Appendix to the working program

Federal State Budgetary Educational Institution of Higher Education
"Privolzhsky Research Medical University"
Ministry of Health of the Russian Federation

BANK OF ASSESSMENT TOOLS FOR DISCIPLINE MICROBIOLOGY

Training program (specialty): **05.33.01 PHARMACY**

Department: **EPIDEMIOLOGY, MICROBIOLOGY AND EVIDENCE-BASED MEDICINE**

Mode of study: **FULL-TIME**

Nizhniy Novgorod
2022

1. Bank of assessment tools for the current monitoring of academic performance, mid-term assessment of students in the discipline / practice

This Bank of Assessment Tools (BAT) for the discipline "**MICROBIOLOGY**" is an integral appendix to the working program of the discipline "**MICROBIOLOGY**". All the details of the approval submitted in the WPD for this discipline apply to this BAT.

(Banks of assessment tools allow us to evaluate the achievement of the planned results stated in the educational program.

Assessment tools are a bank of control tasks, as well as a description of forms and procedures designed to determine the quality of mastering study material by students.)

2. List of assessment tools

The following assessment tools are used to determine the quality of mastering the academic material by students in the discipline/ practice:

No.	Assessment tool	Brief description of the assessment tool	Presentation of the assessment tool in the BAT
1	Test №1	A system of standardized tasks that allows you to automate the procedure of measuring the level of knowledge and skills of a student	Bank of test tasks
2	Test №2		
3	Abstract	The product of the student's independent work, which is a summary in writing of the results of the theoretical analysis of a certain scientific (educational and research) topic, where the author reveals the essence of the problem under study, provides various points of view, as well as his /her own views on it.	List of abstract topics
4	Situational tasks	A method of control that allows you to assess the criticality of thinking and the degree of the material comprehension, the ability to apply theoretical knowledge in practice.	List of tasks

3. A list of competencies indicating the stages of their formation in the process of mastering the educational program and the types of evaluation tools

Code and formulation of competence*	Stage of competence formation	Controlled sections of the discipline	Assessment tools
UC-1, 6, 8, GPC-1, 2	Current	**Section 1** General medical microbiology Ecology of microorganisms. Sanitary microbiology General virology Genetics of bacteria Antibiotics Infectious process Pathogenicity and virulence of microorganisms. Bacteria genetics	Test Abstract Situational tasks
		Section 2 General immunology	Test Abstract Situational tasks

		Section 3 Special medical microbiology	Test Abstract Situational tasks
		Section 4 Special medical virology	Test Abstract Situational tasks
		Section 5 Sanitary microbiology	Test Abstract Situational tasks
UC-1, 6, 8, GPC-1, 2	Mid-term	**Section 1** General medical microbiology Ecology of microorganisms. Sanitary microbiology General virology Genetics of bacteria Antibiotics Infectious process Pathogenicity and virulence of microorganisms. Bacteria genetics **Section 2** General immunology **Section 3** Special medical microbiology **Section 4** Special medical virology **Section 5** Sanitary microbiology	Exam questions

4. The content of the assessment tools of entry, current control

Entry /current control is carried out by the discipline teacher when conducting classes in the form of: test, abstract, situational tasks

Assessment tools for current control.

1. test
2. abstract
3. situational tasks

4.1. Tests for the assessment of competence " UC-1, 6, 8, GPC-1, 2"*:*

1. Who was the first person to examine bacterial cells under the microscope?

1) Louis Pasteur;
2) Robert Koch;
3) Anthony van Leeuwenhoek;
4) Dmitry Ivanowsky;
5) Hans Christian Gram.

2. Prokaryotes:

1) are “prenucleus” organisms;
2) may include single-cell organisms;
3) may belong to domen Archaea / Archaebacteria;
4) may belong to domen Bacteria / Eubacteria;
5) are Eucarya (nuclear organisms).

3. Components of prokaryotes are:

1) a cytoplasm membrane;
2) peptidoglycan;
3) a single circular chromosome;
4) cell wall;

5) ribosome 80S.

4. Which group of microbial agents is eukaryotic:
1) viruses;
2) bacteria;
3) actinomycetes;
4) fungi;
5) prions.

5. Which characteristics are true for prokaryotic cells?
1) a membrane-bound nucleus;
2) a single plasma membrane between the cell wall and the cytoplasm;
3) a cell wall;
4) a nucleoid;
5) 70s ribosomes.

6. The components of a bacterial cell are:
1) a cytoplasmic membrane;
2) ribosomes;
3) mitochondria;
4) chloroplasts;
5) inclusions.

7. **Nuclear analogue/ equivalent of bacteria:**
1) contains a haploid set of genes;
2) is enclosed in a membrane;
3) is called a nucleoid;
4) contains DNA;
5) includes a single chromosome.

8. Bacteria can have:
1) a Golgi apparatus;
2) a nucleoid;
3) a cell wall;
4) pili;
5) flagella.

9. The basic structural unit of biological taxonomy (the narrowest taxon) is:
1) class;
2) order;
3) family;
4) genus;
5) species.

10. The scientist who introduced the binomial / binary ("two word naming system) nomenclature to indicate the species is:
1) Anthony van Leeuwenhoek;
2) Hans Christian Gram;
3) Carl Linnaeus;
4) Robert Koch;
5) Louis Pasteur.

11. The strains that have antigenic properties different from other strains of the same species are:
1) morphovars;

2) biovars (biotypes);
3) resistovars;
4) phagovars (phagotypes);
5) serovars (serotypes).

12. The main morphological groups of bacteria are:
1) prokaryotes;
2) eukaryotes;
3) cocci;
4) rod-shaped;
5) spiral-forms.

13. Cocci arranged in a grapelike cluster (amorphous clumps) are:
1) micrococci;
2) tetrads;
3) sarcina;
4) staphylococci;
5) streptococci.

14. Cocci arranged in chains are:
1) diplococci;
2) spirochaetes;
3) bacilli;
4) streptococci;
5) vibrios.

15. Rod-shaped bacteria arranged in chains are:
1) diplobacilli;
2) clostridia;
3) vibrios;
4) streptobacilli;
5) sarcinae.

16. Comma-shaped bacteria are:
1) bacilli;
2) spirilla;
3) vibrios;
4) clostridia;
5) spirochetes.

17. Spiral-form bacteria are called:
1) bacilli;
2) spirilla;
3) sarcinae;
4) clostridia;
5) spirochetes.

18. Spirochetes with 6 to 14 curls are called:
1) vibrios;
2) leptospires;
3) borreliae;
4) spirilla;
5) treponemes.

19. Fungi-like bacteria forming long filaments are:

1) mycoplasmas;
2) rickettsiae;
3) actinomycetes;
4) chlamydiae;
5) spirochetes.

20. The main structural components of a bacterial cell characteristic of most bacteria ("obligatory" structures) are:
1) a nucleoid;
2) a cytoplasmic membrane;
3) ribosomes;
4) a cytoplasm;
5) a cell wall.

21. The structural component containing peptidoglycan is:
1) a nucleoid;
2) a ribosome;
3) a flagellum;
4) a cell wall;
5) a plasma membrane.

22. What is true for a bacterial cell wall it?
1) determines the bacterial cell shape;
2) contains peptidoglycan;
3) always contains endotoxin;
4) determines the bacterial staining properties;
5) presents in L-forms.

23. According to the structural features of the cell wall bacteria are classified into:
1) gram-negative;
2) gram-positive;
3) protoplasts;
4) acid-fast;
5) spheroplasts.

24. Peptidoglycan consists of the following polymers:
1) N-acetylglucosamine (NAG);
2) N-acetylmuramic acid (NAM);
3) lipopolysaccharide;
4) polymetaphosphates;
5) tetrapeptide chains.

25. Gram staining is determined by:
1) the form and size of a bacterial cell;
2) the structure of a capsule;
3) the presence of a spore;
4) the structure of a bacterial cell wall;
5) the structure of a cytoplasmic membrane.

26. The components of a gram-positive bacteria cell wall are:
1) a single-layer peptidoglycan;
2) a multilayer peptidoglycan;
3) the presence of teichoic acids;
4) the presence of endotoxin;
5) the presence of outer membrane.

27. What is true for teichoic (lipoteichoic) acids?

1) typical structures of gram-positive bacteria;
2) components of a cell wall;
3) they are connected with pili;
4) they are connected with peptidoglycan (cell membrane);
5) fragments of ribosomes.

28. What is true for gram-negative bacteria?

1) the presence of a multilayered peptidoglycan;
2) the presence of an outer membrane;
3) the presence of teichoic acids;
4) the absence of a periplasm;
5) the presence of lipopolysaccharide (LPS).

29. The components of a gram-negative cell wall are:

1) teichoic acids;
2) lipopolysaccharide;
3) endotoxin;
4) teichoic acids;
5) outer membrane.

30. The specific component of gram-negative bacteria is:

1) a capsule;
2) a flagellum;
3) an endospore;
4) an outer membrane;
5) a peptidoglycan.

31. Which of the following characteristics are true for a lipopolysaccharide:

1) it is a component of a cytoplasmic membrane;
2) it is a component of a capsule;
3) it is a component of an outer membrane;
4) it is a component of a peptidoglycan;
5) it is a bacterial endotoxin.

32. What are the factors that determine the acid resistance of bacteria?

1) the structure of the cell wall;
2) the structure of the cytoplasmic membrane;
3) the presence of lipids in the cell wall;
4) the presence of peptidoglycan in the cell wall;
5) the presence of a capsule.

33. Bacteria without a cell wall/ bacterium that lack a cell wall are:

1) mycoplasmas;
2) rickettsiae;
3) actinomycetes;
4) chlamydiae;
5) spirochetes.

34. Cell wall deficient bacterial forms which can multiply are called:

1) protoplasts;
2) spheroplasts;
3) L-forms;
4) streptococci;

5) staphylococci.

35. Characteristics true for bacterial l-forms are:
1) bacteria deficient in nucleus;
2) bacteria deficient in fimbriae;
3) bacteria deficient in peptidoglycan;
4) the form of bacterial adaptation to antibiotics;
5) a multiplying protoplast /spheroplast.

36. A complex stain method:
1) is the application of a single dye for staining;
2) is the application of two or more dyes;
3) it requires several steps;
4) it permits the differentiation of cell types or cell structures;
5) is Gram stain.

37. The function of a cytoplasmic membrane is:
1) a selective transport of nutrient molecules;
2) ATP- synthesis/ energy transformation;
3) participation in a binary fission;
4) protection from UV- light;
5) adhesion.

38. The functions of bacterial fimbriae (pili) are:
1) locomotion;
2) adhesion;
3) augmentation of pathogenicity;
4) DNA replication;
5) sporulation.

39. Ecologically-dependent components of bacteria are:
1) a cytoplasmic membrane;
2) a capsula;
3) a nucleoid;
4) an endospore;
5) a flagella.

40. Characteristics which are true for a bacterial capsule are:
1) protection of bacteria from aggressive chemical and mechanical substances;
2) protection of bacteria from phagocytosis;
3) amplification of pathogenicity;
4) a variable part of a bacterium;
5) being mostly polysaccharide in nature.

41. What is the complex staining method (special stain) for capsule detection?
1) Gram stain;
2) Neisser's method;
3) Ozheshko method;
4) Ziehl-Neelsen stain;
5) Burri-Gins method.

42. The functions of a bacterial endospore are:
1) multiplication;
2) protection from environment influence;
3) protection from host immunity;

4) determinant of bacterial stability at high temperature;
5) increasing stability to drying.

43. Bacteria forming an endospore are:
1) spirochetes;
2) vibrios;
3) bacilli;
4) streptococci;
5) clostridia.

44. Rods with a spore size (diameter) more than a diameter of a vegetative part of a bacterial cell are:
1) spirochetes;
2) vibrios;
3) bacilli;
4) cocci;
5) clostridia.

45. The complex staining method (special stain) for the detection of an endospore is:
1) Gram stain;
2) Neisser's method;
3) Ozheshko method;
4) Ziehl-Neelsen stain;
5) Burri-Gins method.

46. Bacteria with two or more flagella at the cell end is called:
1) monotrichous;
2) atrichous;
3) lophotrichous;
4) amphitrichous;
5) peritrichous.

47. The chemical composition of bacterial flagella is:
1) glycoprotein;
2) glycogen;
3) protein;
4) lipopolysaccharide;
5) nucleic acid.

48. Complex staining method (special stain) for flagella detection is:
1) Gram stain;
2) Neisser's method;
3) Ozheshko method;
4) Ziehl-Neelsen stain;
5) silvering according to Morozov.

49. Bacteria that can move by reducing the axial thread are:
1) mycoplasmas;
2) rickettsiae;
3) actinomycetes;
4) chlamydiae;
5) spirochetes.

50. Which characteristics are true for volutin granules?
1) they contain polyphosphate;

2) reserve of energy-rich components;
3) methachromatic granules;
4) they protect bacteria from UV-light;
5) throphycal function.

51. What is a complex staining method for detecting volutin granules?

1) Gram stain;
2) Neisser's method;
3) Ozheshko method;
4) Ziehl-Neelsen stain;
5) silvering according to Morozov.

ANSWER KEY

1) 3. **2)** 1–4. **3)** 1–4. **4)** 4. **5)** 2–5. **6)** 1–2, 5. **7)** 1, 3–5. **8)** 2–5. **9)** 5. **10)** 3. **11)** 5. **12)** 3–5. **13)** 4. **14**) 4. **15**) 4. **16)** 3. **17)** 2, 5. **18)** 5. **19)** 3. **20)** 2–5. **21)** 4. **22)** 1, 2, 4. **23**) 1, 2, 4. **24**) 1, 2, 5. **25)** 4. **26**) 2, 3. **27**) 1, 2, 4. **28)** 2, 5. **29**) 2, 3, 5. **30)** 4. **31)** 3, 5. **32)** 1, 3. **33)** 1. **34)** 3. **35)** 3–5. **36)** 2–5. **37)** 1–3. **38)** 2, 3. **39)** 2, 4. **40)** 2–5. **41)** 5. **42)** 2, 4, 5. **43)** 3, 5. **44)** 5. **45)** 3. **46)** 3. **47)** 3. **48)** 5. **49)** 5. **50)** 1–3, 5. **51)** 2.

4.2. Abstracts for the assessment of competence " UC-1, 6, 8, GPC-1, 2"*:*

1.	Features of the microbiota species composition in various ecological niches
2.	Interaction of normal and pathogenic microflora in pathological processes
3.	Study of water, soil and other substrates.
4.	The place of microbiota in ecological systems

4.3. Tasks (assessment tools) for the credit for the assessment of competence *(*UC-1, 6, 8, GPC-1, 2*):*
Example 1
A 65-year-old woman consulted a dermatologist for vesicular-erosive skin rashes resembling chickenpox exanthema, the rash present in thoracic or lumbar region. From the anamnesis: she suffered from chickenpox in early childhood. First symptom that appeared a few days before exanthema and is present at the time of examination is a sharp pain along the nerves of the affected skin segment.
Questions:
1. Guess a possible pathogen based on clinical data, life history and illness. Give general characteristics it.
2. Describe the mechanism of the virus persistence? What cells did the virus end up in after childhood chickenpox? How can this disease be characterized in relation to chickenpox?
3. What is the outcome of the disease? What is characteristic for the recurrence of this infection, in comparison with other epithelial viruses?
4. Is the vaccine effective for this infection?
5. If the patient is in a satisfactory condition, is it possible to involve her in caring for a one-year-old granddaughter who has not been sick or vaccinated against chickenpox? Justify the answer.
Answers:
1. According to anamnestic and examination data, it is possible to assume that these are manifestations caused by the chickenpox virus - herpes zoster. This virus belongs to the Herpesviridae family, genus Varicellovirus, human herpesvirus - 3 (HHV-3). A large spherical virion, complex (envelope), autonomous genome presented double-stranded linear DNA. Capsid is a cubic type of symmetry. Between the capsid and the supercapsid is the tegment, an amorphous layer containing proteins for starting the replicative process.
2. After chickenpox in childhood and recovery, the virus did not leave the body (clinical, but not microbiological recovery), it entered the regional ganglia of sensory nerves and persisted in neurons in the form of a genomic molecule (persistence mechanism - non-integrative virogeny).
In relation to chickenpox (primary infection), herpes zoster is a secondary infection resulting from recurrence of an endogenous infection.

3. Clinical recovery. The process is dangerous for patients with immune defects. Relapses are less frequent compared to HSV infection, but they are more severe (very painful neuralgia may appear, as in the case of our patient).
4. No, the live attenuated vaccine provides protection against chickenpox, but does not protect against herpes zoster.
5. This is not possible, because the rash is highly contagious and the grandmother can become a source of chickenpox infection for her granddaughter. Patients are not dangerous for people who have had chickenpox, but they can infect those who have not yet encountered the virus.
Example 2
A patient with urological infection was taken urine for bacteriological examination. Round flat mucous colonies were found on the nutrient (peptone) agar after cultivation (24 h, 37°C). The medium around colonies was colored greenish.
Questions:
1. What microorganism caused the disease? Write the ecologic characteristics of the pathogen.
2. Give general characteristics of the pathogen.
3. Describe the immunity after an infection. Is there a specific prevention of the disease?
4. What kind of infection are produced by the pathogen? What factors of pathogenicity contribute to the development of disease?
5. Is it necessary to conduct a study on antibiotic sensitivity when prescribing antibiotic therapy?
Answers:
1. Pseudomonas aeruginosa. Saprophytes. Opportunistic pathogen. Ubiquitous. It can be stored for a long time in environment. It can survive in a wide range of temperatures 4 - 45 °C.
2. P. aeruginosa are gram-negative non-spore forming rods. It is mobile and has one or more polar flagella. They are obligate aerobic bacteria. There are mucous types with a capsule-like mucous layer. It can grow well on simple nutrient media. P. aeruginosa has a relatively weak saccharolytic activity, has sufficiently pronounced proteolytic properties.
P.aeruginosa has unique cultural characteristics:
1) A characteristic biological feature of Pseudomonas aeruginosa is an ability to produce pigments. There are cultures that produce the blue pigment - pyocyanin and yellow-green - fluorescin. 2) Colonies also have a specific smell. It is like a smell of blooming violets.
3. Postinfectious immunity is short-time, non-sterile (Antibody presence don`t prevent new infection). There is no specific prevention (vaccination).
4. P.aeruginosa is one of the main pathogens cause opportunistic local and systemic purulent-inflammatory processes in hospitals. It can produce wound and catheter-associated infections.
P. aeruginosa can produce wide spectrum of virulence factors.
- inflammatory factors (endotoxin, exotoxins, proteases, lecithinase, hemolysins)
- resistance to phagocytosis (extracellular mucus - alganate)
- primary resistance to antibiotics (extracellular mucus- alganate), and secondary (acquired, plasmid-dependent) resistance to antibiotics.
5. Yes, because strains of P. aeruginosa have multiresistance to antibiotics.

5. The content of the assessment tools of mid-term assessment

Mid-term assessment is carried out in the form of **a exam**.

The content of the assessment tool

https://sdo.pimunn.net/course/index.php?categoryid=743

5.1 The list of control tasks and other materials necessary for the assessment of knowledge, skills and work experience

5.1.1. Questions for the discipline exam **MICROBIOLOGY**

Competence code (according to the WPD) UC-1, 6, 8, GPC-1, 2

General medical microbiology

1. Systematics of bacteria. Species as the main taxonomic unit. Principles of intraspecific differentiation of bacteria. Intraspecific variants (groups, types, vars). Strain, clone, population.
2. The main groups of microorganisms. Eukaryotes and prokaryotes. Features of prokaryotic structural organization. The genetic apparatus of bacteria, its features, examples of autonomous replicons of bacteria.

3. The concept of mobile genetic elements. Gene insertions, transposons, their functions. Insertion mutagenesis.
4. Bacterial plasmids: functions and their varieties. Significance in bacterial ecology. Phenotypic characteristics of bacteria determined by plasmids. The ѕ "bacteria-plasmids" system in genetic engineering; recombinant proteins.
5. Phenotypic and genotypic variability of bacteria. Mechanisms and examples of phenotypic variation. Gene expression regulation. Environmentally dependent co-expression of genes, regulon. The concept of spontaneous and induced mutations.
6. Types of genetic recombinations (homologous, nonhomologous, site-specific). Mobilization mechanisms of bacterial genes: transformation, transduction and conjugation. Phage conversion.
7. The principle of the phenotypic bacteria classification. The main morphological forms of bacteria. A. Leeuwenhoek writings.
8. Structural components of a bacterial cell: cytoplasmic membrane, intracellular inclusions, flagella, their structure and functions. Detection methods of inclusions and flagella.
9. Environmentally dependent bacterial cell structures. The structure and functions of bacterial endospores and capsules, detection methods.
10. Tinctorial properties of bacteria. Relation to the structural features of three main types of a cell wall. Gram staining principle.
11. Actinomycetes, spirochetes as atypical bacteria. Features of their structure and physiology.
12. Rickettsiae, Chlamydia, Mycoplasma as atypical bacteria. Features of their structure, metabolism, ecology.
13. Classification of bacteria in relation to carbon sources and growth factors. Autotrophs, heterotrophs. Prototrophs, auxotrophs. Environmental characteristics of bacteria: saprophytes and symbionts. Commensals. Obligate and facultative parasites.
14. Constructive metabolism of bacteria. Bacterial reproduction rate and phases on culture media. Bacterial enzymes, their functions. Exoenzymes and endoenzymes. Constitutive and inducible enzymes.
15. Bacterial cultivation principles and methods. The conditions contributing to bacterial growth and reproduction. Growth factors. Culture media and their classification. Works by R. Koch.
16. Energy metabolism of bacteria. Phototrophs and chemotrophs. Chemosynthesis types (respiration, fermentation). Obligate aerobes and anaerobes, their varieties. Facultative anaerobes. Pasteur effect. Cultivation principles of obligate anaerobes.
17. Cultural properties of bacteria. Characteristics of colonies. Research methods of cultural properties of bacteria. The concept of a biotype (biovar).
18. Sterilization and disinfection. The concept of disinfectants and antiseptics. The main sterilization methods in microbiological studies.
19. Antibiotics. Origin classification (producers). The main chemical groups of antibiotics. The action of antibiotics, selective toxicity. Chemotherapeutic index. Classification of antibiotics by the mechanism of their action. Classification of antibiotics by the antimicrobial activity spectrum.
20. Antibiotic resistance of bacteria. Genetic mechanisms of drug resistance of bacteria, the ways to overcome resistance. Methods for determining bacterial sensitivity to antibiotics.
21. Viruses as a special life form. Viral ecology. The structure and chemical composition of the virion. Principles of viral classification. The significance of viruses in human pathology. Works by D. Ivanovsky.
22. Molecular basis of viral reproduction. Reproduction of DNA-containing viruses, options for the reproduction of RNA-containing viruses. Principles of etiotropic treatment of viral infections. Possible targets for antiviral drugs.
23. Results of virus-cell interaction (for a virus and for a cell). Virus persistence: ecological significance and clinical manifestations. Molecular mechanisms of persistence (virogenation), its varieties.
24. Bacteriophages: structure, interaction with a bacterial cell. Temperate and virulent phages. Lysogeny. Practical use of phages. The concept of phagovar.
25. Microbiological analysis as a basis for laboratory diagnosis of infectious diseases. Principles and main directions. Culture-dependent and culture-independent diagnostic methods.

26. Culture method (bacteriological analysis) in the diagnosis of infectious diseases. The rules of material sampling and the main stages of analysis. Principles of bacterial identification.
27. Principles and methods for instant diagnosis of infectious diseases. Molecular-genetic methods. The concept of polymerase chain reaction (PCR), its advantages and limitations.
28. Immunochemical assay. Immunochemical assay problems. Serotyping and serodiagnosis. Biological neutralization reactions.
29. Immunochemical assay: agglutination, precipitation reactions. Variants of reactions.
30. Immunochemical assay based on labeled antibodies. Enzyme immunoassay (ELISA). Immunoblotting.
31. Serological diagnosis. Antibody titer. Conception of studying qualitative and quantitative seroconversion.
32. Normal human microbiota: permanent and transient, obligate and facultative. Mechanisms of microbiota formation. The importance of normal microbiota in human body activity. Microbiota and pathology.
33. An infectious process and infectious disease. Primary, secondary (opportunistic) infections, superinfection, reinfection, relapse. Exogenous and endogenous infections. Transmission of the pathogen. Entry of infection. Generalization mechanisms of an infectious process. The concept of pathogen persistence.
34. Ecology as the basis of pathogenicity of microorganisms. Pathogenic, opportunistic and nonpathogenic microorganisms. The concept of opportunistic infections. Anthroponosis, zoonoses, sapronosis (examples of infections). The concept of infections associated with first-aid. Physiological features of hospital bacterial strains.
35. Pathogenicity and virulence of bacteria. Pathogenicity as a potential symptom. Direct and indirect pathogenicity of bacteria. Genetic basis of pathogenic bacteria, the concept of pathogenicity islands.
36. Pathogenicity and virulence of bacteria: factors and mechanisms contributing to adhesion, colonization, invasion, persistence. Antiphagocytic factors of bacteria.
37. Bacterial exotoxins, their characteristics, the principle of action. Classification of exotoxins. Molecular structure and function of binary toxins. Super-antigens, the mechanism of their toxic effect.
38. Bacterial endotoxins, their characteristics. Pathogenesis of LPS-dependent intoxication. The concept of modulins. Contact toxins, their mechanism of action.
39. Viral pathogenicity factors. Mechanisms of direct and mediated disease viruses. Possible mechanisms for the escape of viruses from immunity effectors.
40. Micromycetes (yeast, mold): structural organization and chemical composition features. Dimorphic and polymorphic, higher and lower micromycetes. Vegetative and sexual reproduction of fungi. Varieties of sexual spores.

General immunology

1. The definition of "immunity". Types of immunity: natural and acquaired immunity, their characterictics. Examples of immunity factors: specific and non-specific, humoral and cellular.
2. Antigens: definition. Sources and chemical composition of antigens. Antigenic epitope. Functions of complete antigen (specificity, foreignness, antigenicity and immunogenicity). Structural and functional differences of B and T-epitopes. Polyvalence of a natural antigen. T-dependent and T-independent antigens.
3. Antigens: T-epitope formation. Processing an antigen by the antigen-presenting cell. Complete antigens and haptens. Properties of haptens.
4. Antibodies. Chemical composition of antibodies. Cells which produce antibodies. Submolecular structure of typical immunoglobulin molecule (IgG): light and heavy chains, constant and variable doments. Fab and Fc fragments. Structure of antigen binding site (paratope).
5. Isotypes, allotypes and idiotypes of immunoglobulins. Classes of immunoglobulins. Secondary (effector) function of different antibody classes.
6. Immunoglobulins of classes G, M. Structure and functions.
7. Immunoglobulins of classes A, E, D. Structure and functions.

8. Primary and secondary response to an antigen: quantitative and qualitative differences. Kinetics of of IgG and IgM production in primary and secondary immunity. Polyclonality of natural immune response. Monoclonal antibodies (principles of B-hybridoma biotechnology).
9. Antigen-recognizing molecules of T and B cells. B cell receptor (BCR). Recognition of antigen by BCR. CD-antigens and functional subdivision of T cells. T cell receptor (TCR), structure, similarities and differences with BCR.
10. Major histocompatibility complex - MHC/HLA: genes and their products. Genetic basis of HLA-polymorphism (multiplicity of alleles in population, codominance of paternal and maternal alleles). Main classes of HLA, cell distribution and immunologic functions.
11. Induction phase of immunity: general conception. Co-stimulatory signals for lymphocyte activation: humoral and intercellular contacts.
12. Induction of humoral immunity: activation of naïve CD4+ cells. Functional variants of Th cells (Th0, Th1 and Th2). Function of Th1 and Th2 cells in immune response.
13. Induction of immunity: activation of naïve B lymphocytes and production of plasma cells. Results of B cells activation. Role of T helpers in B cell activation.
14. Phagocytic cells: classification. Function of phagocytes in inductive and effectors phase of immune response. Steps of phagocytosis. Oxidative and nonoxidative mechanisms of intracellular killing of microorganisms. Direct phagocytosis and immune phagocytosis (opsonization). Opsonins.
15. Functions of antibodies in effector phase of immunity. Functional cooperation of specific and innate immunity effectors: interaction between antibodies, complement and phagocytes in humoral immunity.
16. The complement system. Function of the complement in immune response and inflammation. Basic principles of complement activation. Membrane attack complex of complement.
17. Infection immunity. Mechanisms specific and non-specific. Specific post-infection immunity.
18. Levels of anti-infectious defense. General characteristics of the skin and mucosal defence. Factors of colonize resistance. Role of normal microbiota in the oral cavity defence. Resident and recruited (inflammation-dependent) immune factors of subepitelial tissues, lymph and blood.
19. Immunity against viral infections: effector cells and molecules. Role of antibodies in antiviral immunity. Interferons: classification and mechanisms of antiviral activity.
20. Types of acquired (specific) anti-infective immunity. Active and passive, natural and artificial. Concepts the specific prevention of infectious diseases. Passive artificial immunization. Serotherapy and seroprophylaxis of infectious diseases. Preparations (homologous and heterologous) for passive immunization.
21. Immunological basis of vaccination. Types of vaccines (alive attenuated, killed, subunit vaccines), benefits and hazards. Toxoids.
22. Methods for enhancing immunogenicity of vaccines. Conjugated vaccines. Adjuvants. Structural variants of vaccines: recombinant vaccines. Composition of vaccines: mono-, associated and polyvalent vaccines. Mucosal vaccines.

Special medical bacteriology

1. General characteristics of staphylococci (taxonomy, morphology, tinctorial properties), representatives. Cultural properties. The spectrum of diseases caused by staphylococci. Purulent inflammatory infections, examples. Typical manifestation of staphylococcal invasion. Features of immunity, attitude to antibiotic therapy, laboratory diagnosis principles.

2. Pathogenicity factors of staphylococci contributing to pyogenic invasions. Invasion factors, toxins, antiphagocytic factors of S. aureus. The role of staphylococci in the occurrence of nosocomial infections. Catheter-associated infections related to staphylococci, significance of *S. epidermidis*.

3. S. aureus as a causative agent of specific intoxications. Intoxication variants, clinical manifestations. Toxins mechanism of action of toxins. Immunity against staphylococcal intoxication.

4. General characteristics of streptococci, genera *Streptococcus* and *Enterococcus* (taxonomy, morphology, tinctorial properties). Classification principles of streptococci. R. Lensfield classification, main serogroups, examples. Streptococci not satisfying the serogroup classification.

5. Pathogenicity factors of *S. pyogenes* contributing to pyogenic invasions (invasion factors, toxins, antiphagocytic factors). Typical manifestation of streptococcal invasion. Examples of the skin and mucous membrane infections caused by *S. pyogenes*. Pathogenetic evolution of streptococcal angina. Pyogenic and reactogenic complications of streptococcal invasions.
6. Pathogenicity factors of *S. pyogenes* involved in specific intoxication development. The mechanism of action of erythrogenic (scarlet) toxins. Scarlet fever pathogenesis. The immunity features in scarlet fever. Laboratory diagnostic principles of infections caused by *S. pyogenes* (pyo-inflammatory infections, specific intoxication, reactogenic complications).
7. General characteristics of pneumococci (taxonomy, morphology, tinctorial properties). *S. pneumoniae*. Ecology. Intraspecific classification. Pathogenicity factors. Pyogenic pneumococcal invasions. Features of immunity and specific prevention of pneumococcal infection.
8. Streptococci composing the normal microflora ("oral" streptococci, *S.agalactiae*, enterococci). General characteristics (taxonomy, morphology, tinctorial properties), ecology and their role in pathology. The resistance of *Streptococcus* and *Enterococcus* genus to the antibiotics.
9. General characteristics of hemophilic bacteria (morphology, tinctorial properties). *H.influenzae*: cultural properties. Intraspecific classification and ecology of serotypes. The value of the capsule in the pathogenicity implementation. The spectrum of diseases. Laboratory diagnostic principles.
10. *H. influenzae* type b (Hib) pathogenicity factors. Role in human pathology. The value of Hib cap-antigen in the disease pathogenesis and immunity formation. Specific prevention of hemophilic infection.
11. General characteristics of the genus *Neisseria*: morphology, tinctorial properties. Cultural properties. Ecology of Neisseria. Pathogenic Neisseries (features of morphology and intra-species classification). Relationship with phagocytes. Variants of infections (local, generalized).
12. Pathogenicity factors of *N. meningitidis* contributing to local meningococcal infection. The disease epidemiology and clinical manifestations. Laboratory diagnosis of meningo-coccal nasopharyngitis. Temperature and culture test. The dichotomy of immunity in local and generalized meningococcal infections.
13. Pathogenicity factors of *N. meningitidis*, contributing to the generalization of meningococcal infection. Pathogenetic value of the capsule. Endotoxin features. Pathogenesis and clinical manifestations of meningococcal (specific) meningitis. Principles of antibiotic therapy. Specific prevention. Laboratory diagnostic principles.
14. General characteristics of *N. gonorrhoeae* (taxonomy, morphology, tinctorial properties). Epidemiology and clinical forms. Acute and chronic gonorrhea. Agent persistence mechanisms. Features of immunity. Laboratory diagnostic principles. Tests to identify acute and chronic gonorrhea.
15. Pathogenicity factors of *N. gonorrhoeae*. Pathogenesis of gonococcal infection, features of the course in men and women, outcomes. Ophthalmia neonatorum (epidemiology, prevention).
16. General characteristics of *P. aeruginosa* (taxonomy, morphology, tinctorial properties). Ecology. Cultural properties of *Pseudomonas aeruginosa*. Epidemiology, the spectrum of diseases. Laboratory diagnostic principles.
17. Major pathogenic factors of *P. aeruginosa*. Pseudomuscular infection, features, clinical manifestations. *P.aeruginosa* as the causative agent of hospital and catheter-associated infections. Features of immunity, laboratory diagnostic principles, the problems of anti-biotic therapy.
18. General characteristics of *Enterobacteriaceae* family (examples of generic taxons, morphology, tinctorial properties). Enterobacteria cultivation principles. Enterobacterial ecology. The role of enterobacteria in human pathology (diseases variants).
19. General characteristics of the genus *Shigella* (morphology, tinctorial properties). Cultural properties. Causative agents of dysentery (species). Epidemiology and pathogenesis of dysentery.
20. *Shigella spp*. as infectious agents (clinical manifestations, disease outcomes). Shigella producing Shiga toxin. The toxin characteristics, its mechanism of action, local and systemic effects. Post-infectious immunity. Laboratory diagnostic principles of shigellosis.
21. General characteristics of E.coli (taxonomy, morphology, tinctorial properties). Cultural properties. Escherichia as the pathogens of extraintestinal pyogenic infections: epidemiology, pathogenicity factors. Laboratory diagnostic principles.

22. Escherichia as the causative agents of acute intestinal infections (AII). The main ecological groups of diarrheal Escherichia are enteropathogenic, enteroinvasive, enterotoxigenic, enterohemorrhagic (factors of pathogenicity within the group, pathogenesis mechanism, diarrhea type). The concept of an immunodominant phenotype.
23. General characteristics of the genus Salmonella (taxonomy, morphology, tinctorial properties). Cultural properties. *S.enterica*. Intraspecific classification features. The spectrum of diseases caused by salmonella. Salmonella are the causative agents of food toxicoinfection (gastroenteritis): pathogenicity factors, pathogenesis, post-infectious immunity.
24. Salmonella are the causative agents of typhoid and paratyphoid. Epidemiology (sources of infection, transmission mechanism). Pathogenicity factors of *S.Typhi*. Typhoid fever pathogenesis. Specific prophylaxis. Laboratory diagnostic principles of typhoid fever.
25. General characteristics of *V. cholerae* (taxonomy, morphology, tinctorial properties). Intraspecific classification. Cultural properties. Ecology and epidemiology (*infection* reservoirs and transmission mechanism). Clinical manifestations and possible outcomes. Specific prevention.
26. Pathogenicity factors of *V. cholerae*. Genetic basis of toxigenicity. Environmentally dependent co-expression of virulence genes. Characteristics of choleragen (structure, mechanism of action, target cells). Cholera pathogenesis. Laboratory diagnostic principles of cholera.
27. General characteristics of the genus *Clostridium* (taxonomy, morphology, tinctorial properties, physiology, ecology). *C. difficile* (taxonomy, morphology, tinctorial properties), pathogenicity factors. The disease pathogenesis. Laboratory diagnostic and therapeutic principles.
28. The main causative agents of gas anaerobic infection. Ecology and epidemiology of agents. Pathogenicity factors of *C.perfringens*. Pathogenesis of the disease. Specific and etiotropic treatment features.
29. General characteristics of *C. tetani* (taxonomy, morphology, tinctorial properties, ecology). Characteristics of the toxin (structure, targets, mechanism of action). Tetanus pathogenesis and clinical manifestations. Specific therapy and prevention (emergency and planned) of the disease.
30. General characteristics of *C. botulinum* (taxonomy, morphology, tinctorial properties, ecology). Characteristics of the toxin (types, structure, targets, mechanism of action). Conditions for the toxin accumulation in food. Pathogenesis of the disease, botulism clinical manifestations. Laboratory diagnostic principles and specific treatment.
31. General characteristics of *B. anthracis* (taxonomy, morphology, tinctorial properties). Cultural properties. Ecology of the pathogen, the transmission principle and mechanisms. Pathogenicity factors, characteristic of polyfunctional toxin. The main clinical forms of anthrax, infection outcomes. Laboratory diagnostic principles and specific prophylaxis.
32. General characteristics of *C. diphtheriae* (taxonomy, morphology, tinctorial properties). Cultural properties. Characteristics of the main biovars. Diphtheria epidemiology (transmission mechanisms and routes), the main clinical manifestations. Diphtheria diagnostic stages (determination of toxigenicity).
33. Pathogenicity factors for *C. diphtheriae*. Diphtheria toxin (structure, targets, mechanism of action). Genetic basis of toxigenicity. Diphtheria as a monomolecular intoxication, pathogenesis (local and systemic manifestations). Post-infectious immunity. Specific prevention and specific treatment.
33. General characteristics of mycobacteria (morphology, tinctorial properties), ecological groups. Signs of mycobacteria associated with the cell wall structural features. Cultural properties. Mycobacterium causing tuberculosis. Pathogenicity factors of *M. tuberculosis*.
34. The relationship of *M. tuberculosis* with macrophages. Stages of granuloma and tubercle formation. The concept of "primary" and "secondary" tuberculosis. Epidemiology and pathogenesis of "primary" tuberculosis. Primary tuberculosis complex, infection outcomes.
35. Epidemiology of "secondary" tuberculosis. Features of granuloma formation in “secondary” tuberculosis; the disease pathogenesis, clinical manifestations, outcomes. Features of immunity in tuberculosis. Screening tests. Laboratory diagnostic principles and specific prevention of tuberculosis.
36. General characteristics of chlamydia (morphology, peptidoglycan features, ecology), classification (examples of genera and species). *C. pneumoniae*: epidemiology, pathogenicity factors,

disease pathogenesis, features of antibiotic therapy, diagnostics. *C. psittaci*: epidemiology, features of the course of the disease, outcomes of the disease.
37. *C.trachomatis*: general characteristics (morphology, peptidoglycan features, ecology). Pathogenetic characteristics of serotypes. Trachoma and genital chlamydia (epidemiology, pathogenesis, clinical manifestations). Reiter's syndrome. Newborn pathology. Etiotropic therapy, immunity, laboratory diagnostic principles.
38. *M. pneumoniae* as a causative agent of respiratory mycoplasmosis. General characteristics. Epidemiology, pathogenicity factors and mechanisms, immunologically mediated pathogenicity. Variants of diseases. The concept of "atypical" pneumonia (examples of pathogens).
39. Classification of urogenital mycoplasmas. General characteristics. Epidemiology. Factors and pathogenicity mechanisms of *U.urealyticum*. Epidemiology. Pathology and bacteriology, possible sequelae. Features of etiotropic therapy of mycoplasmoses. Laboratory diagnostic principles, test interpretation.
40. General characteristics of rickettsiae (morphology, tinctorial properties, ecology features), basic genus taxa. *R.prowazekii*: epidemiology, pathogenicity factors, the disease pathogenesis. Epidemic typhus manifestations and outcomes (clinical and microbiological). Brilla-Zinsser disease. Laboratory diagnosis.

Special medical virology

1. *Paramyxoviridae*. Classification. Virion characteristics, antigenic structure. The replication mechanism of paramyxoviruses. "Respiratory" paramyxoviruses, representatives, spectrum of diseases caused by paramyxoviruses.
2. The measles virus and the mumps virus. Classification of viruses (family, genus). Virion characteristics, antigenic structure. Epidemiology of diseases. Pathogenesis of infections, tissue tropism, clinical manifestations, outcomes, possible complications. Post-infectious immunity. Specific prevention of measles and mumps.
3. *Orthomyxoviridae*. Classification (types, subtypes). Virion characteristics, antigenic structure. Virus replication features (deproteinization zone, RNA replication). Influenza pathogenesis: entrance gates of infection, cellular targets, possible complications. Targets for etiotropic treatment of influenza A. Laboratory diagnostic principles.
4. *Influenzavirus* A. Shift- and drift variations: causes, mechanism. The participation of supercapsid antigens in originating new subtypes and epidemic strains. Actual (current) subtypes of influenza virus A. Protective antigens of the virus. Variants and composition of vaccines. Immunity. Vaccinal prevention problems.
5. *Picornaviridae*. Classification (the most significant generic taxa). Virion characteristics, antigenic structure. The virus replication mechanism. The genus *Rhinovirus* and the genus *Enterovirus* (representatives, epidemiology, spectrum of diseases, vaccination problems). Polytropism of Coxsackie and ECHO viruses.
6. Polio viruses. Classification (family, genus), ecology and epidemiology. Pathogenesis of poliovirus infection. The virus primary replication zones. The concept of primary and secondary viremia. The cell damage mechanism. The main variants of infection, possible outcomes. Laboratory diagnostic principles. Specific prevention.
7. The rabies virus. Classification (family, genus). Characteristics of the virion (morphology, structure). Reproduction mechanism. Tropic tropism. Epidemiology, reservoirs of rabies in nature. Dependence of post-exposure prophylaxis on the category of contact with a supposedly rabid animal. Works of L. Pasteur on vaccination. Laboratory diagnostic principles. Postmorbid diagnosis.
8. The rabies virus. Pathogenesis of the disease (infection conditions, entry gate, pathways, pathogenetically significant targets). Clinical manifestations, infection outcome. Specific prophylaxis (emergency and planned).
9. *Herpesviridae* (species). Virion characteristics (morphology, structure). Reproduction stages and mechanisms. Causes of the virus relative autonomy. The principle of the relationship of herpes viruses with the host, the persistence mechanism. Possible places of persistence with different members of the family. Antiviral therapy targets.
10. *Herpes simplex virus* 1 and 2. Classification (family, genus). Ecology, epidemiology. Targets for replication and persistence of viruses. Clinical manifestations (with primary infection and relapse).

Factors contributing to reactivation. Herpes virus infection of newborns: epidemiology, clinical manifestations, outcomes. Etiotropic therapy.

11. *Varicella-zoster virus*. Classification (family, genus). Virion characteristics (morphology, structure). Ecology, epidemiology. Significant reservoir for the virus persistence. Clinical manifestations of primary infection and endogenous relapse. Factors contributing to re-activation. Specific prevention opportunity. Etiotropic therapy.

12. *Cytomegalovirus*: epidemiology, infection variants ~~s~~. Cytomegalovirus (CMV) as an etiological factor of TORCH infections. CMV diagnosis principles. *Epstein-Barr virus*: epidemiology, a significant reservoir for persistence, the result of relationships with B-lymphocytes, clinical variants of the infection, etiotropic therapy.

13. Human immunodeficiency viruses (HIV). Classification. Virion characteristics, antigenic structure. Tropic virus. Reception mechanism, reproduction feature. The role of viral enzymes. The main reservoirs of replicative and persistent HIV infection. The mechanism of viral persistence at a cellular level.

14. HIV infection pathogenesis. Factors and mechanisms contributing to the viral persistence. Persistence aggressiveness. Cofactors of infection "acceleration". Reasons for immunodeficiency in HIV infection. Mechanisms of damage to CD4 T-lymphocytes and escape from the immune system effectors.

15. The main phases of HIV infection development, and their characteristics. Dynamics of changes in immune parameters and virus concentration in the course of the disease. AIDS-related diseases (examples). Etiotropic therapy targets. Algorithm for HIV laboratory diagnosis. Problems of specific vaccination.

16. Causative agents of viral hepatitis: classification. Comparative characteristics of "parenteral" and "intestinal" human hepatitis viruses: morphology, epidemiology, persistence ability, possible complications, specific prophylaxis. Hepatocyte damage mechanism.

17. *Hepatitis A virus*. Classification (family, genus). Virion characteristics, antigenic structure. Epidemiology. Pathogenesis. Clinical manifestations, infection outcomes. Post-infectious immunity. Specific prevention. Material for research, the dependence of diagnostic methods on the disease stage.

18. *Hepatitis B virus*. Classification (family, genus). Virion characteristics. Functions of structural and non-structural proteins. Replicative cycle features. Epidemiology. Virological and clinical outcomes of the infection, possible complications. Specific prevention. The main serum markers of the infection, their importance in the diagnosis.

19. *Hepatitis C virus*. Virion characteristics. Epidemiology. Tropic tropism. Virological and clinical outcomes of the infection, possible complications. The persistence mechanism and escape from the immune system effectors. Immunity features (antibody production). Laboratory diagnostic principles.

20. Micromycetes of the genus *Candida*. Classification, the main representatives. Morphology and general characteristics. Cultural properties. Pathogenicity factors. The main types (forms) of the diseases. Laboratory diagnostic principles of candidiasis. Principles of antifungal therapy and targets for antifungal drugs.

Sanitary microbiology

1. The concept of sanitary microbiology. Targets and tasks. Air microflora. Sanitary and bacteriological examination of air.
2. Microflora of medicinal raw materials. Microbiological control of medicines.
3. Phytopathogenic viruses and viral diseases. The origin of the disease.
4. Plant microbiota. Epiphytic bacteria. Bacteria of the root zone of the plant.
5. Plant microflora. Root flora and its significance for plants.
6. Plant microflora. Flora of the above-ground part of the plant. Flora of the root zone of the plant.
7. Fungi are causative agents of plant diseases. forms of parasitism.
8. Epiphytic flora of plants. Characteristics of the genus Erwinia.
9. The concept of phytopathogenic flora. Examples.
10. Phytopathogenic flora. Characteristics of the genus Xanthomonas.
11. Phytopathogenic flora. Characteristics of the genus Agrobacterium.

12. The concept of parenchymal and vascular lesions of plants. Tumor process.
13. Reasons and sources of medicine contamination.
14. Pharmacy microflora. Sanitary and microbiological study of pharmacies.
15. Microbiological investigation of pharmacies. Analysis of pharmacy equipment.
16. Sanitary and microbiological analysis of pharmacies. Research of distilled water for preparation of injection solutions and eye drops.
17. Sanitary and microbiological analysis of pharmacies. Air research.
18. Sanitary and microbiological investigations of pharmacies. The investigation of water for the preparation of medicines, except for injection solutions and eye drops.
19. Sanitary and microbiological investigation of pharmacies. Brief sanitary-microbiological analysis.
20. Microflora of medicinal raw materials. Microbiological control of medicines.
21. Sanitary and microbiological control of contaminated plant medicinal raw materials.
22. Sources of drug contamination.
23. Ways to improve the microbial purity of medicines. Methods for purification of raw materials and medicines.

6. Criteria for evaluating learning outcomes

For the exam (example)

Learning outcomes	**Assessment of competence developed**			
	unsatisfactory	**satisfactory**	**good**	**excellent**
Completeness of knowledge	The level of knowledge is below the minimum requirements. There were bad mistakes	The minimum acceptable level of knowledge. A lot of light mistakes were made	The level of knowledge in the volume corresponding to the training program. A few light mistakes were made	The level of knowledge in the volume corresponding to the training program, without errors
Availability of skills	Basic skills are not demonstrated when solving standard tasks. There were bad mistakes	Basic skills are demonstrated. Typical problems with light mistakes have been solved. All tasks have been completed, but not in full.	All basic skills are demonstrated. All the main tasks have been solved with light mistakes. All tasks have been completed, in full, but some of them with shortcomings	All the basic skills were demonstrated, all the main tasks were solved with some minor shortcomings, all the tasks were completed in full
Availability of skills (possession of experience)	Basic skills are not demonstrated when solving standard tasks. There were bad mistakes	There is a minimal set of skills for solving standard tasks with some shortcomings	Basic skills in solving standard tasks with some shortcomings are demonstrated	Skills in solving non-standard tasks without mistakes and shortcomings are demonstrated
Characteristics of competence	The competence is not fully formed. The	The formation of competence	The formation of competence	The formation of competence fully

Learning outcomes	Assessment of competence developed			
	unsatisfactory	**satisfactory**	**good**	**excellent**
formation*	available knowledge and skills are not enough to solve professional tasks. Repeated training is required	meets the minimum requirements. The available knowledge and abilities are generally sufficient to solve professional tasks, but additional practice is required for most practical tasks	generally meets the requirements, but there are shortcomings. The available knowledge, skills and motivation are generally sufficient to solve professional tasks, but additional practice is required for some professional tasks	meets the requirements. The available knowledge, skills and motivation are fully sufficient to solve complex professional tasks
The level of competence formation*	Low	Below average	Intermediate	High

For testing:

Mark "5" (Excellent) - points (100-90%)
Mark"4" (Good) - points (89-80%)
Mark "3" (Satisfactory) - points (79-70%)

Less than 70% – Unsatisfactory – Mark "2"

Developer(s):
Makhrova Tatyana Vladimirovna Ph.D. of Medical Sciences, Docent, Associate Professor at the Department of Epidemiology, Microbiology and EBM of FSBEI HE PRMU MOH Russia

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