
- Redox processes and redox systems.
- Hydrocarbons.
- Hydroxyl derivatives of hydrocarbons and thiols.
- Carbonyl derivatives of hydrocarbons.
- Carboxylic acids.
- Amino derivatives.
- Amino acids and peptides.
- Carbohydrates.
- Lipids.
- Heterocyclic compounds.

Teaching methods: traditional and innovative teaching methods, explanation, lecture, discussion, experiment, computer modelling, multimedia presentation, projects, case studies, incidents, teamwork, etc.

Forms of independent work: coursework of a referential type, problems for independent solving on topics from practical classes, written control work on sections of the curriculum, solving tests, elaboration of protocols for laboratory exercises, colloquia.

Methods of assessment: current control during the classes, colloquia on the main sections of the discipline and final control - theoretical exam.

Prerequisites for students' basic knowledge and skills:

Students should have a good basic knowledge of high school chemistry and the ability to work with substances, laboratory vessels and apparatus.

Expected results:

Upon successful completion of the course, students should have the following knowledge and skills:

- Understand the meaning and content of concepts such as concentration of solutions, reaction to the medium (and its determination), the importance and action of buffer systems in the body.
- To know the classification, structure and chemistry of biocatalysts.
- Know the nature of redox processes in the body (biological oxidation) and the basic principles of biological metabolism.
- Know the type of macroergic compounds and their place in metabolism.
- Know the chemical aspect of carbohydrate, amino acid and lipid metabolism.
- Know the main types of heterocyclic compounds and especially the biologically active substances based on them (enzymes, vitamins and hormones).
- To know the type of analysis devices used during the practical classes, to be familiar with their capabilities for the analysis of biological objects.
- To have the skills necessary to find solutions to specific problems, to perform basic operations and procedures to influence the objects under study, to work with laboratory equipment and apparatus, to observe health and safety conditions.
- To have acquired competences for scientific explanation of facts and phenomena, for application of experimental results, competences for observation, modelling, analysis, development of logical and creative thinking, development of independence, teamwork, self-control.

CURRICULUM CONTENT

LECTURES

Topic	hours
1. Chemical bond and structure of the molecule. 1.1. Nature of the chemical bond. Covalent bond. Method of valence bonds. Hybridization of atomic orbitals. Delocalized chemical bond. Method of molecular orbitals. 1.2. Ionic bond. Intermolecular interactions. Hydrogen bond - nature, types, meaning. Role of hydrogen bonds in stability and structure formation of molecules. Biological role. 1.3. Coordination compounds. Donor-acceptor (coordinative) bond. Classification and nomenclature. Spatial structure and isomerism. Stability of the complex ion. Chelates - biological significance.	4
2. Dispersion systems. 2.1. Solutions and solubility. Concentration of solutions. Solutions of weak and strong electrolytes. Equilibrium in solutions of weak electrolytes - dissociation constant. Strong electrolytes - activity and ionic strength. Equilibrium in solutions of weakly soluble ionic compounds - solubility product.	10

2.2. Colligative properties of dilute solutions: vapour pressure, boiling point, freezing point. Diffusion and osmosis. Biological significance. 2.3. Protolysis processes. Brønstedt and Lowry's notions of acids and bases. Strength of protoliths - pK_a and pK_b . Factors on which the strength of protoliths depends. Lewis's notions of acids and bases. 2.4. Hydrolysis processes. Hydrolysis rate and hydrolysis constant. Relationship between hydrolysis constant and protolysis constants. Biological significance of hydrolysis processes. 2.5. Autoprotolysis. Ion product of water. Hydrogen index. pH scale. Methods of pH determination. Physiological pH-values. 2.6. pH of buffer solutions - Henderson-Hasselbalch equation for acidic and basic buffer solutions. Buffer capacity. Biological significance. Blood buffers. 2.7. Colloid-dispersed systems. Classification. Structure of colloidal particles. Kinetic, optical and electrical properties of colloidal solutions. Solutions of high molecular weight compounds. Stability and coagulation of colloidal solutions. Biological significance.	
3. Chemical kinetics and chemical equilibrium. 3.1. Chemical reaction rates. Law of action of masses. Rate constant. Mechanism of chemical reactions. Molecularity and order. Kinetic equations. 3.2. Effect of temperature on the rate of chemical reactions. Active complex. Activation energy - Arrhenius equation. 3.3. Criteria for determining the direction of chemical processes and the associated basic thermodynamic quantities - enthalpy, entropy, free energy. Exergonic, endergonic and energetic processes. Compressed processes. Compounds with macroergic bonds. Examples of energetic reactions in living organisms. 3.4. Reversibility of chemical processes. Chemical equilibrium. Equation of the Vant Hoff reaction isotherm. Factors affecting chemical equilibrium.	4
4. Redox processes and redox systems. 4.1. Degree of oxidation (oxidation number). Oxidation-reduction processes. Modes of electron exchange and types of redox processes. 4.2 Reversible galvanic element. Electromotive force of galvanic elements. Redox potential. Nernst equation. Relationship between redox potential and equilibrium constant. Direction of redox processes. Features of biological oxidation. 4.3 Boundary-surface phenomena. Adsorption. Adsorption equilibrium. Adsorption isotherm. Exchange and selective adsorption. Lyotropic series. Application of adsorption processes.	4
5. Hydrocarbons. 5.1. Saturated fatty hydrocarbons. Alkanes - reactivity. Mechanism of radical chain substitution reactions (S_R). Cyclohexane - chair and bath conformation, equatorial and axial substituents. Free radicals and carcinogenesis.	4

5.2. Unsaturated fatty hydrocarbons (alkenes and alkynes) - properties. Acidity of alkynes. Mechanism of electrophilic addition reactions (A_E). Oxidation and polymerization of alkenes. 5.3. Aromatic hydrocarbons - properties. Criteria for aromatic character - Hueckel's rule. Mechanism of electrophilic substitution reactions (S_E). Orientation in the benzene nucleus. Activating and deactivating substituents, electronic effects. Polynuclear aromatic hydrocarbons with fused nuclei. Concept of carcinogens.	
6. Hydroxyl derivatives of hydrocarbons and thiols. 6.1. Alcohols and phenols - general characteristics. Reactivity, acidity and basicity. Chemical properties of alcohols and phenols. Biooxidation of methanol, ethanol and ethylene glycol. Toxicity of phenol. 6.2. Thioalcohols (mercaptans) - acid properties and oxidation reactions.	4
7. Carbonyl derivatives of hydrocarbons. Aldehydes and ketones - reactivity. Chemical properties. Mechanism of nucleophilic addition reactions(A_N). Oxidation-reduction reactions. Polymerization and polycondensation reactions. Role of aldol condensation in biological processes. Canicaro reaction. Major representatives of aldehydes and catenates. Quinones - structure and properties.	4
8. Carboxylic acids. 8.1. Monocarboxylic acids. Saturated and aromatic monobasic acids. More important representatives: formic, acetic, propionic, butyric, valerian and benzoic acids. Chemical properties. Relationship between structure and acidity (pKa). 8.2. Unsaturated monocarboxylic acids. Chemical properties and representatives: acrylic, methacrylic and oleic acids. Essential higher unsaturated fatty acids - linoleic, linolenic, arachidonic, eicosapentaenoic and docosahexaenoic acids (vitamin F). Role of ω-3 polyunsaturated acids in cardiovascular disease prevention. 8.3. Saturated dicarboxylic acids - properties and representatives (oxalic, malonic, succinic, glutaric, adipic acids). Unsaturated dicarboxylic acids - maleic and fumaric acids. Aromatic dicarboxylic acids - phthalic, isophthalic and terephthalic acids. 8.4. Hydroxycarboxylic acids (fatty and aromatic) - structure and properties. Representatives - lactic acid, β-hydroxybutyric acid, tartaric, citric and salicylic acids. Drugs - derivatives of salicylic acid. 8.5. Aldehyde- and ketocarboxylic acids - structure and properties. More important representatives - glyoxalic, pyruvic, acetoacetic, oxaloacetic acids. Acids involved in the Krebs cycle. Ketone bodies - biological significance. 8.6. Carbonic acid and derivatives - uric acid, urethanes, urea, ureides, biuret, guanidine, creatine, creatine phosphate, creatinine. Biological significance.	8
9. Amino derivatives. Amines. Fatty and aromatic amines. Basic nature of amines (pK_b). Physical and chemical properties. Biogenic amines. Amides of medicinal importance - phenacetin and paracetamol. Biologically important amino alcohols - collamine, choline.	2

Acetylcholine - biological role. Catecholamines - dopamine, adrenaline, noradrenaline.	
10. Amino acids and peptides. 10.1. Amino acids - classification, representatives. Essential amino acids. Chemical properties - reactions associated with the amine and carboxyl group. Heating behavior. Lactam-lactam tautomerism. Biological significance of amino acids. 10.2. Peptides - peptide bond stereochemistry. Biologically important peptides - glutathione, vasopressin, oxytocin, insulin.	2
11. Carbohydrates. 11.1. Carbohydrates. Classification. Monosaccharides - structure, representatives (mannose, galactose, fructose, ribose and deoxyribose), stereoisomerism. Semi-acetal forms of monosaccharides. Structure of vitamin **C** and its role as an antioxidant. 11.2. Chemical properties of monosaccharides - oxidation reactions, reduction to polyvalent alcohols, reactions for carbonyl and hydroxyl groups. Biologically important esters. Alkylation and formation of glycosides. 11.3. Disaccharides. Types of binding of monosaccharide residues. Reducing and non-reducing disaccharides - structure and properties. Homopolysaccharides and heteropolysaccharides - structure and properties. Representatives.	4
12. Lipids. 12.1. Lipids - classification. Hydrolyzable lipids - structure, properties, representatives. Chemical aspects of biological oxidation of fats. Phospholipids - types and biological significance. 12.2. Non-hydrolyzable lipids. Terpenes and steroids. More important representatives of biological importance - carotene and retinol (vit. A). Retinal - chemical aspects of visual perception. Cholesterol and vitamin D.	2
13. Heterocyclic compounds. 13.1. Heterocyclic compounds - classification. Heterocyclic compounds with a pentatomic ring and one heteroatom (furan, pyrrole, thiophene). Structure and chemical properties. Biologically active substances with pyrrole structure. 13.2. Heterocyclic compounds with a pentatomic ring and two heteroatoms (pyrazole, imidazole and thiazole). Structure and more important chemical properties. Biologically active substances with pyrazole, imidazole and thiazole structures. 13.3 Heterocyclic compounds with a hexatoms ring and one heteroatom (pyridine). Structure and basic chemical properties. Biologically active substances with pyridine structure. 13.4. Heterocyclic compounds with a six-atom ring and two heteroatoms. Pyrimidine. Barbituric acid and barbiturates. Pyrimidine bases - cytosine, uracil, thymine. 13.5 Bicyclic heterocyclic compounds with fused nuclei. Pteridine - structure and properties. Purine group. Structure and properties of purine. Oxygen derivatives of purine - hypoxanthine, xanthine and picric acid. Purine bases - adenine and guanine.	8

13.6. Nucleic acids (DNA and RNA) - concept. Alkaloids - general characteristics. Nicotine, atropine, cocaine, quinine and morphine. Morphine derivatives - codeine and heroin. Physiological action.	
Total:	**60**

OPERATIONS

Topic	Hours
1. Rules for work in the laboratory. Safety technique. Solutions. Concentration of solutions - types. Conversion of molar to normal concentration. Preparation of solutions of specified concentration.	3
2. Acid-base interactions. Brønsted-Lowry theory. Protolysis constants. Hydrogen index. Methods for calculating and measuring the pH of solutions. Acid-base indicators and pH-meters.	3
3. Buffers. Definition and biological significance. Henderson-Hasselbach equation. Preparation of buffers.	3
4. Redox interactions. Oxidants as disinfectants in medical practice. Potassium permanganate - application in medicine and analytical chemistry. Permanganometry.	3
5. Complexation processes. EDTA - structure and properties of polydentate ligand. Chelate complexes. Experimental determination of total water hardness.	3
6. Rate of chemical reactions. Law of action of masses. Rate constant. Effect of temperature on the rate of chemical reactions. Dependence of chemical reaction rates on the concentration of reactants.	3
7. Reversibility of chemical processes. Chemical equilibrium. Equation of the reaction isotherm of Vant Hoff. Factors affecting chemical equilibrium. Preparation of potassium chromate.	3
8. Colloquium I.	3
9. Hydroxyl derivatives. Comparative consideration of alcohols and phenols. Analytical reactions in glycerol and phenol.	3
10. Carbonyl derivatives. Reactivity of aldehydes and ketones. Mechanism of A_N reactions. Analytical reactions for aldehyde group, aldol condensation, Canizzaro reaction, detection of acetone in urine - Legall's sample.	3
11. Carboxyl derivatives. Acidic properties - protolysis constants. Mechanism of S_N reactions. Esterification. Decarboxylation.	3
12. Amines. Basic properties - protolysis constants. Comparison of fatty and aromatic amines. Interaction with nitrous acid.	3
13. Amino acids. Essential α-amino acids. Isoelectric point. Peptides. Structure of a peptide bond.	3
14. Carbohydrates. Monosaccharides - structure, optical activity and chemical properties. Relation of glucose and fructose to weak oxidants. Reducing and non-reducing disaccharides. Polysaccharides.	3
15. Colloquium II.	3
Total:	**45**

BACKGROUND
for Chemistry exam
for students of the specialty "Medicine"

1. Nature of the chemical bond. Covalent bond. Method of valence bonds. Hybridization of atomic orbitals. Delocalized chemical bond. Method of molecular orbitals.

2. Ionic bond. Intermolecular interactions. Hydrogen bond - nature, types, meaning. Role of hydrogen bonds in stability and structure formation of molecules. Biological role.

3. Coordination compounds. Donor-acceptor (coordinative) bond. Classification and nomenclature. Spatial structure and isomerism. Stability of the complex ion. Chelates - biological significance.

4. Solutions and solubility. Concentration of solutions. Solutions of weak and strong electrolytes. Equilibrium in solutions of weak electrolytes - dissociation constant. Strong electrolytes - activity and ionic strength. Equilibrium in solutions of weakly soluble ionic compounds - solubility product.

5. Colligative properties of dilute solutions: vapour pressure, boiling point, freezing point. Diffusion and osmosis. Biological significance.

6. Protolysis processes. Brönsted and Lowry's notions of acids and bases. Strength of protoliths - pK_a and pK_b . Factors on which the strength of protoliths depends. Lewis's notions of acids and bases.

7. Hydrolysis processes. Degree of hydrolysis and hydrolysis constant. Relationship between hydrolysis constant and protolysis constants. Biological significance of hydrolytic processes.

8. Autoprotolysis. Ion product of water. Hydrogen index. pH scale. Methods of pH determination. Physiological pH-values.

9. pH of buffer solutions - Henderson-Hasselbalch equation for acidic and basic buffer solutions. Buffer capacity. Biological significance. Blood buffers.

10. Colloid-dispersed systems. Classification. Structure of colloidal particles. Kinetic, optical and electrical properties of colloidal solutions. Solutions of high molecular weight compounds. Stability and coagulation of colloidal solutions. Biological significance.

11. Chemical kinetics. Rate of chemical reactions. Law of action of masses. Rate constant. Mechanism of chemical reactions. Molecularity and order. Kinetic equations.

12. Effect of temperature on the rate of chemical reactions. Active complex. Activation energy - Arrhenius equation.

13. Criteria for determining the direction of chemical processes and related basic thermodynamic quantities - enthalpy, entropy, free energy. Exergonic, endergonic and energetic processes. Compressed processes. Compounds with macroergic bonds. Examples of energetic reactions in living organisms.

14. Reversibility of chemical processes. Chemical equilibrium. Equation of the reaction isotherm of Vant Hoff. Factors affecting chemical equilibrium.

15. Degree of oxidation (oxidation number). Oxidation-reduction processes. Modes of electron exchange and types of redox processes.

16. Reversible galvanic element. Electromotive force of galvanic elements. Redox potential. Nernst equation. Relationship between redox potential and equilibrium constant. Direction of redox processes. Features of biological oxidation.

17. Boundary-surface phenomena. Adsorption. Adsorption equilibrium. Adsorption isotherm. Exchange and selective adsorption. Lyotropic series. Application of adsorption processes.

18. Saturated fatty hydrocarbons. Alkanes - reactivity. Mechanism of radical chain substitution reactions (S_R). Cyclohexane - "chair" and "tub" conformation, equatorial and axial substituents. Free radicals and carcinogenesis.

19. Unsaturated fatty hydrocarbons (alkenes and alkynes) - properties. Acidity of alkynes. Mechanism of electrophilic addition reactions (A_E). Oxidation and polymerization of alkenes.

20. Aromatic hydrocarbons - properties. Criteria for aromatic character - Hueckel's rule. Mechanism of electrophilic substitution reactions (S_E). Orientation in the benzene nucleus. Activating and deactivating substituents, electronic effects. Polynuclear aromatic hydrocarbons with fused nuclei. Concept of carcinogens.

21. Alcohols and phenols - general characteristics. Reactivity, acidity and basicity. Chemical properties of alcohols and phenols. Biooxidation of methanol, ethanol and ethylene glycol. Toxicity of phenol.

22. Thioalcohols (mercaptans) - acidic properties and oxidation reactions.

23. Aldehydes and ketones - reactivity. Chemical properties. Mechanism of nucleophilic addition reactions(A_N). Oxidation-reduction reactions. Polymerization and polycondensation reactions. Role of aldol condensation in biological processes. Canicaro reaction. Major representatives of aldehydes and catenates. Quinones - structure and properties.

24. Monocarboxylic acids. Saturated and aromatic monobasic acids. More important representatives: formic, acetic, propionic, butyric, valerian and benzoic acids. Chemical properties. Relationship between structure and acidity (pKa).

25. Unsaturated monocarboxylic acids. Chemical properties and representatives: acrylic, methacrylic and oleic acids. Essential higher unsaturated fatty acids - linoleic, linolenic, arachidonic, eicosapentaenoic and docosahexaenoic acids (vitamin F). Role of ω-3 polyunsaturated acids in cardiovascular disease prevention.

26. Saturated dicarboxylic acids - properties and representatives (oxalic, malonic, succinic, glutaric, adipic acids). Unsaturated dicarboxylic acids - maleic and fumaric acids. Aromatic dicarboxylic acids - phthalic, isophthalic and terephthalic acids.

27. Hydroxycarboxylic acids (fatty and aromatic) - structure and properties. Representatives - lactic acid, β-hydroxybutyric acid, tartaric, citric and salicylic acids. Drugs - derivatives of salicylic acid.

28. Aldehyde- and ketocarboxylic acids - structure and properties. More important representatives - glyoxalic, pyruvic, acetoacetic, oxaloacetic acid. Acids involved in the Krebs cycle. Ketone bodies - biological significance.

29. Carbonic acid and derivatives - uric acid, urethanes, urea, ureides, biuret, guanidine, creatine, creatine phosphate, creatinine. Biological significance.

30. Amines. Fatty and aromatic amines. Basic nature of amines (pK_b). Physical and chemical properties. Biogenic amines. Amides of medicinal importance - phenacetin and paracetamol. Biologically important amino alcohols - collamine, choline. Acetylcholine - biological role. Catecholamines - dopamine, adrenaline, noradrenaline.

31. Amino acids - classification, representatives. Essential amino acids. Chemical properties - reactions related to amine and carboxyl group. Heat relationships. Lactam-lactam tautomerism. Biological significance of amino acids.

32. Peptides - peptide bond stereochemistry. Biologically important peptides - glutathione, vasopressin, oxytocin, insulin.

33. Carbohydrates. Classification. Monosaccharides - structure, representatives (mannose, galactose, fructose, ribose and deoxyribose), stereoisomerism. Semi-acetal forms of monosaccharides. Structure of vitamin C and its role as an antioxidant.

34. Chemical properties of monosaccharides - oxidation reactions, reduction to polyvalent alcohols, reactions for carbonyl and hydroxyl groups. Biologically important esters. Alkylation and formation of glycosides.

35. Disaccharides. Types of binding of monosaccharide residues. Reducing and non-reducing disaccharides - structure and properties. Homopolysaccharides and heteropolysaccharides - structure and properties. Representatives.

36. Lipids - classification. Hydrolyzable lipids - structure, properties, representatives. Chemical aspects of biological oxidation of fats. Phospholipids - types and biological significance.

37. Non-hydrolyzable lipids. Terpenes and steroids. More important representatives of biological importance - carotene and retinol (vit. A). Retinal - chemical aspects of visual perception. Cholesterol and vitamin D.

38. Heterocyclic compounds - classification. Heterocyclic compounds with a pentatomic ring and one heteroatom (furan, pyrrole, thiophene). Structure and chemical properties. Biologically active substances with pyrrole structure.

39. Heterocyclic compounds with a pentatomic ring and two heteroatoms (pyrazole, imidazole and thiazole). Structure and more important chemical properties. Biologically active substances with pyrazole, imidazole and thiazole structures.

40. Heterocyclic compounds with a six-atom ring and one heteroatom (pyridine). Structure and basic chemical properties. Biologically active substances with pyridine structure.

41. Heterocyclic compounds with a six-atom ring and two heteroatoms. Pyrimidine. Barbituric acid and barbiturates. Pyrimidine bases - cytosine, uracil, thymine.

42. Bicyclic heterocyclic compounds with fused nuclei. Pteridine - structure and properties. Purine group. Structure and properties of purine. Oxygen derivatives of purine - hypoxanthine, xanthine and picric acid. Purine bases - adenine and guanine.

43. Nucleic acids (DNA and RNA) - concept. Alkaloids - general characteristics. Nicotine, atropine, cocaine, quinine and morphine. Morphine derivatives - codeine and heroin. Physiological action.

BIBLIOGRAPHY

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4. Karen C. Timberlake, Chemistry- An introduction to General, Organic and biologica Chemistry, Tenth Edition, Person education, Inc. New Jesey, 2009
5. Karen C. Timberlake, Laboratory manual for General, Organic and Biological Chemistry: Structure of Life, Person Education, Inc. New Jesey, 2007
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7. Benjamin Abelow, Understanding Acid-Base, Williams &Wikins, Maryland, 2007
8. Ouellette R J, Introduction to General, Organic and Biological Chemistry, Prentice-Hall 1997 and new editions
9. Bruice P.Y., Organic Chemistry, 2003, Prentice Hall PTR eight and previous editions

Students can use any other textbook in chemistry covering above topics.

Compiled by: .....

(Assoc. Prof. Rumyana Yankova, PhD)

.....

(Assoc. Prof. Svetlana Zheleva, PhD)

Approved by a decision of the Council of the Department of Physiology, Pathophysiology, Chemistry and Biochemistry, Protocol №8/09.07.2024

Head of Department ....

(Assoc. Prof. Yordan Georgiev, PhD)

Approved by a decision of the Faculty Council of the Medical Faculty, Protocol №10/11.07.2024

Secretary of the Council of the Medical Faculty: ..

(Chief assist. Prof. Ruska Nenkova, PhD)

UNIVERSITY "PROF. DR. ASSEN ZLATAROV" – BURGAS

MEDICAL FACULTY

DEPARTMENT OF BIOLOGY, MEDICAL GENETICS, MICROBIOLOGY, MEDICAL PARASITOLOGY, CLINICAL LABORATORY AND IMMUNOLOGY

Approved by!
DEAN:
/Assoc. Prof. Rumyana Yankova, PhD/

SYLLABUS

Discipline:	**HUMAN BIOLOGY**
Specialty:	**MEDICINE**
Professional field:	**7.1 Medicine**
Educational qualification degree:	**MASTER**
Form of training:	**REGULAR**

Burgas, 2024

EXTRACTS FROM THE CURRICULUM

1. GENERAL PARAMETERS OF THE DISCIPLINE			
Total (academic hours):	270	**ECTS:**	9
Auditorium classes	**Non-auditorium classes**	**Auditorium ECTS**	**Non-auditorium ECTS**
105	165	3.5	5.5
Type of Discipline	**Number of hours per week: /lectures + practicals/**	*Cours:*	*Semester:*
Mandatory	2/2 + 2/2	**I**	**I, II**

2. STUDY FORMS					
Auditorium classes:	**Academic hours**	**ECTS**	**Non-auditorium classes:**	**Academic hours**	**ECTS**
Lectures	60	2	**Consultations**	45	1.5
			Individual work		
			- preparation for colloquiums	45	1.5
			- preparation for seminars - discussions	15	0.5
			- preparation of protocols	15	0.5
Practical sessions	45	1.5	- preparing an essay	45	1.5

3. ASSESSMENT AND CONTROL	
Forms of assessment and control	**Relative share in the total score**
Sessional evaluation: exam	0,4
Semester (ongoing) assessment:	0.6
Forms of semester control:	
- practical exam	0.4
- colloquiums	0.2
- tests	0.2
- defence of essay	0.2

ANNOTATION

of the discipline "Biology"

Purpose of the course

The "Human Biology" course is intended for students of the specialty "Medicine", first year, full-time form of study.

Objectives

The aim of the biology course is to form:

1. The understanding that living systems, including man, have hierarchically arranged levels of organization with their own peculiarities and regularities that determine biological properties and functions.

2. The understanding that man as a product of biological evolution is ecologically related to the nature and development of the biosphere as a whole.

3. The ability to apply biological laws as a natural science theory and methodology of medicine.

4. Practical ability to work in a research and clinical setting, and theoretical knowledge of basic biological research methods with application to medicine.

5. The understanding that the disorders in the molecular-biological, cellular-biological and immunological mechanisms are related to the development of pathology in humans.

6. Knowledge of modern methods of diagnosis and treatment based on medico-biological principles.

Structure of the learning content

The course "Human biology" provides an opportunity to acquire knowledge and skills in the following basic biological concepts:

- Molecular basis of life - biological macromolecules;
- Realization of genetic information - genetic code;
- Organization of genetic material in the cell;
- Karyotype;
- Mutational variability – types of mutations
- Genetic Engineering;
- Cell Biology;
- Reproduction of Organisms;
- Individual Development;
- Immunological Homeostasis;
- Morphology and biological cycle of the most medically important parasites.

Methods of teaching

The training is carried out through lectures and practical exercises according to the specified curriculum. The following aids are used: microscopes, permanent and temporary microscope preparations, multimedia presentations, tools and technical means for visualization and implementation of molecular-biology, cell-biology and immunology techniques, study notebooks and test books.

Forms of independent work

Participation in discussions, preparation and delivery of presentations on assigned topics, solving test tasks, preparation of protocols from laboratory exercises.

Assessment methods

Current control and final exam on students' knowledge of the discipline "Human Biology".

The grade of the current control is formed by the average grade from the colloquiums for each section, the practical exam and the grade from the semester combined test exam. The final determining of the assessment is also influenced by participation and performance in the various forms of independent work.

The final exam is held in the summer session of the 1st year (after the second semester) and includes questions from the lecture course from both semesters.

Expected results

After completing the studies in human biology and successful completion of the examination, students should have the following competencies:

- In the field of theoretical knowledge - in-depth theoretical knowledge of the molecular foundations of life - biological macromolecules, the realization of genetic information, the натуре of the genetic code and organization of the genetic material in the cell; gene and chromosomal mutations and related human diseases, genetic engineering, cell biology, biology of parasites, reproduction of organisms, individual development, immunological homeostasis,
- In the field of practical skills - microscopy, preparation of non-perishable microscopic preparations, determination of blood groups, mastering of immunological methods, skills for identification of main parasites of medical importance in humans, familiarization with the *in vitro* method and related modern assisted reproduction methods, recognition of normal and pathological human karyotype.

CURRICULUM CONTENT
LECTURES

№	Topic	hours
1.	Primary structure of DNA. Bonds in and between nucleotides. Secondary structure of DNA.	2
2.	RNA structure. Types of RNA and function.	2
3.	DNA replication. Mechanism of replication. DNA reparation.	2
4.	Transcription – mechanism, steps, factors. RNA polymerases. Maturation of RNA.	2
5.	Genetic code. Translation. Structure and function of proteins. Posttranslational modifications, aging and degradation of proteins.	2
6.	Genome organization in prokaryotic and eukaryotic cells. Regulation of gene expression.	2
7.	Submicroscopic structure of chromosomes. Normal and abnormal karyotype.	2
8.	Mutational variation. Gene mutations and diseases. Structural and numerical chromosome mutations. Cytoplasmic mutations. Mutational variability. Gene mutations and diseases. Chromosome mutations. Genomic mutations. Cytoplasmic mutations.	2
9.	Cell reproduction. Cell growth and division. Cell cycle - interphase, mitosis. Stages and mechanism of mitosis. Control of cell division.	2
10.	Sexual reproduction. Meiosis. Gametogenesis. Oogenesis.	2
11.	Spermatogenesis. Fertilization. Assisted reproduction.	2
12.	Individual development. Embryonic development in mammals and human. Postembryonic period – aging and death.	2
13.	Apoptosis. Mechanism. Genetic control of apoptosis.	2
14.	Tumor biology.	2
15.	Genetic engineering at the population, organismal and cellular level. Cloning.	2
16.	Recombinant DNA technologies (genetic engineering). Gene cloning. Gene therapy.	2
17.	Methods in molecular biology - *in situ* hybridization, PCR, qPCR, DNA sequencing. Genome editing. SNPs. Pharmacogenetics.	2
18.	Epigenetics. Mechanisms.	2
19.	Immune homeostasis. Innate immunity. Mechanical, chemical and physiological barriers. Phagocytosis. Inflammation. Soluble and cellular factors.	2
20.	Adaptive immunity. Structure and function of antibodies. Main classes of immunoglobulins. Polyclonal and monoclonal antibodies.	2
21.	Antigens. Haptens. ABO(H) system. Biosynthesis of ABO(H)-antigens. Rhesus system. Immunological conflict "mother - fetus".	2
22.	Central and peripheral lymphoid organs. Phases and nature of immune response. Primary and secondary immune response. Immunological memory.	2

23.	Cells of the immune response. Cellular interactions in immune response.	2
24.	T-cell receptor. Major histocompatibility complex (MHC).	2
25.	Transplantation. Types and immunologic mechanisms. Mechanisms of transplant rejection. Graft versus host reaction.	2
26.	Tumor immunology.	2
27.	Immune tolerance. Reproductive immunology.	2
28.	Genetics of antibody synthesis. Complement system.	2
29.	Hypersensitivity reactions.	2
30.	Immunobiology of HIV and SARS-CoV. Immunology of stress.	2
	TOTAL:	**60**

PRACTICAL SESSIONS

№	Topic	hours
	1st semester	
1.	Medico-biological devices and techniques. Light microscope - structure and operation.	2
2.	DNA and chromatin. Giant chromosomes from *Chironomus* larvae. Sex (X) chromatin in cells from buccal mucosa.	2
3.	Cell cycle and cell division. Mitosis, atypical forms of mitosis.	2
4.	Organization of genetic material in the cell. Karyotype.	2
5.	Cellular basis of sexual processes. Meiosis. Gametogenesis.	2
6.	Mammalian fertilization. *In vitro* fertilization.	2
7.	Immunogenetics. ABO (H) system. Determination of blood groups (agglutination). Inheritance of blood groups – building a phylogenetic tree.	2
8.	Immunological reactions. Agglutination, inhibition of agglutination, precipitation, immunofluorescence, immunoelectophoresis, ELISA, RIA.	2
9.	**Colloquium.**	1
	2nd semester - parasitology	
10.	Introduction to parasitology. Relationships between parasites and hosts.	2
11.	Phylum *Sarcomastigophora.* Subphyla *Mastigophora (Flagellata). Trichomonas hominis. Trichomonas vaginalis. Lamblia intestinalis (Giardia lamblia).*	2
12.	Phylum *Sarcomastigophora.* Subphyla *Mastigophora (Flagellata). Trypanosoma rhodesiense & Trypanosoma gambiense, (Trypanosoma brucei). Leishmania donovani. Leishmania tropica.* Subphyla *Sarcodina. Entamoeba histolytica. Entamoeba coli, Entamoeba hominis.*	2

13.	Phylum *Sporozoa (Apicomplexa). Plasmodium vivax. Plasmodium malariae. Plasmodium falciparum.*	2
14.	Phylum *Sporozoa (Apicomplexa). Toxoplasma gondii.* Phylum *Ciliophora.* Class Ciliata. *Balantidium coli.*	2
15.	Phylum *Platyhelminthes (Plathelminthes).* Class *Trematoda. Fasciola hepatica. Dicrocoelium lanceatum (Dicrocoelium dendriticum). Opisthorchis felineus.* Genus *Schistosoma.*	2
16.	Phylum *Platyhelminthes.* Class *Cestoda. Taenia solium. Taeniarhynchus saginatus (Taenia saginata). Diphyllobothrium latum. Hymenolepis nana. Echinococcus granulosus.*	2
17.	Phylum *Nematoda. Ascaris lumbricoides. Enterobius vermicularis. Trichocephalus trichiurus. Trichinella spiralis. Strongyloides stercoralis. Ancylostoma duodenale.*	2
18.	Phylum *Nematoda. Dracunculus medinensis. Wuchereria bankrofti. Loa loa.* Phylum *Arthropoda.* Subphyla Crustacea. Class *Cyclops.* Class *Arachnoidea (Arachnida,* arachnid).	2
19.	Phylum *Arthropoda.* Class *Arachnoidea (Arachnida.* arachnid). Order *Acari* (ticks) – *Sarcoptes scabiei,* genus *Dermatophagoides.*	2
20.	Phylum *Arthropoda.* Ticks - carriers of transmissible diseases: *Ixodes ricinus, Dermacentor marginatus, Hyalomma plumbeum, Rhipicephalus sanguineus,* Class *Insecta. Pediculus hominis. Phthirius pubis.*	2
21.	Phylum *Arthropoda.* Class *Insecta. Cimex lectularius. Pulex irritans.* Genus *Culex* and genus *Anopheles. Phlebotomus papatasii.*	2
22.	Role of insects in the spread of transmissible diseases. Role of insects as mechanical carriers of infectious and parasitic diseases.	2
23.	**Parasitology colloquium**	2
	TOTAL:	**45**

EXAMINATION QUESTIONNAIRE

Human biology for specialty "Medicine"
„MASTER" degree, professional qualification „DOCTOR"

I. MOLECULAR AND CELL BIOLOGY

1. Primary structure of DNA. Bonds in and between nucleotides. Secondary structure of DNA.
2. RNA structure. Types of RNA and function.
3. DNA replication. Mechanism of replication.
4. DNA reparation.
5. Transcription – mechanism, steps, factors.
6. RNA polymerases.
7. Maturation of RNA.

8. Genetic code. Translation.
9. Structure and function of proteins.
10. Posttranslational modifications, aging and degradation of proteins.
11. Genome organization in prokaryotic and eukaryotic cells.
12. Regulation of gene expression.
13. Submicroscopic structure of chromosomes.
14. Normal and abnormal karyotype.
15. Mutational variation. Gene mutations and diseases.
16. Chromosome and genomic mutations. Cytoplasmic mutations.
17. Cell reproduction. Cell growth and division. Cell cycle - interphase, mitosis.
18. Stages and mechanism of mitosis. Control of cell division.
19. Sexual reproduction. Meiosis.
20. Gametogenesis. Oogenesis. Spermatogenesis.
21. Fertilization. Assisted reproductive technology.
22. Individual development. Embryonic development in mammals and human.
23. Postembryonic period – aging and death.
24. Apoptosis. Mechanism.
25. Genetic control of apoptosis.
26. Tumor biology.

II. MODERN DIAGNOSTIC AND SCIENTIFIC APPROACHES

27. Genetic engineering at the population, organismal and cellular level.
28. Cloning.
29. Recombinant DNA technologies (genetic engineering).
30. Gene cloning. Gene therapy.
31. Methods in molecular biology - *in situ* hybridization,
32. PCR, qPCR, DNA sequencing.
33. Genome editing. SNPs.
34. Pharmacogenetics.
35. Epigenetics.

III. BASICS OF IMMUNITY

36. Immune homeostasis. Innate immunity. Mechanical, chemical and physiological barriers. Phagocytosis.
37. Inflammation. Soluble and cellular factors.
38. Adaptive immunity. Structure and function of antibodies. Main classes of immunoglobulins.
39. Polyclonal and monoclonal antibodies.
40. Antigens. Haptens.
41. ABO(H) system. Biosynthesis of ABO(H)-antigenes.

42. Rhesus system. Immunological conflict "mother - fetus".
43. Central and peripheral lymphoid organs.
44. Phases and nature of immune response. Primary and secondary immune response.
45. Immunological memory.
46. Cells of the immune response.
47. Cellular interactions in immune response.
48. T-cell receptor. Major histocompatibility complex (MHC).
49. Transplantation. Types of transplantation and immunologic basis of transplantation.
50. Mechanisms of transplant rejection. Graft versus host reaction.
51. Tumor immunology.
52. Immune tolerance.
53. Reproductive immunology.
54. Genetics of antibody synthesis.
55. Complement system.
56. Hypersensitivity reactions.
57. Immunobiology of HIV and SARS-CoV.
58. Immunology of stress.

IV. BIOLOGY OF PARASITES

59. **Characteristics of primates. Phylum *Sarcomastigophora.*** Subphyla *Mastigophora (Flagellata). Leishmania donovani. Leishmania tropica.*
60. **Phylum *Sarcomastigophora.*** *Lamblia intestinalis (Giardia lamblia).*
61. **Phylum *Sarcomastigophora.*** *Trichomonas hominis. Trichomonas vaginalis.*
62. **Phylum *Sarcomastigophora.*** *Trypanosoma rhodesiense* and *Trypanosoma gambiense.*
63. **Subphyla *Sarcodina.*** *Entamoeba histolytica. Entamoeba coli. Entamoeba hominis.*
64. **Phylum *Sporozoa (Apicomplexa).*** *Plasmodium vivax. Plasmodium malariae. Plasmodium falciparum.* Types of malaria.
65. **Phylum *Sporozoa (Apicomplexa)*.** *Toxoplasma gondii.*
66. **Phylum *Ciliophora*. Class *Ciliata*.** *Balantidium coli.*
67. **Phylum *Plathelminthes*** (Platyhelminthes). **Class *Trematoda*.** *Fasciola hepatica.*
68. **Class *Trematoda.*** *Dicrocoelium lanceatum* (*Dicrocoelium dendriticum*).
69. **Class *Trematoda*.** *Opistorchis felineus.* **Genus *Schistosoma.***
70. **Class *Cestoda.*** *Taenia solium.*
71. **Class *Cestoda.*** *Taeniarhynchus saginatus (Taenia saginata).*
72. **Class *Cestoda.*** *Diphyllobothrium latum. Hymenolepis.*
73. **Class *Cestoda.*** *Echinococcus granulosus.*
74. **Phylum *Nematoda.*** *Ascaris lumbricoides.*
75. **Phylum *Nematoda.*** *Enterobius vermicularis. Trichocephalus trichiurus.*
76. **Phylum *Nematoda.*** *Trichinella spiralis.*
77. **Phylum *Nematoda.*** *Strongyloides stercoralis. Ancylostoma duodenale.*
78. **Phylum *Nematoda.*** *Dracunculus medinensis. Wuchereria bankrofti. Loa loa.*
79. **Phylum *Annelida.*** *Lumbricus terrestris. Hirudo medicinalis.*
80. **Phylum *Arthropoda*. Class *Crustacea*** - common feature. **Class *Arachnoidea (Arachnida,*** arachnid).

81. **Order *Acari*** (ticks) - *Sarcoptes scabiei*, genus *Dermatophagoides*. Ticks – carriers of transmissible diseases: *Ixodes ricinus, Dermacentor marginatus, Hyalomma plumbeum, Rhipicephalus sanguineus.*
82. **Class *Insecta*** (insects). *Pediculus hominis (Pediculus humanus), Phthirius pubis. Ci-mex lectularius. Pulex irritans.*
83. **Genus *Culex*** and **genus *Anopheles*** – morphological differences. *Phlebotomus papatasii.*
84. Role of insects in the spread of transmissible diseases. Role of insects as mechanical carriers of infectious and parasitic diseases.

RECOMMENDED LITERATURE

1. **Molecular Biology of the Cell,** by Bruce Alberts, Alexander Johnson, Julian Lewis, David Morgan, Martin Raff, Keith Roberts, Peter Walter. 2014, 6th edition, Garland Science, ISBN 978-0815344322
2. **Bios instant notes. Molecular Biology** by A. McLennan, A. Bates, P. Turner, M. White. 2013; 4th edition; Garland Science, Taylor & Francis Group, LLC; ISBN978-0-415-68416-3
3. **Campbell Biology**, by Lisa A. Urry; Michael L. Cain; Steven A. Wasserman; Peter V. Minorsky; Rebecca Orr. 2020; 12th Edition, Pearson, ISBN 9780135188743
4. **Practical Book. Medical Biology for first year students** by Sarafian V., M. Kazakova, M. Draganova, N. Mehterov. 4th edition. 2023. Medical University Plovdiv ISBN; 978-619-237-041-1
5. **Bios instant notes. Immunology** by P. Lydyard, A. Whelan, M. Fanger. 2008; 8th edition; Garland Science, Taylor & Francis Group, LLC; ISBN 978-0-4156-0753
6. **Basic Immunology: Functions and Disorders of the Immune System** by Abul K. Abbas, Andrew H. Lichtman, Shiv Pellai . 2014; 4thedition; ISBN-13: 978-1455707072; ISBN-10: 1455707074
7. **Paniker's Textbook of Medical Parasitology** by C.K. Jayaram Paniker. 2013; 7th edition; ISBN-10: 9350905345; ISBN-13: 978-9350905340
8. **Parasitology. Manual for first year students in medicine and dental medicine** by Alexandrov V., Feodorova Y., Filipova M., Kazakova M., Mehterov N., Sarafian V., 2016, Plovdiv.

Additional literature

1. **Human Biology** by Starr C. and McMillan B. 2014; 10th edition; Yolanda Cossio; ISBN-13 978:1-133-59916-6

Compiled by: .....

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Approved by a decision of the Council of the Department of Biology, Medical genetics, Microbiology, Medical parasitology, Clinical laboratory and Immunology, Protocol №7/27.06.2024 г.

Head of the Department:

(Assoc. Prof. V. Merhar, PhD)

Approved by a decision of the Faculty Council of the Medical Faculty, Protocol №.10/11.07.2024г.

Secretary of the Council of the Medical Faculty: .....

(Chief Assist. Prof. Ruska Nenkova, PhD)

UNIVERSITY "PROF. DR. ASEN ZLATAROV" - BURGAS

MEDICAL FACULTY

DEPARTMENT OF ANATOMY, HISTOLOGY, EMBRYOLOGY, PATHOLOGY, LATIN LANGUAGE, FORENCIC MEDICINE, DEONTOLOGY

Approved by!

DEAN:

/Assoc. Prof. RumyanaYankova, PhD/

SYLLABUS

Discipline:	**LATIN LANGUAGE AND MEDICAL TERMINOLOGY**
Specialty:	**MEDICINE**
Professional field:	**7.1. Medicine**
Educational and qualification degree:	**MASTER**
Form of training:	**REGULAR**

Burgas, 2023

EXTRACTS FROM THE CURRICULUM

1. GENERAL PARAMETERS OF THE DISCIPLINE			
Total (academic hours):	150	**ECTS:**	5

Auditorium classes	**Non-auditorium classes**	**Auditorium ECTS**	**Non-auditorium ECTS**
60	90	2	3

Type of Discipline:	**Academic hours per week: /lectures + practices/**	*Course:*	*Semester:*
Mandatory	2	**I**	**I+II**

2. STUDY FORMS					
Auditorium classes:	**Academic hours**	**ECTS**	**Non-auditorium classes:**	**Academic hours**	**ECTS**
Practices	60	2	**Consultation**	15	0.5
			Individual work	75	2.5

3.EVALUATION AND CONTROL	
Forms of evaluation and control	**Relative share in the total score**
Sessional evaluation: exam	**0.4**
Semester (ongoing) assessment:	**0.6**
Forms of semester control:	
- Attendance at classes	0.1
- Active participation in classes	0.2
- Continuous assessment in class	0.7

ANNOTATION

Each professional community needs a specialized language for the terminology used at the scientific level. For those, working in the field of medicine, that language is Latin per se, also acting as a mediator of Greek – basic for clinical practice, therapy and pathology. Study of Latin and medical terminology during the first year of medical education is sine qua non for every level of training and for the practice of every physician. The philosophy of medical science as a whole and of all its subspecialties is coded in Latin. Teaching Latin for specialized training in the first year of medical training is the necessary prerequisite for the better acquisition of other disciplines that are part of the syllabus for each specialty studied at Medical University of Plovdiv in the course until completion of studies. According to tradition and methodology accepted and used in Bulgaria, all the diagnoses included in the textbooks and the additional sources for information and practice for the different subjects are written in Latin. That is the reason why the Latin course is of general educational nature, but it is also a supportive discipline for the understanding and 4 utilization of medical concepts in anatomy and clinical practice. In the first year the Latin course meets the immediate needs of students regarding the course in anatomy, while giving them sufficient grammar knowledge and presenting the principles of word formation to meet the long-term needs in the upper courses of study and the medical field of future specialization.

BASIC AIMS

The syllabus offered aims to teach the students the grammatical and lexical minimum necessary for the proper understanding, reading and writing of diagnoses; the principles of word formation; Greek combining forms and their Latin equivalents. Study contents according to the aims: I st semester: basic Latin grammar aimed at the medical profession: nouns and adjectives – morphological features; agreed and non-agreed attributes; study of a minimum quantity of terms necessary to understand subjects taught in the first course; reading and writing of diagnoses with elementary phraseological structure and syntax; basic information on prescription writing. IInd semester: Greek declensions in Latin; compound terms word-formations – Greek and Latin terminological elements, prepositions and prepositions as prefixes in word formation; comparatives and superlatives of the adjectives; clinical and pathoanatomical diagnoses.

EXPECTED RESULTS

It is expected that by the end of the Latin course the students are going to be able to use the grammatical and lexical minimum that forms the basic microlanguage in the field of medicine as a science. The course gives the information about the medical terminology as a part of the general human knowledge achieved in its diachronic development. When the Latin course is completed students should be able to: - use the lexical minimum that serves the needs of other disciplines; - use the minimum of grammar necessary for diagnoses understanding; - use the acquired grammatical minimum for writing diagnoses in Latin with familiar and unfamiliar vocabulary; - know the principles of compound terms word-formation used in clinical practice, for different types of treatment and kinds of pathology; - know how to understand the compound clinical and pathological terms; - be able to produce compound terms by their own.

EVALUATION CRITERIA:

- complex annual final written exam aiming to control the achieved self-training skills while using in practice the acquired knowledge during the course - 40%;
continuous assessment and term tests - 60%.

Continuous assessment – complex assessment of knowledge and skills with the following components.

Theses to seminars

Seminar № 1 – 2 hours Alphabet and pronunciation History and development of the Latin language. Alphabet. Classification of sounds: vowels, consonants, diphthongs, digraphs. Pronunciation of vowels, consonants, diphthongs, digraphs. Accentuation Quantity and syllabification Rules of accentuation

Seminar № 2 – 2 hours Nouns and adjectives – general information Grammatical categories of nouns and adjectives: gender, number, case. Declensions of nouns. First declension. Vocabulary forms of nouns. Defining the practical stem. Case endings. First Greek declension. Syntax structure of a phrase. Initial information on the use of prepositions. 9

Seminar № 3 – 2 hours Word-formation in medical terminology Defining term components: prefix, root, suffix. Greek combining term-elements corresponding to nouns of the first Latin declension. Decoding clinical and pathoanatomical terms. Coining terms.

Seminar № 4 – 2 hours Second Latin declension. Second Greek declension.

Seminar № 5 – 2 hours Word-formation in medical terminology Greek combining term-elements corresponding to nouns of the second Latin declension

Seminar № 6 –. Decoding clinical and pathoanatomical terms. Coining terms 2 hours Adjectives of the first and second declension. Past participle. Agreed and non-agreed attributes. Suffixes in the formation of adjectives. Meaning of suffixes. Agreement of adjectives and nouns. Word-formation. Greek term-elements corresponding to adjectives of first and second declension.

Seminar № 7 – 2 hours Drills on first and second declension – nouns and adjectives and Greek term-elements corresponding to nouns and adjectives of first and second declension.

Seminar № 8 – 2 hours Written examination (nouns and adjectives of first and second declension and their corresponding Greek term-elements)

Seminar № 9 – 2 hours Thrid declesion Third declension – consonant stems Characteristic features. Characteristic endings for nominative

Seminar № 10 – 2 hours Terms of Greek origin (Third Greek declension). Locative Adjectives with the -ior/-ius-suffix. Combining term-elements corresponding to third consonant declension Latin nouns.

Seminar № 11 – 2 hours Drills on third declension consonant stems

Seminar № 12 – 2 hours Third vocal declension – i-stems Feminine nouns (Latin and Greek). Neuter nouns

Seminar № 13 – 2 hours Terms of Greek origin (Third Greek declension). Combining term-elements corresponding to third vocal declension Latin nouns. Decoding clinical and pathoanatomical terms. Coining terms

Seminar № 14 – 2 hours Third declension – mixed stems. Word-formationParisyllabic names – how to differentiate them from third vocal declension nouns. Imparisyllabic names - how to differentiate them from third consonant declension nouns.

Seminar № 15 – 2 hours Greek term-elements corresponding to third mixed stem declension Latin nouns. Decoding clinical and pathoanatomical terms. Coining terms.

Seminar № 16 – 2 hours Revision of first and second declension – nouns and adjectives. General rules. Revisional drills.

Seminar № 17 – 2 hours Adjectives of the third declension. Adjectives of three nominative endings for the three genders. Adjectives of two nominative endings for the three genders. Adjectives of one nominative ending for the three genders.

Seminar № 18 – 2 hours Present Participle – formation and usage

Seminar № 19 – 2 hours Comparative and superlative forms of the adjectives – usage. Comparative degree of adjectives. Superlative degree of adjectives. Comparatives in anatomy
Seminar № 20 – 2 hours Revision of third declension – nouns (consonant, vocal, and mixed stems) and adjectives. General rules. Revisional drills.
Seminar № 21 – 2 hours 11 Greek declensions in Latin –revisional notes. Frist Greek declension Second Greek declension Third Greek declenison
Seminar № 22 – 2 hours Written examination (first, second, third declension – nouns and adjectives and their corresponding Greek term-elements)
Seminar № 23 – 2 hours Fourth declension. Word formation Masculine nouns. Neuter nouns.
Seminar № 24 – 2 hours Greek combining forms, corresponding to nouns of the fourth declension Decoding clinical and pathoanatomical terms. Coining terms and using them in diagnoses.
Seminar № 25 – 2 hours Fifth declension Agreed attributes and attributive genitive in the description of caries.
Seminar № 26 – 2 hours Combining term-elements corresponding to fifth declension Decoding clinical and pathoanatomical terms. Coining terms and using them in diagnoses.
Seminar № 27 – 2 hours Prepositions with Accusative and Ablative case. Latin declensions – revision. Prepositions in diagnoses and prescriptions.
Seminar № 28 – 2 hours Greek and Latin prepositions used as prefixes in the formation of medical terms. Latin prepositions used as prefixes in the formation of medical terms. Greek prepositions used as prefixes in the formation of medical terms
Seminar № 29 – 2 hours Revision of combining forms Classification of combining forms: combining forms for parts of the body Combining forms for therapeutic, diagnostic and surgical procedures Combining forms for colors and body liquids
Seminar № 30 – 2 hours Preparation for the final exam

BIBLIOGRAPHY

1. Repertitorium Latinum - Iavora Oprova 2018
2. Latin and Introduction to Medical terminology – teaching materials. Ivana Ikonomova, 2011
3. Lingua Latina Medicinalis, V. Nikolova, I. Koleva, Sofia 2002
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