



**MINISTRY OF HEALTH OF UKRAINE  
NATIONAL UNIVERSITY OF PHARMACY  
Department Microbiology, Virology and Immunology**

*MICROBIOLOGY WITH BASIC OF EPIDEMIOLOGY*

(the name of educational component)

**WORK PROGRAM  
of educational component**

training for MASTER  
(Higher Educational Level Name)  
in specialty «226 Pharmacy and industrial pharmacy»  
(Code and Specialty Name)  
field of knowledge «22 Health »  
(Code and Knowledge Field Name)  
of educational program « Pharmacy »  
(Educational Program Name)  
in specialization(s) \_\_\_\_\_  
(name of specialization, if available)

**Kharkiv-2022**  
(year of creation)

The work program of the educational component **Microbiology with basic of epidemiology** in specialty 226 educational program "Pharmacy" in specialization(s) \_\_\_\_\_ for applicants for higher education 2-3 year of study.

**EDUCATIONAL COURSE TEAM:**

Filimonova Nataliia, Head of the Department of Microbiology, Virology and Immunology,  
Doctor of Medicine, Professor

Tischenko Iryna, assistant professor, PhD, senior scientist researcher of Microbiology, Virology and Immunology

(specify the LAST NAME, first name of the authors, their positions, scientific degrees and academic titles)

Work program has been considered and approved at the Department meeting

Record from «31» august 2022 № 1

Head of the Department \_\_\_\_\_

(sig.)



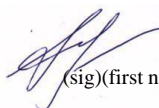
prof. Nataliia FILIMONOVA

(first name LAST NAME)

Educational program has been approved at the meeting of the Methodical Commission of biomedical disciplines

Record from «12» september 2022 № 1

Head of Specialized Committee \_\_\_\_\_



(sig)(first name LAST NAME)

prof. Nadia

KONONENKO

## 1. Description of the educational component

**Language of study: english**

**Status of the educational component:** compulsory

**Prerequisites for studying the educational component:** Microbiology as an educational discipline:

a) is based on studying students of philosophy, botany, biology with the basics of normal anatomy and physiology, inorganic chemistry, Latin language, physics, organic chemistry, and integrates with these disciplines;

b) laying the foundations for students to study pharmacology, clinical pharmacology, pharmacotherapy, laboratory diagnostics, hygiene, pharmacy technology of medicines, factory technology of medicines, toxicological chemistry, pharmacognosy, which involves the integration of teaching with these disciplines and the formation of skills to apply knowledge of microbiology in the process of further education and in professional activity.

The subject of educational component study « Microbiology with the basics of epidemiology » is the most important physiological processes of microorganisms - pathogenic and conditionally pathogenic to humans, development of methods of microbiological diagnostics, specific prophylaxis and etiotropic treatment of infectious diseases caused by them; phytopathogenic microorganisms; principles of standardization of microbiological indicators of quality of medicinal raw materials and finished dosage forms.

**Information content of the educational component.** 8 ECTS credit 240 hours are assigned to the study of the educational component.

## 2. Objectives and tasks of the educational component

**The purpose of teaching the educational component** «Microbiology with the basics of epidemiology» is preparation of specialists-pharmacists who must have a significant amount of theoretical and practical knowledge regarding morphology, physiology of pathogens of human infectious diseases, medicinal plants, methods of transmission, pathogenesis of diseases, methods of their laboratory diagnosis, treatment and prevention, provision of professional knowledge and practical skills in terms of providing the population with effective antimicrobial and immunobiological drugs.

**The main tasks** of the educational component «Microbiology with the basics of epidemiology» are the formation of knowledge about the general regularities of the structure, life-affairs and the spread of microbes, their importance as contaminants of medicinal preparations and pathogens of infectious diseases, knowledge of antimicrobial chemotherapy and immune prophylaxis.

## 3. Competence and planned educational outcomes

Educational component «Microbiology with basic of epidemiology» ensures the acquisition of applicants for higher education the following **competences**:

*special (professional):*

PC 1. Ability to conduct sanitary and educational work among the population to prevent common diseases, prevent dangerous infectious, viral and parasitic diseases, as well as to facilitate the timely detection and maintenance of adherence to treatment of these diseases in accordance with their medical and biological characteristics and microbiological characteristics.

Integrative final program learning outcomes (PLO), the formation of which is facilitated by the  
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educational component:

PLO 13. To carry out sanitary and educational work in professional activity in case of outbreaks of infectious, viral and parasitic diseases.

As a result of studying the educational component, the applicant for higher education will be *know*:

- Stages of microbiology as a fundamental and applied discipline for medicine and the contribution of individual scientists at each of its stages.
- Features of the structure, morphology, physiology of individual groups of microbes.
- Methods for the allocation of pure cultures of aerobic and anaerobic bacteria.
- Mechanism of action of antibiotics on a microbial cell.
- Side effect on micro- and macroorganism.
- Mechanisms of complications of antibiotic therapy.
- The concept of "infectious process", the forms of the infectious process, their characteristics and conditions of occurrence.
- Factors of pathogenicity of bacteria, the concept of "pathogenicity", "virulence".
- Etiotropic therapy and prevention of infectious diseases, opportunistic and intradermal infections.
- The concept of "sanitary indicative microorganisms" and their role as an indicator in assessing the degree of contamination of pathogenic microorganisms of the environment: water, soil and air.
- The concept of "phytopathogenic microorganisms" and the types of damage to herbal medicinal products and medicines.
- Methods of microbiological assessment of suitability of medical products and norms of microorganism content in non-sterile medicinal forms.

*be able to*:

- to allocate pure cultures of aerobic and anaerobic microorganisms, to identify the selected cultures by morphological, tinctorial, cultural, biochemical, antigenic properties, to determine phagotype, to determine sensitivity to antibiotics;
- To record and evaluate the results of serological reactions (agglutination reactions, precipitation, complement complement, immunofluorescence, immunoassay analysis);
- to determine the research methods appropriate for diseases caused by pathogenic microorganisms;
- detect bacterial sensitivity to antibiotics;
- to carry out the infection of chicken embryos for the isolation of viruses and to carry out the indication of viruses in the culture of cells in the cytopathic action and in the hemagglutination reaction

*possess*:

- the technique of cooking smears-preparations with coloring simple and complex methods;
- microscopy technique using an immiscible microscope system; technique for sowing material on nutrient media;
- the technique of infection and autopsy of laboratory animals.

#### 4. The educational component structure

Names of content modules and topics	The amount of hours					
	the whole amount	full time study				
		including				
		1.	sem	Practical lessons	lab	self-study
<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>	<i>7</i>
<b>MODULE 1. GENERAL MICROBIOLOGY</b>						
<b>Content module 1.</b> The concept of microbiology. Morphology of microorganisms. Physiology of microorganisms. Human microflora and the environment. Phytopathogenic microorganisms. Microbial disruption of plant medicinal raw materials, microbial contamination of the finished dosage forms.						
<b>Topic 1.</b> The concept of microbiology. Morphology of prokaryotes	<b>12</b>			<b>6</b>		<b>6</b>
<b>Topic 2.</b> Morphology of eukaryotes.	<b>13</b>	<b>1</b>		<b>6</b>		<b>6</b>
<b>Topic 3.</b> Morphology and biology of viruses.	<b>10</b>	<b>1</b>		<b>3</b>		<b>6</b>
<b>Topic 4.</b> Physiology of prokaryotes.	<b>14</b>	<b>2</b>		<b>6</b>		<b>6</b>
<b>Topic 5.</b> Genetics of microorganisms.	<b>6</b>					<b>6</b>
<b>Topic 6.</b> Action of physical, chemical and biological factors on microorganisms.	<b>11</b>	<b>2</b>		<b>3</b>		<b>6</b>
<b>Topic 7.</b> Environmental microflora.	<b>10</b>	<b>2</b>		<b>3</b>		<b>5</b>
<b>Topic 8.</b> Human microbiocenoses. Eubiotics.	<b>10</b>	<b>1</b>		<b>3</b>		<b>6</b>
<b>Topic 9.</b> Phytopathogenic microorganisms. Microbial spasm of plant medicinal raw materials. Microbial contamination of the finished dosage forms	<b>10</b>	<b>2</b>		<b>3</b>		<b>5</b>
<b>The whole amount of hours for the content module 1</b>	<b>96</b>	<b>11</b>		<b>33</b>		<b>52</b>
<b>Content module 2.</b> The doctrine of infection. The basics of chemotherapy. The doctrine of immunity. Immunodiagnosics, immunotherapy and immunoprophylaxis of infectious diseases. Allergy.						
<b>Topic10.</b> The doctrine of infection.	<b>4</b>	<b>1</b>		<b>3</b>		
<b>Topic 11.</b> Fundamentals of chemotherapy. Antibiotics	<b>8</b>	<b>2</b>		<b>3</b>		<b>3</b>
<b>Topic 12.</b> Immunity. Immunodiagnosis of infectious diseases.	<b>16</b>	<b>2</b>		<b>6</b>		<b>8</b>
<b>Topic 13.</b> Immunobiological	<b>16</b>	<b>2</b>		<b>6</b>		<b>8</b>

preparations for the prevention and treatment of infectious diseases. The concept of immunobiotechnology						
<b>Topic 14.</b> The concept of allergy.	<b>1</b>					<b>1</b>
<b>The whole amount of hours for the content module 2</b>	<b>45</b>	<b>7</b>		<b>18</b>		<b>20</b>
<b>Semester credit from module</b>	<b>9</b>			<b>9</b>		
<b>The whole amount of hours for the course</b>	<b>150</b>	<b>18</b>		<b>60</b>		<b>72</b>
<b>MODULE 2. SPECIAL MICROBIOLOGY.</b>						
<b>Content module 3. Causative agents of bacterial, rickettsial diseases.</b>						
<b>Topic 15.</b> The causative agents of meningitis, pertussis, legionellosis.	<b>2</b>					<b>2</b>
<b>Topic 16.</b> Pathogens of escherichiosis, shigellosis, typhoid fever and paratyphoid A and B, food poisonous infections, cholera.	<b>5</b>			<b>4</b>		<b>1</b>
<b>Topic 17.</b> Stimulants of tetanus, gas anaerobic infection, botulism.	<b>7</b>	<b>1</b>		<b>4</b>		<b>2</b>
<b>Topic 18.</b> The causative agents of gonorrhoea, syphilis, chlamydia, mycoplasmosis.	<b>7</b>	<b>1</b>		<b>4</b>		<b>2</b>
<b>Topic 19.</b> Pathogenic agents of zoonotic infections: plague, tularemia, anthrax, brucellosis, campylobacteriosis, leptospirosis.	<b>3</b>	<b>1</b>				<b>2</b>
<b>Topic 20.</b> Pathogens of recurrent typhus, epidemic typhus and Brill-Qinsser's disease, endemic typhus, tick-borne typhus.	<b>2</b>					<b>2</b>
<b>Topic 21.</b> Pathogenic inflammatory and hospital infections. Gram-positive pyogenic cocci: staphylococci, streptococci. Conditionally-pathogenic rodokovidnyh bacteria: Pseudomonas aeruginosa, Protees, Klebsiella.	<b>2</b>	<b>1</b>				<b>1</b>
<b>Topic 22.</b> Pathogens of tuberculosis, diphtheria.	<b>5</b>	<b>1</b>		<b>4</b>		
<b>The whole amount of hours for the content module 3</b>	<b>33</b>	<b>5</b>		<b>16</b>		<b>12</b>
<b>Content module 4. Causative agents of viral, fungal and protozoal diseases</b>						

<b>Topic 23.</b> Influenza pathogens, para-influenza, measles.	<b>4</b>	<b>1</b>		<b>2</b>		<b>1</b>
<b>Topic 24.</b> Stimulant of rubella, adeno-virus..	<b>3</b>			<b>2</b>		<b>1</b>
<b>Topic 25.</b> Pathogenic agents of poliomyelitis, hepatitis A.	<b>6</b>			<b>4</b>		<b>2</b>
<b>Topic 26.</b> Pathogenic agents of viral hepatitis B, AIDS, herpes.	<b>5</b>	<b>1</b>		<b>4</b>		
<b>Topic 27.</b> Pathogens of rabies, tick-borne encephalitis.	<b>2</b>					<b>2</b>
<b>Topic 28.</b> Pathogens of dermatomycosis, deep mycoses, candidiasis, actinomycosis.	<b>5</b>	<b>1</b>		<b>4</b>		
<b>Topic 29.</b> Pathogenic agents of amebiasis, balantidiasis, lambliosis.	<b>2</b>					<b>2</b>
<b>Topic 30.</b> Pathogens of trypanosomiasis, malaria.	<b>2</b>					<b>2</b>
<b>Topic 31.</b> Pathogens of trichomoniasis, toxoplasmosis, leishmaniasis	<b>2</b>					<b>2</b>
<b>The whole amount of hours for the content module 4</b>	<b>31</b>	<b>3</b>		<b>16</b>		<b>12</b>
<b>Semester credit from module _</b>	<b>4</b>			<b>4</b>		
<b><i>The whole amount of hours for the course</i></b>	<b>68</b>	<b>8</b>		<b>36</b>		<b>24</b>
<b>Semester exam</b>	<b>22</b>					<b>22</b>
<b><i>The whole amount of hours for the course</i></b>	<b>240</b>	<b>26</b>		<b>96</b>		<b>118</b>

## 5. Contents of the educational component

### MODULE 1. General microbiology.

**Content module 1.** *The concept of microbiology. Morphology of microorganisms. Physiology of microorganisms. Human and environmental microflora. Phytopathogenic microorganisms. Microbial spoilage of plant medicinal raw materials, microbial contamination of finished dosage forms.*

**Topic 1.** The concept of microbiology. Morphology of prokaryotes. The main stages of development of microbiology. The founders of microbiology, virology and immunology as the founders of the main directions of the discipline. The first ideas about the emergence of infectious diseases. The world of microbes: prokaryotes. Principles of classification and taxonomy of microorganisms. Main taxonomic categories: department, class, order, family, genus, species. Binary nomenclature of microorganisms. The concept of biovar, serovar, phagovar, strain, clone. Methods of microscopy: light, dark field, phase-contrast, luminescent, electronic (principles of structure, purpose, possibilities of magnification). Main forms, sizes, features of structure of microorganisms (bacteria, actinomycetes, mycoplasmas, rickettsiae, chlamydia): cell wall, cytoplasmic membrane, cytoplasm, nucleoid, ribosomes, lysosomes, inclusions, inclusions, inclusions, inclusions. Functions of structural elements.

Polymorphism of microorganisms. L-forms of microorganisms.

**Topic 2.** Morphology of eukaryotes. Eukaryotes (protozoa, fungi). The main forms, sizes, features of the structure of protozoa, fungi: cell wall, cytoplasmic membrane, cytoplasm, nucleus, mitochondria, ribosomes, lysosomes, inclusions, spores, capsules, flagella, dust, cilia, fim. Functions of structural elements.

**Topic 3.** Morphology and biology of viruses. RNA-, DNA-containing viruses. Principles of classification and taxonomy of viruses. Main taxonomic categories: family, genus. Morphology and ultrastructure of viruses. Bacteriophages. Chemical composition of viruses. Types of interaction of viruses with cells. Moderate and virulent phages. Reproduction of viruses. Cultivation of viruses.

**Topic 4.** Physiology of prokaryotes. Chemical composition and functions of individual components: water, proteins, nucleic acids, carbohydrates, lipids, minerals. Microbial enzymes: classification (exo- and endoenzymes, constitutive, inducible, hydrolases, oxidoreductases, transferases, isomerases, lyases, ligases), enzymes of aggression. Methods of research of enzymatic activity, use for identification of microorganisms. The concept of engineering enzymology. Nutrition and cultivation of microorganisms. Mechanisms and types of nutrition (auxotrophs, autotrophs, heterotrophs, phototrophs, chemotrophs). Sources of carbon, nitrogen, energy. Classification of nutrient media. Growth factors. Features of cultivation of rickettsiae, chlamydia, viruses. Pigmentation. Types of respiration: obligate aerobes, microaerophiles, facultative and obligate anaerobes. Chemical bases of the respiratory process. Growth and reproduction of microorganisms. Stages of growth and reproduction. Stages of selection of pure culture. Characteristics of colonies. Features of reproduction of actinomycetes, mycoplasmas, rickettsiae, chlamydia.

**Topic 5.** Genetics of microorganisms. Fundamentals of genetics. DNA as the material basis of hereditary properties. Types of variability: genotypic, phenotypic. Mutations are spontaneous and induced. Genetic recombination: conjugation, transformation and transduction.

Extrachromosomal factors of heredity (plasmids), their role in the formation of antibiotic resistance. Heterology of populations of microorganisms. Types and mechanisms of population variability. The concept of bacterial dissociation. The value of variability in the evolution of microorganisms. Practical use of the laws of genetics in obtaining vaccines and strains - producers of biologically active substances. Microbiological bases of genetic engineering and biotechnology.

**Topic 6.** The effect of physical, chemical and biological factors on microorganisms. Thermophiles, mesophiles, psychrophiles. The effect of physical, chemical and biological factors on microorganisms. Asepsis, antiseptics, conservation, disinfection, sterilization. Disinfectants and antiseptics. Sterilization methods.

**Topic 7.** Environmental microflora. The concept of gnotobiology. Natural microbiocenoses and their forms: symbiosis (mutualism, commensalism, parasitism), antibiosis (isoantagonism, heteroantagonism). Anabiosis, metabiosis. Microflora of soil, water, air. Sanitary-indicative microorganisms. Principles of sanitary-microbiological research. Indication of pathogenic microbes in the environment, determination of total microbial contamination and detection of sanitary-indicative microorganisms. Microbiological aspects of environmental protection.

**Topic 8.** Human microbiocenoses. Eubiotics. Eumicrobiocenosis. Normal microflora of the human body, endogenous (autochthonous, allochthonous) and exogenous microflora of the human body. The role of normal microflora of the human body and drugs for physiological recovery. Eubiotics. Basic principles of creating microbial biologicals. Modern eubiotics (bifidumbacterin, lactobacterin, colibacterin, etc.).

**Topic 9.** Phytopathogenic microorganisms. Microbial spoilage of plant medicinal raw materials. Microbial contamination of finished dosage forms. Methods of preventing their microbial contamination. Methods for determining microbial contamination. Phytopathogenic



microorganisms. Epiphytic microflora. Diseases of medicinal plants and ways to control phytopathogenic microorganisms. Sources and ways of microbial contamination of medicinal plant medicinal raw materials, finished dosage forms. Methods for determining microbial contamination of medicinal raw materials and finished drugs.

**Content module 2. *The doctrine of infection. Basics of chemotherapy. The doctrine of immunity. Immunodiagnosics, immunotherapy and immunoprophylaxis of infectious diseases. Allergy.***

**Topic 10.** The doctrine of infection. Pathogenic or pathogenic microbes. Definitions of "pathogenicity", "virulence". Units of virulence. Characteristics of pathogenic factors (aggression enzymes, toxins, capsular polysaccharides, adhesion and colonization factors). Characteristics, classification of microbial toxins. Allergens and tolerogens of microbes. Definitions of "infection", "infectious process", "infectious disease". Features of an infectious disease. The role of microbes, macroorganisms, the environment in the occurrence of infectious diseases. Anthroponotic, zoonotic infectious diseases. Mechanisms and ways of transmission of infection. Distribution of microbes and toxins in the body: bacteremia, toxemia, viremia. Dynamics of development of an infectious disease, periods: penetration, incubation, prodromal, heat, final. Forms of infectious disease: by term - acute, subacute, chronic, persistent; by manifestations - clinically pronounced, erased, asymptomatic; by localization - focal, generalized; by origin - endogenous. exogenous. Monoinfection, mixed, secondary infection, reinfection, superinfection, relapse. Carrier. The concept of epidemic, pandemic, endemic, sporadic morbidity, nosocomial infections. Quarantine infections. Autoinfections. Disinsection, deratization. Pathogenetic features of viral infections. Experimental infection.

**Topic 11.** Basics of chemotherapy. Basic requirements for chemotherapeutic drugs. The main groups of chemotherapeutic drugs, mechanism of action, application. Antibiotics: classification, mechanism and spectrum of action. Side effects of antibiotics. Methods for determining the sensitivity of microorganisms to antibiotics. Chemotherapy of infectious diseases. The main stages of development of chemotherapy. General characteristics of chemotherapeutic drugs. Antimicrobial spectrum of chemotherapeutic drugs. Chemotherapeutic index. The main groups of chemotherapeutic and antiseptic agents: halogen preparations, oxidants, heavy metal salts, nitrofurans derivatives, dyes, aldehydes, acids, alcohols, phenols, 8-oxyquinoline derivatives, ionic and nonionic surfactants, antipyretic drugs, sulfamides antiprotozoal agents. Antibiotics. Classification of antibiotics by biological origin, mechanism of biological action, spectrum of biological action. Antibiotic resistance of bacteria. Side effects of antibiotics.

**Topic 12.** Immunity. Immunodiagnosis of infectious diseases. Nonspecific resistance of the body: protective functions of the skin, gastric juice, lymph nodes, blood, inflammation. Phagocytosis. Works by Mechnikov II Cell reactivity as a component of nonspecific resistance. Definition of "immunity". Types of immunity: hereditary, absolute, relative, acquired, natural, artificial, active, passive, sterile, non-sterile, local, general, cellular, humoral, antibacterial, antitoxic, antiviral, antiparasitic, collective, transplantation, autoimmunity. Humoral factors of natural immune system, lysines, interferons, leukins, antiviral inhibitors, lysozyme, plakin, properdin, fibronectin, etc. Interferons. Classification, inducers, mechanism of formation, biological functions (antiviral, antitumor, immunomodulatory, radioprotective). Structure and functions of the immune system. Central organs of the immune system: thymus, bone marrow, etc. Peripheral organs of the immune system: spleen, lymph nodes and follicles. Immunocompetent cells. T-lymphocytes, ontogenesis. T-cell subpopulations: T-helpers, T-suppressors, cytotoxic T-cells (T-effectors). Surface markers and receptors of these cells. B-lymphocytes, ontogenesis. B-cell subpopulations. Surface markers and receptors of these cells. Cooperation between immunocompetent cells in the process of immune response.

Mediators of the immune system, interleukins, etc. Principles and mechanisms of management and communication between them. The body's immune response. Antigens as

inducers of the immune response. Full-fledged antigens, haptens. Adjuvants. Antigenic structure of microorganisms. Localization, chemical composition and specificity of antigens of bacteria, viruses, enzymes, toxins. The role of microbial antigens in the infectious process and the development of the immune response. The concept of human antigens. Human histocompatibility antigens. Antibodies as a product of the immune response. Structure and functions of immunoglobulins. Constant and variable regions of H- and L-polypeptide chains, domains. Structure of active centers of immunoglobulins. Heterogeneity of molecules. The concept of valence of antibodies. Fc- (cellular) receptors. The mechanism of interaction of antibodies with antigens. Classes of immunoglobulins, their structure and properties. Pathological immunoglobulins. Genetics of immunoglobulins. Autoantibodies. The concept of polyclonal and monoclonal antibodies. Hybridomas as producers of monoclonal antibodies. Types of immune response. Humoral immune response and its stages: recognition, antigen rearrangement, antigen presentation to T- helpers and B-lymphocytes, proliferation and differentiation of B-lymphocytes. T- and B- dependent antigens, their effect on the immune system. Memory cells, synthesis of antibodies by plasma cells. Immunological memory. Primary and secondary immune responses. Cellular immune response. Features. Stages. Antigen recognition. Antigen-recognizing proteins, antigen rearrangement and its presentation to the corresponding T-lymphocyte clone. T-lymphocyte proliferation and differentiation. Memory cells. Sensitized T lymphocytes. Types of cellular type immune reactions: cellular immunity, transplant immunity, delayed type hypersensitivity, cellular reactions in autoimmune processes, viral diseases, tumors. Immunological tolerance: natural and acquired. Conditions of tolerance induction. Tolerance mechanism. Practical use of tolerance in medicine. Anti-infective immunity and its forms. The mechanism of immune destruction of pathogens of bacterial, viral, fungal and parasitic diseases. Immunodiagnostics. Serological reactions (antigen-antibody reactions). Characteristics of serological reactions: specificity, sensitivity, two-phase nature, reversibility. The mechanism of reactions. Practical use of serological reactions: identification of antigen, diagnostic detection of antibodies. The main components of serological reactions. Diagnostic immune sera, diagnosticum. Monoclonal antibodies, their use. Phenomena of detection and methods of registration of serological reactions. Reactions based on the phenomenon of agglutination: direct and indirect agglutination, inhibition reaction of indirect hemagglutination, reaction of inverse indirect hemagglutination, Coombs reaction (antiglobulin test). Reactions based on the phenomenon of precipitation: ring precipitation, flocculation, gel precipitation. Immune lysis reactions (bacteriolysis, spirochetolysis, hemolysis). Complement binding reaction. Immobilization reaction of microorganisms. Opsono-phagocytic reaction. Neutralization reaction (toxins, viruses, rickettsiae). Reactions using labeled antigens and antibodies: immunofluorescence (direct and indirect), enzyme-linked immunosorbent assay (direct, indirect, solid-phase, competitive), radioimmunoassay (competitive, reverse, indirect). Immunoelectron microscopy.

**Topic 13.** Immunobiological drugs for the prevention and treatment of infectious diseases. Vaccines Serums. The concept of immunobiotechnology. Immunoprophylaxis and immunotherapy of infectious diseases. Development of the doctrine of immunoprophylaxis and immunotherapy. E. Jenner, L. Pasteur, E. Bering, G. Ramon and others. Active and passive immunoprophylaxis. Drugs for active immunoprophylaxis. Modern classification of vaccines: live, inactivated, chemical, toxoids, subcomponent, genetically engineered, synthetic, antiidiotypic. Methods of manufacture, evaluation of efficiency and control. Associated vaccines. Adjuvants. Autovaccines, vaccine therapy. Methods for determining the intensity of collective immunity. Seroprophylaxis and serotherapy. Homologous and heterologous sera. Antitoxic, antibacterial, antiviral immune sera. Immunoglobulins (normal and directed action). Principles of production, purification and control of sera and immunoglobulins.

**Topic 14.** The concept of allergies. Allergy. The concept of allergies. Allergens, their production

and use. Classification of allergic reactions according to Jel and Coombs. Allergic reactions of humoral (immediate) type - ITH. Reagin type of ITH. Development mechanism. Clinical manifestations: anaphylactic shock, urticaria, Quincke's edema. Atopy: bronchial asthma, hay fever. Cytotoxic type of ITH. Mechanism of development, clinical detection. Ways to prevent. Immunocomplex type of ITH. Mechanism of development, clinical detection. Diagnostic tests to detect allergies of the humoral type. Allergic reactions of cellular (delayed) type - DTH. Mechanism of development, clinical detection: infectious, contact allergy. Methods of detection of DTH - skin allergy tests. Clinical detection.

**Semester module supervision – semester credit.**

## **MODULE 2. Special microbiology.**

**Content module 3.** Pathogens of bacterial, rickettsial diseases.

**Topic 15.** Pathogens of Escherichia coli, Shigellosis, typhoid fever and paratyphoid fever A and B, food poisoning, cholera. Classification and general characteristics. Localization in the body. Bacteriocarriers. Dissemination. Survival in the environment. Escherichia. Basic properties. Physiological role and sanitary-indicative value. Pathogenic serovars of Escherichia coli, their differentiation. Role in human pathology. Methods of microbiological diagnosis of colinfection. Prevention. Shigella. Classification. Biological properties. Role in human pathology. Pathogenesis of dysentery, the role of toxins and pathogenic enzymes. Immunity. Methods of microbiological diagnosis of dysentery. Specific therapy. Salmonella. Kaufman-White classification. Pathogenicity to humans and animals. Salmonella- pathogens of typhoid fever and paratyphoid A and B. Biological properties. Antigenic structure. Pathogenesis of diseases. Methods of microbiological diagnostics. Immunity. Bacteriocarriers. Specific prevention and therapy. Salmonella - the causative agents of nosocomial salmonellosis, food poisoning. Vibrio cholerae. Biological properties, biovars. Classification of Vibrios by Heiberg. Pathogenicity factors. Toxins, their characteristics. Pathogenesis and immunity in cholera. Methods of microbiological diagnostics. Specific prevention and treatment of cholera. Cholera spread.

**Topic 16.** Pathogens of tuberculosis, diphtheria. Mycobacteria. Classification. General characteristics. Pathogens of tuberculosis. Properties. Features of chemical composition, resistance. Pathogenicity factors. Pathogenesis. Features of immunity and allergic manifestations. Methods of microbiological diagnostics. Antimicrobial drugs. Specific prevention. Corynebacteria. Classification. The causative agent of diphtheria. Properties. Resistance. Biovars. Pathogenicity factors. Pathogenesis and immunity in diphtheria. Bacteriocarriers. Methods of microbiological diagnostics. Specific prevention and therapy.

**Topic 17.** Pathogens of meningitis, pertussis, legionellosis. Neisseria. Meningococci. Biological properties, classification. Pathogenesis and microbiological diagnosis of meningococcal diseases and bacteriocarriers. Brothels. Classification. Biological properties. The causative agent of whooping cough. Morphological, cultural, antigenic properties. Pathogenesis and immunity. Methods of microbiological diagnostics. Differentiation of pertussis, pertussis and bronchosepticosis. Specific prevention and therapy of pertussis. Legionella. Classification. Characteristics of biological properties. Ecology. Distribution in the environment. The causative agent of legionnaires' disease. Properties. Antigenic structure. Pathogenesis. Methods of microbiological diagnostics. Prevention.

**Topic 18.** Pathogens of tetanus, gas anaerobic infection, botulism. Clostridia. Classification. Ecology. Properties. Resistance to environmental factors. Toxicity. Clostridium tetanus. Properties. Pathogenicity factors, toxins. Pathogenesis. Antitoxic immunity. Methods of microbiological diagnostics. Specific treatment and prevention. Clostridia are the causative agents of wound anaerobic infection. See. Properties. Pathogenicity factors, toxins. Pathogenesis. Antitoxic immunity. Methods of microbiological diagnostics. Specific treatment and prevention.

Clostridia botulism. Properties. Pathogenicity factors, toxins. Pathogenesis. Antitoxic immunity. Methods of microbiological diagnostics. Specific treatment and prevention. **Topic 19.** Pathogens of gonorrhoea, syphilis, chlamydia, mycoplasmosis. Gonococci. Biological properties. Pathogenicity for humans, variability. Acute and chronic gonorrhoea. Immunity. Methods of microbiological diagnosis of gonorrhoea. Prevention and specific therapy of gonorrhoea and gonoblenorrhoea. Spirochetes. General characteristics of the spirochete family. Classification. Treponema. The causative agent of syphilis. Morphological, cultural properties. Pathogenesis and immunogenesis. Methods of microbiological diagnostics and specific therapy. Chlamydia. Classification. Ecology. Biological properties. Resistance. Intracellular parasitism. Antigenic structure. Pathogenicity factors. The causative agent of ornithosis. Pathogenicity to humans and animals. Pathogenesis and immunity. Microbiological diagnostics. Antimicrobial drugs. Prevention. The causative agent of trachoma. Pathogenicity to humans. Microbiological diagnostics. Antimicrobial drugs. Prevention. Mycoplasmas. General characteristics. Classification. Biological properties. Mycoplasmas - pathogens of pneumonia, acute respiratory diseases, urethritis, endocarditis. Pathogenesis, immunity. Microbiological diagnostics. Antimicrobial drugs. Prevention.

**Topic 20.** Pathogens of zoonotic infections: plague, tularemia, anthrax, brucellosis, campylobacteriosis, leptospirosis. The causative agent of plague. Properties. Resistance. Pathogenicity to humans and animals. Pathogenicity factors. Pathogenesis. Immunity. Methods of microbiological diagnostics. Specific treatment and prevention of anthrax. The causative agent of tularemia. Biological properties. Pathogenesis, immunity, methods of microbiological diagnosis and specific prevention of tularemia. Bacilli. Classification. Ecology. The causative agent of anthrax. Properties. Resistance. Pathogenicity to humans and animals. Pathogenicity factors. Pathogenesis. Immunity. Methods of microbiological diagnostics. Specific treatment and prevention of anthrax. Brucella. Classification. Biological properties. Morphological, cultural and biochemical features. Antigenic structure. Differentiation of brucellosis. Pathogenicity to humans and animals. Pathogenicity factors. Pathogenesis and immunity in brucellosis. Methods of microbiological diagnostics. Specific prevention and therapy. Helicobacter pylori (Campylobacter). Classification. Properties. See. Pathogenicity to humans. Microbiological diagnostics. Prevention and therapy. Leptospira. Classification. Pathogens of leptospirosis. Properties. Serogroups and serovar leptospira. Pathogenicity to humans and animals. Pathogenesis and immunity. Methods of microbiological diagnostics. Specific prevention.

**Topic 21.** Pathogens of epidemic lice and endemic tick-borne typhus. Borrelia. The causative agent of relapsing typhus. Pathogenesis and immunity. Methods of microbiological diagnostics. Specific prevention. Rickettsia. General characteristics and classification. Rickettsiae are the causative agents of epidemic typhus and Brill-Zinsser disease, endemic typhus, tick-borne typhus (North Asian rickettsiosis). Ecology. Biological properties. Host and carriers. Resistance. Antigenic structure. Toxin formation. Pathogenicity to humans and animals. Immunity. Methods of microbiological diagnosis of rickettsiosis. Antimicrobial drugs. Specific prevention.

**Topic 22.** Pathogens of purulent-inflammatory and nosocomial infections. Gram-positive pyogenic cocci: staphylococci, streptococci. Conditionally pathogenic rod-shaped bacteria: Pseudomonas aeruginosa, Proteus, Klebsiella. Staphylococci. Classification. Biological properties. The role of staphylococci in human pathology. Pathogenesis of the processes caused by them. Role in the development of nosocomial infections. Methods of microbiological diagnosis of staphylococcal infections. Immunity and its features. Drugs for specific prevention and therapy. Streptococci. Classification. Biological properties. Toxins, enzymes of pathogenicity. Role in human pathology. Pathogenesis of streptococcal diseases. Immunity. Methods of microbiological diagnosis of streptococcal infections. Pseudomonads. Classification. Ecology. Resistance. Pseudomonas aeruginosa. Biological properties. Pathogenicity factors. Role in the development of nosocomial infections. Microbiological diagnostics. Proteus. Etiological and pathogenetic role of proteins in purulent and mixed infections, in food poisoning. Role in

nosocomial infections. Microbiological diagnostics. Klebsiella. Characteristics of Klebsiella ozena and rhinoscleroma. Microbiological diagnosis of rhinoscleroma and ozena. Klebsiella pneumoniae and its role in human pathology.

**Content module 4.** Pathogens of viral, fungal and protozoan diseases

**Topic 23.** Pathogens of influenza, parainfluenza, mumps, measles, respiratory syncytial virus. Orthomyxoviruses (family Orthomyxoviridae). General characteristics and classification. Human influenza viruses. Structure and chemical composition of the virion. Features of the genome. Cultivation. Sensitivity to physical and chemical factors. Characteristics of antigens. Hemagglutinin, neuraminidase, matrix and nucleoprotein antigens, their localization, structure, classification, functional activity. Classification of human influenza viruses. Types of antigenic variability, its mechanisms. Pathogenesis of influenza. The value of the secondary microflora. The role of virus persistence in humans and animals in the preservation of epidemically significant strains. Immunity. Laboratory diagnostics. Specific prevention and treatment. Paramyxoviruses (family Paramyxoviridae). General characteristics and classification. The structure of the virion. Hemagglutinating and hemadsorbing properties. Antigens. Cultivation. Sensitivity to physical and chemical factors. Genus of paramyxoviruses: human parainfluenza viruses, mumps virus. Role in human pathology. Immunity. Special prevention. Genus of measles: measles virus. Biological properties. Pathogenesis of the disease. Immunity and specific prevention. Genus of pneumoviruses: respiratory syncytial virus. Biological properties. Pathogenesis of the disease. Immunity. Laboratory diagnosis of paramyxovirus infections.

**Topic 24.** The causative agent of rubella, adenoviruses. Togaviruses (family Togaviridae) (ecological group of arboviruses). General characteristics and classification. The structure of the virion. Antigens. Cultivation. Sensitivity to physical and chemical factors. Genus of rubiviruses. Rubella virus. General characteristics. Role in human pathology. Laboratory diagnostics. Adenoviruses (family Adenoviridae). General characteristics and classification. The structure of the virion. Antigens, their localization and specificity. Cultivation. Sensitivity to physical and chemical factors. Hemagglutinating activity. Pathogenesis of diseases. Persistence. Oncogenic serotypes of adenoviruses. Laboratory diagnosis, specific prevention and treatment.

**Topic 25.** Pathogens of polio, hepatitis A. Picornaviruses (family Picornaviridae). General characteristics and classification. Enteroviruses. Polio viruses. Characteristics of the virion. Antigens. Cultivation. Sensitivity to physical and chemical factors. Pathogenesis of polio. Immunity. Laboratory diagnostics. Specific prevention and therapy. Enterovirus 72 - hepatitis A virus. Biological properties. Pathogenesis of the disease. Immunity. Laboratory diagnostics. Approaches to specific prevention.

**Topic 26.** Pathogens of viral hepatitis B, AIDS, herpes. Hepadnaviruses (family Hepadnaviridae). General characteristics and classification. Hepatitis B virus. History of study. The structure of the virion. Surface antigen of Dane HBs particles. Sensitivity to physical and chemical factors. Features of the pathogenesis of the disease. Persistence. Immunity. Microbiological diagnostics, detection methods and diagnostic value of hepatitis B markers (antigens and antibodies). Specific prevention and treatment. Retroviruses (family Retroviridae). General characteristics and classification. Human immunodeficiency virus (HIV). Structure and chemical composition of the virion. Features of the genome. Antigenic variability, its mechanisms. Classification of pathogens. Origin and evolution. Cultivation, stages of interaction with sensitive cells. Sensitivity to physical and chemical factors. Pathogenesis of HIV infection. Target cells in the human body, characteristics of surface receptors. Acquired immunodeficiency syndrome (AIDS). The mechanism of immunodeficiency development. AIDS-associated infections. Laboratory diagnostics. Chain polymerase reaction in the diagnosis of HIV infection. Treatment (etiologic, immunomodulatory, immunosuppressive). Prospects for specific prevention. Herpesviruses (family Herpesviridae). General characteristics and classification. The structure of the virion. Antigens. Cultivation. Sensitivity to physical and chemical factors. Herpes viruses pathogenic to humans: Alphaherpesvirus chickenpox, shingles. Cytomegaly

beta herpesvirus. Epstein-Barr gammaherpesvirus is the causative agent of infectious mononucleosis, human cancer. Human herpes virus type 6. Biological properties. Role in human pathology. The mechanism of persistence of the herpes virus. Laboratory diagnosis, prevention and treatment of herpes infections.

**Topic 27.** Pathogens of rabies, tick-borne encephalitis. Rhabdoviruses (family Rabdoviridae). General characteristics and classification. Rabies virus. Biological types. The structure of the virion. Cultivation. Sensitivity to physical and chemical factors. Pathogenicity to humans and animals. Pathogenetic features of the disease. Intracellular inclusions (Babes-Negri bodies). Laboratory diagnostics. Specific prevention. Flaviviruses (family Flaviviridae) (ecological group of arboviruses). Tick-borne encephalitis virus. Biological properties, ecological variants of the pathogen. Distribution in nature. The mechanism of transmission of the pathogen to humans. Pathogenesis and immunogenesis. The role of domestic scientists in the study of flavivirus infections (LO Zilber, MP Chumakov, AK Shubladze, etc.). Laboratory diagnosis, specific prevention and treatment.

**Topic 28.** Pathogens of dermatomycoses, deep mycoses, candidiasis, actinomycosis. Pathogenic fungi. Dermatophytes - pathogens of dermatomycoses (epidermatophytosis, trichophytosis, microsporia, favus). Properties. Pathogenicity to humans. Microbiological diagnostics. Antimicrobial drugs. Pathogens of deep mycoses: chromomycosis, cryptococcosis. Properties. Pathogenicity to humans. Microbiological diagnostics. Antimicrobial drugs. Yeast-like fungi of the genus *Candida*. Properties. Pathogenicity to humans. Factors that contribute to the emergence of candidiasis (dysbacteriosis, etc.). Microbiological diagnostics. Antimicrobial drugs. Prevention. Pathogens of aspergillosis and penicillinosis. Properties. Pathogenicity to humans. Actinomycetes. General characteristics of the genus Actinomycetes. The causative agent of actinomycosis. Ecology. Resistance. Properties. Pathogenesis of the disease. Immunity. Methods of microbiological diagnostics. chemotherapeutic drugs. Immunotherapy. Prevention.

**Topic 29.** Pathogens of amebiasis, balantidiasis, giardiasis. Pathogenic protozoa. Amoebae, balantidia, *Giardia*. Classification. Ecology. Biological properties. Properties. Pathogenesis and microbiological diagnosis of diseases. Antimicrobial drugs. Prevention.

**Topic 30.** Pathogens of trypanosomiasis, malaria. Pathogenic protozoa. Classification. Ecology. Biological properties. Trypanosomes. Properties. Pathogenesis and microbiological diagnosis of diseases. Antimicrobial drugs. Prevention. Plasmodia of malaria. Development cycles. Pathogenesis and immunity. Microbiological diagnostics. Antimicrobial drugs. Prevention.

**Topic 31.** Pathogens of trichomoniasis, toxoplasmosis, leishmaniasis. *Trichomonas*, toxoplasma, leishmaniasis. Properties. Pathogenesis and microbiological diagnosis of diseases. Antimicrobial drugs. Prevention.

**Semester module supervision \_ semester credit.**

**Examination**

## 6. Topics of lectures

№	Name of topic	The amount of hours
		full time study
<b>Module 1. General microbiology</b>		
1	Morphology of prokaryotes.	
2	Morphological and biological features of eukaryotes.	1
3	Physiology of microorganisms.	2
4	Viruses: general characteristics, features of cultivation. Bacteriophages.	1
5	Genetics of microorganisms. Microbiological aspects of genetic engineering and medical biotechnology.	

6	Ecology of microorganisms. Forms of symbiosis. Microflora of soil, water and air, sanitary-indicative microorganisms.	2
7	Influence of environmental factors on microorganisms. The concept of asepsis, antiseptics, disinfection. Sterilization. Sterilization methods.	2
8	Human microbiocenoses. Eubiotics. Principles of probiotic therapy.	1
9	Phytopathogenic microorganisms. Microbiological control of medicinal raw materials and finished drugs	2
10	The doctrine of infection.	1
11	Antimicrobial chemotherapy. The main groups of chemotherapeutics. Modern requirements for them.	1
12	Problems of drug resistance of microorganisms. Side effects of antibiotics	1
13	The doctrine of immunity.	2
14	Immunobiological drugs for the prevention and treatment of infectious diseases.	2
15	Methods of laboratory diagnosis of bacterial and viral infections	
<b>Module 2. Special microbiology</b>		
16	Pathogens of typhoid fever, cholera.	
17	Pathogens of tetanus, botulism	1
18	The causative agent of tuberculosis, diphtheria.	1
19	Pathogens of zoonotic infections: anthrax, plague, rabies	1
20	Pathogens of sexually transmitted infections: syphilis, ureaplasmosis	
21	Pathogens of influenza, measles, rubella.	1
22	Pathogens of polio, hepatitis A	
23	Pathogens of viral hepatitis B, AIDS. AIDS-associated infections.	1
24	Pathogens of candidiasis, dermatomycoses.	1
25	Modern aspects of prion infections.	
26	Nosocomial infections.	1
27	Emergency microbiology.	
<b>The whole amount of hours</b>		<b>26</b>

## 7. Topics of practical lessons

№	Name of topic	The amount of hours
		full time study
1-2	The concept of microbiology. Morphology of prokaryotes.. Principles of classification and taxonomy of microorganisms. Main taxonomic categories. Binary nomenclature of microorganisms. Methods of microscopy. Morphology of bacterias. Simple and complex methods of staining.	3

3-4	Morphology of eukaryotes.	3
5-6	Physiology of prokaryotes.	3
7	Morphology and biology of viruses.	3
8	Action of physical, chemical and biological factors on microorganisms.	3
9	Environmental microflora.	3
10	Human microbiocenoses. Eubiotics. <b>Content module control 1</b>	3
11	Phytopathogenic microorganisms. Microbial spasm of plant medicinal raw materials. Microbial contamination of the finished dosage forms	3
12	The doctrine of infection.	3
13	Fundamentals of chemotherapy. Antibiotics	3
14-15	Immunity. Immunodiagnosis of infectious diseases.	3
16-17	Immunobiological preparations for the prevention and treatment of infectious diseases. The concept of immunobiotechnology <b>Content module control 2</b>	3
	<b>Semester credit</b>	3
<b>MODULE 2. SPECIAL MICROBIOLOGY.</b>		
	Pathogens of escherichiosis, shigellosis, typhoid fever and paratyphoid A and B, food poisonous infections, cholera.	4
	Pathogens of tuberculosis, diphtheria.	4
	The causative agents of gonorrhoea, syphilis, chlamydia, mycoplasmosis.	4
	Pathogens of tetanus, gas anaerobic infection, botulism. <b>Content module control 3</b>	4
	Pathogenic agents of respiratory viral infections^ influenza, veasels, rubella.	4
	Pathogens of viral hepatitis A, Polio. Rabies pathogen.	4
	Pathogens of viral hepatitis B, C. AIDS. AIDS-associated infections.	4
	Pathogens of dermatomycosis, deep mycoses, candidiasis, actinomycosis <b>Content module control 4</b>	4
	<b>Semester credit</b>	4

### 8. Self-study work

№	Name of topic	The amount of hours
		full time study
1	The main stages of microbiology development. Founders of microbiology, virology and immunology as founders of the main directions of development discipline. The first ideas about the emergence of infectious diseases.	2
2	Methods of microscopy: dark-field, phase-contrast, luminescent, electron microscopy (principles of structure, purpose, magnification possibilities).	2
3	Morphology of prokaryotes - rickettsia, chlamydia, mycoplasma, actinomycetes.	2
4	Morphology of protozoa. Basic forms, sizes, features of structure. Functions of structural elements.	3
5	Morphology of fungi. Features of structure. Functions of structural elements.	3
6	Features of reproduction and cultivation of viruses, rickettsia, chlamydia,	6



	mycoplasmas, actinomycetes.	
7	Physiology of prokaryotes	6
8	Fundamentals of genetics. DNA as the material basis of hereditary properties. Types of variability: genotypic, phenotypic. Mutations - spontaneous and induced. Genetic recombination: conjugation, transformation and transduction. Extrachromosomal heredity factors (plasmids), their role in formation of antibiotic resistance. Heterology of populations microorganisms. Types and mechanisms of population variability. The concept of dissociation of bacteria. The importance of variability in the evolution of microorganisms.	4
9	Practical use of the laws of genetics in the production of vaccines and strains - producers of biologically active substances. Microbiological basics of genetic engineering and biotechnology. The concept of engineering enzymology.	2
10	Thermophiles, mesophiles, psychrophiles. The effect of physical, chemical and biological factors on microorganisms. Aseptic, antiseptic, preservation, disinfection, sterilization. Disinfectants. Methods of sterilization.	3
11	Main groups of antiseptics: halogen preparations, oxidants, heavy metal salts, nitrofurans derivatives, dyes, aldehydes, acids, alcohols, phenols, 8-oxyquinoline derivatives, ionic and non-ionic surface-active substances.	3
12	The concept of gnotobiology. Natural microbiocenoses and their forms: symbiosis (mutualism, commensalism, parasitism), antibiosis (isoantagonism, heteroantagonism). Anabiosis, metabiosis.	6
13	Indication of pathogenic microbes in environmental objects, determination of total microbial contamination and detection of sanitary indicative microorganisms. Microbiological aspects of environmental protection. environment protection.	5
14	Phytopathogenic microorganisms and their distribution.	5
15	Eubiotics. Basic principles of creation of microbial biological products. Modern eubiotics (bifidum bacterin, lactobacillin, colibacterin, etc.).	
16	Chemotherapeutic drugs. Modern directions of search for BAS with antimicrobial activity.	3
17	Works of Mechnikov I.I. Cell reactivity as a component of nonspecific resistance. Interferons. Classification, inducers, mechanism of formation, biological functions (antiviral, antitumor, immunomodulatory, radioprotective).	1
18	Central organs of the immune system: thymus, bone marrow, etc. Peripheral organs of the immune system: spleen, lymph nodes and follicles.	0,5
19	The concept of human antigens. Human histocompatibility antigens.	0,5
20	Pathological immunoglobulins. Genetics of immunoglobulins. Autoantibodies. The concept of polyclonal and monoclonal antibodies. Hybridomas as producers of monoclonal antibodies.	1
21	Types of immune response. Humoral immune response and its stages: recognition, rearrangement of antigen, presentation of antigen to T-helper and B-lymphocytes, proliferation and differentiation of B-lymphocytes. T- and B-dependent antigens, their influence on the immune system. Memory cells, synthesis of antibodies by plasma cells. Immunological memory. Primary and secondary immune responses.	1
22	Cellular immune response. Features. Stages. Recognition of antigen. Antigen recognition proteins, restructuring of the antigen and its presentation to the appropriate clone of T-lymphocytes. Proliferation and differentiation of T-lymphocytes. Memory cells. Sensitized T-lymphocytes. Types of cell-type immune reactions: cellular immunity, transplantation immunity, delayed type hypersensitivity, cellular reactions in autoimmune processes, viral diseases, tumors.	1

23	Immunological tolerance: natural and acquired. Conditions of induction of tolerance. Mechanism of tolerance. Practical use of tolerance in medicine.	1
24	Reaction of immobilization of microorganisms. Opson-phagocytic reaction. Reaction of neutralization (toxins, viruses, rickettsia). Reactions with using labeled antigens and antibodies: immunofluorescence (direct and indirect).	1
25	Enzyme-linked immunosorbent assay (direct, indirect, solid-phase, competitive), radioimmune method (competitive, reverse, indirect). Immunoelectron microscopy. Immunoblotting reaction. Polymerase chain reaction.	1
26	Development of the doctrine of immunoprophylaxis and immunotherapy. E. Jenner, L. Pasteur, E. Behring, G. Ramon et al.	4
27	Associated vaccines. Adjuvants. Autovaccines, vaccine therapy. Methods determination of the intensity of collective immunity.	4
28	Allergy. The concept of allergy. Allergens, their production and use. Classification of allergic reactions by Jell and Coombs. Allergic reactions humoral (immediate) type - HST. Reagin type of HST. The mechanism of development. Clinical manifestations: anaphylactic shock, urticaria, edema Quincke. Atopy: bronchial asthma, pollenosis. Cytotoxic type of HNT. Mechanism of development, clinical detection. Ways of prevention. Immunocomplex type of HNT. Mechanism of development, clinical detection. Diagnostic tests for detection of humoral allergies. Allergic reactions of cellular (delayed) type - HIT. Mechanism of development, clinical detection: infectious, contact allergy. Methods of detection HUT - skin allergy tests. Clinical detection.	1
29	Pathogens of meningitis, whooping cough, legionellosis	2
30	Pathogens of tetanus, gas anaerobic infection, botulism.	
31	Pathogens of shigellosis, salmonellosis-food toxic infections	
32	The causative agent of tuberculosis, diphtheria, pertussis. Features of epidemiology of tuberculosis of tuberculosis in Ukraine.	
33	Pathogens of mycoplasmosis.	
34	Pathogens of campylobacteriosis, leptospirosis	1
35	Pathogens of typhoid fever, epidemic typhus and Brill-Zinsser disease, endemic typhus, tick-borne typhus (North Asian rickettsiosis).	2
36	Gram-positive pyogenic cocci: staphylococci, streptococci.	0,5
37	Conditionally pathogenic rod-shaped bacteria: Escherichia coli, Proteus, Klebsiella	0,5
38	Pathogens of zoonotic infections	2
39	Pathogens of influenza, parainfluenza, mumps, measles, respiratory syncytial virus.	1
40	Rubella pathogen, adenoviruses.	1
41	Pathogens of poliomyelitis, hepatitis A	2
42	Pathogens of hepatitis C, D, herpes.	
43	Causative agents of tick-borne encephalitis	
44	Pathogens of dermatomycoses, deep mycoses (chromomycosis, cryptococcosis), candidiasis, actinomycosis.	
45	Pathogens of amebiasis, balantidiasis, giardiasis	2
46	Pathogens of trypanosomiasis, malaria.	2
47	Pathogens of trichomaniasis, toxoplasmosis, leishmaniasis.	2
48	Examination	
<b>The whole amount of hours</b>		<b>96</b>

## Tasks for Self-study work

1. Preparation of lecture notes on the topic.
2. Performing tasks in the workbook.
3. Testing on the topic.

### 9. Criteria and evaluation order of educational outcomes

#### 1. Evaluation system for the educational component

The success of the applicant for higher education in the semester (module) is evaluated on a 100-point scale, which consists of the current control of theoretical, practical training at each lesson, independent work, the results of content module controls.

Points from the educational component are awarded according to the ratio given in Table 1.

Points from the educational component are awarded according to the following ratio

Types of assessment	Maximum number of points (% of the number of points per module - for content modules)
<b>MODULE 1</b>	
Content module 1: <i>The concept of microbiology. Morphology of microorganisms. Physiology of microorganisms. Human and environmental microflora.</i> - Assessment of topics (1-8) (work in classes 1-8): work in classes (oral questioning, test tasks); - control of content module 1 (test tasks, oral questioning).	50 (50 %)
Content module 2: <i>Phytopathogenic microorganisms. Microbial spoilage of plant medicinal raw materials, microbial contamination of finished dosage forms. The doctrine of infection. Fundamentals of chemotherapy. The doctrine of immunity. Immunodiagnostics, immunotherapy and immunoprophylaxis of infectious diseases. Allergies.</i> - Assessment of topics (9-14) (work in classes 9-14): work in classes (oral questioning, test tasks); - control of content module 2 (test tasks, oral questioning).	50 (50 %)
<b>Semester control of module 1</b>	<b>100</b>
Content module 3: <i>Pathogens of bacterial, rickettsial diseases.</i> - evaluation of topics (15-21) (work in classes 15-21): work in classes (oral questioning, test tasks, solving situational problems); - control of content module 3 (test tasks, oral questioning).	50 (50 %)
Content module 4: <i>Pathogens of viral, fungal and protozoal diseases</i> - assessment of topics (22-30) (class work 22-30): class work (oral questioning, test tasks, solving situational problems); - control of content module 4 (test tasks, oral questioning).	50 (50 %)
<b>Semester control of module 2</b>	<b>100</b>

The maximum number of points assigned to higher education students for mastering a module (credit) is 100, including for current learning activities (conducted at each practical lesson, including control of theoretical knowledge, practical skills) and the results of control of mastering content modules.

The minimum number of points assigned to higher education applicants for mastering the

module (credit) is 60, including for current learning activities (conducted at each practical lesson, including control of theoretical knowledge, practical skills) and the results of control of mastering content modules.

When assessing the knowledge of higher education students, preference is given to a standardized method of control - oral questioning, written questioning, testing and control of practical skills.

Applicants for higher education have the opportunity to receive incentive (additional) points (up to 10 points):

participation in the Republican Student Olympiad - 10 points;

participation in the university student scientific conference - 8 points;

participation in the departmental stage of the student scientific conference - 6 points;

publication of scientific works - 10 points;

writing essays - 1-4 points;

preparation of illustrative material (multimedia presentation, sets of tables, diagrams) - 1-4 points.

**The current control rating** is calculated on a cumulative basis.

Depending on the curriculum of the current academic year, the number of classes per semester may vary, but the overall rating is in accordance with the ECTS scale.

At the practical class, the assessment of higher education students is made according to the criteria given in Table 2.

Table 2.

#### Criteria for evaluating the results of learning activities in practical classes

Scale	Criteria	Evaluation of the lesson in points, min - max
<b>"5" excellent 90-100%</b>	Tasks for independent preparation for the lesson are completed correctly and in full. Answers to theoretical questions on the topic of the lesson are given correctly and clearly. Practical tasks during classroom work are completed correctly and in full.	4,5-5,0
<b>"4" very good 82-89%</b>	Tasks for self-preparation for the class are completed correctly and in full. Answers to theoretical questions on the topic of the class are provided in full with minor deviations. Practical tasks during classroom work are performed with minor deviations.	4,1-4,4
<b>"4-" good 74-81%</b>	Tasks for self-preparation for the class are performed with minor errors. Answers to theoretical questions on the topic of the class are incomplete with inaccuracies. Practical tasks during classroom work are performed with minor deviations.	3,7-4,0
<b>"3" Satisfactory 64-73%</b>	Tasks for self-preparation for the class are performed with significant errors. Answers to theoretical questions on the topic of the class are provided incompletely or with significant errors. Practical tasks during classroom work are performed with significant deviations.	3,2-3,6

<b>"3-" enough 60-63%</b>	Tasks for independent preparation for the class are partially completed and with significant errors. Answers to theoretical questions on the topic of the class are incomplete with significant errors. Practical tasks during classroom work are partially completed with significant deviations.	3,0-3,1
<b>"2" Unsatisfactory 0-59%</b>	Tasks for independent preparation for the class are not completed or completed incorrectly. Answers to theoretical questions on the topic of the class are not provided. Practical tasks during classroom work are not completed or completed incorrectly.	0-2,9

**The control of mastering the content modules (CM)** is carried out at the last practical lesson of studying the topics of CM. Only those applicants for higher education who have completed all types of work provided by the curriculum, worked out the missed practical classes are allowed to control the CM. The means of diagnosing the level of training of higher education applicants are testing, theoretical oral or written questioning. The result of control of mastering the content module is set according to the criteria given in Table 3.

Table 3.

**Criteria for evaluating the results of control of content modules**

	Evaluation in points, min - max	Criteria		
		Passing test tasks	Answer to the question	Solving the situational problem
Control CM 1, CM 2	6-10	4-6	2-4	-
	6-10	4-6	2-4	-
Control CM 3, CM 4	12-20	9-15	-	3-5
	18-30	12-20	-	6-10

The structure of the ticket for the control of the content modules includes 30 test tasks, questions (WP 1, WP 2) or a situational task (WP 3, WP 4).

**Semester control** is carried out in the form of a semester test and a semester exam on the educational component in the amount of educational material determined by the work program and in the terms established by the curriculum.

The results of semester control in the form of a semester test are evaluated on a 100-point, non-differentiated scale ("passed", "not passed") and on the ECTS scale.

A higher education applicant is considered admitted to semester control if he has worked all the classroom classes provided by the work program for the educational component, has completed all the types of work provided by the work program for the educational component.

A higher education applicant receives a credit at the last lesson of the educational component based on the results of the current assessment. This type of final control does not provide any additional work, surveys or testing at the last lesson.

The final grade for the educational component for the semester is the final semester grade,

which consists of the points of the current control.

Grades A, B, C, D, E are assigned only to higher education students who have enrolled in the educational component.

The structure of the ticket for the control of the content modules includes 30 test tasks, questions (CM 1, CM 2) or a situational task (CM 3, CM 4).

Semester control is carried out in the form of a semester test and a semester exam on the educational component in the amount of educational material determined by the work program and in the terms established by the curriculum.

The results of semester control in the form of a semester test are evaluated on a 100-point, non-differentiated scale ("passed", "not passed") and on the ECTS scale.

A higher education applicant is considered admitted to semester control if he has worked all the classroom classes provided by the work program for the educational component, has completed all the types of work provided by the work program for the educational component.

A higher education applicant receives a credit at the last lesson of the educational component based on the results of the current assessment. This type of final control does not provide any additional work, surveys or testing at the last lesson.

The final grade for the educational component for the semester is the final semester grade, which consists of the points of the current control.

Grades A, B, C, D, E are assigned only to higher education students who have enrolled in the educational component.

The FX grade corresponds to "unsatisfactory" ("not enrolled") and the student may be admitted to the semester control subject to certain additional work.

They have the right to repeat the test during the winter holidays and within 2 (additional) weeks after the end of the spring semester according to the schedule approved by the rector.

Applicants for higher education who received a grade of F, which corresponds to "unsatisfactory" ("not enrolled") must re-study the educational component.

Higher education applicants who, during the study of the educational component, had the results of semester control in all semesters from 91 to 100 points are exempted from taking the exam (by agreement), while the presence of the higher education applicant at the exam is mandatory. In this case, the grade that the applicant for higher education received as an average for 2 semesters during which the educational component was studied is set.

In case of disagreement with the grade, this category of higher education applicants passes the exam according to the general rules.

The structure of the semester exam ticket includes 20 test tasks, 2 questions from module 1 "General Microbiology" and a situational task from module 2 "Special Microbiology".

The evaluation criteria for the semester exam are given in Table 4.

Table 4.

**Criteria for evaluating the results of learning activities at the semester exam**

<b>Criteria</b>	<b>Evaluation of the lesson in points, min - max</b>
Passing test tasks	24-40
Answers to 2 questions from module 1 "General Microbiology".	12-20
Solution of the situational task from module 2 "Special microbiology"	24-40
Total for the semester exam	60-100

The results of semester control in the form of a semester exam are evaluated on the ECTS scale, 100-point and four-point scale ("excellent", "good", "satisfactory", "unsatisfactory") (Table 5).

Table 5.

**Transformation of the national grading scale into the ECTS system (European Community Course Credit Transfer System. European Community Course Credit Transfer System)**

Sum of points for all types of educational activities		Evaluation on the national scale
90-100	A	excellent
82-89	B	good
74-81	C	
64-73	D	satisfactory
60-63	E	
35-59	FX	unsatisfactory with the possibility of retaking
1-34	F	unsatisfactory with mandatory re-study of the discipline

**Scoring scheme and points distribution**

Distribution of points for module 1

Current testing and independent study																Total
Content module 1									Content module 2							
T 1	T 2	T 3	T 4	T 5	T 6	T 7	T 8	CCM 1	T 9	T 10	T 11	T 12	T 13	T 14	CCM 2	
5	5	5	5	5	5	5	5	10	5	5	5	10	10	5	10	100

Distribution of points for module 2

Current testing and independent study																	Total
Content module 3									Content module 4								
T 15	T 16	T 17	T 18	T 19	T 20	T 21	T 22	K3M 3	T 23-24	T 25, 27	T 26	T 28	T 29	T 30	T 31	K3M 4	
5	-	5	5	5	5	-	5	30	5	5	5	5	-	-	-	30	100

## 10. Forms of progress and semester supervision of academic achievements

**Form of control** - semester credit, semester exam.

**Current control** is carried out systematically during the semester during practical classes and is evaluated by the amount of points gained for the assessment of theoretical knowledge, practical skills and independent work of the applicant for higher education, as well as control of content modules, and is conducted during classroom classes. Current control is mandatory, the knowledge of higher education students is assessed at each lesson (on each topic).

**Control of practical work** is carried out at each practical lesson in accordance with specific goals. It includes oral questioning, individual interview, testing, evaluation of practical tasks.

**Control of independent work** assesses the level of knowledge that higher education students acquire independently during self-preparation for classes, as well as working through the list of questions included in certain modules. Independent work of higher education students is evaluated during the current control and during the content module.

**Semester control** is carried out in the form of a semester test and a semester exam on the educational component in the amount of educational material determined by the work program and in the terms established by the curriculum.

A higher education applicant is considered admitted to semester control if he has worked all the classroom classes provided by the work program for the educational component, has completed all the types of work provided by the work program for the educational component. A higher education applicant receives a credit at the last lesson of the educational component based on the results of the current assessment. This type of final control does not provide any additional work, surveys or testing at the last lesson.

Credit is given to applicants for higher education who have scored the required minimum number of points during the current control (60 points and above), have no unexcused absences from practical classes and have fulfilled all the requirements provided by the work program of the educational component.

## 11. Methodological support

- a. Workbook on microbiology, virology and immunology : [for classroom and out-of-class work of students of higher educational institutions studying in the specialty "Pharmacy"] / NUPh, Dep. of Microbiology, Virology and Immunology. Part 1 : General microbiology / N. I. Filimonova, O. A. Shakun, I. Yu. Tyshchenko, 2021. - 96 p.
- b. Workbook by Microbiology to prepare for the licensed exam "Krok-1" : [designed for classroom and extracurricular work of students and teachers of higher education in the specialty "Pharmacy"] / N. I. Filimonova [et al.], 2020. - 146 p.
- c. Moodle distance learning system  
<https://pharmel.kharkiv.edu/moodle/course/view.php?id=3470&notifyeditingon=1>  
<https://pharmel.kharkiv.edu/moodle/course/view.php?id=4035>

## 12. Reading suggestions

### The main reading suggestions

1. General microbiology: synopsis of lectures to laboratory classes. / N. I. Filimonova, M. M. Velika, NY Sheveleva.- Kharkiv: NUPh: Golden Pages, 2011. - 128 p.
2. Microbiology: method. recommend. for in-class work of students / edited by N.I.Filimonova/ - Kharkiv : NUPh, 2019/ - 98 p.

### Supplementary reading suggestions

1. Blinder O. O. General Microbiology and Basics of Immunology [Text] : textbook / O. O. Blinder, L. Y. Sydoruk, O. A. Olenovich ; Bukovinian State Medical University. — Chernivtsi : [s. n.], 2016. — 219 p.



2. Medical Microbiology / ed. M. R. Barer [et al.]. — 19th ed. — Philadelphia : Elsevier, 2018. — XV, 7483 p. : il.
3. MIMS' Medical Microbiology and Immunology/ R. V. Goering [et al.]. — 6th ed. — Edinburgh : Elsevier, 2019. — XV, 552 p. : il.
4. Infectious diseases [Text] : textbook / O. A. Holubovska [et al.] ; ed. O. A. Holubovska. — Kyiv : Medicine, 2018. — 664 p. : il. — Approved by the Ministry of Education and Science of Ukraine (letter № 1/11-8095, 28 May 2012). Approved by the Ministry of Health of Ukraine (the letter № 23-01-8/130, 15 June 2012). — Bibliogr.: p. 655-660. — Index: p. 661-662. — ISBN 978-617-505-727-8

### 13. Electronic resources, including the Internet

1. Department of Microbiology, Virology and Immunology of NUPh. <http://microbiology.nuph.edu.ua/>
2. Scientific library of NUPh. <http://lib.nuph.edu.ua>
3. <http://www.webmedinfo.ru> Medical information and review portal. Pozdeev OK, Pokrovsky VI Medical microbiology. Book in DJVU format. Pages: 765 pages Year of publication: 2001 Archive size: 25.3 MB.
4. <http://www.booksmed.com> / Tec VVMicroorganisms and antibiotics - Infections of the skin, soft tissues, bones and joints. Book in PDF format. Pages: 128 pages Year of publication: 2006 Archive size: 1.5 MB.
5. <http://www.booksmed.com> / Ruanet VV Theory and technique of laboratory work. Book in DJVU format. Pages: 175 pages Year of publication: 2007 Archive size: 2.9 MB.
6. <http://www.booksmed.com> / V.V. Zverev, MN Boychenko. Medical microbiology, virology and immunology. IN2 volumes Volume 1. Book in PDF format. Pages: 448 pages Year of publication: 2010 Archive size: 50.1 MB. Volume 2. Book in PDF format. Pages: 480 pages Year of publication: 2010 Archive size: 57.4 MB.