

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

**Контрольный  
экземпляр**



**APPROVED**

by First Vice-Rector, Professor

I.N.Moroz

04.07.2022

Reg. # UD-1.721/2223/edu.

**MICROBIOLOGY, VIROLOGY, IMMUNOLOGY**

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

**1-79 01 07 «Dentistry»**

Curriculum is based on the educational program «Microbiology, Virology, Immunology» in the specialty 1-79 01 07 «Dentistry», approved 01.07.2022, registration # УД-Л.721/2223/уч; on the educational plan in the specialty 1-79 01 07 «Dentistry», approved 18.05.2022, registration N L 79-1-7/2223/mf.

### **COMPILERS:**

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### **RECOMMENDED FOR APPROVAL:**

by the Department of Microbiology, Virology, Immunology of the educational institution «Belarusian State Medical University»  
(protocol N 13 of 12.05.2022);

by the Scientific and Methodological Council of the educational institution «Belarusian State Medical University»  
(protocol N 6 of 29.06.2022)

## EXPLANATORY NOTE

«Microbiology, Virology, Immunology» is a discipline of the Medical-preventive Module that contains systematized scientific knowledge about microorganisms, etiology, mechanisms of pathogenesis, specific prevention, causal treatment, methods of laboratory diagnostics of bacterial, viral, fungal, protozoan diseases; of the structure and mechanisms of functioning of the human immune system, methods and means of diagnostics, treatment and prevention of diseases, caused by violations of the immune system and/or immunologic mechanisms in pathogenesis; of the composition and role of the oral microbiota, periodontopathogenic microorganisms and immune mechanisms in pathogenesis of diseases of the teeth, periodontum, and maxillofacial area tissues.

The aim of the discipline «Microbiology, Virology, Immunology» is the formation of basic professional competence to gain latest scientific data on the etiology, pathogenetic mechanisms, laboratory diagnostic methods, the basics of epidemiology, specific prevention and etiotropic therapy of infectious diseases; of the structure, development and methods of evaluation and correction of the human immune system, necessary for the professional training and subsequent practical activity of the stomatologist.

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

- microorganisms place and role in the biosphere;
- systematic and nomenclature of microorganisms;
- susceptibility and resistance of microorganisms to environmental factors, means and methods of sterilization, disinfection, antiseptics, asepsis necessary for stomatologist;
- morphology, physiology, genetics, ecology and evolution of microorganisms;
- general regularities of arising, transmission and development of bacterial, viral, fungal and protozoan infection and invasion;
- pathogenicity factors of microorganisms, molecular pathogenesis mechanisms of human infectious diseases;
- opportunistic microorganisms and opportunistic infections;
- main groups of antimicrobial chemotherapeutic preparations and their action on microorganisms;
- the mechanisms of resistance to antimicrobial preparations development and methods for its evaluation;
- the structure and function of the human immune system;
- humoral and cellular immune response, antiinfection immunity regularities;
- immunopathogenesis of allergic, infection-allergic and autoimmune diseases, immunodeficiencies and immunocorrection principles;
- the composition and role of the oral microbiota in etiology and pathogenesis of diseases of the teeth, periodontal tissue, soft tissue of the mouth and maxillofacial region;
- skills and abilities necessary for:
  - safe work with biological materials and cultured bacteria;
  - sampling, labeling and ordering laboratory research of the sample;

performance of microbiological, immunological and molecular-biological methods for diagnosis of bacterial, viral, fungal and protozoan diseases;  
interpretation of microbiological and immunological research results.

The knowledge, skills, and abilities acquired during the study of the academic discipline «Microbiology, Virology, Immunology» are necessary for successful mastering of the following academic disciplines: «Epidemiology», «Infectious Diseases», «Dermatovenerology», modules «Therapeutic Dentistry», «Pediatric Dentistry» and «Periodontology».

Studying the educational discipline «Microbiology, Virology, Immunology» should ensure the formation of students' basic professional competence:

BPC. Use knowledge about the main characteristics of microorganisms that cause human infectious diseases, the laws of the immune system functioning, the mechanisms of disease development during microbiological diagnostics, use knowledge about the basics of oral infections etiopathogenesis during prevention, rational antiseptics and chemotherapy in dentistry.

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

**know:**

principles of taxonomy and nomenclature of microorganisms;  
morphology, genetics, antigenic structure, physiology and ecology of bacteria, viruses, fungi, protozoa, basics of biotechnology and genetic engineering;  
environmental factors influence on microorganisms, risk groups of microorganisms, microbiological bases of antimicrobial measures;  
main groups of antimicrobial drugs, the mechanisms of their action on microorganisms, the mechanisms of development and methods for controlling the resistance of microorganisms;  
normal microflora of the human body, the development and age-related features of the normal human microflora, the causes of development and the principles of correction of dysmicrobiosis (dysbacteriosis);  
factors of microorganisms pathogenicity, their genetic control;  
etiology, mechanisms of molecular pathogenesis, microbiological, immunological and molecular-biological diagnostic methods, the basics of etiotropic therapy and immunoprophylaxis of infections and protozoal invasions, manifestations in the oral cavity;  
human immune system, the mechanisms of natural and acquired immunity, the immunopathogenesis of allergic, infectious-allergic and autoimmune diseases, immunodeficiencies, the basics of antitumor immunity;  
immune status, age-related characteristics, methods of its assessment;  
rules for the collection, labeling and transportation of biological material for bacteriological, virological, immunological and molecular-biological research;  
microflora and immunity factors of the oral cavity, manifestations of allergic, autoimmune and immunodeficiency conditions in the oral cavity;  
etiology, pathogenesis and immunology of infectious and inflammatory diseases of the teeth, oral mucosa, tissues of the maxillofacial region, stomatogenic opportunistic infections,

**be able to:**

wright up directions for microbiological, immunological and molecular-biological research;

determine the sensitivity of bacteria to antibiotics using the disk diffusion method;

perform serological tests (agglutination, passive hemagglutination, latex agglutination, fluorescent antibodies test, enzyme immunoassay, immunochromatographic analysis);

evaluate and analyze immunograms and indicators of oral immunity;

evaluate the results of microbiological, immunological and molecular biological research;

**master:**

skills of safe work with biological material and live cultures of microorganisms;

modern methods of disinfection of waste biological material and objects of the external environment contaminated with microorganisms;

technique of smears preparing and staining them by simple methods and by Gram method;

technique of light immersion microscopy with a result description;

technique of nutrient media inoculation to isolate a pure culture of bacteria;

skills of biological material sampling from the oral cavity for microbiological, immunological and molecular-biological studies.

**Total number** of hours for the study of the discipline is 176 academic hours. Classroom hours according to the types of studies: lectures - 22 hours (including 7 hours of supervised student independent work), practical classes - 87 hours, student independent work (self-study) - 67 hours.

Intermediate assessment is carried out according to the syllabus of the specialty in the form of an examination (4 semester).

Form of higher education -- full-time.

### ALLOCATION OF ACADEMIC TIME ACCORDING TO SEMESTERS OF STUDY

Code, name of the specialty	semester	Number of academic hours						Form of intermediate assessment
		total	in-class	including			out-of-class self-studies	
				lectures (including supervised independent work)	supervised student independent work	practical classes		
1-79 01 07 «Dentistry»	3	108	65	14	4,5	51	43	—
	4	68	44	8	2,5	36	24	examination
		<b>176</b>	<b>109</b>	<b>22</b>	<b>7</b>	<b>87</b>	<b>67</b>	

## THEMATIC PLAN

Section (topic) name	Number of class hours	
	lectures	practical
<b>1. General microbiology</b>	<b>4</b>	<b>24</b>
1.1. Microbiology as a science. Microbial world	1	-
1.2. Morphology of microorganisms	-	6
1.3. Genetics of microorganisms	-	3
1.4. Physiology of microorganisms	1	6
1.5. Ecology of microorganisms. Basics of infectology	1	3
1.6. Microbiological bases of chemotherapy and antiseptics of bacterial infections	1	6
<b>2. Theoretical and applied medical immunology</b>	<b>6</b>	<b>18</b>
2.1. Immunology as a science. Immune system	1	-
2.2. Innate immunity	1	3
2.3. Immune response	1	3
2.4. Anti-infection immunity	1	-
2.5. Immunodiagnostics of infectious diseases	-	3
2.6. Immunoprophylaxis and immunotherapy of infectious diseases	1	3
2.7. Immunopathology and clinical immunology	1	6
<b>3. Stomatological microbiology</b>	<b>12</b>	<b>45</b>
3.1. Special medical microbiology	-	19
3.2. General and special medical virology	4	12
3.3. Microbiology and immunology of the oral cavity	4	4
3.4. Clinical stomatological microbiology	4	10
<b>Total hours</b>	<b>22</b>	<b>87</b>

## CONTENT OF THE EDUCATIONAL MATERIAL

### 1. GENERAL MICROBIOLOGY

#### 1.1. Microbiology as a science. Microbial world

*Subject, tasks, methods of microbiology and its connection to other biomedical sciences.* Microbiology as a complex science about morphology, physiology, ecology, genetics, and evolution of microorganisms. Classification of the microbiological sciences by object: of study (general microbiology, bacteriology, virology, mycology, protozoology); by applied goals (medical, sanitary, veterinary, technical, soil, sea, space).

Medical microbiology as a science about germs essential for the human health, etiology, pathogenesis, diagnostics, causal treatment and specific prevention of caused diseases. Importance of microbiology in the progress of the natural sciences and the human society and the development and implementation of measures to improve the health of the humanity. The tasks of medical microbiology. Microbiological methods of research: microscopic, cultural, immunobiological (serological, cellular, allergic, etc.), molecular-biological, experimental. Connections of medical microbiology with biological, biomedical, clinical, hygienic and other sciences.

Place of Microbiology in the health protection system; structure and the principles of microbiology and immunology services organization. Stomatological microbiology as a section of medical microbiology. Role of Medical Microbiology in the professional activities of a stomatologist.

*History of Microbiology.* Early ideas about invisible to the naked eye organisms - Contague (I century BC - I century AC - Roman encyclopedists; XVI century - D.Frakastoro; XVII century - A.Kirher).

The invention of the microscope and the discovery of the world of microbes by A.Levenhook. The emergence of scientific microbiology in the second half of the XIX century. L. Pasteur - the founder of the technical and medical microbiology, the creator of the theory of immunization against infectious diseases. R.Koch's role in the development of microbiological methods, discovery of tuberculosis and cholera pathogens. Establishment of the doctrine of the cellular (I.Mechnikov) and humoral (P.Erlih) mechanisms of immunity to infectious diseases. Works of D.Ivanovski and importance of viruses discovery for biology and medicine. Development of principles of antiseptics (I.Zemmelveys, D.Lister) and chemotherapy (D.L.Romanovsky, P.Erlih) for bacterial infections. The main directions of microbiology development in the XX and XXI centuries. Development of microbiology in the Republic of Belarus.

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

Principles and approaches to the taxonomy and nomenclature of microorganisms. Genosystematics. DNA and 16s rRNA based systematics. Joined approach to taxonomy. Taxonomic categories: domain, type (division), class, order, family, genus, species. Subspecies categories: variant (var), strain, culture, clone. Specie as the main taxonomic category. Criteria for species in microbes.

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

International principles and rules of nomenclature of microorganisms.

The evolution of microorganisms. Origin and development of microorganisms. Factors of evolution. Morphological, biochemical and ecological evolution of microorganisms during the formation of the biosphere. The subsequent evolution of microorganisms. Sources and time of arising pathogenic microorganisms for humans. The main directions and driving factors of the microorganisms evolution in the modern period.

## 1.2. Morphology of microorganisms

**Morphology of bacteria.** Differences between prokaryotes and eukaryotes. Basic shapes and sizes of true bacteria. The structure of the bacterial cell. The cell wall of Gram-positive and Gram-negative bacteria. Bacteria with defective cell wall (protoplasts, spheroplasts, L-forms).

**Morphology of actinomycetes, spirochetes, rickettsia, chlamydia, mycoplasma,** forms of existence, ultrastructure, differences from the true bacteria, methods of study.

### **Morphology of eukaryotic microorganisms (fungi and protozoa)**

**Methods of study of bacterial morphology.** Microscopic research method, steps, evaluation. Types of preparations for microscopy. Techniques for fixed smear preparation. Methods of light microscopy: darkfield, phase contrast, fluorescent. Tinctorial properties of microbes. Simple and differential methods of staining. Gram staining technique. Methods for native microorganisms study.

## 1.3. Genetics of microorganisms

**Heredity.** Microbiology role in the development of molecular genetics. Organization of the genetic apparatus in bacteria (nucleoid, plasmids, transposons, Is-elements, integrons). Principles of operation of the bacterial genome. Operon organization. Genotype and phenotype. CRISPR/Cas9 system for genome editing.

Genomics and proteomics of microorganisms.

**Variability** of microbes. Modifications in bacteria, importance, gene expression regulation.

Genotypic variability: mutational and recombination. Mutations, recombinations, dissociation, transposition.

The practical importance microbial variability.

**Methods for the genetic analysis** Practical importance of bacterial genetics. Molecular hybridization, polymerase chain reaction (PCR), blotting, sequencing of nucleic acids. The value of genetic methods in the laboratory diagnostics of infectious diseases.

The concept of genetic engineering and its application in microbiology and biotechnology. Production and use of genetically engineered vaccines and cytokines.

## 1.4. Physiology of microorganisms

**Metabolism and energy exchange in microorganisms.** Characteristics of metabolism and energy exchange in microorganisms. Enzymes of microbes, classification. Types of secretory systems in bacteria.



Holozoic and holophytic nutrition.

*Nutrition in bacteria.* Nutrients - carbon and nitrogen sources. Autotrophs and hemoorganotrophs. Extracellular and parietal digestion of polymers. Mechanisms of nutrient transport through the membrane.

*Respiration in bacteria.* The energy requirements of bacteria. Energy metabolism in autotrophs (photosynthesis, chemosynthesis). Energy metabolism in hemoorganotrophs. Respiratory apparatus in bacteria. Aerobic and anaerobic types of biological oxidation in bacteria. Aerobic, anaerobic, facultative anaerobic, and microaerophilic bacteria. Capnophiles. Features of metabolism and energy exchange in microbes. Enzymes of microbes, classification. Biotechnology.

*The growth and reproduction of microorganisms.* Process of reproduction. Binary (simple) division. Schizogony. Budding. Sporulation. Conditions of growth and reproduction. Reproduction of rickettsia, chlamydia, mycoplasmas. Resting forms of microbes, their properties and purpose.

*Bacteriological (cultural) method of investigation.* Principles and methods of bacteria cultivation.

Nutritional needs of the microbes. Culture media for bacteria cultivation. Requirements for the medium. Classification of culture media. Conditions and techniques for cultivation of bacteria. Growth of bacteria on solid and liquid nutritive media. Dynamics (phases) of bacterial population development in periodic culture.

Stages and evaluation of bacteriological (cultural) research. Requirements for sampling and transportation of the material for investigation. Techniques for nutrient medium inoculation. Methods for the isolation and identification of pure cultures of aerobic and anaerobic bacteria. Automatic microbiological analyzers. MALDI-TOFF MS method for bacteria identification. Cultivation of Rickettsia, Chlamydia and Mycoplasma.

### **1.5. Ecology of microorganisms. Basics of infectology**

Environmental microbiology development (S.N. Vinogradski, 1945). Microbes' role in the formation, existence and development of the biosphere. The concept of microbial dominant. Microbiological aspects of the environment protection. Ecological environments of microorganisms. Microflora of anthropogenic environments (objects, food, medicines, medical devices, etc.). Criteria for microbiological safety of the human environment. Sanitary-indicative microorganisms.

The microflora of the human body (autochthonous and allochthonous, parietal and luminal). Development of normal microflora, its role (protective, metabolic, immune, and others.). Biofilm. Quorum sensing. Human microbiome, metagenomics approach for its study.

Ecological relationships of microbes (symbiosis, commensalism, neutralism, competition, parasitism).

The influence of environmental factors on microorganisms. Influence of physical and chemical factors.

*Antimicrobial measures.* Sterilization, disinfection, asepsis, definitions. Sanitary and anti-epidemic regime in healthcare organizations. Sterilization and disinfection in dentistry and microbiology: goals, methods, objects, quality control.

***Infections and invasions:*** definition, general characteristics. Causes and conditions for infection. Differences between infectious and non-infectious diseases.

The role of microorganisms in the infectious process. The infectious dose. Routs of infection. Entrance gate. Pathogenicity. Virulence. Genetic control of pathogenicity and virulence. Pathogenicity islands. Pathogenicity factors. Adhesins. Microbial colonization of tissues. Ways for penetrating skin, mucosa, the internal environment of the body, the cells. Factors for the immune system suppression. Exotoxins, endotoxins, enzymes-toxins and their properties. Allergens. Intracellular parasites. Superantigens, heat shock proteins.

The role of the macroorganism in the development of infectious diseases. Susceptibility. Hereditary factors. The role of anatomical and physiological condition of the body and lifestyle. The role of living conditions in the development of infectious diseases. Natural and social factors.

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

Classification of infectious processes by severity, the nature of the pathogen, the source of infection (anthroponoses, zoonoses, sapronoses), the mechanism of transmission and routs of infection (aerosol, fecal-oral, transmissible, contact, transplacental, parenteral disease, exogenous, endogenous, self-infection ), by the prevalence (pandemic, epidemic, endemic, sporadic infections). Classification by microbial focus localization (local, systemic and generalized infections), by the terms of development (acute, chronic primary, secondary chronic, slow infection) and multiplicity of infection (primary, secondary, mixed infection, superinfection, reinfection, relapse).

***Biological (experimental) research method:*** steps, evaluation. Laboratory animals. Use of a method to isolate and identify the causative agent, assessment of microbial virulence, toxicity, toxigenicity, immunogenicity.

## **1.6. Microbiological basis of antiseptics and chemotherapy of bacterial infections**

***Chemotherapy and chemoprophylaxis,*** definitions. Place of chemoprophylaxis and chemotherapy in the treatment and infections control measures. History of chemotherapy (D.Romanovski, 1882; P.Erlih, 1906). Implementation in practice of the infectious diseases treatment of sulfonamides (G.Domagk, 1936), antibiotics (A.Fleming, 1926; H.Flori, E.Cheyn, 1940), nitrofurans (M.Dodd, U.Stillman, 1944). Modern trends in the development of chemotherapy and chemoprophylaxis.

***Antimicrobial medicines,*** properties, requirements, etio- and organotropism, chemotherapeutic index. The concept of selectivity and the «target» of action of antimicrobial drugs, the effect and the range of actions, mechanisms of action on microorganisms.

Main groups of antimicrobial chemotherapeutic drugs: sulfonamides, azoles, quinolones, nitrofurans, fluoroquinolones, oxazolidinones and others.

***Antibiotics,*** definition. Producers of antibiotics. Natural, synthetic and semi-synthetic antibiotics. The main groups of antibiotics: beta-lactam (penicillins, cephalosporins, carbapenems, monobactams), aminoglycosides, tetracyclines,

macrolides, and azalides, lincosamides, ansamycins (rifamycins), chloramphenicol, polypeptides, glycopeptides, lipopeptides, streptogramins, polyenes.

Bacterial resistance to antimicrobial medicines. Natural resistance. Acquired resistance, genetic and biochemical mechanisms. The role of plasmids and transposons in the emergence and spread of multidrug-resistant strains. Extreme (extensive) and pan-drug resistance. The concept of international clones of microorganisms of high epidemic risk.

Methods for assessment and indicators of bacteria sensitivity to antibiotics. The concept of the minimal inhibitory/suppressive and minimal bactericidal concentration. Categories of microorganisms according to the level of resistance (susceptible, moderate resistant, resistant). Performance and evaluation of the disk-diffusion method. Epsilometric method (E-tests). Method of serial dilutions of antibiotics in liquid and solid nutrient media. Interpretation of the sensitivity measurement results using the threshold values of the minimal inhibitory concentrations and diameters of the growth inhibition zones. Devices and test systems for automated determination of antibiotic sensitivity, molecular genetic methods.

*Antiseptics*, definition, types (preventive, therapeutic). Preventive antiseptics types. Antiseptic methods (chemical, biological, physical and mechanical).

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

Principles of chemotherapy, chemoprophylaxis and antisepsis in stomatology.

## **2. THEORETICAL AND APPLIED MEDICAL IMMUNOLOGY**

### **2.1. Immunology as a science. Immune system**

Immunology, definition, history and development (E.Dzhenner, L.Pasteur, I.I.Mechnikov, P.Erlih, K.Landsteiner, F.Bernet, S.Tonegava). The problems of medical immunology, value for practical medicine. The main sections of modern immunology. The role of immunology in biology and medicine development.

*The immune system*. Properties of the immune system. Immunocompetent organs: central and peripheral, structure and function, changes through ontogenesis. Immunocompetent cells: types, morphology, CD markers, identification. Major histocompatibility complex (MHC). The structure of MHC-molecules of I and II classes and their expression on cells and tissues. The biological significance of MHC molecules. Intercellular interaction factors of the immune system (selectins, integrins, molecules of the immunoglobulin superfamily).

Pattern recognition receptors. Toll-like receptors.

Cytokines: classification (interleukins, interferons, growth factors, chemokines), characteristics, structure and functions, receptors. Pro- and anti-inflammatory cytokines. The protective function of the respiratory, digestive, endocrine and other systems of the human body. Cooperative mechanism of the immune system functioning.

### **2.2. Innate immunity**

Definition, innate immunity characteristics. Non-immune mechanisms of the innate immunity: barrier and antimicrobial properties of the skin, mucous membranes, tissue unresponsiveness, the normal microflora. Immune factors: humoral and cellular.

The complement system, structure, activation pathways (classical, alternative, lectin). Activators of the complement system. Biologically active fragments, and their functions. The membrane attacking complex. Bacteriolysis, cytolysis. Interferons. Polymorphonuclear and mononuclear phagocytes (origin, characteristics, functions). Phagocytic reaction (phases, mechanisms, intracellular bactericidal factors). Outcomes of phagocytosis. The persistence of microorganisms in phagocytes. Natural killer cells. Mechanism of target cells killing.  $\gamma\delta$ T lymphocytes.

### **2.3. Immune response**

Immune response: the definition and the factors influencing its development. Types, manifestations, the genetic control of the immune response.

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

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

*Humoral immune response*. B-lymphocyte system, surface markers. B-cell receptor. Mechanisms of B cell activation. APC: role in humoral immune response, follicular dendritic cells. Stages of the humoral immune response development. Mediators of humoral immune response. T cells role in humoral immune response development. Antibodies: structure, biosynthesis, antibodies diversity. Classes, subclasses, isotypes, allotypes and idiotypes of immunoglobulins. Monoclonal antibodies. Biological properties of the antibodies. Fab-fragments of antibodies and their properties. The mechanism of interaction with antigens. Antibodies valence, affinity and avidity. Complete and incomplete antibodies. Fc fragment and its properties. Immune complexes. Biological effects of the interaction between antibodies and antigens: activation of complement, neutralization of toxins and viruses, lysis, agglutination and opsonization of bacteria, fungi and protozoa, inhibition of adhesion, invasion. Antibody-dependent cellular cytotoxicity.

*Cellular immune response*. T-lymphocyte system: development, membrane markers. APC: the role in cellular immune response. Characteristics of subpopulations and their role in the immune response. T cell receptor. T cell activation, the antigen recognition, costimulation. Anergy. Mediators of cellular immune responses: stages, mechanisms. Immunological tolerance, central and peripheral.

### **2.4. Anti-infection immunity**

The concept of natural and artificial, active and passive, general and local, post-infectious and infectious (non-sterile) types of immunity. Immunity against extracellular and intracellular parasites. Mechanisms of immune inactivation of bacteria, fungi, protozoa, viruses and neutralization of toxins and exoenzymes.

### **2.5. Immunodiagnosics of infectious diseases**

Serological research, stages, evaluation of results. Diagnosticum. Diagnostic antisera, methods for preparation. Adsorbed (polyclonal) and monoclonal serum and diagnostic test systems. Methods for the production of monoclonal antibodies.

Quantitative evaluation of serological tests: antisera titer, diagnostic titer increase of antibody titer, affinity. Types of serological tests. Agglutination and passive agglutination tests (latex agglutination test) methods of performance and results evaluation. Immunoprecipitation, main variants, evaluation of results. Lysis reactions.

**The solid-phase immunoassay** (immunofluorescence, enzyme immunoassay and radioimmunoassay, immunoelectron microscopy): the principles, main variants, evaluation of results. Immunoblotting (Western blotting). Immunochromatography based tests.

## **2.6. Immunoprophylaxis and immunotherapy of infectious diseases**

Immunoprophylaxis, definition. Active immunoprophylaxis. Vaccine, requirements. Types of vaccines (inactivated, live, toxoids, chemical, subunit, chemical, subunit, genetically engineered). Factors influencing the efficiency of post-vaccination immunity. The dose, interval, competition of antigens, duration of antigenic stimulation, booster effect. Influence of body condition, age, nutrition on the immunity. Methods for assessment of post-vaccination immunity. Protective antibody titers.

Passive immunoprophylaxis. Immune sera and immunoglobulins, indications for use.

**Immunotherapy**, definition. Medicines for immunotherapy, indications for use. Complications of immunization and immunotherapy.

## **2.7. Immunopathology and clinical immunology**

Allergies definition. Allergens. Domestic, pollen, epidermal, food, chemicals, pharmaceuticals, microbial exoallergens. Pathways allergens into the body. Endoallergens. Stage allergy: sensitization, resolution, de (hypo) sensitization. Role of T-helper type I and II and their cytokines in the development of hypersensitivity. Hypersensitivity of immediate type (ITH). IITH of mediator type (I). Anaphylactic shock, the mechanism of development. Atopy, the mechanism of development, clinical forms. ITH of cytotoxic type (II). ITH of immunocomplex type (III). Delayed Type Hypersensitivity (DTH, IV). Contact allergy. Infection allergy. Drug allergy. Mechanisms of development. Prevention. Anergy. Idiosyncrasy. Methods of diagnostics of allergic diseases. Prevention of allergic diseases in the workplace, at home, in health care.

**Clinical Immunology**, definition, objectives, objects of study.

The immune status of the organism, the characteristics, methods of determination and evaluation. Immunotherapy, indications, preparations, methods. Immunocorrection efficacy monitoring.

**Immunodeficiencies**: hereditary and acquired. The clinical syndromes associated with deficiency of B- and T-lymphocytes systems, phagocytosis, complement system.

**Autoimmune diseases**, pathogenesis, clinical forms.

**Transplant immunity**. The types of grafts. Transplantation antigens. Conditions for the development of the immune response to the graft and its mechanisms. Methods for inhibiting of transplant reaction. Complications in the treatment with immunosuppressants.

### 3. STOMATOLOGICAL MICROBIOLOGY

#### 3.1. Special medical microbiology

***Staphylococci***, classification, general characteristics, pathogenicity factors. Staphylococcal infection. Purulent-inflammatory diseases. Sepsis. Immunity and principles of microbiological diagnostics. Medicines for immunoprophylaxis and immunotherapy of staphylococcal infections, chemotherapeutic agents, antiseptics.

***Streptococci***, general characteristics, classification by biological properties and antigenic structure. Pyogenic streptococci, properties, antigenic structure, serovars, pathogenicity factors, the role in the pathology of the oral cavity. Etiology, pathogenesis, immunity, microbiological diagnostics, prevention, acute and chronic streptococcal infections (septic infections, sore throat, scarlet fever, rheumatic fever, glomerulonephritis, erysipelas, streptoderma). *Streptococcus pneumoniae*, properties, differentiation by capsular antigen, pathogenicity factors. Pneumococcal infection, pathogenesis, immunity, microbiological diagnostics. Medicines for immunization and chemotherapy of pneumococcal infections.

***Neisseria***, general characteristics, classification.

Pathogenic *Neisseria*. Gonococci, properties, pathogenicity factors. Prevalence, pathogenesis, immunity, microbiological diagnostics of gonorrhea. Prophylaxis of gonococcal disease. Oral lesions.

*Meningococcus*, properties, pathogenicity factors. Pathogenesis and clinical forms of meningococcal infections, immunity, microbiological diagnostics. *Medicines for immunization and chemotherapy of meningococcal disease.*

#### ***Aerobic and facultative anaerobic gram-negative rod-shaped bacteria***

***Enterobacteriaceae***, general characteristics, classification, pathogenic and opportunistic species, role in human pathology. Acute intestinal infections: prevalence, etiology, pathogenesis, manifestations in the oral cavity, microbiological diagnostics.

*Escherichia*, properties, serological classification. Opportunistic and obligate pathogenic *Escherichia*, pathogenicity factors. Prevalence, pathogenesis and clinical forms of *Escherichiosis*.

*Shigella*, general characteristics, classification, pathogenicity factors. Prevalence, the pathogenesis of dysentery, immunity.

*Salmonella*, general characteristics, biological and serological classification. Etiology, pathogenesis of typhoid and paratyphoid fever, manifestations in the oral cavity. Phage typing of *Salmonella*. Immunity and carrier state in typhoid fever. Salmonellosis, the properties of pathogens, pathogenesis, immunity, prevention.

Etiology and principles of diagnostics of food poisoning of microbial nature (poisoning and intoxication).

*Klebsiella*, general characteristics, species composition. Scleroma: the pathogen, prevalence, pathogenesis, immunity. Ozaena: the pathogen, prevalence, pathogenesis, immunity. Opportunistic *Klebsiella* (*K. pneumoniae*, *K. oxytoca*) and their role in human pathology.

*Pseudomonas*, characteristics, classification, properties, persistence in the hospital environment. *Pseudomonas aeruginosa*, pathogenicity factors, role in human pathology, sensitivity to antibiotics, antiseptics and environmental factors.

*Campylobacter*, general characteristics, role in human pathology. *Helicobacter*, role in the development of peptic ulcer disease and gastric cancer.

*Bordetella*. The causative agent of whooping cough, properties, antigenic structure, sensitivity to environmental factors, pathogenicity factors, differentiation with the paraptussis agent. Pathogenesis, immunity, principles of microbiological diagnostics of bordetella infections. Immunization.

***Aerobic and facultative anaerobic Gram-positive bacteria and actinomycetes***

*Actinomycetes*, systematic position, general characteristics, prevalence, role in the pathology of the oral cavity. Etiology, pathogenesis, principles of microbiological diagnostics of actinomycosis of the head and neck tissues.

*Mycobacteria*, general characteristics, resistance to acids. The causative agents of tuberculosis, species composition, morphology, nutritional needs, pathogenicity factors, differences from non-tuberculosis mycobacteria. The pathogenesis of tuberculosis, infectious granuloma, immunity, allergy, anergy. Principles of microbiological diagnostics of tuberculosis, immunoprophylaxis. TB chemotherapeutic drugs.

*Corynebacterium*, general characteristics, classification. *Corynebacterium diphtheria*, properties, pathogenicity factors, toxigenicity, biovars, sensitivity to environmental factors. Diphtheria, prevalence, pathogenesis, toxinemia, manifestations in the oral cavity, immunity, microbiological diagnostics, immunoprophylaxis. Medicines for immuno- and chemotherapy for diphtheria.

***Pathogens of extremely dangerous and highly contagious infections***

*Vibrio*, general characteristics, classification. *Vibrio cholerae*, properties, antigenic structure, serotypes, pathogenicity factors. Cholera, prevalence, pathogenesis, drugs for chemotherapy and immunization.

*Brucella*, general characteristics, classification, properties. Human brucellosis, pathogenesis, immunity, medicines for immunization.

The causative agent of *plague*, systematic position, general characteristics, pathogenicity factors. Pathogenesis, clinical forms, immunity, methods of microbiological diagnostics of plague. Medicines for immuno- and chemoprophylaxis of plague.

The causative agent of *tularemia*, general characteristics, pathogenicity factors. Pathogenesis, immunity. Live tularemia vaccine (B.Ya.Elbert, N.A.Gaysky).

*Bacilli*, the systematic position, classification. *Anthrax*, properties, pathogenicity factors. Anthrax in humans, pathogenesis, prevalence, immunoprophylaxis, manifestations in the oral cavity.

***Environmental Group of anaerobic bacteria***. Sensitive to oxygen and aerotolerant anaerobes. Sporogenous and asporogenous anaerobes. Gram-positive and Gram-negative anaerobes.

*Clostridium*, general characteristics, classification, sporulation.

*Clostridium tetani*, properties. Tetanus exotoxin. Pathogenesis of tetanus, immunity, passive and active immunoprophylaxis, immunotherapy.

*Clostridium* of anaerobic gas infections, properties, toxins. The pathogenesis of gas gangrene, medicines for immunization and serotherapy.

*Asporogenous gram-negative and gram-positive anaerobes.* Bacteroides, fusobacteria, peptococci, peptostreptococci, veillonella, characteristics, role in human pathology.

Principles of microbiological diagnostics of diseases caused by sporogenous and asporogenous anaerobes.

***Spirochetes***, systematic position, general characteristics, classification, role in the pathology of the oral cavity.

*Treponema*, general characteristics, classification. *Treponema pallidum*, morphology, tinctorial properties, antigenic structure, pathogenicity factors. The pathogenesis of syphilis, the principles of microbiological diagnostics in different periods of the disease, manifestations in the oral cavity.

*Leptospira*. Properties, pathogenicity factors. Leptospirosis, prevalence and pathogenesis.

*Borrelia*, properties, antigenic structure. Etiology and pathogenesis of epidemic relapsing fever. Etiology and pathogenesis of Lyme borreliosis.

***Rickettsiae***, systematic position, classification, general characteristics, morphological types, pathogenicity factors, role in human pathology.

***Chlamydia***, systematic position, classification, general characteristics, life cycle, elementary and reticular cells morphology, role in human pathology.

***Mycoplasma***, systematic position, classification, general characteristics. Mycoplasmas and ureaplasmas role in human pathology.

***Fungi***. Systematic position and classification of fungi. Human pathogenic fungi, morphology, biology, pathogenicity factors, the role in the pathology of the oral cavity.

### **3.2. General and special medical virology**

***General Virology***. History of viruses discovery (D.I.Ivanovsky). Objectives of Medical Virology, its relationship with other sciences, the value in the professional activities of a stomatologist. Kingdom of viruses. Viruses as an independent form of organic matter existence. The main features that distinguish viruses from other forms of organic matter. Classification of viruses. Prions. Viroids.

*The morphology of viruses*. Forms of viruses existence. Morphology of virions of simple (non-enveloped) and complex (enveloped) viruses. Chemical composition of viruses.

*The reproduction of viruses*. Strict parasitism and cytotropism of viruses. Stages of viruses reproduction: adsorption, viropexis, deproteinization, the synthesis of early and late proteins, multiple replication of the genome, assembly of the virions, the release of virions from the cell. Abortive and lytic infection. Integrative infection of cells.

*Viruses of bacteria (bacteriophages)*. The morphology of the phages, properties. Virulent and temperate phages, and the characteristics of their interaction with bacteria. Lysogenic infection. The use of bacteriophages for the diagnostics, treatment and prevention of bacterial infections.

*Viral diseases*. Viruses as a cause of cancer and infectious diseases. Prevalence of virus infections. The types of viral infections. Mechanisms of viral damage of cells in the organism. Cytopathic and cytotoxic action of viruses. Immune-mediated



damage. Immunotropic, tolerogenic, tumorigenic, teratogenic viruses. The persistence of virus in the host. The concept of slow infections of viral and prion origin, features of the pathogenesis.

*Antiviral immunity.* Factors of innate antiviral immunity. Antiviral inhibitors. Natural killer cells. Interferons, types, classes, properties. Antiviral, anti-tumor, immunomodulatory and radioprotective effects.

Acquired immunity to viral infections. Mechanisms of neutralization of infectivity of virions by antibodies. The cytotoxic effects of lymphocytes in virus infected cells.

The concept of *chemotherapy and chemoprophylaxis* of viral infections.

*Immunoprophylaxis and immunotherapy* of viral infections.

*Virological methods of investigation.* The study of viruses' morphology. Methods for the isolation, indication and identification of viruses in chicken embryo. Cell culture. Methods for the isolation, indication and identification of viruses in cell cultures. Cultivation of virus in laboratory animals. Serological diagnostics of viral infections. Neutralization of virus activity. Hemagglutination inhibition test. Rapid diagnostic methods: immunofluorescence, enzyme immunoassay and radioimmunoassay. Methods of molecular genetic analysis (molecular hybridization, PCR).

### ***RNA-genomic viruses***

*Orthomyxoviruses*, characteristics, classification. *Influenza viruses A and B*, the structure of the virion, properties, antigenic structure, serotypes, antigenic variability and its consequences. Influenza, prevalence, pathogenesis, immunity virological diagnostic methods. Medicines for specific therapy, immunotherapy and chemoprophylaxis of influenza.

*Paramyxoviruses*, characteristics, classification. Parainfluenza viruses, structure, properties, serotypes. Pathogenesis, immunity. Mumps virus, structure, properties. Pathogenesis, immunity, specific prevention of mumps. Measles virus, structure, properties. Measles, prevalence, pathogenesis, immunity, medicines for active and passive immunization.

*Pneumovirus*, structure, properties, pathogenicity for humans.

*Retroviruses*, characteristics, classification. Human immunodeficiency virus (HIV-1, HIV-2), virion morphology, genome, antigenic structure, propagation in T-lymphocytes, sensitivity to physical and chemical factors. HIV infection, prevalence, transmission, groups at high risk of infection. Development of immunodeficiency and its characteristics. Pre-AIDS and its manifestations. AIDS. AIDS-associated opportunistic infections and tumors. Diagnosis of HIV infection, causal treatment. Prevention of AIDS and its complications.

*Rhabdoviridae*, characteristics, family composition. Rabies virus properties. Route of human infection, pathogenesis, virological diagnostics. L. Pasteur role in the development of vaccines. Modern rabies vaccine and gamma globulin to prevent rabies, indications for use.

Ecological group of arboviruses and viruses with natural foci (arboviruses): general characteristics, role in human pathology.

Coronaviruses. Classification and role in human pathology, virion structure, properties. SARS and MERS viruses. SARS-Cov2 virus. COVID-19, pathogenesis, influence on the immune status, laboratory diagnostics, specific prevention.

#### ***DNA-genomic viruses***

*Herpesviruses*, characteristics, composition of the family, resistance to physical and chemical factors, oncogenic properties.

Human herpes viruses

alpha herpesviruses. Herpes simplex viruses 1 and 2 (HHV-1, HHV-2), properties. Pathogenesis of herpetic infections, immunity, virological diagnostics, chemotherapy. Varicella-zoster virus (HHV-3), properties. Pathogenesis, immunity, prevention of varicella. Etiology and pathogenesis of herpes zoster.

beta-herpesviruses. Cytomegalovirus (HHV-5), properties. Main forms of the infection. Human herpes viruses of 6, 7 serotypes and their role in human pathology (roseola infantum, chronic fatigue syndrome).

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

*Adenovirus*, characteristics, tumorigenicity. Human adenoviruses, virion structure, properties, serotypes. Pathogenesis, immunity.

***Hepatitis viruses***. Classification (HAV, HBV, HCV, HDV, HEV, TTV, SEN).

Hepatitis A virus, structure and properties. Prevalence, route of infection, pathogenesis, immunity, diagnostics, specific and nonspecific prophylaxis.

Hepatitis B virus, morphological and antigenic structure, tumorigenicity. Pathogenesis of hepatitis B, immunity, diagnostics, specific and nonspecific prophylaxis. Delta infection, pathogenesis.

Hepatitis C, D, E viruses, characteristics.

### **3.3. Microbiology and immunology of the oral cavity**

***Oral microflora***. Autochthonous, allochthonous oral microflora. The composition of autochthonous microflora. Gram-positive and Gram-negative cocci: oral and other streptococci, properties, pathogenetic significance; staphylococci, veillonella, neisseria. Gram-positive and Gram-negative bacilli (lactobacilli, propionibacteria, actinomycetes, aktinobacilli, bacteroides, prevotella, fuzobacteria, leptotrichia), their pathogenic significance. Curved form: vibrio, spirochetes. Mycoplasma, fungi, protozoa.

The ontogeny of the normal microflora. Composition of the microflora of the mouth in the first hours after birth, before and after the appearance of the teeth and in elderly persons.

Microbial flora of specific areas of the mouth. Microflora of saliva, composition, quantitative characteristics of various species.

Composition of the microflora of the tongue and soft tissues. The mechanisms of microorganisms adhesion.

Microflora of dental plaque. Microorganisms-colonizers, quantitative ratio at different stages of plaque formation. Dental plaque as a biofilm. The role of quorum sensing factors in plaque formation. New approaches to reduce the bioburden of dental plaque.

The microflora of the periodontal pocket. Qualitative and quantitative composition.

The influence of genetic and non-genetic factors on the microflora of the mouth. Influence of environmental factors and physiological features of the oral cavity of the host on the microflora of the biotope.

The role of saliva, the presence or absence of teeth, removable and non-removable prosthesis, defects and anomalies of the teeth-jaw system, the diet, bad habits, good hygiene of the oral cavity in the oral microflora condition.

Value of the normal oral flora - positive (biological barrier, immunization and immunostimulatory function, metabolic and digestive function, role in the self-cleaning of the mouth) and negative. Normal microflora as a potential reservoir of infection. Disbiosis of the oral cavity.

Methods for the study of oral microflora in normal and pathological processes.

### ***Immune mechanisms in the oral cavity***

*Nonspecific protection factors.* Protective mechanisms of saliva: mineralization, mechanical and detoxification functions, antimicrobial factors of saliva (lysozyme, beta-lysinase, lactoperoxidase, sialin, proteins of the complement system, interferons and viral inhibitors), the aggregation function of saliva, role in reducing of the virulence and calcification microbes, saliva enzymes. Role of leukocytes and natural antibodies. Protective mechanisms of the mucous membranes: mucous barrier properties, mechanical removal of microorganisms, phagocytosis. Protective mechanisms of gingival fluid, composition, the bactericidal properties of gingival fluid, phagocytosis. The protective role and properties of the tooth enamel. Defense mechanisms of the normal microflora.

*Specific protective factors.* The role of antibodies and T lymphocytes in protection against infection. Humoral immune response. Local immunity of the oral cavity. Function of secretory immunoglobulin A. Cellular immune response and its manifestations in the oral cavity.

Immunopathological processes in the mouth. Allergic and autoimmune reactions, role in the etiology and pathogenesis of stomatitis of various etiology. The role of immunodeficiency states.

### **3.4. Clinical stomatological microbiology**

#### ***Microbiology of the caries and its complications. Odontogenic inflammation***

Dental diseases and their complications. Caries, definition, prevalence, etiology. Criteria of cariogenicity. Cariogenic streptococci. Characteristics of *Streptococcus mutans* and *S.sobrinus*. Characteristics of Lactobacilli. Accessory microbes, role in caries development.

Pathogenesis of dental caries: adhesion mechanisms (carbohydrate-dependent and independent) of streptococci and dental tissue destruction mechanisms. Streptococci role in co-aggregation. Glucanes. Conditions for the development of caries. Caries resistance. Nonspecific and specific prevention of dental caries. Fluorides and their influence on oral microbes.

Pulp and its protective role. Routes of pulp infection. Microbes species and their role in initiation and pathogenesis of pulpitis, acute and chronic apical periodontitis, periostitis, osteomyelitis, abscess and phlegmona of the soft tissue.

Microflora in inflammatory processes in the oral cavity. Odontogenic inflammation: etiology, types and phases of the inflammation. Importance in the pathology of the chronic odontogenic infection.

*Diseases of periodontium*: classification, risk factors. The role of microorganisms in the etiology and pathogenesis of gingivitis. The microflora dynamics in the case of successful and failed implantation.

The role of the dental plaque in periodontitis development. The role of microorganisms in dental calculus development. Pathogenetic importance of the dental calculus.

General properties of periodontopathogenic microorganisms. Red complex microorganisms: *Porphyromonas gingivalis*, *Tannerella forsythia*, *Treponema denticola*. Characteristics, pathogenicity factors, their role in the pathogenesis of periodontitis.

Microorganisms of orange, green and yellow complexes, their role in the development of periodontal diseases. Characteristics of *Aggregatibacter actinomycetemcomitans*, pathogenicity factors, mechanism of invasion and persistence, role in the development of periodontitis.

Etiology and pathogenesis of catarrhal and ulcerative gingivitis, the role of microorganisms. Etiology and pathogenesis of marginal periodontitis, the role of microorganisms and their metabolic products. Juvenile periodontitis.

Immune mechanisms in periodontal diseases. Factors contributing to the invasion of microorganisms. Mechanisms of tissue protection from microbial invasion. Principles of prevention and treatment of periodontitis. Immunological aspects of the relationship between inflammatory periodontal diseases, cardiovascular and rheumatic diseases.

### ***The role of microorganisms in inflammatory diseases of the oral mucosa***

Lesions of the oral mucosa and maxillofacial area with specific bacterial infections (actinomycosis, tuberculosis, leprosy, syphilis, scarlet fever, diphtheria, typhoid fever, anthrax, gonorrhoea). Etiological role of microorganisms, pathogenesis, microbiological diagnostics, prevention. Fusospirochetosis, etiology, pathogenesis, complications of fusospirochetosis, microbiological diagnostics.

Oral candidiasis: candidal glossitis, cheilitis, gingivitis, stomatitis (thrush), pathogens, factors contributing to development, clinical manifestations in HIV infection and AIDS. Blastomycosis, histoplasmosis. Microbiological diagnosis of fungal stomatitis. Viral stomatitis. Etiology and pathogenesis of acute and recurrent herpetic stomatitis. Stomatitis in influenza, parainfluenza, measles, mumps, adenovirus infection, rubella, chickenpox, infectious mononucleosis. Enteroviral stomatitis. Stomatitis in HIV infection.

Erythema exudativum multiforme and chronic recurrent aphthous stomatitis, the role of microorganisms, immunopathological mechanisms.

### ***Stomatogenic infection***

Opportunistic infections in dentistry, prevalence, conditions for the development, manifestations, methods of microbiological diagnostics. Opportunistic microbes, systematic position, differences from non-pathogenic microbes. Criteria for assessing the etiological significance of microbes isolated from pathological focus.

Etiology and pathogenesis of septic stomatogenic infections (bacteremia, sepsis, bacterial shock, inflammatory diseases of the skin, subcutaneous tissue and soft tissue of the maxillofacial region). Microbiological diagnostics.

Etiology, pathogenesis, microbiological diagnostics of stomatogenic bronchopulmonary diseases.

Health care-associated infections (HCAI) in dental practice, distribution, socio-economic consequences, etiological structure. Hospital ecovars and strains of HCAI pathogens. Obligate pathogenic microorganisms are the causative agents of HCAs. Exogenous and endogenous conditionally pathogenic microorganisms - causative agents of HCAs Development conditions, principles of microbiological diagnosis and prevention of HCAs. Microbiological monitoring. The concept of infection control. Anti-epidemic regime in dental organizations.

## ACADEMIC DISCIPLINE CURRICULAR CHART

Section, topic #	Section (topic) name	number of hours				Self-studies	Form of control
		lectures	supervised student work	practical or (laboratory or seminars)			
	<b>3rd semester</b>						
<b>1.</b>	<b>General Microbiology</b>	<b>4</b>	<b>1</b>	<b>24</b>	<b>21</b>		
1.1.	Medical microbiology: tasks and methods. Systematics, nomenclature and classification of microorganisms. Physiology of microorganisms	2	0,5	-	-		
1.2.	Morphology of microorganisms. Research methods in microbiology. Bacterioscopic research method. Characteristics of the main forms of bacteria. Simple methods of staining	-	-	3	3		Interview, control questioning, tests, written report on laboratory work, computer tests
1.2.	Bacterioscopic research method. The structure of the bacterial cell. Complex methods of staining. Peculiarities and methods of study of spirochetes, rickettsia, chlamydia, mycoplasma	-	-	3	3		Interview, control questioning, tests, written report on laboratory work, computer tests
1.3.	Genetics of microorganisms. Methods for studying the genetics of bacteria. Methods of molecular diagnostics	-	-	3	3		Interview, control questioning, tests, written report on laboratory work, computer tests
1.4.	Physiology of bacteria. Bacteriological research method. Methods for the bacteria pure culture isolation	-	-	3	3		Interview, control questioning, tests, written report on laboratory work, computer tests
1.4.	Bacteriological research method. Methods for bacteria pure culture identification	-	-	3	-		Interview, control questioning, tests, report on laboratory work with their oral defense, computer

1.5.	Ecology of microorganisms. Basics of the infection doctrine. Microbiological basis of chemotherapy and antiseptics of bacterial infections	2	0,5	-	-	Interview, control questioning, tests, report on laboratory work with their oral defense, computer tests
1.6.	Ecology of microorganisms. Antimicrobial measures: methods of sterilization, disinfection, antiseptics, asepsis	-	-	3	3	Interview, control questioning, tests, written report on laboratory work, computer tests
1.5.	Basics of the infection doctrine. Biological method of investigation. Microbiological basis of chemotherapy and antiseptics of bacterial infections	-	-	3	3	Interview, control questioning, tests, written report on laboratory work, computer tests
1.6.	Concluding lesson «General Microbiology»	-	-	3	3	Control questioning, control test, computer tests
<b>2.</b>	<b>Theoretical and applied medical immunology</b>	<b>6</b>	<b>1,5</b>	<b>18</b>	<b>15</b>	
2.1.	Immunology. Immune system.	2	0,5	-	-	
2.2.	Innate immunity	-	-	3	2	Interview, control questioning, tests, written report on laboratory work, computer tests
2.2.	Immune system. Methods for the innate immunity studying	-	-	3	2	Interview, control questioning, tests, written report on laboratory work, computer tests
2.3.	Immune response. Antigens. Antibodies. Humoral and cellular immune response. Antiinfection immunity	2	0,5	-	-	
2.4.	Methods in clinical and infection immunology. Humoral immune response. Antigens. Antibodies	-	-	3	2	Interview, control questioning, tests, written report on laboratory work, computer tests
2.5.	Immunodiagnosics of infectious diseases. Serological method of investigation	-	-	3	2	Interview, control questioning, tests, report on laboratory work with their oral defense, computer tests
2.7.	Methods of clinical and infection immunology. Cellular immune response. Allergy	-	-	3	3	Interview, control questioning, tests, written report on laboratory work, computer tests
2.6.	Immunoprophylaxis and immunotherapy for infectious diseases. Immunopathology. Clinical Immunology. Allergy.	2	0,5	-	-	
2.7.						

	Immune status. Immunodeficiencies. Autoimmune diseases. Immunocorrection								Interview, control questioning, tests, written report on laboratory work, computer tests
2.6.	Immunoprophylaxis and immunotherapy for infectious diseases. Immunopathology. Clinical Immunology	-	-	3	3				Control questioning, control test, computer tests
	Concluding lesson «Theoretical and applied medical immunology»	-	-	3	3				
<b>3.</b>	<b>Stomatological microbiology</b>	<b>4</b>	<b>2</b>	<b>9</b>	<b>7</b>				
3.1.	Special medical microbiology. Methods for microbiological diagnostics of diseases caused by Staphylococci, Streptococci, Neisseria		-	3	2				Interview, control questioning, tests, written report on laboratory work, computer tests
3.1.	Methods for microbiological diagnostics of acute intestinal infections caused by Enterobacteria. Principles of food poisoning diagnostics	-	-	3	2				Interview, control questioning, tests, written report on laboratory work, computer tests
3.1.	Methods for microbiological diagnostics of klebsiellosis. Diagnostics of diseases caused by Campylobacteria, Helicobacteria, Pseudomonada	-	-	3	3				Interview, control questioning, tests, written report on laboratory work, computer tests
3.2.	General and special medical virology. Viruses: morphology, reproduction, genetics. Viral infections. Antiviral immunity	2	1	-	-				
3.2.	Viruses that cause influenza, parainfluenza, mumps, measles. Retroviruses. Herpesviruses. Viral hepatitis viruses. Adenoviruses	2	1	-	-				
	<b>4<sup>th</sup> semester</b>	<b>8</b>	<b>2,5</b>	<b>36</b>	<b>24</b>				
<b>3.</b>	<b>Stomatological microbiology</b>	<b>8</b>	<b>2,5</b>	<b>36</b>	<b>24</b>				
3.1.	Special medical microbiology. Methods for microbiological diagnostics of diphtheria and pertussis	-	-	2	1				Interview, control questioning, tests, written report on laboratory work, computer tests
3.1.	Methods for microbiological diagnostics of diseases caused by Actinomycetes and Mycobacteria	-	-	2	1				Interview, control questioning, tests, written report on laboratory work, computer tests
3.1.	Methods for microbiological diagnostics of diseases caused by environmental group of anaerobic bacteria	-	-	2	1				Interview, control questioning, tests, written report on laboratory work, computer tests



3.1.	Causative agents of especially dangerous infections	-	-	-	-	2	Interview, control questioning, tests, written report on laboratory work, computer tests
3.1.	Methods for microbiological diagnostics of diseases caused by Spirochetes, Rickettsia, Chlamydia, Mycoplasma	-	-	2	1	1	Interview, control questioning, tests, written report on laboratory work, computer tests
	Concluding lesson «Special medical microbiology»	-	-	2	1	1	Control questioning, control test, computer tests
3.2.	General and special virology. Methods of research in virology. Bacteriophages	-	-	2	1	1	Interview, control questioning, tests, written report on laboratory work, computer tests
3.2.	Methods for virusological diagnostics of diseases caused by Orthomyxoviruses, Paramyxoviruses, Coronaviruses	-	-	2	2	2	Interview, control questioning, tests, written report on laboratory work, computer tests
3.2.	Methods for virusological diagnostics of diseases caused by Enteroviruses. Rubella virus	-	-	2	2	2	Interview, control questioning, tests, written report on laboratory work, computer tests
3.2.	Methods for virusological diagnostics of HIV infection. Rabies viruses	-	-	2	1	1	Interview, control questioning, tests, written report on laboratory work, computer tests
3.2.	Hepatitis viruses	-	-	2	1	1	Interview, control questioning, tests, written report on laboratory work, computer tests
3.2.	Methods for virusological diagnostics of diseases caused by Herpesviruses and Adenoviruses. Human Papillomaviruses	-	-	2	1	1	Interview, control questioning, tests, written report on laboratory work, computer tests
3.3.	Microbiology and immunology of the oral cavity. Microflora of the oral cavity	2	0,5	-	-	-	
3.3.	Immune and nonimmune protective mechanisms in oral cavity	2	0,5	-	-	-	
3.3.	Microbiology and immunology of the oral cavity. Methods for studying normal microflora. Clinical stomatological microbiology. Microbiology of caries	-	-	2	1	1	Interview, control questioning, tests, written report on laboratory work, computer tests

3.3.	Methods for studying oral immunity factors	-	-	2	1	Interview, control questioning, tests, written report on laboratory work, computer tests
3.4.	Non-specific infectious processes in the oral cavity. Dental diseases and their complications. Odontogenic inflammation. The role of microbes and immune mechanisms in diseases of periodontal tissues and oral mucosa	2	0,5	-	-	
3.4.	Specific and non-specific stomatitis. Stomatogenic infection. Health care-associated infections in stomatological practice	2	1	-	-	
3.4.	Clinical stomatological microbiology. Microbiology of periodontitis and peri-implantitis	-	-	2	2	Interview, control questioning, tests, written report on laboratory work, computer tests
3.4.	Methods for microbiological diagnostics of stomatitis. Methods of microbiological diagnosis of mycosis of the oral cavity	-	-	2	1	Interview, control questioning, tests, written report on laboratory work, computer tests
	Concluding lesson «General and special medical virology», «Microbiology and immunology of the oral cavity», «Clinical stomatological microbiology»	-	-	2	2	Control questioning, control test, computer tests
3.4.	Methods of microbiological diagnostics of stomatogenic purulent-inflammatory diseases	-	-	2	1	Interview, control questioning, tests, written report on laboratory work, computer tests
3.4	Methods of microbiological diagnostics of stomatogenic bronchopulmonary infections. Health care-associated infections in dental practice	-	-	2	1	Interview, control questioning, tests, written report on laboratory work, computer tests. Exam
	<b>Total hours</b>	<b>22</b>	<b>7</b>	<b>87</b>	<b>67</b>	

## INFORMATION AND INSTRUCTIONAL UNIT

### LITERATURE

#### **Basic (relevant):**

1. Generalov, I. I. Medical Microbiology, Virology & Immunology : lecture course for students of medical universities. Pt. 1 : General Microbiology & Medical Immunology / I. I. Generalov. - Vitebsk : VSMU, 2016. - 281 p.
2. Generalov, I. I. Medical Microbiology, Virology & Immunology : lecture course for students of medical universities. Pt. 2 : Medical Bacteriology & Medical Virology / I. I. Generalov. - Vitebsk : VSMU, 2016. - 390 p.
3. Zverev, V. V. Medical Microbiology, Virology, Immunology : textbook. Vol. 1 / V. V. Zverev, M. N. Boichenko. - Москва : ГЭОТАР-Медиа, 2020. - 384 p.
4. Zverev, V. V. Medical Microbiology, Virology, Immunology : textbook : Vol. 2. / V. V. Zverev, M. N. Boichenko. - Москва : ГЭОТАР-Медиа, 2020. - 392 p.

#### **Additional:**

5. Generalov, I. I. Instructions for laboratory training in Special Microbiology and Virology for students of Faculty of Dentistry / I. I. Generalov, A. V. Frolova. – Vitebsk : VSMU, 2016. – 32 p. – Electronic version of publ.
6. Generalov, I. I. Medical Microbiology, Virology & Immunology : lecture course for students of medical universities. Pt. 1 : General Microbiology & Medical Immunology / I. I. Generalov. – Vitebsk : VSMU, 2016. – 281 p. – Electronic version of publ.
7. Микробиология, вирусология, иммунология = Microbiology, virology, immunology : лабораторный практикум / В. В. Кочубинский [и др.]. – 6-е изд. – Минск : БГМУ, 2022. – 84 с.
8. Стоматологическая микробиология, вирусология, иммунология = Stomatological microbiology, virology, immunology : пособие / Д. А. Черношей [и др.]. – Минск : БГМУ, 2020. – 152 с.

### **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 exam in the academic discipline;
- solution of situational problems;
- performance of research and creative tasks;
- preparation of thematic reports, abstracts, presentations;
- performance of test tasks;
- note-taking of educational literature;
- compiling a review of scientific literature on a given topic;
- design of information and demonstration materials (stands, posters, graphics, tables, newspapers, etc.);

production of layouts, laboratory teaching aids, multimedia audio and video materials;

compiling a thematic selection of literary sources, Internet sources;

drawing up tests for the organization of mutual control;

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

The main forms of supervised student independent work:

writing and presentation of the essay;

presentation of the report;

the study of topics and problems that are not covered by lectures;

reviewing primary sources (scientific articles, text books, monographs);

computer testing;

preparation of tests by students for the organization of mutual control;

production of educational materials;

preparation and participation in active forms of education.

Control of supervised student independent work is carried out in the form of:  
control work;

concluding session, colloquium in the form of an oral interview, written work, testing;

discussion of essays;

defending educational tasks;

assessment of an oral answer to a question, report or problem solution;

checking abstracts, written reports, reports, recipes;

checking summaries of primary sources, monographs and articles;

individual conversation.

### **LIST OF AVAILABLE DIAGNOSTIC TOOLS**

For the assessment of competencies, the following forms are used:

#### **Oral form:**

interview;

control questioning;

exam;

#### **Written form:**

tests;

control questioning;

control test;

written report on laboratory work;

#### **Oral and written form:**

report on laboratory work with their oral defense;

assessment based on the module-rating system

#### **Technical form:**

computer tests.

### LIST OF AVAILABLE TEACHING METHODS

Traditional method (lecture, laboratory practicals);

Active (interactive) methods:

- Problem-Based Learning (PBL);
- Team-Based Learning (TBL);
- Case-Based Learning (CBL);
- Research-Based Learning (RBL).

### LIST OF PRACTICAL SKILLS

1. Preparation of a smear from a solid culture of bacteria.
2. Preparation of a smear from a liquid culture of bacteria.
3. Staining a smear with a fuchsin.
4. Staining a smear with a methylene blue.
5. Microscopy of smears using an immersion system.
6. Staining of smears by Gram method.
7. Identification of staphylococcus in a smear.
8. Identification of streptococcus in a smear.
9. Identification of gram-negative rod-shaped bacteria in a smear.
10. Identification of bacilli in a smear.
11. Identification of encapsulated bacteria in a smear.
12. Detection of gonococcus in a smear of pus.
13. Microscopic examination of sputum smears stained by Ziehl-Neelsen to detect mycobacteria.
14. Identification of Candida in a smear.
15. Identification of corynebacteria in a smear stained by Loeffler.
16. Inoculation of pathological material on agar plate (MPA) to obtain a pure culture of bacteria.
17. Determination of the type of colonies on a solid media (MPA).
18. Inoculation of a slanted MPA from an isolated colony on agar plate (MPA).
19. Determination of the sensitivity/resistance of a bacterial culture to antibiotics by disk diffusion method.
20. Performance and evaluation of slide agglutination test.
21. Evaluation of indirect hemagglutination test.
22. Determination of the antibodies titer in agglutination reaction in tubes.
23. Evaluation of radial immunodiffusion test by Mancini.
24. Evaluation of hemagglutination inhibition test for the identification of influenza viruses.
25. Evaluation of ELISA.
26. Evaluation of PCR.
27. Registration of primary medical documentation for laboratory diagnostics:  
N 218 / y-07 «Microbiological study of biological material»,  
N 351 / y-08 «Order for clinical and microbiological research»,  
N 354 / y-08 «Label for package with biomaterial»

### LIST OF EQUIPMENT USED

1. Light immersion microscope.
2. Dark field microscope.
3. Luminescent microscope.
4. Thermostat.
5. ELISA reader.
6. Computers/tablets (computer class).
7. Multimedia projector.
8. TV.
9. Ovoscope.
10. Spirit lamps.
11. Bacteriological loops.
12. Pipette dispensers.
13. Laboratory glassware (Petri dishes, test tubes).
14. Nutrient media.
15. Gram stain kit, reagents.

### LIST OF LECTURES

#### *3rd semester*

1. Medical microbiology: tasks and methods. Systematics, nomenclature and classification of microorganisms. Physiology of microorganisms.
2. Ecology of microorganisms. Fundamentals of the infection doctrine. Microbiological bases of chemotherapy and antiseptics for bacterial infections.
3. Immunology. The immune system. Innate immunity.
4. Immune response. Antigens and antibodies. Humoral and cellular immune response. Anti-infection immunity.
5. Immunoprophylaxis and immunotherapy of infectious diseases. Immunopathology and clinical immunology. Allergy. The immune status. Immunodeficiencies. Autoimmune diseases. The concept of immunocorrection.
6. Medical virology. Viruses: morphology, reproduction, genetics. Viral diseases. Antiviral immunity.
7. Influenza, parainfluenza, mumps, measles viruses and respective diseases. Retroviruses. Herpesviruses. Hepatitis viruses. Adenoviruses.

#### *4th semester*

1. Microbiology of the oral cavity. Composition of autochthonous microflora. Ontogeny of normal microflora.
2. Immune and non-immune defense mechanisms in the oral cavity.
3. Nonspecific infectious processes in the oral cavity. Dental diseases and their complications. Odontogenic inflammation. The role of microbes and immune mechanisms in diseases of periodontal tissues and oral mucosa.
4. Specific and non-specific stomatitis. Dental infection. Health care-associated infections in dental practice.

**LIST OF PRACTICAL CLASSES***3rd semester*

1. Research methods in microbiology. Bacterioscopic research method. Characteristics of the main forms of bacteria. Simple staining methods.
2. Bacterioscopic research method. The structure of a bacterial cell. Differential staining methods. Features of morphology and methods of studying spirochetes, rickettsia, chlamydia, mycoplasmas.
3. Methods for studying the genetics of bacteria. Molecular diagnostics methods.
4. Cultural (bacteriological) research method. Methods for isolating pure cultures of bacteria.
5. Cultural (bacteriological) research method. Methods for identification of pure cultures of bacteria.
6. Ecology of microbes. Antimicrobial measures: methods of sterilization and disinfection, antiseptics, asepsis.
7. The doctrine of infection. Biological research method. Methods for studying the sensitivity of microbes to antibiotics.
8. Concluding lesson «General Microbiology».
9. Methods of clinical and infection immunology. The immune system. Methods for studying innate immunity.
10. Methods of clinical and infection immunology. Humoral immune response. Antigens. Antibodies.
11. Methods of clinical and infection immunology. Cellular immune response. Allergy.
12. Immunodiagnostics of infectious diseases. Serological research method.
13. Immunoprophylaxis and immunotherapy of infectious diseases. Immunopathology and clinical immunology.
14. Concluding lesson «Theoretical and applied medical immunology».
15. Methods of microbiological diagnostics of diseases caused by staphylococci, streptococci, neisseria.
16. Methods of microbiological diagnostics of acute intestinal infections caused by enterobacteria. Principles of food poisoning diagnosis.
17. Methods of microbiological diagnostics of Klebsiellosis. Diagnosis of diseases caused by Campylobacter and Helicobacter. Microbiological diagnosis of infection caused by Pseudomonas aeruginosa.

*4th semester*

1. Methods of microbiological diagnosis of diphtheria and whooping cough.
2. Methods of microbiological diagnostics of diseases caused by actinomycetes and mycobacteria.
3. Methods of microbiological diagnostics of anaerobic infections.
4. Methods of microbiological diagnostics of diseases caused by spirochetes, rickettsia, chlamydia, mycoplasmas.
5. Concluding lesson «Special medical microbiology».
6. Methods of virological research. Bacteriophages.

7. Methods of virological diagnosis of diseases caused by orthomyxoviruses, paramyxoviruses. Coronaviruses.
8. Methods of virological diagnosis of enteroviral diseases. Rubella virus.
9. Methods of virological diagnosis of viral hepatitis.
10. Methods of virological diagnosis of HIV infection. Rabies virus.
11. Methods of virological diagnosis of herpetic and adenovirus diseases of the oral cavity. Human papilloma virus.
12. Methods for studying normal microflora. Microbiology of caries.
13. Methods for studying oral immunity factors.
14. Clinical stomatological microbiology. Microbiology of periodontitis and peri-implantitis.
15. Methods of microbiological diagnostics of stomatitis. Methods for microbiological diagnosis of mycosis of the oral cavity.
16. Concluding lesson «General and special medical virology», «Microbiology and immunology of the oral cavity», «Clinical stomatological microbiology».
17. Methods of microbiological diagnostics of stomatogenic purulent-inflammatory diseases.
18. Methods of microbiological diagnostics of stomatogenic bronchopulmonary infections. Health care-associated infections in dental practice.



**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 N )
1. Epidemiology	Department of epidemiology	No suggestions	protocol N 13 of 12.05.2022,
2. Infectious diseases	Department of Infectious Diseases	No suggestions	protocol N 13 of 12.05.2022,
3. Dermatovenerology	Department of Skin and Venereal Diseases	No suggestions	protocol N 13 of 12.05.2022,

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

Dean of the Medical Faculty for International Students of the educational institution «Belarusian State Medical University»

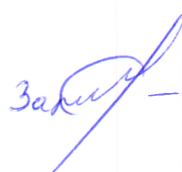
28.06.22



O.S. Ishutin

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S.V. Zaturanova

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