PLAN OF PRACTICAL CLASSES IN MICROBIOLOGY, VIROLOGY, IMMUNOLOGY
Specialty "GENERAL MEDICINE"
4th semester 2025-2026 academic year

You can find the plan of practical classes on the university website (department page, section "Information for students") and in the e-test (Electronic educational and methodical complex MICROBIOLOGY, VIROLOGY, IMMUNOLOGY for the specialty 7-07-0911- 01 "General medicine")

Academic training: from February, 9th to June, 5th.

April 21; May 1are holidays. Classes are not scheduled for these days, but are shifted a week later (provided there are enough school weeks)

Section «General microbiology»	
PRACTICAL CLASS 1	**Date: 09.02.26 – 13.02.26**
TOPIC: Morphology of microorganisms. Basic forms of bacteria. Bacterioscopic research method. Simple methods of staining.	
Suggested reading for self-study. History of the department microbiology, virology, immunology; main spheres of activity and trends in research. Design and equipment of microbiological laboratory, biosafety levels. Basic rules of work in microbiological laboratory (biosafety in work with class II biohazards). Universal precautions in work with burners and electric supplies. Taxonomy of microorganisms: classification and nomenclature. Modern approaches to taxonomy of microorganisms. Taxonomic ranks. Vars (types), strains, clones, pure cultures. Basic morphological forms of bacteria. Morphological characteristics of cocci, rods and spiral-shaped bacteria. Microscopic method of examination: tasks, procedure, evaluation of the method. Bright-field light microscope: components and proper use of the microscope. Smear preparation and fixation. Simple methods of staining. The technique of oil immersion microscopy.	

PRACTICAL CLASS 2	**Date: 16.02.26 – 20.02.26**
TOPIC: Bacterioscopic research method. The structure of the bacterial cell. Complex methods of staining. Features of morphology and methods of studying spirochetes, rickettsia, chlamydia, mycoplasmas.	
Suggested reading for self-study. Distinctive features of prokaryotic and eukaryotic cells. Basic bacterial cell structure: components of bacterial cell. The composition, function, detection methods of bacterial cell wall. The structure of murein (syn. peptidoglycan). The cell wall of gram-positive bacteria. The cell wall of gram-negative bacteria. Gram stain: medical application, principles, procedure for Gram stain. Bacterial forms with defective cell wall (protoplasts, spheroplasts and L forms): factors inducing cell wall removal, medical importance of L-forms. The composition, function of capsule, flagella, pili (fimbriae) and methods for their detection. Detection of capsule using negative staining. The cytoplasmic membrane: structure, function. The most important bacterial cytoplasmic membrane proteins. Bacterial core: cytoplasm, cytoplasmic structures (nucleoid, plasmids, ribosoms, and mesosomes). Inclusion bodies — storage granules (starch, fat, sulfur, polymetaphosphate (volutin)). Methods for nucleoid and volutin detection. Loeffler and Neisser stain for volutin granules. Acid-fast bacteria and unique properties of their cell wall. Ziehl–Neelsen acid-fast staining: medical application, principle, procedure. Resting forms of microorganisms. Bacterial endospores: medical importance, properties of endospore, the stages of endospore formation, detection methods. Spore stain using Ozheshko method: principle, procedure. Taxonomy, morphology, medical significance of the spirochetes. Methods for spirochetes morphology study. Romanowsky–Giemsa stain. Actinomyces: taxonomy, morphology and culture, medical significance. Rickettsiae: taxonomy, morphology, culture, medical significance and methods of examination. Chlamydiae: taxonomy, morphology, reproduction cycle (elementary and reticulate body), culture, medical significance and methods of examination. Mycoplasmas: taxonomy, morphology, culture, medical significance, methods of examination.	

PRACTICAL CLASS 3	**Date: 23.02.26 – 27.02.26**
TOPIC: Genetics of microorganisms. Methods for studying the genetics of bacteria. Methods of molecular diagnostics	
Suggested reading for self-study. Heredity. Value of microbiology in development of molecular genetics. The organization of the genetic apparatus	

in bacteria (nucleoid, plasmids, Is-sequences, transposons, integrones). Principles of bacterial genome functioning. Operone organization. A genotype and a phenotype. CRISPR/Cas9 - genome editing technology.

Genomics of microorganisms. Proteomics of microorganisms.

Variability of microbes. Modifications in bacteria, value, the basic characteristics (not hereditary character, adaptability, high frequency of direct and reverse changes, inducing factors). Genotypic variability. Mutations and their classification. Mutagens. Phenotypic manifestations of mutations. Transposition. Dissociation in bacteria. System of genome damages reparation. Recombinational variability. Mechanisms of combined genome formation. Frequency of changes of separate attributes. Transformation, transduction, conjugation, transposition. The fate of mutants and recombinants. Selective influence of discriminative factors.

Methods of the genetic analysis. Practical value of knowledge about microbes' genetics. Principles of genetic mapping. Molecular hybridization, polymerase chain reaction (PCR), blotting, sequencing. The value of genetic methods in laboratory diagnosis of infectious diseases and epidemiological analysis.

Concept of genetic engineering and use of the methods in microbiology and biotechnology. Creation and application of gene-engineered vaccines and cytokines.

PRACTICAL CLASS 4 **Date: 02.03.26 – 06.03.26**

TOPIC: Antimicrobial measures: methods of sterilization and disinfection, antiseptics, asepsis. Cultural (bacteriological) research method. Methods for isolating pure cultures of bacteria.

Suggested reading for self-study.

Antimicrobial measures. Sterilization, disinfection, asepsis, definition of concepts. Purposes, methods, means and objects for sterilization and disinfection in medicine and microbiology. Sterilization and disinfection quality control. Sanitary and anti-epidemic regimen in healthcare organizations.

Bacteriological (cultural) research method. Principles and methods of bacteria culturing. Nutrition requirements of microbes. Nutrient media for bacteria. Requirements to nutrient media. Classification of nutrient media. Conditions and technics of bacteria culturing. Regularities and character of bacterial growth on solid and liquid nutrient media. Dynamics (phases) of development of a bacterial population in a periodic culture.

Objectives, steps, advantages and disadvantages of a bacteriological method. Rules of sampling and transportation of investigated material. Technics of culture medium inoculation. Methods for isolation and identification of pure culture of aerobic and anaerobic bacteria.

PRACTICAL CLASS 5 **Date: 09.03.26 – 13.03.26**

TOPIC: Cultural (bacteriological) research method. Methods for identification of pure cultures of bacteria.

Suggested reading for self-study.

Identification of microorganisms: approaches and methods. Bacterial species: definition of the term, species criteria and methods for discovering bacterial species. Using Bergey's manual of systematic bacteriology to identify bacteria.

Biochemical activities of bacteria and methods for the biochemical properties' detection of microorganisms. Enzymes of microorganisms: classification, importance for identification: a) proteolytic (proteases, peptidases, decarboxylases, deaminases, cysteine desulfurase, urease, tryptophanase); b) carbohydrate hydrolyses (carbohydrase, amylase); c) lipolytic (lipases, lecithinase); d) oxidative-reductive (dehydrohenase, oxidase, catalase); e) hemolysins; α-, β-, γ-hemolysis. Rapid multitest systems for identification of microorganisms. Automatic microbiological analyzers, principles of operation. Time-of-flight mass spectrometry (MALDI-TOFF MS) for bacteria identification.

PRACTICAL CLASS 6 **Date: 16.03.26 – 20.03.26**

TOPIC: Basics of the infection doctrine. Methods of human normal flora investigation.

Suggested reading for self-study.

Infection (infection process) and invasion: definition, general characteristics. Differences between infectious and non-infectious diseases. The history of ideas about the causes of infectious diseases. Miasmatic (Hippocrates) and contagious (Varron, Fracastoro, Pliny) hypothesis, monocausalism (R. Koch). Causes and conditions for the infectious process.

The role of microorganisms in the infectious process. The infectious dose. Ways of infection. Entrance gate. Pathogenicity. Virulence. Heterogeneity and variability in virulence in microbial populations. Genetic control of pathogenicity and virulence. Pathogenicity islands. Factors that increase and decrease the virulence of bacteria. Pathogenicity factors. Adhesins. Colonization factors. Invasins. Factors that suppress the immune system of the host. Exotoxins, endotoxins, enzyme-toxins, heat shock proteins, their properties. Types of bacterial exotoxins, targets and mechanisms of action. Methods for determination of pathogenicity factors. Intracellular pathogens. Pathogenic, opportunistic and nonpathogenic microbes.

The role of the macroorganism in the development of infectious diseases. Hereditary factors. Anatomical and physiological condition of the body, lifestyle. The role of living conditions in the development of infectious diseases, the influence of natural and social factors.

The evolution of infectious diseases, positive and negative changes in infectious pathology in the second half of the 20th and early 21st centuries. The concept of emerging infections and global epidemiological surveillance.

Classification of infectious processes: by severity (carrier state, asymptomatic infection, infectious disease); by nature of the pathogen (bacterial, viral, prion, fungal, protozoan); by source of infection (anthroponoses, zoonoses, sapronoses); by the mechanism of transmission and routs of infection (aerosol, fecal-oral, contact, transmissible, transplacental, exo-, endo-, autoinfection); by the prevalence and intensity of the epidemic process (ubiquitous, endemic, pandemic, epidemic, sporadic infections); by localization (local, systemic (respiratory, gastrointestinal, urogenital, skin, nervous system), generalized infection (bacteremia, toxemia, septicemia, septicopyemia, bacterial shock); by duration (acute, subacute, chronic, slow infection); by the multiplicity of infection (primary, secondary, mixed infection, superinfection, reinfection, relapse).

Normal (resident) microflora. Autochthonous and allochthonous, parietal and luminal microflora. The concept of microbiota. Formation and development of normal microflora. Species and quantitative structure of normal microflora of distinct biotopes of a human body. The role of normal microflora: antiinfection, metabolic, immunobiological, antitoxic. Biofilms. Colonization resistance. Quorum sensing. The factors influencing structure of normal microflora. Dysmicrobiocenosis (dysbacteriosis), the reasons, types, correction principles. Preparations for restoration of microflora. The role of normal microflora in infectious processes, conditions of manifestation. Methods for studying human microflora. Gnotobiology. Human microbiome, metagenomic approach to study.

PRACTICAL CLASS 7 **Date: 23.03.26 – 27.03.26**

TOPIC: Microbiological basics of chemotherapy and antiseptics of bacterial infections. Methods for determining the sensitivity of microbes to antibiotics. Biological research method.

Suggested reading for self-study.

Chemotherapy and chemoprophylaxis: definition, place in the therapeutic and anti-epidemic measures. History of chemotherapy. Empirical period. Establishment of the doctrine of chemotherapy (D.L. Romanovsky, 1882; P. Erlih, 1906). Implementation of sulfonamides in the practice of therapy (G. Domagk, 1936), antibiotics (A. Fleming, 1926, X. Florey, E. Chain, 1940; Z.V. Ermoleva, 1942), nitrofurans (M. Dodt, W. Stillman, 1944). Modern directions in chemotherapy development: the search for natural compounds, chemical synthesis and modification, improvement of application schemes. Principles of rational chemotherapy, peculiarities in children and elderly.

Antimicrobial agents: properties, requirements, etiotropic and organotropic features, chemotherapeutic index. The concept of selectivity and «targets» of antimicrobial drugs action, the effect and spectrum of action, mechanisms of action on microorganisms.

Side effects of chemotherapy: dysbacteriosis, disease exacerbation (Jarisch–Herxheimer reaction), secondary infection, the negative organotropic effect (toxic, allergenic, teratogenic, mutagenic, carcinogenic).

The main groups of antimicrobial drugs: sulfonamides, azoles, quinolines, nitrofurans, fluoroquinolones, oxazolidinones and others.

Antibiotics, definition. Natural producers of antibiotics. Synthetic and semi-synthetic antibiotics. The main groups of antibiotics: beta-lactam (penicillins, cephalosporins, carbapenems, monobactams), aminoglycosides, tetracyclines, macrolides and azalides, lincosamides, chloramphenicol, ansamycins (rifamycins), polymyxins, cyclopeptides, glycopeptides, lipopeptides, streptogramins, polyenes.

Bacterial resistance to antimicrobial drugs. Natural resistance. Acquired resistance, its genetic and biochemical mechanisms. The role of plasmids and transposons in the emergence and spread of multidrug-resistant strains. Extreme and total resistance to antimicrobial drugs. The concept of international clones of microorganisms with a high epidemic risk.

Indications and methods for determining the sensitivity (resistance) of bacteria to antibiotics. Technics of performance and evaluation of the disk-diffusion method. Epsilometric method (E-tests). Method of antibiotics serial dilutions in liquid and solid nutrient media. Sensitivity interpretation using thresholds for minimum inhibitory concentrations and inhibition zone diameters. Devices and test systems for automated determination of antibiotic sensitivity. Molecular genetic methods (PCR).

Antisepsis, definition, types (preventive, therapeutic). Categories of preventive antiseptics. Antiseptics (chemical, biological, physical, mechanical).

Chemical antiseptics: requirements, origin, properties, groups, mechanisms of action on microorganisms.

Biological (experimental) research method: tasks, steps, advantages, disadvantages. Laboratory animals. Methods of infection. Application for isolation and identification of the causative agent, assessment of virulence, toxicity and toxigenicity of microbial cultures, immunogenicity, sterility, biosafety, pyrogenicity of drugs.

PRACTICAL CLASS 8 **Date: 30.03.26 – 03.04.26**

TOPIC: Ecology of microorganisms. Concluding session «General microbiology»

1. History of microbiology as a science. Periods. The founders of main routs of microbiology.
2. Microscopic method of examination: tasks, procedure, evaluation of the method.
3. Bright-field light microscope: components and proper use of the microscope. Darkfield light microscopy: the principle behind dark-field microscopy. Phase-contrast light microscope: basic principles behind phase-contrast microscopy. Fluorescence microscopy: principles behind the fluorescence microscopy. The technique of oil immersion microscopy.
4. Type of microscopic preparations. Smear preparation and fixation. Simple methods of staining.
5. Differential stains of microorganisms. Gram stain: medical application, principles, procedure for Gram stain.
6. Basic bacterial cell structure: components of bacterial cell. Morphology of bacteria. Distinctive features of prokaryotic and eukaryotic cells. Basic morphological forms of bacteria. Morphological characteristics of cocci, rods and spiral-shaped bacteria.
7. Structure and function of cell envelope and appendages. Capsule. Detection methods of the capsule.
8. The composition, function, detection methods of bacterial cell wall. The structure of murein (syn. peptidoglycan). The cell wall of gram-positive bacteria. The cell wall of gramnegative bacteria. Bacterial forms with defective cell wall. Factors inducing cell wall removal, medical importance of L-forms.
9. Bacterial core: cytoplasm, cytoplasmic structures; their functions and detection methods. Acid-fast bacteria and unique properties of their cell wall. Methods of acid-fast staining: medical application, principle, procedure.
10. Resting forms of microorganisms. Bacterial endospores: medical importance, properties of endospore, the stages of endospore formation, detection methods (principles, procedures).
11. Motility of bacteria, methods of detection.
12. Taxonomy of microorganisms: classification and nomenclature. Modern approaches to taxonomy of microorganisms. Taxonomic ranks. Vars (types), strains, clones, pure cultures.
13. Taxonomy, morphology, medical significance of the spirochetes. Methods for spirochetes detection.
14. Taxonomy, morphology, medical significance of Actinomyces.
15. Taxonomy, morphology, medical significance of Mycoplasmas. Methods for Mycoplasmas investigations.
16. Taxonomy, morphology, medical significance of Chlamydiae.
17. Nutrition of microorganisms. Source of macro- and micronutrients, growth factors. Nutritional types. Transport mechanisms for nutrient absorption.
18. Energy strategies in microorganisms. aerobic and anaerobic respiration. structures involved in respiration in microorganisms.
19. Reproduction of microorganisms. Mechanisms and phases of bacterial division.
20. Bacteriological method of laboratory diagnosis: tasks, procedure, evaluation of the method.
21. Cultivation of microorganisms. Conditions required for growth. Nutrient media for culturing bacteria: classification and characteristics. Culture media ingredients, procedure of preparation and sterilization. General requirements to bacteriologic nutrient media.
22. Methods of isolation of aerobic microorganisms in pure culture.
23. Methods of isolation of anaerobic microorganisms in pure culture. Cultivation of anaerobic bacteria: culture media, techniques, equipment.
24. Identification of microorganisms: morphological, cultural, serologic, biological, genetic.
25. Biochemical identification of microorganisms. Detection of: a) proteolytic enzymes; b) carbohydrate hydrolyses enzymes; c) lipolytic enzymes; d) oxidative- reductive enzymes; e) hemolysins. Automatic stations for identification of bacteria.
26. The structure of bacterial genetic apparatus. Phenotype, genotype, genome, genes. Regulation of gene expression. General properties and varieties of plasmids. Detection of plasmids. Mobile genetic elements: transposons and IS elements.
27. Bacterial varibility: phenotypic and genetic. Practical significance of bacterial variability. Population variability.
28. Mechanisms of genetic variability: mutations and recombinations. Classification of mutations. Methods of mutant bacteria selection. Horizontal gene transfer: transformation, transduction, conjugation. Genomics. Bioinformatics. Genetic engineering. Gene Cloning.
29. Molecular methods in diagnosis of infection diseases: aims, methods, advantages. Molecular hybridization and polymerase chain reaction: principles of the methods. Equipment for PCR and hybridization. DNA extraction.
30. Doctrine regarding infections. Terms for emergence of infectious disease. Basic terminology of infectology. Classification of infections.
31. Role of microorganisms in infection emergence. Bacterial pathogenicity and virulence. Measurements of virulence: ID50, LD50, DLM. The genetics of bacterial pathogenicity. Pathogenicity islands. Pathogenicity factors: adhesins, invasins, impedins, agressins, modulins. Bacterial toxins.
32. Role of macroorganism, social and physical factors in infection emergence.
33. Evolution of microorganisms and infection diseases.
34. Biological method (application of laboratory animals in microbiology): tasks, phases, evaluation of the method. Animal models for infection diseases. Routs for laboratory animal infection. Ethical, humane and legal considerations involved in the use of laboratory animals.
35. Chemoprophylaxis and chemotherapy; antimicrobial chemotherapeutic agents and antibiotics. Sources of antibiotics. Spectrum of action. Chemical classification of antibiotics.
36. Mechanisms of action of antibiotics.
37. Side effects of antibiotics. Principles for rational antimicrobial therapy.
38. The problem of resistance to antimicrobials: definitions (intrinsic, acquired resistance), incidence, significance. Resistance mechanisms: non-genetic and genetic origin of drug resistance. Biochemical resistance.
39. Evolution of resistance to anti-infective agents. Antibiotic susceptibility testing of microorganisms: methods and principles.
40. Ecology of microorganisms. Basic terminology of ecology. Interspecific and intraspecific relations. Symbiosis, its variants. Antagonistic microbial relationships, its background and medical importance. Bacteriocins.
41. Diversity of normal flora at different sites of human body. Origin of the normal flora. Beneficial effects of the normal flora. Methods of normal flora investigation. Gnotobiology. Dysbacteriosis: aetiology, pathogenesis, symptoms, approaches to treatment, prophylaxis.

42. Sterilization: definition, methods of sterilization (physical, chemical, mechanical), quality control.
43. Disinfection: definition, methods of disinfection.
44. Antisepsis: definition, methods of antisepsis. Disinfectant and antiseptics: classification and modes of action.
45. Asepsis: definition, surgical, medical asepsis, asepsis in microbiological laboratory.

Practical skills

1. Prepare fixed smears from the broth culture of bacteria and Gram stain.
2. Prepare fixed smears from agar cultures of bacteria and Gram stain.
3. Determine the morphology of staphylococcus, pure culture, Gram stain.
4. Determine the morphology of streptococcus, a pure culture, Gram stain.
5. Determine the morphology of Neisseria gonorrhoeae in pus from urethra, Gram stain.
6. Determine the morphology of Escherichia coli, pure culture, Gram stain.
7. Determine the morphology of the mixture of Staphylococcus aureus and Escherichia coli, Gram stain.
8. Determine the morphology of Bacillus anthracis, a pure culture, Gram stain.
9. Determine the morphology of Vibrio cholerae, pure culture, Gram stain.
10. Determine the morphology of Brucella, a pure culture, Gram stain.
11. Determine the morphology of Corynebacterium diphtheria, pure culture, Loeffler stain.
12. Determine the morphology of Klebsiella, a pure culture, negative staining by Hins-Burri.
13. Determine the morphology of mycobacteria in sputum stain Ziehl-Nielsen.
14. Technique of seeding by loop on Petri dish from tube.
15. Technique of seeding by loop from Petri dish to Petri dish.
16. Technique of seeding by loop from the tube to tube.
17. Evaluate the results of antibiotic resistance detection by disk-diffusion method.
18. Evaluate the biochemical properties of enterobacteria on triple sugar iron agar (Kligler agar).

Section «Theoretical and applied medical immunology»

PRACTICAL CLASS 9 **Date: 06.04.26 – 10.04.26**

TOPIC: Immune system. Innate immunity

Suggested reading for self-study:

Immunology as a science: definition, history of foundation and development (E. Jenner, L. Pasteur, I.I. Mechnikov, P. Ehrlich, K. Landsteiner, F. Bernet, S. Tonegava, Ch. Janeway, P. Matzinger). The main sections of modern immunology. Immunology role in the development of biology and medicine. Problems of medical immunology, its value for practical medicine.

Immune system. Organs of the immune system (central and peripheral): structure, function, changes in ontogeny. Immunocompetent cells: types, morphology, CD-markers, identification methods. Major histocompatibility complex (MHC). Molecule I, II and III classes of MHC, structure, expression on cells and tissues. The biological significance of MHC molecules, role in recognition and elimination of antigens. Factors of intercellular interaction in the immune system (the selectins, integrins, immunoglobulin superfamily molecules).

Pattern recognition receptors. Toll-like receptors.

Cytokines: classification (interleukins, interferons, growth factors, chemokines), characteristics, structure, function, receptors. Pro-inflammatory cytokines. Cytokines – regulators of hematopoiesis. Interferon system, classification, structure, function.

The protective function of the respiratory, digestive, endocrine and other systems of the human body.

Cooperative mode of an immune system functioning.

Innate immunity, definition, characteristics. Non-immune mechanisms of innate immunity: barrier and antimicrobial properties of the skin, mucous membranes, lymph nodes, tissue unresponsiveness, normal microflora. Protective function of the respiratory, digestive, endocrine and other systems of the human body. Immune factors: humoral and cellular factors of innate immunity. The complement system, structure, activation pathways (classical, alternative, lectin). Activators of the complement system. Inhibitors of the complement system. Complement receptors, expression on cells, function. Biologically active fragments of complement proteins and their functions. Anaphylatoxins. The membrane attack complex. Control mechanisms for complement system activation. Methods for the complement system activity assaying. Lysozyme. Acute-phase proteins. Natural antibodies.

Polymorphonuclear and mononuclear phagocytes (origin, characteristics, functions). Phagocytic reaction (phases, factors and mechanisms of intracellular killing). Phagocytosis outcomes. Persistence of bacteria in phagocytes. Phagocytosis indices and methods for evaluation. Principles of recognition and response in innate immunity system Toll-dependent signaling pathways of phagocytes activation. Activated macrophages (classical and alternative) and the regulation of their functions. Neutrophil extracellular traps.

Natural killer cells, the mechanism of damage to the target cells. γδ-T- lymphocytes.

PRACTICAL CLASS 10 **Date: 13.04.26 – 17.04.26**

TOPIC: Antigens. Humoral immune response. Antibodies.

Suggested reading for self-study:

Antigens: structure, properties, classification. Adjuvants. Antigenic structure of bacteria: O, H, K, fimbrial, cytoplasmic, membrane, extracellular antigens (toxins and exoenzymes). Group, species, typal antigens. Antigenic variation. Cross- reacting antigens. Antigenic mimicry. Antigens of viruses, fungi and protozoa. T-dependent and T-independent antigens. Superantigens: structure, function.

Antigen-presenting cells (APC): the types and characteristics. APC interaction with antigen: antigen processing and presentation, APC activation.

B-lymphocytes: development, markers. B-cell receptor: structure, constant and variable regions. Mechanisms of B-cell activation. The function of B-lymphocytes. Memory B-cells. Methods for assaying B-lymphocytes amount and functional activity.

Humoral immune response: the dynamics of development, manifestation. Primary and secondary immune response, switching of immunoglobulin classes, affinity maturation.

Antibodies. The structure of immunoglobulin molecules: variable and constant regions, the location and structure of the domains, the antigen and complement-binding regions. Classes and subclasses of immunoglobulins, isotypes, allotypes, idiotypes. Biological properties of the immunoglobulins. Biosynthesis, specificity, and genetic control of antibody diversity. Immunoglobulin genes. The mechanism of interaction of antibodies with antigens. Valence, affinity and avidity of antibodies. Cross-reactions. Complete and incomplete antibodies. Immune complexes. Utilization of immune complexes. Biological effects of the interaction of antibodies with antigens: activation of the complement, toxins and viruses neutralization, lysis, agglutination and opsonization of microorganisms, inhibition of adhesion, invasion. Transport of antibodies into tissues (fetus), regulation of the synthesis (quantity) of antibodies.

PRACTICAL CLASS 11 **Date: 20.04.26 – 24.04.26**

TOPIC: Cellular immune response. Allergy and ecological immunology.

Suggested reading for self-study:

T-lymphocyte: development, markers. Subpopulations of T-lymphocytes (helper T cells: T-helper 1, 2 and other types, T-regulators, cytotoxic T-lymphocytes, memory T-lymphocytes). T-cell receptor: structure, types, genetic control, diversity. T-cell epitopes. T-cell restriction (MHC molecules, CD4/CD8). T-lymphocyte activation: a model of two signals, the role of the T-cell receptor, costimulatory interactions (CD28–CD80/86, CD40–CD40L, ICOS-ICOSL, PD-PDL, CD28/CTLA4), cytokines, hormones. Anergy, apoptosis. Methods for assaying the amount and functional activity of T- lymphocytes.

Cellular immune response: the dynamics of development, manifestation. T- dependent effector and regulatory mechanisms.

Immunological tolerance, central and peripheral. Conditions for the development and manifestation of immunological tolerance.

Allergy, definition. Allergens. Domestic, pollen, epidermal, food, chemical, pharmaceutical, microbial exoallergens. Routs for allergens entering the human body. Endoallergens. Stages of allergy development: sensitization, challenge, de- and hyposensitization. Role of T-helper cells type 1 and 2 and cytokines synthesized in the development of hypersensitivity. Types of allergic reactions. Immediate type hypersensitivity (ITH). ITH of mediator type (I). Anaphylactic shock, the mechanism of development. Atopy: the mechanism of development, clinical forms. Cytotoxic (II) and immunocomplex (III) types: anemia, Goodpasture's syndrome, serum sickness, infection immunocomplex allergy. Delayed Type Hypersensitivity (DTH, IV). Contact allergy. Infection allergy. Drug allergy. Exudative erythema multiforme. Lyell's syndrome. Food allergy. Idiosyncrasy. Methods of allergic diseases diagnostics. Specific immunotherapy. Prevention of allergic diseases at the workplace, at home, in health care.

Molecular Allergology. Modern approaches to allergen classification, diagnosis and treatment of ITH type I.

Ecological immunology: definition, objects of study. Immunotropic ecological factors (IEF), natural and anthropogenic. Mechanisms and conditions of the IEF effect on the human immune system. Bioaccumulation and biodegradation of IEF in the environment and in the body. Range and immune mechanisms of adaptation in ecosystems with extreme conditions (the Arctic, desert). Ecoimmunological monitoring in the areas of working and living of people burdened by environmental conditions.

PRACTICAL CLASS 12 **Date: 27.04.26 – 30.04.26**

TOPIC: Immunodiagnostics of infectious diseases. Serological research method.

Suggested reading for self-study:

Serological method of investigation: tasks, steps, evaluation. Diagnosticum, diagnostic antisera, methods of preparation. Polyvalent, monospecific adsorbed (polyclonal) and monoclonal diagnostic serum and test systems. Monoclonal antibodies: methods of production, application. Hybridoma biotechnology.

Quantitative evaluation of serological reactions, antiserum titer, diagnostic titer, increase in antibody titer, affinity. Types of serological tests. Agglutination tests, indirect / passive hemagglutination, latex agglutination. Immunoprecipitation: variants of performance, methods of results accounting, evaluation, application. Immune lysis reactions. Toxin neutralization test.

PRACTICAL CLASS 13 **Date: 04.05.26 – 08.05.26**

TOPIC: Methods of clinical and infectious immunology. Solid phase immunological assay.

Suggested reading for self-study:

Solid-phase immunoassay: fluorescent antibodies test, immunoelectron microscopy (IEM), enzyme-linked immunosorbent assay (ELISA), immunochromatography assay (ICA) - the principles, variants of performance, results accounting, evaluation, application. Immunoblotting (Western blotting). Express tests.

PRACTICAL CLASS 14 **Date: 11.05.26 – 15.05.26**

TOPIC: Immunoprophylaxis and immunotherapy of infectious diseases. Methods of vaccinal immunity evaluation

Suggested reading for self-study:

Immunoprophylaxis**:** definition. Active immunoprophylaxis. National immunization schedule and the list of preventive vaccinations for epidemiological indications. Vaccine, requirements: immunogenicity, safety, areactogenicity, stability, associability. Types of vaccines: inactivated, live, toxoids, chemical, subunit, genetically engineered. Adjuvants. The main vaccines against bacteria, viruses, and parasites. New approaches to the creation of vaccines (vector vaccines, DNA and mRNA vaccines, with MHC gene products, based on the principle of «reverse» vaccinology, etc.). Factors affecting the effectiveness of post-vaccination immunity: associated with the vaccine (dose, interval, competition of antigens, duration of antigenic stimulation ("depot" principle), booster effect) and with the state of the human body (age, hormonal status, nutritional status, etc.). Dynamics of development and methods for assessing post-vaccination immunity. Protective antibody titer.

Passive immunoprophylaxis: definition, indications for use.

Immunotherapy: definition. Therapeutic and prophylactic immune sera and immunoglobulins: types and methods of production, activity determination

PRACTICAL CLASS 15 **Date: 18.05.26 – 22.05.26**

TOPIC: Basics of clinical immunology. Methods of determination and estimation of the immune status. Immunopathology. Transplantation immunity. Antitumor immunity.

The immune status of an organism, definition. Parameters, methods of determination and estimation of the immune status. Immunogram. Flow cytometry to assess immunocompetent cell subpopulations.

Immunodeficiencies (congenital and acquired): classification, mechanisms, clinical syndromes, principles of diagnosis and correction. Diagnosis/monitoring system for primary immunodeficiencies in the Republic of Belarus.

Autoimmune diseases: classification, mechanisms of damage to organs, cells and tissues, principles of diagnosis and treatment.

Autoantigens. Autoantibodies.

Transplant immunity. Types of transplants. Transplant antigens. Conditions for development of transplant rejection and its mechanisms. Methods for diagnosing and suppressing the transplant reaction, complications. Graft-versus-host reaction.

Antitumor immunity. The concept of immune surveillance. Characteristics of tumor antigens. Mechanisms of anti-tumor immunity. Mechanisms of tumor escape from immune surveillance. Immunodiagnostics and immunotherapy of tumors. Tumor markers.

The concept of immune correction: indications, means, methods, monitoring the effectiveness of immune correction. Immunotropic drugs: groups, mechanisms of action, indications. The use of the immunotropic drugs in the treatment of transplant rejection, autoimmune and allergic diseases. Immunotherapy of malignant neoplasms. Immunotherapy with monoclonal antibodies

PRACTICAL CLASS 16 **Date: 25.05.26 – 29.05.26**

TOPIC: Anti-infective immunity. Concluding session «Theoretical and applied medical immunology»

Suggested reading for self-study:

General regularities of anti-infection immunity development and basic protective mechanisms at different stages

of the infectious agent interaction with the host. Immunity against extracellular and intracellular parasites. Mechanisms of immune inactivation of bacteria, fungi, protozoa, viruses and neutralization of their toxins and exoenzymes. The concept of natural and artificial, active and passive, systemic and local, post-infection and infection (non-sterile) types of immunity. Maternal (transplacental, trophic) immunity in newborns and infants: mechanisms, significance.

Question for concluding session «Theoretical and applied medical immunology»

1. Immunology. Definition, tasks, methods. History of immunology.
2. Immune system. Characteristics. Organs, cells.
3. Molecules of an immune system: receptors, MHC molecules of I, II and III types, adhesins, immunoglobulins superfamily.
4. Cytokines. Definition, classification. Biological importance, clinical application. Chemokines and its receptors.
5. Immunity: definition, classification. Characteristics of innate and acquired immunity. Anti-infection immunity.
6. Innate immunity: definition, immune and non immune factors, characteristics.
7. Complement system: definition, ways of activation, functions. Medical importance. Methods of complement activity evaluation.
8. Phagocytosis. Phagocytes. Phagocytosis phases. Intracellular killing mechanisms. Phagocytosis outcome (complete, incomplete). Chemotaxins, opsonins: origin and medical importance.
9. Phagocytosis evaluation methods.
10. Immune response and factors influencing its strength. Genetic control of humoral and cellular immune response.
11. Humoral immune response. Primary and secondary immune response.
12. B-lymphocytes, characteristics, main markers. Methods for B-lymphocytes quantity and functional activity evaluation. 13. Antigens: structure, classification, characteristics.
14. Bacteria antigenic structure. Group, species and type antigens. Cross-reacting antigens. Antigenic formula.
15. Antibodies, structure-functional organization of immunoglobulin molecule, characteristics. Antiidiotypic antibodies.
16. Classes of immunoglobulins, characteristics. Immunoglobulins Subclasses, allotypes, isotypes, idiotypes. Methods of immunoglobulins concentration determination.
17. Mechanisms of antigens and antibodies interactions. Specificity. Phases. Affinity. Avidity.
18. Serology reactions, characteristics. Serum titer, diagnosticum, diagnostic serum, clinical importance.
19. Agglutination reaction. Methods of conduction and result registration. Medical importance.
20. Passive hemagglutination, ingredients. Methods of conduction and result registration. Medical importance. Reversed passive agglutination test. Latex agglutination.
21. Precipitation reaction. Methods of conduction and result registration. Medical importance.
22. Immunofluorescence test. Medical importance.
23. Immunoenzyme analysis. ELISA. Ingredients, methods of conduction, results registration, characteristics. Medical importance.
24. Immune lysis reactions.
25. Cellular immune response, main phenomena. Immunological memory.
26. Subpopulations of T-lymphocytes (T-helpers, killers, regulators), characteristics. Main markers, TCR. Genetic control of TCR diversity.
27. T-lymphocyte activation. Costimulation. Two signals model. Anergy. Apoptosis.
28. Methods for T-lymphocytes quantity and functional activity evaluation.
29. Local immunity, main components. Medical importance.
30. Allergy: definition, classification. Allergy phases.
31. Allergens: definition, classification, characteristics.
32. Allergic reaction of immediate type, clinical phenomena.
33. Mediator type of ITH: definition, mechanisms, clinical phenomena, approaches for prophylaxis.
34. Cytotoxic (II) and immunocomplex (III) ITH types: definitions, mechanisms, clinical phenomena.
35. Hypersensitivity of delayed type (IY): definition, classification, clinical phenomena.
36. Methods for ITH diagnostics (in vivo and in vitro).
37. Methods for DTH diagnostics (in vivo and in vitro).
38. Immune tolerance: definition, mechanisms, medical importance.
39. Transplantation immunity. MHC antigens of I, II, III types, role for an immune response development. Transplantological reactions. Mechanisms of transplant rejection. Prophylaxis.
40. Clinical immunology: definition, aims. Ecological immunology, main immunotropic ecological factors.
41. Primary and secondary immunodeficiencies: definitions, classification, medical importance.
42. Immune status: definition, methods for evaluation. Immunogram. Influence of way of life on the immune system function.
43. Autoimmune diseases, classification. Autoantigens. Mechanisms of autoimmunity. Tumor associated immunity.
44. Immunoprophylaxis and immunotherapy of infections. Achievements and problems.
45. Vaccines, main demands. Classification, characteristics, approaches to development. New vaccines.
46. Vaccinal immunity. Factors influencing vaccinal immunity. Methods of evaluation. Collective immunity, methods of evaluation.
47. Passive immunoprophylaxis. Antisera for therapy and prophylaxis, medical importance.
48. Immunocorrection. Methods for suppression and stimulation of an immune response, drugs for immunocorrection.

List of practice.

1. Register the result of agglutination test.
2. Register the result of gel immunoprecipitation test.
3. Register the result of complement fixation test.
4. Register the result of passive hemagglutination test.
5. Perform the slide agglutination test

6. Determine the immunoglobulins concentration.
7. Determine T-lymphocytes quantity in ready slide by immune rosettes method.
8. Determine phagocytosis indices in ready slides.

Section «Special medical microbiology»

PRACTICAL CLASS 17 **Date: 01.06.26 – 05.06.26**

TOPIC: Special medical microbiology. Methods for microbiological diagnostics of diseases caused by Staphylococci, Streptococci, Neisseria.

CREDIT (Pass-fail test).

Suggested reading for self-study:

Staphylococci: systematic position, general characteristics, main species, sensitivity to environmental factors, resistance to chemotherapeutic drugs and antiseptics. Pathogenicity factors of staphylococci: alpha-toxin, exfoliative toxin, toxic shock syndrome toxin, enzyme-toxins, enterotoxins. Staphylococcal infections (local, systemic, generalized). Staphylococcal food intoxication, pathogenesis, immunity and methods for microbiological diagnostics. Toxic shock syndrome. “Scalded skin” syndrome. Hospital ecovars of staphylococci: phage-, resistance- and genotyping. Methicillin and vancomycin resistant *Staphylococcus aureus* (MRSA, VRSA); *S.aureus* intermediate resistant to vancomycin (VISA). Drugs for etiotropic therapy of staphylococcal infections, antiseptics.

Streptococci: systematic position, general characteristics, classification by biological properties and antigenic structure. Pyogenic streptococci, properties, antigenic structure and serovars, sensitivity to environmental factors, pathogenicity factors (erythrogenic toxin, cross-reactive antigens, enzymes toxins, capsular substance, toxic shock syndrome toxin). Etiology, pathogenesis, immunity, diagnostics, prevention of acute and chronic streptococcal infections and poststreptococcal diseases (purulent-septic infections, streptodermia, chronic tonsillitis, scarlet fever, erysipelas, rheumatic fever, glomerulonephritis). Antibodies to toxins and enzymes of streptococci and their role in immunity and diagnostic value. *Streptococcus pneumoniae*, properties, differentiation by capsular antigen, pathogenicity factors. Pneumococcal infection, pathogenesis, immunity, microbiological diagnostics. Invasive strains of pneumococcus as the causative agents of childhood purulent meningitis. Preparations for specific prevention and chemotherapy of pneumococcal infections.

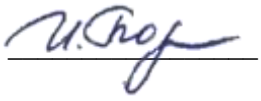
The basics of enterococci and enterococcal infections.

Neisseria**, s**ystematic position, general characteristics. Pathogenic Neisseria. Gonococci: properties, differentiation by fimbrial antigens, sensitivity to environmental factors, pathogenicity factors. Prevalence, pathogenesis, immunity, diagnostics of gonorrhea and gonoblennorrhea. Gonoblennorrhea prevention in newborns.

Meningococci: properties, differentiation by surface antigen, sensitivity to environmental factors, pathogenicity factors. Pathogenesis and clinical forms of meningococcal infections, immunity, microbiological diagnostics, carrier state. Preparations for specific prevention and chemotherapy of meningococcal infection.

CREDIT (Pass-fail test). Questions for the credit were uploaded to the e-test (section "Final knowledge control")

Plans for laboratory classes were approved on 05.02.2026, protocol No.11.

Head of departament  I.A.Gavrilova