PLAN OF PRACTICAL CLASSES IN MICROBIOLOGY, VIROLOGY, IMMUNOLOGY
Specialty "PHARMACY"
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 7-07-0912-01 «Pharmacy»)

Academic training: from February, 9th to June, 12th.

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

Section «General and sanitary 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. Structure of a bacterial cell. Features of the chemical composition of bacteria in comparison with eukaryotic organisms. Structures of a bacterial cell (nucleoid, cytoplasm, ribosomes, mesosomes, inclusions, cell wall, cytoplasmic membrane, periplasmic space, capsule, pili, flagella), their chemical composition and functional significance, identification methods. Differences in the structure of gram-positive and gram-negative bacteria. Forms of bacteria with a cell wall defect (protoplasts, spheroplasts, L-forms). Bacterial spores, their characteristics. Taxonomy, morphology, methods of examination of the spirochetes, actinomyces, rickettsiae, chlamydiae, mycoplasmas.	

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: Organization of the genetic apparatus in bacteria. Nucleoid and plasmids. Genotype and phenotype. Organization of the operon. Modifications in bacteria. Mechanism and phenotypic manifestation. Mutations and mutagenesis. Spontaneous and induced, gene and chromosomal, direct and reverse mutations in bacteria and their characteristics. R-S dissociation, mechanism. Genetic exchange and recombination in bacteria. Transformation, transduction and conjugation. Their mechanisms. Reparations. Principles of genetic mapping. Extrachromosomal factors of heredity. Definition and general characteristics. Bacterial plasmids. Episomes. Conjugative and non-conjugative plasmids. Types of plasmids (F, R, Col, Ent, Hly, etc.) and their role in determining pathogenic traits and drug resistance in bacteria. Transposable genome elements – transposons and Is elements. Genetic control of bacterial virulence. The importance of mutations, recombinations and reparations in the evolution of microorganisms. Theoretical and practical significance of the study of bacterial genetics for microbiology	

and medicine.

The concept of genetic engineering.

Genetic analysis methods (molecular hybridization, polymerase chain reaction, nucleic acid sequencing). The importance of genetic methods in the laboratory diagnosis of infectious diseases.

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:

Nutrition of bacteria. Metabolism of bacteria. Sources of carbon, nitrogen and minerals. Growth factors. Autotrophs and heterotrophs. Holophytic mode of nutrition. Mechanisms of nutrient transfer into the bacterial cell.

Respiration of bacteria. Biological oxidation in bacterial metabolism. The main types of biological oxidation of substrates in bacteria. Aerobes, anaerobes, facultative anaerobes, microaerophiles, general characteristics. Methods for cultivating anaerobes.

Growth and reproduction of microorganisms. Phases of reproduction of the bacterial population in liquid and solid nutrient media; colonies of microorganisms; pigments. Biofilms. Types of secretion in bacteria.

Cultural (bacteriological) research method. Principles and methods of bacterial cultivation. Nutrient media for the cultivation of bacteria. Objectives, stages, advantages and disadvantages of the bacteriological research method.

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:

Principles to the systematics and nomenclature of microorganisms. Phenosystematics. Gene systematics. Use of DNA and 16s rRNA for taxonomy. A mixed approach to taxonomy. Taxonomic categories: domain, phylum (division), class, order, family, genus, species. Subspecies categories: subspecies, variant (var), strain, culture, clone. Species as the main taxonomic category. Species criteria for microorganisms.

Bacterial enzymes. Constitutive and inducible-adaptive enzymes of bacteria. Practical use of the biochemical activity of microorganisms in medical microbiology and in the microbiological industry (for the production of antibiotics, enzymes, vitamins, organic acids, feed protein, etc.), genetic engineering.

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

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

Suggested reading for self-study:

Ecology of microorganisms. The concept of microbial biocenoses. Symbiotic and antagonistic interactions between a microorganism and other organisms: mutualism, commensalism, synergism, parasitism, antagonism. Microbiological aspects of environmental protection. Microorganisms and the biosphere. Microorganisms as sources of vitamin synthesis.

Microflora of the human body. Microflora of the human body. The role of the microflora of the human body in normal physiological processes and pathology. Obligate (resident) and facultative (transient) microorganisms. Formation of microbial biocenoses in different age periods. Microflora of the skin, oral cavity, gastrointestinal tract, respiratory tract, conjunctiva of the eye, genitourinary tract. Dysbiosis. Factors influencing the formation of dysbiosis. The treatment and prevention of dysbiosis.

Infection (infectious process) and invasion: definition, general characteristics. Differences between infectious and non-infectious diseases. Causes and conditions for the occurrence of an infectious process. Classification of infectious processes.

Dynamics of development of infectious disease. Periods of infectious disease. Forms of infection: exo- and endogenous, focal and generalized, mono- and mixed; secondary infection, reinfection, superinfection, relapse; acute, chronic, persistent infections, microbial carriage. The concept of wound, respiratory, intestinal, skin, urogenital infections; anthroponotic, zoonotic, diseases transmitted by household contact, airborne droplets, vector-borne and other means.

The role of microorganisms in the infectious process. Pathogenicity. Virulence. Pathogenicity/virulence factors. Types of bacterial exotoxins, targets and mechanisms of action. Pathogenic, opportunistic and non-pathogenic microorganisms. The role of the macroorganism in the development and course of infectious diseases. The role of lifestyle in the development and course of infectious diseases, the influence of natural and social factors.

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

TOPIC: Microbiological basics of chemotherapy of bacterial infections. Methods for determining the

sensitivity of microbes to antibiotics.

Suggested reading for self-study:

Antibiotics. Definition, requirements for antibiotics. Producers of antibiotics. The main groups of antibiotics: penicillins, cephalosporins, carbapenems, monobactams, aminoglycosides, tetracyclines, chloramphenicol, macrolides, fluoroquinolones, lincosamides, oxazolidinones, polymyxins, cyclopeptides, polyene compounds. Antibiotics of narrow and broad action.

Mechanisms of antimicrobial action of antibiotics. Inhibitors of cell wall synthesis, protein and nucleic acid synthesis. Inhibitors of cytoplasmic membrane synthesis in becterias and fungi.

Side effects of antibiotics.

Drug resistance of microorganisms and ways to overcome them. The emergence and spread of drug resistance as both a biological and medical problem. Primary and acquired resistance to chemotherapeutic agents. Biochemical and genetic mechanisms of resistance to chemotherapeutic agents. Selective action of antibiotics and other chemotherapeutic drugs as factors in the selection of resistant individuals in the bacteriological population. Pathways to overcome drug resistance.

Methods for determining resistance of bacteria to antibiotics.

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

TOPIC: Antimicrobial measures: methods of sterilization and disinfection, asepsis, antiseptics. Pharmaceutical microbiology. Sanitary bacteriological research methods.

Influence of physical, chemical, biological factors on microorganisms.Antimicrobial measures, definition. Microbiological grounds of asepsis, preservation, sterilization, antiseptics and disinfection. The concept of antiseptics and disinfectants. Mechanisms of antimicrobial action of antiseptics and disinfectants.

Microflora of air, water, soil. Sanitary indicator microorganisms.

Pharmaceutical microbiology. Sanitary and epidemiological requirements for pharmacies. Sanitary and hygienic regime of pharmacies.

Sanitary and bacteriological study of water and air in pharmacy. Sanitary and bacteriological examination of pharmaceutical glassware, equipment and hands of pharmacy workers.

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

TOPIC: Microbiological examination of medicinal raw materials and finished dosage forms

Suggested reading for self-study:

Phytopathogenic bacteria. Microflora of medicinal raw materials and finished dosage forms

The concept of epiphytic and phytopathogenic microorganisms. Rhizosphere, mycorrhiza, role for plants. Infectious plant diseases caused by phytopathogenic microorganisms, their manifestation. Methods of infection of plants and ways of spreading bacteria in affected plants. Control measures.

Microflora of medicinal raw materials and finished dosage forms. Sources and causes of microbial contamination. Signs of microbial spoilage of dosage forms and measures to prevent it. Endotoxins as a cause of pyrogenicity of injection solutions. Microbiological assessment of herbal medicinal raw materials. Methods for assessing the microbiological purity and sterility of medicines. Microbiological control of water for injection.

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

TOPIC: Biological (experimental) research method. Concluding session: «General Microbiology»

Biological (experimental) research method: objectives, stages, advantages, disadvantages, use.

Questions for concluding session: «General Microbiology»

1. The subject, tasks, methods of microbiology. History of microbiology.
2. Systematics and nomenclature of microorganisms. Species as the main taxonomic category. Criteria for the species of microorganisms.
3. Shapes and sizes of bacteria. Differences between prokaryotic and eukaryotic cells.
4. The structure of the bacterial cell. Spores, their characteristics.
5. Taxonomy, morphology, methods for spirochaetes, rickettsias, chlamydia, mycoplasmas, actinomycetes detection.
6. The structure of the bacterial cell wall. Differences in the structure of gram-positive and gram-negative bacteria.
7. Gram staining technique. Forms of bacteria with a cell wall defect.
8. Microscopic method of examination: tasks, stages, advantages, disadvantages. Simple and complex staining methods for fixed preparations.

9. Types of microscopic preparations. The technique of preparation of fixed and native slides.
10. Nutrition of bacteria.
11. Bacterial respiration.
12. Growth and reproduction of microorganisms.
13. Bacterial enzymes.
14. Cultural (bacteriological) research method.
15. The structure of bacterial genetic apparatus. Modifications in bacteria. Mechanism and phenotypic manifestation.
16. Mutations and mutagenesis. R-S dissociation. Genetic exchange and recombination in bacteria.
17. Extra-chromosomal factors of heredity. Definition and general characteristics.
18. The importance of mutations, recombinations and reparations in the evolution of microorganisms. The theoretical and practical significance of the doctrine of bacterial genetics for microbiology and medicine. The concept of genetic engineering.
19. Methods of genetic analysis
20. Ecology of microorganisms.
21. Microflora of the human body. Dysbiosis.
22. Infection (infectious process) and invasion: definition, general characteristics. Differences between infectious and non-communicable diseases. Causes and conditions of the infectious process.
23. Classification of infectious processes. Dynamics of the development of an infectious disease. Periods in the development of an infectious disease.
24. The role of microorganisms in the infectious process. Pathogenicity. Virulence. Pathogenicity/virulence factors.
25. Types of bacterial exotoxins, targets and mechanisms of action. Pathogenic, opportunistic and non-pathogenic microorganisms.
26. The role of the macroorganism in the development and course of infectious diseases. The role of living conditions in the development and course of infectious diseases, the influence of social factors.
27. Biological (experimental) research method: tasks, stages, advantages, disadvantages.
28. Chemotherapy and chemoprophylaxis.
29. Antibiotics. Definition, classifications.
30. Mechanisms of antimicrobial action of antibiotics. Side effect of antibiotics.
31. Primary and acquired resistance of microorganisms to chemotherapeutic drugs, their biochemical and genetic mechanisms.
32. Methods for determining bacterial resistance to antibiotics.
33. Antimicrobial measures. Asepsis. Sterilization, preservation.
34. The concept of antiseptics and disinfectants. Mechanisms of antimicrobial action.
35. Microflora of air, water, and soil. Sanitary-indicative microorganisms. Sanitary and bacteriological examination of water and air in pharmacy premises.
36. Sanitary and epidemiological requirements for pharmacies. Sanitary and hygienic regime of pharmacy facilities. Sanitary and bacteriological examination of pharmacy utensils, equipment and hands of pharmacy workers.
37. Phytopathogenic bacteria. Microflora of medicinal raw materials and finished dosage forms.

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 11 **Date: 20.04.26 – 24.04.26**

TOPIC: Immunology. The immune system. Innate immunity

Suggested reading for self-study:

Classification of various forms of immunity. Natural and acquired immunity, comparative characteristics.

The immune system. Immunocompetent organs (central and peripheral): structure, functions. Immunocompetent

cells: types, morphology, CD markers.

Polymorphonuclear and mononuclear phagocytes: origin, characteristics, functions.Natural killer cells, mechanism of target damage.

Cytokines: interleukins, interferons, tumor necrosis factors, colony-forming factors.

Innate immunity. Nonspecific factors of protection of the human body. Protective functions of the skin, mucous membranes, connective tissue, normal human microflora. Humoral nonspecific immunity factors. Proteins of the acute phase of inflammation, lysozyme, lactoferrin and other humoral nonspecific factors.

Phagocytosis. The main stages of phagocytosis and their characteristics. Opsonins and their role in phagocytosis. Immune and non-immune phagocytosis. Completed and incomplete phagocytosis.Granulocyte system. Activation of neutrophils, bactericidal effect. Antigen presenting cell system. Dendritic cells, their role.

Complement system, activation pathways. Biological functions of proteins of the complement system.

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

TOPIC: Antigens. Antibodies

Suggested reading for self-study:

Antigens. General characteristics of antigens. Definition of concepts: antigen, hapten, antigenicity, immunogenicity. Chemical structure of antigens and their determinant groups. Immunochemical specificity of antigens: species, group, type. Autoantigens. Allergens.

Antigenic structure of a bacterial cell: O-, K-, H-antigens. Protective antigens. Antigenic properties of toxins, anatoxins, bacterial enzymes. Antigens of viruses. Antigenic mimicry.

Non-infectious antigens. Human cell antigens: differentiation Ags (CD-AGs), major histocompatibility complex (MHC). Molecules of MHC classes I and II: structure, distribution on cells, biological significance.

Antibodies. Antibodies (immunoglobulins). Classes of immunoglobulins, their main characteristics. Functions of antibodies. Dynamics of antibody formation.

The concept of monoclonal antibodies, methods of production, significance.

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

TOPIC: Mechanisms of immune response development. Humoral and cellular immune response.

Suggested reading for self-study:

Antigen-presenting cells (APC): types, characteristics. Interaction of APC with antigens.

B lymphocytes: development and differentiation. B cell subpopulations. The role of B lymphocytes.

Humoral immune response: definition, dynamics of development, manifestations. Primary and secondary immune response, switching the biosynthesis of immunoglobulin classes, immunological memory.

T-lymphocytes: Subpopulations of T-cells (T-helper null, T-helper types 1 and 2, follicular T-helper, T-regulatory, cytotoxic T-lymphocytes, memory T-lymphocytes). Spectrum of produced cytokines. T cell receptor. The role of different subpopulations in the immune response.

Cellular immune response: dynamics of development, manifestations.

T-dependent effector and regulatory mechanisms.

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

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

TOPIC: Immunodiagnostics. Serological and cellular reactions

Suggested reading for self-study:

Antigen-antibody reactions (serological reactions). General characteristics of reactions: specificity and sensitivity, reversibility, optimal ratios of ingredients. Reaction mechanism, diagnostic value.

Serological research method: tasks, stages, assessment. Diagnosticums, diagnostic immune sera, titer of immune sera, diagnostic titer, increase in antibody titer.

Types of serological reactions. Agglutination reactions (RA), indirect/passive hemagglutination (IRHA/RPHA), latex agglutination, immunoprecipitation. Immune lysis reactions. Complement fixation reaction.

Solid-phase immunological analysis: immunofluorescence reaction (RIF), immunoelectron microscopy (IEM), enzyme-linked immunosorbent assay (ELISA), immunochromatographic analysis (ICA) - essence, formulation options, accounting, evaluation, application. Immunoblotting (Western blotting). Express tests.

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

TOPIC: Methods of clinical and infectious immunology. Allergy

Allergy. Stages and mechanisms of allergy development.

Immediate hypersensitivity. Types of GNT: anaphylactic, cytotoxic, immunocomplex, antireceptor. Immunopathological mechanisms. Autoimmune diseases occurring through the mechanisms of HNT.

Delayed-type hypersensitivity (DTH). The role of HRT in immunity. Skin allergy tests and their diagnostic value.

Prevention of allergic diseases in pharmaceutical production and at home.

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

TOPIC: Immunoprophylaxis and immunotherapy of infectious diseases. Methods for evaluation post-vaccination immunity.

Suggested reading for self-study:

Immunoprophylaxis and immunotherapy of infectious diseases. Principles of immunoprophylaxis and immunotherapy, indications for implementation. Characteristics of modern vaccine preparations: live, inactivated and chemical vaccines, toxoids, associated vaccines, genetically engineered and synthetic vaccines.

Serotherapy and seroprophylaxis. Characteristics of antitoxic, antibacterial and antiviral immune sera and immunoglobulins, their preparation. Immunoglobulin for intravenous administration.

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

TOPIC: Immune status. Immunodeficiency. Autoimmune diseases.

Suggested reading for self-study:

Immune status of the human body. Definition, indicators, methods for determining and assessing immune status.

Types of immunopathology. Classification of immunopathological reactions.

Congenital and acquired immunodeficiency conditions. Primary and secondary immunodeficiencies.

Autoimmune diseases: classification, mechanisms of damage to organs, cells and tissues. Autoantigens. Autoantibodies, meaning of definition in clinical practice.

PRACTICAL CLASS 18 **Date: 08.06.26 – 12.06.26**

TOPIC: The concept of immunocorrection. Concluding session: «Theoretical and applied medical immunology» Credit

Suggested reading for self-study:

Natural and synthetic immunomodulators. Immunosuppressants.

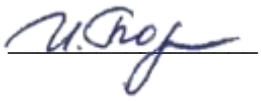
Question for concluding session «Theoretical and applied medical immunology»:

1. Immunity. Types of immunity. Immunocompetent organs (central and peripheral): structure, functions.
2. Immunocompetent cells, types, morphology, CD markers.
3. Cytokines, definition, producer cells, functions
4. Innate immunity, differences with acquired immunity.
5. Phagocytosis. Stages, types. Opsonins.
6. Complement system, activation pathways. Biological functions.
7. Antigens. General characteristics, properties and types.
8. Infectious antigens. Protective antigens. Antigenic mimicry.
9. MHC class I and II: structure, distribution on cells, biological significance.
10. Classes of immunoglobulins, their main characteristics. Antibody functions. Dynamics of antibody production.
11. Antigen-presenting cells (APC): types, characteristics. The interaction of APC with antigens.
12. B-lymphocytes: development and differentiation. Subpopulations of B-cells. The role of B-lymphocytes.
13. Humoral immune response: definition, dynamics of development, manifestations.
14. T-lymphocytes, subpopulations, spectrum of cytokines produced. The T-cell receptor.
15. Cellular immune response: dynamics of development, manifestations.
16. Immunological tolerance, conditions of development and manifestations
17. Antigen-antibody reactions (serological reactions). General characteristics, reaction mechanism, diagnostic value.
18. Serological research method: tasks, stages, evaluation. Serum titer, diagnosticum, diagnostic serum, diagnostic titer, antibody titer increase.
19. Reactions of agglutination, indirect/passive hemagglutination, latex agglutination, immunoprecipitation.
20. Immune lysis reactions. Complement fixation test.

21. Immunofluorescence reaction, immunoelectron microscopy.
22. Enzyme immunoassay (ELISA), immunochromatographic analysis ingredients, methods of conduction, results registration, characteristics.
23. Allergy, stages and mechanisms of allergy development.
24. Types of ITH: anaphylactic, cytotoxic, immunopathological mechanisms.
25. Types of ITH: immunocomplex, antireceptor, immunopathological mechanisms.
26. Hypersensitivity of delayed type: definition, classification. Skin allergy tests and their diagnostic significance.
27. Immune status of the human body, definition. Indicators, methods for determining and assessing immune status
28. Congenital and acquired immunodeficiency.
29. Autoimmune diseases: classification, mechanisms of damage to organs, cells and tissues.
30. Transplant immunity. Antitumor immunity, immunity in the mother-fetus system.
31. Immunocorrection
32. Principles of immunoprophylaxis and immunotherapy.
33. Vaccines, main demands. Classification, characteristics.
34. Serotherapy and seroprophylaxis.

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