UNIVERSITY "PROF. DR. ASSEN ZLATAROV" - BURGAS

MEDICAL FACULTY

DEPARTMENT OF NEUROLOGICAL DISEASES, PSYCHIATRY AND PSYCHOLOGY

APPROVED BY THE DEAN
.....
/Assoc. Prof. R. Yankova-Avramova, PhD/

SYLLABUS

Academic discipline: **MEDICAL PSYCHOLOGY**

Specialty: **7.1. MEDICINE**

Field of higher education: **7. HEALTH CARE AND SPORTS**

Education and qualification degree: **MASTER**

Form of education: **FULL-TIME**

Burgas
2024

1. GENERAL PARAMETERS OF DISCIPLINE			
General educational employment (hours):	60	**Credits:**	2

Auditorial	**Extracurricula**	**Auditorial**	**Extracurricula**
30	30	1,00	1,00

Type of subject*:*	**Number of hours per week: /lectures + seminars+practicals/**	**Course:**	**Semester:**
Задължителна	1+1	II	III

2. EDUCATIONAL FORMS

Auditorial:	**Hours**	**Credits**	**Extracurricula:**	**Hours**	**Credits**
Lectures	15	0,50	Consultations (work with a teacher)	10	0,3
Seminars	15	0,50	Self-study - Referencing a scientific text - Course project	10 10	0,3 0,4
Practicals	-	-			

3.ASSESSMENT AND CONTROL

Assessment and control forms	**Relative proportion in the total assessment**
Sessional Assessment: Exam	**0.4**
Current assessment:	**0.6**
Forms of semester control:	
- Attendance and active participation in classes	0,2
- Preparation of an abstract of a scientific text	0,2
- Course project	0,2

ANNOTATION

The academic discipline "Medical psychology" is obligatory for the students of the specialty "Medicine", second year, EQD "Master", full-time form of education.

Aims and objectives

The course focuses, based on biopsychosocial paradigm, on the interaction of psychological, physical and social factors with an individual's health and illness.

Basic aims of the discipline are to acquire knowledge about the main principles of medical psychology, the concepts of illness and patient, stress and anxiety, and how the psyche influence the onset, the course and the treatment of the illness, as well as the psychosomatic problems and the health related behavior.

Students will learn more about:

- The specifics of human psyche in health and illness, as well as the relevant psychological concepts and models;
- The psychological factors affecting physical disorders;
- The effects of traumatic stress and types of coping mechanisms;
- A holistic approach to patient care;
- The doctor-patient relationship and the effective communication within therapeutic-like context.

Structure of the learning content

The course is structured in ten basic topics related to general and medical psychology.

Teaching methods

In the learning process, a central place is given to lectures and seminars as the main organizational forms, in which a variety of learning methods are offered (presentations, discussions and debates, case work).

Significant attention is also given to working in small groups, case studies and role-plays, project work and research tasks are offered within the seminars.

Forms of self-study

Working with information sources (specialized literature, electronic resources, Internet sources), referencing scientific text, development of a course project.

Forms of assessment

The course finishes with a written exam (test). The evaluation is formed by three components: current evaluation of the work in the classes, referencing of the text and presentation of the course project; assessment from a written exam (test).

Prerequisites for students' basic knowledge and skills

The discipline is basic and there are no requirements for the students' prior preparation.

Expected results

The expected learning outcomes are aimed at students acquiring basic knowledge in the field of medical psychology. Students are expected to form practical knowledge and skills for assessing the patient's needs, building an individual care plan based on effective communication, forming trusting relationships and interactions, which knowledge and skills can competently apply in their future professional practice.

CONTENT OF THE SYLLABUS

A. Lectures

Topic:	Hours:
1. Introduction to Medical psychology History and contemporary development of medical psychology Subject and tasks of medical psychology.	1 h
2. Psychological approaches in medical practice part 1 Research methods and approaches in psychology applicable in medical practice.	1 h
3. Structure of human psyche Psychological characteristics, processes and states. Temperament and character**.**	1 h
4. Behaviour, needs, motivation Needs and motivation. Extrinsic and intrinsic motivation. Emotions and emotional regulation of behavior.	1 h
5. Personality. Factors and models of personality development. Personality. Factors. Theories and concepts (psychoanalysis, behavioral, cognitive and humanist approach).	2 h
6. Health and Illness. Attitudes towards health and disease. Illness Behavior Health Belief Model. Attitudes, beliefs and coping strategies. Psychological defense mechanisms.	2 h
7. Psychosomatics Theoretical foundations of psychosomatic medicine. Psychosomatic disorders: cardiovascular, gastrointestinal, respiratory and, musculoskeletal system disorders, migraine, oncological, endocrine and skin disorders.	2 h
8. Crisis and crisis intervention Social adjustment and maladaptation. Frustration, deprivation, conflict and crisis states.	2 h
9. Psychology of stress, anxiety and coping Protection from stressful situations. Coping strategies. Strategies for coping with stress in medical practice. Burn out syndrome.	2 h

10. Communication in medical practice.	1 h
First impression. Building a strong doctor - patient relationship.	
Breaking bad news to patients and relatives.	
Total: 15 hours	
B. SEMINARS	
Topic:	**Hours**:
1. Human psyche, behaviour, needs and motivation	
Psyche – systems.	2 h
Temperament and character.	
Needs, motivation, behavior	
2. Personality. Factors and models of personality development.	2 h
Theories and concepts.	
3. Health and Illness. Attitudes towards health and disease. Illness behavior	2 h
Health Belief Model	
Illness behavior	
4. Psychosomatic medicine	
Definitions.	2 h
Classification and diagnosis	
5. Importance of communication in medical practice	
First impression.	2 h
Building trust in the doctor - patient relationship.	
Barriers to effective communication.	
6. Medical examination and first interview	
Approaches to medical examination.	2 h
Clinical interview - steps and phases in progress.	
Interviewing techniques.	
Patient defensive behaviors.	
7. Crisis and crisis intervention. Traumatic stress reactions	2 h
Stress management in a critical situation.	
	1 h

8. A psychotherapeutic approach in medical setting.	
Psychotherapy in somatic medicine.	
Total: 15 hours	

COURSE PROJECT

A list of individual assignments related to the lectures is offered, which are prepared and presented within the semester.

CONSPECTUS

1. Subject and tasks of medical psychology
2. Psychological diagnostic. Research methods and approaches in psychology
3. Structure of human psyche. Psychological characteristics, processes and states
4. Temperament and character
5. Behavior, needs and motivation
6. Emotions and emotional regulation of behavior
7. Personality. Theories of personality
8. Health and Illness. Attitudes towards health and disease. Illness behavior
9. Psychosomatic disorders. Classification and diagnosis
10. Psychological factors in somatic diseases. Psychological issues in chronically ill and terminally ill people
11. Crisis and crisis intervention. Social adjustment and maladaptation. Frustration, deprivation, conflict and crisis states
12. Psychology of stress, anxiety and coping. Coping strategies. Strategies for coping with stress in medical practice and burn out syndrome
13. Communication in medical practice. Breaking bad news to patients and relatives
14. Clinical interview - steps and phases in progress. Interviewing techniques
15. Psychotherapeutic approach in doctor – patient relationship

LITERATURE FOR SELF-STUDY

Mandatory

1. Akabaliev, V, & D. Stoyanov (Ed.) (2016). Medical psychology. 2nd ed., Lax book
2. Ayers, S., R. de Visser. (2021). Psychology for medicine and healthcare. 3d ed., SAGE Publications Ltd
3. Balint, M. (2000). The doctor, his patient and the illness. 2nd ed, Churchill Livingstone
4. Fernald, D. (2008). Psychology: six perspectives. SAGE Publications Inc.
5. Lloyd, M. et all. (2018). Clinical communication skills for medicine. Elsevier.

Recommended

1. Kadosh, Sh., A. Ben-shahar. (2019). Incorporating psychotherapeutic concepts and interventions within medicine with the heart in mind. Routledge
2. Kübler-Ross, E., & D. Kessler. (2014). On grief and grieving: Finding the meaning of grief through the five stages of loss. Scribner; Reprint edition
3. Lazarus, R., S. Folkman. (1984). Stress, appraisal and coping. Springer Publishing Company
4. Lazarus, R. (2006). Stress and emotion. Springer Publishing Company
5. Levenson, J. L. (Ed.). (2007). Essentials of psychosomatic medicine. American Psychiatric Publishing, Inc.
6. Roberts, A. (Ed). (2000). Crisis intervention handbook: Assessment, treatment, and research. Oxford University Press
7. Silverman, J. (2019). Medical Interviewing. In: Llewellyn C, Ayers S, McManus C, et al., eds. Cambridge Handbook of Psychology, Health and Medicine. Cambridge University Press, pp. 387-394.

Authors: .....
(Prof. Dr. G. Panov, MD, PhD, DSs)

……
(Assoc. Prof. B. Tsonkova, PhD)

The curriculum was discussed and adopted at a meeting of the Department of "Nervous Diseases, Psychiatry and Psychology", protocol No. ... of 04.09.2024.

Head of Department: .....
(Prof. Dr. G. Panov, MD, PhD, DSs)

The curriculum was adopted and discussed at the Faculty Council of the Faculty of Medicine, protocol No... from ……..2024.

Scientific Secretary of the Faculty of Medicine: .....
(……)

PROF. DR. ASEN ZLATAROV UNIVERSITY OF BURGAS

MEDICAL FACULTY

DEPARTMENT OF PHYSIOLOGY, PATHOPHYSIOLOGY, CHEMISTRY AND BIOCHEMISTRY

Approved by!

DEAN:…….

/Assoc. Prof. Rumyana Yankova, PhD/

SYLLABUS

Discipline:	**BIOCHEMISTRY**
Specialty:	**MEDICINE**
Field of higher education	**HEALTHCARE AND SPORTS**
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):	420	**ECTS:**	14
Auditorium classes	**Non-auditorium classes**	**Auditorium ECTS**	**Non-auditorium ECTS**
180	240	6	8
Type of Discipline*:*	**Academic hours per week: /lectures + practices/**	*Course:*	*Semester:*
Mandatory	3 + 3	**II**	**3rd and 4th**

2. STUDY FORMS					
Auditorium classes:	**Academic hours**	**ECTS**	**Non-auditorium classes:**	**Academic hours**	**ECTS**
Lectures	90	3	**Consultation**	70	2,3
Seminars	60	2	**Individual work**		
Practices	30 90	1 3	- preparation for practical exercises and protocols from experimental work; - preparing for seminars; - preparing for colloquia; - preparation of a report and presentation on a scientific problem; - Preparation for the final exam.	23 48 30 18 51	0.8 1.6 1 0.6 1.7

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 and active participation in the discussions during classes	0.05
- Preparation of protocols of practical exercises	0.05
- Written current control before each exercise and seminar	0.2
- Taking colloquia with a written part (test with multiple choice questions and open-ended questions, and parts of questions from the synopsis) and an oral part	0.2
- Working with scientific literature, preparation of a report and presentation on a scientific problem	0.1

ANNOTATION
of the discipline Biochemistry

Purpose of the course:

The course Biochemistry is designed as a two-semester mandatory discipline, which is intended for second-year students studying in the Medicine specialty, a full-time form of education, in the Master's educational-qualification degree.

The aim of the Biochemistry course is to build knowledge in the Medical students on the chemical nature, functions and metabolic pathways of biogenic compounds in the human organism, with the participation of biocatalysts, and under energetic, genetic and hormonal control. It also aims to study the possible disorders in the synthesis and/or degradation of human metabolites. This knowledge contributes to the study and characterization at the genetic and molecular level of all diseases known to humans, and also to the diagnosis of new diseases, as well as to the treatment of all imbalances of homeostasis. The discipline is the basis for providing theoretical and practical knowledge to understand some clinical branches of the Medical Sciences.

Main tasks of the program:

The main tasks of the Biochemistry course are related to introducing the students with the biochemical processes and regulatory mechanisms that take place in the cell and the organism, as well as with the possible disorders leading to pathological conditions. This includes studying the main sections of Biochemistry as a science with assignments on:

1. Getting to know the structural features and biological functions of amino acids, their derivatives and proteins, nucleotides and nucleic acids, carbohydrates, lipids, porphyrins, vitamins, etc.;
2. Getting to know the structural, catalytic and regulatory aspects of enzymatic biocatalysis;
3. Getting to know the basics of biochemical thermodynamics in the mitochondrion for obtaining energy from the oxidation of nutrients during catabolic processes and using the accumulated energy for the needs of anabolic processes, active transport and other needs of the body;
4. Getting to know the metabolism of amino acids, their derivatives, carbohydrates, lipids, nucleotides, porphyrins, trace elements and other biogenic substances in different tissues under normal and pathological conditions;
5. Getting to know the biosynthesis of nucleic acids and proteins;
6. Getting to know the integration of metabolism and regulatory mechanisms at the level of replication, transcription and translation;
7. Getting to know the mechanisms of intercellular communication and signaling pathways for the action of hormones, growth factors, neurotransmitters and other physiologically active molecules;
8. Getting to know the molecular mechanisms for the development of a number of socially significant diseases, incl. with genetically determined enzymopathies;
9. Getting to know the biochemical foundation for the functioning of individual organs and systems in the human body, incl. nutrition, to protect homeostasis.
10. Acquaintance with modern biochemical parameters and methods used in scientific research and clinical practice.

Structure of learning content:

1. Composition, structure, functions and methods for studying proteins
2. Composition, structure, functions and methods for studying nucleic acids
3. Structural organization, catalytic action, regulation and clinical significance of enzymes
4. Cellular bioenergetics – biological oxidation of substances, Krebs cycle, respiratory chain and free oxidation
5. Carbohydrate metabolism in different tissues with hormonal control and disorders - digestion and resorption, glycolysis, gluconeogenesis, pentose phosphate pathway, metabolism of fructose, galactose, mannose and glycogen
6. Lipid metabolism in various tissues with hormonal control and disorders - digestion, resorption, transport forms of lipids, triacylglycerols, higher saturated and unsaturated fatty acids, ketone bodies, cholesterol, cholesterol derivatives, glycerophospholipids, sphingolipids and eicosanoids
7. Amino acid metabolism in various tissues with hormonal control and disorders - digestion of proteins and absorption of amino acids, degradation and synthesis of amino acids and their derivatives, and detoxication of ammonia
8. Purine and pyrimidine metabolism - digestion of nucleic acids, metabolic significance of nucleotides, regulation and disorders
9. Metabolism of the microelement iron and porphyrins - metabolic significance, regulation and disorders
10. Integration of metabolism – structural aspects and tissue specificity
11. Biosynthesis of nucleic acids with regulation of gene expression at the level of replication and transcription
12. Biosynthesis of proteins with post-translational modifications and regulation of gene expression at the level of translation
13. Signal transduction - general principles, types of plasma membrane receptors, intracellular receptors, secondary mediators in cell signaling and cell adhesion
14. Hormones - representatives, metabolism with regulation, receptor signaling, and disorders
15. Molecular mechanisms of apoptosis, oncogenesis, atherosclerosis, obesity, and diabetes
16. Biochemistry of blood, connective tissue, liver, and nutrition

Teaching methods:

Using traditional methods by presenting the learning material in a written form on a whiteboard and with multimedia presentations. Examining clinical cases to illustrate the educational material through biochemical diagnostics and monitoring of diseases by changes in the chemical composition of blood, urine and other biological fluids, as well as interpretation of experimental and clinical results. Discussion on current scientific problems during the seminars and giving individual tasks of each student on them. Practical experiments with biological fluids to determine modern clinical indicators in laboratory conditions. Assignment of independent tasks in test and free format during colloquia. Individual and/or group work with students to write scientific publications and present oral presentations at scientific conferences.

Forms of independent work:

Preparation for each seminar and practical exercise and for the colloquia. Solving tests and answering open-ended questions from the Biochemistry guide book for preparing for colloquia. Preparation of experimental protocols for the practical exercises. Preparation of literature references on current scientific problems and their presentation during seminars. Preparation of reports and multimedia presentations on a given or self-selected topic. Preparation for the final exam.

Methods of assessment:

Carrying out a written current control at the beginning of each seminar and presenting protocols of the practical exercises. Active participation during discussions of lectures, seminars and practical exercises. Preparation of a report and multimedia presentation on a given scientific problem. Final examination - entrance test with multiple choice questions, with more than one correct answer, and open-ended questions, parts of questions from the synopsis of the two semesters (3 questions from each semester), and an oral examination. Three grades are formed – one average grade for each semester and a final grade from the exam.

Prerequisites for students' basic knowledge and skills:

Students must have knowledge and skills in General and Inorganic Chemistry, Organic Chemistry, Human Biology, Cytology, General Histology and Human Embryology, Human Anatomy and Histology, Physics and Biophysics, as well as skills to read with understanding in English language, and to handle the basic functions of Microsoft Word, Excel and PowerPoint.

Expected results:

After successful completion of the course in the discipline, students should know and be able to:

- Explain and graphically present the structural organization of proteins and nucleic acids, as well as to know their main functions in the body;
- Present the chemical structures of the biogenic molecules studied from the groups of amino acids and their derivatives, carbohydrates, lipids, nucleotides, porphyrins and vitamins, as well as the metabolic pathways studied for some of them with disorders in pathology;
- Distinguish the individual classes of enzymes, to correctly represent enzyme-catalyzed reactions, to explain the importance of the main kinetic parameters of enzymes, as well as the types of enzyme inhibition and the mechanisms for regulation of enzyme action;
- Explain the mechanisms of energy transfer in cellular bioenergetics and its use for metabolic and other needs;
- Explain the transport mechanisms of metabolites in the cell and the importance of cellular compartmentalization, and the need for integration of metabolism;
- Explain the peculiarities of the metabolism of amino acids, carbohydrates, lipids, and other compounds in different organs (liver, muscles, adipose tissue, brain, kidneys, intestines, etc.), and cells (erythrocytes, immune cells, tumor cells);
- Explain the mechanisms of action of hormones, intercellular communication and adhesion with the means of signal transduction;
- Explain the regulation of gene expression at the levels of replication, transcription and translation under normal and pathological conditions;

- Explain the biochemical basis of the studied metabolic and hereditary diseases;
- Be able to build skills for forecasting and diagnosis of common diseases in clinical practice based on the results obtained from biochemical tests;
- Apply in a theoretical aspect the studied biochemical methods for the analysis of biomolecules under normal and pathological conditions;
- Apply the basic acquired practical skills to work in a clinical laboratory.

In the elective course Glycobiology, more in-depth theoretical and practical knowledge on the application of various chromatographic and electrophoretic techniques in clinical laboratory practice can be acquired.

CURRICULUM CONTENT

LECTURES

Topic	hours
1. Composition, structure and functions of proteins Structural organization and biological functions of proteins (Questions 1 to 3)	3
2. Methods for studying proteins. Composition, structure, and functions of nucleic acids Analytical methods for the study of proteins. Structure, functions, and significance of nucleic acids. Purine and pyrimidine analogues with therapeutic action (Questions 4 to 6)	3
3. Enzymes and their cofactors Characterization of enzymes and kinetics of enzyme action. Michaelis-Menten equation and meaning of K_m and V_{max}. Lineweaver-Burk plot. Types, importance and avitaminosis of water- and lipid-soluble vitamins (Questions 7 to 10)	3
4. Influence of enzyme activity and significance of enzymes for Medicine Irreversible and reversible enzyme inhibition with changes in K_m and V_{max}. Lineweaver-Burk plot for reversible enzyme inhibition. Regulation of enzyme action. Genetically determined enzymopathies. Therapeutic enzyme inhibitors and clinical importance of enzymes (Questions 11 to 13)	3
5. Biochemical thermodynamics – oxidation and phosphorylation Fundamentals of biochemical thermodynamics and features of biological oxidation. Oxidoreductases. Redox systems of biological significance. Examples of oxidative phosphorylation at the substrate level (Questions 14 and 15)	3
6. Biochemical thermodynamics – respiratory chain and free oxidation Structure, functions, and regulation of the respiratory chain. Free oxidation – heat production and metabolic significance. Formation of free oxygen and nitrogen species, and their neutralization with enzymatic and non-enzymatic antioxidants (Questions 16 and 17)	3
7. Krebs cycle Krebs cycle - chemical reactions, features, regulation and connections with respiratory chain and metabolism of carbohydrates, lipids, amino acids, ammonia, and porphyrins (Question 18)	3
8. Glycolysis and gluconeogenesis Digestion and absorption of carbohydrates in the gastrointestinal tract. Glycolysis and gluconeogenesis - chemical reactions, metabolic significance, regulation, and disorders (Questions 19 and 20)	3
9. Pentose phosphate pathway and other pathways for metabolizing monosaccharides Pentose phosphate pathway - chemical reactions, metabolic significance, regulation, and disorders. Fructose, galactose, and mannose metabolism - chemical reactions, metabolic importance, regulation, and disorders (Questions 21 to 23)	3

10. Glycogen metabolism. Peculiarities of carbohydrate metabolism in tissues Glycogen metabolism - chemical reactions, metabolic significance, regulation, and disorders. Carbohydrate metabolism in different tissues and hormonal regulation of blood sugar level (Questions 24 and 25)	3
11. Lipids - classification and transport forms. Metabolism of triacylglycerols Classification, digestion and transport forms (chylomicrons, VLDL, IDL, LDL and HDL) of lipids. Triacylglycerol metabolism - chemical reactions, metabolic significance, regulation, and disorders (Questions 26 and 27)	3
12. Metabolism of fatty acids and ketone bodies Degradation and biosynthesis of fatty acids - chemical reactions, metabolic significance, regulation, and disorders. Ketone body metabolism – chemical reactions, metabolic significance, regulation, ketonemia, and ketoacidosis (Questions 28 to 30)	3
13. Metabolism of cholesterol and complex lipids Metabolism of glycerophospholipids, sphingolipids, eicosanoids, and cholesterol - chemical reactions, metabolic significance, regulation, and disorders (Questions 31 to 33)	3
14. Cholesterol derivatives. Disorders of lipid metabolism Cholesterol derivatives (bile acids, steroid hormones, vitamin D_3). Diseases of lipid metabolism (Questions 34 and 35)	3
15. General reactions and specific pathways for the degradation of amino acids. Ammonia toxicity Digestion of proteins and general reactions for the breakdown of amino acids. Ammonia detoxification. Breakdown of phenylalanine, tyrosine, tryptophan, and other amino acids (Questions 36 to 38)	3
16. Biosynthesis of amino acids and their derivatives. Disorders of amino acid metabolism Biosynthesis of non-essential and essential amino acids. Derivatives of serine, arginine, tyrosine, tryptophan, and glutamate. Diseases of amino acid metabolism (Questions 39 to 41)	3
17. Metabolism of purines and pyrimidines Purine and pyrimidine nucleotide metabolism - chemical reactions, metabolic significance, regulation, and disorders (Questions 42 and 43)	3
18. Metabolism of the microelement iron and porphyrins Metabolism of the trace element iron - resorption, metabolic significance, regulation, and disorders. Biosynthesis of porphyrins and degradation of hemoglobin - chemical reactions, metabolic importance, regulation, and disorders (Questions 44 to 46)	3
19. Integration of metabolism Structural aspects in the integration of metabolism. Tissue and organ specificity in the integration of metabolism (Questions 47 and 48)	3
20. Biosynthesis of nucleic acids Biosynthesis of DNA, RNA, and recombinant DNA technologies (Questions 49 to 51)	3

21. Biosynthesis of proteins. Introduction to signal transduction Biosynthesis of proteins and post-translational processing of proteins. General principles of signal transduction (Questions 52 to 54)	3
22. Plasma membrane receptors Types of plasma membrane receptors. Types of secondary mediators in signal transduction (Questions 55 and 56)	3
23. Metabolism of hormones - thyroid and steroid hormones Hypothalamic-pituitary system – biosynthesis, functions, regulation, signaling, and disorders in thyroid and steroid hormones (Questions 57 and 58)	3
24. Metabolism of hormones - other representatives. Types of intracellular receptors Hypothalamic-pituitary system – growth hormone, oxytocin, and prolactin. Hormones regulating water-salt balance. Hormones from the pancreas, digestive tract, and adrenal cortex. Signaling and disorders. Types of intracellular cytoplasmic and nuclear receptors (Questions 59 to 61)	3
25. Molecular mechanisms of apoptosis and oncogenesis Molecular mechanisms in programmed cell death and oncogenesis (Questions 62 and 63)	3
26. Diabetes mellitus Molecular mechanisms in Diabetes mellitus - risk factors and pathobiochemical mechanisms of disorders in type 1 and 2 diabetes (Question 64)	3
27. Biochemical foundations of blood - blood cells and serum proteins Types of blood cells and their metabolism. Types of serum proteins of clinical importance (Questions 65 and 66)	3
28. Biochemical foundations of blood - blood coagulation. Cell adhesion Molecular mechanisms in blood coagulation – norm and pathology. Molecular mechanisms of cell adhesion (Questions 67 and 68)	3
29. Biochemical foundations of connective tissue Formation of connective tissue - structure, biological role, and disorders. Disorders in calcium and phosphorus metabolism (Questions 69 and 70)	3
30. Biochemical foundations of nutrition. Biochemical functions of the liver Nutrition and dietetics – digestion and absorption of macro- and micronutrients, balanced nutrition and disorders. Liver biochemistry – metabolic, excretory, and detoxifying functions (Questions 71 and 72)	3
Total:	**90**

SEMINARS AND PRACTICALS

Topic	Hours
1. Rules for work in a biochemical laboratory. Composition, structure and functions of proteins	3

Seminar: Workplace safety techniques. Rules for work in a biochemical laboratory. Working with automatic pipettes. Concentration of solutions. Structural organization and biological functions of proteins (Questions 1 to 3) *Practical part:* Qualitative tests for cysteine, phenylalanine, and tryptophan	
2. Methods for the study of proteins. Composition, structure, and functions of nucleic acids *Written current control on the seminar from exercise 1.* *Seminar:* Analytical methods for the study of proteins. Structure, functions, and significance of nucleic acids. Purine and pyrimidine analogues with therapeutic action (Questions 4 to 6) *Practical part:* Determination of total protein content in blood serum by the Lowry method. Determination of concentration and purity of DNA isolated from *E. coli*	3
3. Enzymes and their cofactors *Written current control on the seminar from exercise 2.* *Seminar:* Characterization of enzymes and enzyme kinetics. Michaelis-Menten equation and meaning of K_m and V_{max}. Lineweaver-Burk plot. Types, importance, and avitaminosis of water- and lipid-soluble vitamins (Questions 7 to 10) *Practical part:* Determination of the influence of time, temperature, and pH on the activity of salivary α-amylase. Qualitative test to prove presence of vit. B_1. Determination of kinetic parameters of hexokinase	3
4. Influence of enzyme activity and significance of enzymes for Medicine. Revision *Written current control on the seminar from exercise 3.* *Seminar:* Irreversible and reversible enzyme inhibition with changes in K_m and V_{max}. Lineweaver-Burk plot of a reversible enzyme inhibition. Regulation of enzyme action. Therapeutic enzyme inhibitors. Clinical significance of enzymes. Genetically determined enzymopathies. Brief discussion and preparation for the first colloquium (Questions 1 to 13) *Practical part:* Study of the influence of activators and inhibitors on the action of salivary α-amylase. Determination of lactate dehydrogenase activity in blood serum	3
5. Colloquium I on proteins, nucleic acids, enzymes, and vitamins (Questions 1 to 13)	3
6. Biochemical thermodynamics – oxidation and phosphorylation *Written current control on the seminar topics.* *Seminar:* Fundamentals of biochemical thermodynamics and features of biological oxidation. Oxidoreductases. Redox systems of biological significance. Examples of oxidative phosphorylation at a substrate level (Questions 14 and 15) *Practical part:* Determination of vitamin C in blood serum. A qualitative reaction to demonstrate the use of inorganic phosphate in glycolysis and alcoholic fermentation	3
7. Biochemical thermodynamics – respiratory chain and free oxidation *Written current control on the seminar topics.* *Seminar:* Construction, functions, and regulation of the respiratory chain. Free oxidation – heat production and metabolic significance. Formation of free oxygen and	3

nitrogen forms, and their disposal with enzymatic and non-enzymatic antioxidants (Questions 16 and 17) *Practical part:* Determination of total content of phenolic antioxidants in herbal infusions and decoctions	
8. Krebs cycle. Revision *Written current control on the seminar topic.* *Seminar:* Krebs cycle - chemical reactions, features, regulation and connections with respiratory chain and metabolism of carbohydrates, lipids, amino acids, ammonia, and porphyrins (Question 18). Brief discussion and preparation for the second colloquium (Questions 14 to 18) *Practical part:* Qualitative test to prove the action of succinate dehydrogenase	3
9. Colloquium II on bioenergetics (Questions 14 to 18)	3
10. Glycolysis and gluconeogenesis *Written current control on the seminar topics.* *Seminar:* Digestion and resorption of carbohydrates in the gastrointestinal tract. Glycolysis and gluconeogenesis - chemical reactions, metabolic significance, regulation, and disorders (Questions 19 and 20) *Practical part:* Quantitative assay for determination of pyruvate in blood serum	3
11. Pentose phosphate pathway and other pathways for metabolizing monosaccharides *Written test on the seminar topics.* *Seminar:* Pentose phosphate pathway - chemical reactions, metabolic significance, regulation, and disorders. Fructose, galactose, and mannose metabolism - chemical reactions, metabolic importance, regulation, and disorders (Questions 21 to 23) *Practical part:* Action of α-amylase and β-fructofuranosidase. Quantitative assay for determination of reducing sugars in blood serum	3
12. Glycogen metabolism. Peculiarities of carbohydrate metabolism in tissues. Revision *Written current control on the seminar topics.* *Seminar:* Glycogen metabolism - chemical reactions, metabolic significance, regulation, and disorders. Carbohydrate metabolism in different tissues and hormonal regulation of blood sugar level (Questions 24 and 25). Brief discussion and preparation for the third colloquium (Questions 19 to 25) *Practical part:* Determination of glucose in blood serum by glucose oxidase test with o-toluidine. Qualitative test for detection of glucose in urine by Fehling reaction	3
13. Colloquium III on carbohydrate metabolism (Questions 19 to 25)	3
14. Lipids - classification and transport forms. Metabolism of triacylglycerols *Written current control on the seminar topics.* *Seminar:* Classification, digestion, and transport forms (chylomicrons, VLDL, IDL, LDL and HDL) of lipids. Triacylglycerol metabolism - chemical reactions, metabolic significance, regulation, and disorders (Questions 26 and 27) *Practical part:* Quantitative assay for determination of total lipid content and tri-	3

acylglycerols in blood serum	
15. Metabolism of glycerophospholipids, sphingolipids and eicosanoids *Written current control on the seminar topics.* *Seminar:* Metabolism of glycerophospholipids and sphingolipids - chemical reactions, metabolic importance, regulation, and disorders. Eicosanoids - classification, biosynthesis, functions, and role under normal and pathological conditions (Questions 31 and 32) *Practical part:* Determination of the inhibitory effect of natural antioxidants on lipoxygenase	3
16. Metabolism of fatty acids and ketone bodies *Written current control on the seminar topics.* *Seminar:* Degradation and biosynthesis of fatty acids - chemical reactions, metabolic significance, regulation, and disorders. Ketone body metabolism – chemical reactions, metabolic significance, regulation, ketonemia, and ketoacidosis (Questions 28 to 30) *Practical part:* Qualitative reactions to prove ketone substances in urine	3
17. Cholesterol metabolism and cholesterol derivatives. Disorders of lipid metabolism. Revision *Written current control on the seminar topics.* *Seminar:* Cholesterol metabolism - chemical reactions, metabolic significance, regulation, and disorders. Cholesterol derivatives (bile acids, steroid hormones, vitamin D_3). Diseases of lipid metabolism (Questions 33 to 35). Brief discussion and preparation for the fourth colloquium (Questions 26 to 35) *Practical part:* Determination of total cholesterol and HDL in blood serum by enzyme-colorimetric method with cholesterol oxidase and peroxidase. Qualitative test for cholesterol in gallstones	3
18. Colloquium IV on lipid metabolism (Questions 26 to 35)	3
19. General reactions and specific pathways for the degradation of amino acids. Ammonia toxicity *Written current control on the seminar topics.* *Seminar:* Digestion of proteins and general amino acid degradation reactions. Ammonia detoxification. Catabolism of phenylalanine, tyrosine, tryptophan, and other amino acids (Questions 36 to 38) *Practical part:* Determination of the activities of aspartate aminotransferase (ASAT) and alanine aminotransferase (ALAT) in blood serum. Determination of urea in blood serum	3
20. Biosynthesis of amino acids and their derivatives. Disorders of amino acid metabolism *Written current control on the seminar topics.* *Seminar:* Biosynthesis of non-essential and essential amino acids. Derivatives of serine, arginine, tyrosine, tryptophan, and glutamate. Diseases of amino acid metabolism (Questions 39 to 41) *Practical part:* Quantitative assay for determination of creatinine in blood serum and urine. A qualitative test for the detection of proteins in urine	3

21. Metabolism of purines and pyrimidines *Written current control on the seminar topics.* *Seminar:* Metabolism of purine and pyrimidine nucleotides - chemical reactions, metabolic significance, regulation, and disorders (Questions 42 and 43) *Practical part:* Quantitative assay for determination of uric acid in blood serum and urine	3
22. Metabolism of iron and porphyrins. Revision *Written current control on the seminar topics.* Seminar: Metabolism of the trace element iron - resorption, metabolic significance, regulation, and disorders. Biosynthesis of porphyrins and degradation of hemoglobin - chemical reactions, metabolic significance, regulation, and disorders (Questions 44 to 46). Brief discussion and preparation for the fifth colloquium (Questions 36 to 46) *Practical part:* Determination of total and direct bilirubin in blood serum with diazo reagent	3
23. Colloquium V on exchange of amino acids, nucleotides and porphyrins (Questions 36 to 46)	3
24. Introduction to signal transduction *Written current control on the seminar topics.* *Seminar:* General principles of signal transduction. Types of plasma membrane receptors. Types of secondary mediators in signal transduction (Questions 54 to 56) *Practical part:* None	3
25. Metabolism of hormones - thyroid and steroid hormones *Written current control on the seminar topics.* *Seminar:* Hypothalamic-pituitary system - biosynthesis, functions, regulation, signaling, and disorders in thyroid, steroid hormones, growth hormone, oxytocin, and prolactin. Hormones regulating water-salt balance. (Questions 57 to 59) *Practical part:* Qualitative test for the detection of 17-ketosteroids in urine	3
26. Metabolism of hormones - other representatives. Types of intracellular receptors. Molecular mechanisms of oncogenesis. Revision *Written current control on the seminar topics.* *Seminar:* Hormones from the pancreas, digestive tract, and adrenal cortex. Signaling and disorders. Types of intracellular cytoplasmic and nuclear receptors. Molecular mechanisms in oncogenesis (Questions 60, 61 and 63). Brief discussion and preparation for the sixth colloquium (Questions 54 to 61 and 63) *Practical part:* Simulation of acute pancreatitis - determination of α-amylase activity in blood serum and urine. Qualitative test to prove the presence of adrenaline in urine	3
27. Colloquium VI on Signal transduction (Questions 54 to 61 and 63)	3
28. Diabetes mellitus *Written current control on the seminar topics.* *Seminar:* Molecular mechanisms in Diabetes mellitus - risk factors and pathobiochemical mechanisms of disorders in type 1 and 2 diabetes (Question 64)	3

Practical part: Quantitative assay for determination of glucose in blood serum and urine by the glucose oxidase test with 4-aminoantipyrine and phenol. Qualitative test for the presence of glucose in urine	
29. Biochemical foundations of blood - blood cells, serum proteins and blood coagulation *Written current control on the seminar topics.* *Seminar:* Types of blood cells and their metabolism. Types of serum proteins of clinical importance. Molecular mechanisms in blood coagulation – norm and pathology (Questions 65 to 67) *Practical part:* Determination of prothrombin index in blood plasma	3
30. Biochemical foundations of nutrition. Biochemical functions of the liver *No written current control on the seminar topics.* *Seminar:* Nutrition and dietetics - digestion and absorption of macro- and micronutrients, balanced nutrition, and disorders. Liver biochemistry – metabolic, excretory, and detoxifying functions (Questions 71 and 72) *Practical part:* Quantitative assay for determination of the trace element iron in food products	3
Total:	**90**

BACKGROUND

for Biochemistry exam

for students of the specialty Medicine

I. Structure and functions of proteins

1. Scope, tasks and challenges in Medical Biochemistry. Biological functions of proteins. Classification of biogenic amino acids according to the structure of their radicals and polarity at pH=7. Atypical amino acids. Oligopeptides, polypeptides and proteins. Hetero-, iso- and alloproteins. Structural levels of protein organization. Primary structure of the protein molecule
2. Conformation. Chemical features of the peptide bond. Types of secondary structures – α- and β-helices. Disordered regions in the polypeptide chain. Super-secondary structure – motifs and domains. Tertiary structure of proteins. Chemical interactions in the tertiary structure. Globular and fibrillar proteins
3. Quaternary structure of proteins. Mechanisms for maintaining the conformation of proteins. Denaturation and renaturation. Relationship between the structure and biological functions of proteins. Defects in receptors (familial hypercholesterolemia, Diabetes insipidus). Conformational diseases (Alzheimer's disease, Prion's disease, cystic fibrosis). Point mutations (sickle cell anemia). Defects in post-translational modification of proteins (glycated hemoglobin and scurvy)
4. Charge properties of proteins. Methods for isolation, purification, and quantitative analysis of proteins. Analytical approaches for structural studies of proteins of medical importance (1D and 2D electrophoresis, Western blot analysis, chromatographic analysis, mass spectral analysis, X-ray structural analysis, circular dichroism, NMR analysis)

II. Structure and functions of nucleic acids

5. Purine and pyrimidine nitrogen bases, nucleosides and nucleotides. Minor Bases. Types and biological functions of free nucleotides. Primary structure of nucleic acids. Watson and Crick model. Purine and pyrimidine analogues with therapeutic action
6. Conformational forms of DNA. Unusual DNA structures. Histone and non-histone proteins, nucleosome, and chromatin. Denaturation and renaturation of DNA. Types, role and conformation of RNA. Ribozymes - application in Medicine

III. Enzymes and vitamins

7. Characteristics of enzymes as biological catalysts. Structure of enzymes - types of coenzymes and prosthetic groups. Nomenclature and classification of enzymes with examples from the six main groups. Concept of the mechanism of enzyme catalysis - formation of an enzyme-substrate complex. Active center. Specificity of enzyme action
8. Water-soluble vitamins - representatives, chemical structures, natural sources, and biological functions. Avitaminoses
9. Lipid-soluble vitamins - representatives, chemical structures, natural sources, and biological functions. Avitaminoses
10. Kinetics of enzyme action – influence of time, enzyme and substrate concentrations, temperature, and pH on the rate of enzyme-catalyzed reactions. Michaelis-Menten equation and meaning of K_m and V_{max}. Enzyme activity and methods for its determination. Lineweaver-Burk equation. Application of enzyme kinetics to prove enzyme defects
11. Irreversible and reversible enzyme inhibition. Reversible competitive, non-competitive, and uncompetitive inhibition – effects on K_m and V_{max}. Drugs acting as competitive and non-competitive inhibitors. Enzyme activators
12. Regulation of enzyme action. Regulation of absolute enzyme amount - inducible and constitutive enzymes, half-life time of enzymes. Regulation of catalytic activity of enzymes - compartmentalization, shuttle mechanisms, multienzyme complexes, reversible covalent modification by phosphorylation/dephosphorylation, allosteric regulation, and retroinhibition
13. Clinical significance of enzymes. Diagnostic role of serum-uncharacteristic intracellular enzymes (myocardial infarction, hepatitis, etc.). Isoenzymes. Atypical changes in the levels of functional plasma enzymes. Genetically determined enzyme diseases - gout, Lesch-Nyhan syndrome, phenylketonuria and orotaturia. Application of enzymes in clinical analyzes - enzyme-linked immunosorbent assay (ELISA) and restriction enzymes. Enzymes as drugs and therapeutic targets

IV. Bioenergetics and biological oxidation

14. Basics of biochemical thermodynamics - features of organisms as open systems. Exergonic and endergonic processes. Types of macroergic compounds. Central role of the ADP/ATP system for metabolism. Peculiarities of biological oxidation - oxidation-reduction processes, substrates and final hydrogen acceptors, stages in aerobic metabolism. Oxidoreductases. Redox systems with biological significance
15. Oxidative phosphorylation at a substrate level. Molecular mechanism of the oxidative phosphorylation of glyceraldehyde-3-phosphate and of 2-phosphoglycerate to generate ATP in glycolysis. Oxidative decarboxylation of α-ketoacids (pyruvate and α-ketoglutarate) – molecular mechanism of action of pyruvate dehydrogenase complex. Regulation of the pyruvate dehydrogenase complex

16. Respiratory chain - localization, structure and mode of action. Regulation. Inhibitors of electron transport in proton translocation sites (barbiturates, antimycin A, CO/KCN). Chemo-osmotic theory of the mechanism of oxidative phosphorylation in the respiratory chain. ATP synthase complex. Uncoupling agents and inhibitors of oxidative phosphorylation. Mitochondrial diseases
17. Free oxidation. Heat production – brown adipose tissue and the action of thermogenin. Electron transfer in the endoplasmic reticulum – short electron transport chains with cytochrome P_{450} and b_5. Formation and neutralization of free radicals - reactive oxygen and nitrogen species. Antioxidant enzymes and non-enzymatic antioxidants
18. Citric acid cycle. Features, chemical reactions, and energy balance. Relationship of the citrate cycle with the respiratory chain and the metabolism of carbohydrates, lipids, amino acids, ammonia and porphyrins. Mechanisms of regulation. Complementary reactions. Pyruvate dehydrogenase deficiency

V. Carbohydrate metabolism

19. Digestion and resorption of carbohydrates in the gastrointestinal tract. Glycolysis – metabolic significance and chemical reactions. Relationships of glycolysis with the respiratory chain (glycerol-3-phosphate and malate-aspartate shuttles) and the Krebs cycle. Energy balance under aerobic and anaerobic conditions. Tissue specificity. Regulation by hormonal control. Anaerobic predetermination of pyruvate. Pasteur effect. Lactic acidosis and pyruvate kinase deficiency. Cancer and glycolysis
20. Gluconeogenesis – metabolic significance, cellular compartmentalization and chemical reactions. Overcoming the irreversible steps of glycolysis. Substrates for gluconeogenesis (glucose-alanine cycle and Cori cycle). Reciprocal regulation of gluconeogenesis and glycolysis. Role of gluconeogenesis in the kidney and small intestine. Pyruvate carboxylase and fructose-1,6-diphosphatase deficiency
21. Pentose phosphate pathway – metabolic significance, tissue specificity, and chemical reactions. Regulation. Glucose-6-phosphate dehydrogenase deficiency
22. Metabolism of fructose - sources, resorption in enterocytes and metabolization in liver, muscles and extrahepatic tissues. Relationship of fructose metabolism with other metabolic pathways. Essential fructosuria and hereditary fructose intolerance
23. Metabolism of galactose - sources, resorption in enterocytes, and degradation in liver. Synthesis of galactose and lactose in the lactating mammary gland. Products formed by the metabolism of galactose. Lactose intolerance and types of galactosemia. Mannose metabolism – sources, metabolic significance, and congenital disorders
24. Glycogen metabolism – model structure of amylose and amylopectin, degradation (hydrolytic and phosphorolytic) and biosynthesis. Regulation with hormonal control of glucogenogenesis and glycogenolysis. Interorgan interactions in glycogen utilization. Types of glycogenosis. Fate of non-degradable carbohydrates
25. Metabolic and hormonal control of blood glucose concentration – enzymes, insulin, glucagon, adrenaline, cortisol, thyroid hormones, and growth hormone. Peculiarities of carbohydrate metabolism in different organs and tissues (liver, muscles, adipose tissue, brain, kidneys and erythrocytes). Disorders in hypo- and hyperglycemia

VI. Lipid metabolism

26. Classification, significance, digestion, and resorption of lipids in the gastrointestinal tract. Transport forms of lipids in the blood - types, composition, origin, and metabolism of lipoprotein complexes. Receptors, apolipoproteins, and enzymes of lipoprotein metabolism. Hyperlipoproteinemia type I

27. Biosynthesis and degradation of triacylglycerols. Tissue specificity. Fate of fatty acids and glycerol during the degradation of triacylglycerols in the body. Regulation of triacylglycerol metabolism. Adipocyte triacylglycerol lipase and hormone-dependent adipocyte lipase

28. Degradation of saturated fatty acids with even and odd number of carbon atoms by β-oxidation. Carnitine shuttle. Beta-oxidation and peroxidation of polyunsaturated fatty acids. Regulation, metabolic, and energy balance of β-oxidation. Peroxisomal β-oxidation. Omega-oxidation. Alpha-oxidation of branched-chain fatty acids. Enzyme defects in the breakdown of fatty acids

29. Biosynthesis of fatty acids. Citrate shuttle. Role of acetyl-coenzyme A carboxylase. Structure of an acyl synthase complex. Rapid and long-lasting mechanisms of lipogenesis regulation. Biosynthesis of unsaturated higher fatty acids. Biological functions of essential polyunsaturated fatty acids and disorders in their deficiency

30. Importance, biosynthesis and degradation of ketone bodies. Sources for the formation of ketone bodies. Absorption of ketone bodies in extrahepatic tissues. Regulation of ketogenesis (control in adipose tissue, metabolic possibilities for fatty acids and acetyl-coenzyme A). Ketonemia and ketonuria. Ketoacidosis during fasting and diabetes. Ketogenic diet

31. Types, biological role, biosynthesis, and degradation of glycerophospholipids. Sphingolipids - representatives, functions, and metabolism. Multiple sclerosis and neonatal respiratory distress syndrome. Sphingolipidoses

32. Origin, nomenclature, biological role, and biosynthesis (cyclooxygenase, lipoxygenase and cytochrome P_{450} pathway) of eicosanoids. Degradation of eicosanoids. Action of steroidal and non-steroidal drugs against the formation of eicosanoids

33. Biosynthesis and importance of cholesterol in the body. Role of lipoprotein complexes in cholesterol metabolism. Short- and long-term regulation of cholesterol biosynthesis. Removal of cholesterol from the body. Drugs to lower serum cholesterol levels. Hereditary hypercholesterolemia

34. Cholesterol derivatives - types (steroid hormones, bile acids, and vitamin D_3) and basic biological functions. Biosynthesis of bile acids by classical and alternative pathways, and regulation of the process. Enterohepatic circulation of bile acids. Gallstone disease. Biosynthesis of vitamin D_3

35. Diseases of lipid metabolism. Adipose tissue as an endocrine organ. Obesity and metabolic syndrome. Fatty dystrophy of the liver. Atherosclerosis - mechanism of atherosclerotic plaque formation. Determining the risk of developing cardiovascular disease using indicators of lipid metabolism. Role of nutrition in the prevention and treatment of lipid disorders

VII. Amino acid metabolism

36. Digestion of proteins and absorption of amino acids in the gastrointestinal tract. Intracellular degradation of proteins. Gamma-glutamyl cycle. Kwashiorkor and amino acid transport disorders. Nitrogen balance and end products of nitrogen exchange. General reactions of oxidative and non-oxidative deamination, transamination, transdeamination, and decarboxylation of amino acids. Clinical significance of transaminases

37. Ammonia toxicity. Ammonia disposal pathways – reductive amination of α-ketoglutarate, glutamine formation, glucose-alanine cycle, and renal-renal ammoniagenesis. Ammonia detoxification in the urea cycle - significance, chemical reactions, relation to the Krebs cycle (aspartate-argininosuccinate shunt), regulation and enzyme disorders

38. Degradation of the carbon skeleton of amino acids. Degradation of phenylalanine and tyrosine, tryptophan, and branched-chain amino acids. Involvement in the Krebs cycle of glycogenic, ketogenic and mixed amino acids. Types, origin, and meaning of one-carbon-atom

(C_1) residues. Role of folic acid, vitamin B_{12}, and S-adenosylmethionine in the transfer of C_1 residues. Therapeutic analogues of folic acid

39. Non-essential and essential amino acids. Selenocysteine. Biosynthesis of non-essential and essential amino acids. Homocystinuria. Metabolism and significance of derivatives of the amino acids serine (ethanolamine, choline, phospho- and sphingolipids) and arginine (creatine phosphate, citrulline, nitric oxide, and polyamines). Biogenic amines - types and functions

40. Metabolism and significance of amino acid derivatives - tyrosine (thyroid hormones, catecholamines, and melanins) and tryptophan (NAD^+, serotonin and melatonin). Products of glutamate and glutamine metabolism and their functions in the body

41. Diseases of amino acid metabolism. Enzyme disorders in the metabolism of phenylalanine and tyrosine (phenylketonuria, tyrosinosis, alkaptonuria, and albinism), tryptophan (pellagra) and aliphatic amino acids (methylmalonate acidemia). Parkinson's disease. Peculiarities in the metabolism of amino acids in different tissues and hormonal control

VIII. Nucleotide metabolism

42. Digestion of nucleic acids and resorption of the products in the gastrointestinal tract. Biosynthesis and degradation of purine nucleotides. Regulation of biosynthesis. Enzyme disorders in the metabolism of purine nucleotides - immune deficiencies, hyperuricemia and gout, Lesch-Nyhan syndrome. Tissue specificity in the metabolism of purine nucleotides. Purine analogs as drugs

43. Biosynthesis of pyrimidine nucleotides. Regulation of biosynthesis. Ribonucleotide reductase and thymidylate synthase reactions. Degradation of pyrimidine nucleotides. Enzyme disorders in the metabolism of pyrimidine nucleotides - dihydrofolate reductase deficiency and orotate aciduria. Drugs to control nucleotide biosynthesis

IX. Metabolism of porphyrins

44. Metabolism of the trace element iron. Iron-containing proteins. Absorption of heme and non-heme iron in enterocytes and transport to the liver. Mechanism of iron uptake by cells. Iron-transporting and iron-storing proteins. Hormonal and post-transcriptional control of iron metabolism. Disturbances in iron homeostasis – iron-deficiency anemias, hemochromatosis, and iron-induced oxidative stress

45. Types of hemoproteins and their importance for the body. Biosynthesis of porphyrins. Regulation of the production of porphyrins. Inducers and repressors of δ-aminolevulinate synthase. Types of porphyrias - acute intermittent porphyria. Types of thalassemias. Lead poisoning. Application of exogenous porphyrins in oncology

46. Degradation of hemoglobin in the reticuloendothelial system to hemobilirubin. Heme oxygenase isoforms and functions. Conversion of hemobilirubin to cholebilirubin in the liver and secretion into the bile. Fate of cholebilirubin in the intestine. Enterohepatic circulation of bile dyes. Types of jaundice and genetic disorders of bilirubin metabolism

X. Integration of metabolism

47. Integration of metabolism. Metabolic interactions and regulation of metabolic pathways. Structural aspects of integration - at the level of a protein molecule (two- and multi-enzyme complexes), compartmentalization, selective permeability, shuttle, and transport mechanisms for transferring metabolites. Dynamic aspects – economy and standardization, nodal, common and limiting metabolites and cofactors, rate-limiting reactions, and enzyme activity (allosteric control, reversible covalent modification, limited proteolysis, signaling cascades and gene expression)

48. Tissue and organ specificity in the integration of metabolism. Hormonal and metabolic control - brain, skeletal muscle, heart, liver, and adipose tissue. Peculiarities of metabolism in the fed state, fasting and in disease states

XI. Biosynthesis of nucleic acids

49. Biosynthesis of DNA - general characteristic. DNA polymerases and other proteins involved in replication in eukaryotes. Stages of replication. Regulation of gene expression at the DNA level. Cell cycle and mechanisms of its control in mammals. DNA repair mechanisms. Disorders of DNA replication and repair

50. Biosynthesis of different types of RNA. RNA polymerases. Structure and function of promoters in eukaryotes. Transcription complex and stages of transcription. RNA maturation. Regulation of gene expression at the level of transcription and post-transcriptional processing. Transcription inhibitors. Alternative splicing of mRNA. Fragile X chromosome. Ebola virus

51. Recombinant DNA technologies. Role of restriction enzymes, reverse transcriptase, and chemical methods. Methods for determining sequences in DNA - electrophoresis, Southern blot technique, Sanger method, and polymerase chain reaction (PCR). Production of vaccines and human therapeutic proteins. Hereditary polymorphisms. Gene therapy

XII. Biosynthesis of proteins

52. Biosynthesis of proteins. Role of mRNA, mRNA, rRNA, and ribosomes in the protein biosynthesis. Enzymes and steps of translation. Regulation of gene expression at the level of translation. Inhibitors of protein synthesis. Transport of the newly synthesized proteins

53. Post-translational processing of proteins. Proteolytic modifications. Protein modifications by methylation, acetylation, myristoylation, prenylation, and glycosylation. Phosphorylated and sulfated proteins. Citrullinated proteins and selenoproteins. Vitamin C- and vitamin K-dependent modifications. Ubiquitination. Post-translational modifications under oxidative and carbon stress

XIII. Signal transduction

54. Options for intercellular communication. General principles of signal transduction. Structural organization of a signaling pathway (types of extracellular signaling molecules, types of receptors and intracellular participants in the signaling cascade). Basic mechanisms for the regulation of signaling pathways by protein kinases/phosphatases, adapter proteins, GTP-binding proteins, and switch-off mechanisms. Characteristic features of signaling pathways - signal transmission by amplification, integration, convergence, divergence, and crosstalk

55. Types of plasma membrane receptors. Receptors associated with ion channels. G-protein coupled receptors. Blockade of G-protein signaling by bacterial toxins. Receptors with tyrosine kinase activity. Receptors interacting with non-receptor tyrosine kinases. Receptors with tyrosine phosphatase activity. Receptors with serine/threonine kinase activity. Receptors with guanylate cyclase activity

56. Types of secondary mediators involved in signal transduction. Cyclic AMP and classes of adenylate cyclases. Cyclic GMP and NO (nitric oxide synthase isoforms). Calcium and calmodulin. Lipid secondary mediators – diacylglycerol, inositol-3-phosphate, phosphatidylinositol-1,(3),4,5-triphosphate (phosphatidylinositol-3-kinase classes), eicosanoids, ceramide, and sphingosine-1-phosphate

XIV. Hormones

57. Basic characteristics of hormones. Hypothalamic-pituitary system - hormonal hierarchy. Types of hormones from the anterior pituitary gland. Hypothalamic-adenohypophyseal axes. Hypothalamic-pituitary-thyroid axis. Biosynthesis and degradation of thyroid hormones. Involvement of thyroid hormones in metabolism. Hypo-, hyperthyroidism, and iodine deficiency

58. Hypothalamic-pituitary-adrenal axis and gonads - biosynthesis of steroid hormones. Proopiomelanocortin and peptides formed during its cleavage. Regulation of the biosynthesis of mineralocorticoids, glucocorticoids, and sex hormones. Biological action and metabolic significance of steroid hormones in the body. Addison's disease, adrenogenital syndrome, and Cushing's syndrome. Clinical significance of 5-α-reductase and aromatase

59. Formation, biological functions and molecular signaling of growth hormone, insulin-like growth factors, and prolactin. Dwarfism, gigantism, and acromegaly. Oxytocin. Biological functions and molecular signaling of hormones regulating water-salt exchange (natriuretic hormones, parathyroid hormone, calcitonin, and vasopressin). Renin-angiotensin system

60. Insulin, glucagon, and somatostatin - formation in the pancreas, biological functions with metabolic significance and molecular signaling. Types and biological action of gastrointestinal hormones. Biosynthesis and degradation of catecholamines. Molecular signaling and metabolically relevant biological functions of catecholamines

61. Mechanism of action of hydrophobic signaling molecules through intracellular cytoplasmic and nuclear receptors. Type 1 and 2 intracellular receptors. Biological action of retinoic acid and receptors for its recognition. Thyroid hormone receptors. Steroid hormone receptors. Suppression of the NF-*k*B signaling pathway by glucocorticoids. Vitamin D_3 receptors. Other types of receptors – retinoid X (RXRs), liver X (LXRs), farnesoid X (FXRs), peroxisome proliferator-activated receptors (PPARs), and pregnane X (PXRs) receptors

XV. Apoptosis and oncogenesis

62. Biological significance of programmed cell death. Types of caspases. Extrinsic and intrinsic pathway of apoptosis. Bcl-2 family of proteins. TNFR and Fas signaling pathways. Role of PI3K, PDK, and Akt in cell survival. mTOR inhibitors. Integrin signaling in cell survival and apoptosis. p53 signaling pathway

63. Mechanisms of oncogenesis. Risk factors and prerequisites for the occurrence of cancer. Features of tumor cells. Stages in the development of tumors. Types of tumor markers. Direct and procarcinogens. Mechanisms of conversion of proto-oncogenes into oncogenes. Oncogenic viruses. Importance of growth factors in the development of tumors. Cancer and apoptosis - tumor suppressor genes (RB1 and P53). Chronic myelogenous leukemia and KRAS/NRAS mutational status in colorectal carcinoma. Mechanism of action of anticancer drugs

XVI. Diabetes

64. Molecular mechanisms of blood sugar level regulation. Types of diabetes (Diabetes mellitus). Genetic and other risk factors for developing diabetes. Metabolic disturbances and complications in type I and II diabetes. Pathobiochemical mechanisms in hyperglycemia – oxidative stress, sorbitol pathway, activation of protein kinase C, non-enzymatic glycation of proteins and hexosamine pathway. Biochemical indicators for diagnosis and monitoring of patients with diabetes. Drug therapy in type II diabetes

XVII. Blood biochemistry

65. Blood - composition and biological functions. Types of blood cells - role and metabolism of erythrocytes, monocytes/macrophages, neutrophils and other phagocytes, T- and B-

lymphocytes. Phagocytosis and the T-cell immune response. Molecular mechanisms of toll-like receptor activation in bacterial infections. Erythrocyte enzyme diseases

66. Blood plasma and blood serum. Types, biological role and diagnostic significance of serum proteins (albumin, C-reactive protein, serum amyloid A, haptoglobin, hemopexin, transferrin, ferritin, ceruloplasmin, α-2-macroglobulin, α-1-antitrypsin, matrix metals - proteinases, complement proteins, immunoglobulins, cytokines). Analytical approaches for the isolation and study of serum proteins. Participation of serum proteins in inflammatory processes

67. Types of endothelial, circulating cells and plasma proteins involved in blood coagulation. Stages of blood coagulation: thrombogenesis, fibrin network formation, and fibrinolysis. Molecular mechanisms of blood coagulation – extrinsic, intrinsic, and common coagulation pathways. Role of glutamate carboxylase and transglutaminase in blood coagulation. Regulation of blood coagulation. Thrombosis. Prothrombin time

XVIII. Cell adhesion

68. Mechanisms of cell adhesion. Types and biological functions of cell adhesion molecules – immunoglobulin superfamily, cadherins, selectins and integrins. Cytoskeleton and cell adhesion - actin filaments, intermediate filaments and microtubules, and their involvement in cellular functions. Defects in cell adhesion

XIX. Biochemistry of connective tissue

69. Structure and biological role of connective tissue. Cells forming components of the extracellular matrix. Biosynthesis and functions of collagen, elastin, and fibrillin. Fibronectin and laminin. Glycoproteins. Proteoglycans and glycosaminoglycans containing them. Composition of cartilage. Disorders in the metabolism of structural, specialized proteins and glycosaminoglycans (mucopolysaccharidoses)

70. Bones and teeth. Calcium and phosphorus metabolism. Inorganic and organic composition of bones and teeth. Cells involved in bone resorption and deposition. Mechanisms of bone resorption and ossification. Regulation of bone metabolism. Disorders of bone metabolism

XX. Biochemistry of nutrition

71. Nutrition and dietetics. Types of foods and their biological value. Transport and distribution of water, minerals, and vitamins in the body. Digestion and resorption of carbohydrates, lipids, proteins, and nucleic acids. Processes in the colon. Beneficial actions of probiotic bacteria and dietary fiber. Basic aspects of nutrigenomics. Disturbances in digestion and resorption.

XXI. Liver biochemistry

72. Cells in liver. Metabolic, excretory, and detoxifying functions of the liver. Stages of biotransformation of xenobiotics and their removal from the body. Role of cytochrome P_{450} monooxygenase. Basic aspects of pharmacogenetics. Liver disorders

BIBLIOGRAPHY

1. Rodwell, V.W., Bender, D.A., Botham, K.M., Kennelly, P.J., Weil, P.A. Harper's Illustrated Biochemistry, 31st edition, in: Weitz, M., Boyle, P.J. (Eds.). McGraw-Hill Education, New York, USA, 2018, pages 2023, ISBN: 978-1-25-983794-4.
2. Bivolarska, A. Biochemistry Guide Book for students in Medicine, Dental Medicine and Pharmacy, 1st edition, in: Vlaykova, T. (Ed.). Lax Book Publishing House, Plovdiv, Bul-

garia, 2021, 111 pages, ISBN: 978-619-189-164-1.

3. Vlaykova, T., Bivolarska, A., Delcheva, G., Dimitrov, I., Stankova, T., Dimov, I., Boyanov, K., Choneva, M., Stefanova, K. Workbook for practical exercises and preparation in Biochemistry for students of Medicine. Medical University of Plovdiv, Plovdiv, Bulgaria, 2020, 117 pages.
4. Lieberman, M., Peet, A. Marks' Basic Medical Biochemistry. A Clinical Approach, 6th edition, in: Vosburgh, A. (Ed.). Wolters Kluwer, Philadelphia, PA, USA, 2023, pages 1830, ISBN: 9781975150167.
5. Ferrier, D.R. Lippincott Illustrated Reviews: Biochemistry, 7th edition, in: Jameson, B.A. (Ed.). Wolters Kluwer, Philadelphia, PA, USA, 2017, pages 1716, ISBN 9781496344496.
6. Rosenthal, M.D., Glew, R.H. Medical Biochemistry. Human Metabolism in Health and Disease, 1st edition. John Wiley & Sons, Inc., Publication, USA, 2009, pages 439, ISBN: 978-0-470-1 2237-2.

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

Compiled by: ……..

(Assoc. Prof. Yordan Georgiev, 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 № 10/11.07.2024л

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

(Chief assist. Prof. Ruska Nenkova, PhD)

UNIVERSITY "PROF. Dr. ASEN ZLATAROV" - BURGAS
FACULTY OF MEDICINE
DEPARTMENT OF "INTERNAL DISEASES, SOCIAL MEDICINE, EMERGENCY MEDICINE, PHYSIOTHERAPY AND REHABILITATION"

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

SYLLABUS

Study discipline:	**BIOSTATISTICS**
Specialty:	**MEDICINE**
Professional direction:	**7.1. MEDICINE**
Educational and qualification degree:	**MASTER**
Form of education:	**REGULAR**

BURGAS 2024

SAMPLES FROM THE CURRICULUM

1. GENERAL PARAMETERS OF THE DISCIPLINE			
Total (academic hours):	60	**ECTS:**	2
Auditorium classes	**Non-auditorium classes**	**Auditorium ECTS**	**Non-auditorium ECTS**
30	30	1	1
Type of Discipline*:*	**Academic hours per week: /lectures + practic-es/**	*Course:*	*Semester:*
MANDATORY	1+1	**II**	**III**

2. STUDY FORMS					
Auditorium classes:	**Academic hours**	**ECTS**	**Non-auditorium classes:**	**Hours**	**Credits:**
Lectures	15	0.5	Consultations (work with a teacher)	10	0.3
Seminar classes	15	0.5	Independent work	20	0.7
Practical classes	—	—			

3. EVALUATION AND CONTROL	
ASSESSMENT AND CONTROL FORMS	**Relative share in the total assessment**
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 "BIOSTATISTICS"

Purpose of the study discipline:

The study discipline "BIOSTATISTICS" is intended for the students of the specialty "MEDICINE", OCS "MASTER'S", regular form of study.

The aim of the study discipline "BIOSTATISTICS" is for students to acquire a mandatory minimum of knowledge about the essence, principles and logic of statistical analysis, about the cognitive and specific requirements for the use of basic statistical methods in biology, medicine and health care. To form skills for computer application of the most important statistical methods.

Structure of the learning content: In the teaching of the discipline, lectures, exercises and tasks are set for independent work.

Teaching methods and means: Teaching methods are a way of working for the university teacher and the student, with the help of which mastery of knowledge, skills and habits is achieved, the students' worldview is formed and their abilities are developed. Training in the discipline "BIOSTATISTICS" is conducted by combining traditional methods, multimedia presentations and developed methodologies.

Forms of study: The study of the discipline takes place in the following forms:

1. Lectures in which the basic theoretical knowledge is given on the topics under consideration. For some of the topics and subtopics that can be studied independently by the students, the lectures are introductory. They reveal the essence of the questions falling within the scope of the topics and direct independent work on the recommended literature. In parallel with the lecture material, there will also be discussions on theoretical issues, solving tasks related to the practical application of the methods under consideration, solving didactic tests and case studies, etc.
2. Consultations to clarify basic concepts, statistical characteristics, etc. and targeting their specific features, with a view to overcoming difficulties in independent work, etc.
3. The independent work of the students is organized through consultations in the teachers' reception hours, through e-mail communication, joint work on scientific and professional tasks, covering current tests on a given topic by the teacher conducting the exercises, etc.

Assessment methods: The course ends with an exam. During each exercise, tasks related to the topic are set. At the end of the semester, a grade is formed from each student's participation in the exercises based on the assigned case studies for each exercise, tasks for independent work, attendance at classes, as well as the active participation in the exercises, which has a coefficient of 0.3 in the overall grade. The main share in the overall grade is given by the grades from the two control tests during the semester.

Expected results

After successful completion of the course in the discipline, students should know and be able to:

To acquire knowledge about the subject and importance of medical statistics, types of statistical analyses, theoretical and practical skills in working with the various methods and products of statistical analysis.

CONTENTS OF THE CURRICULUM
THEMATIC PLAN OF LECTURES

BIOSTATISTICS

	Hours
1. The role of statistics in medicine and healthcare. Definition of medical statistics as a scientific discipline. Use of statistics in medicine and healthcare. Use of statistical concepts and methods in medical practice	**1**
2. Planning of scientific studies. Population and sample. Types of scientific research. Stages of scientific studie	**1**
3. Health data – sources, levels and quality of measurementSources and procedures for collecting data on health and the activity of the health service. Types of variables. Measuring scales	**1**
4. Representative surveys Nature of representative surveys. Basic concepts and principles of sample selection. Types of samples. Systematic errors in representative surveys. Group properties of statistical populations	**1**
5. Organization and presentation of data from scientific studies Tabular presentation of data. Frequency distributions. Graphical presentation of tabular data and frequency distributions	**1**
6. Description of qualitative variables Proportions (extensive indicators). Frequency indicators (intensive indicators). Errors in the interpretation of extensive and intensive indicators. Nature of standardized indicators	**1**
7. Description of quantitative variables. A measure of central tendency. Two basic properties of quantitative variables. A measure of central tendency. Arithmetic mean value. Median. Fashion. Comparison of arithmetic mean, median and mode. Other positional averages – percentiles and quartiles	**1**
8. Description of quantitative variables. Measuring variation.Measures of variability (dispersion). Span (range, extent, limit) of the variation order. Interquartile range. Standard deviation and variance. Coefficient of variation. Variation trends. Normal distribution	**1**
9. Creation of norms in medicine Essence of regulations. Martin's method of creating norms. Method of percentiles for creating norms	**1**

10. Probability and probability distributions **1**

Basic concepts. Probability measurement and types of probability. Basic rules for measuring probability. Probability distributions.

11. Statistical estimation: from sample to population **1**

Need to study samples. Nature of statistical evaluation. Basic concepts in statistical evaluation. Standard (stochastic mean) error. Warranty probability (reliability). Guarantee (trust) coefficient. Maximum (stochastic) error. Confidence interval (confidence limits). Practical steps in static evaluation. Estimation of averages. Estimation of coefficients and proportions. Determining the minimum sample size for estimating parameters in a population. Determining the sample size for quantitative variables. Determining the sample size for qualitative variables

12. Statistical testing of hypotheses **1**

Meaning and nature of comparing data from samples. Basic concepts in hypothesis testing. Nature and types of statistical hypotheses. Errors of the 1st and 2nd generation. Statistical significance of hypotheses. Statistical tests for testing hypotheses. Basic principles and procedures for hypothesis testing. Basic principles in hypothesis testing. Basic steps of the hypothesis testing procedure. Selection of statistical tests of significance. Parametric methods of hypothesis testing. Comparing two groups of observations by t-test. Comparing more than 2 groups by analysis of variance. Nonparametric methods of hypothesis testing. Nature of non-parametric criteria. Chi-square criteria. Other non-parametric criteria. Interpreting statistical tests

2

13. Methods for studying causal dependencies

Basic concepts of correlation analysis. Functional and correlation dependence. Types of correlation dependencies. Correlation coefficient - essence and evaluation. Scatter diagram. Methods for calculating correlation coefficients. Correlation coefficient for qualitative variables. Spearman's rank correlation coefficient. Pearson correlation coefficient for quantitative variables. Coefficient of determination. Regression analysis

14. Analysis of dynamic changes **1**

Significance of the study of trends in the development of health and social phenomena. Dynamic queues - characteristic and basic elements. Descriptive indicators of dynamics. Analytical indicators of dynamics

Total: 15 h

THEMATIC PLAN OF EXERCISES **Hours**

BIOSTATISTICS

1. Representative studies. Organization and presentation of research data. Frequency **2**

distributions

2. Structure, functions and operation of a statistical application. Analysis of empirical (frequency) distributions. Tabular and graphical representation of the data - polygon and histogram	**2**
3. Description of quantitative variables - mean, median, mode, variance, standard deviation, coefficients of variation, skewness, and kurtosis. A measure of central tendency. Using the Descriptive Statistics procedure from the Data analysis module	**2**
4. Creation of norms in medicine. Interval statistical estimation - standard error, maximum error and confidence interval of arithmetic mean	**2**
5. Statistical testing of hypotheses of difference between two samples (dependent and independent). Comparison of variances of two samples Fisher's F-test. Using the t-test for independent samples and t-test for dependent samples procedures from the Data analysis module to determine significance of the difference between means.	**2**
6. Methods for studying causal dependencies. Calculating a Pearson correlation coefficient to determine a linear relationship between two variables by using the Correlations procedure from the module. Data analysis. Construction of a two-dimensional scatter diagram (Scatter Plot).	**2**
7. Methods for studying causal dependencies. Linear regression. Multiple linear regression. Using the Multiple Regression module to examine the linear relationship between variables. Defining the linear regression model – defining the dependent and independent variables. Interpretation of the results of the regression analysis - coefficient of multiple correlation (Multiple R), coefficient of multiple determination (R-square), standard error of the estimate (Standard Error of the estimate). Obtaining the regression coefficients, their standard errors, determining their statistical significance. Obtaining graphs. Finding predicted values of the dependent variable.	**2**
8. Control work	**1**
Total:	**15 h**

EXAM QUESTIONNAIRE

1. The role of statistics in medicine and healthcare. Planning scientific studies.
2. Health data – sources, levels and quality of measurement.
3. Representative studies.
4. Organization and presentation of research data.
5. Description of qualitative variables.
6. Description of quantitative variables. A measure of central tendency.
7. Description of quantitative variables. Measuring variation.
8. Creation of norms in medicine.
9. Probability and probability distributions.
10. Statistical evaluation: from sample to population.
11. Statistical testing of hypotheses.
12. Basic concepts in data comparison and hypothesis testing.
13. Parametric methods for testing hypotheses.
14. Non-parametric methods for testing hypotheses.
15. Methods for studying causal dependencies.
16. Correlation analysis.

17. Regression analysis.
18. Analysis of dynamic changes.

LITERATURE FOR PREPARATION

Mandatory

1. Electronic lecture course on "Medical Statistics"
2. Gena Grancharova, Petkana Hristova, Medical Statistics, 2011, Publishing Center of MU - Pleven
3. N. Tsacheva, K. Lyubomirova, M. Stoycheva, T. Kundurdzhiev, E. Naseva, Statistics in occupational medicine and public health, Sofia, 2015
4. Dokova, Kl., Mirvheva, I., Biostatistics, Lecture course&Practical seminars for Medical students, Medical university of Varna 2011

Recommended

1. Ivo Dimitrov, medical statistics, Plovdiv, ed. Pygmalion, 1996
2. G. Ranchov, Medical statistics. Sofia, Gorex Press 1997, 274

Compiled the curriculum:

1……..... .....
Prof. Dr. Vladimir Gonchev)

2…… ...
(Assoc. Prof. Dr. Velichka Traneva)

The curriculum was discussed and adopted at a meeting of the Department of "Internal Diseases, Social Medicine, Disaster Medicine, Physiotherapy and Rehabilitation", Protocol No. 7 of 12.09.2024

Head of department .....
(Prof. Dr. Vladimir Gonchev)

The curriculum was adopted and discussed at the Faculty Council of the Faculty of Medicine, Protocol No. from ……..

FS Secretary: .....
(Assistant Prof Ruska Nenkova)

PROF. DR. ASEN ZLATAROV UNIVERSITY OF BURGAS

MEDICAL FACULTY

DEPARTMENT OF PHYSIOLOGY, PATHOPHYSIOLOGY, CHEMISTRY AND BIOCHEMISTRY

Approved by!

DEAN:…….

/Assoc. Prof. Rumyana Yankova, PhD/

Educational subject:	**HUMAN PHYSIOLOGY**
Specialty:	**MEDICINE**
Professional regulation:	**7.1. Medicine**
Educational Qualification:	**MASTER'S DEGREE**
Form of education:	**REGULAR**

Burgas, 2024

EXTRACTS FROM THE CURRICULUM

1. GENERAL PARAMETERS OF THE DISCIPLINE			
Total (academic hours):	450	**ECTS:**	15

Auditorium classes	**Non-auditorium classes**	**Auditorium ECTS**	**Non-auditorium ECTS**
195	255	6.5	8.5

Type of Discipline*:*	**Academic hours per week: /lectures + practices/**	*Course:*	*Semester:*
Mandatory	3+3 and 4+3	***II***	***III and IV***

2. STUDY FORMS					
Auditorium classes:	**Academic hours**	**ECTS**	**Non-auditorium classes:**	**Academic hours**	**ECTS**
Lectures	105	3.5	**Consultation**	60	2
Seminars			**Individual work**		
Practices	90	3	- Preparation for colloquia; - Preparation for the final exam - Preparation of reports and presentations	70 90 35	2.3 3 1.2

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:	
- Attendance at classes	0.1
- Current control examination before each exercise	0.04
- Active participation in classes	0.02
- Examinations and tests	0.1
- Preparation and presentation of essays, presentations	0.04
- Seminar classes	0.05
- Colloquia	0.05

ANNOTATION
of the subject "Human Physiology"

Purpose of the subject

The subject "Human Physiology" is intended for students of the specialty "Medicine", a regular form of education.

Aims

The purpose of the subject "Human Physiology" is to give students knowledge and the opportunity to acquire basic competencies in the field of processes occurring in the human organism at different levels - cellular, tissue, organ, and system, as well as the interaction between them and the individual with the environment while maintaining the constancy of all parameters in the body. All these levels of organization of physiological processes reveal the mechanisms of homeostasis and adaptation of the organism in various physiological states and environmental changes. All this places Human Physiology in a fundamental position in medical science because it provides essential knowledge of basic processes and their variability in the growth, maturation, reproduction, and aging stages. Student's full assimilation of this knowledge in the second year will provide them with a solid base for further development and understanding of the pathophysiological mechanisms of diseases, correct and complex diagnosis, and selective and timely therapy. Practical exercises in physiology will give them the opportunity for the first time to make real measurements of many basic parameters and tests that are common in medical practice and to acquire a routine in their performance.

Main tasks of the subject:

- Mastering basic concepts to form students' scientific, scientific-applied, and practical knowledge and skills.
- Studying the mechanisms of functioning of individual organs and systems, the subcellular and cellular mechanisms of individual functions;
- Studying the homeostatic regulations of the functions at cellular, organ, and system levels;
- Studying the mechanisms of adaptation to inner or environmental changes;
- Building a theoretical basis for revealing the pathophysiological mechanisms, as well as different therapeutical approaches;
- Introduction to basic principles, planning, and conducting experimental studies using some conventional and modern research methods;
- Acquiring the usage of a professional research base of data, specific terminology, and development of working skills in the creation of a scientific text in oral or written form;
- Digital competence - preparing presentations on specific topics as a part of the course program;
- Stimulation of individual and team research, planning, organizing, and managing educational, experimental, and scientific-applied activities;
- Forming of social and civic competencies - communication skills, critical and creative thinking when making decisions, discussing problems, solving tasks and cases, tolerant attitude, and acceptance of different points of view during discussions and debates;
- Creating a basis for professional communication with patients according to medical and ethical norms.

Structure of the subject matter:

- Physiology of excitable tissues
- Mechanisms of intercellular signaling
- Physiology of the muscles
- Physiology of the cardiovascular system
- Physiology of the blood, lymph, and immune system
- Physiology of the Respiratory system
- Physiology of the Digestive system
- Body metabolism and energy
- Physiology of the renal system
- Maintaining water-salt and acid-base balance
- Physiology of the nervous system
- Physiology of the sensory systems
- Physiology of the autonomic nervous system
- Physiology of the endocrine system
- Physiology of the reproductive systems
- Physiology of physical activity

Teaching methods:

Conventional and innovative teaching methods, lectures, discussions, practical work, computer modeling, multimedia presentations, projects, case reports, teamwork, etc. A key moment will be interactive learning, helping the joint interpersonal cognitive communication and interaction between professor and student in the learning process through the exchange of knowledge and ideas, solving cases, and debates. Stimulating individual abilities to express, visualize, and choose the appropriate model for graphical representation of logical connections knowledge - experiment, capture images, take notes.

Forms of individual work:

Tasks for self-solving on topics from the lectures and practicals, preparation for current tests on every section of the educational content and the final exam, solving tests, drawing up protocols for laboratory work, colloquiums, preparation of abstracts, and oral presentations.

Evaluation methods:

Ongoing control during the conduct of classes, including oral examination before conducting the practicals, tests, seminar discussions, and colloquiums. To exclude any potential plagiarism or use the artificial intelligence, most of the tasks will include creativity in the preparation and oral presentation. The final evaluation includes a complex grade from the current grades, practical and theoretical semester exams with a written part kept in the archive of the department and an oral part before a committee of qualified professors.

Preliminary requirement for students' basic knowledge and skills:

Students should have good basic knowledge of biology from the high school course and upgraded knowledge of biology, chemistry, physics, anatomy, and biochemistry from the 1st year, as well as acquired skills for laboratory work.

Expected results:

After completing the Human Physiology course, students must master the following knowledge and skills:

- General cell physiology, intercellular signaling, physiology of excitable tissues;

• Understanding the mechanisms of action and regulation of individual organs and systems in the human body;
• Individual research of information from reliable sources and creation of a scientific text;
• Basic research methods in physiology.

CURRICULUM CONTENT

Lectures

Topic	hours
1. Introduction.	3
1.1. Subject, aim, and subdivisions of human physiology.	
1.2. General principles of regulation in the human organism. Homeostasis.	
1.3. Structure and functions of the cell membrane. Transcellular and paracellular transport.	
2. Physiology of excitable structures.	3
2.1. Excitable structures - general characteristic.	
2.2. Ion channels.	
2.3. Membrane potentials.	
2.4. Resting membrane potential.	
3. Physiology of excitable tissues.	3
3.1. Dynamics of the excitation.	
3.2. Generation of action potential.	
3.3. Encoding the information.	
3.4. Conduction of the excitation and classification of the nerve fibers.	
4. Mechanisms of intercellular signaling I.	3
4.1. Physiology of the synapse. Functional construction of synapses.	
4.2. Mechanism of transmission of excitation through chemical synapses.	
5. Mechanisms of intercellular signaling II.	3
5.1. Types of mediators in chemical synapses.	
5.2. Membrane receptors. Postsynaptic potentials.	
6. Physiology of muscles I.	3
6.1. Functional structure of muscle tissue.	
6.2. Physiological properties of muscles.	
6.3. Mechanism of muscle contraction.	
7. Physiology of muscles II.	3
7.1. Metabolism and energetics of muscle contraction.	
7.2. Physiology of smooth muscle.	
7.3. Functional unit of muscles.	
7.4. Types of muscle fibers.	
8. Physiology of the cardiovascular system I.	3
8.1. Functional structure of the cardiovascular system.	
8.2. Physiology of the heart.	
8.3. Myocardial electric potentials. Electrical conduction system of the heart. Electrocardiography.	
9. Physiology of the cardiovascular system II.	3
9.1. Cardiac cycle.	
9.2. Regulation of cardiac functions. Pressures, volumes, and capacity of the heart.	
10. Physiology of the cardiovascular system III.	3

10.1. Physiology of blood vessels. Factors determining the movement of blood in the vascular system. Arterial blood pressure.
10.2. Arterial circulation.
11. Physiology of the cardiovascular system IV. 3
11.1. Microcirculation - regulation of local blood flow.
11.2. Venous circulation and venous blood pressure.
12. Physiology of the cardiovascular system V. 3
12.1. Regulation of blood vessels tonus.
12.2. Regulation of blood circulation. 12.2. Specificity of blood circulation in individual vascular areas.
13. Blood physiology 3
13.1. Composition and physic and chemical properties of blood.
13.2. Functions of the blood.
13.3. Blood plasma.
13.4. Formed elements. Erythrocytes, hemoglobin. Erythropoiesis - regulation.
13.5. Blood group systems. Hemotransfusion.
14. Physiology of lymph and protective functions of blood. 3
14.1. Composition and functions of lymph and tissue fluid.
14.2. Leukocytes. Regulation of leukopoiesis. Differential blood count.
14.3. Immune functions of the blood.
14.4. Platelets. Hemostasis and blood coagulation. Blood clotting system.
15. Physiology of respiratory system I. 3
15.1. Biological significance of breathing. Phases of breathing.
15.2. Functional anatomy of the respiratory tract. Pulmonary ventilation - volumes and capacities.
15.3. Regulation of ventilation.
16. Physiology of the respiratory system II. 2
16.1. Gas transport - physical principles.
16.2. Transport of oxygen and carbon dioxide. Hemoglobin saturation.
16.3. Pulmonary ventilation/perfusion.
17. Physiology of the digestive system I. 2
17.1. Functional anatomy of the digestive system. Enteric nervous system.
17.2. Stages of digestion.
17.3. Motility of the gastrointestinal tract.
17.4. Neural and humoral regulation of gastrointestinal motility.
18. Physiology of the digestive system II. 2
18.1. Secretion, digestion, and resorption of the food in the digestive tract.
18.2. Neural and humoral regulations of the digestion and gastrointestinal blood supply.
19. Metabolism and energy of the human organism I. 2
19.1. Metabolism, anabolic and catabolic processes.
19.2. Metabolism of proteins and carbohydrates.
20. Metabolism and energy of the human organism II. 2
20.1. Metabolism of lipids.
20.2. Vitamin metabolism.
20.13. Liver physiology.
21. Metabolism and energy of the human organism III. 2
21.1. Energy exchange, basal metabolic rate.
21.2. Thermoregulation.
21.3. Regulation of metabolism and energy transfer.

22. Physiology of the renal system I. 2
22.1. Functional structure and physiological functions of the renal system.
22.2. Glomerular filtration. Concept of clearance.
23. Physiology of the renal system II. 2
23.1. Transport processes in the renal tubules.
23.2. Urine concentration and dilution.
23.3. Micturition. Urine volume and composition.
24. Physiology of the renal system III. 2
24.1. Endocrine function of the kidneys.
24.2. Regulation of kidney function.
24.3. Renal regulation of blood pressure.
25. Water-electrolyte balance. 2
25.1. Regulation of water-salt balance and maintenance of blood and tissue osmolarity.
25.2. Acid-base balance regulation.
26. Physiology of the nervous system. 2
26.1. Physiology of the neuron. Neural networks.
26.2. Methods of studying the nervous system.
26.3. Reflex activity of the nervous system.
27. **Physiology of sensory systems I.** 2
27.1. Receptor physiology.
27.2. General principles of organization of the sensory systems.
27.3. Somatosensory system.
28. Physiology of sensory systems II. 2
28.1. Vestibular sensory system
28.2. Structure and functions of the vestibular system.
28.3. Role in the regulation of movements.
29. Physiology of sensory systems III. 2
29.1. Functional anatomy and physiology of the auditory sensory system.
29.2. Processing of auditory information at the subcortical and cortical level.
30. Physiology of sensory systems IV. 2
30.1. Physiology of the visual sensory system.
30.2. Structure and functions of the optic system of the eye.
30.3. Structure and processing of information in the retina.
31. Physiology of sensory systems V. 2
31.1. Physiology of the visual sensory system. Visual pathways.
31.3. Processing of visual information at the subcortical and cortical level. Image analysis.
32. Regulation of muscle activity and movements I 2
32.1. General mechanisms of movement regulation.
32.2. Muscle receptors.
32.3. Spinal regulation of movements.
33. Regulation of muscle activity and movements II 2
33.1. Brain stem and cortical regulation of movements.
33.2. Regulation of movements by the cerebellum and basal ganglia.
33.3. Voluntary movements regulation.
34. Physiology of central nervous system I. 2
34.1. Regulation of consciousness, levels of consciousness.
34.2. Stages of sleep and alertness.
34.3. Electroencephalography.

35. Physiology of central nervous system II. 2
35.1. Integrative functions of the cerebral cortex.
35.2. Neurophysiological basis of speech.
35.3. Physiological bases of memory.
36. Physiology of central nervous system III. 2
36.1. Physiological basis of behavior and emotions.
36.2. Limbic system and hypothalamus.
37. Physiology of the autonomic nervous system. 2
37.1. Characteristics of the sympathetic and parasympathetic divisions of the autonomic nervous system.
37.2. Main effects of the departments of the autonomic system on body functions.
38. Physiology of the endocrine system I. 2
38.1. General principles of endocrine regulation.
38.2. Mechanism of action of hormones.
39. Physiology of the endocrine system II. 2
39.1. Hypothalamic-pituitary system.
39.2. Physiological action of pituitary hormones.
40. Physiology of the endocrine system III. 2
40.1. Hormones of the adrenal glands - physiological action and regulation of their secretion.
40.2. Physiology of stress.
41. Physiology of the endocrine system IV. 2
41.1. Physiology of the thyroid and parathyroid glands.
41.2. Regulation of calcium and phosphate homeostasis.
42. Physiology of the endocrine system V. 2
42. 1. Endocrine functions of the pancreas.
42.2. Regulation of blood glucose level.
43. Endocrine regulation of the reproductive process. 2
44.1. Hormonal functions of the male gonads.
44.2. Hormonal functions of the female gonads. Menstrual cycle.
44. Reproductive functions of the reproductive system. 2
44.1. Reproductive functions of the male reproductive system.
44.2. Reproductive functions of the female reproductive system. Pregnancy. Lactation.
45. Physiology of physical exercises. 2
45.1. Physiology of sports.
45.2. Temporary and permanent changes in the body's functional parameters during systematic training.

Total: 105

Practical exercises

Topic	hours
1. Excitable structures and membrane potentials. Introduction to work in the physiology laboratory. Apparatus and technique for conducting physiological experiments. Calculations of resting membrane potential.	3
2. Physiology of the nerve cell. Physiology of synapses. Electroneurogram, rheobase, chronaxie.	3
3. General physiology of excitable tissues - seminar.	3

4. Physiology of muscles. Registration of muscle contraction. Determination of absolute and specific muscle strength. Registration of muscle fatigue.	3
5. Cardiovascular system. Myocardial functions.	3
6. Cardiac cycle. Electrical activity of the heart. Recording and analysis of electrocardiogram.	3
7. Stroke volume and cardiac output. Auscultation of heart sounds. Regulation of cardiac activity.	3
8. Blood vessels. Hemodynamics. Arterial pulse. Arterial blood pressure. Capillaroscopy.	3
9. Regulation of vascular tone and arterial blood pressure - seminar.	3
10. Physiology of blood. Functions of the blood. Composition of blood and regulation of its volume. Hematocrit. Blood groups.	3
11. Erythrocytes - morphology and number. Erythrocyte indices. Erythrocyte sedimentation rate. Osmotic resistance of erythrocytes.	3
12. Leukocytes - types, morphology, and number. Differential leukocyte count. Platelets. Hemostasis and blood coagulation.	3
13. Physiology of the blood system - seminar.	3
14. Colloquium I.	3
15. Respiratory system. Pulmonary ventilation, volumes, and capacities. Spirometry.	3
16. Exchange and transport of oxygen and carbon dioxide. Oxyhemoglobin saturation.	3
17. Respiratory regulation - seminar.	3
18. Digestive system. Effect of bile on the filtration rate of lipids.	3
19. Nutrition, digestion, metabolism, and energy expenditure. Digestion and resorption of proteins, carbohydrates, and fats. Resorption of electrolytes, water, and vitamins. Basal metabolic rate. Basis of rational feeding.	3
20. Renal system - water-salt and acid-base balance regulation. Clearance methods. Urine screening with rapid tests.	3
21. Physiology of digestion and excretion - seminar.	3
22. The reflex activity of the nervous system. Clinically significant reflexes.	3
23. Visual system. Determination of visus and color vision.	3
24. Auditory sensory system. Tonal audiometry.	3
25. Somatosensory system. Estesiometry. Stereognosy.	3
26. Electroencephalography. A study of visual memory.	3
27. Hormonal regulation of reproduction. Hormonal research methods. Spermaological studies. Early pregnancy and ovulation tests.	3
28. Hormonal regulation of physiological functions - seminar.	3
29. Sports physiology. Assessment of the functional state of the body through physical exercises.	3
30. Colloquium II.	3
Total:	90

SYNOPSIS
for the "Human Physiology" exam.
for the students of the specialty "Medicine"

1. Homeostasis. Principles and levels of homeostatic regulation.
2. Structure and functions of the cell membrane. Transcellular and paracellular transport.

3. Physiology of excitable structures.

Ion channels. Membrane potentials. Resting membrane potential.

4. Dynamics of the excitation. Action potential. Encoding the information. Conduction of the excitation and classification of the nerve fibers.

5. Physiology of the synapse. Mechanism of transmission of excitation through chemical synapses. Mediators. Postsynaptic potentials.

6. Physiology of muscles - functional morphology. Mechanism and energetics of muscle contraction. Functional properties of muscles. Types of muscle fibers.

7. Functional organization of smooth muscles. Excitation, electrophysiological characteristics, and mechanism of contraction.

8. Physiology of the cardiovascular system. Functional organization of the contractile myocardium and the electrical conduction system of the heart: of the heart. Physiological properties of the myocardium.

9. Electrical phenomena during the cardiac cycle. Origin, registration, and evaluation of the electrocardiogram.

10. Cardiac cycle. Structure and functions of the valvular apparatus during the different phases of the cardiac cycle. Heart tones.

11. Heart rate. Stroke and cardiac output. Pressures in the heart. Humoral regulation of cardiac functions.

12. Regulation of cardiac activity. Intracardiac self-regulation. Automaticity.

13. Extracardiac nervous regulation of cardiac activity. Baroreceptor reflex.

14. Functional characteristics of blood vessels. Hemodynamics of blood in the vascular system. Volumetric and linear velocity of blood flow.

15. Arterial circulation. Arterial pulse and arterial blood pressure. Venous circulation and central venous pressure.

16. Microcirculation. Functional organization of capillaries. Regulation of microcirculation.

17. Vascular tone. Mechanisms of vascular tone control.

18. Specificity of blood circulation in individual vascular areas.

19. Regulation of blood circulation. Cardiovascular center in the brain. Supramedullary regulation of blood circulation.

20. Regulation of arterial blood pressure. Mechanisms of rapid short-term, rapid long-term and long-term regulation.

21. Functions of the blood system. Composition and volume of blood - regulation of blood volume. Blood plasma - composition and properties of blood plasma components. Hematocrit. Blood depots.

22. Erythrocytes. Number and functions. Hemoglobin. Erythrocyte indices. Hemolysis. Erythropoiesis and iron metabolism. Regulation of erythropoiesis.

23. Blood group systems – physiological and clinical significance. Methods for determining blood groups. Principles of blood transfusion.

24. Leukocytes. Number, types, and functions of individual types of leukocytes. Immunity. Regulation of leukopoiesis.

25. Platelets. Hemostasis and blood coagulation. Regulation of hemostasis.

26. Physiology of the lymphatic system. Formation, composition, and functions of lymph. Physiological role of the spleen.

27. Physiology of breathing. Functional anatomy of the respiratory tract. Lung volumes and capacities. Pulmonary ventilation. Mechanics of lungs ventilation.

28. Gas exchange - physical principles. Solubility, diffusion coefficient, and diffusion capacity of gases. Diffusion of gases through the respiratory membrane. ventilation-perfusion ratio.

29. Transport of oxygen through the blood. Saturation of hemoglobin. Oxygen exchange in lungs and tissues.

30. Transport of carbon dioxide in the blood. Carbon dioxide exchange in lungs and tissues.

31. Regulation of breathing. Respiratory center in the brain. Reflex regulation of breathing. Protective respiratory reflexes – sneezing and coughing. Humoral regulation of breathing.

32. Physiology of digestion. Digestion in the oral cavity. Chowing and swallowing – phases and regulation.

33. Motor activity of the stomach. Regulation of the stomach motility. Vomiting.

34. Chemical processing of food in the stomach. Absorption of nutrients through the gastric mucosa. Composition and action of gastric juice. Regulation of gastric secretion. Protective capabilities of the gastric mucosa.

35. Motor activity of the small intestine - types of movements. Regulation of motor activity of the small intestine. Chemical processing of food in the small intestine. Regulation of the pancreatic juice secretion, bile and intestinal juice. Absorption of nutrients in the small intestine.

36. Secretion and resorption in the colon. Regulation of the motor activity of the colon. Defecation.

37. Metabolism in the body. Anabolic and catabolic processes. Carbohydrate metabolism. Blood sugar level and its regulation.

38. Protein metabolism. Nitrogen balance. Regulation of protein metabolism. Lipid metabolism and regulation. Metabolism of vitamins. Liver physiology.

39. Exchange of energy. Basic exchange. Thermoregulation. Acclimatization. Thermoregulation during physical exercises.

40. Physiology of excretion. The renal system. Functional structure of the kidneys and the nephron. Urine formation. Clearance. Extrarenal excretory system.

41. Transport in the kidneys. Urine concentration and dilution.

42. Endocrine function of the kidneys. Regulation of kidney function. The kidney in the regulation of blood pressure.

43. Micturition. Urine volume and composition. Regulation of the micturition.

44. Water-salt balance. Regulation of water-salt balance and maintenance of blood and tissue osmolality. Thirst. Maintenance of alkaline-acidic balance.

45. Physiology of the nervous system. Physiology of the neuron. Neural networks. Electrical activity of the brain. Methods for studying brain functions.

46. Reflex activity of the nervous system. Reflex arc. Characteristics of the somatic and autonomic reflex arcs.

47. Nervous regulation of autonomic functions. Functional anatomy of the autonomic nervous system. Influence of the autonomic nervous system on the activity of various organs and systems.

48. Role of the limbic system and the hypothalamus in the regulation of autonomic functions. Participation of the cerebellum and the cerebral cortex in the regulation of autonomic functions.

49. Brain organization of the consciousness. Levels of consciousness - clinical significance.

50. Sensory systems. Receptor physiology. General organization of sensory systems.

51. Somatosensory system – organization and modalities. Mechanoreception, thermoreception and pain sensitivity (nociception).

52. Auditory sensory system. Functional morphology of the ear. Peripheral and central mechanisms of sound perception. Vestibular sensory system. Maintaining balance. Vestibular reflexes.

53. Physiology of smell and taste. Peripheral and central mechanisms of the gustatory and olfactory sensory systems.

54. Physiology of vision. Optical system of the eye. Eye movements and reflexes.

55. Visual sensory system. Physiology of the retina. Processing of visual information at the subcortical and cortical level.

56. Regulation of muscle activity and motor coordination. General scheme of motor regulation. Muscle receptors. Spinal regulation of movements.

57. Subcortical and cortical regulation of motor activity. Maintaining body posture and voluntary movements. Regulation of movements by the cerebellum and basal ganglia.

58. Brain activity during sleep and wakefulness. Reticular activating system. Types and phases of sleep. Sleep regulation.

59. Integrative functions of the cerebral cortex. Neurophysiological control of speech, learning, memory and emotions.

60. Types of higher nervous activity - characteristic. Physiological bases of motivation and behavior.

61. Physiology of the endocrine system. General principles of endocrine regulation. Mechanism of action of hormones. Regulation of hormonal activity.

62. Hypothalamic-hypophyseal system. Neurosecretion. Hormones of the adenohypophysis - physiological action and mechanism of their secretion.

63. Physiology of the thyroid gland. Functional structure of the gland. Thyroid hormones - physiological action and regulation of their secretion.

64. Physiology of the parathyroid glands. Calcium-phosphorus homeostasis. Parathyroid hormone, calcitonin and calcitriol - physiological action and regulation of their secretion.

65. Endocrine function of the pancreas - types of hormones, physiological action and regulation of their secretion.

66. Physiology of the adrenal glands. Functional structure and hormones of the adrenal glands. Physiological effects and regulation of medular hormones secretion.

67. Hormones of the adrenal cortical gland hormones. Physiological action and regulation of glucocorticoid secretion. Pharmacology of stress.

68. Hormones of the cortex of the adrenal glands - mineralocorticoids and adrenal sex hormones. Physiological action and regulation of their secretion.

69. Hormones of the gonads. Hormonal functions of the testes, physiological action, and regulation of their secretion.

70. Reproductive functions of the male reproductive system. Physiology and regulation of the male reproductive system.

71. Hormonal activity of the ovaries. Estrogens and progesterone – physiological action and regulation of their secretion. Menstrual cycle.

72. Reproductive functions of the female reproductive system. Ovarian cycle regulation.

73. Physiology of fertilization. Pregnancy and breastfeeding

74. Physiology of physical exercises. Transient and permanent changes in the human body during physical training.

SYNOPSIS
for the "Human Physiology" practical exam.
for the students of the specialty "Medicine"

1. Excitable structures and membrane potentials. Introduction to work in the physiology laboratory. Apparatus and technique for conducting physiological experiments. Calculations of resting membrane potential.

2. Physiology of the nerve cell. Physiology of synapses. Electroneurogram, rheobase, chronaxie.
3. Physiology of muscles. Registration of muscle contraction. Determination of absolute and specific muscle strength. Registration of muscle fatigue.
4. Cardiovascular system. Myocardial functions. Electrical conduction system of the heart.
5. Cardiac cycle. Electrical activity of the heart. Recording and analysis of electrocardiogram.
6. Stroke volume and cardiac output. Auscultation of heart sounds. Regulation of cardiac activity.
7. Blood vessels. Hemodynamics. Arterial pulse. Arterial blood pressure. Capillaroscopy.
8. Physiology of blood. Functions of the blood. Composition of blood and regulation of its volume. Hematocrit. Blood groups.
9. Erythrocytes - morphology and number. Erythrocyte indices. Erythrocyte sedimentation rate. Osmotic resistance of erythrocytes.
10. Leukocytes - types, morphology, and number. Differential leukocyte count. Platelets. Hemostasis and blood coagulation.
11. Respiratory system. Pulmonary ventilation, volumes, and capacities. Spirometry.
12. Exchange and transport of oxygen and carbon dioxide. Oxyhemoglobin saturation.
13. Digestive system. Effect of bile on the filtration rate of lipids.
14. Nutrition, digestion, metabolism, and energy expenditure. Digestion and resorption of proteins, carbohydrates, and fats. Resorption of electrolytes, water, and vitamins. Basal metabolic rate. Basis of rational feeding.
15. Renal system - water-salt and acid-base balance regulation.
16. Clearance methods. Urine screening with rapid tests.
17. The reflex activity of the nervous system. Clinically significant reflexes.
18. Visual system. Determination of visus and color vision.
19. Auditory sensory system. Tonal audiometry.
20. Vestibular sensory system. Vestibular reflexes.
21. Somatosensory system. Estesiometry. Stereognosy.
22. Electroencephalography. A study of visual memory.
23. Hormonal regulation of reproduction. Hormonal research methods. Spermaological studies. Early pregnancy and ovulation tests.
24. Sports physiology. Assessment of the functional state of the body through physical exercises.

LITERATURE FOR STUDENTS

Mandatory

1. Vitanova L., Garchev R. (Ed. by) Human Physiology, Arso, Sofia, 2023, 561 pages, ISBN: 9786191970445
2. Hall J. E., Hall, M. E. (Ed. by) Guyton and Hall Textbook of Medical Physiology, 14th Edition, Elsevier, 2022, 1152 Pages, ISBN: 9780323597128
3. Barrett K. E., Barman S M., Brooks H L., Yuan J X.-J. Ganong's Review of Medical Physiology, 26e, 2019, ISBN 978-1-260-12240-4
4. Sembuling, K. Sembuling, P. Essential of Medical Physiology. 6th Edition, 2012, New Jaypee Brothers Medical Publishers, Delhi, India. ISBN 978-93-5025-936-8
5. Costanzo L. Physiology - Elsevier eBook, 7th Edition, 2022, ISBN: 9780323793346
6. Dzhambazova E, Raychev P, Assenov B, Pechlivanova D, Tchekalarova J. A Laboratory Guide to Human Physiology for Students in Medicine. 2017, St. Kliment Ohridski University Press, Sofia, ISBN: 978-954-07-4304-2

Recommended: for the preparation of individual or team presentations

1. Science Direct
2. PubMed Central

Compiled by:

(Assoc. Prof. Daniela Pehlivanova, PhD)

(Prof. Petya Tzvetkova, DSc)

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)