

MINISTRY OF HEALTH OF UKRAINE
ODESA NATIONAL MEDICAL UNIVERSITY

Department of Microbiology, Virology and Immunology

CONFIRMED by



Acting vice-rector for scientific and pedagogical work

Eduard BURIACHKIVSKYI

September 1st, 2023

WORKING PROGRAM IN THE DISCIPLINE
«MICROBIOLOGY, VIROLOGY AND IMMUNOLOGY»

Level of higher education: second (master's degree)

Field of knowledge: 22 «Health care»

Specialty: 222 «Medicine»

Educational and professional program: Medicine

The working program is compiled on the basis of the educational and professional program "Medicine" for the training of specialists of the second (master's) level of higher education in the specialty 222 "Medicine" of the field of knowledge 22 "Health care", approved by the Academic Council of ONMedU (minutes No. 8 dated 29/06/2023).

Authors:

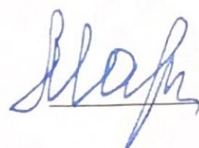
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The working program is approved at the meeting of the department of Microbiology, Virology and Immunology
 Minutes No. 1 dated 28/08/2023.

Head of the department

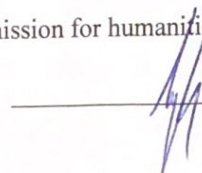
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Approved by the guarantor of
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 Valeriia MARICHEREDA

Approved by the subject-cycle methodological commission for medico-biological disciplines of ONMedU
 Minutes No. 6 dated 30/06/2023

Head of the subject-cycle methodological commission for humanities of ONMedU

 Leonid GODLEVSKY

Revised and approved at the meeting of the department *of General and Clinical Epidemiology and Biosafety with course in Microbiology and Virology*
 Minutes No. 1 dated 01/09/2023

Head of the department

 Mykola Kolybiatnykov

Revised and approved at the meeting of the department _____

Minutes No. ___ dated ___/___/20__.

Head of the department _____

1. Description of the discipline:

Name of indicators	Field of knowledge, specialty, specialization, level of higher education	Characteristics of the discipline
Total number:	Field of knowledge 22 «Health care»	<i>Full-time (day) education</i>
Credits of ECTS: 7		<i>Compulsory discipline</i>
Hours: 210	Specialty 222 «Medicine»	<i>Course: 2</i>
Content modules: 5		Level of higher education second (master's degree)
	<i>Lectures (28 hours)</i>	
	<i>Seminars (0 hours)</i>	
	<i>Practical classes (112 hours)</i>	
	<i>Laboratories (0 hours)</i>	
	<i>Independent work (70 hours)</i>	
		<i>including individual tasks (0 hours)</i>
		<i>Form of final control – Exam</i>

2. The purpose and tasks of the educational discipline, competencies, program learning outcomes

The purpose is to master the knowledge about the physiological role of microorganisms in the human body, their interaction with the human body; mechanisms of development of infectious diseases; to form the ability to determine the necessary methods of diagnosis, specific prevention and treatment of infectious diseases.

The tasks of the discipline are the following:

1. To teach to interpret the biological properties of pathogenic and non-pathogenic microorganisms, viruses and the patterns of their interaction with the macroorganism, with the human population and the environment.

2. To form the ability to determine the methods of microbiological and virological diagnostics, etiotropic therapy and specific prevention of infectious diseases.

3. To explain the structure of the immune system of the human body.

4. To form the ability to interpret the main mechanisms of the formation of the body's immune response.

5. To form the ability to determine the main types of pathological reactions of the immune system and their role in the development of the most common human diseases.

The process of studying the discipline is aimed at forming elements of following competencies:

- **General competencies:**

IC. Ability to solve typical and complex problems, including those of a research and innovation nature in the field of medicine. Ability to continue learning with a high degree of autonomy.

GC 2. Ability to learn and master modern knowledge

GC 3. Ability to apply knowledge in practical situations

GC 4. Knowledge and understanding of the subject area and understanding of professional activity

GC 5. Ability to adapt and act in a new situation

GC 6. Ability to make reasonable decisions

- **Special competencies are:**

SC 2. Ability to determine the necessary list of laboratory and instrumental studies and evaluate their results

SC 3. Ability to establish a preliminary and clinical diagnosis of the disease

SC 4. Ability to determine the necessary regime of work and rest in the treatment and prevention of diseases

SC 5. Ability to determine the nature of nutrition in the treatment and prevention of diseases

SC 6. Ability to determine the principles and nature of treatment and prevention of diseases

SC 14. Ability to plan and carry out preventive and anti-epidemic measures for infectious diseases

SC 28. Ability to apply fundamental biomedical knowledge at a level sufficient to perform professional tasks in the field of health care

Program learning outcomes are:

PLO 7. Assigning and analyzing additional (mandatory and optional) examination methods (laboratory, functional and/or instrumental) (according to list 4) of patients with diseases of organs and body systems for differential diagnosis of diseases (according to list 2).

PLO 19. Planning and implementing a system of anti-epidemic and preventive measures regarding the occurrence and spread of diseases among the population.

PLO 20. Analyzing the epidemiological situation and carrying out measures for mass and individual, general and local prevention of infectious diseases.

PLO 23. Assessment of the impact of the environment on human health to assess the morbidity of the population.

PLO 29. Planning, organising and carrying out measures for the specific prevention of infectious diseases, including by the National calendar of preventive vaccinations, both mandatory and recommended. Managing vaccine residues, and organization of additional vaccination campaigns, including immunoprophylaxis measures.

As a result of studying the discipline, the student has to

Know:

- algorithm for carrying out serological reactions in infectious diseases;
- algorithm for conducting microbiological research of biological fluids and secretions;
- an algorithm for conducting chemical, organoleptic, bacteriological types of studies on the quality of food and water.

Be able:

- to evaluate the results of laboratory and instrumental studies;
- to predict the negative consequences of exposure to dangerous factors on the human body;
- to master modern methods of microbiological research in infectious diseases;
- to analyze the principles of vaccines production, methods of their standardization, control and practical use;
- to master the principles immune sera production, methods of their standardization, control and practical use;
- to interpret the development of medicine in historical retrospective;
- to interpret the main historical and medical events;
- to demonstrate possession of moral and ethical principles of treating a living person, their body as an object of anatomical and clinical research.

3. The content of the educational discipline

Content module 1. General microbiology

Theme 1. Subject and tasks of medical microbiology. Equipment and organization of laboratory. Microscopic method of studying microorganisms. Microscopy technique.

Definition of microbiology as a science. Medical microbiology and its sections. Tasks of medical microbiology. Methods of microbiological research: microscopy, staining, cultivation, isolation of pure cultures, immunological methods, animal modeling, virological methods, biotechnological and genetic engineering methods. The relationship of medical microbiology with the practical activities of the doctor. Principles of organization of microbiological service, institutions of microbiological profile. Equipment and facilities of microbiological laboratory. Mode of operation in the bacteriological laboratory.

Microorganisms as the main object of study of microbiology. Cellular and non-cellular forms of microorganisms.

Microscopic method of studying microorganisms. Mode of work in the bacteriological laboratory. Microscopy technique. Microscopic method of studying microorganisms. Specimens for microscopic examination, slides preparation techniques.

Theme 2. Methods of microscopic examination. Main bacterial shapes. Simple and differential staining. Gram stain.

Simple and differential methods of staining. Gram's method, mechanism, application of the method. The basic shapes and sizes of bacteria. Morphologic features of gram-positive and gram-negative bacteria.

Theme 3. The structure of a bacterial cell.

Structure of the bacterial cell. Chemical composition and functional significance of different structures of prokaryotic cells. Polymorphism of bacteria. Spore formation. Properties of L-form bacteria. Methods for detection of prokaryotic cell's structures: Ziehl-Neelsen staining, Aujeszky staining, Neisser staining, Hiss staining etc. Mechanisms of interaction of dyes with structures of bacterial cells.

Theme 4. Morphology and cell structure of bacteria, fungi and protozoa.

The concept of population, culture, strain and clone in microorganisms. Binary nomenclature of bacteria. Classification of fungi and protozoa.

Cytomorphological features of fungal and protozoan cells.

Features of the composition of bacteria in comparison with eukaryotic cells.

Theme 5. Physiology of bacteria. Nutrient media.

The chemical composition of the bacterial cell. Features of metabolism in bacteria. Constructive and energy metabolism and their relationship.

Nutrition of bacteria. Sources of nitrogen, carbon, minerals and growth factors. Classification of bacteria by types of nutrition.

Bacterial respiration. Energy needs of bacteria. Sources and ways of energy production in photoautotrophs, chemoautotrophs.

Types of biological oxidation of the substrate and ways of energy production in heterochemoorganotrophs: oxidative metabolism; putrefaction, fermentative, nitrate respiration.

Reproduction of microorganisms. Phases of reproduction of microbes in liquid nutrient medium in stationary conditions. Continuous cultivation, its importance in biotechnology.

Nutrient media. Requirements for nutrient media. Types of nutrient media. Basic principles and methods of bacterial cultivation.

Theme 6. Methods of sterilization. Disinfection.

Sterilization. Sterilization methods, sterilization modes. Disinfection, the purpose of routine and final disinfection. Disinfectants.

Theme 7. Culture methods. Isolation of pure culture of aerobic and anaerobic bacteria.

Mixed and pure bacterial cultures. Principles and methods of isolation of pure cultures of aerobic and anaerobic bacteria. Colonies, features of their formation in different types of bacteria. The concept of "isolated" and "suspicious" colonies. Stages of isolation of pure bacterial cultures by inoculation on dense nutrient media. Characteristics of each stage.

Theme 8. Cultural and biochemical properties of bacteria. Identification of bacteria.

Bacteriological (cultural) properties of bacteria. Cultural properties of microorganisms. Morphology of colonies, growth morphology *in vitro* on nutrient agar and nutrient broth. Types of colonies. Pigment synthesis.

Enzymes of bacteria and their classification. Constitutive and inductive enzymes, genetic regulation. Specificity of enzyme action. Exo- and endoenzymes. Limiting factors of the environment. The concept of mesophiles, thermophiles, psychrophiles. Halophiles, alkaliphilic and acidophilic bacteria.

Methods for studying the enzymatic activity of bacteria and their use for identification of bacteria. Modern methods for rapid identification of bacteria.

The use of microbes and their enzymes.

Methods of identification of isolated cultures.

Theme 9. Phages. Genetics of microorganisms.

Phages. Morphological types and structure and classification of bacteriophages. Stages of productive type of interaction of bacteriophages with bacterial cells. Lysogeny and phage conversion. Practical use of bacteriophages in microbiology and medicine.

The role of microbial genetics in fundamental and practical medicine. The concept of gene, genotype and phenotype. Organization of genetic material of a bacterial cell. Structure of the chromosome. Principles of functioning of the bacterial genome. Operon.

Bacterial plasmids, their properties. Classification of plasmids by functional activity. Transposons, insertion sequences. General characteristics and functions of mobile genetic elements.

Types of variability in bacteria. Modification variability, its mechanisms and forms of manifestation in bacteria.

Genotypic variability. Mutations of bacteria, their varieties. Mutagens, their classification.

Genetic recombination and its types. Mechanisms of genetic information transfer in bacteria. Transformation, transduction and conjugation. Types and mechanisms of population variability. The concept of bacterial dissociation, S- and R-forms of colonies. The importance of variability in the evolution of microorganisms.

Microbiological basis of genetic engineering and biotechnology. Practical use of the results of genetic engineering research in medicine, biology and national economy.

Theme 10. Molecular diagnostic methods.

Genetic methods in the diagnosis of infectious diseases and in the identification of bacteria: nucleic acid sequencing, polymerase chain reaction, nucleic acid hybridization. Phylogenetic classification of microorganisms.

Theme 11. Microbiological basis of antimicrobial chemotherapy and antiseptic.

Antibiotics, definition, concept, biological role in nature.

Classification of antibiotics by origin, chemical composition, mechanism and spectrum of antimicrobial action. Bactericidal and bacteriostatic action of antibiotics. Units of measurement of antimicrobial activity of antibiotics. Methods for determining the susceptibility of bacteria to antibiotics. The concept of minimum inhibitory concentration. Antibioticogram.

Complications of antibiotic therapy. Dysbacteriosis.

Antibiotic-resistant, antibiotic-dependent and antibiotic-tolerant forms of bacteria. Natural and acquired resistance to antibiotics. Genetic and biochemical mechanisms of antibiotic resistance. Ways to prevent the formation of bacterial resistance to antibiotics. Principles of rational antibiotic therapy.

Antiseptics. Antiseptic agents. Mechanisms of antimicrobial action of antiseptics. Acquired resistance to antiseptics.

Theme 12. Drilling of the algorithm of application general diagnostic methods in microbiology.

Content module 2. Infection. Immunity

Theme 13. Infection. Biological method of investigation.

Definition of "infection", "infectious process", "infectious disease".

The role of microorganisms in the infectious process. Pathogenicity of microorganisms, definition. Pathogenicity as a consequence of the evolution of parasitism. Obligate-pathogenic, conditionally pathogenic, non-pathogenic microorganisms.

Virulence, definition, units of measurement. Factors of bacterial pathogenicity. Microbial toxins, their classification.

Forms of infection. Mechanisms of infection transmission. The concept of pathogenesis of infectious disease.

Phases of the infectious process. Critical doses of microorganisms that cause infectious disease. Ways of penetration of pathogens into the body. Colonization, invasion. Distribution of microorganisms and their toxins in the body: bacteremia, toxemia, sepsis and its consequences. Microbial carriage. Asymptomatic infection. Dynamics of infectious disease development.

Biological method of study in the diagnosis of infectious diseases and identification of pathogens.

Theme 14. Concept of immunity. Types of immunity. Cellular and humoral factors of non-specific immunity. Antigens. Antibodies.

The concept of immunity. Formation of the body's immune system. Factors of nonspecific protection of the body. Humoral factors of nonspecific protection: complement system, lysines, interferons, leukins, antiviral inhibitors, lysozyme, plakins, properdin, fibronectin, etc.

Antigens and their properties. Classification of antigens. Types of antigenic specificity. Antigens of microorganisms. Human antigens.

Antibodies (immunoglobulins). Structure, function and classes of immunoglobulins. Pathological immunoglobulins. Genetics of immunoglobulins. Mechanism of interaction of antibodies with antigens. Autoantibodies. The concept of polyclonal and monoclonal antibodies.

Theme 15. Cellular and humoral factors of nonspecific defense. Phagocytosis.

Immune system. Central and peripheral organs of the immune system. Immunocompetent cells: T-lymphocytes and B-lymphocytes. Cooperation between immunocompetent cells in the process of forming an immune response. The concept of immunomodulators. Immunostimulants and immunosuppressors.

Complement systems. Ways of complement activation. Interferons.

Phagocytosis. Classification of phagocytic cells. The main stages of phagocytosis.

Theme 16. Biology of immune response.

Forms and types of immune response. Humoral immune response and its stages. Primary and secondary immune response. Interaction of immune system cells in the process of immune response. Participation of macrophages, T- and B-cells. Interleukins.

Cellular immune response and its stages. Cytokines and their role in the formation of cellular immunity reactions.

Characteristics of immune response manifestations: antibody synthesis, hypersensitivity of immediate and delayed types, immunological memory, immunological tolerance, idiotype-antidiotype interactions.

Principles of obtaining monoclonal antibodies. Hybridoma technology.

Natural killer system of the human body.

Theme 17. Reactions of "antigen-antibody": agglutination test, precipitation test, neutralization test.

Mechanism of interaction of antibodies and antigens in serological reactions. Serological reactions, their varieties, characteristics and use. Mechanism of serological reactions. Agglutination reactions: direct and indirect agglutination, indirect hemagglutination inhibition reaction, reverse indirect hemagglutination reaction, Coombs reaction - antiglobulin test. Precipitation reactions: ring precipitation, flocculation, gel precipitation. Reaction of biological neutralization (toxins, viruses, rickettsia). Anatoxins, method of preparation, titration, units of measurement - binding unit (BU), LF.

Theme 18. Reactions of "antigen-antibody": serological tests with use of the labels

Reactions using labeled antigens and antibodies: immunofluorescence (direct and indirect), enzyme-linked immunosorbent assay (direct, indirect, solid-phase, competitive), radioimmunoassay (competitive, reverse, indirect), chemiluminescence, lateral immunochromatography.

Theme 19. Reactions of "antigen-antibody": reaction of immune lysis, complement fixation test,

Immune lysis reactions (bacteriolysis, spirochetolysis, hemolysis). Reaction of complement binding. Reaction of immobilization of microorganisms.

Theme 20. Allergy.

Allergies. The concept of allergies. Allergens. Classification of hypersensitivities by Jell and Coombs. Mechanisms of development, clinical manifestations, methods of diagnosis and therapy of various types of hypersensitivity.

Autoimmune processes. Immunopathology. Principles and prospects of therapy of autoimmune diseases.

Transplantation immunity. Mechanisms of development, clinical manifestations, methods of diagnosis and therapy.

Theme 21. Immunodeficiencies. Methods of assessment of the immune state of the organism.

Assessment of immune status. Two-stage principle of immune status examination. Indicators of human immune status. The role of assessing the immune status of the body in the diagnosis of infectious diseases and pathology of the immune system.

Immunodeficiencies. Classification of immunodeficiency. Characteristics of immunodeficiencies by the level of defect of the immune system. Principles of diagnosis and means of immunocorrection.

Theme 22. Immunoprophylaxis. Immunotherapy.

Immunoprophylaxis and immunotherapy. Modern classification of vaccines. Methods of production, evaluation of efficacy and control. Adjuvants. Vaccine therapy.

Principles of use of antibodies for immunoprophylaxis and immunotherapy. Principles of manufacturing immune therapeutic and prophylactic sera. Homologous and heterologous serums, their comparative characteristics. Immunoglobulins as therapeutic and prophylactic agents. Human normal immunoglobulin and directed immunoglobulins.

Theme 23. Drilling of the algorithm of using general methods of examination in immunology.

**Content module 3.
Special microbiology. Part 1.**

Theme 24. Methods of laboratory diagnostics of the infections. Gram-positive cocci.

The principle of microbiological diagnostics - direct or indirect determination of the pathogen in the body.

Characteristics of methods of microbiological diagnosis of infectious diseases, their advantages and disadvantages, limitations, principles of application.

Biological samples. Selection, rules of taking, transportation, registration directly to the laboratory.

Genus of staphylococci (*Staphylococcus*). Classification. Biological properties. Factors of pathogenicity. The role of staphylococci in the development of human pathology. Pathogenesis of

the processes caused by them. Role in the development of hospital infection. Immunity and its features. Drugs for specific prophylaxis and therapy. Methods of microbiological diagnosis of staphylococcal infections.

The genus *Streptococcus*. Classification, biological properties. Toxins, pathogenicity enzymes. Role in human pathology. Pathogenesis of streptococcal diseases. Immunity and its features. Methods of microbiological diagnosis of streptococcal diseases. Oral streptococci, their role in caries and other dental diseases.

Streptococcus pneumoniae - pneumococcus, biological properties. Factors of pathogenicity. Etiological and pathogenetic role of *Streptococcus pneumoniae* in human pathology. Microbiological diagnostics. Pathogenicity for humans and animals.

Theme 25. Methods of laboratory diagnostics of the infections. Gram-negative cocci.

The genus *Neisseria*. Biological properties. Classification.

Meningococci (*Neisseria meningitidis*). Biological properties, classification. Pathogenesis and microbiological diagnosis of meningococcal diseases and bacterial carriage. Differentiation of meningococci and gram-negative diplococci of the nasopharynx.

Gonococci (*Neisseria gonorrhoeae*). Biological properties. Acute and chronic gonorrhea. Immunity. Pathogenesis and microbiological diagnosis of gonorrhea. Prevention and specific therapy of gonorrhea and blenorrhea.

Theme 26. Clostridia of wound anaerobic infection, tetanus, botulism. Anaerobic non-clostridial infections.

The genus *Clostridium*. Classification. Ecology, properties. Resistance to environmental factors. Toxicity. Genetic control of toxin formation. *Clostridium tetani*, *Clostridium botulinum*, *Clostridium difficile* and clostridia are the causative agents of anaerobic wound infection. Properties, pathogenicity factors, toxins. Pathogenesis. Antitoxic immunity. Microbiological diagnostics. Specific treatment and prevention.

Anaerobic non-clostridial bacteria and their role in human pathology.

Theme 27. Spirochaetes.

General characteristics of the family *Spirochaetaceae*. Classification.

Treponema (Treponema). The causative agent of syphilis. Morphological, cultural properties. Pathogenesis and immunogenesis of syphilis. Microbiological diagnosis and specific therapy. Pathogens of frambesia, pinta. Properties. Ways of human infection. The course of the disease in humans. Microbiological diagnostics.

Borrelia (Borrelia). The causative agent of epidemic relapsing typhus and endemic tick-borne borreliosis, Lyme disease. Classification, pathogenesis, immunity, microbiological diagnosis and prevention.

Leptospira. The causative agent of leptospirosis. Classification, pathogenesis, immunity, microbiological diagnosis and prevention.

Theme 28. Brucellae. *Francisella tularensis*. *Bacillus anthracis*.

Brucella (family *Brucellaceae*) Classification. Biological properties. Factors of pathogenicity. Pathogenesis and immunity in brucellosis. Methods of microbiological diagnosis, specific prophylaxis and therapy.

The causative agent of tularemia (*Francisella tularensis*) Biological properties. Pathogenesis, immunity, methods of microbiological diagnosis, specific prevention and therapy.

The causative agent of anthrax (*Bacillus anthracis*). Properties. Resistance. Pathogenicity factors, toxins. Pathogenesis of the disease in humans, immunity. Microbiological diagnosis, specific prevention and treatment of anthrax.

Theme 29. *Corynebacteria*.

The causative agent of diphtheria (*Corynebacterium diphtheriae*). Morphology. Cultural properties. Biovars. Resistance. Pathogenicity factors. Diphtheria toxin. Pathogenesis of diphtheria. Antitoxic immunity. Bacterial carriage. Microbiological diagnosis of diphtheria. Immunological and genetic methods for determining the toxicity of the diphtheria pathogen.

Differentiation of the diphtheria pathogen with other pathogenic and non-pathogenic corynebacteria for humans, toxigenicity control, specific prevention and treatment of diphtheria.

Theme 30. Mycobacteria.

Pathogenic, opportunistic and saprophytic mycobacteria. *Mycobacteria* of tuberculosis. Biological properties. Features of the pathogenesis of the disease. Variability of tuberculosis bacteria, pathogenicity factors. Tuberculin. Patterns of immunity, the role of cellular mechanisms. BCG vaccine. Microbiological diagnostics. Antimicrobial drugs. The problem of multiple resistance of *Mycobacteria tuberculosis* to chemotherapeutic drugs. Epidemic spread of tuberculosis in modern conditions. *Mycobacterium leprae*. Microbiological diagnosis of leprosy. Pathogens of mycobacteriosis. Classification, properties. Role in human pathology. Mycobacteriosis as a manifestation of HIV infection.

Theme 31. Rickettsia.

Rickettsia (family *Rickettsiaceae*) General characteristics and classification of rickettsiae. Rickettsiaceae, the causative agents of epidemic typhus and Brill-Zinsser's disease, endemic typhus, the causative agent of Q fever. Biological properties. Ecology. Hosts and vectors. Resistance. Antigenic structure. Toxin formation. Pathogenicity for humans. Immunity. Microbiological diagnosis of rickettsiosis. Antimicrobial drugs. Specific prophylaxis.

Theme 32. Chlamydia. Mycoplasmas.

Chlamydia (family *Chlamydiaceae*) Classification. Biological properties. Ecology. Resistance. Intracellular parasitism. Antigenic structure. Pathogenicity factors. The causative agent of ornithosis. Pathogenicity for humans and birds. Pathogenesis and immunity. Microbiological diagnostics. Antimicrobial preparations. The causative agent of trachoma. Pathogenicity for humans. Trachoma, conjunctivitis of newborns (blepharitis with inclusions). Urogenital chlamydiosis. Pathogenesis. Microbiological diagnostics. Principles of specific prophylaxis and therapy.

Mycoplasmas (family *Mycoplasmataceae*) General characteristics of the class of Mollicutes. Classification of the class. Biological properties. Role in human pathology. Mycoplasmas, the causative agents of pneumonia, acute respiratory diseases, urethritis, endocarditis, pregnancy pathology and fetal damage. Pathogenesis of diseases, immunity. Microbiological diagnostics. Principles of specific prophylaxis and therapy. Mycoplasmas of the oral cavity.

Theme 33. Drilling of the algorithm of laboratory diagnosis of bacterial infections. Part 1.

**Content module 4.
Special microbiology. Part 2.**

Theme 34. Vibrio.

Cholera vibrios (*Vibrio cholerae*). Biovars (classical and El Tor), their differentiation. Spread of cholera. Morphology. Cultural properties, enzymatic activity. Classification of vibrios by Heiberg. Antigenic structure. Virulence factors. Cholero-gen, mechanism of action, methods of cholero-gen detection. Cholera vibrios that are not agglutinated by O-1 serum, O-139 "Bengal" vibrio. Pathogenesis and immunity in cholera. Methods of microbiological diagnostics. Express diagnosis of the disease and indication of cholera vibrio in the environment. Specific prevention and therapy of cholera. Halophilic vibrios - causative agents of toxic infections. Biological properties. Pathogenicity for humans. Features of microbiological diagnostics. Other vibrios as a cause of gastroenteritis, wound infection, inflammatory diseases of internal organs.

Theme 35. Escherichia. Shigella.

Classification and general characteristics of *Enterobacteriaceae*. Antigenic structure and pathogenicity factors of pathogenic and opportunistic enterobacteria. Distribution and ability to survive in the environment.

The genus *Escherichia*, their main properties. Physiological role and sanitary-indicative value. *E. coli* pathovars. Parenteral escherichiosis. Microbiological diagnosis of escherichiosis.

The genus *Shigella*. Biological properties, classification and virulence factors. Pathogenesis of shigellosis dysentery. Immunity. Methods of microbiological diagnosis. The problem of specific prophylaxis.

Theme 36. Salmonella.

The genus *Salmonella*. General characteristics of the genus. Kaufman-White classification. Pathogenicity for humans and animals.

Salmonella, the causative agents of generalized infections (typhoid and paratyphoid). Biological properties. Antigenic structure, pathogenicity factors. Pathogenesis and immunogenesis of diseases. Bacterial carriage. Methods of microbiological diagnosis.

Salmonella, the causative agents of acute gastroenterocolitis. Features of pathogenesis.

Methods of microbiological diagnosis of salmonellosis. Specific prevention and treatment.

Theme 37. Other pathogenic enterobacteria: Klebsiella, Enterobacter.

Pathogenic representatives of the genus *Klebsiella* are causative agents of nosocomial infections. Biological properties. Antigenic structure, pathogenicity factors. Pathogenesis and immunogenesis of diseases. Methods of microbiological diagnosis.

The genus *Enterobacter*. General characteristics of the genus. Biological properties, classification and virulence factors. Pathogenesis. Immunity. Methods of microbiological diagnosis.

Theme 38. Yersinia.

The genus *Yersinia*. *Yersinia* are the causative agents of intestinal yersinosis and pseudotuberculosis. Biological properties. Microbiological diagnosis of intestinal yersinosis. The causative agent of plague. Biological properties. Factors of virulence. Pathogenesis of plague. Methods of microbiological diagnosis of plague. Criteria for identification of the plague pathogen. Specific prevention and treatment of plague.

Other representatives of the genus are *Y. enterocolitica* and *Y. pseudotuberculosis*. Epidemiology and pathogenesis of diseases caused by these pathogens. Methods of laboratory diagnosis of yersinia. Principles of treatment and prevention.

Theme 39. Pseudomonas.

The genus *Pseudomonas* is a pathogen of opportunistic infections. Cultural and biological properties. Antigenic structure, pathogenicity factors. Pathogenesis and immunogenesis of diseases. Methods of microbiological diagnostics.

Theme 40. Campylobacter. Helicobacter.

The genus *Campylobacter*. Classification, biological properties, role in pathogenesis and microbiological diagnosis.

The genus *Helicobacter*. *Helicobacter pylori* is a causative agent of human gastroduodenal diseases. Biological properties. Factors of gastric mucosa colonization. Urease activity. Pathogenesis of Helicobacter infection. Methods of microbiological diagnosis and treatment of Helicobacter infection.

Theme 41. Drilling of the algorithm of laboratory diagnosis of bacterial infections. Part 2.

Content module 5. General and special virology

Theme 42. General virology. Classification of viruses.

General, medical and sanitary virology. The tasks of medical virology. The importance of medical virology in the activities of the doctor. The organization and activities of virological laboratories.

The kingdom of viruses. Principles of structural organization of viruses. Virion and its components. Classification of viruses. Enzymes of viruses, their role, classification.

Classification of viruses by Baltimore. Types and main stages of interaction of viruses with host cells. Interference of viruses, defective interfering particles. Satellite viruses.

Methods of virus cultivation in chicken embryos, in the body of laboratory animals.

Theme 43. Cultivation of viruses. Methods of diagnostics of viral infections. Prions.

Methods of cultivation of viruses in cells. Classification of cell cultures and their characteristics. Methods of detection (indication) of viral reproduction. Methods of quantitative determination (titration) of viruses. Genetic methods for the determination of viruses and their nucleic components.

Features of serological reactions used in virology.

Prions. Properties of prions. Mechanism of their replication in vivo. Prion diseases, pathogenesis, methods of postmortem and vital diagnosis.

Theme 44. Orthomyxoviruses.

Human influenza viruses. Structure of the virion. Features of the genome. Cultivation. Susceptibility to physical and chemical factors. Characteristics of antigens. Hemagglutinins, neuraminidases, functional activity. Classification of human influenza viruses. Types of antigenic variability, its mechanisms. Pathogenesis of influenza. The role of virus persistence in humans and animals in the preservation of epidemically significant strains. Immunity. Laboratory diagnostics. Specific prophylaxis and treatment. Antigens. Cultivation. Susceptibility to physical and chemical factors.

Theme 45. Paramyxoviruses Human parainfluenza viruses (types 1 - 5). Mumps virus of epidemic parotitis. Role in human pathology. Immunity. Specific prevention and diagnosis.

The genus *Morbilliviruses*. Measles virus, biological properties. Pathogenesis, immunity, specific prevention and diagnosis of the disease.

The genus *Pneumoviruses*. Human respiratory syncytial virus. Biological properties. Pathogenesis, immunity and diagnosis of the disease.

Theme 46. Picornaviruses.

General characteristics and classification of the family. Division into genera.

Genus *Enteroviruses*. Classification: poliomyelitis viruses, Coxsackie viruses, ECHO viruses, enteroviruses of types 68 - 72. Characteristics of virions. Antigens. Cultivation. Pathogenicity for animals. Sensitivity to physical and chemical factors. The importance of genetic heterogeneity of enterovirus populations in the development of the disease. The role of enteroviruses in human pathology. Pathogenesis of poliomyelitis and other enterovirus infections. Immunity. Specific prophylaxis and therapy. Laboratory diagnosis of enterovirus infections.

Hepatitis A virus, features. Approaches to specific prevention of hepatitis A. Laboratory diagnosis of hepatitis A.

The genus of *Rhinoviruses*. General characteristics. Classification. Pathogenesis of rhinovirus infection. Laboratory diagnostics.

The genus Aftovirus (*Aftovirus*). Foot-and-mouth disease viruses. Biological properties. Classification. Pathogenesis of infection in humans. Laboratory diagnosis, specific prophylaxis.

Genus *Cardiovirus* (*Cardiovirus*). General characteristics. Role in human pathology.

Theme 47. Rhabdoviruses. Arboviruses.

Rabdoviruses (family *Rabdoviridae*). General characteristics and classification.

The genus *Lyssavirus*. Rabies virus. Structure of the virion. Cultivation. Sensitivity to physical and chemical factors. Pathogenicity for humans and animals. Pathogenetic features of the disease. Intracellular inclusions (Babesh-Negri bodies). Laboratory diagnostics. Specific prophylaxis.

Genus *Vesiculovirus*. Vesicular stomatitis virus, its role in human pathology, diagnosis.

Theme 48. Arboviruses: yellow fever, dengue fever, Crimean-Congo hemorrhagic fever, tick-borne encephalitis, West Nile fever.

Ecological group of arboviruses. General characteristics. Classification. Antigens. Cultivation. Sensitivity to physical and chemical factors. The main representatives of flaviviruses

pathogenic for humans are viruses of tick-borne encephalitis, yellow fever, dengue fever, Japanese encephalitis, Omsk hemorrhagic fever. Features of pathogenesis. Natural focalities.

Tick-borne encephalitis virus. Biological properties, ecological variants of the pathogen. Distribution in nature. Mechanism of transmission of the pathogen to humans. Pathogenesis and immunogenesis of the disease. Microbiological diagnosis of flavivirus infections. Specific prevention and treatment.

Theme 49. Coronaviruses.

Characterization of the coronavirus family. Classification. Pathogenic representatives of the family. SARS-COV-2 virus. Features of the course of infection, pathogenesis, complications of the disease. Laboratory diagnosis of coronaviruses. Treatment and specific prevention of coronavirus infection. The COVID-19 pandemic. Global impact on the world and Ukraine.

Theme 50. Herpesviruses.

Herpesviruses. General characteristics and classification. Structure of the virion. Antigens. Cultivation. Sensitivity to physical and chemical factors. Herpes viruses pathogenic to humans: herpes simplex virus types 1 and 2, herpes zoster; cytomegalovirus, Epstein-Barr virus, human herpes viruses types 6, 7, 8. Biological properties. Role in human pathology. Mechanism of persistence of herpes viruses. Laboratory diagnosis, specific prevention and treatment of herpes infections.

Theme 51. Adenoviruses. Papillomaviruses. Parvoviruses.

Adenoviruses. General characteristics and classification. Human adenoviruses. 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. Intestinal adenoviruses. Laboratory diagnosis of adenovirus infections. Specific prophylaxis and treatment.

Theme 52. Poxviruses.

Poxviruses (family *Poxviridae*). Genus *Ortopoxvirus*. General characteristics and classification. Smallpox viruses of humans, monkeys, cows, smallpox vaccine, ectromelia. Structure of the virion. Antigens. Cultivation. Sensitivity to chemical and physical factors. Hemagglutination, its mechanism. Pathogenetic features of the disease. Laboratory diagnostics. Intracellular inclusions (Guarnieri bodies). Specific prevention of smallpox. Global eradication of smallpox. The genus *Parapoxvirus*. Virus of a contagious mollusk. Pathogenesis of infection. Laboratory diagnostics.

Theme 53. Causative agents of viral hepatitis.

Hepatitis A virus, features. Approaches to specific prevention of hepatitis A. Laboratory diagnosis of hepatitis A.

Hepatitis B virus. Structure and antigens of virion. Sensitivity to physical and chemical factors. Pathogenesis of the disease. Persistence of the disease. Immunity. Microbiological diagnostics, methods of detection and diagnostic value of hepatitis B markers (antigens, antibodies, nucleic acids). Specific prevention and treatment.

Other hepatitis pathogens (C, D, E, F, G, TTV, SENV), their taxonomy, properties, role in human pathology, methods of laboratory diagnosis.

Theme 54. Retroviruses. HIV. Oncoviruses.

General characteristic. Classification. Representatives of subfamilies *Oncovirinae*, *Lentivirinae*. Human immunodeficiency virus (HIV). Morphology and chemical compound of viruses. Features of genome. Variability, its mechanisms. Types of HIV, their origin and evolution. Cultivation, stages of interaction with sensitive cells. Sensitivity to physical and chemical factors.

Pathogenesis of HIV-infections. Cells-targets in human organism, characteristic of superficial receptors. Mechanism of development of immunodeficiency. AIDS-associated infection. Laboratory diagnostics. Polymerase chain reaction and westernblot (immunoblot) test in diagnostics of HIV-infection. Treatment (etiologic, immunomodulative, immunoreplacing preparations). Prospects of specific preventive measures.

Oncogenic viruses. Signs of a transformed cell. Mechanisms of transforming action of oncogenic viruses. Oncogenic DNA-containing viruses from the family of papoviruses, herpesviruses and others. General characteristics, participation in viral carcinogenesis in humans. Oncogenic RNA-containing viruses from the retrovirus family - representatives of the subfamily *Oncovirinae*. Morphology, classification. Role in human carcinogenesis. Oncogenic viruses of other taxonomic groups (representatives of the families *Adenoviridae*, *Poxviridae*, *Hepadnaviridae*, etc.). General characteristics. Endogenous retroviruses.

Theme 55. Drilling algorithm of the laboratory diagnosis of viral infections.

Final test control.

Test control is carried out in the Educational and Production Complex of Innovative Technologies of Education, Informatization and Continuing Education of ONMedU by solving test tasks in the format of state licensing exams "Krok-1" with five answers, one of which is correct.

4. The structure of the educational discipline

Themes	Number of hours					
	Total	including				
		lectures	seminars	practical classes	laboratories	Independent work
Content module 1. General microbiology						
Theme 1. Subject and tasks of medical microbiology. Equipment and organization of laboratory. Microscopic method of studying microorganisms. Microscopy technique	5	2	0	2	0	1
Theme 2. Methods of microscopic examination. Main bacterial shapes. Simple and differential staining. Gram stain.	3		0	2	0	1
Theme 3. Structure of a bacterial cell.	3		0	2	0	1
Theme 4. Morphology and structure of bacteria, fungi and protozoa.	3		0	2	0	1
Theme 5 Physiology of bacteria. Nutrient media.	3		0	2	0	1
Theme 6. Methods of sterilization. Disinfection.	3		0	2	0	1
Theme 7. Culture methods. Isolation of pure culture of aerobic and anaerobic bacteria	3		0	2	0	1
Theme 8. Cultural and biochemical properties of bacteria. Identification of bacteria.	3		0	2	0	1

Theme 9. Phages. Genetics of microorganisms.	3		0	2	0	1
Theme 10. Molecular diagnostic methods.	3		0	2	0	1
Theme 11. Microbiological basis of antimicrobial chemotherapy and antiseptic.	3		0	2	0	1
Theme 12. Drilling of the algorithm of application general diagnostic methods in microbiology.	4	0	0	2	0	2
<i>Total by content module 1</i>	39	2	0	24	0	13
Content module 2. Infection. Immunity						
Theme 13. Infection. Biological method of investigation	3	0	0	2	0	1
Theme 14. Concept of immunity. Types of immunity. Antigens. Antibodies	5	2	0	2	0	1
Theme 15. Cellular and humoral factors of nonspecific defense. Phagocytosis	3		0	2	0	1
Theme 16. Biology of immune response.	3		0	2	0	1
Theme 17. Reactions of "antigen-antibody": agglutination test, precipitation test, neutralization test.	3	0	0	2	0	1
Theme 18. Reactions of "antigen-antibody": serological tests with use of the labels	3	0	0	2	0	1

Theme 19. Reactions of "antigen-antibody": reaction of immune lysis, complement fixation test	3	0	0	2	0	1
Theme 20. Allergy.	4	1	0	2	0	1
Theme 21. Immunodeficiencies. Methods of assessment of the immune state of the organism	3	0	0	2	0	2
Theme 22. Immunoprophylaxis. Immunotherapy.	4	1	0	2	0	2
Theme 23. Drilling of the algorithm for using of general methods of examination in immunology.	4	0	0	2	0	2
<i>Total by content module 2</i>	39	4	0	22	0	13
Content module 3. Special microbiology. Part 1.						
Theme 24. Methods of laboratory diagnostics of the infections. Gram-positive cocci	4	1	0	2	0	1
Theme 25. Methods of laboratory diagnostics of the infections. Gram-negative cocci	4	1	0	2	0	1
Theme 26. Clostridia of wound anaerobic infection, tetanus, botulism. Anaerobic non-clostridial infections.	5	2	0	2		1
Theme 27. Spirochetes.	5	2	0	2	0	1
Theme 28. Brucellae. Francisella tularensis. Bacillus anthracis	3	0	0	2	0	1

Theme 29. Corynebacteria.	4	1	0	2	0	1
Theme 30. Mycobacteria.	4	1	0	2	0	1
Theme 31. Rickettsia.	4	1	0	2	0	1
Theme 32. Chlamydia. Mycoplasmas.	4	1	0	2	0	1
Theme 33. Drilling of the algorithm of laboratory diagnosis of bacterial infections. Part 1	4	0	0	2	0	2
<i>Total by content module 3</i>	41	10	0	20	0	11
Content module 4. Special microbiology. Part 2.						
Theme 34. Vibrio.	4	1	0	2	0	1
Theme 35. Escherichia. Shigella.	4	1	0	2	0	1
Theme 36. Salmonella.	4	1	0	2	0	1
Theme 37. Other pathogenic enterobacteria: Klebsiella, Enterobacter	3	0	0	2	0	1
Theme 38. Yersinia	3	0	0	2	0	1
Theme 39. Pseudomonas	3	0	0	2	0	1
Theme 40. Campylobacter. Helicobacter.	4	1	0	2	0	1
Theme 41. Drilling of the algorithm of laboratory diagnosis of bacterial infections. Part 2.	4	0	0	2	0	2
<i>Total by content module 4</i>	29	4	0	16	0	9
Content module 5. General and special virology.						
Theme 42. General virology. Classification of viruses	4	1	0	2	0	2
Theme 43. Cultivation of viruses. Methods of	4	1	0	2	0	1

diagnostics of viral infections. Prions						
Theme 44. Orthomyxoviruses.	5	2	0	2	0	1
Theme 45. Paramyxoviruses	3		0	2	0	1
Theme 46. Picornaviruses.	3		0	2	0	1
Theme 47. Rhabdoviruses.	3		0	2	0	1
Theme 48. Arboviruses: yellow fever, dengue fever, Crimean-Congo hemorrhagic fever, tick-borne encephalitis, West Nile fever.	3		0	2	0	2
Theme 49. Coronaviruses	3		0	2	0	1
Theme 50. Herpesviruses.	3		0	2	0	1
Theme 51. Adenoviruses. Papillomaviruses. Parvoviruses	3		0	2	0	2
Theme 52. Poxviruses.	3		0	2	0	1
Theme 53. Causative agents of viral hepatitis.	5	2	0	2	0	2
Theme 54. Retroviruses. HIV. Oncoviruses.	5	2	0	2	0	2
Theme 55. Drilling algorithm of the laboratory diagnosis of viral infections.	4	0	0	2	0	2
<i>Total by content module 5</i>	56	8	0	28	0	20
<i>Individual task</i>	0	0	0	0	0	0
Final test control	6	0	0	2	0	4
Total hours	210	28	0	112	0	70

5. Themes of lectures / seminars / practical classes / laboratories

5.1. Themes of lectures

No.	Theme	Hours
Content module 1. General microbiology		
1.	Lecture 1. The significance of medical microbiology for medical practice. History of microbiology. Physiology of microorganisms. Chemical composition and metabolism of microorganisms. Microbial and viral genetics. Essentials of biotechnology and genetic engineering	2
Content module 2. Infection. Immunity		
2.	Lecture 2. Human immune system. Antigens, properties. Microbial antigens. Antibodies, structure. Immunoglobulin classes. Immune response. Immune cells interaction in immune response	2
3.	Lecture 3. Immunoprophylaxis. Immunotherapy. Immunopathology.	2
Content module 3. Special microbiology. Part 1		
4.	Lecture 4. Introduction to special microbiology. Pathogenic pyogenic cocci	2
5.	Lecture 5. Causative agents of anaerobic infections	2
6.	Lecture 6. Spirochetes.	2
7.	Lecture 7. Vibrios. Campylobacter. Helicobacter.	2
8.	Lecture 8. Causative agents of diphtheria and tuberculosis	2
Content module 4. Special microbiology. Part 2		
9.	Lecture 9. Rickettsia. Chlamydia. Mycoplasma	2
10.	Lecture 10. Pathogenic enterobacteria. Escherichia and Shigella. Salmonellae.	2
Content module 5. General and special virology		
11.	Lecture 11. Morphology and ultrastructure of viruses. Culturing of viruses. Interaction between viruses and cells	2
12.	Lecture 12. RNA-genomic viruses. DNA-genomic viruses	2
13.	Lecture 13. Retroviruses. Oncoviruses. Hepatitis viruses	2
14.	Lecture 14. Human immunodeficiency virus.	2
	Total	28

5.2. Themes of seminars

Seminars are not provided.

5.3. Themes of practical classes

No.	Theme	Hours
Content module 1. General microbiology		
1.	Theme 1. Subject and tasks of medical microbiology. Equipment and organization of laboratory. Microscopic method of studying microorganisms. Microscopy technique. Individual survey on the theme, testing.	2
2.	Theme 2. Methods of microscopic examination. Main bacterial shapes. Simple and differential staining. Gram stain	2

	Individual survey on the theme, testing.	
3.	Theme 3. Structure of a bacterial cell. Individual survey on the theme, testing.	2
4.	Theme 4. Morphology and structure of bacteria, fungi and protozoa	2
5.	Theme 5. Physiology of bacteria. Nutrient media. Individual survey on the theme, testing	2
6.	Theme 6. Methods of sterilization. Disinfection. Individual survey on the theme, testing.	2
7.	Theme 7. Culture methods. Isolation of pure culture of aerobic and anaerobic bacteria. Individual survey on the theme, testing.	2
8.	Theme 8. Cultural and biochemical properties of bacteria. Identification of bacteria. Individual survey on the theme, testing.	2
9.	Theme 9. Phages. Genetics of microorganisms. Individual survey on the theme, testing.	2
10.	Theme 10. Molecular diagnostic methods. Individual survey on the theme, testing.	2
11.	Theme 11. Microbiological basis of antimicrobial chemotherapy and antiseptic. Individual survey on the theme, testing.	2
12.	Theme 12. Drilling of the algorithm for using of general methods of examination in microbiology, testing.	2
Content module 2. Infection. Immunity		
13.	Theme 13. Infection. Biological method of investigation. Individual survey on the theme, testing.	2
14.	Theme 14. Concept of immunity. Types of immunity. Antigens. Antibodies. Individual survey on the theme, testing.	2
15.	Theme 15. Cellular and humoral factors of nonspecific defense. Phagocytosis Individual survey on the theme, testing.	2
16.	Theme 16. Biology of immune response. Individual survey on the theme, testing.	2
17.	Theme 17. Reactions of "antigen-antibody": agglutination test, precipitation test, neutralization test. Individual survey on the theme, testing.	2
18.	Theme 18. Reactions of "antigen-antibody": serological tests with use of the labels Individual survey on the theme, testing.	2
19.	Theme 19 Reactions of "antigen-antibody": reaction of immune lysis, complement fixation test. Individual survey on the theme, testing.	2
20.	Theme 20. Allergy. Individual survey on the theme, testing.	2
21.	Theme 21. Immunodeficiencies. Methods of assessment of the immune state of the organism Individual survey on the theme, testing	2
22.	Theme 22. Immunoprophylaxis. Immunotherapy. Individual survey on the theme, testing.	2

23.	Theme 23. Drilling of the algorithm of using general methods of examination in immunology, testing.	2
Content module 3. Special microbiology. Part 1		
24.	Theme 24. Methods of laboratory diagnostics of the infections. Gram-positive cocci. Individual survey on the theme, testing.	2
25.	Theme 25. Methods of laboratory diagnostics of the infections. Gram-negative cocci Individual survey on the theme, testing	2
26.	Theme 26. Clostridia of wound anaerobic infection, tetanus, botulism. Anaerobic non-clostridial infections Individual survey on the theme, testing	2
27.	Theme 27. Spirochaetes Individual survey on the theme, testing	2
28.	Theme 28. Brucellae. Francisella tularensis. Bacillus anthracis Individual survey on the theme, testing	2
29.	Theme 29. Corynebacteria Individual survey on the theme, testing	2
30.	Theme 30. Mycobacteria Individual survey on the theme, testing	2
31.	Theme 31. Rickettsia Individual survey on the theme, testing	2
32.	Theme 32. Chlamydia. Mycoplasmas Individual survey on the theme, testing.	2
33.	Theme 33. Drilling of the algorithm of laboratory diagnosis of bacterial infections. Part 1, testing.	2
Content module 4. Special microbiology. Part 2		
34.	Theme 34. Vibrio. Individual survey on the theme, testing.	2
35.	Theme 35. Escherichia. Shigella. Individual survey on the theme, testing.	2
36.	Theme 36. Salmonella Individual survey on the theme, testing.	
37.	Theme 37. Other pathogenic enterobacteria: Klebsiella, Enterobacter Individual survey on the theme, testing.	2
38.	Theme 38. Yersinia Individual survey on the theme, testing.	2
39.	Theme 39. Pseudomonas. Individual survey on the theme, testing.	2
40.	Theme 40. Campylobacter. Helicobacter Individual survey on the theme, testing.	2
41.	Theme 41. Drilling of the algorithm of laboratory diagnosis of bacterial infections. Part 2, testing.	2
Content module 5. General and special virology		
42.	Theme 42. General virology. Classification of viruses. Individual survey on the theme, testing.	2
43.	Theme 43. Cultivation of viruses. Methods of diagnostics of viral infections. Prions.	2

	Individual survey on the theme, testing.	
44.	Theme 44 Orthomyxoviruses. Individual survey on the theme, testing.	2
45.	Theme 45 Paramyxoviruses. Individual survey on the theme, testing.	2
46.	Theme 46 Picornaviruses. Individual survey on the theme, testing.	2
47.	Theme 47 Rhabdoviruses. Individual survey on the theme, testing.	2
48.	Theme 48. Arboviruses: yellow fever, dengue fever, Crimean-Congo hemorrhagic fever, tick-borne encephalitis, West Nile fever. Individual survey on the theme, testing.	2
49.	Theme 49. Coronaviruses. Individual survey on the theme, testing.	2
50.	Theme 50. Herpesviruses. Individual survey on the theme, testing.	2
51.	Theme 51. Adenoviruses. Papillomaviruses. Parvoviruses. Individual survey on the theme, testing.	2
52.	Theme 52. Poxviruses. Individual survey on the theme, testing.	2
53.	Theme 53. Causative agents of viral hepatitis. Individual survey on the theme, testing.	2
54.	Theme 54. Retroviruses. HIV. Oncoviruses. Individual survey on the theme, testing.	2
55.	Theme 55. Drilling algorithm of the laboratory diagnosis of viral infections, testing.	2
56.	Final test control. Final test control consists of test tasks in the format of state licensing exams "Krok-1" with five answers, one of which is correct.	2
	Total	112

5.4. Themes of laboratories

Laboratories are not provided.

6. Independent work of the student

No.	Theme	Hours
Content module 1. General microbiology		
1.	Theme 1. Preparation for practical class 1	1
2.	Theme 2. Preparation for practical class 2	1
3.	Theme 3. Preparation for practical class 3	1
4.	Theme 4. Preparation for practical class 4	1
5.	Theme 5. Preparation for practical class 5	1
6.	Theme 6. Preparation for practical class 6	1
7.	Theme 7. Preparation for practical class 7	1
8.	Theme 8. Preparation for practical class 8	1
9.	Theme 9. Preparation for practical class 9	1
10.	Theme 10. Preparation for practical class 10	1
11.	Theme 11. Preparation for practical class 11	1
12.	Theme 12. Preparation for practical class 12	2

Content module 2. Infection. Immunity		
13.	Theme 13. Preparation for practical class 13	1
14.	Theme 14. Preparation for practical class 14	1
15.	Theme 15. Preparation for practical class 15	1
16.	Theme 16. Preparation for practical class 16	1
17.	Theme 17. Preparation for practical class 17	1
18.	Theme 18. Preparation for practical class 18	1
19.	Theme 19. Preparation for practical class 19	1
20.	Theme 20. Preparation for practical class 20	1
21.	Theme 21. Preparation for practical class 21	1
22.	Theme 22. Preparation for practical class 22	2
23.	Theme 23. Preparation for practical class 23	2
Content module 3. Special microbiology. Part 1		
24.	Theme 24. Preparation for practical class 24	1
25.	Theme 25. Preparation for practical class 25	1
26.	Theme 26. Preparation for practical class 26	1
27.	Theme 27. Preparation for practical class 27	1
28.	Theme 28. Preparation for practical class 28	1
29.	Theme 29. Preparation for practical class 29	1
30.	Theme 30. Preparation for practical class 30	1
31.	Theme 31. Preparation for practical class 31	1
32.	Theme 32. Preparation for practical class 32	1
33.	Theme 33. Preparation for practical class 33	2
Content module 4. Special microbiology. Part 2		
34.	Theme 34. Preparation for practical class 34	1
35.	Theme 35. Preparation for practical class 35	1
36.	Theme 36. Preparation for practical class 36	1
37.	Theme 37. Preparation for practical class 37	1
38.	Theme 38. Preparation for practical class 38	1
39.	Theme 39. Preparation for practical class 39	1
40.	Theme 40. Preparation for practical class 40	1
41.	Theme 41. Preparation for practical class 41	2
Content module 5. General and special virology		
42.	Theme 42. Preparation for practical class 42	2
43.	Theme 43. Preparation for practical class 43	1
44.	Theme 44. Preparation for practical class 44	1
45.	Theme 45. Preparation for practical class 45	1
46.	Theme 46. Preparation for practical class 46	1
47.	Theme 47. Preparation for practical class 47	1
48.	Theme 48. Preparation for practical class 48	2
49.	Theme 49. Preparation for practical class 49	1
50.	Theme 50. Preparation for practical class 50	1
51.	Theme 51. Preparation for practical class 51	2
52.	Theme 52. Preparation for practical class 52	1
53.	Theme 53. Preparation for practical class 53	2
54.	Theme 54. Preparation for practical class 54	2
55.	Theme 55. Preparation for practical class 55	2

56.	Theme 56. Preparation for final test control	4
	Total	70

7. Teaching methods

Lecture.

Practical classes:

- verbal methods: conversation, explanation, discussion, discussion of the acute issues;
- visual methods: illustration (including multimedia presentations);
- practical methods: testing, solving situational tasks, evaluation of lab reports.

Independent work:

- independent work with recommended basic and additional literature, with electronic information resources;
- independent work with the bank of test tasks Step-1.

8. Forms of control and evaluation methods (including criteria for evaluating learning outcomes)

Ongoing control: individual survey on the theme, testing, evaluation of practical skills, solving situational problems, the ability to analyze and interpret research results and correctly draw reasonable conclusions, evaluation of activity in the classroom.

Final control: testing in a format of “Krok-1”, exam.

Assessment of the ongoing learning activity at the practical class:

1. Assessment of the theoretical knowledge on the theme:
 - methods: individual survey on the theme, participation of the student in the discussion of problem situations; assessment of performance of tests on the theme;
 - the maximum score – 5, the minimum score – 3, the unsatisfactory score – 2.
2. Assessment of practical skills on the theme:
 - methods: assessment of the solution of situational tasks (including calculation) on the theme;
 - the maximum score – 5, the minimum score – 3, the unsatisfactory score – 2.

The score for one practical class is the arithmetic average of all components and can only have an integer value (5, 4, 3, 2), which is rounded statistically.

Criteria of ongoing assessment at the practical class

Score	Assessment criterion
Excellent «5»	The student takes an active part in practical classes, demonstrates deep knowledge, gives complete and detailed answers to questions. Takes an active part in discussing problem situations, demonstrates good skills and abilities in performing practical tasks, correctly evaluates the results. Test tasks are completed in full.
Good «4»	The student participates in practical classes; has a good command of the material. Demonstrates the necessary knowledge, but answers questions with some mistakes; participates in the discussion of problem situations. Test tasks are completed in full, at least 70% of answers to questions are correct.
Satisfactory «3»	The student sometimes participates in practical classes; partially speaks and asks questions; makes mistakes when answering questions; shows passive work in practical classes. Demonstrates skills and abilities in performing practical tasks, but evaluates the results obtained insufficiently fully and accurately. Testing is completed in full, at least 50% of answers are correct,

	answers to open questions are not logical, with obvious significant errors in definitions.
Unsatisfactory «2»	The student does not participate in the practical lesson, is only an observer; never speaks and does not ask questions, is not interested in learning the material; gives incorrect answers to questions, demonstrates insufficient skills and abilities, cannot cope with practical work and evaluation of the results. Testing is not completed.

The student is admitted to the exam provided that the requirements of the curriculum are fulfilled and if they received at least 3.00 points for the current educational activity and passed the final test control of the "Krok-1" format by at least 90% (50 tasks).

The final test control is conducted at the Educational and Production Complex of Innovative Technologies of Education, Informatization and Continuing Education of ONMedU at the last lesson before the exam.

Assessment of learning outcomes during the final test

Number of correct answers	Score
50	Excellent («5»)
47-49	Good («4»)
45-46	Satisfactory («3»)
44 and less	Unsatisfactory («2»)

Criteria for assessing the learning outcomes of students in the exam

Score	Assessment criteria
Excellent («5»)	The student has correctly, accurately and completely completed all the tasks of the examination paper, clearly and logically answered the questions posed by the examiners. He/she has a thorough and comprehensive knowledge of the content of theoretical questions, is fluent in professional and scientific terminology. He/she thinks logically and constructs an answer, freely uses the acquired theoretical knowledge in the analysis of practical tasks in the system of microbiology, virology and immunology and their integration with other disciplines - biology, human anatomy, histology, medicinal chemistry, physiology, pathological anatomy, pathological physiology and pharmacology. The student demonstrates good skills and abilities in performing practical tasks, correctly evaluates the results obtained.
Good («4»)	The student has completed all the tasks of the examination paper, clearly and logically answered the questions posed by the examiners. He/she has a sufficiently deep and comprehensive knowledge of the content of theoretical questions, knows professional and scientific terminology. He/she thinks logically and constructs an answer, demonstrates sufficient skills and abilities when performing a practical task. However, some questions lack sufficient depth and argumentation, and the candidate makes minor mistakes that are eliminated by the candidate when pointed out by the examiner.
Satisfactory («3»)	The student has incompletely completed all the tasks of the examination paper, the answers to additional and leading questions are vague and unclear. The student has the basic amount of theoretical knowledge, uses professional and scientific terminology inaccurately. Experiences significant difficulties in constructing an independent logical answer, demonstrates skills and abilities in performing a practical task, but evaluates the results obtained insufficiently fully and accurately.

Unsatisfactory («2»)	The student did not complete the tasks of the examination paper, in most cases did not answer additional and leading questions of the examiners. He/she has not mastered the main body of theoretical knowledge, has shown a low level of proficiency in professional and scientific terminology. Answers to the questions are fragmentary, inconsistent, illogical, and unable to cope with practical work and evaluation of the results obtained. There are a significant number of gross errors in the answers.
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9. Distribution of points, obtained by the student

A multi-point scale (200-point scale) characterises the actual performance of each student in mastering the educational component. The conversion of the traditional grade (grade point average) into a 200-point scale is carried out by the University's Information Technology Department.

According to the points obtained on a 200-point scale, the achievements of students are evaluated according to the ECTS rating scale. Further ranking according to the ECTS rating scale allows to evaluate the achievements of student in the educational component, who study in the same course of one speciality, according to the points they received.

The ECTS scale is a relative and comparative rating scale that establishes the applicant's belonging to the group of the best or worst among the reference group of fellow students (faculty, speciality). Grade A on the ECTS scale cannot be equal to grade A, and grade B cannot be equal to grade B, etc. When converting from a multi-point scale, the limits of grades "A", "B", "C", "D", "E" on the ECTS scale do not coincide with the limits of grades "5", "4", "3" on the traditional scale. Students who have received grades "FX" and "F" ("2") are not included in the list of students to be ranked. The grade "FX" is assigned to students who have scored the minimum number of points for the current academic activity, but who have not been credited with the final control. The grade "F" is assigned to students who have attended all classes in the discipline, but have not gained an average score (3.00) for current academic activities and are not admitted to the final control.

Students enrolled in the same course (one speciality), based on the number of points gained in the discipline, are ranked on the ECTS scale as follows:

Conversion table of traditional to multi-point

National score for the discipline	The sum of scores for the discipline
Excellent («5»)	185 – 200
Good («4»)	151 – 184
Satisfactory («3»)	120 – 150
Unsatisfactory («2»)	Less than 120

According to the ECTS rating scale, student' achievements in educational discipline, who study on the same course of one specialty, according to their scores, are assessed by means of rank, namely:

Conversion of the traditional evaluation and and ECTS scores

Score on the ECTS scale	Statistical indicator
A	The best 10% students
B	Next 25% students
C	Next 30% students
D	Next 25% students
E	Next 10% students

10. Methodological support

- Working program in the discipline
- Syllabus
- Methodological recommendations for the practical classes in the discipline
- Multimedia presentations
- Situational tasks (including calculation)
- Tests on the theme

57. Questions for the final control

List of theoretical questions:

1. Microbiology as a branch of modern biology. Tasks of medical microbiology and its importance in the practical activity of the doctor. The main stages of development of microbiology. Works of Louis Pasteur and Robert Koch and their role in the development of microbiology.
2. Contribution of Ukrainian scientists to the development of microbiology, virology and immunology.
3. Principles of organization, equipment and mode of operation of the microbiological laboratory.
4. Principles of systematics and nomenclature of microorganisms. Species as the basic taxonomic unit in microbiology. Other taxonomic categories.
5. Division of microorganisms into prokaryotes and eukaryotes, the main differences between them. Examples of pathogenic representatives of prokaryotes and eukaryotes.
6. Microscopic method of research in microbiology. Characteristics of the main types of microscopy and their purpose. Methods of studying the motility of microorganisms. Morphology and structure of bacteria. Structural elements of bacterial cells and their role in the life and pathogenicity of bacteria.
7. Simple and complex staining methods in microbiology. Purpose and basic principles of complex stains by Gram, Ziehl-Neelsen, Romanovsky-Giemsa, Neisser, Gins-Bury staining, mechanism and its use in diagnostics.
8. Morphology of protozoa. Pathogenic representatives.
9. Types of nutrition of microorganisms. The mechanism of penetration of nutrients into the bacterial cell. Chemical composition of microorganisms.
10. Respiration of microorganisms, types of respiration. Methods of cultivation of anaerobic bacteria.
11. Growth and methods of reproduction of bacteria. Mechanism of cell division. Phases of reproduction of bacterial culture in nutrient medium.
12. Enzymes of microorganisms, their role in metabolism. Methods of studying enzymatic activity and their importance for the identification of bacteria. Basic differential diagnostic media.
13. Bacteriological method of research. Principles of isolation and identification of pure cultures of aerobic microorganisms.
14. Principles of isolation and identification of pure cultures of anaerobic bacteria.
15. The influence of physical, chemical and biological factors on microorganisms.
16. Phages. Structure, methods of qualitative and quantitative determination of bacteriophages. The use of phages in medicine. Interaction of phage with bacterial cell. Characteristics of productive phage infection. Lysogeny. Phage conversion.
17. Genotype and phenotype, the concept of "gene". Functions of the gene. Types of variability in microorganisms. Hereditary variability, its mechanisms and significance. Dissociation in bacteria. L-forms of bacteria.
18. Hereditary variability. The role of hereditary variability in evolution. Mutations. Mutagens.
19. Genetic recombination. Transformation, transduction, conjugation.
20. Extrachromosomal factors of heredity in bacteria. Plasmids, their genetic functions. Role in bacterial variability.
21. The importance of genetics in the development of general and medical microbiology.

Microbiological basis of genetic engineering, its achievements, the use of genetically engineered drugs in medicine.

22. Molecular diagnostic methods in microbiology.
23. Antibiotics, characteristics of their action on microorganisms, methods of studying the susceptibility of microorganisms to antibiotics and their importance in medicine. Side effects of antibiotics, methods of combating it.
24. Drug resistance of microorganisms, the mechanism of formation and methods of combating it.
25. The concept of "infection (infectious process)". Factors that determine the occurrence of the infectious process. Periods in the development of the infectious process.
26. The role of microorganisms in the infectious process. Pathogenicity, virulence, units of measurement, study methods.
27. Factors of virulence of microorganisms, their characteristics.
28. Toxins of microorganisms. Properties, chemical nature, preparation, activity measurement. Toxigenic bacteria. The role of toxins in the pathogenesis of diseases.
29. The role of microorganism in the infectious process. Influence of the environment and social conditions on the emergence and development of the infectious process.
30. Epidemic process, links of the epidemic chain. The concept of pandemic, epidemic, endemic, natural-focal diseases. The concept of "lethality" and "mortality".
31. Classification of infections by type of pathogen, nature of infection, features of pathogenesis and manifestations. Relapse, reinfection, superinfection, secondary infection. Epidemiological classification of infectious diseases by route of transmission.
32. Doctrine of immunity, definition of basic concepts in immunology (immunity, antigen, antibody, immune system). Types of immunity and forms of its manifestations.
33. Nonspecific factors of body protection and their differences from immunological reactivity. Humoral factors of nonspecific immunity. Ways of complement activation.
34. Cellular factors of nonspecific immunity. Phagocytosis. Determination of phagocytic activity. I.I. Mechnikov is the founder of the phagocytic theory of immunity.
35. Antigens. Their characteristics. Haptens. Antigenic structure of bacteria.
36. Antigens of the human body. Antigens of red blood cells, blood groups. HLA system, its importance in transplantation. Autoantigens.
37. Antibodies (immunoglobulins). Place of synthesis, dynamics of production, autoantibodies.
38. Classes of immunoglobulins, their physicochemical properties and role in immunity. Active centers of antibodies.
39. Immune system of the body, central and peripheral organs. Macrophages, T- and B-lymphocytes and their role in immunogenesis.
40. Forms of immune response and their characteristics.
41. Cellular basis of the immune response. Interaction of cells in humoral and cellular immune response. The role of mediators.
42. Theories of immunogenesis.
43. Therapeutic and prophylactic sera, principles of preparation and use.
44. Vaccines, its classification. Live vaccines. Principles of obtaining. Live vaccines for routine prevention. Corpuscular vaccines from killed microorganisms. Associated vaccines. Adsorbed vaccines.
45. Anatoxins. Obtaining, units of measurement, use. Explain the essence of antitoxic immunity.
46. Principles of vaccine prophylaxis, vaccine therapy and specific etiotropic therapy of infectious diseases.
47. Serological reactions, main types. Principles of application.
48. Serological identification. Serological diagnosis.
49. Agglutination and precipitation reactions, its variants, practical use.
50. Reaction of biological neutralization. Antitoxins, their properties, mechanism of action. Principles of obtaining antitoxic sera, units of measurement, practical use.
51. Reaction with labeled antibodies - immunofluorescence reaction, radioimmunoassay, their

practical use.

52. Enzyme-linked immunosorbent assay, principle, importance in diagnosis, practical use.
53. Immune lysis reaction, complement binding reaction, principles of setting and practical use.
54. Diagnostic sera, principles of preparation, titration, use. Monoclonal antibodies, preparation and use.
55. The use of serological studies in the diagnosis of infectious diseases. Serological method of diagnosis. Criteria for serological diagnosis.
56. Allergies. Allergens. Methods of diagnosis of allergic diseases.
57. Type I allergic reactions - anaphylactic and atopic. Prevention of anaphylactic shock when administering heterologous sera and antibiotics.
58. Type II allergic reactions - cytotoxic and cytolytic.
59. Type III allergic reactions - immunocomplex.
60. Type IV allergic reactions - delayed type reactions.
61. Immune status of the body as an indicator of the reactivity of the body. Methods of assessing the immune status of the body.
62. Primary and secondary immunodeficiencies.
63. Autoimmune diseases, pathogenesis. Principles and prospects of therapy of autoimmune diseases.
64. Methods of microbiological diagnosis of diseases of bacterial etiology.
65. General characteristics of the group of pyogenic cocci. Principles of microbiological diagnostics of purulent-inflammatory processes of coccal etiology and general, selective and differential diagnostic media used for this purpose.
66. Staphylococci, biological properties, classification. Factors of pathogenicity. Pathogenesis of staphylococcal diseases, the role of staphylococci in the etiology of hospital-acquired infections. Drugs for specific prophylaxis and therapy. Microbiological diagnostics.
67. Streptococci, biological properties, classification. *Streptococcus pyogenes*. *Streptococcus pneumoniae*. Pathogenesis of diseases, laboratory diagnosis.
68. Meningococci, biological properties, classification. Pathogenesis and microbiological diagnosis of meningococcal diseases and bacterial carriage.
69. Gonococci, biological properties. Pathogenesis and microbiological diagnosis of diseases. Prevention and therapy of gonorrhea and blenorrhea.
70. Tetanus clostridia, properties, toxin formation Tetanus pathogenesis. Specific prophylaxis and therapy, their theoretical justification and evaluation.
71. *Clostridium botulinum*. Biological properties, classification, toxin formation. Pathogenesis of botulism as a toxic infectious disease. Specific therapy and prevention. Microbiological diagnostics. Accelerated method of diagnosis of botulism by S. M. Minervin.
72. Clostridium gas anaerobic infection, biological properties. Pathogenesis of the disease. The role of potential action of toxins. Methods of specific prevention and therapy. Microbiological diagnostics.
73. The causative agent of syphilis, biological properties. Pathogenesis of syphilis, principles of therapy and prevention. Microbiological diagnosis of syphilis.
74. Borrelia. Leptospire. Biological properties. Pathogenesis of diseases. Microbiological diagnostics
75. *Corynebacterium diphtheriae*, biovars, properties. Theoretical basis of specific prophylaxis and therapy of diphtheria. Anti-diphtheria prophylactic and therapeutic drugs.
76. Cholera vibrios, biological properties, classification. Pathogenesis of cholera. Specific prophylaxis. Principles of therapy. Methods of microbiological diagnosis.
77. Campylobacter. Helicobacter. Spirillum. Principles of therapy. Methods of microbiological diagnosis.
78. The causative agent of tularemia, biological properties. Pathogenesis of the disease, methods of prevention and microbiological diagnosis.
79. Brucella, biological properties, classification. Pathogenesis of brucellosis. Prevention. Methods of microbiological diagnosis.
80. The causative agent of anthrax, biological properties. Pathogenesis of anthrax, specific prevention, microbiological diagnosis.

81. *Yersinia*. The causative agent of plague. Pathogens of yersiniosis. Biological properties. The role of D.K.Zabolotny in the study of plague. Pathogenesis, immunity, methods of prevention and treatment. Methods of microbiological diagnosis.
82. Pathogenesis of diphtheria. Characteristics of diphtheria toxin. Microbiological diagnosis of diphtheria and bacterial carriage. Differentiation of the causative agent of diphtheria and diphtheroids.
83. Pathogenic mycobacteria, role in human pathology. Tuberculosis pathogens, types of tuberculosis bacteria. Pathogenesis, principles of therapy, prevention of tuberculosis.
84. *Mycobacterium leprae*. Atypical mycobacteria and their role in human pathology. Actinomycetes.
85. *Bordetella*, their properties. The causative agent of whooping cough. Specific prophylaxis and microbiological diagnosis of pertussis.
86. General characteristics of the family of enterobacteria and genera *Escherichia*, *Salmonella*, *Shigella*. Significance in human pathology. Differential diagnostic and selective nutrient media for primary inoculation of the test material in the microbiological diagnosis of escherichiosis, salmonellosis, shigellosis.
87. *Escherichia*, their properties, role in normal and pathology. Pathogenic serovars of *E. coli* (EPEC, EIEC, ETEC, EGEC). Microbiological diagnosis of escherichiosis.
88. *Shigellae*, biological properties, classification. Pathogenesis of dysentery. Methods of prevention. Microbiological diagnosis of dysentery.
89. *Salmonellae* - causative agents of typhoid and paratyphoid fever. Biological properties, antigenic structure. Pathogenesis of diseases. Immunity. Prevention and therapy. Pathogenetic basis of microbiological diagnosis of typhoid fever and paratyphoid fever A and B. Methods of microbiological diagnosis, their evaluation.
90. *Salmonellae* - causative agents of acute gastroenteritis, their properties. Principles of classification. Pathogenesis of food toxic infections of salmonellosis etiology. Intra-hospital salmonellosis, microbiological diagnosis.
91. *Rickettsia*. Biological properties, classification and general characteristics of rickettsiosis. Pathogenesis of typhus, specific prevention. Microbiological diagnosis of rickettsiosis.
92. *Mycoplasmas*, classification, biological properties, methods of cultivation, role in human pathology. Microbiological diagnosis of mycoplasmosis.
93. *Chlamydia*, classification, biological properties. Methods of cultivation. Role in human pathology. Microbiological diagnosis of chlamydia.
94. Morphology and ultrastructure of viruses. Types of symmetry of viruses. Chemical composition, functions of the constituent parts of viruses.
95. Modern views on the nature and origin of viruses. Place of viruses in the living system. Methods of studying viruses, their evaluation. Principles of virus classification. Basic properties of human and animal viruses.
96. Methods of virus cultivation and their evaluation.
97. Serological reactions used in virology. Virus neutralization, hemagglutination and hemadsorption reactions, hemagglutination inhibition, ELISA, RPC, RIF, ELISA.
98. The use of cell cultures in virology. Classification of cell cultures. Nutrient media for cell culture. Methods of detection of viruses in cell culture and their evaluation. Cytopathic action of viruses, its types.
99. Types of interaction between viruses and cells. Characteristics of productive interaction, stages.
100. Features of the pathogenesis of viral infections. Acute and persistent viral infections.
101. Immunological features of viral infections. Factors of antiviral immunity.
102. Nonspecific factors of protection of the macroorganism from viral agents, their characteristics. Interferons, mechanism of action, interferonogens.
103. Viral vaccines, classification, principles of obtaining, requirements for them, control, evaluation of effectiveness.
104. Family of Orthomyxoviruses. History of discovery, biological properties, classification. Antigenic structure and types of antigenic variability of influenza virus. Modern hypotheses that explain the antigenic variability of orthomyxoviruses.

105. Pathogenesis and immunity in influenza. The role of specific and nonspecific mechanisms in influenza immunity. The problem of specific prophylaxis and therapy of influenza. Drugs and their evaluation. Laboratory diagnostics.
106. Family of Paramyxoviruses, general characteristics of the family. Parainfluenza viruses, their biological properties. Role in the development of human pathology. Laboratory diagnosis of parainfluenza infections.
107. Measles virus, biological properties, cultivation. Pathogenesis of infection. Laboratory diagnosis, specific prevention.
108. Mumps virus of epidemic parotitis. Pathogenesis of infection. Laboratory diagnosis, specific prevention of mumps. Respiratory syncytial virus. Biological properties, role in the development of human pathology. Methods of diagnosis of diseases caused by RS virus.
109. Family Picornaviruses, general characteristics. Antigenic structure. Significance in the development of human pathology. Poliomyelitis viruses, characteristics, classification. Pathogenesis and immunogenesis of infection. Laboratory diagnosis, specific prevention. The problem of polio eradication worldwide.
110. Genus Enteroviruses, general characteristics, classification. Laboratory diagnosis of enterovirus infections.
111. Genus Rhinoviruses, biological properties. Classification. Role in human pathology. Methods of laboratory diagnosis of infections caused by rhinoviruses.
112. Family of Rabdoviruses. Rabies virus, biological properties. Pathogenesis of the disease. Laboratory diagnostics. Differentiation of fixed and wild rabies virus. Specific prophylaxis of rabies.
113. General characteristics of the ecological group of arboviruses. Viruses of tick-borne and Japanese encephalitis. History of discovery and study of these viruses. Biological properties, methods of laboratory diagnosis, specific prevention. Genus Rubiviruses. Rubella virus. Biological properties. Pathogenesis of the disease, immunity. Laboratory diagnostics, specific prophylaxis.
114. Family of Herpesviruses, biological properties, importance in the development of human pathology. Laboratory diagnosis of diseases. Genetic methods of diagnosis.
115. Family of Adenoviruses. Biological properties. Antigenic structure. Cultivation. Pathogenesis and laboratory diagnosis of adenovirus infections. Immunity. Specific prophylaxis.
116. Pathogens of viral hepatitis, properties and classification of viruses. Pathogenesis of diseases. Laboratory diagnostics. Prospects for specific prevention.
117. Family of Retroviruses, biological properties. Classification. Mechanism of viral carcinogenesis.
118. Oncogenic viruses, classification. Virus-genetic theory of tumors.
119. Human immunodeficiency viruses (HIV). Properties. Role in human pathology. Pathogenesis of AIDS. Methods of laboratory diagnosis (immunological, genetic). Prospects for specific prevention and therapy.
120. Prions. Properties. Prion diseases of animals (scrapie, bovine spongiform encephalopathy) and humans (Kuru, Creutzfeldt-Jakob disease, etc.). Pathogenesis of prion diseases. Diagnostics.

List of practical question:

1. Perform a microscopy of the sample slide using an immersion lens, draw a conclusion about the morphological properties of the studied microorganisms.
2. Prepare a bacterial slide, stain by Gram's method, perform microscopy using an immersion lens, draw a conclusion about the purity of the culture of microorganisms under study.
3. Describe the cultural properties of colonies of microorganisms that have grown on the surface of simple nutrient media. Justify the follow-up study.
4. Describe the properties of colonies of microorganisms that have grown on Endo medium. Find colonies that are characteristic of E. coli. Explain the use of differential diagnostic media with carbohydrates.
5. Explain the essence of vaccine prophylaxis. Select 2-3 live vaccines, explain the principles of their manufacture and use.
6. Explain the essence of vaccine prophylaxis. Select 2-3 killed vaccines, explain the principles of

their manufacture and use.

7. Explain the essence of antitoxic immunity. Select drugs to create active antitoxic immunity.
8. Explain the essence of antitoxic immunity. Select drugs to create passive antitoxic immunity.
9. Select drugs that are used for specific prevention and treatment of diphtheria, explain aspects of their use.
10. Explain the essence of enzyme-linked immunosorbent assay. Read the results of ELISA, delivered for the purpose of serological diagnosis of HIV infection.
11. Explain the essence of serological identification of microorganisms. Select the drugs that are used for this purpose. Principles of their preparation.
12. Explain the essence of serological diagnosis of infectious diseases. Select the drugs that are used for this purpose, their preparation.
13. Perform microbiological diagnosis of purulent process by bacterioscopic method. To carry out microscopy of the stained preparation from the material from the patient and draw a conclusion.
14. Perform microbiological diagnosis of acute gonorrhea by bacterioscopic method. Perform microscopy of a stained specimen from a patient and draw a conclusion.
15. Perform serological diagnosis of typhoid fever and paratyphoid, record the indirect hemagglutination reaction (RNGA), draw a conclusion.
16. Perform serological diagnosis of typhoid fever and paratyphoid fever, record the Vidal reaction, draw a conclusion.
17. Explain the essence of bacteriological diagnosis of typhoid fever and paratyphoid. Record biochemical activity and serological identification of hemoculture isolated from the patient. Make a conclusion.
18. Explain the essence of bacteriological diagnosis of dysentery. Perform the biochemical and serological identification of the coproculture isolated from the patient. Make a conclusion.
19. Perform agglutination reaction on glass with adsorbed diagnostic cholera sera for the purpose of serological identification of coproculture. Make a conclusion.
20. Perform microbiological diagnosis of tuberculosis by bacterioscopic method. Perform a microscopy of a specially stained specimen from the patient's material. Make a conclusion.
21. Perform microbiological diagnosis of diphtheria by bacterioscopic method. Perform microscopy of a specially stained preparation from the material from the patient. Make a conclusion.
22. Record the results of microbiological diagnosis of gas anaerobic infection by the accelerated method. Make a conclusion.
23. Perform serological diagnosis of syphilis. Record the reaction of direct immunofluorescence conducted for the diagnosis of primary syphilis, to draw a conclusion.
24. Perform serological diagnosis of brucellosis. Record the Wright reaction. Make a conclusion.
25. Record the results of serological diagnosis of tularemia. Make a conclusion.
26. Record the results of the agglutination reaction, set for the purpose of serological diagnosis of typhus. Make a conclusion.
27. Explain the methods of cultivation of viruses in cell culture, chicken embryos, laboratory animals.
28. Explain the method of preparation of patient material for virological study (virus isolation).
29. Explain the methodology for detecting viral reproduction in cell cultures (CPD, color test, hemadsorption reaction, plaque formation).
30. Explain the method of detection of virus in chicken embryos (hemagglutination reaction).
31. Explain the essence of serological reactions used in virology (RGGA, RVN, RZK, RNGA).
32. Explain the essence of virological diagnosis of influenza. Read the results of the hemagglutination reaction (RGA), performed to detect the virus. Draw a conclusion about the presence and titer of the virus.
33. Explain the essence of virological diagnosis of influenza. To take into account the hemagglutination inhibition reaction (HIA), set for the purpose of serological identification of the isolated virus. Make a conclusion about the type of virus.
34. Perform serological diagnosis of influenza. To record the hemagglutination inhibition reaction (HIR), set with paired sera of the patient. Make a reasonable conclusion.

35. Explain the essence of virological diagnosis of poliomyelitis. Determine the presence of the virus in cell cultures infected with material from the patient, by cytopathic action (CPD) and the phenomenon of plaque formation. Make a conclusion.
36. Explain the methods of diagnosis of herpes and adenovirus infection.
37. Explain the methods of diagnosis of viral hepatitis. Record the results of ELISA conducted for the purpose of serological diagnosis.
38. Explain the methods of diagnosis of HIV infection. Record the results of ELISA, conducted for the purpose of serological diagnosis.
39. Explain the essence of viroscopic diagnosis of viral diseases. Perform microscopy of a preparation made from brain tissue to detect Babesh-Negri bodies.

12. Recommended literature

Main:

1. Abbas, A., Litchman, A. H. & Pillai, S. Basic Immunology - 6th Edition. (Elsevier Ltd, 2019).
2. Anantharyan R. Jayaram Paniker C. K. Textbook of Microbiology. 12-th Edition.- Orient Longman, 2022.
3. Male, D., Peebles, S. & Male, V. Immunology. (2020).

Additional:

4. Barer, M. & Irving, W. L. Medical Microbiology 19th Edition A Guide to Microbial Infections: Pathogenesis, Immunity, Laboratory Investigation and Control. vol. 19 (2018).
5. Burrell, C. J., Howard, C. R. & Murphy, F. A. Fenner and White's Medical Virology: Fifth Edition. Fenner and White's Medical Virology: Fifth Edition (Elsevier Inc., 2016).
6. Cann, A. J. Principles of Molecular Virology: Sixth Edition. Principles of Molecular Virology: Sixth Edition (Elsevier Inc., 2015). doi:10.1016/C2014-0-01081-7.
7. Jawetz, Melnick, & Adelberg's Medical Microbiology, 26th Edition, 2012, English. 880 p.
8. Louten, J. & Reynolds, N. Essential Human Virology. (2016).
9. Marsh D, P., Lewis A O, M., Rogers, H., Williams W, D. & Wilson, M. Marsh and Martin's Oral Microbiology. (Elsevier Limited, 2016).
10. Nath, S. K. & Revankar, S. G. Problem-based microbiology. (Saunders, 2006).
11. Ream, Walt. Molecular microbiology laboratory: a writing-intensive course. (Academic Press, 2013).
12. Review of Medical Microbiology and Immunology, 12 edition/ Warren E. Levinson. McGraw-Hill Prof Med.-Tech., 2012. 688 p.
13. Rich, R. R. & Fleisher, T. A. Clinical Immunology (Fifth Edition) Principles and Practice. Clinical Immunology (2018).
14. Sandle, T. Pharmaceutical Microbiology: Essentials for Quality Assurance and Quality Control. Pharmaceutical Microbiology: Essentials for Quality Assurance and Quality Control (Elsevier Inc., 2015). doi:10.1016/C2014-0-00532-1.
15. Wilson, J. (Nurse) & Stucke, V. A. Clinical microbiology: an introduction for healthcare professionals. (Baillière Tindall, 2000).

13. Electronic information resources

1. <http://moz.gov.ua> – Міністерство охорони здоров'я України
2. <http://www.microbiologybook.org> - Microbiology and immunology on-line
3. <http://www.microbiologyinfo.com> - On-line microbiology note
4. www.cdc.gov - Centers for diseases control and prevention
5. www.ama-assn.org – Американська медична асоціація / American Medical Association
6. www.who.int – Всесвітня організація охорони здоров'я
7. www.dec.gov.ua/mtd/home/ - Державний експертний центр МОЗ України