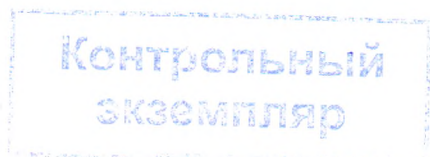
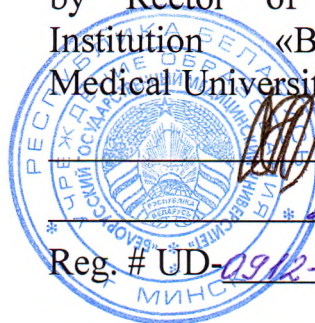


MINISTRY OF HEALTH OF THE REPUBLIC OF BELARUS
Educational Institution
BELARUSIAN STATE MEDICAL UNIVERSITY



APPROVED

by Rector of the Educational
Institution «Belarusian State
Medical University»



S.P. Rubnikovich

20.11.2024

Reg. # UD-0912-01-13/2421/edu.

MICROBIOLOGY, VIROLOGY, IMMUNOLOGY

**Curriculum of the educational institution
in the academic discipline for the specialty**

7-07-0912-01 «Pharmacy»

Curriculum is based on the educational program «Microbiology, Virology, Immunology», approved 20.11.2024, registration # УД-0912-01-13/2425/уч.; on the educational plan in the specialty 7-07-0912-01 «Pharmacy», approved 15.05.2024, registration # 7-07-0912-01/2425/mf.

COMPILERS:

I.A.Gavrilova, Associate Professor of the Department of Microbiology, Virology, Immunology of the Educational Institution «Belarusian State Medical University», PhD, Associate Professor;

T.G.Adamovich, Associate Professor of the Department of Microbiology, Virology, Immunology of the Educational Institution «Belarusian State Medical University», PhD, Associate Professor;

D.A.Chamashei, Associate Professor of the Department of Microbiology, Virology, Immunology of the Educational Institution «Belarusian State Medical University», PhD, Associate Professor;

K.I.Pavlov, Associate Professor of the Department of Microbiology, Virology, Immunology of the Educational Institution «Belarusian State Medical University», PhD

RECOMMENDED FOR APPROVAL:

by the Department of Microbiology, Virology, Immunology of the Educational Institution «Belarusian State Medical University»
(protocol # 4 от 09.10.2024);

by the Scientific and Methodological Council of the educational institution «Belarusian State Medical University»
(protocol # 3 of 20.11.2024)

EXPLANATORY NOTE

«Microbiology, Virology, Immunology» is an academic discipline of the module «Microbiology, Virology, Immunology», containing systematized scientific knowledge about pathogenic and non-pathogenic microorganisms for humans, etiology, mechanisms of pathogenesis, specific prevention, etiotropic therapy, methods of laboratory diagnostics of bacterial, viral, fungal infections and protozoal invasions, microflora of drugs and methods of assessing their microbial contamination, the structure and functions of the human immune system, methods and means of diagnostics, treatment and prevention of diseases based on disorders of the immune system and / or immunological mechanisms of development.

The purpose of the academic discipline «Microbiology, Virology, Immunology» is the formation of specialized competence for the acquisition by students of scientific knowledge about the etiology, mechanisms of pathogenesis, methods of laboratory diagnostics, the basics of epidemiology, specific prevention and etiotropic therapy of human infectious diseases; on the structure, development, methods of assessment and correction of the functioning of the human immune system, necessary for the professional training and subsequent practical activities of a pharmacist.

The objectives of the academic discipline «Microbiology, Virology, Immunology» are to develop students' scientific knowledge about:

- the properties of microorganisms that cause human diseases;
- the routes and mechanisms of infection, spread, pathogenesis, clinical manifestations and laboratory diagnostics, prevention and treatment of infectious diseases;
- the features of the action of antimicrobial drugs;
- methods for assessing the microbial contamination of medicinal raw materials and finished dosage forms, monitoring the sterility and proper storage of drugs;
- the main methods of sterilization, disinfection, asepsis, antisepsis, preservation necessary in the work of a pharmacist;
- the structure and function of the immune system, the mechanisms of immunopathology, methods of immunodiagnostics, immunoprophylaxis, immunotherapy.

The knowledge, skills and abilities acquired in the study of the academic discipline «Microbiology, Virology, Immunology» are necessary for the successful study of the following academic modules: «Pharmacology and Pharmacotherapy», «Pharmaceutical Chemistry and Pharmacognosy», «Pharmaceutical Technology».

A student who has mastered the content of the educational material of the academic discipline «Microbiology, Virology, Immunology» should have the following specialized competence: use the methods for assessing microbial contamination of medicines, monitoring their sterility and appropriate storage.

As a result of studying the academic discipline «Microbiology, Virology, Immunology», the student should

know:

the place and role of microorganisms in the biosphere, morphology, physiology, genetics, ecology of bacteria, viruses, fungi and protozoa, sensitivity-resistance of microbes to environmental factors, sources and routes of microbial contamination of plant medical raw materials and finished dosage forms, methods of microbiological

control of water and air, plant raw materials and finished dosage forms, anti-epidemic and sanitary-hygienic regime in pharmacies;

general patterns of occurrence and development of bacterial, viral, fungal and protozoal infections and invasions, environmental conditions that promote and prevent the occurrence of infections, opportunistic microbes and opportunistic infections;

the human immune system, mechanisms of innate and acquired immunity, immunopathogenesis of allergic, infectious-allergic and autoimmune diseases, immunodeficiencies, patterns of anti-infective immunity;

methods for assessing the microbiological purity and sterility of drugs;

be able to:

assess microbial contamination of medicinal plant materials;

record and evaluate the results of determining the sensitivity of bacteria to antibiotics using the standard paper disk method;

record and evaluate the results of serological reactions of agglutination, precipitation and enzyme immunoassay;

prepare micropreparations of smears from pure cultures of bacteria and biological fluids and conduct microscopic examination;

differentiate microorganisms by morphological characteristics on micropreparations;

sow the test material on various media;

disinfect infected material;

perform antiseptic of hands;

master:

skills in observing storage conditions for medicines for microbial contamination.

Total number of hours for the study of the discipline is 200 academic hours, of which 103 classroom hours and 97 hours of student independent work. Classroom hours according to the types of studies: lectures – 12 hours (including 3 hours of supervised student independent work (SSIW)), laboratory classes – 88 hours.

Intermediate assessment is carried out according to the syllabus of the specialty in the form of a credit (4 semester) and examination (5 semester).

Form of higher education – full-time.

ALLOCATION OF ACADEMIC TIME ACCORDING TO SEMESTERS OF STUDY

Code, name of the specialty	Semester	Total number of academic hours	Number of classroom hours				Out-of-class self-studies	Form of intermediate assessment
			Number of classroom hours	including				
				class lectures	SSIW	laboratory		
7-07-0912-01 «Pharmacy»	4	110	63	6	3	54	47	credit
	5	90	40	6	-	34	50	examination
		200	103	12	3	88	97	

THEMATIC PLAN

Section (topic) name	Number of hours of classroom	
	lectures (incl. SSIW)	laboratory
1. General and sanitary microbiology	6	30
1.1. Microbiology as a science. The world of microorganisms	1,5	3
1.2. Basic methods of studying the morphology of microorganisms	—	3
1.3. Physiology and biochemical activity of bacteria. Basic principles and methods of culturing bacteria	-	6
1.4. Genetics of microorganisms	—	3
1.5. Ecology of microorganisms. Fundamentals of the doctrine of infection. Biological research method	1,5	6
1.6. Microbiological bases of antimicrobial chemotherapy. Antimicrobial measures	1,5	3
1.7. Sanitary and bacteriological research methods. Microbiological study of medicinal raw materials and finished dosage forms	1,5	6
2. Theoretical and applied medical immunology	3	24
2.1. Immune system. Immunity. Types of immunity. Immunocompetent cells and molecules	1,5	3
2.2. Antigens. Antibodies	—	3
2.3. Mechanisms of immune response development	1,5	3
2.4. Immunodiagnostics. Serological and cellular reactions	—	3

2.5.Immunopathology. Evaluation of immune status. Immunoprophylaxis and immunotherapy of infectious diseases	–	12
3. Medical microbiology	1,5	20
3.1.Methods of microbiological diagnostics of purulent infections caused by staphylococci, streptococci and pseudomonas	1,5	2
3.2.Methods of microbiological diagnostics of purulent-septic infections caused by proteus, bacteroides, Clostridium tetani, Clostridias of anaerobic gas infections	–	2
3.3.Methods of microbiological diagnostics of meningococcal infection, whooping cough, diphtheria	–	2
3.4.Methods of microbiological diagnostics of diseases caused by pathogenic mycobacteria, hemoglobinophilic (hemophilic) bacteria, Klebsiella, Nocardia, Actinomycetes	–	2
3.5.Methods of microbiological diagnostics of acute intestinal infections caused by enterobacterias	–	2
3.6.Methods of microbiological diagnostics of bacterial intestinal infections caused by Vibrio cholerae, Clostridium botulinum, Campylobacter, Helicobacter, Listeria	–	2
3.7.Methods of microbiological diagnostics of sexually transmitted infections	–	2
3.8.Methods of microbiological diagnostics of bacterial zoonotic infections	–	2
3.9.Methods of microbiological diagnostics of rickettsiosis	–	2
3.10. Fundamentals of medical mycology and protozoology	–	2
4. Medical virology	4,5	14
4.1.General virology. Methods of virological research. Bacteriophages	1,5	2
4.2.Pathogens of respiratory viral infections: orthomyxoviruses, paramyxoviruses, coronaviruses, adenoviruses. Rubiviruses	1,5	2
4.3.Methods of virological diagnosis of diseases caused by herpesviruses, papillomaviruses, parvoviruses	1,5	2
4.4.Ecological group of arboviruses and reoviruses	–	2
4.5.Picornaviruses, reoviruses, noroviruses, hepatitis viruses A, E, B, C	–	2
4.6.Retroviruses, rhabdoviruses, poxviruses, poliomyxoviruses. Oncogenic viruses. Etiology of slow infections. Prions and prion diseases	–	4
Total hours	15	88

CONTENT OF THE EDUCATIONAL DISCIPLINE

1. General and sanitary microbiology

1.1. Microbiology as a science. The world of microorganisms

Subject, tasks, methods and connections of microbiology. Subject and tasks of microbiology. Main stages of development of microbiology. Sections of microbiology.

Connection of microbiology with other sciences.

Role of microbiology in progress of medicine, pharmacy and in professional activity of pharmacist.

History of microbiology. Early ideas about organisms invisible to the naked eye – contagions. Invention of microscope and discovery of world of microbes by A.Levenhoek. Emergence of scientific microbiology in the second half of 19th century (L.Pasteur, R.Koch). Creation of the doctrine of cellular (I.I.Mechnikov) and humoral (P.Ehrlich) mechanisms of immunity of macroorganism to infectious diseases. Role of D.I.Ivanovsky in discovery of viruses and significance of this discovery for biology and medicine. Development of principles of antisepsis (I.Semmelweis, D.Lister) and chemotherapy (D L.Romanovsky, P.Ehrlich) of bacterial infections. Main directions of development of microbiology in the XX and XXI centuries. Development of microbiology in the Republic of Belarus.

Taxonomy and nomenclature of microorganisms. Place of microorganisms in the organic world. Common with higher animals and plants and specific features of microorganisms.

Principles and approaches to taxonomy and nomenclature of microorganisms, phenosystematics and genosystematics of microorganisms. Use of DNA and 16s rRNA for taxonomy. Mixed approach to taxonomy. Taxonomic categories: domain, type (division), class, order, family, genus, species. Subspecific categories: subspecies, variant (var), strain, culture, clone. Species as the main taxonomic category. Species criteria in microorganisms.

Classification of microorganisms. Prokaryotic (bacteria) and eukaryotic (fungi, protozoa) organisms. Viruses, viroids and prions.

International principles and rules of nomenclature of microorganisms.

Evolution of microorganisms. Origin and development of microorganisms. Factors of evolution. Morphological, biochemical and ecological evolution of microorganisms during the formation of the biosphere. Subsequent evolution of microorganisms. Sources and time of emergence of microorganisms pathogenic for humans. Main directions and driving factors of evolution of microorganisms in the modern period.

1.2. Basic methods of studying the morphology of microorganisms

Morphology of bacteria. Forms and sizes of bacteria. Structure of bacterial cells. Features of chemical composition of bacteria in comparison with eukaryotic organisms. Structures of bacterial cells (nucleoid, cytoplasm, ribosomes, mesosomes, inclusions, cell wall, cytoplasmic membrane, periplasmic space, capsule, pili, flagella), their chemical composition and functional significance, methods of detection. Differences in the structure of gram-positive and gram-negative bacteria. Forms of bacteria with a defect of the cell wall (protoplasts, spheroplasts, l-forms). Spores, their characteristics.

Methods of studying the morphology of bacteria. Microscopic method of research: tasks, stages, advantages, disadvantages. Types of microscopic preparations. Technique of preparation of fixed and native preparations. Microscopy technique in a light microscope. Simple and complex methods of staining fixed preparations. Gram staining technique. Methods of studying microorganisms in a living state.

1.3. Physiology and biochemical activity of bacteria. Basic principles and methods of culturing bacteria

Nutrition, metabolism of bacteria. Sources of carbon, nitrogen and minerals, bacterial growth factors. Characteristics of autotrophs and heterotrophs. Characteristics of the holophytic method of nutrition. Mechanisms of nutrient transfer into a bacterial cell.

Bacterial respiration. Biological oxidation in bacterial metabolism. Basic types of biological oxidation of substrates in bacteria. Aerobes, anaerobes, facultative anaerobes, microaerophiles: general characteristics. Methods of culturing anaerobes.

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

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

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

1.4. Genetics of microorganisms

Organization of the genetic apparatus in bacteria. Nucleoid and plasmids. Definition of the concepts of genotype and phenotype. Organization of the operon.

Modifications in bacteria: mechanism and phenotypic manifestation.

Mutations and mutagenesis of bacteria. 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. Phenomena of transformation, transduction and conjugation, their mechanisms. Reparation mechanisms. Principles of genetic mapping of microorganisms.

Extrachromosomal factors of heredity, definition and general characteristics. Characteristics of bacterial plasmids. Conjugative and non-conjugative plasmids. Types of plasmids (F, R, Col, Ent, Hly, etc.) and their role in determining pathogenic features and drug resistance in bacteria. Characteristics of episomes.

Transposable elements of the genome - transposons and Is-elements.

Genetic control of bacterial virulence.

The importance of mutations, recombinations and reparations in the evolution of microorganisms. Theoretical and practical importance of the theory of bacterial genetics for microbiology and medicine.

The concept of genetic engineering.

Methods of genetic analysis (molecular hybridization, polymerase chain reaction, nucleic acid sequencing). The importance of genetic methods in laboratory diagnostics

of infectious diseases.

1.5. Ecology of microorganisms. Fundamentals of the doctrine of infection. Biological research method

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 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.

Dysbacteriosis, factors influencing its formation. Preparations for the treatment and prevention of dysbacteriosis.

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

Dynamics of infectious disease development. Periods in the development of an infectious disease. Forms of infection: exogenous 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, natural focal infectious diseases; diseases transmitted by contact-household, airborne, transmissible and other routes.

The role of microorganisms in the infectious process. The concepts of pathogenicity and 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 living conditions in the development and course of infectious diseases, the influence of natural and social factors.

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

1.6. Microbiological bases of antimicrobial chemotherapy. Antimicrobial measures

Definition of the concepts of antimicrobial chemotherapy and chemoprophylaxis. The main groups of antimicrobial drugs: sulfonamides, azoles, quinolones, nitrofurans, etc. Mechanisms of antimicrobial action.

Antibiotics: definition, requirements. Antibiotic producers. The main groups of antibiotics: penicillins, cephalosporins, carbapenems, monobactams, aminoglycosides, tetracyclines, chloramphenicol, macrolides, fluoroquinolones, lincosamides, oxazolidinones, polymyxins, cyclopeptides, polyene compounds. Narrow- and broad-spectrum antibiotics.

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

Side effects of antibiotics.

Drug resistance of microorganisms and ways to overcome it. The emergence and spread of drug resistance in bacteria as a biological and medical problem. Primary and acquired resistance of microorganisms to chemotherapeutic agents, biochemical and genetic mechanisms. Selective action of antibiotics and other chemotherapeutic drugs as factors in the selection of resistant individuals in the bacterial population. Ways to overcome drug resistance in bacteria.

Methods for determining bacterial resistance to antibiotics.

Effect of physical, chemical, biological factors on microorganisms.

Antimicrobial measures, definition. Microbiological foundations of asepsis, preservation, sterilization, antisepsis and disinfection. The concept of antiseptics and disinfectants. Mechanisms of antimicrobial action of antiseptics and disinfectants.

1.7. Sanitary and bacteriological research methods. Microbiological study of medicinal raw materials and finished dosage forms

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, air of pharmacy premises. Sanitary and bacteriological study of pharmacy utensils, equipment and hands of pharmacy workers.

Microflora of medicinal raw materials and finished dosage forms. The concept of epiphytic and phytopathogenic microorganisms. Rhizosphere, mycorrhiza, role for plants. Infectious diseases of plants caused by phytopathogenic microorganisms, their manifestation. Methods of plant infection 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 drugs. Determination of endotoxins using amoebocyte lysate (LAL test). Microbiological control of water for injection.

2. Theoretical and applied medical immunology

2.1. Immune system. Immunity. Types of immunity. Immunocompetent cells and molecules

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

Immunocompetent organs (central and peripheral): structure, functions. Immunocompetent cells: types, morphology, CD markers.

Polymorphonuclear and mononuclear phagocytes: origin, characteristics, functions.

Natural killers, mechanism of target damage.

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

The concept of innate immunity. Non-specific factors of human body defense. Protective functions of the skin, mucous membranes, connective tissue, normal human microflora.

Humoral non-specific factors of immunity. Acute phase proteins, lysozyme, lactoferrin and other humoral nonspecific factors.

The main stages of phagocytosis and their characteristics. Opsonins and their role in phagocytosis. Immune and nonimmune phagocytosis. Completed and incomplete phagocytosis.

The granulocyte system. Activation of neutrophils, bactericidal action. The system of antigen-presenting cells. Dendritic cells, their role.

The complement system, activation pathways. Biological functions of complement system proteins.

2.2. Antigens. Antibodies

General characteristics of antigens. Definition of concepts: antigen, hapten, antigenicity, immunogenicity. Chemical nature of antigens and their determinant groups. Immunochemical specificity of antigens: species, group, typical. Antigenic structure of bacterial cells: O-, K-, H-antigens. Protective antigens. Antigenic properties of toxins, anatoxins, bacterial enzymes. Viral antigens. Antigenic mimicry.

Non-infectious antigens. Human cell antigens: differentiation antigens (CD antigens), major histocompatibility complex (MHC). MHC class I and II molecules: structure, distribution on cells, biological significance.

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

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

2.3. Mechanisms of immune response development

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

B-lymphocytes: development and differentiation. Subpopulations of B-cells. The role of B-lymphocytes.

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

T-lymphocytes: subpopulations of T-cells (T-helpers zero, T-helpers types 1 and 2, follicular T-helpers, T-regulatory, cytotoxic

T-lymphocytes, memory T-lymphocytes). Spectrum of produced cytokines.

T-cell receptor. The role of various subpopulations in the immune response.

Cellular immune response: development dynamics, manifestations.

T-dependent effector and regulatory mechanisms.

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

2.4. Immunodiagnostics. Serological and cellular reactions

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 (AR), indirect/passive hemagglutination (INHA/RPHA), latex agglutination, immunoprecipitation. Immune lysis reactions. Complement fixation reaction.

Solid-phase immunoassay: immunofluorescence reaction (IFR), immunoelectron microscopy (IEM), enzyme-linked immunosorbent assay (ELISA), immunochromatographic assay (ICA) – essence, formulation options, recording, assessment, application. Immunoblotting (Western blotting): essence, recording, assessment, application. Serological rapid tests: reactions, application.

2.5. Immunopathology. Evaluation of immune status. Immunoprophylaxis and immunotherapy of infectious diseases

Stages and mechanisms of allergy development.

Immediate-type hypersensitivity (ITH). Types of IHT: anaphylactic, cytotoxic, immune complex, antireceptor. Immunopathological mechanisms. Autoimmune diseases occurring through IHT mechanisms.

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

Prevention of allergic diseases in pharmaceutical production, in everyday life.

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

Types of immunopathology. Classification of immunopathological reactions.

Congenital and acquired immunodeficiency states. Primary and secondary immunodeficiencies.

Autoimmune diseases: classification, mechanisms of damage to organs, cells and tissues. Autoantigens, autoantibodies, the importance of definition in clinical practice.

The concept of transplant immunity. Antitumor immunity, immunity in the mother-fetus system.

Immunomodulators (interferons, interleukins). Natural and synthetic immunomodulators. Immunosuppressants: definition, examples, scope of application.

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

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

3. Medical microbiology

3.1. Methods of microbiological diagnostics of purulent infections caused by staphylococci, streptococci and pseudomonas

Properties of staphylococci, pathogenicity factors. Etiological and pathogenetic role of staphylococci in purulent-inflammatory processes, sepsis and nosocomial infections. Laboratory diagnostics, specific prevention and therapy of staphylococcal infections.

Properties of streptococci, pathogenicity factors and toxins. The role of streptococci in human pathology. Laboratory diagnostics, prevention and therapy of streptococcal infections.

The concept of enterococci and enterococcal infections.

Properties of pseudomonas, pathogenicity factors. The role of pseudomonas aeruginosa in nosocomial infections. Laboratory diagnostics, prevention and therapy of diseases caused by *Pseudomonas aeruginosa*.

3.2. Methods of microbiological diagnostics of purulent-septic infections caused by proteus, bacteroides, Clostridium tetani, Clostridias of anaerobic gas infections

Proteus: classification, properties. The role of Proteus in human pathology.

Characteristics of Clostridia - causative agents of wound anaerobic infection. Toxins and their characteristics. The role of Clostridia toxins and tissue decay products in the pathogenesis of wound infection. Microbial associations in wound anaerobic infection. Antitoxic immunity in gas gangrene. Laboratory diagnostics, specific prevention and etiotropic therapy of wound anaerobic infection.

Characteristics of the causative agent of tetanus. Tetanospasmin and tetanolysin, their pathogenetic action. Tetanus in newborns. Antitoxic immunity in tetanus. Laboratory diagnostics, specific prevention and etiotropic therapy of tetanus.

Bacteroids: characteristics, role in human pathology. Principles of diagnostics of non-clostridial anaerobic infections.

3.3. Methods of microbiological diagnostics of meningococcal infection, whooping cough, diphtheria

The causative agent of meningococcal infection, properties, pathogenicity factors. Etiological and pathogenetic role in epidemic cerebrospinal meningitis, meningococemia and nasopharyngitis. Meningococcal carriage. Immunity in meningococcal infection. Laboratory diagnostics, prevention, therapy of meningococcal infection.

The causative agent of diphtheria, properties, pathogenicity factors. Diphtheria toxin, its properties, mechanism of action. Genetic control of toxin formation. Use of diphtheria toxoid. Antitoxic immunity and methods for its detection. Carriage of *Corynebacterium diphtheriae*. Laboratory diagnostics, specific prevention and therapy of diphtheria.

The causative agent of whooping cough, properties, pathogenicity factors. Pathogenesis and immunity of whooping cough. Laboratory diagnostics, specific prevention, therapy of whooping cough.

3.4. Methods of microbiological diagnostics of diseases caused by pathogenic mycobacteria, hemoglobinophilic (hemophilic) bacteria, Klebsiella, Nocardia, Actinomycetes

Tuberculosis pathogens: properties, pathogenicity for humans and localization in the body. Factors of pathogenicity of mycobacterium tuberculosis. Use of tuberculin. Immunity and its features. Laboratory diagnostics of tuberculosis, specific prevention (BCG vaccine), therapy.

Leprosy pathogen, biological features. Pathogenicity for humans. Laboratory diagnostics of leprosy. Prevention of leprosy, therapy.

Nocardia: systematic position, properties, role in human pathology.

Actinomycetes: systematic position, general characteristics, distribution. The role of actinomycetes in the circulation of substances, production of antibiotics. Etiology, pathogenesis, microbiological diagnostics of actinomycosis.

Hemoglobinophilic (hemophilic) bacteria. *Haemophilus influenzae* and its role in the pathology of children and adults. Microbiological diagnostics and specific prevention of Hib infection.

Klebsiella, general characteristics. Opportunistic Klebsiella (*K. pneumoniae*, *K. oxytoca*) and their role in human pathology. *K. pneumoniae* and their role in infectious pathology. Microbiological diagnostics of Klebsiella.

3.5. Methods of microbiological diagnostics of acute intestinal infections caused by enterobacterias

Escherichia: properties, physiological role and sanitary-indicative value. Serogroups of Escherichia and their role in the etiology of acute intestinal diseases (*Escherichia coli*): enteritis of early childhood, dysentery-like diseases, cholera-like diseases. Enterohemorrhagic Escherichia - causative agents of hemolytic-uremic syndrome. Etiological and pathogenetic role of Escherichia in urinary tract infections, appendicitis, cholecystitis and nosocomial infections. Laboratory diagnostics, prevention and etiotropic therapy of escherichiosis.

Classification of Shigella. Etiological role of Shigella in dysentery. Pathogenesis, laboratory diagnostics, prevention and etiotropic therapy of dysentery. Intracellular persistence of Shigella.

Serological classification of Salmonella, pathogenicity for humans. Typhoid and paratyphoid agents. Pathogenesis and immunology of typhoid fever. Salmonella - causative agents of acute gastroenteritis. Salmonella - causative agents of nosocomial infections. Pathogenesis, laboratory diagnostics, prevention and therapy of typhoid fever and salmonellosis.

Yersinia – causative agents of pseudotuberculosis and enterocolitis. Morphological and physiological features. Pathogenicity for humans and rodents. Laboratory diagnostics, prevention, therapy of yersiniosis.

3.6. Methods of microbiological diagnostics of bacterial intestinal infections caused by Vibrio cholerae, Clostridium botulinum, Campylobacter, Helicobacter, Listeria

Vibrio cholerae, morphological, cultural and biochemical features. Antigenic structure, O- and H-antigens. Biovars of cholera vibrio. Serovars, ecology and resistance of cholera vibrio. Pathogenicity factors. Genetic control of pathogenicity factors. Enterotoxin (cholerogen), properties and mechanism of pathogenetic action. Pathogenesis and immunity in cholera. Laboratory diagnostics, specific prevention, therapy of cholera.

Clostridia - causative agents of botulism, morphological and physiological features. Botulinum toxins, characteristics and pathogenetic action. Laboratory diagnostics, specific treatment, prevention of botulism. Clostridia difficile: natural (species) antibiotic resistance. *Clostridioides difficile*-associated infections, diagnostic and therapeutic methods.

Campylobacter: systematic position, properties, role in human pathology.

Helicobacter: properties, role in the development of gastric ulcer and duodenal ulcer, gastric cancer, maltoma. Laboratory diagnostics, prevention and etiotropic therapy of helicobacteriosis.

Listeria: systematic position, properties, role in human pathology.

3.7. Methods of microbiological diagnostics of sexually transmitted infections

The causative agent of syphilis: properties, pathogenesis and immunity. Laboratory diagnostics, prevention and therapy of syphilis.

Gonococci, etiological and pathogenetic role in urethritis and blennorrhea in children. Prevention of blennorrhea in newborns. Immunity in gonorrhea. Laboratory diagnostics of gonorrhea. Prevention, etiotropic therapy for gonorrhea.

Chlamydia: morphological and biological features, resistance, obligate intracellular parasitism and pathogenicity factors of chlamydia. The causative agent, laboratory diagnostics, prevention, etiotropic therapy of chlamydia.

Mycoplasmas: general characteristics, pathogenicity for humans, diseases caused, role in pregnancy pathology and fetal damage. Laboratory diagnostics of mycoplasmosis, prevention, etiotropic therapy.

3.8. Methods of microbiological diagnostics of bacterial zoonotic infections

Classification of microorganisms and poisons of biological origin by degree of danger. Anti-epidemic regime when working with pathogens of risk groups IV-III.

The causative agent of plague: morphological and physiological characteristics, pathogenicity for humans, pathogenicity factors and toxins. Pathogenesis of plague. Laboratory diagnostics, specific prevention, etiotropic therapy of plague.

The causative agent of tularemia, morphological, cultural and biochemical features. Ecology, resistance and pathogenicity for humans of the causative agent of tularemia, pathogenicity factors. Pathogenesis and immunity in tularemia. Methods of tularemia diagnostics. Live tularemia vaccine (B.Y.Elbert, N.A.Gaisky). Medicines for chemotherapy of tularemia.

Brucellae: morphological, cultural, biochemical and antigenic properties. Pathogenicity factors and resistance of brucellas. Pathogenesis and immunity in brucellosis. Laboratory diagnostics, specific prevention, etiotropic therapy in brucellosis.

The causative agent of anthrax: morphological, cultural and biochemical properties. Resistance of bacilli spores to environmental factors. Pathogenicity factors of the causative agent of anthrax. Toxins of the causative agent of anthrax, their pathogenetic action. Laboratory diagnostics, prevention and etiotropic therapy of anthrax.

Aerobic bacilli - causative agents of food poisoning.

Leptospira: general characteristics, pathogenicity for humans. Pathogenesis, laboratory diagnostics, specific prevention, etiotropic therapy of leptospirosis.

Borrelia: general characteristics, pathogenicity for humans. Characteristics of pathogens, transmission routes, principles of pathogenesis, methods of laboratory diagnostics and therapy of Lyme borreliosis.

3.9. Methods of microbiological diagnostics of rickettsiosis

Classification of rickettsia and rickettsioses. Agents of typhus and Brill-Zinsser disease, endemic rickettsiosis. Hosts and vectors of rickettsia. Obligate intracellular parasitism of rickettsia. Laboratory diagnostics, specific prevention, etiotropic therapy of rickettsiosis.

3.10. Fundamentals of medical mycology and protozoology

Systematic position and classification of fungi.

Fungi pathogenic for humans, morphology, pathogenicity factors. Features of mycotic infection. Principles of diagnostics and features of chemotherapy of mycoses.

Systematic position, general characteristics and classification of protozoa. Features of chemoprophylaxis and chemotherapy of protozoan invasions.

4. Medical virology

4.1. General virology. Methods of virological research. Bacteriophages

Classification and morphology of viruses. Viruses as an independent form of life. The main features that distinguish viruses from other forms of organic matter. Classification of viruses. Morphology of virions of simple (non-enveloped) and complex (enveloped) viruses. Chemical composition of viruses. Viroids. Prions.

Reproduction of viruses. Strict parasitism and cytotropism of viruses. Stages of reproduction (reproduction) of viruses. Features of reproduction of DNA and RNA viruses. Mechanisms of variability of viruses. Productive, abortive and integrative infection of cells.

Ecology of viruses. Human and animal viruses. Sensitivity of viruses to physical and chemical factors of the external environment.

Viruses of bacteria (bacteriophages). Morphology of phage particles, chemical composition, properties. Virulent and temperate phages, features of their interaction with bacteria. Lysogenic infection. Phage conversion. Defective phages. Using phages for diagnostics, treatment and prevention of bacterial infections. Phage typing of bacteria. Sanitary and indicative value of bacteriophages.

Viruses as a cause of tumor and infectious diseases. Spread, features of viral infections. Types of viral infections. Mechanisms of damage to animal cells by viruses. Slow infections.

Antiviral immunity. Factors of innate immunity. Cellular reactivity. Antiviral inhibitors. Natural killers. Viral interference. Interferonogens, definition, examples. Interferons: types, classes, properties, antiviral, antitumor, immunomodulatory effects.

Features of immunity in viral infections. Immunoprophylaxis and immunotherapy of viral infections.

Chemotherapy and chemoprophylaxis of viral infections. Antiviral chemotherapeutic drugs and their mechanisms of action. Antiviral antiseptics.

Virological diagnostic methods. Study of virus morphology. Detection of viral inclusions. Methods of isolation, indication and identification of viruses on chicken embryos, cell cultures, laboratory animals. Serological diagnostic methods for viral infections.

4.2. Pathogens of respiratory viral infections: orthomyxoviruses, paramyxoviruses, coronaviruses, adenoviruses. Rubiviruses

Human influenza viruses. Structure and chemical composition of virions. Influenza virus antigens: hemagglutinin, neuraminidase, ribonucleoprotein proteins. Antigenic variability of the influenza virus, antigenic drift, shift. Cultivation of the influenza virus. Pathogenesis of influenza. The role of secondary bacterial microflora. Laboratory diagnostics, specific prevention, etiotropic therapy of influenza.

Paramyxoviruses: classification, general characteristics. The genus of paramyxoviruses: parainfluenza viruses, role in human pathology. Mumps virus: structure, cultivation. Pathogenetic features, specific prevention of mumps.

Genus of pneumoviruses – respiratory syncytial virus (RSV): structure, cultivation.

Genus of morbilliviruses: measles virus, its structure and cultivation. Pathogenetic features and specific prevention of measles.

Laboratory diagnostics of paramyxovirus infections.

General characteristics, classification and properties of coronaviruses. SARS-Cov-2 virus. Covid-19 infection - pathogenesis, diagnostics, specific prevention, antiviral therapy.

Adenoviruses: characteristics, family composition. Human adenoviruses, virion structure, virus properties, serotypes. Pathogenesis, immunity, virological diagnostics, specific prevention of adenovirus infections.

Rubiviruses. Rubella virus: structure, properties, teratogenic effect. Rubella: pathogenesis, virological diagnostics, principles of prevention.

4.3. Methods of virological diagnosis of diseases caused by herpesviruses, papillomaviruses, parvoviruses

Herpesviruses: characteristics and family composition, oncogenicity. Human herpes viruses (HHV).

Alpha-herpesviruses. Herpes simplex viruses – serotypes HHV-1 and HHV-2. Varicella-zoster virus (HHV-3). Pathogenesis of infections caused by alpha-herpesviruses, immunity, virological diagnostics, chemotherapy and immunotherapy.

Beta-herpesviruses. Cytomegalovirus (HHV-5), properties. Forms of cytomegalovirus infection. HHV-6, 7, role in human pathology (roseola infantum, chronic fatigue syndrome).

Gamma-herpesviruses. Epstein-Barr virus (HHV-4), properties. Pathogenesis, diagnostics of infectious mononucleosis. HHV-8, role in human pathology (Kaposi's sarcoma).

Human papillomaviruses of high carcinogenic risk. The role of papillomaviruses in the etiology of cervical cancer, principles of prevention.

Parvoviruses: virion structure, biological properties, role in human pathology.

4.4. Ecological group of arboviruses and roboviruses

General features of arboviruses, group composition, characteristics of the diseases they cause. Arbovirus and robovirus infections endemic to the Republic of Belarus.

Flaviviruses: characteristics and classification. Tick-borne encephalitis virus, characteristics. Specific prevention of tick-borne encephalitis. Other diseases caused by flaviviruses (Dengue fever, yellow fever, Japanese encephalitis, Zika fever).

4.5. Picornaviruses, reoviruses, noroviruses, hepatitis viruses A, E, B, C

Picornaviruses: general characteristics, properties.

Enteroviruses: polioviruses, Coxsackie and ECHO, features of properties. Localization and spread of the polio virus in the human body. Specific prevention of enterovirus infections. Diseases caused by Coxsackie and ECHO viruses in humans. Rhinoviruses.

Laboratory diagnostics of diseases caused by picornaviruses.

Reoviruses: general characteristics of the family. Rotaviruses, virion structure. Human rotavirus infection: pathogenesis, immunity, diagnostic methods.

Noroviruses: virion structure, biological properties, role in human pathology.

Classification of hepatitis viruses (HAV, HBV, HCV, HEV), other viruses with hepatotropic action.

Hepatitis A virus, virion structure and properties. Infection routes, pathogenesis, immunity, diagnostics, specific and non-specific prevention of hepatitis A.

Hepatitis E virus, virion characteristics. Pathogenesis and virological diagnostics of hepatitis E.

Hepatitis B virus. Morphological and antigen structure of the virion, oncogenicity. Transmission routes, pathogenesis, immunity, virological diagnostics, principles of hepatitis B treatment. Specific and non-specific prevention of hepatitis B. Delta infection, pathogenesis, diagnostics.

Hepatitis C virus, virion structure. Pathogenesis, immunity, virological diagnostics, hepatitis C outcomes. Medicines for specific therapy of hepatitis C.

4.6. Retroviruses, rhabdoviruses, poxviruses, polyomaviruses. Oncogenic viruses. Etiology of slow infections. Prions and prion diseases

Retroviruses: human immunodeficiency viruses (HIV-1 and HIV-2), virion structure. Stages of HIV reproduction in T-lymphocytes. HIV sensitivity to physical and chemical factors. HIV infection, spread, routes of infection, high-risk groups. Formation of immunodeficiency and its characteristics. Diagnosis of HIV infection. Principles of antiretroviral therapy (ART). Primary and secondary prevention of HIV infection.

Rhabdoviruses. Rabies virus, properties. Routes of human infection, pathogenesis and virological diagnostics of rabies. Negri bodies. Modern anti-rabies vaccine and gamma globulin for the prevention of rabies, indications for use.

Poxviruses: characteristics and composition of the family.

Polyomaviruses, characteristics and composition of the family.

History of the development of ideas about the etiology of malignant tumors. Viral hypothesis of carcinogenesis. The concept of «oncogenicity of the virus».

Oncogenic DNA-genomic viruses and RNA-genomic viruses, the mechanism of carcinogenesis.

Prions: properties, role in human pathology, prevention.

Slow infections of viral etiology: HIV infection, subacute sclerosing panencephalitis, rabies, congenital rubella, chronic viral hepatitis B and C, herpes encephalitis.

EDUCATIONAL DISCIPLINE «MICROBIOLOGY, VIROLOGY, IMMUNOLOGY» CURRICULAR CHART

Section, topic #	Section (topic) name	Number of class hours		Supervised student independent work	Literature	Practical skill	Forms of control	
		lectures	laboratory				of practical skills	of current / intermediate assessment
4 semester								
	Lectures	6	-	3	-			
1.1.	Microbiology as a science. The world of microorganisms	1,5	–	–	1, 3,4,7			
1.5.	Ecology of microorganisms. Fundamentals of the doctrine of infection	–	–	1,5	1, 4, 5,7			Review, computer test
1.6.	Microbiological bases of antimicrobial chemotherapy	1,5	–	–	1, 4, 5,7			
1.7.	Sanitary and bacteriological research methods. Microbiological study of medicinal raw materials and finished dosage forms	1,5	–	–	1, 6,7			
2.1.	Immune system. Immunity. Types, systems of immunity. Immunocompetent cells and molecules	1,5	–	–	1, 4 ,7			
2.3.	Mechanisms of immune response development	–	–	1,5	1, 4,7			Review, computer test
	Laboratory classes	-	54	-	-			
1.1.	Microbiology as a science. The world of microorganisms	–	3	–	1, 3-5	Compliance with asepsis rules when working with microorganisms of the 1st biosafety level. Preparation of a fixed smear from agar culture of bacteria. Preparation of a fixed smear from	Laboratory work report	Test, computer test, questioning

						broth culture of bacteria. Staining a fixed smear with an aqueous solution of fuchsin. Staining a fixed smear with an aqueous solution of methylene blue. Oil immersion microscopy of a fixed smear		
1.2.	Basic methods of studying the morphology of microorganisms	–	3	–	1, 3-5,7	Preparation of a fixed smear from agar culture of bacteria. Staining a fixed smear using the Gram method. Oil immersion microscopy of a fixed smear. Detection and determination of the morphology of staphylococci in smears stained by the Gram method. Detection and determination of the morphology of enterobacteria in smears stained by the Gram method. Detection and determination of the morphology of Klebsiella in smears stained by the negative staining. Microscopic examination of sputum smears stained by the Ziehl-Neelsen method to detect mycobacteria. Detection and determination of corynebacteria morphology in smears, stained by the Loeffler method	Laboratory work report	Test, computer test, questioning
1.4.	Genetics of microorganisms	–	3	–	1, 4, 5,7	Accounting for the results of the polymerase chain reaction (detection of amplification products, interpretation of results)	Laboratory work report	Test, computer test, questioning
1.3.	Physiology and biochemical activity of bacteria. Basic principles and methods of	–	3	–	1, 4, 5,7	Determination of the colonies morphotype on a solid nutrient	Laboratory work report	Test, computer test, questioning

	culturing bacteria					medium in Petri dish. Inoculation of isolated colony sample on slanted meat-peptone agar for a pure culture accumulation		
		–	3	–	1, 4, 5, 7	Oil immersion microscopy of a fixed smear	Laboratory work report	Test, computer test, questioning
1.5.	Ecology of microorganisms. Fundamentals of the doctrine of infection.	–	3	–	1, 4, 5, 7	Compliance with asepsis rules when working with microorganisms of the 1 st biosafety level	Laboratory work report	Test, computer test, questioning
1.6.	Microbiological bases of antimicrobial chemotherapy. Antimicrobial measures	–	3	–	1, 4, 5, 7	Determination of bacterial culture susceptibility/resistance to antibiotics using the disk diffusion method (algorithm for conducting, recording, interpretation of results)	Laboratory work report	Test, computer test, questioning
1.7.	Sanitary and bacteriological research methods. Microbiological study of medicinal raw materials and finished dosage forms	–	3	–	1, 4, 5, 6	Compliance with asepsis rules when working with microorganisms of the 1 st biosafety level	Laboratory work report	Test, computer test, questioning
		–	3	–	1, 4, 5, 6	Determination of the colonies morphotype on a solid nutrient medium in Petri dish	Laboratory work report	Test, computer test, questioning
1.5.	Biological research method. Concluding class on the section: «General and sanitary microbiology»	–	3	–	1, 4, 5, 6	Preparation of a fixed smear from agar culture of bacteria. Preparation of a fixed smear from a broth culture of bacteria. Staining a fixed smear using the Gram method. Oil immersion microscopy of a fixed smear. Detection and determination of the morphology of staphylococci in smears stained by the Gram method. Detection and determination of the morphology of streptococci in smears stained by the Gram method. Detection and determination of the	Laboratory work report	Computer test, colloquium*

						morphology of enterobacteria in smears stained by the Gram method. Detection and determination of the morphology of bacilli in smears stained by the Gram method. Detection and determination of the morphology of Klebsiella in smears stained by the negative staining. Determination of bacterial culture susceptibility/resistance to antibiotics using the disk diffusion method (algorithm for conducting, recording, interpretation of results)		
2.1.	The immune system. Immunity. Types of immunity. Immunocompetent cells and molecules	–	3	–	1, 4, 5,7	Detection and determination of <i>Neisseria gonorrhoeae</i> morphology in a smear of pus, stained by the Gram method	Laboratory work report	Test, computer test, questioning
2.2.	Antigens. Antibodies	–	3	–	1, 4, 5,7	Registration of the radial immunodiffusion reaction according by Mancini to determine the concentration of secretory immunoglobulin G	Laboratory work report	Test, computer test, questioning
2.3.	Mechanisms of immune response development.	–	3	–	1, 4, 5,7	Counting the number of blasts in RBTL	Laboratory work report	Test, computer test, questioning
2.4.	Immunodiagnosics. Serological and cellular reactions	–	3	–	1, 4, 5,7	Performance and evaluation of the slide agglutination test to identify enterobacteria. Registration of the indirect (passive) hemagglutination. Registration of the tube agglutination test to determine the antibody titer. Recording the results of the enzyme immunoassay (filling out the research protocol, assessing the reliability of	Laboratory work report	Test, computer test, questioning

						the experiment and interpreting the results)		
2.5.	Immunopathology. Evaluation of immune status. Immunoprophylaxis and immunotherapy of infectious diseases	–	3	–	1, 4, 5,7	Oil immersion microscopy of a fixed smear	Laboratory work report	Test, computer test, questioning
		–	6	–	1, 4, 5,7	Registration of the indirect (passive) hemagglutination	Laboratory work report	Test, computer test, questioning
		–		–				
2.5.	The concept of immunocorrection. Concluding class on the section: «Theoretical and applied medical immunology»	–	3	–	1, 4, 5,7	Registration of the indirect (passive) hemagglutination. Performance and evaluation of the slide agglutination test	Laboratory work report	Computer test, colloquium* Credit

5 семестр

	Lectures	6	-	–	-			
3.1.	Methods of microbiological diagnostics of purulent infections caused by staphylococci, streptococci and pseudomonas	1,5	–	–	2, 4, 5,7			
4.1.	General virology.	1,5	–	–	2, 4, 5			
4.2.	Pathogens of respiratory viral infections: orthomyxoviruses, paramyxoviruses, coronaviruses, adenoviruses.	1,5	–	-	2, 4, 5			
4.3.	Herpesviruses.	1,5	–	–	2, 4, 5			Review, computer test
	Laboratory classes	-	34	-	-			
3.1.	Methods of microbiological diagnostics of purulent infections caused by staphylococci, streptococci and pseudomonas	–	2	–	2, 4, 5, 7	Detection and determination of the morphology of staphylococci in smears stained by the Gram method. Detection and determination of the morphology of streptococci in smears stained by the Gram method	Laboratory work report	Test, computer test, questioning
3.2.	Methods of microbiological diagnostics of purulent-septic infections caused by proteus, bacteroides, <i>Clostridium tetani</i> , Clostridias of anaerobic gas infections	–	2	–	2, 4, 5, 7	Oil immersion microscopy of a fixed smear	Laboratory work report	Test, computer test, questioning
3.3.	Methods of microbiological diagnosis of meningococcal infections, whooping cough, diphtheria	–	2	–	2, 4, 5, 7	Preparation of a fixed smear from agar culture of bacteria. Staining a fixed smear with an	Laboratory work report	Test, computer test, questioning

						aqueous solution of methylene blue. Detection and determination of corynebacteria morphology in smears, stained by the Loeffler method		
3.4.	Methods of microbiological diagnostics of diseases caused by pathogenic mycobacteria, hemoglobinophilic (hemophilic) bacteria, Klebsiella, Nocardia, Actinomycetes	–	2	–	2, 4, 5, 7	Determination of the colonies morphotype on a solid nutrient medium in Petri dish. Detection and determination of the morphology of Klebsiella in smears stained by the BurriGins method. Microscopic examination of sputum smears stained by the Ziehl-Neelsen method to detect mycobacteria	Laboratory work report	Test, computer test, questioning
3.5.	Methods of microbiological diagnosis of acute intestinal infections caused by enterobacteria	–	2	–	2, 4, 5, 7	Performance and evaluation of the slide agglutination test to identify enterobacteria. Detection and determination of the morphology of enterobacteria in smears stained by the Gram method Accounting for the biochemical activity of bacteria on a triple sugar iron medium to identify enterobacteria	Laboratory work report	Test, computer test, questioning
3.6.	Methods of microbiological diagnostics of bacterial intestinal infections caused by <i>Vibrio cholerae</i> , <i>Clostridium botulinum</i> , Campylobacter, Helicobacter, Listeria	–	2	–	2, 4, 5, 7	Oil immersion microscopy of a fixed smear. Detection and determination of the morphology of vibrios in smears stained by the Gram method	Laboratory work report	Test, computer test, questioning
3.7.	Methods of microbiological diagnosis of sexually transmitted diseases	–	2	–	2, 4, 5	Oil immersion microscopy of a fixed smear	Laboratory work report	Test, computer test, questioning
3.8.	Methods of microbiological diagnosis of bacterial zoonotic infections	–	2	–	2, 4, 5, 7	Detection and determination of the morphology of bacilli in smears stained by the Gram method	Laboratory work report	Test, computer test, questioning

						Detection and determination of the morphology of brucella in smears stained by the Gram method		
3.9.	Methods of microbiological diagnosis of rickettsiosis	–	2	–	2, 4, 5, 7	Oil immersion microscopy of a fixed smear	Laboratory work report	Test, computer test, questioning
3.10.	Fundamentals of medical mycology and protozoology. Concluding class on the section: «Special medical Microbiology»	–	2	–	2, 4, 5, 7	Detection and determination of the morphology of Candida in smears stained by the Gram method Detection and determination of the morphology of staphylococci in smears stained by the Gram method. Detection and determination of the morphology of streptococci in smears stained by the Gram method. Detection and determination of the morphology of enterobacteria in smears stained by the Gram method. Detection and determination of the morphology of bacilli in smears stained by the Gram method. Detection and determination of the morphology of Klebsiella in smears stained by the negative staining. Detection and determination of <i>Neisseria gonorrhoeae</i> morphology in a smear of pus, stained by the Gram method Microscopic examination of sputum smears stained by the Ziehl-Neelsen method to detect mycobacteria. Detection and determination of corynebacteria morphology in smears, stained by the Loeffler method	Laboratory work report	Computer test, colloquium*

4.1.	Methods of virological research. Bacteriophages	–	2	–	2, 4, 5	Registration of the hemagglutination inhibition test for seroidentification of influenza viruses and serodiagnosis of viral infection	Laboratory work report	Test, computer test, questioning
4.2.	Pathogens of respiratory viral infections: orthomyxoviruses, paramyxoviruses, coronaviruses, adenoviruses. Rubiviruses	–	2	–	2, 4, 5, 7	Registration of the hemagglutination inhibition test for seroidentification of influenza viruses and serodiagnosis of viral infection	Laboratory work report	Test, computer test, questioning
4.4.	Ecological group of arboviruses and roboviruses	–	2	–	2, 4, 5	Oil immersion microscopy of a fixed smear	Laboratory work report	Test, computer test, questioning
4.3.	Methods of virological diagnosis of diseases caused by herpesviruses, papillomaviruses, parvoviruses	–	2	–	2, 4, 5, 7	Oil immersion microscopy of a fixed smear	Laboratory work report	Test, computer test, questioning
4.5.	Picornaviruses, reoviruses, hepatitis viruses A, E, B, C	–	2	–	2, 4, 5	Recording the results of the enzyme immunoassay (filling out the research protocol, assessing the reliability of the test and interpreting the results)	Laboratory work report	Test, computer test, questioning
4.6.	Retroviruses, rhabdoviruses, poxviruses, poliomyxoviruses. Oncogenic viruses. Etiology of slow infections	–	2	–	2, 4, 5, 7	Detection of rabies virus inclusions in smears stained according to Muromtsev	Laboratory work report	Test, computer test, questioning
4.6.	Prions and prion diseases. Concluding class on the section: «General and private medical virology»	–	2	–	2, 4, 5, 7		Laboratory work report	Computer test, colloquium* Exam
Total hours		15	88	3				

*This is a mandatory form of current certification

INFORMATION AND INSTRUCTIONAL UNIT

LITERATURE

Basic (relevant):

1. Generalov, I. I. Medical microbiology, virology and immunology : textbook for international students of institutions of higher education in the fields of «General Medicine», «Dentistry», «Pediatry». In 2 parts. P. 1. / I. I. Generalov. – 2nd ed. – Vitebsk : VSMU, 2020. – 284 p.

2. Generalov, I. I. Medical microbiology, virology and immunology : textbook for international students of institutions of higher education in the fields of «General Medicine», «Dentistry», «Pediatry». In 2 parts. P. 2. / I. I. Generalov. – 2nd ed. – Vitebsk : VSMU, 2020. – 402 p.

Additional:

3. Structure of bacterial cells. Microscopic examination of bacteria : educational and methodical manual / T. A. Kanashkova, E. Y. Kirilchik, I. A. Gavrilova [et al.]. – Minsk : BSMU, 2023. – 23 p.

4. Ostrovtsova, S. A. General microbiology : training appliance for students of foreign department / S. A. Ostrovtsova, A. U. Gmakin – 3d ed. – Grodno : GrSMU, 2016. – 76 p.

5. Murray, P. R. Medical microbiology / P. R. Murray, K. S. Rosenthal, M. A. Pfaller. – Elsevier, 2015. – 789 p.

6. Sandle, T. Pharmaceutical Microbiology / T. Sandle. – Elsevier, 2016. – 298 p.

Electronic courseware for the educational discipline «Microbiology, Virology, Immunology»

7. <https://etest.bsmu.by/course/view.php?id=190>

METHODOLOGICAL RECOMMENDATIONS FOR THE ORGANIZATION AND PERFORMANCE OF STUDENT INDEPENDENT WORK IN THE ACADEMIC DISCIPLINE

The time allotted for independent work can be used by students for:
preparation for lectures and laboratory classes;
preparation for the colloquia and exam in the academic discipline;
study of topics (questions) submitted for independent study.

METHODOLOGICAL RECOMMENDATIONS FOR THE ORGANIZATION AND PERFORMANCE OF SUPERVISED STUDENT INDEPENDENT WORK IN THE ACADEMIC DISCIPLINE

APPROXIMATE LIST OF TASKS FOR SUPERVISED STUDENT INDEPENDENT WORK:
summary of primary sources, monographs and articles;
computer tests.

FORMS OF CONTROL OF SUPERVISED STUDENT INDEPENDENT WORK:
review;
computer test.

LIST OF AVAILABLE DIAGNOSTIC TOOLS

The following forms are used for competence assessment:
 questioning;
 test;
 computer test;
 colloquium;
 laboratory work report.

LIST OF AVAILABLE TEACHING METHODS

Traditional method;
 Active (interactive) methods:
 Problem-Based Learning (PBL);
 Team-Based Learning (TBL);
 Research-Based Learning (RBL).

LIST OF PRACTICAL SKILLS

Name of practical skills	Form of practical skills control
1. Compliance with asepsis rules when working with microorganisms of the 1st biosafety level	Laboratory work report
2. Inoculation of isolated colony sample on slanted meat-peptone agar to accumulate a pure bacterial culture	Laboratory work report
3. Determination of the colonies morphotype on a solid nutrient medium in Petri dish	Laboratory work report
4. Registration of the radial immunodiffusion reaction according by Mancini to determine the concentration of secretory immunoglobulin G	Laboratory work report
5. Recording the results of the enzyme immunoassay (filling out the research protocol, assessing the reliability of the experiment and interpreting the results)	Laboratory work report
6. Accounting for the results of the polymerase chain reaction (detection of amplification products, interpretation of the results)	Laboratory work report
7. Registration of the tube agglutination test to determine the antibody titer	Laboratory work report
8. Preparation of a fixed smear from agar culture of bacteria	Laboratory work report
9. Preparation of a fixed smear from a broth culture of bacteria	Laboratory work report
10. Staining a fixed smear with an aqueous solution of fuchsin	Laboratory work report
11. Staining a fixed smear with an aqueous solution of methylene blue	Laboratory work report
12. Staining a fixed smear using the Gram method	Laboratory work report

Name of practical skills	Form of practical skills control
13. Oil immersion microscopy of a fixed smear	Laboratory work report
14. Detection and determination of the morphology of staphylococci in smears stained by the Gram method	Laboratory work report
15. Detection and determination of the morphology of streptococci in smears stained by the Gram method	Laboratory work report
16. Detection and determination of the morphology of enterobacteria in smears stained by the Gram method	Laboratory work report
17. Detection and determination of the morphology of bacilli in smears stained by the Gram method	Laboratory work report
18. Detection and determination of the morphology of Klebsiella in smears stained by the negative staining	Laboratory work report
19. Detection and determination of <i>Neisseria gonorrhoeae</i> morphology in a smear of pus, stained by the Gram method	Laboratory work report
20. Detection and determination of the morphology of vibrios in smears stained by the Gram method	Laboratory work report
21. Detection and determination of the morphology of brucella in smears stained by the Gram method	Laboratory work report
22. Microscopic examination of sputum smears stained by the Ziehl-Neelsen method to detect mycobacteria	Laboratory work report
23. Detection and determination of the morphology of Candida in smears stained by the Gram method	Laboratory work report
24. Detection and determination of corynebacteria morphology in smears, stained by the Loeffler method	Laboratory work report
25. Accounting for the biochemical activity of bacteria on a triple sugar iron medium to identify enterobacteria	Laboratory work report
26. Determination of bacterial culture susceptibility/resistance to antibiotics using the disk diffusion method (algorithm for conducting, recording, interpretation of results)	Laboratory work report
27. Performance and evaluation of the slide agglutination test	Laboratory work report
28. Registration of the indirect (passive) hemagglutination	Laboratory work report
29. Registration of the hemagglutination inhibition test for seroidentification of influenza viruses and serodiagnosis of viral infection	Laboratory work report
30. Counting the number of blasts in RBTL	Laboratory work report
31. Detection of rabies virus inclusions in smears stained according to Muromtsev	Laboratory work report

**PROTOCOL OF THE CURRICULUM APPROVAL
BY OTHER DEPARTMENTS**

Title of the discipline requiring approval	Department	Amendments to the curriculum in the academic discipline	Decision of the department, which designed the curriculum (date, protocol #)
Pharmaceutical Chemistry	Pharmaceutical Chemistry with advanced training course and retraining	No amendments	Protocol # 4 of 09.10.2024
Pharmacology	Pharmacology	No amendments	Protocol # 4 of 09.10.2024

COMPILERS/AUTHORS:

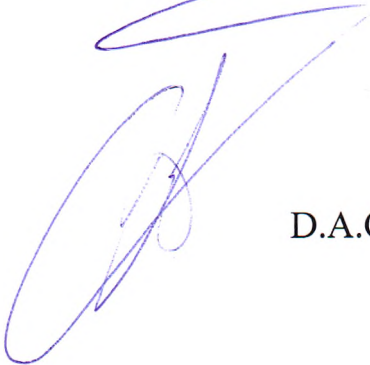
Associate Professor of the Department of Microbiology, Virology, Immunology of the Educational Institution «Belarusian State Medical University», PhD, Associate Professor

 I.A. Gavrilova

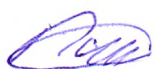
Associate Professor of the Department of Microbiology, Virology, Immunology of the Educational Institution «Belarusian State Medical University», PhD, Associate Professor

 T.G. Adamovich

Associate Professor of the Department of Microbiology, Virology, Immunology of the Educational Institution «Belarusian State Medical University», PhD, Associate Professor

 D.A. Chamashei

Associate Professor of the Department of Microbiology, Virology, Immunology of the Educational Institution «Belarusian State Medical University», PhD, Associate Professor

 K.I. Pavlov

Curriculum content, composition and the accompanying documents comply with the established requirements.

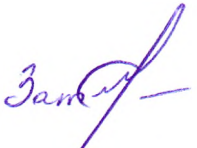
Head of the Office of Educational Activities of the educational institution «Belarusian State Medical University»

24.11.2024

 I.L. Kotovich

Methodologist of the Educational and Methodological Department of the Office of Educational Activities of the educational institution «Belarusian State Medical University»

24.11.2024

 S.V. Zaturanova